C H E M I C A L ((clallargica) E N G I N E E B I N G

SEPTEMBER • 1944

Volume 51

Number 9

In this Issue

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Published monthly. Price 35 cents per copy. Publication office, 99-129 North Broadway, Albany 1, N. Y. Address communications about subscriptions to Director of Circulaabout subscriptions to Director of Circula-tion, Chem. & Met., 330 West 42nd St., New York 18, N. Y. Subscription rates: United States, Mexico, Central and South American Countries, \$3 per year, \$4 for two years, \$5 for three years. Canada \$3.50 per year, \$5 for two years, \$6 for three years (payable in Canadian funds). Great Paincip and Painting Paincip 1990 Britain and British Possessions, 30 shillings per year, 60 shillings for three years. All other countries, \$5 per year, \$10 for three years. Entered as second class matter Sep-tember 3, 1936, at Post Office at Albany, N. Y., U. S. A., under act of March 3, 1879. Contents copyrighted, 1944 by Mc Graw-Hill Publishing Company, Inc. Branch office: 520 North Michigan Argane Chicarg Graw-Hill Fublishing Company, Inc. Branch offices: 520 North Michigan Avenue, Chicago 11; 68 Post Street, San Francisco 4; Ald-wych House, Aldwych, London, W. C. 2; Washington 4; Philadelphia 2; Cleveland 15; Detroit 2; St. Louis 8; Boston 16; Los Angeles 14; Atlanta 3; Pittsburgh 22.

Return Postage Guaranteed

McGRAW-HILL PUBLISHING CO., INC.

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Publication Office 99-129 North Broadway, Albany 1, N. Y.

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Director of Circulation Member A.B.P. Member A.B.C. Cable Address McGRAWHILL, New York (Price of this issue one dollar per copy)

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CHANGE OF ADDRESS	McGRAW-HILL PUBLISHING COMPANY 330 West 42nd Street, New York 18, N. Y. Director of Circulation: Please change my address on Chemical & Metallurgical Engineering From
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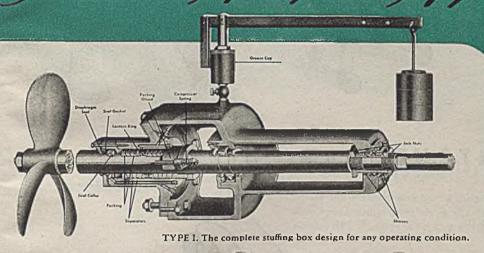
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liquid. This construction permits repacking from outside the tank and without emptying. Three modifications of this standard type are available: Type II for use where repacking with full tank is sole consideration; Type III for use where abrasive conditions occur and tank is empty at frequent intervals; Type IV for very light duty conditions.

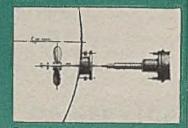
A new Bulletin (B76) just off the press gives more complete information on the new design Side Entering "*LIGHTNIN*" Mixers and specifications of Models and types available and methods of installation. Send for a copy.

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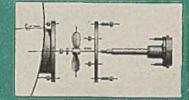
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Large Manway (to pass propeller) Located on center line of tank. Shor nozzle is fornished with mixer, when so quoted. User will farnish large cover plate and fittings. This method frequently utilizes existing manways Photo shows method of mounting Also pipe leg supports and Master Motor.



Companion Nozzle (to fit mixer bolt circle). Located in proper Off Center position. User will furnish and install nozzle. This method useful for installing mixer adajacent to manway which must be kept clear. Photo shows unique method of fabricated support, by user.



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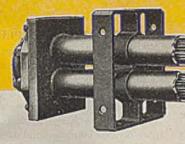
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WATCHING WASHINGTON-

R. S. McBRIDE, Editorial Consultant · PAUL WOOTON, Chief of McGraw-Hill Washington Bureau · MALCOLM BURTON, Washington Correspondent

Uncle Sam begins the sale of industrial facilities . . . Plans for disposing of the properties are beginning to be announced . . . More than 30 items are now offered . . . Nitric acid supplies to chemical users are cut . . . Civilian gasoline is to get only fraction of ethyl fluid which it had in 1941 . . . Estimates place U. S. rubber requirements for each of the next five years at a million tons . . Disposal of chlorine plants will not come up for some months, it now scems certain . . . Six companies are turning out satisfactory rock phosphate which is safe for feed usage . . . Office of the Rubber Director has revised basic regulations

SURPLUS PROPERTY SALES

SALE of industrial facilities by the govermment is now actually beginning. The Industrial Facilities Section of the Surplus War Property Administration is in charge of the disposal of plant sites, factories, and industrial facilities of all kinds, including items of equipment sold separately either for scrap or for reuse. Only a few of the policies regarding such sales have been announced. But the trend of the plans indicates a probable procedure.

An item of industrial property comes to the attention of this office of DPC in either of two ways. It may be an item which has actually been released by the government agency which owns or controls it. Such an item is available immediately for sale. Other items not finally determined as surplus come to this office because the controlling agency has ordered the property put in stand-by condition. Properties so declared no longer needed for active use are not "surplus" and cannot immediately be offered for sale. However, there are means for getting acquainted with the existence of such items and preliminary discussions can sometimes start even though actual negotiations of a formal nature have not been authorized.

GETTING SURPLUS NOTICES

DEFENSE Plant Corp. has adopted for the time a restriction on the publicity policy. It will be necessary for the present for those interested in surplus establishments to follow this policy or they will not be able to get information promptly. The procedure is about as follows:

As soon as an item of property is declared surplus, there is a sheet prepared giving a brief description of it. The sheet identifies the location and the character of the establishment. It indicates the amount of land, the number and types of buildings, and something regarding the machinery and equipment which is included in the surplus property so offered. That sheet is mimeographed and copies of it are sent to each of the 31 district offices of RFC. Each office is given the entire responsibility for bringing such information to the attention of anyone in the district who is interested in surplus property.

The Washington office has set up an almost absolute rule against giving out information except regarding single items on which a specific inquiry may be made without difficulty. All mailing lists for sending out the information are to be maintained in the regional offices. Washington absolutely refuses to take any responsibility of that sort.

LOCAL CONTACT NEEDED

UNDER the circumstances, it is desirable for each individual or company interested in surplus property to make the acquaintance of some proper person in the nearest regional office. Any inquirer can put himself on record in that office requesting notice of new surplus items announced. He will not be given all the items. But he will be given on request any variety of items which he may describe as of interest to him. It will not suffice to say merely any chemical plant, because the definition of chemical plants used by DPC is very much narrower than would probably be intended by the average chemical engineer or industrial executive. Only by continuing and persistent contact with district offices can it be expected that any enterprise will learn promptly of all items of property that are offered for disposal and of importance to them.

PROPERTY NOW "SURPLUS"

As of August 15, there were on the surplus property list approximately 30 items. About a dozen of these represented completed factories, including a substantial amount of machinery or equipment. About a dozen were establishments with more or less complete buildings and building facilities, but without any great amount of process equipment. About a half-dozen represented only plant sites, land ranging from a few acres up to much larger plots, one of more than 13,000 acres.

HOW TO DO IT

IF AN inquirer discovers a surplus property item on which he desires more information, this can be obtained in any one of three ways. Each regional office has descriptive sheets which give a fair idea of the size and general character of each property. Such sheets are available on request. In fact, it is these sheets which will be mailed to inquirers who get their names on the mailing list of the regional office. If such information indicates that further inquiry is desirable, it would be best to consult either the director of the regional office in which the surplus property is located, or the Washington office of DPC. The announcement sheets give in each case the name of the man in charge in the regional district where the surplus property is located. That man can initiate discussions regarding the property, can furnish detailed descriptions, and can show the property to inquirers who are seriously interested. In fact, this regional officer is expected to conduct all of the preliminary negotiations for sales.

NITROGEN CONDITIONS CHANGE

THE INCREASED ordnance requirements for explosives are having the immediate effect of cutting off nitric acid from numerous chemical users. As early as August 15, the government stopped shipping ammonium nitrate from arsenal plants. Delivery from TVA and Canadian plants for fertilizer usage has. however, continued.

The War Department has announced that effective September 1, it was going to cut off shipments of anhydrous ammonia from arsenals, not only from fertilizer users, but also from other chemical establishments. Shipment of nitric acid from these plants was scheduled to stop on October 1. This nitric acid has previously been used for making commercial Available in sizes up to and including 3 horsepower in three different speed ranges—3 to 1, 6 to 1 and 9 to 1. Only with an all-metal drive can you secure the compactness, simplicity, flexibility and economy that are so advantageous today.

Infinitely variable speed may be secured to any R.P.M. within the range of the unit. The output speed is increased or decreased by variation of the position of the ring on the two driving and two driven cones.

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explosives, plastics, dyestuffs, and numerous other products of chemical process industry.

WITH GERMANY'S FALL

COMPLETION of the European conflict will bring with it a big cutback on all military activities. This will undoubtedly occur soon enough to permit adequate supplies of ammonia and ammonia chemicals for spring fertilizer distribution. Presumably it will also relieve other chemical shortages not only for ammonia, nitric acid, and other products, but also sulphuric acid and the other fertilizer components. In fact, 1945 manufacture of chemicals from surplus ordnance raw materials will undoubtedly be encouraged at an early date. Some of this will probably go on even before these government establishments are declared surplus property.

RECONVERSION ORDERS

FIRMS which do not make an aggressive effort to get maximum reconversion authorization from the military and manpower authorities may be handicapping themselves. If they show anxious desire to return to civilian manufacture, such firms will not actually be unpatriotic. It is up to military officials and manpower representatives, working through WPB, to make these decisions. There will be disappointments and turn-downs, but firms that do not ask for civilian privileges are not likely to be sought and forced to take them. Washington is still too busy with manufacture of fighting supplies to give a great deal of thought to civilian requirements, and only a few spokesmen from the Office of Civilian Requirements are aggressively working on that part of the job.

RECONVERSION CRITICS

THOSE who criticize efforts of reconversion are justifiably being told two things. Nelson rightly wrote the rules for reconversion before the game started. He did not choose to umpire a proceeding in which the rules were written only after events made rules necessary. And secondly, reconversion refusals can properly still be made by the military. But it is now up to the military to get out of the way where actual war necessity does not require their restrictions. Civilian needs are secondary; but they are still extremely important.

PRICING UNCLE SAM'S SALES

METHODS which may be used for price control in sales of surplus commodities released by the government have been ruled on by OPA. Regulations regarding resale and stock piling for almost everything except food have been made available. Food pricing had been regulated by earlier rulings. Those people who acquire for resale any government property will be expected to conform just as rigidly to ceiling prices as do other merchants. This policy, which OPA will try to enforce strictly, is intended to have plenty of teeth for the embarrassment of speculators.

HIGH OCTANE DATA

THE reduction of civilian gasoline from 72 to 70 octane rating releases tetraethyl lead enough to make 120 million gallons of aviation gasoline. An equivalent of 90 million gallons of aviation enrichment materials is saved by the curtailment of distribution of premium grades of automobile fuel. As a result of the changes ordered during August, civilian gasoline will get 46 percent of the ethyl fuel which it had in 1941. In that year, less than a quarter of the ethyl fuel went for military uses. Now well over three-fourths of the total is employed for military aviation.

IDLE WAR WORKERS?

WITH the German collapse there will be a 40 percent cutback in military production. This cut, according to Donald Nelson, will permit new civilian manufacture sufficient to give civilian supplies equal to 1939. Thus adequate manufacture for ordinary civilian operations can go on with 60 percent of the war workers still making supplies for the Pacific area and for the eleven million persons in uniform. These facts give some idea of the magnitude of the re-employment problem to take care of these millions when the Pacific fight has also been won.

Many will retire from employment, especially women returning to homemaking. Much new construction and many new consumer's capital goods will then be made. Even so, the figures of the WPB chairman indicate some millions whom it will be hard to place in jobs. Thus the first over-all quantitative statement by a high official is anything but optimistic.

POSTWAR SYNTHETIC RUBBER

QUASI-OFFICIAL estimates of rubber requirements have been prepared by present and former members of the staff of the Office of Rubber Director. These indicate that approximately a million tons of rubber will be required in the U. S. for each of the five years from 1944 to 1948. Military requirements will be tapering off from the present half of the total to almost nothing in 1947, according to these figures.

Washington seems generally to accept the idea that a very large part of this total rubber supply will come from synthetic sources for several years after the Japanese collapse. Rubber from the Far East will be welcome for blending, but a very substantial part of the total from that area will either go to Europe direct or create European demands for our rubber products which are not included in the estimated rubber consumption of the United States. These facts lead to much speculation regarding the future chemical requirements for the synthetic program.

RUBBER RAW MATERIAL

It is the present intention of Washington to use far more butadiene from petroleum beginning next year, just as soon as raw material can be spared from the high octane program. Even in the fourth quarter of 1944, it is expected that much more butadiene will be made from petroleum than from alcohol. This means that next year some of the alcohol producers can probably go back to their beverage business.

Since little alcohol will be used for antifreeze from now on, it seems likely, the industrial alcohol companies will be able to carry their share of the total butadiene load before another 12 months have passed. The abundance of methanol and other alternate solvents for industrial and chemical use will contribute materially to this same end. One estimator, who appears well informed, says that the alcohol business after this year will be largely devoted to the making of rubber raw material, and its survival there will depend on whether alcohol can again be made very cheap. These facts do not worry the beverage industry; but they are of deep concern to those seeking a postwar program for that industrial alcohol which must sell for more than 20c. per gal.

ORD REORGANIZED

IT HAS been announced that following recommendations of Col. Bradley Dewey the President had issued a directive abolishing the Office of Rubber Director and that a Rubber Bureau had been set up within WPB with James F. Clark as director. Mr. Clark has been assistant deputy director of ORD since October, 1943.

The new Rubber Bureau will function under the direction of the Operations Vice Chairman to oversee industry problems and the administration of the Rubber Order. The operation of the synthetic rubber plants and the carrying out of research, development and testing will be in the hands of Rubber Reserve Co. under direction of Jesse Jones.

GOVERNMENT CHLORINE PLANTS

REVIEW of the facilities of the government for the manufacture of chlorine and electrolytic caustic soda shows that there are seven such establishments which have been built with government money. Four of these are connected with the arsenals of Chemical Warfare Service. One is the part of a phenol plant and one a part of a magnesium plant, which have been built by DPC. Only one of the chlorine establishments was built by DPC to make

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2. Tygon tank linings are non-toxic and noncontaminating to solutions. In this respect they closely approach the standards of chemical stoneware, porcelain and glass.

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chlorine for general industrial distribution under WPB allocation.

DISPOSAL OF FACILITIES

Not even preliminary plans have yet been formulated by the government as to the postwar disposition, use, or retention as stand-by of any of these seven chlorine establishments. Ultimate decisions will depend principally on what facilities are deemed necessary for CWS after the war, and what plans are made for the handling of magnesium, phenol, and other general facilities. The problem of disposal of chlorine plants as such will, therefore, not come up actively in Washington for some months, it now appears certain.

PROFIT YARDSTICK USED

WET CORN millers can now ask for ceiling-price changes if over-all profits before income taxes are now less than the base period profits of 1936-1939. Thus OPA has given a much broader basis for judging the fairness of prices in that particular industry. This broad principle is not yet being generally applied in other chemical industries. But there is no harm in asking for it if any management thinks that the new policy would be fairly applicable in its business.

PHOSPHATE ROCK FEED MADE

SHORTAGE of phosphate feeds from normal prewar sources has occasioned development by industry of new methods using phosphate rock as a starting material. The Department of Agriculture reports that six different establishments are now turning out satisfactory rock phosphate which is safe for feed usage.

Previously rock was not considered satisfactory as a raw material because of the high content of fluorine; but methods have been developed in industry and by the Department so that calcium phosphate practically free from fluorine can now be made economically. Approximately 100,-000 tons per year of such feed phosphates are now being manufactured annually.

NEW FERTILIZER BOTTLE-NECKS

RESUMPTION of explosives manufacture on a large scale to support European battlefronts temporarily cut off wanted supplies of chemicals for the fertilizer industry. Major shortages are temporarily being experienced in ammonia, ammonium nitrate, sulphuric acid, superphosphate and other finished fertilizers.

The industry is much less concerned than government officials. The latter are worried lest supplies to be given away for soil improvement programs be cut off by these developments. Shortages for commercial distribution are not very likely except briefly and locally.

Official requests for superphosphate have been as high as 10 million tons for the fertilizer year which began July 1, 1944. It now appears that S million tons of superphosphate will be available which appears adequate to meet commercial demands that are likely to exceed somewhat the last year's consumption of approximately 6.8 million tons. The curtailment in superphosphate will give some comfort to phosphate rock producers who were threatened with difficult conditions when it appeared that they would have to mine more than 6 million tons of rock next year.

"BIG INCH" HAS A GOOD YEAR

DURING its first 12 months of operation, "Big Inch" delivered more than 96 million barrels of crude oil. The line was designed to handle 300,000 bbl. daily. During July it averaged 314,000 bbl. Its daily average for the first year was only 263,000 because many of the pumping stations were not operated for the entire period. Its peak delivery rate was on June 12 of this year, when 326,000 bbl. were handled. Postwar users of petroleum have in this huge pipeline, a delivery system equivalent to 23,000 tank cars working continuously on an 18-day turnabout schedule.

MINERAL STOCKPILING

THE DOMESTIC mining industry, led by American Mining Congress, is seeking to organize a bloc in Congress which will protect American miners from postwar sale of government-owned mineral surpluses. They are-working vigorously with the legislators to secure Congressional action requiring the government to put aside for stockpiling all of the metals and minerals which are owned by Uncle Sam and his corporations. Even in the case of strategic minerals for which domestic production is small, or nil, the industry wishes to prevent the marketing by the government of any of these supplies.

POLITICAL SIGNIFICANCE

OPPONENTS of the mineral stockpiling program argue that it will needlessly burden consumers with high prices both of the minerals and the commodities made from them. They are especially critical of the proposal that even scrap metal and scrapped industrial equipment must be put into the reserves irrespective of the quantity of material which this would put into stockpiles. There has not been clear evidence of a well organized opposition to the program. Washington observers are, therefore, forecasting some success for these proposals of the mining industry. since they may have important political significance in many of the western mining states during an election year.

GLASS CONTAINERS

ALTHOUGH the production of glass containers is at the highest rate in history, the chemical industry has not benefited in the resulting casing of restrictions on the use of glass. The food industry is the beneficiary while the chemical industry merely holds its own by retaining previous packing quotas under the latest revision of the glass container and closure order L-103-b.

When standardization of glass containers took place gains were made not only because production of jars and bottles was increased but also because larger sizes were produced. Reports from the glass industry indicate that present rate of production is approximately 127 percent of prewar capacity. Figures for last June show it to be 15 percent ahead of June, 1943, and for the first six months of this year production was 13 percent ahead of the corresponding period of last year. June, 1944, was the best month in the history of the industry up to that time.

WHOSE ESTIMATE WAS RIGHT?

THE SENATE committee investigating war activities (formerly the Truman Committee) apparently unanimously supported the figures of WPB when these were presented by Donald Nelson and criticized by the Army. The military shortages have apparently been traceable to bad estimates by the Army itself. The cutback on big guns and heavy ammunition made months ago was too deep and the resulting shortages were not caused by inability to get workers.

Several arsenals were closed down but have had to be reopened hastily. This has included several of the establishments making ammonia and various types of explosives. Only a handfull of items, such as big guns, big trucks, and heavy ammunition, have been seriously short. This fact has put the military planners definitcly on the defensive with Congress. No one wants to discipline them. But they are not going to be believed so quickly in the future, even when they do present more carefully studied estimates. Incidentally they are not being blamed for the shortage of tires. That shortage has been caused by conditions in Akron.

NEW RUBBER REGULATIONS

THE OFFICE of the Rubber Director. WPB, has announced a revision of the basic rubber regulations that provides a compilation of all rubber directives and amendments issued previously. The revised regulations include a number of provisions reflecting progress in the nation's conversion from crude to synthetic rubber. They include: 1, all medium-sized highway truck tires to contain 90 percent synthetic; 2, use of neoprene and buna N is now permitted without restriction in all wire and cable construction; 3, elastic thread manufacturers are now permitted to use neoprene without restriction. The officials consider neoprene satisfactory for girdles and similar items.

New Iubricant increases value life reduces maintenance costs

Dow Corning Plug Cock Grease is rapidly proving to be an ideal grease for the lubrication of valves and plug cocks. This basically new product—one of a series of recent Dow Corning silicone developments—is highly resistant to attack by alkalies, acids and oxidizing agents. Because it protects the metal plug cock from corrosive liquids and vapors, it reduces corrosion hazards to a minimum, and so affords continuously efficient, *free* valve operation. Too, Dow Corning Plug Cock Grease maintains its vaseline-like consistency throughout an exceptionally broad range of operating temperatures: from -40° F. to 400° F.

Users of Dow Corning Plug Cock Grease in a wide variety of corrosive chemical services report that valve life was increased three to four hundred per cent when they started to use this silicone lubricant.

DOW CORNING SILICONE PRODUCTS INCLUDE:

Fluids—Inert liquids, with viscosity little affected by temperature changes; for operation at sub-zero as well as elevated temperatures.

Resins—High temperature insulating varnishes for use with heat stable electrical insulating materials.

DOW CORNING CORPORATION, BOX 592, MIDLAND, MICHIGAN

This Duriron Valve, used in the handling of corrosive materials, is but one of many instances where the use of Dow Corning Plug Cock Grease will afford longer life and more efficient operation.

DOW

This installment covers orders rules and regulations issued by the War Production Board and the Office of Price Administration during August, 1944. Copies of each item interpreted here may be obtained from the appropriate federal agency.

CARBON BLACK

ALL members of the rubber industry have been requested to replace their easy processing channel black requirements with medium processing channel black to the fullest possible extent. Where direct substitution is not possible Chemicals Bureau officials have suggested a blend with semireinforcing furnace or high modulus furnace or high modulus alone. This action was taken because increased demand for casy processing black has reduced production of channel black by about 15 percent. The supply situation will improve later since new production of both channel and furnace carbon blacks is scheduled to be brought in each month over the rest of the year.

Since the first of this year, production of furnace black has been increased from less than 100,000,000 lb. a year to more than 430,000,000 lb: and when the present program is completed early next year, production will be at the rate of 625,-000,000 lb. a year. Channel black capacities also are being enlarged and by next March should be at a rate of more than 600,000,000 lb. a year.

TANNING MATERIALS

THE industry advisory committee has asked for a continuation of controls over distribution of chestnut extract. In the first half of this year, production was about 127,000,000 lb. of 25 percent chestnut extract. Results for the second half of the year are expected to be about the same, thus giving a total production of 254,000,000 lb. In 1942 consumption was 391,000,000 lb. Tanners have been drawing from inventories which have been reduced 40 percent in the last six months. Permissible prices for the extract were raised in July and last month announcement was made that users of hemlock and chestnut oak bark will not be permitted to pay more for these commodities than the highest price each user paid for the same product during the period from May 15 to July 15, 1944.

ALLOCATION CONTROLS

BECAUSE of increasing war requirements, ultramarine blue has been subject to allocation since Aug. 1. Those seeking authorization to use or to deliver this pigment must file application on Form WPB- 2947 by the twentieth of the month before the proposed delivery month. Small order exemption is 25 lb. per month.

Distribution of diphenylamine and naphthalene was transferred to Order M-300 with no substantial change in the controls.

Effective Oct. 1, monomethyl amine and dimethyl amine will be placed under quarterly allocation with Order M-300 as directive control. Military demands for them now exceed productive capacity and it is probable that civilian uses will be denied for the next six months.

Sales of uranium or uranium compounds, alloys, or mixtures for certain uses continue to be forbidden and WPB will allocate all other sales and purchases in lots of 10 lb. or more. Persons desiring to purchase must make application on Form 3909 and send it to WPB, P. O. Box 175, Madison Sq. Station, New York 10, N. Y.

Formerly controlled by directive, sodium ferrocyanide, potassium ferrocyanide, potassium ferricyanide and potassium-sodium ferricyanide are now under general allocation. All are in short supply.

Control over ascorbic acid has been transferred to M-300. Three companies are now producing this acid and the output is increasing. Present corn supply is not sufficient to permit maximum production of the acid but if the corn situation should improve it would be possible to remove the allocation controls.

ALLOCATIONS REMOVED

DIRECT allocation controls were removed from polyfiber produced from polystyrene and polydichlorostyrene, and from propylene and diethylene glycols. Production of polyfiber has increased and the other two products which were in active demand as glycerine substitutes, are in better supply because glycerine is now available in a larger way.

Present demands for beryllium have leveled off and users no longer are asked to apply for permission to make purchases other than beryllium copper.

Wider use of DDT in the armed forces has eased the position of methyl bromide and as the supply is regarded as ample for all purposes, allocation controls are no longer in force.

As a result of the drop in amount of alcohol allotted for anti-freeze use, denaturants for anti-freeze alcohol have been freed from controls. These include Acetaldol, ST-115, Dehydrol-0, G.-C.-78, and Pyronate.

Aniline salt was removed from direct allocation according to terms of Order M-300. Its use will now be controlled on the producers level by applications for the allocation of aniline for the manufacture of the salt. Aniline also has been transferred to the regulations of M-300.

LACTIC ACID

MILITARY uses for lactic acid have been growing so fast that it is now expected that 40 percent of all production will go to the armed forces. In order to safeguard this supply, it has been found necessary to control distribution effective Sept. 1. Officials say the larger amounts reserved for military use will not leave sufficient for all civilian needs. Producers have been attempting to increase production by improving present facilities and production techniques. WFA is cooperating through efforts to supply additional raw materials such as corn starch, corn syrup, whey, and high grade molasses.

NAPHTHENIC ACID

DESPITE efforts of manufacturers to speed up outputs, demand for naphthenic acid for military purposes has increased to an extent where virtually all civilian requests will be denied in the allocations for September. While many civilian requests for naphthenic acid for use in protective coatings have been denied, a still smaller quantity of the acid will be allocated for a few highly essential requirements. The acid will continue to be granted for use in ore flotations where special problems exist and for demulsification in petroleum operations.

PRICE CEILINGS

ALL types of boiled-down soap stock have come under price control effective Aug. 16. The specific prices are determined by adding to the Maximum Price Regulation No. 53 ceiling prices for the raw soap stock used, the usual trade differential, which includes processing and delivery costs. Maximum delivered prices for imported boiled-down soap stock will be determined by the port of entry. Imports through Atlantic Coast or Gulf ports will be priced the same as stock produced in Texas, while imports in a Pacific Coast port will be priced the same as stock produced in California.

An increase of 5c. a bu. over previous ceiling prices for flaxseed went into effect on Aug. 14. It affects only Minneapolis, Duluth, Red Wing, Milwaukee, Chicago, and Portland, Ore. This makes the ceiling at those basing points \$3.10 a bu.

Producers of pyrophyllite who are unable to make and sell the product at present maximum prices may apply for adjustment. Increases will not be above the amount necessary to cover total costs of making and selling a particular grade or grades or to cover total costs for a producer's entire production of the commodity.

West Coast producers or distributors of barrels and kegs will have a selling price established on an individual basis.



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scoured off the outer surfaces of the oil reservoir by a high-velocity air stream.

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Write for your copy of the new Speedaire Catalog. The Cleveland Worm & Gear Company, 3273 East 80th St., Cleveland 4, Ohio.

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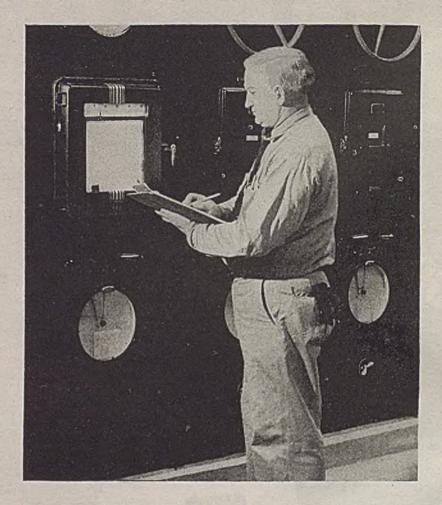
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These are the lenses that make up the heart of a microscope. Assembled and mounted on the stand they become a B&L Microscope ... the microscope you have been planning to purchase when restrictions are lifted.

It will represent the best and the latest in the application of optical science to microscopy. From the initial mathematical calculations to the final inspection each B&L Microscope will always measure up to this standard and each is the product of the experience that has gone before.

There are the facilities of America's first and finest optical glass plant, new methods of manufacture such as the diamond milling of optical parts, new materials such as the B&L low temperature lens cement and other new techniques. All these things, and more, will be combined to give you the finest optical equipment that can be built.







Left: Incoming operators at Butane Products Co., Port Neches, Texas, get a complete temperature history from the wide, easily-read strip-charts of Micromax Pyrometer Recorders. Above: Three of the 60 Micromax Recorders which provide accurate and reliable records of the important fractionating and dehydrogenating temperatures at this hutadiene plant.

BUTANE PRODUCTS CO. USES MICROMAX To Check Vital Butadiene Temperatures

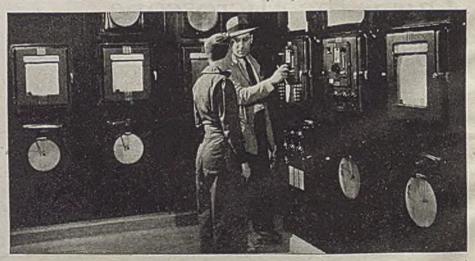
type; gears, bearings and shafts are extra-heavy. And maintenance demands are few: Micromax automatically standardize itself; signals when ink, chart or dry cell need replacing.

Because fractionation temperatures of butane, isobutane, butylene and isobutylene are all within the same ten-degree range, accuracy becomes one of the vital qualities in the temperature instruments used for fractionation of butadiene for synthetic rubber manufacture. At Port Neches, Texas, the Butane Products Co. has turned over the job of automatic temperature watchmen to Micromax Recorders, using in all, 60 Recorders and 20 Indicators on their highly critical fractionating units.

Typical of the hundreds of Micromax instruments in refinery service, these pyrometers have shown on a 24hr., day-in, day-out basis the Micromax ability to hang onto temperature. No matter how small or how great the fluctuation, Micromax detects it, measures it and, by recording it promptly on its wide strip-chart, leaves a permanent temperature guide.



Details of Micromax design assure smooth mechanical action; from its sturdy, cast frame to its vapor-proof door all its parts are rugged. MachineAn L & N engineer will be glad to give you more specific Micromax information, or will send you a catalog if you prefer.



Temperatures of near or distant couples are read with equal reliability on the many L&N Manual Indicators in the Neches plant.



MATERIALS OF CONSTRUCTION FOR CHEMICAL ENGINEERING EQUIPMENT

TWENTY-ONE years ago we published our first "Corrosion" issue, focussing attention on the comparatively few materials then available for the construction of chemical engineering equipment. Cast iron, lead, wood and stoneware were the standbys. Chrome-nickel and other ferrous and non-ferrous alloys were just beginning to claim attention while plastics and other synthetics were largely confined to the laboratory. Then, as the process industries began their great growth and development, the chemical engineer set out in earnest to solve the ever-present problem of corrosion.

His progress to date is fairly reflected in these biennial "Materials of Construction" issues. Each, since 1929, has been planned and produced under the direction of our managing editor, James A. Lee. Each has pointed the trends and presented in convenient form the most reliable information available on the properties and applications of the many metallic and non-metallic materials used by the chemical engineer in his continuing battle against the destructive forces of corrosion.

For corrosion is a relentless as well as an insidious enemy. It has been quick to take advantage of our weaknesses during the past few years when war demands have pushed for capacity production from over-worked equipment, often built of substitute materials, in makeshift designs. Metals have been scarce and that scarcity has been aggravated by corrosion losses — in materials, but more important, in time and, therefore, even in lives.

Shortly, we hope, there will be an opportunity to redesign equipment and to replace ineffective materials with those that have proved their worth in the fiery furnaces of experience. To help Chem. & Met. readers in that process of preparing for the resumption of peace-time production, this issue puts special emphasis on corrosion experiences. More data are presented on the resistance of more materials against more corrosives than in any of the preceeding issues. The test of all this is its value and practical usefulness to you who are responsible for chemical engineering progress. We hope it serves you well.



CHEMICAL

&

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ENGINEERING

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CORROSION Experiences in Chemical Process Industries

Here is how chemical engineers in 60 typical plants in the process industries size up their corrosion problems. Their views—sometimes amounting only to personal opinions — are largely based on their own experiences with the various metals, alloys and other materials of construction they use. This article tells the story largely in the words of the men we interviewed. We promised not to reveal their names or their plants, but we are all indebted to them for this sharing of their corrosion experiences. — Editors

E ISEWHERE in this Eleventh Materials of Construction issue of Chem. & Met. is tabulated the most recent and comprehensive information available on the metals, alloys, plastics, rubber, glass, ceramics and other structural materials most widely used in the chemical process industries. For the most part, this information has been supplied by the manufacturers whose research and service staffs have long studied the application and corrosion resistance of their products. To supplement this excellent and authoritative information with the results of operating experience, we have gone to the users of construction materials. Trained investigators have visited plants and interviewed approximately 60 men in responsible operating positions in as many different localities. In addition, questionnaires were sent to a carefully selected list of almost a hundred chemical engineers who were asked to tabulate their recommended practices in the use of materials for various equipment and processes.1 All this is briefly summarized, as objectively as possible, in this introductory article.

Wartime experiences with corrosion have been unusually severe. Plants have often been forced to increase production beyond the capacity of existing equipment and, where new facilities have been provided it has sometimes been necessary to use substitute materials for which adequate operating information was not available. Wartime restrictions on secret processes and products have prevented frank discussion among users faced with similar problems or with the suppliers of equipment. Thus, it is not surprising that our investigators often reported conflicting and contradictory experiences, sometimes within the same industry. Take, for example, the views of several men in the alcohol industry, purposely selected from plants in different parts of the country:

Distiller's Dilemma

An engineer in an eastern distillery, converted entirely to industrial alcohol for the war effort reports: "Wheat is now the raw material for our grain alcohol and, in the raw mash stage, it is extremely corrosive. This raw wheat mash has caused considerable trouble with our pumps. We use a bronze, open-impeller centrifugal type, and so far we have had to replace the impellers about every four months, which involves too much maintenance for truly efficient operation. We are not certain whether this excessive wear is caused by corrosion or erosion. We strongly suspect that it is a combination of both."

The plant superintendent for a midwestern solvents manufacturer said: "Corrosion has become a much more troublesome problem since the advent of the war. For one thing, we are handling considerably greater quantities of alcohol, but the rate of corrosion, it seems, increases at a faster rate than the volume. If we double our volume, the rate of corrosion is almost tripled. Consequently, we have found that corrosion from raw mash has made most of our present liquid-handling equipment entirely unsuitable.

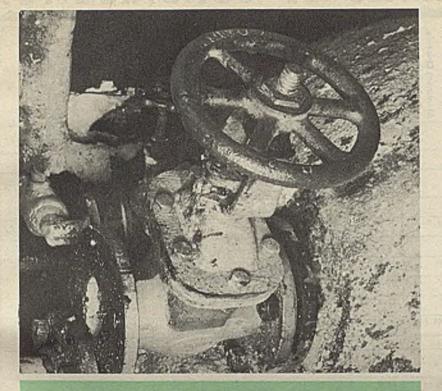
"For instance, we have a number of lead

centrifugal pumps and have always found lead to be a pretty good corrosion-resistant material for most chemical uses. But because a lead impeller is heavy, it cannot be used in a high-speed pump. In peace time this might not be too important a drawback but, due to war demands, we have to have high-speed equipment. Also, our lead pumps have lower efficiency so that from a cost standpoint, it would save us money to have a more efficient pump provided we could get one that would resist corrosion by the raw mash."

A third producer reports more satisfactory use of copper and bronze: "Alcohol, when it gets down to around pH 5 is so corrosive that the only material which satisfactorily resists it is copper. Most of our valves are bronze-seated gate valves which have proved very successful in our operations. We have considered glass or glass-lined pumps, but have not found any large enough for our work."

Acids Are Bad Actors

"We use acetic acid in manufacturing esters in our chemical plant," reports an eastern chemical engineer. "It has given us many sleepless nights in trying to locate the correct material to withstand its corrosion under the various conditions we encounter. Originally we used aluminum in alloy form on our acetic acid lines and valves, but we had to discard this in favor of bronze. This gave us better service, but even so, bronze valves would show up with completely corroded gates at the end of three months' operation. We are now in



Corrosion often occurs in dangerous and inaccessible places as in this pipeline in a petroleum resin plant which had to be replaced with high Ni-Cr-Mo alloy steel after a costly failure of valve and fittings

the process of changing over to stainless steel. It costs at least twice what bronze costs, but we believe it will outlast bronze by about three times in this application, making the amortized cost of stainless steel actually less than that of bronze. Stainlesssteel lines and valves will stand up for about a year.

"But the acetic-acid problem is still further complicated. At one stage in the operation, acetic acid is mixed with sulphuric acid and even stainless steel shudders in the presence of this combination. We are searching for an alloy that will give us at least a year's service in the presence of acetic and sulphuric acids."

Another manufacturer reports severe corrosion experiences with formic acid: "We have used glass pipelines on formic acid but we have replaced these with naturalrubber-lined pipe. Now we have been forced to use synthetic rubber in place of natural, but we have not been in operation long enough to draw any conclusions. Stainless steel seems to be the best material for use in formic-acid storage tanks. This is more expensive than plastic or rubber-lined steel, but we feel the cost to be justified. Highsilicon iron cocks have given us good results. Copper condenser coils in formic acid formerly had to be replaced once a year. We installed stainless steel condensers two and a half years ago and they are still in operation. In general, we want material that will stand up with a minimum of maintenance. We know that 75 percent of our maintenance cost is in labor, only 25 percent in materials. To keep our maintenance cost down, we have to use the best materials available."

Lactic acid is not ordinarily considered a bad actor, but in one castern chemical plant all of the lactic acid equipment was formerly made of silver "because it will not contaminate anything with which it comes into contact." Interestingly enough, our interviewer was told that this plant had "replaced most of the silver with stainless steel because of the cost differential."

Pros and Cons on Stainless

This very evident trend toward the increased use of chromium-nickel steel was frequently mentioned to our interviews. Occasionally, however, these materials came in for criticism on the basis of cost. A quite typical comment was that of a hard-boiled plant superintendent who said: "We have to watch our costs constantly. We are no 'war baby'. We are manufacturing the same product we did in peace times, the only difference being that our only customer is the government. Our gross sales are up, it is true, but so are taxes, labor costs and materials. We can't go 'hog wild' on expenses if we expect to remain in business after the war. This policy has to be reflected in our equipment. We can't afford extravagance, or bright shiny equipment that will run our costs up. We want equipment of the 'work-horse' kind, that will stand up day in and day out even under the bad care that green help is giving it."

Contrast that view with the following statement from a chemical engineer in a paint manufacturing plant: "As far as we are concerned, one of the most important developments in paint equipment is the increased use of stainless steel. Contamination can not be tolerated in paint manufacture and stainless steel is definitely impervious to contamination. We plan to replace all of our tanks with stainless after the war, as well as a number of iron lines and in any other place the application may seem desirable. The advantages of stainless steel are well known, but there is one reason for liking it that doesn't seem to be generally considered. That is the manner in which it 'dresses up' the plant. The men working around stainless equipment seem to desire to keep it looking bright and clean, and of course, stainless is easier to keep in this condition. It's an intangible advantage. It could be compared to what we recently did in our laboratory when we doubled our window space, installed new lighting, painted the walls and floors white. Definite advantages almost immediately developed in terms of higher employee morale and lessened fatigue. It is our belief that stainless steel equipment would help to make this a brighter, more cheerful atmosphere."

The maintenance engineer in a much larger paint and varnish plant reports: "We have been and are going to continue to install more stainless steel kettles, mixers and the like. Stainless will withstand caustic cleaning solutions and also will stand higher temperatures.

Mineral Acids Make Mischief

The design engineer in a rayon plant has had interesting experience with sulphuric acid of various strengths. He reports: "We handle considerable quantities of sulphuric acid in all stages of concentration. By far the most pressing problem with our liquidhandling equipment is corrosion, particularly as related to pumps. From the standpoint of corrosion resistance, one of the best pumps in our plant is the centrifugal made from high silicon iron. It requires little maintenance and is highly efficient. Hard lead is best for corrosion resistance alone, but because the impeller is so heavy the end result with this pump is that you have to use a lot of power and obtain a lower rate of efficiency. We have a few rubber-lined pumps in operation and have had pretty good luck with them. But as with both rubber and lead pumps we do find that repairs are necessary quite frequently because the moving parts will not retain their tolerances.

¹⁰n the following pages (96, 97 and 98) are tabulated the results of this inquiry. Recognized chemical engineering authorities in plants manufacturing these chemical products were asked to report their best practice in the selection of materials of construction for the various pieces of processing equipment listed in this tabulation. Comments and criticisms will be welcomed.

MATERIALS OF CONSTRUCTION

FOR CHEMICAL ENGINEERING EQUIPMENT AS REPORTED BY TYPICAL USERS

Artine (one to choose forme to choose forme to choose for and which the and which the	Acetic Acid	Acetic Anhydride	Alcohol	Aluminum Chloride, Anhydrous	Ammonia Soda Alkalis	Ammonium Nitrate	Ammonium Sulphate	Bromine	Cane Sugar Refining	Cellulose Acetate	Chlörine, Dry	Chlorine, Wet	Chromic Acid
Absorbers	21,5,78, 28,41	21	10		10		1.2.2			Poter	84,33L 69L,48,9	84,33L, 69L,48	
Acetylators	21,5,78, 28,41	3,7,28, 41,78	21	13. 55	Starting 1			3 903	1.25	7,21,77, 57,58		1915	13
Agitators	21, 5, 78, 28, 41	3,7,28, 41,78	9	15.10	10,9	76	1		10,6,9		70,33L,39	70,33L,39	13
Autoclaves	21, 5, 78, 28, 41	3,7,28, 41,78	Salaria I	-11-10		A. 2.	La la contrata			3	1.11.2	1.2	9
Bins and Hoppers	- Teksti	Web Str.	9	54,9	20,93,10, 9	16,68,9	1.000	74	32,74	77,7		1-+	-
Centrifugals	21, 5, 78, 28, 41	3,7,28, 41,78	7,74		10,74		7,54	110.00	9			11	
Classifiers	-11. 72	Setter our	Id Lynn	54	10,9	15.47	B. Letter		21	174. TT 11	9	10900 C	-
Columns, Fractionating	21,5,78, 28,41	21,3,7, 28,41,78	21,74		10,9	122-67	El ani	33,84	9,21	74	9	and the	-
Condensers	21,5,78, 28,41,72	21,3,7, 28,41,78	21,7,2	9	10,57,54,		21-1-1	86,33,84 33,86	21,2		9		-
Condenser Tubes	21,5,78, 28,41,72	21,3,7, 28,41,78	21	501,74,9	10,57,54, 3			33,00					- 34
Conveyors	21,5,78,	21,3,7.	9	54	69				9,7 9	1		1.1.1.2	9
Cookers	28,41	28,41,78	ACTIV .	Sec.	in Carrie	12-17	11-1 201	2.44	1	2-121	1 212 1		13
Crushers and Grinders	21,5,78,		9	10,54	10,9	10,11		74	9		Total CELT		13
Crystallizers	28,41 21,5,78,	21 3 7	10.9		10,9		42,7	74	9	3	69L,84,33	69L, 24, 33	-
Dryers	28,41	21,3,7, 28,41,78	10,7		10,9	Gardenie				1000	69L,84,	69L,84, 33,64,71	
Drying Towers	28,41	21 3 7	21,7		10, 57, 58	80,76,10	atti ta u	-	9,10,21	and the second	33,7 57,9	33,04,71	-
Evaporators	21,5,78, 28,41 21,5,78	21,3,7, 28,41,78	9	54	10,9				9,74		10.9	84	
Fans and Blowers	21,5,78, 28,41 23	17.0	93,9,23,	-	and a se	-	- HILVAS	22.00	46	Control		1.19-11-2.4	
Fermenters	21, 5, 78,	21.3.7	67		10	10	01-1-0	74	10,7,50L	93			-
Filler Presses	28,41,23	21,3,7, 28,41,78 21,3,7,	21,9,7	9	10,3,9	81,80	12 Aug. 22	57	54 9,21,2,	- La Co	9,57,7	691,84,	- X
Heat Exchangers	28,41	28,41,78	21,7,7	the use	10	10	and the series		28	77	alaninin a	33	9
Kettles	28,41	21,3,7, 28,41,78			SAUG-F		tall p	de th	0502-0	-	0.01	69L,33,	9
Piping	3,21,5, 78,28,41, 7,74,33, 33L	21,3,7, 28,41,78, 9	21,74,48, 9	\$	10,9	81,76,9	6	33,84,50, 71	9,6,21, 74	74,21,3	9,21	84	
Pumps	21,5,78, 28,41,43	21,3,7, 28,41,78, 43,10	10,7,54	1.475	10,74,54	10,76	42,94,54	33,84	10,7,74	74,7,42	10	43,33	
Reaction Vessels	21,5,78, 28,41	21,3,7, 28,41,78		Jen yo	10,9			74	9	7,74	331,57	331,57	-
Retorts	21,5,78, 28,41	21,3,7, 28,41,78	10	29	and the		1.1.1.2	233 13	74	145			-
Screens	21,5,78, 28,41	1.	54,7	54,9	74	76,9	# 48-	Long and	9,7,21, 54,74	The later	2	84,48	
Scrubbers	21,5,78, 28,41	14141	10,9		10	The second		84	9	2012	84,48	all al	9
Shipping Containers	93,3,33, 9,93	3,9	93,61,33, 9	9	47,61,93, 9,57	66,16,68, 93,9,61		33,50L, 84	61,22,47, 9	1	9	9	+
Stills	21,5,78, 28,41,72L	21,3,7,9 28,41,78,	21	9	10,9	יה מכ וה	a state a	33,86	21	100	Sau outo	in the	-
Tanks, Settling	21,5,78, 28,41,23	21;3,7,9 28,41,78,	9	1,21973	10,9	1.10.760	No Sole	432.3	9		and the second	-	9
Tanks, Storage	3,21,5,78 28,41,23, 84,69L,1	21,3,7, 28,41,78, 9	93,9		10,9	16,68,9, 10,93		50L	9,21	74,3,93	9	9	-
Tanks, Wash	21,5,78, 28,41,23		9		10,20,9		121-21.4			-	15-31	1 million	+
Thickeners	21,5,78, 28,41,23	12			9	a fai tank	e ga ap		9		a there is	12 2 4 3 5 1	-
Tower Packing	64.84	64,84	84,8	-126-210	84,8	10.71	1000	64,33,84		71	48,84,33	48,84,33	9
Valves and Fittings	3,7,21,5, 78,28,41, 23,15,74	21,3,7, 28,41,84 78,9,72L	10,7,54	9	10,74,54	a tel hand		33,39,84	, 10,7,74	74	9, 34, 6, 57, 39, 10 84, 48, 64		

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	Dyes	Ethyl Acetate	Formaldehyde	Formic Acid	Glycerine	Hydrochloric Acid	Hydrofluoric Acid	Lactic Acid	Magnesium Chloride	Magnesium Sulphate	Methylene Chloride	Naphthalene	Nitric Acid, Strong	81,80,76	Paint & Varnish	Phenol	Phosphoric Acid	Potassium Chloride	Potassium Hydroxide	Soap	Sodium Chloride	Sodium Chromate & Bichromate	Sodium Hydroxide	Sodium Hypochlorite	Sulphate Pulp	Sulphide Pulp	Sulphuric Acid	
	9,10,84, 40	- Falling	2000	engely:	it was in	85,1,48, 86,40,31, 15L,84,65L	3 11-10/	S. TES	1.253.44		Stat of	Ile - trest -	1,84	1,84	de-sv	384 1		23390		1.24372.25	10410-ht-	1. 1. 1. 1.	7,37,34	69L		9	1,84,9	Absorbers
	331,3	21,74,33L, 7,50L	19-5-3		2	19.20					1	100	71	74	1. 6. 6.	77.10.0		1.3.3			1.275.1	1 334	1225		Elling C		ONL SHIT	Acetylators
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	58,9,74	T Dhealt	1.30.5	9		an ser here	19.10	74	9	9	1251	9	1 2 20	1. 2. 18	N. S. LOW		9	9		9,58,75	54,93,58	9	9,54,57	S in 1	12,50	93,9	0	Bins and Hoppers
	70,54,7, 9,74	Station -	N SIL	1 star	28,74,54	W1 - 163	1.36		45	9,57	-0.27	9,74	par l'an	1.		74	1000	54, 57, 45,	9,57	En et a	77,54	9	9,54,57	69L,77, 72	-5,55	10130	"Ren YEA	Centrifugals
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81.	74	21,74	- 0101	74	9	48,40,85, 1,65L 86,48	-	74	0.45		74,18	9	42 21 22	02 01 22		9 23,57,1L,	10		10		10.00	1. 1. 1.	0-55			to (Wage-	100744	Columns, Fractionating
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	9						AB-100		9,10	0		9			1	17,21,57, 9,77 9	69	0	51		10 51 55	9,95	9,2,6	72,33	74,9			Condenser Tubes
	1	11-12-10	Page A	10 100	The second	minist	E Mark	1944	7,10	1.1.1.	1000			3 - 4 - 2	1-	1	09	4	-200	9,32	69,54,93	9	9,54,57		69 53,9,78	9,69 1L	50,53	Conveyors
	10,9,74	Con-				California California California		124 July 194	9,10	101020 300	The State	9	ACTOR A	in the second	0		69L, 50L, 9	0				0.10						Cookers
	10		al l'art	Stat S.	-LEGITS	Carrie and	North St	Street of La		9,54	1.000	9		1 · · +2	1720	La" - Sta	07L, 30L, Y	9	57,58		10,74,9	9,10 9,10	10 9,57	69L 69L				Crushers and Grinders Crystallizers
	54,9,10, 74	5/4/2	11 - 11 - 11 - 11 - 11 - 11 - 11 - 11		CALL THE REAL	10.00	11-30	With in	9,45, 29L	9,54	ENEX	an an ang	AF Get Ch	A. S.	2	9	10.25	9	Section	9	54,54L, 95	9	10	10,33L			1	Dryers
	A CONTRACTOR	101-2	t : Att	11		1,85L,65L	20194	PLANT S	9,1L,45	4,2000	10000	ELAS IS	No and A	12.28	Part 19	17 - Antalia	Haliper.	1.3.25	1 alerta - M	9	15		84,1	1.00			11	Drying Towers
-	9,10	- 202	1	Teres and	10,21,9	48,86,1L 65L		21,74	9,11,45	9,74		9	86,43	86,43	Sale P	1L, 57, 10, 9,77	50L,1L, 78,35,51	10,54,9	57,58	21,12,10	10,74,21 59,9	, 9,10	58,10,54 57	, 69L,72L	53			Evaporators
450	9,69L	5213	- Alt	No. W		40,91,36L, 64,84,15	21.21	18 and	9	9	199030	9	-24T3)		12-312	9	9.70	9	alline a	Street L	1.50	9	9	69L	9,78,95, 54,16	35	50L,9,10	Fans and Blowers
	97 79 10	Strate B	471.51	1.5	10,32,59	9 24 70	STALL PR	96	10.50	10.0.00	and the	22001	E Carlos B		S	Par 196			States -	1 2 2 3 5 6	1.2.2		5 2 P. 74 P			10.543	1.00	Fermenters
	93,39,10, 96 33,9,10,	21,74			10,32,39	48,86			10,59	10,9,93	C.X. 5	9,74					69,77,50, 93,70		10,57	3,21,6, 7,10,9	59,54	10	10,9,57	69L,36, 92,34	1	the start	Sec. 1	Filter Presses
	7	H- 15-9	12 Cardena	ALCONT STATE	COLUMN STR				11,74,621				81,76,80	81,76,80	74,33,3	9,74,77,	1 1 2 2	54,9	57		TOTAN -	9	57,54,9	72,33	18. 22	1.1.5	9,74,10	Heat Exchangers
8	9,50L,10, 1L,3,74, 69L,33L				15 11	1.2.4	12534	1.2018	Con Stream	5445		9,74,54, 3	Sub- Con		ST SET	2	245	2212	10	58,75,9, 54L	- AL	9	10	331,72	1.25	- Lines	1. A. A.	Kettles
	74,93,39, 69,85,71, 9,10,3, 69L,50	7	88	69L,33L, 85,74,9 33	9	91,36,71, 69L,40,33, 48,64,31, 84L	69	1 278 20	102 St - 74	9	77	9,50,3	43,3,81 33	81,76,80, 43,33	74,33,32 9	64,33,21, 9,69L,57, 10,50	69L,50L, 50,69, 1L	69,69L, 54,10,84, 93	9,57	66,9,74	53,9,95,	9,10	9,57,15L 69L	, 69L,36, 10,33,7	9,10,95, 78,36,52	89,93,95 10,78,21 20L,6	5, 9,10,95, 1, 50,43,40 21,7	' Piping
	74,10,39, 69L,7,57, 36L	53	74,7	43	10,7,74	68,63,48, 25,33,69L, 69,36	53,26,36 9,54,48	74,7,76	10, 59, 45	10,54	74	9,10,50L 43	43,33,74, 77,84	77,33,43, 84	10	33,38,74, 501,9	77,35,70	59,10	59	9,74,10, 54,59,7, 43	59,94,7	10,7	57,10,43	3 69L,43, 10	78,77,74 59,54,27 60,7,10, 12	:	10,43,74 50,94,69 7,35,84,3	, J. Pumps
	74,58,23, 9,50L,10,	21,74				85,1,48, 86,40,15L,			12002		121675	9				9,10,50L	70,77, 50L,1L					.9	9,10,57, 69L	69L,33L			49,44,13	
	11,3,331				(de la	84,65L						9	and the state	1.000							34.57		691	20			10	Reaction Vessels
	9.6.54, 74	in the	220.23	1. se 1	12		the state	74	9,45	74,54		74	14 E		100000	77		76	57		7,74,54	9	9,54	77.70	54 9 74	10	10	Retorts
100	9,10,84, 40	C - Current	13.15	and and a state	1. 4-1. S.	85,1,48, 86,40,15L, 84,65L		33,40	93		1	9	81,84	81,84		9	90,21,71, 54,69	1 Same			1,14,34	9	9,10	77,70, 72 84,70	54,9,74, 57		50,84	Screens
	1	53,9	3	33	9	84,65L 69L,33	9	93,33	9	9		93,47,9	81,80,9,3	91.90.0	200		12907- 5	T			- neg		1,10			5.50-		Scrubbers
	9,74,21	21,74		10	9	48,86,1,	10.00	74		-		9	81,80,9,3	81,80,9	74	9	9,69L	1	9	61	47,61,93	93,61	9,69L	33,69L, 32,9,84	an provide a	1425365		Shipping Containers
	93,9,1L, 50L		1.			65L	12-14	74	11	9		9			14	9,77	601.11			74,75,54, 57		2 2 3	5	S 224.0			13	Stills
	50L 74,50L,9, 3,57,69L	53	3,74,33L 69L,20	74,40	3,74,54	69L,91,40 33,84,33L	53	74	9,1L	9	77	9,3	331,4	81,80,33L		9,93 33L,9	50L,1L	9	9,58	23,9	67	9	9,58,57	-		00	0.000	Tanks, Settling
		1.1.1.1.	69L,20		69L,50L, 75L,32	33,84,33L	1.1.1	NE SE			14 30	i alcale				031,4	501,9	9	9	9,23,93, 75,58	9	9	9,58,57	69L,20		93	9,331,84	Tanks, Storage
1.5	93,9,50L 1L,69L	14 24	1.50						11	9	2.500	9	1224	Se SUT T		9	and -	9	9		1.7	9	9,58	69L,20	78,54,9,	93		Tanks, Wash
	84,8		15125	-					45,1L	9	2	60.275	22.45	MARCE'S	152	157520	70,93,50, 77,50L,1L	9,1L	9,57,58		1000	9	9	69L	1 20 20	100		Thickeners
	39,54,9 10,50,6,74 57	7,53		26,74,43	9,6	64,8,15 56,69,48, 54	53, 30, 54,	74,72,7,	64 10,59	10,74		84,64 9	64,84,33, 64,43,3, 81	1,15,33	74,9,84	64, 8, 15 9, 10, 74,	YPECTER	10,9,74	57,59	0 10 7/	74	84,64,15	5 9	84,64	78 93 54	50 4 7	1,15,33	Tower Packing
	57					34	13	09					81	10-1	43,7	9,10,74, 50L,64	77,50L, 69L	10,7,74	37,39	9,10,74	7,0	9,10	7	69L,36, 10,72,37	78,83,54 10,77,59 14	78,54,10	39,35,43 33L,64,69	Valves and Fittings

CHEMICAL & METALLURGICAL ENGINEERING

SEPTEMBER 1944

L=lined 1 Acid-proof brick 2 Admiralty 3 Aluminum 4 Aluminum 25 5 Aluminum Bronze 6 Brass 7 Bronze 8 Carbon

9 Carbon steel 10 Cast Iron 11 Cast Iron (Ni, 2; Cr, 0.4) 12 Cast Iron (Ni, 5) 13 Cast Steel 14 Causul 15 Ceramics 16 Chlorinated Rubber Paint

17 Chrome Alloy 18 Chrome Steel 19 Chrome Plate 20 Concrete 21 Copper 22 Cotton 23 Cypress 24 Dilecto

25 Durichlor 26 Duramet 27 Elcomet K 28 Everdur 29 Fire Brick 30 Forged Steel 31 Fused Quartz or Silica 32 Galvanized Iron

33 Glass 34 Glass Cloth 35 Hard Lead 36 Hard Rubber 37 Hostelloy 38 Hastelloy B 39 Hastelloy C 40 Haveg

41 Herculoy 42 High Cr Steel 43 High Si Iron 44 Illium 45 inconel

46 Ingot Iron 47 Jute 48 Karbate

96

49 LaBour-R55 50 Lead 51 Pb Covered Cu 52 Low Cr Ni C. I. 53 Mild Steel 54 Monel

55 Natural Rubber 56 Neoprene

57 Nickel 58 Nickel Clad 59 Ni-Resist 60 Ni Steel (2%) 61 Paper 62 Phenolic Resin 63 Plastic 64 Porcelain

65 Pyroflex 66 Red Brass 67 Red Wood 71 Saran 72 Silver

68 Resin-Base Paint 69 Rubber 70 Rubber Covered

73 Soapstone 74 Stainless 75 Stainless Clad 76 Stainless 304 77 Stainless 316 78 Stainless 317 79 Stainless 344 80 Stainless 347

81 Stainless 430 82 Stainless 443 83 Stellite 84 Stoneware 85 Synthelic Rubber 86 Tontalum 87 Tile 88 Tinned Copper

89 Transite 90 Treated Wood 91 Tygon 92 Vinyon 93 Wood 94 Worthite

95 Wrought Iron 96 Yellow Pine



97,

solution containing 25 percent of sulphuric rubber would withstand the acid, it would not withstand the oil. We tried synthetic which you would think would be a natural, rubber instead of hard rubber and this was but the hot chromic acid loosened it. Now even worse. We are experimenting with stoneware at the present time, and we hope that this material will solve our problem, We have just installed carbon heating coils in our acid tanks. These replace lead coils."

Looking toward the millenium, our de-"Our major problem with materials of construction is this. We have tanks constructed out of wood, lead, steel, concrete and brick. What we are after is an all-purpose material that will withstand acid, alkalis and oils, so that we can standardize and avoid the safe to use glass-lines on pressure service of 100 lb. per sq. in. "Recently," he added, "we have scrapped a number of lead valves ravon we can't tolerate any foreign subfiber which is the end product.'

An assistant production superintendent in an eastern coal-tar products plant reports: steel. "We use a considerable amount of sulphuric acid as a reagent in washing. Other than the corrosion angle, this is an acid which poses some definite safety hazards. It can easily burn and scald the worker, number of metals, finally concentrating on pipelines than any of these new materials. and if the line or valve carrying sulphuric copper, Monel and nickel, with emphasis I am just saving myself work in the long run acid should suddenly go, there is no end of on the first two at the present time. But we if I get corrosion-resistant metals in the damage the spray might do. Consequently, can't honestly say that these metals are giv- plant in the first place." we equip our workers handling the acid with rubber caps, gloves, and in some cases, service. Dilute HF will force us to replace are what make horse races interesting. Our with full-length coats. These provide ade- lines and equipment made with these metals quate protection, but the rubber safety every six months." caps we have in use are improperly designed. The caps do not fit tightly over the back tendent brought out the fact that dilute of the neck and it is possible, and has been HF (under 60 percent concentration) atthe case, that drops of acid filter down the tacked steel but if 1¹/₂ percent sulphuric worker's neck, and this form of 'human acid is added, for some unknown reason it corrosion' is highly unpleasant, to say the serves to pacify or protect the steel drums least.

"We use two different materials in our The chief supervising engineer in an we know of none better."

rial that will stand up in our chromic-acid but, of course, it must be continuously flakers is a problem that we have never lubricated and flushed in order to deliver really solved. Under the double action of top performance. The acid is peculiar in corrosion and abrasion, the rolls corrode that it has different qualities in dilute and and form pits in which the flakes stick. concentrated forms. Although carbon steel When pressure is put on the knives to will withstand the attack of hydrofluoric scrape out the pits, the knives are mined. acid in concentrated form, it quickly cor-

mic acid seemed to take the carbon out of acid as well as some oil. Although the the steel and even went to work on the steel in some places. We tried chrome plate, we use an extra heavy steel and must resurface the rollers about once every eight months. We are very much interested in spraying metals because there are any number of places where such deposits could be used advantageously in the chemical indus- or crack a comparatively minor matter, since sign engineer sums up his needs as follows: try. We ourselves have tried to spray tanks a pump or line can be repaired in very short with stainless steel, but the coating did order. Carbon is also a good heat-transfer not adhere strongly. Major problems with sprayed metals are eliminating porosity and attaining adherence, but these properties and can stand extremes of temperature and will ultimately come, in our opinion.

present wide divergence in the types of ma- ing use as a catalyst in the petroleum interials we have in use." Nevertheless, he dustry, is now becoming one of our imcontinues to experiment with both glass portant mineral acids. It is bringing with and plastic, only to discover that the latter it a number of corrosion problems to both material would not withstand temperatures manufacturers and users. The chief engibeyond 200 deg. C. and that it was scarcely neer of one such chemical plant says: "Valves on our anhydrous HF lines were made of cast iron at one time and they were entirely unsuited for this service. At celain valves. The lead in the former type forged steel with a Monel trim and alumibe possible on plastic lines of larger was going into the acid. In manufacturing num packing, Can't say too much in favor of diameter. these valves. They have been in service

> which we are faced in our entire plant is the direction of such non-metallic materials related to the handling of dilute HF. We as glass, plastics and synthetics. I personhave at various times experimented with a ally would rather have metal equipment or ing us what might be regarded as optimum Someone said that differences of opinion

Interview with another plant superinfrom corrosion.

sulphuric acid line, depending on whether eastern oil refinery reported: "We use hythe acid is in concentrated or dilute form, drofluoric acid as a catalyst and this is a For the concentrated acid, we use carbon particularly mean acid for us to handle. steel, for the dilute, we use lead-lined pipe. After experimenting with a variety of ma-Both materials are excellent for the purpose; terials in pumps for HF, we finally resolved on carbon steel with a Monel metal trim. Another plant reports: "Finding a mate. This pump is giving us excellent service

carbon almost completely to handle dilute about the new non-metallics. hydrofluoric acid. We have found it to be of a highly satisfactory material."

A development engineer in another petroleum refinery reports: "We're partial to carbon equipment. In the first place, it's so very easy to repair. Carbon cement, which gave us a lot of trouble before we learned how to use it, now makes any break medium. If the product is developed to a point where it has greater tensile strength turbulence, it will be the most wonderful Hydrofluoric acid, because of its increas- material the chemical industry will have at its disposal.

Another plant reports: "We have recently installed a number of the new plastic tubes on HF lines and believe they are going to work out fine. Plastic is more expensive than copper which it is replacing, but it is non-corrosive, and I think the additional cost is justified. These lines are only 1/4 in, in diameter, so that the mateon our sulphuric acid line in favor of por- the present time we use valves made of rial can be used at pressures that would not

Despite his interest in plastics, this stance in the acid since it would color the three years and have given us almost com- chemical engineer says: "The major depletely trouble-free performance. Our an- velopment I would like to see after the war hydrous HIF lines are also made of forged is the development of more durable and less easily corroded metals and alloys. The "Probably the toughest problem with trend during the war has seemed to be in

Consequently, we are turning to structural in the same plant were most enthusiastic

Paint Problems

"Fortunately, the problem of corrosion in this plant (a large castern paint factory) is comparatively minor. Our main problems, particularly, with liquid-handling equipment are first, contamination (that is the color of a pigment being affected by the material with which it comes into contact), and second, the caking of moving valves and pump parts with drying oils.

"With respect to the problem of contamination, we have experimented with and are very much interested in glass. In the paint industry glass as a material has certain definite advantages. It won't contaminate and it is possible to check the pigmentation easily and safely. But, sometimes we feel the price we have had to pay for this is almost too great. We're hoping that postwar developments in this field will bring a greater durability to glass which will enable us to use the material for purposes where we need the intrinsic qualities of

A dyestuff manufacturer and user must also guard against contamination. The manager of one small unit in the Middle West reported: "After the war, we're going to spend from \$60,000 to \$100,000 on stainless steel equipment. It may not be a not contaminate the product. We are relot of money to some companies, but it is placing the steel salt dissolving tanks with certainly a major expenditure for a com- the same material. We are using lead coils pany of our size. Stainless is the best mate- in our fatty-acid tanks which are giving us rial available for dycing work. It has a poor service due to the fact that the coils number of very important advantages. First, corrode. We will install Type 347 stainless it is easy to clean. When we want to steel coils as soon as the present lead coils change from one color to another, it is important that the kettle be cleaned thoroughly. Second, it resists dilute acids and alkalis as well as peroxides. The equipment we are going to replace with stainless

pumps, dye parts and packaged dye units."

Alum Allergies

"In each of our alum boiling tanks," said the superintendent of a medium sized heavy chemical plant, "we maintain a steam coil at the bottom. Originally these coils were constructed entirely of lead, but we found that the lead bulged from the steam pres-To lick this problem, we started covering copper pipe with lead, which climinated the problem of bulging. After a couple of years, however, the alum liquor penetrates the lead and although we could recoat the ences in meeting the many corrosion probpipe, we have found that it costs no more to purchase and install an entire new unit."

The chief engineer in a larger eastern plant reported: "We are replacing brass filtrate pipes on our alum rotary filter with stainless steel. Although the cost of stainless is mich higher, we feel it is justified in terms of better service. We are also in the process of installing stainless steel coils in place of aluminum coils in our kettles. Our reason for this is that aluminum restricts the use of the kettles. Stainless can be used on more types of acids than aluminum, consequently, a kettle equipped with stainlesssteel coils can be used for many different plant operations. And, too, stainless will completely wear out."

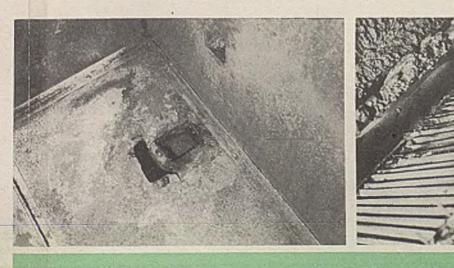
Cosmetic Chemistry

The chief chemist in charge of cosmetics in an eastern plant reports: "We are really



Original thickness A

A 4 in. black-iron pipe in a constant-level tank after 18 months' service in an alcohol plant



Inside of the dried grain bins and ducts steel plate is badly damaged, probably as a result of a combination of corrosion and erosion. Raw-mash proves equally corrosive

Aluminum baffle plates in the dust collectors of a grain drying unit in a whisky distillery now converted to the production of industrial alcohol were seriously corroded

"We have one hard rubber pump on a We used a high-carbon steel, but the chro- rodes in the presence of the dilute acid. interviewer remarked that two other men steel includes peroxide bleaching kettles, not chemical manufacturers, but rather packagers and compounders. All of the actual ingredients which go into our cosmetics are purchased from other companies. We manufacture various types of creams, hair-setting lotions, hand lotions and the like for the 10-cent store market. Our compounding kettles are steam-jacketted copper, lined with tin. The copper itself would be no good as a lining inasmuch as it would sure wherever there was a weak spot in the soon turn green and contaminate the prodmaterial. This usually took about 8 months. uct. Tin is expensive but it stands up well, and it is comparatively easy to reline a kettle when this becomes necessary."

Space does not permit us to include more of these first-hand reports of experilems that are so common to most chemical engineering operations. Perhaps these are sufficient, however, to show something of the severity and importance of these problems as well as their great diversity. The most encouraging comment reported by practically all of our interviewers is the recognition that progress is being made. Chemical engineers generally feel that their corrosion problems can be and are being solved. Even though complaining and often finding fault with new and untried materials, the truth is that a great deal of research and experimentation is under way in all of the plants we visited. The cooperation extended to our investigators is encouraging evidence that the users of chemical engineering equipment are willing to join with the manufacturers² of such equipment and the producers of materials to make certain that corrosion problems are brought out into the open, so that all may benfit through frank discussion and a sharing of experiences.

"As an example of what leading producers of equipment are doing to help chemical engineers keep corrosion under control, the reader is reforred to a comprehensive article and tabulation by L. G. Vande Bogart, research engineer of the Crane Co. of Chicago which appeared originally in "Valve World," for May, 1944 and is now available in re-print form. This tabulation recommends the mate-rials of construction be used in handling corrosive solutions most often met in industry.-Editor.



DIRECTORY OF METALS Materials for Chemical Engineering Equipment

Herewith has been compiled, with the assistance of the manufacturers, a list of most of the metallic materials that are used for the construction of process industry equipment. Ferrous alloys are followed by non-ferrous. The name of each material is accompanied by name and address of the manufacturer, essential nominal chemical composition, and forms in which it is available. In addition, the table gives the primary purpose of the material: corrosion, heat or abrasion resistance. The numbers in the first column refer to a tabulation appearing on pages 107-130 in which resistance of the metals to 80 corrosive chemicals is shown.

No.	. Material	Manufacturer	Essential Nominal Chemical Composition, Percent	Forms Available*	Primarily for
	FERROUS ALLOYS			the man adda	any la
1	301 Stainless Steel, wrought	Note: Physical and chemical properties for those stainless steels in wrought.form which	Fe; Cr. 16-18; Ni, 6-8; C, 0.08-02; Mn, 2.0 max.; Si, 1 max.	B, CR, D, HR, P, S, W	Corrosion
2	302 Stainless Steel, wrought	have been assigned type numbers by the American Iron & Steel Institute are grouped	Fe: Cr. 17-19: Ni, 8-10: C > 0.08-0.20: Mn. 2.0 max :	B, CR, D, HR, P, S, W, T, R	Corrosion
3	302B Stainless Steel, wrought	berowith at the suggestion of the Staipless	Fo; Cr, 17.0-19; Ni, 8-10; C, 0.08-0.20; Si, 2-3; Ma, 2.0		in the second
4	303 Stainless Steel, wrought	Steel Technical Committee of the producers. These stainless steels in <i>urought</i> form are	 Fe; Cr, 17-19; Ni, 8-10; C, 0.03-0.20; Si, 2-5; Mi, 2.0 Fe; Cr, 17-19; Ni, 8-10; C, 0.2 max.; P or S or Se, 0.07 min. Zr or Mo, 0.60 max. 	B, CR, D, HR, P, S, W B, CR, D, HR, P, S, W	Corrosion Corrosion
5	304 Stainless Steel, wrought	generally available from the following pro- ducers:	Fo; Cr, 18-20; Ni, 8-10; C, 0.08 max.; Mn, 2.0 max.; Si, 1 max.	B, CR, D, HR, P, R, S, T, W	Corrosion
6	308 Stainless Steel, wrought	Allegheny-Ludlum Steel Corp., Pitteburgh, Pa. Alloy Metal Wire Co., Prospect Park, Pa.	Fe; Cr, 19-21; Ni, 10-12; C, 0.08 max.; Mn, 2 max.; Si,	B, CR, D, HR, P, R, S, T, W	Corrosion
7	309 Stainless Steel, wrought	American Rolling Mill Co., Middletown, Ohio Babcock & Wilcox Tube Co., Beaver Falls, Pa. Bathlaham Starl Co. Bettle Laurer	l max. Fe; Cr, 22-24; Ni, 12-15; C, 0.20 max.; Mn, 2 max.;	I Dealer Change Change & Status	Corrosion
8	310 Stainless Steel, wrought	Bethlehem Steel Co., Bethlehem, Pa. A. M. Byors Co., Pittsburgh, Pa. Carpenter Steel Co., Reading, Pa.	Si, 1 max. Fe; Cr, 24-26; Ni, 19-22; C, 0.25 max.; Mn, 2 max.;		Corrosion
9	316 Stainless Steel, wrought	Cooper Alloy Fdry. Co., Elizabeth, N. J. Crucible Steel Co., New York, N. Y.	Si, 1.5 max. Fe; Cr, 16-18; Ni, 10-14; C, 0.10 max.; Mo, 1.75-2.5; Mn, 2 max.; Si, 1 max.	B, CR, D, HR, P, R, S, T, W	Corrosion
10	321 Stainless Steel, wrought	Wilbur B, Driver Co., Newark, N. J. Firth Sterling Steel Co., McKeesport, Pa.	Fe; Cr, 17-19; Ni, 8-11; C, 0.10 max.; Ti, min. 4xC; Mn, 2 max.; Si, 1. max.	B, CR, D, HR, P, R, S, T, W	Corrosion
11	347 Stainless Steel, wrought	Forging and Casting Corp., Ferndale, Mich. Henry Disston & Sons, Philadelphia, Pa. Ingersoll Steel & Disc Div., Borg-Warner	Fe; Cr, 17-19, Ni, 9-12; C, 0.10 max.; Cb8xC; Mn, 2 max.; Si, 1 max.	B, CR, D, HR, P, R, S, T, W	Corrosion
12	403 Stainless Steel, wrought	Corp., New Castle, Ind.	Fe; Cr, 11.5-13; C, 0.15 max.; Mn, 1 max.		Aller A
	405 Stainless Steel, wrought	Jessop Steel Co., Washington, Pa.	Fe; Cr, 11.5–13.5; C, 0.05; Al, 0.10–0.30	B, CR, D, HR, P, R, S, T, W	Corrosion
14	406 Stainless Steel, wrought	Latrobe Electric Steel Co., Latrobe, Pa.	Fe; Cr, 12–14; C, 0.15 max.; Al, 3.5–4.5	B, CR, D, HR, P, S, W	Corrosion
15	410 Steinless Steel, wrought	A state of the sta	Fe; Cr, 11.5–13.5; C, 0.15 max.	B, CR, D, HR, P, S, W B, CR, D, HR, P, R, S, T, W	Corrosion Corrosion
16	414 Stainless Steel, wrought	Spang Chalfant Div., Nat. Supply Co., Pitts-	Fe: Cr. 11.5-13.5: Ni. 2.5 mar. C. 0.15 max	B, D, HR, P, R, S, W	Corrosion
17	416 Stainless Steel, wrought	burgh, Pa. Timken Roller Bearing Co., Canton, Ohio	Fe; Cr, 12-14; C, 0.15 max.; P or S or Se, 0.07 min. Zr or Mo, 0.60 max.	B, CR, D, HR, P, R, S, T, W	Corrosion
	420 Stainless Steel, wrought		Fe; Cr, 12-14; C, > 0.15; Mn, 1 max.	B, CR, D, HR, P, R, S, W	Corrosion
19	430 Stainless Steel, wrought	Rustless Iron & Steel Corp., Baltimore, Md.		B, CR, HR, P, R, S, T, W	Corrosion
20	430F Stainless Steel, wrought	Superior Steel Corp., Carnegie, Pa. United States Steel Corp., Pittsburgh, Pa. Universal Cyclops Steel Corp., Bridgeville, Pa.	Fe; Cr, 14-18; C, 0.12 max.; P or S or Se, 0.07 min. Zr or Mo, 0.60 max.	B, CR, D, HR, R, W	Corrosion
21	431 Stainless Steel, wrought		Fe; Cr, 15-17; Ni, 1.25-2.5; C, 0.20 max.		-
	440A Stainless Steel, wrought	- Indiana Indys bicti 00., Dattobe, 18.	Fe; Cr, 16-18; C, 0.60-0.75; Mn, 1 max.; Si, 1 max.	B, CR, D, HR, P, S, W	Corrosion
	440B Stainless Steel, wrought		Fe; Cr, 16-18; C, 0.05-0.95; Mn, 1 max.; Si, 1 max.		Corrosion
	440C Stainless Steel, wrought		Fe; Cr, 16-18; C, 0.95-1.20; Mn, 1 max.; Si, 1 max.		Corrosion
	442 Stainless Steel, wrought		the second	P CP D UP P P C	Corrosion
	443 Stainless Steel, wrought		Fe; Cr, 18-23; C, 0.20 max.; Mn, 1 max.; Si, 1 max.	B, CR, D, HR, P, R, S	Corrosion Corrosion

No.	Material	Manufacturer	Essential Nominal Chemical Composition, Percent	Forms Available*	Primarily for
	446 Stainless Steel, wrought	See previous page for manufacturer's name		B, CR, D, HR, P, R, S, T, W	Corrosion
28	501 Stainless Steel, wrought 502 Stainless Steel, wrought	and address.	Fe; Cr, 4-6; C, > 0.10; Mn, 1 max. Fe; Cr, 4-6; C, 0.10 max.; Mn, 1 max.	B, CR, D, HR, P, R, S, T, W B, CR, D, HR, P, R, S, T, W	Corrosion Corrosion
30	and a second sec		Fe; Cr, 11-14; Ni, 1 max.; C, 0.14 max.	Castings	Corrosion
31			Fe; Cr, 11-14; Ni, 1 max.; C, 0.20-0.40 Fe; Cr, 18-22; Ni, 2 max.; C, 0.30 max.	Castings Castings	Corrosion Corrosion
32			Fe; Cr, 27-30; Ni, 3 max.; C, 0.35 max.	Castings	Corrosion
34	CD-10M Stainless Steel, cast	No. 191 Alexandreal Inclusion	Fe; Cr, 27-30; Ni, 3-6; C, 0.10 max.; Mo, 2.00 max.	Castings	Corrosion
35	CE-30 Stainless Steel, cast CF-7 Stainless Steel, cast	Note: These are the standard designations of cast compositions for nickel-chromium	Fe; Cr, 18-20; Ni, 8-10; C, 0.07 max.	Castings Castings	Corrosion Corrosion
37	CF-10 Stainless Steel, cast	alloys published by the Alloy Casting In-	Fe; Cr, 18-20; Ni, 8-10; C, 0.10 max.	Castings	Corrosion
38 39	CF-16 Stainless Steel, cast CF-20 Stainless Steel, cast	stitute. The recommended uses have been assembled from published data of individual	Fe; Cr, 18-20; Ni, 8-10; C, 0.16 max. Fe; Cr, 18-20; Ni, 8-10; C, 0.20 max.	Castings Castings	Corrosion Corrosion
40	CF-7Se Stainless Steel, cast	producers. These compositions are available	Fe; Cr, 18-20; Ni, 8-10; C, 0.07 max.; Sc, 0.20-0.35	Castings	Corrosion
41	CF-7C Stainless Steel, cast	from one or more of the following foundries:	Fe; Cr, 18-20; Ni, 8-10; C, 0.07 max.; Cb, 10XC	Castings	Corrosion
42 43	CF-7M Stainless Steel, cast CF-10M Stainless Steel, cast		Fe; Cr, 18-20; Ni, 8-10; C, 0.07 max.; Mo, 2.5-3.5 Fe; Cr, 18-20; Ni, 8-10; C, 0.10 max.; Mo, 2.5-3.5	Castings Castings	Corrosion Corrosion
44	CF-16M Stainless Steel, cast		Fe; Cr, 18-20; Ni, 8-10; C, 0.16 max.; Mo, 2.5-3.5	Castings	Corrosion
45	CF-7MC Stainless Steel, cast	Heights, Ill. American Steel Castings Co., Newark, N. J.	Fe; Cr, 18-20; Ni, 8-10; C, 0.07 max.; Mo, 2.5-3.5; Cb, 10XC	Castings	Corrosion
46	CG-7 Stainless Steel, cast	Atlas Foundry Co., Irvington, N. J.	Fe; Cr, 20-22; Ni, 10-12; C, 0.07 max.	Castings	Corrosion
47	CG-10 Stainless Steel, cast	Babcock & Wilcox Co., Barberton, Ohio	Fe; Cr, 20-22; Ni, 10-12; C, 0.10 max.	Castings	Corrosion
48 49	CG-16 Stainless Steel, cast CG-16Se Stainless Steel, cast	Chicago Steel Foundry, Chicago, Ill. Cooper Alloy Foundry Co., Elizabeth, N. J.	Fo; Cr, 20–22; Ni, 10–12; C, 0.16 max. Fe; Cr, 20–22; Ni, 10–12; C, 0.16 max.; Sc, 0.20–0.35	Castings Castings	Corrosion Corrosion
50	CG-7C Stainless Steel, cast	Crane Co., Chicago, Ill.	Fo; Cr, 20-22; Ni, 10-12; C, 0.07 max.; Cb, 10XC	Castings	Corrosion
51	CG-7M Stainless Steel, cast	Driver Harris Co., Harrison, N. J.	Fe; Cr. 20-22; Ni, 10-12; C, 0.07 max.; Mo, 2.5-3.5	Castings	Corrosion
52 53	CG-10M Stainless Steel, cast CG-16M Stainless Steel, cast	Duraloy Co., Scottdale, Pa. Duriron Co., Inc., Dayton, Ohio	Fe; Cr, 20-22; Ni, 10-12; C, 0.10 max.; Mo, 2.5-3.5 Fe; Cr, 20-22; Ni, 10-12; C, 0.16 max.; Mo, 2.5-3.5	Castings Castings	Corrosion Corrosion
51	CG-7MC Stainless Steel, cast	Electric Steel Foundry Co., Portland, Ore.	Fe; Cr, 20-22; Ni, 10-12; C, 0.07 max.; Mo, 2.5-3.5;	Castings	Corrosion
	CIT 10 Stateling Shad and	Electro-Alloys Co, Elyria, Ohio Empire Steel Castings, Inc., Reading, Pa.	Cb, 10XC Fe; Cr, 23-26; Ni, 10-12; C, 0.10 max.	Castings	Corrosion
55 56	CH-10 Stainless Steel, cast CH-20 Stainless Steel, cast	General Alloys Co., Boston, Mass.	Fe; Cr, 23-26; Ni, 10-12; C, 0.20 max.	B, C	Corrosion
57	CH-10C Stainless Steel, cast	General Metals Corp., Oakland, Calif.	Fe; Cr, 23-26; Ni, 10-12; C, 0.10 max.; Cb, 10XC	Castings	Corrosion
58 59	CH-10M Stainless Steel, cast CH-20M Stainless Steel, cast	Grede Foundries, Milwaukee, Wis. Hoskins Mfg. Co., Detroit, Mich.	Fe; Cr, 23–26; Ni, 10–12; C, 0.10 max.; Mo, 2.5–3.5 Fe; Cr, 23–26; Ni, 10–12; C, 0.20 max.; Mo, 2.5–3.5	Castings B, C	Corrosion Corrosion
60		Lebanon Steel Foundry, Lebanon, Pa. Michiana Products Corp., Michigan City, Ind.	Fe; Cr, 23-26; Ni, 10-12; C, 0.10 max.; Mo. 2.5-3.5; Cb, 10XC	Castings	Corrosion
	CK-25 Stainless Steel, cast	Michigan Steel Casting Co., Detroit, Mich.	Fe; Cr, 23-26; Ni, 19-21; C, 0.25 max.	Castings	Corrosion Corrosion
62 63	CM-25 Stainless Steel, cast CN-25 Stainless Steel, cast	Midvale Co., Philadelphia, Pa. National Alloy Div. of the Blaw-Knox Co.,	Fe; Cr, 8-11; Ni, 19-21; C, 0.25 max. Fe; Cr, 18-22; Ni, 23-26; C, 0.25 max.	Castings Castings	Corrosion
64	CS-25 Stainless Steel, cast	Blawnox, Pa.	Fe; Cr, 8-12; Ni, 29-32; C, 0.25 max.	Castings	Corrosion
65	CT-25 Stainless Steel, cast HB Stainless Steel, cast	the second se	Fe; Cr, 13-17; Ni, 34-37; C, 0.25 max. Fe; Cr, 18-22; Ni, 2 max.	Castings Castings	Corrosion Heat
66 67	HC Stainless Steel, cast		Fe; Cr, 27-30; Ni, 3 max.	Castings	Heat
68	HD Stainless Steel, cast		Fe; Cr, 27-30; Ni, 3-6	Castings	Heat
69 70	HE Stainless Steel, cast HF Stainless Steel, cast	and the second se	Fe; Cr, 27-30; Ni, 8-11 Fe; Cr, 18-23; Ni, 8-11	Castings Castings	Heat Heat
71	HH Stainless Steel, cast .	Symington-Gould Corp., Rochester, N. Y.	Fe; Cr, 23-27; Ni, 10-13	Castings	Heat
72	HI Stainless Steel, cast		Fe; Cr, 26-30; Ni, 13-16	Castings	Heat Heat
73 74	HK Stainless Steel, cast HL Stainless Steel, cast	Bridge, N. J. Warman Steel Casting Co., Huntington Park,	Fe; Cr, 23-26; Ni, 19-21 Fe; Cr, 28-32; Ni, 19-21	Castings Castings	Heat
75	HN Stainless Steel, cast	Calif.	Fe; Cr, 18-22; Ni, 23-26	Castings	Hent
76 77	HP Stainless Steel, cast HS Stainless Steel, cast	Utility Electric Steel Foundry, Los Angeles, Calif.	Fe; Cr, 28–32; Ni, 29–31 Fe; Cr, 8–12; Ni, 29–32	Castings Castings	Heat Heat
78	HT Stainless Steel, cast		Fe; Cr, 13–17; Ni, 34–37	Castings	Heat
79	HU Stainless Steel, cast		Fe; Cr. 17-21; Ni, 37-40.	Castings	Heat
80 81	HW Stainless Steel, cast HX Stainless Steel, cast		Fe; Cr, 10-14; Ni, 59-62 Fe; Cr, 15-19; Ni, 65-68	Castings Castings	Heat Heat
8Z	A Metal	Midvale Co., Philadelphia, Pa.	Fe; Cr, 19; Ni, 35; C, 0.35; Si, 1; Mn, 0.5	Castings	Heat
83 84	A M F Abrasion Resisting	Midvale Co., Philadelphia, Pa. Lukeus Steel Co., Coatsville, Pa.	Fe; Ni, 46-50; C, 0.1-0.2; Mn, 1-2 Fe; C, 0.4-0.5; Mn, 1.80 max.	Castings HR, P	Corrosion Abrasion
84 85	Alchrome 3	Wilbur B. Driver Co., Newark, N. J	Fe; Cr, 20; Al, 3	R, W	Heat
86	Alchrome 6		Fe; Cr, 20; Al, 6	R, W	Heat
87 88	AND AND STREET		Fe; Cr, 24–26; Ni, 19–22; C, 0.25 max.; Mn, 2.00 max.; Mo, 2–3 Fe; Cr, 12–14; C, 0.15 max.; W, 2.5–3.5; Mn, 0.50 max.;	B, C, CR, HR, D, P, S, R, T, F, W B, C-R, F	СКН
89	to a constant - Stand of		Ni, 0.5 max. Fe; Cr, 4-6; C, 0.10 max.; Mn, 0.50 max.; Ni, 0.50 max.;		С & Н
90			Mo, 0.4–0.6 ¹ See footnote 2		Corrosion
	Airay D Amsco Hardface-Self		Fe; Cr, 35; Ni, 15 Fe; C; Cr; Mo; Mn		Heat Abrasion
03	Amsco Hard Facing Rod 217	Shoe & Fdry. Co., Chicago Heights, Ill. Amer. Manganese Steel Div., Amer. Brako	Fe: C: Cr: Mn: W. Mo	Welding rod	Abrasion
	million a wattra	Shoe & Fdry. Co., Chicago Heights, Ill. Amer. Manganese Steel Div., Amer. Brake		H county roa	Abrasion
	Antaciron	Shoe & Fdry. Co., Chicago Heights, Ill. Worthington Pump & Mach., Corp., Harrison,	Fe; C, 0.60; Si, 14.5; Mn, 0.50	Castings	Corrosion
200		N. J. Debasek & Wilson Co. Neur York, N. V.	For Co. 1.4. C. 1.0. May 0.4. St. 0.05		E WIT ST
		Babcock & Wilcox Co., New York, N. Y. Bethlehem Steel Co., Bethlehem, Pa.	Fe; Cr, 1.4; C, 1.0; Mn, 0.4; Si., 0.25 Fe; C, 0.35; Mn, 1.20–1.75; Si, 0.15–0.25		Abrasion
97 98			Fe; C, 3.2-3.6; Ni, 2 max.; Si, 1-2; Mn, 0.6-0.9	Castings	10. 112-12
99		Calorizing Co., Wilkinsburg, Pa.	Fe; Cr, 15; Ni, 35; C, 0.55 max.	C, T	Heat

No.	Material	Manufacturer	Essential Nominal Chemical Composition, Percent	Forms Available*	Primarily for
100 101 102	Calite B-28 Carbon-Molybdenum Steel Cast Iron	Calorizing Co., Wilkinsburg, Pa Lukens Steel Co., Coatsville, Pa. Generally available	Fe; Cr, 25-28; Ni, 10-12; C, 0.35; Mo, 0.8-1.1 Fe; C, 0.18-0.28; Mo, 0.4-0.6; Mn, 0.5-0.9 Fe; C, 3.55 (graphite, 2.79)	C; T HR, P, S Castings	Heat . Heat
103		Generally available	Fe; C, 2.52; Si, 2.25; P, 0.76; S, 0.13; Mn, 0.58	Castings	
104	Causul Metal	Lunkenheimer Co., Cincinnati, Ohio	Fe; Ni, 19; C, 2.2-2.8; Cu, 4; Cr, 1.5	Castings	Corrosion
105	Chromax	Driver Harris Co., Harrison, N. J.	Fe; Cr, 19; Ni, 35	B, CR, HR, P, R, S, W	Heat
106 107	Chromel C 4-6 Chrome	Hoskins Mfg. Co., Detroit, Mich. Spang Chalfant Div., Nat. Supply Co., Pitts- burgh, Pa.	Fe; Cr, 16; Ni, 61; C, 0.10 Fe; Cr, 4-6; C, 0.10 max.; Mu, 0.5 max.; Ti, 4-6XC	B, CR, D, HR, R, W HR, T	Heat C & H
108	4-6 Chrome	Spang Chalfaut Div., Nat. Supply Co., Pitts- burgh, Pa.	Fe; Cr, 4-6; C, 0.20 max.; Mn, 0.5 max.	HR, T	C & H
109	Chrome Copper Nickel Steel	Lukens Steel Co., Coatsville, Pa.	Fe; Cr, 0.65–0.85; Cu, 0.45–0.65; Ni, 0.75 max.; C, 0.12 max.; Mn, 0.65–0.85	HR, P, S	iand III
110 111	Chrome Manganese Steel Circle L13	Lukens Steel Co., Contaville, Pa. Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 0.50; Mn, 0.90; C, 0.40 Fe; Cr, 13; C, 0.25 max.; Mn, 0.75; Ni, 0.75 max., Mo, 0.40	HR, P, S Castings	Abrasion C & A
112	Circle L21	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 19; Ni, 9; C, 0.07 max.; Mn, 0.75; Cb, 0.75	Castings	Corrosion
113	Circle L22M	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 19; Ni, 9; C, 0.07 max.; Mn, 0.75; Mo, 1.75; Se, 0.25	Castings	Corrosion
	Circle L22XM	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 20; Ni, 10; C, 0.07 max.; Mn, 0.75; Mo, 3	Castings	Corrosion
1	Circle L23XM	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 19; Ni, 9; C, 0.20 max.,; Mn, 0.75; Mo, 3	Castings	Corrosion
116 117	Circle L24 Circle L31	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr. 10; Ni, 20; C, 0.20 max., Mn, 0.75	Castings Castings	Corrosion Corrosion
118	Circle L32XMC	Lebanon Steel Fdry., Lebanon, Pa. Lebanon Steel Fdry., Lebanon, Pa.	 Fo; Cr, 29; Ni, 9; C, 0.30 max.; Mn, 0.75 Fe; Cr, 15; Ni, 35; C, 0.07 max.; Mo, 3.25; Cu, 2.25; Mn, 0.75 	Castings	Corrosion
119	Circle L30-H	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 24; Ni, 12; C, 0.50 max.; Mn, 0.75	Castings	Heat
120	Circle L31-H Circle L32	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 29; Ni, 9; C, 0.50 max., Mn, 0.75	Castings	Heat
and the second se	Circle L34	Lebanon Steel Fdry., Lebanon, Pa. Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 15; Ni, 35; C, 0.50 max.; Mn, 0.75	Castings	Heat Corrosion
123	Circle L41	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 21; Ni, 29; C, 0.07 max.; Mo, 3.25; Mn, 0.75 Fe; Cr, 15; Ni, 65; C, 0.50 max.; Mn, 0.5	Castings Castings	Heat
124	Circle L46	Lebanon Steel Fdry., Lebanon, Pa.	Fe; Cr, 25; Ni, 20; C, 0.18 max.; Mn, 0.75	Castings	Heat
125	Colonial 610	Vanadium-Alloys Steel Co., Latrobe, Pa.	Fe; Cr, 16-18; Ni, 1; C, 0.12 max.; S, optional	B, D, HR, P, R, S, W	Corrosion
126		Cooper Alloy Fdry. Co., Hillside, N. J	Fe; Cr, 15-17; C, 0.15; Ni, 0.50 max.; Mo, 0.3-0.4	Castings	Corrosion
127	Cooper 21 A-B-C Cooper 22 P-M	Cooper Alloy Edry, Co., Hillside, N. J.	Fe; Cr, 15-20; Ni, 20-25; C, C.07-0.10; Mo, 3; Si, 1.5	Castings	Corrosion
128	Corrosiron	Cooper Alloy Fdry, Co., Hillside, N. J. Pacific Fdry. Co., San Francisco, Calif.	Fe; Cr, 24–28; Ni, 9–12; C, 0.2–0.5; Mo, 3 Fe; C, 0.8–1.0; Si, 14.50; Mn, 0.50	Castings Castings	Corrosion Corrosion
130	Crane 5-Cr-Mo Steel	Crane Co., Chicago, Ill.	Fe; Cr, 4-6; C, 0.30 max.; Mo, 0.55	Castings	C & H
131	Croloy 2	Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Fe; Cr. 2; C. 0.15 max.; Mo. 0.50	B, C, HR, P, S, T, W	oun
and the second second	and the second sec	Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Fe; Cr. 2.25; C. 0.15 max.; Mo. 1	B, C, HR, P, S, T	
133	Croloy 5 Croloy 7	Babcock & Wilcox Tube Co., Beaver Fails, Pa.	Fe; Cr, 4-6; C, 0.15 max.; Mo, 0.45-0.65	B, C, HR, D, P, S, R, T, W	C & H
134	Croloy 9	Babcock & Wilcox Tube Co., Beaver Falls, Pa. Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Fe; Cr, 7; C, 0.15 max.; Mo, 0.55; Si, 0.5–1	B, C, HR, P, S, T	Corrosion
136	Croloy 16-13-3	Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Fe; Cr. 17: Ni. 13: C. 0.10 max : Mo. 1.2-1.5	B, C, P, S, R, T, W B, C, CR, HR, P, S, R, T, W	Corrosion Corrosion
137	Dopploy 30	Sowers Mfg. Co., Buffalo, N. Y.	Fe; Cr, 2.35; Ni, 18.5; C, 2.85; Mn, 1	Castings	Corrosion
138	Duraloy 25-20M	Duraloy Co., Scottdale, Pa.	Fe; Cr, 24-26; Ni, 19-21; C, 0.20; Mo, 2-3	Castings	C&H
139 140	Durichlor Durimet T	Duriron Co., Dayton, Ohio Duriron Co., Dayton, Ohio	Fe; C, 0.85; Si, 14.5; Mo, 3; Mn, 0.35	Castings	Corrosion
141	Durimet 20	Duriron Co., Dayton, Ohio	Fe; Cr, 19; Ni, 22; C, 0.07 max.; Mo, 2; Cu, 1; Si, 1 Fe; Cr, 20; Ni, 29; C, 0.07 max.; Mo, 2; Cu, 4; Si, 1	B, C, D, HR, P, R, S, W Castings	Corrosion
142	Duriron	Duriron Co., Dayton, Ohio	Fe; C, 0.80; Si, 14.50; Mn, 0.35	Castings	Corrosion Corrosion
143	Elverite A	Babcock & Wilcox Co., New York, N. Y.	Fe; C, 3-3.5; Mn, 0.35; Si, 0.25-1	a compa	Abrasion
	Elverite B	Babcock & Wilcox Co., New York, N. Y.	Fe; Cr, 1-1.8; Ni, 3.75-4.75; C, 3-3.5; Si, 0.25-1		Abrasion
1 St. 1 M - 1	Elverite C Genesee 255	Babcock & Wilcox Co., New York, N. Y.	Fe; Cr, 1-1.8; C, 3-3.5; Si, 0.25-1; Ni, 3.75-4.75		Abrasion
146	Genesee 4-12	Symington-Gould Corp., Rochester, N. Y. Symington-Gould Corp., Rochester, N. Y.	Fo; Cr. 5; C, 0.20; Mn, 0.70; Mo, 0.50 Fc; C, 1.10; Mn, 11-14	Castings	C &H
		Ingersoll Steel & Disc Div., Borg Warner Corp., Chicago, Ill.	See footnote 2	HR, P, S	Abrasion Corrosion
149	Invar	Midvale Co., Philadelphia, Pa.	Fe; Ni, 26; C, 0.25; Mn, 0.60; Si, 0.20	B, C, HR, F	
and the second s	K-4	Key Co., E. St. Louis, Ill.	Fe; Cr, 5; C, 0.25; Mn, 0.75; Mo, 0.50	and the second second second	СФН
151		Key Co., E. St. Louis, Ill.	Fe; Cr, 9; C, 0.15; Mo, 1.25; Mn, 0.75	117 York 1	Corrosion
and the second design of the s	Kanthal A Kanthal A-1	C. O. Jelliff Mfg. Corp., Southport, Coun. C. O. Jelliff Mfg. Corp., Southport, Conn.	Fe; Cr, 20–25; Co, 1–3; A1, 6 Fe; Cr; Co; Al	W, Ribbon W, Ribbon	Heat
154		C. O. Jelliff Mfg. Corp., Southport, Conn.	Fe; Cr, 20-25; Co, 1-3; Al, 4-5	W, Ribbon	Heat Heat
155 156	Manganese Molybdonum Steel	Lukens Steel Co., Coatesville, Pa. Bethlohem Steel Co., Bethlehem, Pa.	Fe; C, 0.25 max.; Mn, 1.65 max.; Mo, 0.75 max.; Si, 0.25 Fe; Cr, 0.2–1; Ni, 0.25–0.75; C, 0.12 max.; Cu, 0.5–0.7;	HR, P, S	Abrasion Abrasion
157 158	Midvaloy ATV-1 Mivaloy ATV-3	Midvale Co., Philadelphia, Pa. Midvale Co., Philadelphia, Pa.	Mn, 0.5-1 Fe; Cr, 10-12; Ni, 33-39; C, 0.25-0.35; Mn, 1.1-1.3 Fe; Cr, 13-15; Ni, 25-28; C, 0.40-0.55; W, 2.8-4.0;	B, C, HR, F B, C, HR, F	H&C H&C
159	Midvaloy Hy X	Midvale Co., Philadelphia, Pa.	Mn, 1-1:6; Si, 0.95-1.75 Fe; Cr, 7.75-8.5; Ni, 21-23; C, 0.45-0.55; Cu, 0.9-1.1;		НСС
160	Midvaloy 13-0-Mo	Midvale Co., Philadelphia, Pa.	Si, 1 max. Fe; Cr, 13; Ni, 0.5; C, 0.15; Mo, 0.5; Mn, 0.4	B, C, HR, F	Corrosion
161 162	Midvaloy 1500 Midvaloy 18-8-Se	Midvale Co., Philadelphia, Pa. Midvale Co. Philadelphia, Pa.	Fe; Cr, 14-16; C, 0.3-0.4; Mn, 0.50; Si, 0.15-0.30 Fe: Cr 20; Ni 10; C 0.8 max : Si 1; Mn, 0.5; So 0.3	B, C, HR, F B C HR F	Corrosion
163	Midvaloy 25-12	Midvale Co., Philadelphia, Pa. Midvale Co., Philadelphia, Pa.	Fe; Cr, 20; Ni, 10; C, 0.8 max.; Si, 1; Mn, 0.5; Se, 0.3 Fe; Cr, 22-26; Ni, 11-13; C, 0.25 max.; Mn, 0.25-1	B, C, HR, F B, C, HR, F	Corrosion C & H
164	Milwaukee 28-12	Milwaukee Steel Fdry., Milwaukee, Wis.	Fe; Cr, 27-30; Ni, 11-13; C, 0.25 max.; Mil, 0.25-1 Fe; Cr, 27-30; Ni, 11-13; C, 0.25 max.	Castings	C&H
165	Milwaukee 15-26	Milwaukee Steel Fdry., Milwaukee, Wis.	Fe; Cr, 14-17; Ni, 25-28; C, 0.45 max.	Castings	Heat
166	Milwaukee M-3	Milwaukee Steel Fdry., Milwaukee, Wis.	Fe; Cr, 13-15; Ni, 0.5-1; C, 0.12-0.20	Castings	Corrosion
167	Milwaukee M-4	Milwaukee Steel Fdry., Milwaukee, Wis.	Fe; Cr, 13-15; Ni, 0.50-1; C, 0.12-0.20; Mo, 0.9-1	Castings	Corrosion
168	Milwaukee K-G	Milwaukee Steel Fdry., Milwaukee, Wis.	Fe; Cr, 11-12; C, 1.45-1.60; Mo, 0.9-1; V, 0.20-0.25	Castings	Abrasion
169 170	Milwaukee Si-Cu Milwaukee 22Cr-1.2C	Milwaukee Steel Fdry., Milwaukee, Wis. Milwaukee Steel Fdry., Milwaukee, Wis.	Fe; C, 0.25 max.; Si, 2-2.5; Cu, 1-1.25 Fe; Cr, 20-22; C, 1.25-1.50; Ni, 0.25 max.; Mo, 0.5-0.6;	Castings Castings	Abrasion
171	Miscrome 4	Michigan Steel Casting Co., Detroit, Mich.	Si, 2-2.5 Fe; Cr, 11.5-13; C, 0.12 max.; Ni, 0.80 max.	Castings	Corrosion
Same in the					

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No.	Material '	Manufacturer	Essential Nominal Chemical Composition, Percent	Forms Available*	Primarily for
172	Nichrome	Driver Harris Co., Harrison, N. J.	Fe; Cr, 15; Ni, 60	B, CR, HR, P, R, S, T, W	Heat
	2% Nickel Steel	Lukens Steel Co., Coatsville, Pa.	Fe; Ni, 2 min.; C, 0.25 max.	HR, P,S	101 77
174	Ni-Hard Nilstain	International Nickel Co., New York, N. Y. Wilbur B. Driver Co., Newark, N. J.	Fe; Cr, 1.4-1.6; Ni, 4.4-4.6; C, 2.75-3.6; Si, 0.5-1 Fe; Cr, 18-20; Ni, 8-10; C, >.20; Mn, 2 max.	Castings	Abrasion
176	Ni-Resist	International Nickel Co., New York, N. Y.	Fe; Ni, 13-15; Cu, 5.5-7; C, 2.95-3.1; Cr, 1.5-2.5;	D, HR, R, W Castings	Corrosion Corrosion
5 44			Mn, 1-1.75 ⁷	Castings	Corrosion
177	Pyrasteel 20	Chicago Steel Fdry, Co., Chicago, Ill.	Fe; Cr. 16-18; Ni, 35	Castings	Heat
178	Pyrasteel 2000	Chicago Steel Fdry. Co., Chicago, IlL	Fe; Cr, 26; Ni, 12-14	Castings	Heat
179 180	Pyrasteel 14 Pyrocast	Chicago Steel Fdry. Co., Chicago, Ill. Pacific Foundry Co., San Francisco, Calif.	Fe; Cr, 6; Mo, 0.40–0.60 Fe; Cr, 22–30	Castings	С&Н
181	Rex Z Metal	Chain Belt Co., Milwaukee, Wis.	Fe; C, 2.5; Si, 1–1.5; Cu, 1; Mn, 0.8	Castings Castings	Heat
182	Sivyer 5% Cr	Sivyer Steel Castings Co., Milwaukee, Wis.	Fe; Cr, 4.5-6.5; C, 0.25 max.; Mo, 0.45-0.65	Castings	C&H
183	Spang Chalfant 1	Spang Chalfant Div., Nat. Supply Co., Pitts-	Fe; C, 0.15; Cr, 1.75-2.25; Mn, 0.3-0.6; Mo, 0.45-0.65	HR, T	
184	Spang Chalfant 2	burgh, Pa. Spang Chalfant Div., Nat. Supply Co., Pitts-	Fe; C, 0.1-0.2; Mu, 0.3-0.6; Si, 0.25 max.	HR	Star (Conta
185	Spang Chalfant 3	burgh, Pa. Spang Chalfant Div., Nat. Supply Co., Pitts-	Fe; C, 0.1-0.2; Mo, 0.45-0.65; Mn, 0.3-0.6	HR	aber tut
186	Stainless Steel	burgh, Pa. Cooper Alloy Fdry. Co., Elizabeth, N. J.	Fe; Cr, 15; Ni, 65; C, 0.40	O. Kan	T
187	Steel	Generally available	Fe; C, 0.92; Si, 0.20; P, 0.042	Castings	Heat
188	Steel	Generally available	Fe; C, 0.42; Si, 0.33; P, 0.02		PER PART
189	Steel	Generally available	Fe; C, 0.39; Si, 0.19; P, 0.044		
190	Ni Steel	Generally available	Fe; C, 0.39; Ni, 3.04; Mn, 0.65		4-77 .5
191	Timken 16-13-3	Timken Roller Bearing Co., Canton, Ohio	Fe; Cr, 15.5–17; Ni, 12.5–14.5; C, 0.13 max.; Mo, 2.5– 3.25; Mn, 1.5 max.	and the second second	Corrosion
192 193	Timken 2512 Timken 2% Cr-0.5% Mo	Timken Roller Bearing Co., Canton, Ohio Timken Roller Bearing Co., Canton, Ohio	Fe; Ni, 4.75–5.25; C, 0.20 max. Fe; Cr, 1.75–2.25; C, 0.15 max.; Mo, 0.45–0.65; Mn,	T B. HR. T	Corrosion Corrosion
1.37	uslit		0.3-0.6	abiet al-	
194	Timken 5 Cr-Mo plus Ti	Timken Roller Bearing Co4 Canton, Ohio	Fe; Cr, 4.6; C, 0.12 max.; Mn, 0.50 max.; Mo, 0.45-0.65; Ti, 4XC min, 0.70 max.	в, нк, к, т	C & H
195	Timken DM	Timken Roller Bearing Co., Canton, Ohio	Fe; Cr, 1-1.5; C, 0.15 max.; Mn, 0.3-0.6; Mo, 0.45-0.65	B, HR, R, T	
196 197	Timken Silcromo 5 S Timken Silcromo 7	Timken Roller Bearing Co., Canton, Ohio	Fe; Cr, 4-0; C, 0.15 max.; Si, 1-2; Mn, 0.5 max.	B, HR, R, T	C & H
197	Timken Silcromo 7M	Timken Roller Bearing Co., Canton, Ohio Timken Roller Bearing Co., Canton, Ohio	Fe; Cr, 6-8; C, 0.15 max.; Si, 0.5-1; Mn, 0.50 max. Fe; Cr, 6-8; C, 0.15 max.; Mo, 0.9-1.1; Mn, 0.50 max.;	B, D, HR, R, T, W B D HR W B T	C & H
12	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Si, 0.5-1	Part Part	
199 200	Timken Silcromo 9M Tophet C	Timkon Roller Bearing Co., Canton, Ohio Wilbur B. Driver Co., Newark, N. J.	Fe; Cr, 8-10; C, 0.15 max.; Mn, 0.50 max.; Mo, 0.9-1.1 Fe; Ni, 60; Cr, 15	B, D, HR, R, T, W D, HR, R, W	C & H Heat
201	Tophet D	Wilbur B, Driver Co., Newark, N. J.	Fe; Ni, 35; Cr, 18.5	B, CR, D, HR, R, W	Heat
202	Utiloy 46	Utility Electric Steel Fdry., Los Angeles, Calif.	Fe; Cr, 4-7; C, 0.25 max.; Mo, 0.5; Mn, 0.75; Si, 0.4	Castings	С & Н
203	Uilloy 12	Utility Electric Steel Fdry., Los Angeles, Calif.	Fe; Cr, 11-13; C, 0.12 max.; Mn, 0.4; Si, 0.9	Castings	Corrosion
204	Utiloy I2N	Utility Electric Steel Fdry., Los Angeles, Calif.	Fe; Cr, 11-13; C, 0.12 max.; Ni, 1.75-2.5	Castings	C & H
205 206	Utiloy X Utiloy XX	Utility Electric Steel Fdry., Los Angeles, Calif. Utility Electric Steel Fdry., Los Angeles, Calif.	Fe; Cr, 18; Ni, 8; C, 0.15 max.; Si, 0.9; Mn, 0.5 Fe; Cr, 18; Ni, 8; C, 0.07 max.; Mo, 3.5-4.5	Castings Castings	Corrosion Corrosion
207	Utiloy H		Fe; Cr, 23-26; Ni, 11-13; C, 0.28-0.32; Si, 0.9-1.1; Mn, 0.6-0.8	Castings	Heat
208	Warman 5M	Warman Steel Casting Co., Los Angeles, Calif.		Castings	C&H
209	Worthite	Worthington Pump and Machinery Corp., Harrison, N. J.	Fe; Cr, 20; Ni, 24; C, 0.07 max.; Si, 3.25; Mo, 3; Cu, 1.75; Mn, 0.5	B, C, CR, HR, R, W	Corrosion
210	Wrought Iron, Genuine	A. M. Byers Co., Pittsburgh, Pa.	Fe; C, 0.02; Mn, 0.03; P, 0.12; Si, 0.15; S, 0.02	B, HR, P, R, S, T	Corrosion
NON	FERROUS ALLOYS			- search of the	
211	Admiralty	Generally available	Cu, 70; Sn, 1; Zn, 29	CR, D, P, S, T	Corrosion
212	Advance	Driver Harris Co., Harrison, N. J.	Cu, 55; Ni, 45	B, CR, HR, P, R, S, W	Heat
213	Alcon ZS	Aluminum Co. of Amer., Pittsburgh, Pa.	Al, 99 min.	B, C, CR, P, S, R, T, W, Shapes	
214	Alcoa 3S Alcoa 52S	Aluminum Co. of Amer., Pittsburgh, Pa.	Al; Mn, 1.2 Al; Mg, 2.5; Cr, 0.25	B, CR, P, S, R, W, Shapes B, CR, P, S, R, T, W	Corrosion Corrosion
215	Alcoa 53S	Aluminum Co. of Amer., Pittsburgh, Pa. Aluminum Co. of Amer., Pittsburgh, Pa.	Al; Mg, 1.3; Si, 0.7; Cr, 0.25	B, CR, P, S, R, W, Shapes	Corrosion
217	Alcoa Alclad (72S) 3S	Aluminum Co. of Amer., Pittsburgh, Pa.	See footnote 3		Corrosion
Z18	Alcon 61S	Aluminum Co. of Amer., Pittsburgh, Pa.	Al; Mg, 1; Si, 0.6; Cr, 0.25; Cu, 0.25	CR, P, S, T	Corrosion
219	Alcoa 43	Aluminum Co. of Amer., Pittsburgh, Pa.	Al; Si, 5	Castings	Corrosion Corrosion
220 221	Alcoa 100 Alcoa 220-T4	Aluminum Co. of Amer., Pittsburgh, Pa. Aluminum Co. of Amer., Pittsburgh, Pa.	Al, 09 min. Al; Mg, 10	Castings Castings	Corrosion
222	Alcoa 356	Aluminum Co. of Amer., Pittsburgh, Pa.	Al; Mg, 0.3; Si, 7	Castings	Corrosion
224	Alcumite	Duriron Co., Dayton, Ohio	Cu, 89.75; Al, 9; Fe, 1.25	Castings	Corrosion
225	Alloy A	C. O. Jelliff Mfg. Corp., Southport, Conn.	Ni, 78-80; Cr, 20 max.; Si, 1.5 max:	CR, D, HR, R, W	Heat
226	Alloy C	C. O. Jelliff Mfg. Corp., Southport, Conn.	Ni, 58-62; Cr, 14-18; Si, 1.5 max.	CR, D, HR, R, W CR, D, HR, R, W	Heat Heat
227	Alloy D Alloy 45	C. O. Jelliff Mfg. Corp., Southport, Conn. C. O. Jelliff Mfg. Corp., Southport, Conn.	Ni, 30–35; Cr, 15–20; Si, 1.5 max. Cu, 55; Ni, 45	W, Ribbon	C&H
229	Alray A	Alloy Metal Wire Co., Prospect Park, Pa.	Ni, 80; Cr, 20	W, R, Strip	Heat
230	Aluminum 2S	Reynolds Metals Co., Louisville, Ky.	Al, 99.0 min.; Fe + Si, 1.0 max.; Cu, 0.20 max.	B, R, W	Corrosion
231 232	Aluminum 3S Aluminum 14S	Reynolds Metals Co., Louisville, Ky. Reynolds Metals Co., Louisville, Ky.	Al; Mn, 1-1.5; Fe, 0.7 max.; Si, 0.60 max.; Cu, 0.2 Al; Cu, 3.9-5; Si, 0.5-1.2; Fe, 1.0 max.; Mn, 0.4-1.2;	B, R, W B, R, W	Corrosion Corrosion
233	Aluminum 17S	Reynolds Metals Co., Louisville, Ky;	Mg, 0.2-0.8 Al; Cu, 3.5-4.5; Si, 0.8 max.; Fe, 1.0 max.; Mn, 0.4-1;	B, R, W	Corrosion
234	Aluminum 18S	Reynolds Metals Co., Louisville, Ky;	Mg, 0.2-0.8 Al; Cu, 3.5-4.5; Ni, 1.7-2.3; Si, 0.90 max.; Fe, 1.0 max.;	B, R, W	Corrosion
1. Com		Demail Mark Co. Ladarithe Ka	Mg, 0.45-0.90	שממ	Corrosion
235	Aluminum 24S	Reynolds Metals Co., Louisville, Ky.	Al; Cu, 3.8–4.9; Mg, 1.2–1.8; Si, 0.50 max. See footnote 4	B, R, W	Corrosion
236	Aluminum 24S Pureciad	Reynolds Metals Co., Louisville, Ky. Reynolds Metals Co., Louisville, Ky.	Al; Cu, 3.9-5; Si, 0.5-1.2; Fe, 1.0 max.	B, R, W	Corrosion
237	Aluminum 25S Aluminum 32S	Reynolds Metals Co., Louisville, Ky.	Al; Si, 11-13.5; Cu, 0.5-1.3; Fe, 1.0 max.; Mg, 0.8-1.3;		Corrosion
238	Alduniani 220	and a press of a property of	Ni, 0.5-1.3	24,72	The in

No.	Material	Manufacturer	Essential Nominal Chemical Composition, Percent	Forms Available*	Primarily for
239	Aluminum & 51S	Reynolds Metals Co., Louisville, Ky.	Al; Si, 0.6-1.2; Fe, 1.0 max.; Cu, 0.35; Mg, 0.45-0.80		Corrosion
240	Aluminum 52S	Reynolds Metals Co., Louisville, Ky;	Al; Mg, 2.2-2.8; Fe + Si, 0.45 max.; Cu, 0.1 max.	B, R, W	Corrosion
241	Aluminum 53S Aluminum 61S	Reynolds Metals Co., Louisville, Ky. Reynolds Metals Co., Louisville, Ky.	Al; Fe, 0.35 max.; Mg. 1.1–1.4; Cr, 0.15–0.35 Al; Si, 0.4–0.8; Fe, 0.7 max.; Mg, 0.8–1.2	B, R, W B, R, W	Corrosion Corrosion
242 243	Aluminum R 301	Reynolds Metals Co., Louisville, Ky.	See footnote 5	S, P	Corrosion
244	Aluminum Bronze	Amer. Brass Co., Waterbury, Conn.	Cu, 82-95; Al, 5-9.5; Fe, Mn, Ni, Sn	C, CR, F, HR, P, R, S, T, W	Corrosion
245	Aluminum Bronze	Hills McCanna Co., Chicago, Ill.	Cu, 85-89; Al, 9-10; Fe, 1.4; Mn, 0.5	Castings	Corrosion
246	Aluminum Bronze 5%	Revere Copper & Brass, New York, N. Y.	Cu, 95; Al, 5	Т	Corrosion
247 248	Aluminum Bronze 5% Aluminum Brass	Amer. Brass Co., Waterbury, Conn. Generally available	Cu, 95; Ai, 5 Cu, 76; Zn, 21.5-22; Ai, 2-2.5	CR, D, T	Corrosion
240	Ambrac 850	Amer. Brass Co., Waterbury, Conn.	Cu, 75; Ni, 20; Zn, 5	B, C, CR, D, HR, P, R, S, T, W	Corrosion
250	Ampco 12	Ampeo Motal, Inc., Milwaukee, Wis.	Cu; Al, 8.5-9.3; Fe, 2.5-3.25	B, C, R, T	C & H
Z51	Ampco 15	Ampco Metal, Inc., Milwaukee, Wis.	Cu; Al, 9-10; Fe, 2.75-3.5	B, C, P, S, R, T	C&H
252	Ampco 18	Ampeo Metal, Inc., Milwaukee, Wis	Cu; Al, 10.5-11.2; Fe, 3-4	B, C, R, T	C&A
253 254	Ampco 18-23 Ampcoloy A-3	Ampeo Metal, Inc., Milwaukee, Wis. Ampeo Metal, Inc., Milwaukee, Wis.	Cu; Al, 10.5-11.2; Fe, 3-4 Cu; Al, 9.5-10.5; Fe, 0.1 max.	B, C, R, T B, C	C & A C & H
256	Ampcoloy 40	Ampeo Metal, Inc., Milwaukee, Wis.	Cu; Al, 9.5-10.5; Fe, 0.1 max.	B, C	C&H
257	Antimonial Admiralty	Chase Brass & Copper Co., Waterbury, Conn.	Cu, 72; Zn, 27; Sb, 0.07; Sn, 1	S, T, W	Corrosion
258	Arsenical Admiralty	Amer. Brass Co., Waterbury, Conn.	Cu, 70; Zn, 28.95; Sn, 1; As, 0.05	T	Corrosion
	Arsenical Copper	Generally available 6	Cu; As, 0.15–0.75	D, T	Corrosion
260	Beraloy Beraloy 175	Wilbur B. Driver Co., Newark, N. J.	Cu; Be, 1.9; Co, 0.5	B, CR, D, HR	112 120
261 262	Beraloy 175 Beryllium Copper	Wilbur B. Driver Co., Newark, N. J. Amer. Brass Co., Waterbury, Conn.	Cu; Be, 1.9; Ni, 0.5 max. Cu, 97.4; Be, 2.25; Ni, 0.35	B, CR, D, HR B, C, CR, D, HR, P, R, S, W	Corrosion
263	Beryllium Copper	Riverside Metal Co., Riverside, N. J.	Cu, 97.05; Be, 2.0; Ni, 0.35	B, CR, D, P, R, S, W	and the of
264	Cadmium Copper	Phelps Dodge Copper Products Corp., New York, N. Y.	Cu, 99; Cd, 1	B, CR, D, HR, R, W	bit itt
265 266	Chromel A Chromium Conner	Hoskins Mfg. Co., Detroit, Mich.	Ni, 78; Cr, 20; Mn, 2 max.; C, 0.06	B, CR, D, HR, R, W B, C, CR, D, HR, P, R, S, W	Heat Corrosion
267	Chromium Copper Colmonoy 4	Amer. Brass Co., Waterbury, Conn. Wall-Colmonoy Corp., Detroit, Mich.	Cu, 99.05; Cr, 0.85; Si, 0.10 Ni, 80 ; Cr, 11; B, 2; Fe + Si + C, 8 max.	B, C, R B, C, R	C & A
268	Colmonoy 5	Wall-Colmonoy Corp., Detroit, Mich.	Ni, 76; Cr, 13; B, 3; Fe + Si + C, 9 max.	B, C, R	C&H
269	Colmonoy 6	Wall-Colmonoy Corp., Detroit, Mich.	Ni, 68; Cr, 18; B, 4; Fe + Si + C, 10 max.	B, C, R	C&H
270	Colmonoy 20	Wall-Colmonoy Corp., Detroit, Mich.	Ni, 85; Cr, 7; B, 1.5; Fo + Si + C, 7 max.	B, C, R	C&H
271 272	Colmonoy 300C Commercial Bronze	Wall-Colmonoy Corp., Detroit, Mich.	Ni, 77; Cr, 19; B, 4	B, C, R	C & H
273	Commercial Bronzo F. C.	Chase Brass & Copper Co., Waterbury, Conn Chase Brass & Copper Co., Waterbury, Conn.	Cu, 90; Zn, 10 Cu, 89; Zn, 9; Pb, 2	CR, D, S, T, W B, D, R	Corrosion Corrosion
274	Cupron	Wilbur B. Driver Co., Newark, N. J.	Cu; Ni, 45	B, CR, D, HR	Contraction
275	20% Cupro-Nickel	Generally available 6	Cu, 80; Ni, 20	P, T	
276	30% Cupro-Nickel	Generally available 4	Cu, 70; Ni, 30	B, C, CR, D, HR, P, R, S, T, W	41. mc
277	Deoxidized Copper Dowmetal C	Generally available [®] Dow Chemical Co., Midland, Mich.	Cu, 99.9 +; P, 0.01-0.03 Mg; Al, 9; Mn, 0.1; Zn, 2	B, C, CR, D, HR, P, R, S, T, W Castings	Corrosion
279	Dowmetal J	Dow Chemical Co., Midland, Mich.	Mg; Al, 6.5; Mn, 0.2; Zn, 1	Cercures	Corrosion
280	Dowmetal M	Dow Chemical Co., Midland, Mich.	Mg; Mn, 1.5		wi ere the
281	Dowmetal O	Dow Chemical Co., Midland, Mich.	Mg; Al, 8.5; Mn, 0.2; Zn, 0.5		
282	Durco D-10 Everdur 1000	Duriron Co., Dayton, Ohio Amer. Brass Co., Waterbury, Conn.	Ni, 57; Cr, 23; Cu, 8; Mo, 4; W, 2; Mn, 1	AFT Jampah	0
284	Everdur 1010	Amer. Brass Co., Waterbury, Conn.	Cu, 94.9; Si, 4; Mn, 1.1 Cu, 95.8; Si, 3.1; Mn, 1.1	B, CR, D, HR, P, R, S, T, W	Corrosion Corrosion
	Everdur 1015	Amer. Brass Co., Waterbury, Conn.	Cu, 98.25; Si, 1.5; Mn, 0.25	B, CR, D, HR, P, R, S, T, W	Corrosion
	Frontier 5	Frontier Broizo Corp., Niagara Falls, N. Y.	Cu, 89; Al, 10; Fe, 1	Castings	Corrosion
287 288	Frontier 11 Frontier 40	Frontier Bronze Corp., Niagara Falls, N. Y.	Cu, 88; Ni, 5; Sn, 5; Zn, 2	Castings	Corrosion
289	Gold	Frontier Bronze Corp., Niagara Falls, N. Y. Baker & Co., Newark, N. J.	Cu, Zn, 5; Mg, 0.5; Cr, 0.5; Ti, 0.2 Au, 99.99	Castings B, CR, C, D, HR, P, R, S, T, W	Corrosion Corrosion
290	Hastelloy A	Haynes Stellite Co., Kokomo, Ind.	Ni; Mo, 23 max.; Fe, 23 max.	B, C, HR, P, R, S, T, W	Corrosion
291	Hastelloy B	Haynes Stellito Co., Kokomo, Ind.	Ni; Mo, 33 max.; Fe, 7 max.	B, C, HR, P, R, S, T, W	Corrosion
292	Hastelloy C	Haynes Stellito Co., Kokomo, Iud.	Ni; Cr, 18 max.; Fe, 7 max.; W, 6 max.	B, C, P, S, T	Corrosion
293 294	Hastelloy D Hardware Bronze	Haynes Stellite Co., Kokomo, Ind. Scovill Mfg. Co., Waterbury, Conn.	Ni; Si, 11 max.; Cu, 4 max. Cu, 89; Zn, 8; Pb, 2; Ni, 1	B, C	Corrosion
294	Herculoy A	Revere Copper & Brass, New York, N. Y.	Cu, 39; Zn, 8; F0, 2; Ni, 1 Cu, 96; Si, 3; Mn, 1; Sn, 0.5	D, R, W B, CR, D, HR, P, R, S, W	Corrosion Corrosion
296	Herculoy B	Revere Copper & Brass, New York, N. Y.	Cu, 98; Si, 1.75; Sn, 0.25	B, CR, D, HR, P, R, S, T, W	Corrosion
297	High Brass	Generally available ⁴	Cu, 66; Zn, 34		Corrosion
298	High Silicon Bronze	Phelps Dodge Copper Products Corp., New York, N. Y.	Cu, 97.3; Sn, 1.65; Si, 1.05	B, CR, D, HR, R, W	and the second
299 300	Hytensl Bronze Illium G	Amer. Manganese Bronze Co., Philadelphia, Pa. Burgess-Parr Co., Freeport, Ill.	Cu, 63; Zn, 23; Al, 4; Fe, 3; Mn, 3 Ni, 56; Cr, 22; Mo, 6; Fe, 6; Cu, 6; Mn; Si; C	C, HR, S	
301	Illium R	Burgess-Parr Co., Freeport, Ill.	Ni, 55-60; Cr, 18-24; Mo, 5-8; Fo, 5-8; Cu, 2-6; Mn, 0.5-1.75; Si; C	Castings B, C, CR, P, R, S, T, W	NG W. U
302	Inconel	International Nickel Co., New York, N. Y.	Ni, 79.5; Cr, 13; Fe, 6.5; C, 0.08; Cu, 0.2; Mn, 0.25	B, C, CR, D, HR, P, R, S, T, W	С&Н
303	Inconel Clad Steel	Lukens Steel Co., Coatesville, Pa.	Ni, 79.5; Cr, 13; Fe, 6.5; C, 0.08; Cu, 0.2; Mn, 0.25		С%Н
304 305	Indium Metal Iridio Platinum	Amer. Smelting & Ref. Co., New York, N. Y. Baker & Co., Inc., Newark, N. J.	In Pt; Ir, 5-30	B, C, CR, R, S, T, W B, C, CR, D, HR, P, R, S, T,	Corrosion Corrosion
306	10% Iridium Platinum	J. Bishop & Co., Malvern, Pa.	Pt, 90; Ir, 10	W B, C, CR, D, HR, P, R, S, T,	Corros on
307	30% Iridium Platinum	J. Bishop & Co., Malvern, Pa.	Pt, 70; Ir, 30	W B, C, CR, D, HR, P, R, S, T, W	Corrosion
308	Lead, Antimonial	Amer, Smelting & Ref. Co., New York, N. Y. National Lead Co., New York, N. Y.	Pb, 94; Sb, 6	W C, CR, D, R, S, T, W	Corrosion
309 310	Lead, Antimonial Lead, Asarco Acid	Northwest Lead Co., Seattle, Wash. Amer. Smelting & Ref. Co., New York, N. Y.	Pb, 93.45; Sb, 6.5; Cu, 0.04-0.08 Pb; Cu, 0.06; Bi, 0.02	C, S, T, W C, CR, R, S, T, W	Corrosion Corrosion
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No.	Material	Manufacturer	Essential Nominal Chemical Composition, Percent	Forms Available*	Primarily for
+ 311	Lead, Chemical	Amer. Smelting & Ref. Co., New York, N. Y. National Lead Co., New York, N. Y.	Pb, 99.93; Cu, 0.06	B, C, CR, R, S, T, W	Corrosion
312	Lead, Chemical	Northwest Lead Co., Seattle, Wash.	Pb, 99.95; Cu, 0.04-0.08	C, S, T, W	Corrosion
313		Northwest Lead Co., Seattle, Wash.	Pb, 99.9; Te, 0.02-0.06; Cu, 0.04-0.08	C, S, T, W	Corrosion
314		Amer. Smelting & Ref. Co., New York, N. Y. National Lead Co., New York, N. Y.		B, C, CR, R, S, T, W	Corrosion
315	Leaded Commercial Bronze	Chase Brass & Copper Co., Waterbury, Conn.	Cu, 89; Zn, 9; Pb, 2	B, D, R	Corrosion
316	Monel	International Nickel Co., New York, N. Y.	Ni, 67; Cu, 30; Fe, 1.4; Si, 0.1; C, 0.15	B, C, CR, D, HR, R, S, T, W, P	Corrosion
317	Monel Clad Steel	Lukens Steel Co., Coatesville, Pa.	Ni, 67; Cu, 30; Fe, 1.4; Si, 0.1; C, 0.15		Corrosion
318	Muntz	Generally available *	Cu, 60; Zn, 40	R, S, T, W	Corrosion
319	National Alloy 40	National Smelting Co., Cleveland, Ohio	Al; Cu, 4	Castings	Corrosion
320	National Alloy 40M	National Smelting Co., Cleveland, Ohio	Al; Mg, 4	Castings	Corrosion
321	National Alloy 42	National Smelting Co., Cleveland, Ohio	Al; Cu, 4; Si, 2	epilet	Corrosion
322	National Alloy 70S	National Smelting Co., Cloveland, Ohio	Al; Si, 7.5	Castings	Corrosion
323	National Alloy 5 Si	National Smelting Co., Cleveland, Ohio	Al; Si, 5		Corrosion
324	National Alloy Red X10	National Smelting Co., Cleveland, Ohio	Al; Si, 10; Cu, 1.5; Mn, 0.6; Mg, 0.5	Castings	Corrosion
325	National Alloy Y	National Smelting Co., Cleveland, Ohio	Al; Cu, 4; Ni, 1.5; Mg, 1.5	Castings	Corrosion
326	National Alloy 99+	National Smelting Co., Cleveland, Ohio	Al, 99+	Castings	Corrosion
327	National Alloy 98-99	National Smelting Co., Cleveland, Ohio	Al, 98-99	Castings	Corrosion
328	Naval Brass	Generally available 6	Cu, 60; Zn, 39.25; Sn, 0.75	D, R, T, W	Corrosion
329	Nichrome V	Driver-Harris Co., Newark, N. J.	Ni, 80; Cr, 20	B, CR, D, HR, P, R, S, T, W	Heat
330	Nickel	International Nickel Co., New York, N. Y.	Ni, 99.4; Mn, 0.2; Cu, 0.1; Fe, 0.15; Si, 0.05	B, C, CR, HR, D, P, R, S, T, W	С % Н
331	Nickel Clad Steel	Lukens Steel Co., Coatesville, Pa.	Ni, 99.4; Mn, 0.2; Cu, 0.1; Fe, 0.15; Si, 0.05	HR, P, S	C & H
332	Nickelchrome	Generally available	Ni, 85; Cr, 15		Heat
335	Nickelchrome	Generally available	Ni, 80; Cr, 14-20; Fo	the state of the second s	Heat
336	Nickelchrome	Generally available	Ni, 60; Cr, 15; Fe	Chief and the state of the state	Heat
337	Nickel Silver 18%	Generally available 4	Cu, 65; Ni, 18; Zn, 17	B, C, CR, D, P, R, S, T, W	Corrosion
338	Nickel Silver 18%	Generally available *	Cu, 55; Zu, 27; Ni, 18	B, C, CR, D, P, R, S	Corrosion
339 340	Nirex O. F. H. C. Copper	Driver-Harris Co., Harrison, N. J. Amer. Metal Wire Co., Prospect Park, Pa.	Ni, 80; Cr, 14; Fe, 6 Cu, 99.085	B, CR, HR, P, R, S, W B, C, CR, D, HR, P, R, S, T, W	Heat Corrosion
341	Olds Bearing Bronzo	Olds Alloys, Pasadena, Calif.	Cu, 65; Ni	W	C&A
342	Oldsmoloy	Olds Alloys, Pasadena, Calif.	Cu, 40; Zn, 40; Ni, 15; Sn, 5; Mo, 1.5; Fe, 1		C&A
343	Olympic Bronze A	Chase Brass & Copper Co., Waterbury, Conn.	Cu, 96; Si, 3; Zn, 1	CR, HR, D, S, R, T, W	Corrosion
344	Olympic Bronze B	Chase Brass & Copper Co., Waterbury, Conn.	Cu, 97.5; Si, 1.5; Zu, 1	R, W	Corrosion
345	P. D. C. P. Copper	Phelps Dodge Copper Products Corp., New York, N. Y.	Cu, 09.985	B, C, D, CR, HR, R, T, W	Corrosion
346	Palladium	Baker & Co., Newark, N. J.	Pd, 99.991	B, C, CR, D, HR, P, R, S, T, W	Corrosion
347	Permite 1008	Aluminum Industries, Cincinnati, Ohio	Al; Cu, 4-5; Fe, 1.0 max.; Si, 2-3	Castings	Corrosion
348	Permite 1020-2020	Aluminum Industrics, Cincinnati, Ohio	Al; Si, 6.5-7.5; Fe, 0.6 max.; Mg, 0.2-0.4	Castings	Corrosion
349	Permite 2010	Aluminum Industries, Cincinnati, Ohio	Al; Cu, 4-5; Si, 1.5 max.; Fe, 1.0 max.	Castings	Corrosion
350	Phosphor Bronze A	Generalty available *	Cu, 94.8-95.5; Su, 4.3-5.0; P	B, CR, D, P, R, S, T, W	Corrosion
351	Phespher Bronze C	Generally available 6	Cu; Sn, 7-9; P, 0.03-0.25		Corrosion
352	Phosphor Bronze D	Generally available 6	Cu, 89.5-90; Sn, 10-10.5; P	B, CR, D, P, R, S, T, W	Corrosion
353	Phosphor Bronze F. C	Generally available *	Cu, 88; Zn, 4; Sn, 4; Pb, 4	B, CR, D, P, R, S	Corrosion
354	Phosphorized Admiralty	Scovill Mfg. Co., Waterbury, Conn.	Cu, 70; Zn, 29; Sn, 1; P, 0.03		Corrosion
355	Phosphorized Copper	Chase Brass & Copper Co., Waterbury, Conn.		CR, D, S, T	Corrosion
	Pioneer	Pioneer Alloy Products Co., Cleveland, Ohio			Heat
357	Platinum	Baker & Co., Newark, N. J.	Pt, 99.99	B, C, CR, D, HR, P, R, S, T, W	Corrosion
358	Platinum	J. Bishop & Co., Malvern, Pa.	Pt, 99.95	B, C, CR, D, HR, P, R, S, T, W	Corrosion
359	Red Brass	Generally available 6	Cu, 85; Zn, 15	1.10-11-11-11-11-11-11-11-11-11-11-11-11-1	Corrosion
360	Resistac	Amer. Manganese Bronze Co., Holmesburg, Philadelphia, Pa.	Cu, 88; Al, 10; Fe, 2	C, HR, P, S	
361	Rhodio Platinum	Baker & Co., Newark, N. J.	Pt; Rh, 5-40	B, C, CR, D, HR, P, R, S, T, W	СКН
362	Rooflay	Amer. Smelting & Ref. Co., New York, N. Y.	Pb; Sn, 0.25; Mg, 0.02; Bi, 0.02	CR, R, T	Corrosion
363	Silver, Fine	Baker & Co., Newark, N. J.	Ag, 99.0+		Corrosion
364	Silver, Fine	Handy & Harman, New York, N. Y.	Ag, 99.9+	B, C, CR, D, P, R, S, T, W	Corrosion
	Stellite 1	Haynes Stellite Co., Kokomo, Ind.	Co; Cr; W -	C, Welding rod	Abrasion
	Stellite 6	Haynes Stellite Co., Kokomo, Ind.	Co, 55 min.; Cr, 33 max.; W, 6 max.	Welding rod	Abrasion
	Stellite 98M2	Haynes Stellite Co., Kokomo, Ind.	Cr, 35; max. Co, 35 min.; W, 20 max.		Abrasion
	Stellite Star J-Metal	Haynes Stellite Co., Kokomo, Ind.	Co, 40 min.; Cr, 35 max.; W, 20 max.		Abrasion
	Super Nickel Clad Steel	Lukens Steel Co., Coatesville, Pa.		HR, P, S	Corrosion
	Tantalum	Fansteel Metallurgical Corp., N. Chicago, Ill.	Ta, 99.9+	D, R, S, T, W	Corrosion
371	Tellurium Copper	Chase Brass & Copper Co., Waterbury, Conn.	Cu, 99.5; Te, 0.5	B, D, R, T, W	Corrosion
	Telnic Bronze	Chase Brass & Copper Co., Waterbury, Conn.	Cu, 98.3; Ni, 1; Te, 0.5; P, 0.2	D, R	Corrosion
372	the same of the state of the st		C 40 # 20 00 7	D TTD 10 101 10 00 10 00 00 00 00 00 00 00 00	a .
372 373	Tobin Bronze Tophet A	Amer. Brass Co., Waterbury, Conn. Wilbur B. Driver Co., Newark, N. J.	Cu, 60; Zn, 39.25; Sn, 0.75 Ni, 80; Cr, 20	D, HR, R, W, B, CR, P, S, T D, HR, R, W	Corrosion Heat

* Forms available: B,bars; C,castings; CR,cold-rolled; D,drawn; HR,hot rolled; P,plates; R,rods; S,sheets; T,tubes; W,wire. ¹ Types 501 and 502 stainless steels with additions of W, Al, Cu or Co may be obtained for special applications from Allegheny Ludlum Corp. ² Clad stainless steels are available in many of the standard compositions. ³ Surface layer of aluminum alloy which is anodic to the core and will therefore protect the latter electrolytically. ⁴ Aluminum 24S core covered with aluminum of high purity. ⁵ High strength aluminum alloy core clad with corrosion-resistant aluminum alloy of intermediate strength. ⁶ Copper and copper alloys are available from such companies as the following: American Brass Co., Waterbury, Conn.; Bridgeport Brass Co., Flidgeport, Conn.; Bristol Brass Corp., Bristol, Conn.; Chase Brass and Copper Co., Waterbury, Conn.; Mueller Brass Co., Huron, Mich.; New England Brass Co., Taunton, Mass.; Phelps Dodge Products Corp., New York, N, Y.; Revere Copper and Brass, Inc., New York, N, Y.; Riverside Metal Co., Riverside, N, J.; Scovill Mfg, Co., Waterbury, Conn.; Seymour, Mfg, Co., Seymour, Conn.; Wolverine Tube Co., Detroit, Mich. [†] Where copper contamination is undesirable a copper-free Ni-Resist is available.

CORROSION RESISTANCE Of Metallic Materials of Construction

At the repeated demand of its readers for concrete information on the resistance to corrosion of the various materials available for the construction of chemical engineering equipment, *Chem. & Met.* has, with the cooperation of manufacturers, compiled this tabulation of the properties of the metals and alloys. The 80 chemicals for which information is given are arranged alphabetically. The numbers in the first column refer to the Directory of Metals on pages 101-106 of this issue. The second column is intended to give only a general idea of the composition of the material. To identify the specific metal or alloy the reader is referred to the corresponding number in the directory. The unit in which the data are expressed, inches penetration per year, represents, for the most part, an average penetration as calculated from loss in weight suffered by the metal while exposed to attack.

No.	Material	Exposure Conditions		rrosion Year @ Deg. F.)	No.	Material	Exposure Conditions		Corrosion r Year @ D)eg. F.)
ACE	TALDEHY	DE						Room temp.	95°	Boil
		aller to all	instatt in		32	Stainless	Glacial		< 0.001	nil
139		Iron Any conc.	Recom. to boiling		33	Stainless	0.5, 10%	R	A BURNES	R
142		Any conc.	Recom. to boilir	g	0001		Glacial		nil	0.031
209		Mo Cu Commercial grade	< 0.001 at cold		34	Stainless	0.5-100%	R		R
1.5-1	All copper ba		Recommended		35	Stainless	0.5, 10%	R		R
370	Tantalum	Any conc.	None at any ten	ap.	1 1 1 1 1 1 1		80%	R		
					- 112		Glacial	R	nil	0.036
					36	Stainless	0.5, 10%	R		R
ACE	TIC ACID						80%	R		1.
					1 223		Glacial	< 0.001		0.09
2	Stainless	10-80% sol:	< 0.0042 at 70°	to 180°	37	Stainless	Glacial		< 0.001	0.09
		10-60% sol.	0.042-0.12 at bo	iling	and the second sec	Staiuless	0.5-100%	R		R
		90% acrated	0.042-0.12 at 18	00	44, 47,		0.0 10070			
		80% sol.	0.12-0.24 at boil	ing	50,52,					
		100%	< 0.0042 from 7	'0° to 180°	53,58,					
		100%	0.042-0.12 at bo	iling	80					
		100% at 150 psi:	> 0.12 at 400°		41	Stainless	0.5, 10%	R		R
5	Stainless		70°	180°	42	Stainless	0.5-80%	R		R
		3% sol.	0.0047	0.000			100%	< 0.001		0.003
		20% sol.	0.0043	0.000	46, 55,	Stainless	0.5-100%	R		0.000
		40% sol.	0.0216	0.0086	68. 81		010 10070	1 1 1 1 1 1 1		
9	Stainless	All conc.	< 0 0042 from 7	0° to 180°	56	Stainless	0.5, 10%	R		R
		10-33% sol.	< 0.0042 at boil	ing	1		80%	R		
		50-100% sol.	0.0042-0.042 at 1				Glacial	R	nil	0.058
		100% sol. at 150 psi.	0.042-0.12 at 400		59	Stainless	0.5-80%	R		R. 8
15	Stainless	5-10% agitated	< 0.0042 at 70°			Dronneau	100%	R		0.0017
		5-10% acrated	< 0.0042 at 70°		61	Stainless	0.5-100%	R		0.0011
		5% sol.	> 0.1 at 130°			Contractor (Glacial	R	nil	0.15
		20% agitated or aerated	0.042-0.12 at 70°		71	Stainless	10%	R	The	0.10
18	Stainless	5% sol.1	0.00634 at 68°		91	Cr Ni Steel	0.5-100%	R		R
100	a constant of the	15% sol.1	0.00541 at 68°		103	Cast Iron	33%1	ALL CONTRACTOR		0.322
		33% sol.1	0.00541 at 68°		105	Ni Cr Steel	0.5-100%	R		0.044 R
19	Stainless	0070 001	70°	100°	125	Cr Steel	0.5, 10%	R		R
	Lo romancos	5% agitated or aerated	<0.0042	0.0042-0.042	120	Or oteer	80%	R		r.
		10% agitated or nerated	< 0.0042	0.0012-0.012	129	High Si Iron	0.5-100%	R		R
		15% agitated or aerated	0.0010	> 0.12	136	Fe Cr Ni Mo		R		R
		20%	< 0.0042	- U.L.	137	Ni Cr Cast Iro		0.0019		0.0033
		33, 60%	0.042-0.12	0.12-0.42	137	Fe Cr Ni Mo		R		
		\$0%	0.0042-0.042	0.0042-0.042	139		the second se	R		R
		100%				High Si Mo Ir				R
21	Stainless	100%	< 0.0042	<0.0042	140, 141	Fe Ni Cr Cu M		R		R
-1	Destiness	Carl and the concernment of the	< 0.0046 at 68°	to bolling	140	TE-L C' T	100%	R		D
		50% - conc.1	< 0.0046 at 68°		142	High Si Iron	Any conc.	R		R
20	Chail Land	50% - conc.1	< 0.046 at 68°		164	Cr Ni Steel	0.5-100%	R		
30	Stainless	0.5, 10%	R at room temp.	WELST MARY	172	Ni Fe Cr	0.5-100%	R		R
20		To a land	Room temp.	Boiling	175	Cr Ni Steel	0.5-100%	R		R
32	Stainless	0.5, 10%	R	R	176	Fe Ni Cu Cr	0.5%	R		R

No.	Material	Exposure Conditions	C (Inches per	orrosion Year @	Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @	Deg. F.)
		TA A B	Room temp.	2.7	Boil	334	Ni Cr Alloy	30%1	0.010 at 65°	tine .
176	FeNiCuCr	10%	0.0021		R			Glacial 1	0.055 at 68°	
180	Cr Cast Iron	0.5-100%	R		R	335, 336	Ni Cr Steel	10, 100% 1	< 0.004 at 68°	
187 189	Steel Steel	33% ¹ 33% ¹			0.076	1 20		10, 100%1	0.040 at boiling	
190	Steel	33%1		1.	0.091 0.037	337 338	Nickel Silver	0.5-100%	Room temp. Boilin R R	g
200	Ni Cr Fe	0.5-100%	R		R	343	Bronze	0.5, 10%	R R R R	
206	Fe Cr Ni Mo		R	176°	R	010	DIGUSC	80, 100%	R R	
209		lo Cu 0.5-100%	< 0.001	< 0.001		346	Palladium	0.5-100%	R R	
211	Admiralty	0.5, 10%	R		R	350,	P Bronza	0.5-100%	R R	
		80, 100%	R			352, 353				
213	Aluminum	0.5%	0.0013			357,358	Platinum	0.5-100%	R R	
		10%	0.0012			361	Rh Platinum	0.5-100%	R R	
		55%	it Summer 1		0.2	363, 364	Silver	0.5-100%	R R	
		80%	< 0.001				Co Cr W	0.5-100%	RR	
-	1.11.1.2.2.4	100%	< 0.001			370	Tantalum	0.5-100%	R R	
214	Al Alloy	5, 10%	. 0.0013		1941.913	374	Ni Cr Alloy	0.5-100%	R	
		55%	< 0.001		0.31	Sec. mail		di ito moinfindut		
110	11 Allow	100%	< 0.001			ACET	TC ANUN		ainit palità	
215	Al Alloy	5, 10% 80%	0.0014 0.001			ACEI	IC ANHY	DRIDE		
		100%	< 0.001			and the			70° 180°	Boiling
216	Al Alloy	5%	0.0038	2/24/2		2	Stainless	90%	<0.0042	<0.0042
		10%	0.0017			and the second		90% aerated	>0.12	1-1-
		80%	0.0011			. and .		60%	0.0042-0.04	2
		100%	< 0.001	701.		Trains and		30%	>0.12	
24	Al Bronze	0.5%	R			10-10-0		Commercial grade	<0.003	
25, 226	Ni Cr Si	0.5-100%.	R		R		Stainless		a responding	< 0.004
227						and the second sec	Stainless	Commercial grade	<0.003	
29	Ni Cr Alloy	0.5-100%	R		R	9	Stainless	90%	<0.0042	< 0.0042
44	Al Bronze	0.5-100%	R		R	in Dec		90% aerated	0.042-0.12	
45	Al Bronze	0.5%	R		R			30, 60%	0.0042-0.042	2
		10%	R		164 51		Stainless	Commercial grade	<0.030	
49	Cu Ni Zn	0.5-100%	R		R	15	Stainless	Commercial grade Pure 1	<0.030	<0.000
57	Admiralty	0.5, 10%	R		R	19	Stainless	90%	<0.0046 · <0.0042	<0.038 0.042-0.1
66	Cr Copper	0.5-100%	R R		R R	10	Ctamess .	Pure ¹	<0.0042	<0.032-0.1
73	Bronze	0.5, 10% 80, 100%	R		R	104	Fe Ni Cu Cr	T utc	<0.001 at 80°	-0.000
77	Deox. Copper		R		R	139		on Any conc.	Recom. to boiling	
	Cu Si Mn	0.5-100%	R		R			Any conc.	Recom. to boiling	
86	Al Bronze	0.5-100%	R		R			o Cu Commercial grade	No loss at cold	
280	Gold	0.5-100%	R		R		Al Alloy	CALLER OF US REALED	0.003 at room temp.	
				158°	T AT -	213-222	Al Alloys	All Al alloys are expected to	be same as 216.	
290	Ni Mo Fe	10%	0.002		0.0024	and the second se	Al Bronze		Recommended	
		99% (glacial)	< 0.001		0.0094	249	Cu Ni Zn		Recommended	
		Crude, aerated		0.02			Admiralty		Slight to moderate	
91	Ni Mo Fe	0.5-100%	R		R	259, 262	Copper		Recommended	
292	Ni Cr Fe W	10%	0.000		0.000	266, 277		With all the stand	011 1 4 1 1 1 1 1	
		99%	0.000	10. 11.	0.000	272, 273,	Bronze		Slight to moderate	
		Crude, aerated		0.000	2	315, 343,				
93	Ni Si Cu	10%	0.0036		0.0044	344, 372	Cu Ni Alloy		Recommended	
		99%	0.0054	0.0000	0.0044		Cu Si Mu		Recommended	
OF.	Q. C. M. C.	Crude, aerated	D	0.0089	D		Ni Mo Fe	All cone;	Recom; at all temp.	
95 06	Cu Si Mn Sn Cu Si Sn	0.5-100%	R R		R		Ni Cr Fe W	All cone:	Preferred to 290, 291, 29	3
96	High-brass	0.5%	R		D	293	Ni Si Cu	All conc.	Recom. at all temp.	1374
97 00	Ni Cr Cu Mo I		**		R <0.004		Nickel Silver	and the many set	Recommended	
		80% plus 2% KMnO4			<0.004		P Bronze		Recommended	
02	Ni Cr Fe	5% serated	< 0.001 at 86°		10.002	355, 371			Slight to moderate	
-		10% aerated, refluxed	0.13 at boiling				Red Brass		Recommended	
		80% storage tank	0.028			364	Silver		Not appreciably attacked	ł
		Glacial, distilling column	0.006 at boil.			365-368		All conc.	Recom. at all temp.	
			Room temp.		Boiling	370	Tantalum	Any conc.	None at any temp.	
04	Indium	0.5-100%	R		2					
05, 306,	Ir Platinum	0.5-100%	R		R	ACET	ONE			
307		1	in the second for				34			
08	Sb Lead	0.5-80%	R				Stainless	The second second	<0.0042 at 70° to boil.	
11, 314		0.5, 10%	0.020			The second se	Stainless	Conc:	<0.003 at 70°	-
16	Ni Cu Alloy	5% aerated	0.034 at 86°				Stainless		<0.0042 at 70° to boil.	
		5% unaerated, refluxed	0.001 at boiling				Stainless		<0.040 at 70°	
		10% aerated	0.016 at 86°			18-20				
		50% unacrated, refluxed	0.002 at boiling				Fe Ni Cu Cr	Hanna Hanna	No attack	
		80% in storage tank	0.002				High Si Mo Ire		Recom. to boiling	
	10000	Glacial, aerated	0.001 at 86° 0.003 at boiling			142	High Si Iron		Recom. to boiling	
- Colore		Glacial, distill, column				209	Fe Ni Cr Si M	Contraction of the second s	No loss at cold	
0.0	NE CE All	Vapors	0.007 at 220°	hail		218	Al Alloy	Exposed for one year	Only mildly stained	
29	Ni Cr Alloy	0.5-100%	R at room temp			900 001	All copper base		Recommended	
30	Nickel	5% unacrated, reflux.	0.010 at boiling				Ni Mo Fe	All cone.	Recom. at all temp.	
			0.052 at boiling			292	Ni Cr Fe W	All conc.	Recom. at all temp.	
		10% aerated	0.09 at 86°			293	Ni Si Cu Sh Lord	All conc.	Recom. at all temp.	
		50% unaerated, reflux.	0.019 at boiling			308	Sb Lead		Probably OK	
		80% in storage tank	0.018 0.32 at 86°		-	311 314	Chem. Lead Te Lcad		Probably OK Probably OK	
		Glacial, aerated Glacial, distill. column	0.32 at 50° 0.003 at boiling			319	Ni Cu Alloy	C. P. sol.	0.013 at room temp.	
							and ou many	V- A + UVII	wind at 100m (cmp.	

No.	Material	Exposure Conditions		rosion ear @ Deg. F.)	No.	Material	Exposure Conditions	Corrosie (Inches per Year)	
330	Nickel	C. P. sol.	0.007 at room ter		257	Admiralty	Salar and The sales	Severe	
	0"1	Vapors of C. P. sol.	<0.001 at boiling	And the second	259, 262,	Copper		Recommended	
64 65-368	Silver Co Cr W	All conc.	No attack Recom. at all ten	n.	266, 277 272, 273	Bronze		Severe	
		THE OWNER OF THE		THE LAND AND	315, 343,			DOTTING .	
ACET	YLENE				344, 372			and a manual second	
						Cu Ni Alloy		Recommended	
2	Stainless	Conc.	<0.003 at 70°		283-285	Cu Si Mn Ni Mo Fe	All conc.	Recommended Recom. to 158°	
5-11	Stainless Stainless	Conc.	<0.003 at 70° <0.005 at 70°		291	Ni Mo Fe	All conc.	Preferred to 290, 292	
	Stainless	Commercially pure	<0.003 at 70°		292	Ni Cr Fe W	All conc.	Recom. to 122°	
39	High Si Mo Ir		Recom. to boiling	1.	308	Sb Lead	a francis a	Not recom.	
42	High Si Iron	Any conc.	Recom. to boiling		311	Chem. Lead To Lead	taberta.	Not recom.	
	Al Alloys	Dry acetylene	No attack expect	ed	314	Nickel Silver		Not recom. Recommended	
57	Admiralty Bronze	minister 1 1 1	Little to none Little to none			P Bronze		Recommended	
15, 343,			Minic to hobe		355, 371	Copper		Severe	
144, 372					359	Red Brass		Recommended	
808	Sb Lead		Probably OK		370	Tantalum	Any conc.	None at any temp.	
811 814	Chem. Lead Te Lead	the state of	Probably OK		1-1-1-				
318	Muntz		Probably OK Recommended	ENVIRON A	ALUN	IINUM S	ULPHATE		
328	Naval Brass		Recommended		1000			70° 150°	Boiling
55, 371	Copper		Little to none		2	Stainless	5%	<0.00423	
64	Silver		Rapid attack at 1	,100°	the select	Car al al	10%, sat. sol.	<0.00422	0.0042-0.042
73	Tobin Bronze	deboats	Recommended		δ	Stainless	10%	0.004	0.04
	- And - And					Chain!	Sat. sol.	< 0.0043	
ALUN	1		30.00		6-11 g	Stainless Stainless	Sat. sol. 5%	<0.0043 <0.0042	
			70°	Boiling		Standicoa	10%, sat. sol.	<0.0042	< 0.0042
2	Stainless	2, 10% sol.	<0.00421	<0.00421	12, 15,	Stainless	5%1	<0.0042	
		Sat. sol.; no free H2SO4	<0.06422	0.0042-0.0422	18, 19		10%, sat. sol.*	0.12-0.42	>0.42
5-11	Stainless	Sat. sol.; no free H2SO4	<0.0042		20	Stainless	10%	NR	NR
8	Stainless	10% sol. ¹ Sat. sol. ¹	<0.0044	<0.0044	83	Ni Steel	10%	0.0032 Recom. to boiling	
12, 15	Stainless	Sat. sol.	<0.01	<0.044	139 142	High Si Iron	on Any conc. Any conc.	Recom. to boiling	
19	Stainless	2% sol.	<0.00423		161	Cr Steel	10%	0.0503 at 70°	
		10% sol.	0.0042-0.0422	0.042-0.122	176	Fe Ni Cu Cr	0.1-5%	0.002-0.016 at room t	emp.
	Chatalana	Sat. sol.	10.0045	0.12-0.423	and the second sec	Al Bronze		Recommended	
20	Stainless	10% sol. ¹ Sat. sol ¹	<0.0046	<0.0046	249	Cu Ni Zn		Recommended	
104	Fe Ni Cu Cr	12.5%	0.0057 at 125°	<0.0046	257 259, 262,	Admiralty		Slight to moderate Recommended	
129	High Si Iron	10.75%	<0.001 at room t	cmp.	266, 277	Copper		Recommended	
139		on Any conc.	Recom. to boiling	LER SITE ALL	272, 273,	Bronze		Recommended	
142	High Si Iron		Recom. to boiling	5-5-1-5- 1 - 5-1	315, 343,				
209	Fc Ni Cr Si M Al Bronze	lo Cu Paper makers	<0.001 at 150° Recommended		344, 372			and a sub	
249, 247 249 -	Cu Ni Zn		Recommended		and the second sec	Cu Ni Alloy Cu Si Mn		Recommended Recommended	
257	Admiralty		Slight to moderat	e	292	Ni Cr Fe W	All conc.	Recom. at all temp.	
259, 262	, Copper		Recommended		293	Ni Si Cu	All conc.	Recom. at all temp.	St = 12
266, 277					300	Ni Cr Cu Mo	Fe H2SO4 boil of clay	>0.125 at 300°	
265	Ni Cr Alloy	Sat. Sol. ¹	0.0878 at 194°		200	N. C. F.	Effluent from clay boil	<0.004 at 210°	102.14
315, 343	, Bronze		Slight to moderat		302	Ni Cr Fe Sb Lead	In evaporator concentrating Various conc.		
344, 372					311	Chem. Lead	Various conc.	OK at various temps. OK at various temps.	
	Cu Ni Alloy		Recommended		314	Te Lead	Various conc.	OK at various temps.	
283-285	Cu Si Mn	C. M. C. S. S. S. S.	Recommended		316	Ni Cu Alloy	0.1% sol.	0.002 at 60°	
308	Sb Lead	Various conc.	OK at various te				5% sol.	0.007 at 60°	
311 314	Chem. Lead Te Lead	Various conc. Various conc.	OK at various te OK at various te		- 1. 1		25% sol. (storage tank)	0.002 at 95°	
336	Ni Cr Steel	various conc.	0.004 at 68°1	mb.	330	Nickel	In evaporator concentrating 25% sol. (storage tank)	<0.001 at 95°	
	Nickel Silver		Recommended				In evaporator concentrating		
	P Bronze		Recommended	1	335, 336	Ni Cr Steel	50% sol1	<0.0038 at 68°	
	Copper		Slight to modera	te			50% sol.1	<0.0038 at 212°	
353	Red Brass	In dyestuff plants	Recommended			Nickel Silver		Recommended Recommended	
364	Silver	In ayestan pisnts	No attack		355, 371	P Bronze Conner		Slight to moderate	
5.0					359	Red Brass		Recommended	
ALUI	MINUM C	HLORIDE			364	Silver	In dyestuff plant	No attack	
2	Stainless	10, 25%	0.12-0.42 at 70°			Co Cr W	All conc.	Recom. at all temp.	
		Sat. sol.	<0.003 at 70°2		370	Tantalum	Any conc.	None at any temp.	
5	Stainless		Not recom. at 70	0					
		Sat. sol.	<0.003 at 70°2		AMM	ONIA			511-12
	Stainless	Sat. sol.	<0.003 at 70°2					-0.0010	151
9 10, 11	Stainless Stainless	10, 25% Sat. sol.	0.042-0.12 at 70° <0.003 at 70°2	ant miner	2	Stainless	Any conc. sol: Anhydrous	<0.0042 at 70° to boi <0.004 at 70°	112
12	Stainless	Sat. sol.	Attacked		E		Gas	0.12-0.42 at hot	
) Stainless		Not recom. at 70		5-11	Stainless	Anhydrous or sol.	<0.004 at 70°	
83	Ni Steel	4.6 gm. HCl + 6.7 gm. Al			9	Stainless	Any conc. sol.	<0.0042 to boiling	
139		on Any conc.	Recom. to boiling	ş	12, 15	Stainless	Anhy drous	<0.004 at 70°	
142	High Si Iron	Any conc. lo Cu Low conc.	Recom. to boiling				Any conc. sol.	<0.005 at 70°	
209 244 247	Al Bronze	to Cd Llow conc.	Satisfactory at co Recommended	DIQ.	10	Stainland	Gas 1	No attack at 68°	
249, 247	Cu Ni Zn		Recommended	2	19	Stainless	Anhydrous Any conc. sol.	<0.004 at 70° <0.0042 at 70° to bo	31
			recommended		1			-0.0012 at 10 to DO	A

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No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. I
19	Stainless	Gas	0.12-0.42 at hot	302	Ni Cr Fe	Concentrating from 28 to 40	% in evaporator <0.001
20, 21	Stamless	Any conc. sol.	<0.004 at 70°			35% sol + <0.5% NHz	0.002 at boiling
25	Stainless	Anhydrous	<0.004 at 70°	305	Sb Lead	Various conc.	OK at various temp.
		Any conc. sol.	<0.004 at 70°	311	Chem. Lead		Same as 308
C4	Fe Ni Cu Cr	Anhydrous or sol.	Noattack	314	Te Lead		Same as 308
39		on Any conc. sol.	Recom. to boiling				60° 200°
42		Any conc. sol.	Recom. to boiling	310	Ni Cu Alloy	5% sol.	
76	Fe Ni Cu Cr		and the second se	510	MI Cu Anoy		
			<0.001 at room temp.	12 12 1		10% sol.	0.010 0.011
88	Steel	Conc. sol.1	0.0084 at 65°	2. 2. 30-		20% sol.	0.013 0.006
80	Ni Steel	Gas 1	Strong attack at 932"	122.00		35% sol. + <0.5% NH3	0.005 at boiling
09	Fe Ni Cr Si M	o Cu Anlıydrous	No loss at cold	1		Concentrating from 28 to	
		Solutions	No loss at all temp.	1 MEAL		40% in evaporator	0.012
	All Cu alloys	Anhydrous - perfectly dry	Recommended	330	Nickel	35% sol. + <0.5% NH;	0.005 at boiling
		Solutions	Attacked			Concentrating from 28 to	Contrast of the state of
13	Aluminum	10% sol.	0.0057 at room temp.			40% in evaporator	0.012
14	Al Alloy	10% sol.	0.0093 at room temp.	335	Ni Cr Steel	Dilute sol.1	<0.004 at 68°
15	Al Alloy	10% sol.	0.0143 at room temp:	1 2 2 1		Sat. sol.1	>0.004 at 68°
		10% sol.	0.0101 at room temp:	364	Silver		
16	Al Alloy			004	Suver	In dyestuff plant	No attack at cold
18	Al Alloy	10% sol.	0.0158 at room temp:	070		10% C. P., refluxed	<0.001 at boiling
90, 291	Ni Mo Fe	Anhydrous	Recom. at all temp.	370	Tantalum	Any conc. sol.	None at any temp:
		Any conc. sol.	Recom. at all temp.	Section.		and the second sec	
92	Ni Cr Fe W	Anhydrous	Recom. at all temp:	AMA	ONIUM N	TTDATE	S. H. STATE
		Any conc. sol.	Recom, at all temp:	TALIFA ITA	ONION N		the second of the second second
93	Ni Si Cu	Anhydrous	Recom. at all temp:	2	Stainless	All sons regitated an and d	<0.0012 -1.709
The let	a service a	Any conc. sol.	Recon. at all temp:	4	Branness	All conc.; agitated or aerated	<0.0042 at 70°
00	Ni C. C. M.	Fe Anhydrous	<0.004 at 70°		au the states	Sat. sol.	<0.0042 at boiling
00	MI CF CU MIO I			5-11		Sat. sol.	<0.004 at 70°
		28% sol.; agitated	<0.004 at 70°	5	Stainless		<0.004 at 70°, boiling
		Cone. sol.; quiet	<0.004 at 70°	9	Stainless	All conc.; agitated or aerated	<0.0042 at 70°
		Conc. sol.; agitated	0.004-0.015 at 70°			Sat. sol.	<0.0042 at boiling
02	Ni Cr Fe	5-23% sol.; aerated	<0.001 at 86°	12, 15	Stainless	All conc.; agitated or acrated	
08	Sh Lead	Anhydrous	OK			Sat. sol.	<0.0042 at boiling
		Various conc. sol.	OK at various temps	18	Stainless	Dat. sol.	Las Las Press, and a
11	Chem. Lead	2011	Same as 308			AN ADDRESS OF A DESCRIPTION	<0.004 at 70°, boil.
14	Te Lead		Same as 308	19, 20	Stainless	All conc.; agitated or aerated	
		0.707 and company	<0.001 at room temp.		- A LUCCION	Sat. sol.	<0.0042 at 70°, boil;
16	Ni Cu Alloy	2.7% sol., aerated	- I want the second sec	25	Stainless	Sat. sol.	<0.004 at 70°
		3.6% sol., aerated	0.070 at room temp.	104	Fe Ni Cu Cr	anti-	No attack
		12.5% sol., acrated	0.376 at room temp.	139	High Si Mo Ire	on Any conc.	Recom. to boiling
		25.8% sol. aerated	0.036 at room temp.	142	High Si Iron	Any conc.	Recom. to boiling
30	Nickel	1.1% sol.; aerated	<0.001 at room temps	200	Fe Ni Cr Si M	o Cu	<0.001 at 120°
		2.5% sol.; acrated	0.532 at room temp:	1.15- 74	All Cu - Base		Attacked
		27% sol.; acrated	0.187 at room temp.	308, 311,		into ju	Not recommended
35 336	Ni Cr Steel	Solutions 1	0.0038 at 68°	314	Dead		Hot recommended
64	Silver	Anhydrous	Attacked at high temp:	014			
0.	conver	Or-free sol.	No attack at 70°	1.			
	0 0 W			AMM	ONIUM P	HOSPHATE	
65-365	Co Cr W	Anhydrous	Recom. at all temp			at all leaders and a second	· internation and all other
	- 1 - 1 - 1 - 1 - 1 - 1 1	Any conc. sol;	Recom. at all temp.	2, 5	Stainless	5% sol.	<0.0042 at 70°
70	Tantalum	Solutions	Attacked at high temps			Sat. sol.	<0.004 at 70°
				6-11	Stainless	Sat. sol.	<0.004 at 70°
MM	ONIUM C	HLORIDE		9	Stainless	5% sol.	<0.004 at 70°
						# 0H 1	
2	Stainless	16 sol.; quiet, agitated, or a	erated ² <0.0042 at 70°	12, 15	Stainless	5% sol.	<0.004 at 70°
		10. 20% sol.2	<0.0042 at boiling		- Still Fina	Sat. sol.	<0.005 at 70°
		28, 50% sol.2	0.0042-0.042 at boil;	18-20	Stainless	5% sol.	<0.004 at 70°
		Sat. sol. ^{1, 2}	<0.0044 at 212°	25	Stainless	5% sol.	<0.004 at 70°
	5.10 32			139	High Si Mo Ir		Recom. to boiling
	a	Sat. sol.2	<0.004 at 70°	142	High Si Iron		Recorn. to boiling
4	Stainless	50%	<0.04 at boiling	209	Fe Ni Cr Si M		<0.001 at 150°
5-8	Stainless	Sat. sol. ²	<0.004 at 70°	and the second second	Al Bronze		Recommended
9	Stainless	1% sol.; quiet, agitated, or a	erated <0.0042 at 70°	a la			Recommended
		10% - cone. sol.*	<0.0042 at boiling	249	Cu Ni Zn		
		Sat. sol.	<0.004 at 70°	257	Admiralty		Slight to moderate
0, 11	Stainless	Sat. sol. ²	<0.004 nt 70°	and the second second	, Copper		Recommended
		1% sol.; quiet, agitated, or a		200, 277			
12, 15	Stainless	a set of a set of the		272, 273			Slight to moderate
1.20		Sat. sol.	<0.01 at 70°	315, 343			
19	Stainless	1% sol.; quiet, agitated, or a		344, 372			
		10% sol.1	<0.0456 at boiling				Recommended
		25% sol.1	<0.0456 at boiling		Cu Ni Alloy		Recommended
		Sat. sol.1	<0.456 at boiling		Cu Si Mn	destante	
0	Staiuless	10% - sat. sol.1	<0.00456 at boiling	308	Sb Lead	Various conci	OK at various temp
-	Stainless	10% sol.1	<0.00456 at hoiling	311	Chem. Lead		Same as 308
	Litanicaa			314	Te Lead		Same as 308
1		25% sol.1	<0.0456 at boiling	316	Ni Cu Alloy	Solutions	<0.004 at 65°
	Y - V	Sat. sol.1	<0.456 at boiling	and the second sec	Nickel Silver	Including	Recommended
13	Cast Iron	5% sol1.	0.0066 at 65°	1	P Bronze		Recommended
04	Fe Ni Cu Cr	25% NH4 CI + 1% HCl sel.	0.0977				Slight to moderate
29	High Si Irou	27% sol., quiet	<0.001 at room temp:	and the second sec	Copper		and the second se
<u>щ</u>		an Any cone, sol	Recom. to boiling	359	Red Brass		Recommended
	and the second		Recom. to boiling	the second			
12	High Si Iron	and the second					
6	Fe Ni Cu Cr		0.003 0.01 at 70°-200°	AMM	IONIUM S	ULPHATE	
90	Ni Steel	5° sol.1	0.0075 at 65°				
	All Cu-base Al	loys	Attacked	2	Stainless	1. 5% sol.; agitated or aerate	
65	Ni Cr Alloy	Sat. sol.1	0.411 at 65°			10% sol.1	<0.0044 at 65°2
00	Ni Mo Fe	All conc. sol	Recom. to 158°	Section in		10% sol.	0,0042-0.042 at boil.2
	Ni Mo Fe	All conc. sol.	Preferred to 290, 292			Sat. sol.	<0.004 at 70°
		an conc. sol.	Recom. to 122°			Sat. sol.	0.0042-0.042 at boil.
91		Ill come col					VIVUIA VIVIA IIS DUIL
91 92	Ni Cr Fo W	All conc. sol.		-	Stal-1	1007	
91 92 00			<0.004 at 70° <0.004 at 330°	5	Stainless	10% Sat. sol.	<0.040 at boiling <0.004 at 70°

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
6-11	Stainless	Sat. sol.	<0.004 at 70°	BARI	UM SULI	HIDE	Section and the second
9	Stainless	1, 5% sol.; agitated or aerat			0 1	0.1	That
		10% вој.	<0.0042 at 70°, boil. ²	2	Stainless	Sol.	Little or none
COLUMN T		Sat. sol.	<0.0042 at 70°, boil.	E 11	Charlestown	Sat. sol. Sat. sol.	<0.004 at 70°
12, 15	Stainless	1, 5% sol.; agitated or aerat		and the second second	Stainless		<0.004 at 70°
		10%	Slight attack at 70°		Stainless	Sol.	Little or none
1-1-1	avera la com	Sat. sol.	<0.010 at 70°	130	High Si Mo Ir		Recom. to boiling
19	Stainless	1, 5% sol.; agitated or aerate		142	High Si Iron		Recom. to boiling
2.35		10% sol.	<0.004 at 70°a	209	Fe Ni Cr Si M	A REAL PROPERTY OF A REAL PROPER	<0.001 at cold
20	Stainless	Sol.1	<0.0046 at 70°	and the local division of the	Admiralty	Dil. sol. or at room temp.	Recommended
25	Stainless	10% sol.	<0.004 at 70°3	248	Al Brass		Same as 211
139	High Si Mo Ir	A THE REAL PROPERTY AND A REAL	Recom. to boiling	257	Admiralty		Devere astack
142	High Si Iron	Any conc.	Recom. to boiling	272, 273			Severe attack
176	Fe Ni Cu Cr		<0.006 at room temp:	315, 343			
209	Fe Ni Cr Si Mo	Cu Sat. sol. + 7% H ₁ SO ₄	<0.001 at 150°	344, 372	230 223		
214	Al Alloy	1, 5%	No attack at 70°	297	High Brass		Same as 211
213-222	Al Alloys	All Al alloys expected to be :	same as 214.	308, 311	Lead	Solutions of Ba from	
244, 247	Al Bronze		Recommended	314		which BaS is pptd.	OK
249	Cu Ni Zn		Recommended	318	Muntz		Same as 211
257	Admiralty		Slight to moderate	328	Naval Brass		Same as 211
259, 262,		and add the state that	Recommended	355, 371	Copper		Severe attack
266, 277	and the second division of the second divisio		There are an	373	Tobin Bronze		Same as 211
272, 273			Slight to moderate				
315, 343	the second se		the second s				
344, 372			the same of a second se	BENZ	ALDEHY	DE	
	Cu Ni Alloy		Recommended				and the second of the
	and the second sec		Recommended	139	High Si Mo Ir		Recom. to boiling
	Cu Si Mn		Recommended	142	High Si Iron		Recom. to boiling
292	Ni Cr Fe W		Recommended	209	Fe Ni Cr Si M	o Cu	No loss at cold
293	Ni Si Cu		Recommended	1.17	All Cu - Base		Recommended
308	Sb Lead	Various cone:	OK at various temp	364	Silver		Attacked at 122°
311	Chem. Lead		Same as 308	Torrent			
314	Te Lead		Same as 308	XXXXXXX		automatical in the second	
316	N ₁ Cu Alloy	5, 10% sol.	<0.001 at 60°	BENZ	OL		
		25% воl.	<0.002 at 60°		04.1.1		<0.0040 - 4 702 4 - 1 - 4
		Sat. sol.	<0.001 at 203°	2	Stainless	the second s	<0.0042 at 70° to hot
337, 338	Nickel Silver		Recommended	1.00		Purel	<0.0044 at 176°
350-353	P Bronze		Recommended			Conc.	<0.004 at 70°
355, 371	Copper		Slight to moderate	5	Stainless	Conc.	<0.004 at 70°
359	Red Brass		Recommended				<0.004 at hot
	Co Cr W		Recommended	1000		50% + 50% aviation gas	<0.001 at 70°
			are out the deal	6-11	Stainless	Conc.	<0.004 at 70°
				9	Stainless		<0.0042 at 70° to hot
AMYI	ACETAT	Ŧ				Puret	<0.0044 at 176°
		-		1. 1.3 .		Sat. sol.	<0.004 at 70°
2,5-12	, Stainless	Conc. sol.	<0.004 at 70°	12, 15	Stainless	Sat. sol.	<0.005 at 70°
15,19,2	5			-30 L - 10			Slight attack at hot
104	Fe Ni Cu Cr	Contraction of the second	No attack	19	Stainless		<0.0042 at hot
139	High Si Mo Ir	on Any cone;	Recom. to boiling	1200.0	the second	Commercially pure	<0.004 at 70°
142	High Si Iron		Recom. to boiling	25	Stainless	Commercially pure	<0.004 at 70°
200	Fe Ni Cr Si M	and the second sec	<0.001 at 150°	104	Fe Ni Cu Cr	WAR IN THE	No attack
	All Cu Base		Recommended	139		on Any conc.	Recom. to boiling
213-222	Al alloys		None expected	142	High Si Iron	Any conc.	Recom. to bailing
			Hone expected	176	Fe Ni Cu Cr	,	0.001-0.008
		- IPO - IR I - ATTACANTA		209		o Cu In tar acids	<0.001 at 175°
ANTV	L CHLOR	IDE			All Cu Base		Recommended
ADI I.	L CHLON			213-222	Al Alloys		None expected
2,9	Stainless	1 a general land	No attack	302	Ni Cr Fe	In vapors and liquid of still	0.0C1
	Stainless	LUNERSE ERRY	Slight attack	001		In benzol still body	
139		on Any cone.	Recom. to boiling	308, 311	Load	AN DENSOL BUIL DOGY	<0.001 Probably OK
139	High Si Iron		Recom. to boiling	308, 311	Licau		Probably OK
		huy tout.	and the second sec	the second se	Nichall	In support and light of the	0.005
	Admiralty		Recommended	316	Ni Cu Alloy	In vapors and liquid of still	0.005
	Al Bronze	A CONTRACTOR	Recommended	000	Mistell	In benzol still body	0.001
248	Al Brass		Recommended	330	Niekel	In vapors and 'iquid of still	0.004
249	Cu Ni Zn		Recommended	004 000	MIC CH I	In benzol still body	0.001
259, 262	1.00000		Recommended		Ni Cr Steel	Pure 1	<0.004 at 176°
266 277				370	Tantalum	Any conc.	None at any temp.
			and the second se				
275, 276	Cu Ni Alloy		Recommended	Later			
275, 276 283-285	Cu Ni Alloy Cu Si. Mn		Recommended	DOD	C LOID	logi litari di les d	
275, 276 283-285 337, 338	Cu Ni Alloy Cu Si. Mn Nickel Silver		Recommended Recommended	BORI	C ACID		
275, 276 283-285 337, 338	Cu Ni Alloy Cu Si. Mn		Recommended	2.314			
275, 276 283-285 337, 338	Cu Ni Alloy Cu Si. Mn Nickel Silver		Recommended Recommended	BORI 2	C ACID Stainless	5% sol.	<0.0042 at hot or cold
275, 276 283-285 337, 338 350-353	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze	Any conc:	Recommended Recommended Recommended	2.314		Saturated	<0.00'4 at 70°2
275, 276 283-285 337, 338 350-353 359	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass	Any conc:	Recommended Recommended Recommended Recommended	2.	Stainless	Saturated Saturated	<0.00'4 at 70°3 <0.0042 at boil. ²
275, 276 283-285 337, 338 350-353 359 370	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Rod Brass Tantalum	Any conc:	Recommended Recommended Recommended Recommended	2.5	Stainless Stainless	Saturated Saturated 5% sol.	<0.00'4 at 70°s <0.0042 at boil. ² <0.004 at 70°
275, 276 283-285 337, 338 350-353 359	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Rod Brass Tantalum	Any conc:	Recommended Recommended Recommended Recommended	2.	Stainless	Saturated Saturated	<0.00'4 at 70°3 <0.0042 at boil. ²
275, 276 283-285 337, 338 350-353 359 370 ANIL	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum		Recommended Recommended Recommended Recommended	2.5	Stainless Stainless	Saturated Saturated 5% sol.	<0.00'4 at 70°s <0.0042 at boil. ² <0.004 at 70°
275, 276 283-285 337, 338 350-353 359 370 ANIL	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Rod Brass Tantalum	Any conc: 3% sol.	Recommended Recommended Recommended Recommended	2· 5 5-8	Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol.	<0.00'4 at 70° ² <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° ²
275, 276 283-285 337, 338 350-353 359 370 ANIL	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum		Recommended Recommended Recommended Recommended None at any temp.	2. 5 5-8 9	Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² , or 5% sol.	<0.00 ⁴ at 70° ² <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° ² <0.0042 at boil. ² , 70°
275, 276 283-285 337, 338 350-353 359 370 ANIL	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum	3% sol.	Recommended Recommended Recommended None at any temp. <0.0042 at 70°	2. 5 5-8 9 10, 11	Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² , or 5% sol. Sat. sol. ² 5% ²	<0.00 ⁴ at 70° ¹ <0.004 ² at boil. ² <0.004 at 70° <0.004 at 70° ² <0.004 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 70°
275, 276 283-285 337, 338 350-353 359 370 ANIL 2, 9, 19	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum INE	3% sol. Cone. crude Cone. crude	Recommended Recommended Recommended None at any temp. <0.0042 at 70° <0.0042 at 70° <0.004	2. 5 5-8 9 10, 11 12, 15	Stainless Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² , or 5% sol. Sat. sol. ² 5% ² Sat. sol. ¹	<0.00 ⁴ at 70° ¹ <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° ² <0.0042 at boil. ² , 70° <0.004 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 212°
275, 276 283-285 337, 338 350-353 370 ANIL 2, 9, 19 5, 20 139	Cu Ni Alloy Cu Si. Mn 9 Nickel Silver P Bronze Rod Brass Tantalum INE 9 Stainless Stainless High Si Mo Ir	3% sol. Cone. crude Cone. crude on Any cone.	Recommended Recommended Recommended None at any temp. <0.0042 at 70° <0.0042 at 70° <0.004 At 70°	2. 5 5-8 9 10, 11 12, 15 18	Stainless Stainless Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. ² Sat. sol. ² or 5% sol. Sat. sol. ² $5\%^2$ Sat. sol. ¹ 5% sol.	<0.00 ⁴ at 70° ¹ <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° ² <0.0042 at boil. ² , 70° <0.004 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 70°
275, 276 283-285 337, 338 360-353 370 ANIL 2, 9, 18 5, 20 139 142	Cu Ni Alloy Cu Si. Mn S Nickel Silver P Bronze Red Brass Tantalum INE Stainless High Si Mo Ir High Si Iron	3% sol. Conc. crude Conc. crude on Any conc. Any conc.	Recommended Recommended Recommended None at any temp. <0.0042 at 70° <0.0042 at 70° <0.004 Recom. to boiling Recom. to boiling	2. 5 5-8 9 10, 11 12, 15	Stainless Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² or 5% sol. Sat. sol. ² 5% sol. 5% sol.	<0.00 ⁴ at 70° ¹ <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° ² <0.0042 at boil. ² , 70° <0.004 at 70°
275, 276 283-285 337, 338 350-353 370 ANIL 2, 9, 19 5, 20 139	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum INE Stainless Stainless High Si Mo Ir High Si Iron Fe Ni Cr Si M	3% sol. Conc. crude Conc. crude on Any conc. Any conc. o Cu	Recommended Recommended Recommended None at any temp. <0.0042 at 70° <0.0042 at 70° <0.004 Recom. to boiling Recom. to boiling No loss at cold	2. 5 5-8 9 10, 11 12, 15 18 19	Stainless Stainless Stainless Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² $5\%^2$ Sat. sol. ² 5% sol. 5% sol. 5% sol. Sat. sol,	<0.00 ⁴ at 70° ¹ <0.004 ² at boil. ² <0.004 at 70° <0.004 at 212°
275, 276 283-285 337, 338 350-353 370 ANIL 2,9, 19 5, 20 139 142 209	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum INE Stainless Stainless High Si Mo Ir High Si Iron Fe Ni Cr Si M All Cu — Base	3% sol. Cone. crude Cone. crude on Any cone. Any cone. o Cu e Alloys	Recommended Recommended Recommended Recommended None at any temp. <0.0042 at 70° <0.0042 at 70° <0.004 Recom. to boiling Recom. to boiling No loss at cold Attacked	2. 5 5-8 9 10, 11 12, 15 18	Stainless Stainless Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² or 5% sol. Sat. sol. ² 5% ³ Sat. sol. ¹ 5% sol. 5% sol. Sat. sol. 5% sol.	<0.004 at 70°1 <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° <0.0042 at boil. ² , 70° <0.0042 at boil. ² , 70° <0.004 at 70° <0.004 at 70° <0.004 at 212° <0.004 at 70° <0.004 at 212° <0.004 at 21° <0.004 at 21° <0.0042 at boil. ² <0.0042 at boil. ²
275, 276 283-285 337, 328 350-353 359 370 ANIL 2, 9, 19 5, 20 139 142 209 213	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum INE Stainless Stainless High Si Mo Ir High Si Iron Fe Ni Cr Si M All Cu — Base Aluminum	3% sol. Conc. crude Conc. crude on Any conc. Any conc. o Cu Alloys Boiling for 16 hr.	Recommended Recommended Recommended Recommended None at any temp.	2. 5 5-8 9 10, 11 12, 15 18 19 20	Stainless Stainless Stainless Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² or 5% sol. Sat. sol. ² Sat. sol. ² Sat. sol. ¹ 5% sol. Sat. sol. S% sol. Sat. sol. S% sol. Sol. ¹	<0.004 at 70°1 <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° <0.0042 at boil. ² <0.004 at 70° <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 70°
275, 276 283-285 337, 338 350-353 370 ANIL 2,9, 19 5, 20 139 142 209	Cu Ni Alloy Cu Si. Mn Nickel Silver P Bronze Red Brass Tantalum INE Stainless Stainless High Si Mo Ir High Si Iron Fe Ni Cr Si M All Cu — Base	3% sol. Cone. crude Cone. crude on Any cone. Any cone. o Cu e Alloys	Recommended Recommended Recommended Recommended None at any temp. <0.0042 at 70° <0.0042 at 70° <0.004 Recom. to boiling Recom. to boiling No loss at cold Attacked	2. 5 5-8 9 10, 11 12, 15 18 19	Stainless Stainless Stainless Stainless Stainless Stainless Stainless Stainless	Saturated Saturated 5% sol. Sat. sol. Sat. sol. ² or 5% sol. Sat. sol. ² 5% ³ Sat. sol. ¹ 5% sol. 5% sol. Sat. sol. 5% sol.	<0.004 at 70°1 <0.0042 at boil. ² <0.004 at 70° <0.004 at 70° <0.0042 at boil. ² , 70° <0.0042 at boil. ² , 70° <0.004 at 70° <0.004 at 70° <0.004 at 212° <0.004 at 70° <0.004 at 212° <0.004 at 21° <0.004 at 21° <0.0042 at boil. ² <0.0042 at boil. ²

No.	Material	Exposure Conditions	Carrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.
139	Iligh Si Mo Ir	on Aux conc.	Recom. to boiling	249	Cu Ni Zn	FILTER LIEUCES	Recommended
142	High Si Iron,		Recom. to boiling	257.	Admiralty		Slight to moderate
209	Fe Ni Cr Si M		Gain at cold		, Copper		Recommended
	12 1 L	Aqueous sol.	Satisfactory at 210°	266, 277		- HALL LAND	and the state of the state of the
	All Cu - Base	a lot a longer line of the local sectors and	Recommended		, Bronze		Slight to moderate
290. 291	Ni Mo Fe.	All conc.	Recom. at all temp.	315, 343			and to incuctore
292	Ni Cr Fe W	All conc.	Recom. at all temp.	344, 372			
293	Ni Si Cu	All cone.	Recom. at all temp.		Cu Ni Alloy		Recommended
300	Ni Cr Cu Mo		<0.004 at 70°		Cu Si Mn		Recommended
308	Sb Lead	Various conc.	OK at various temp.		Ni Mo Fe	All conc.	Recom. at all temp.
311	Chem. Lead	various conc.	Same as 308	292	Ni Cr Fe W	All conc.	Recom. at all temp.
814	To Lead		Same as 308	293	Ni Si Cu	All conc.	Recom. at all temp.
816	Ni Cu Alloy	4% sol.	0.003 at room temp.	302	Ni Cr Fe		to 35% <0.001 at 160-320°
010	INI OU Alloy	4% sol.	0.005 at 104°	302	Sb Lead	in evaporator concentrating	Not recommended
125 226	Ni Cr Steel	Sol.1	<0.004 at 68°	311	Chem. Lead		Not recommended
164	Silver	In dyestuff plant	No attack	314	Te Lead	William of all sold to the	Not recommended
	Ni Cr Cu Mo		Recom. at all temp.	314		FOT sensind	
				510	Ni Cu Alloy	5% acrated	<0.001 at 60°
370	Tantalum	Any conc.	None at any temp.	E.		16% aerated	0.00S at room temp.
					a E shart	20% unaerated	<0.001 at room temp.
non	ATAUS			161-15		46-47%	0.014 at 360°
RKOV	AINE					In evaporator concentrating	to 35% <0.001 at 160-320°
1-25	Stainless	Bromine bromine weter	Strong attack at 70°	328	Naval Brass	Harris - Republic	Recommended
		Bromine; bromine water		330	Nickel	46-47%	0.010 at 360°
104	Fe Ni Cu Cr	1-1-1-1-1-1-1-3.2.1	Rapid attack			In evaporator concentrating	to 35% <0.001 at 160-320
139	High Si Mo Ire	m	Not recom.		Nickel Silver		Recommended
142	High Si Iron	A MARKEN STATE	Not reconi.	350-353	P Bronze		Recommended
	Al Bronze	Perfectly dry gas	Recommended	355, 371	Copper		Slight to moderate
249	Cu Ni Zn		Same as 244	359	Red Brass		Recommended
257	Admiralty		Severe attack	365-368	Co Cr W	All cone.	Recom. at all temp.
259, 262,	Copper		Same as 244	370	Tantalum	Any cone.	None at any temp.
266, 267			the state in the second	373	Tobin Bronze	and done and the	Recommended
272, 273,	Bronze		Severe attack	5.0			
315, 343,				1.000			
344, 372				1. 1.			
	Cu Ni Alloy		Same as 244	CALC	TIM HV	POCHLORITE	
	Cu Si Mn		Same as 244	CALC	HOM HIL	OCHEORITE	
	Ni Mo Fe	Dry	Recom, at all temp.	2	Stainless	Dry 1	<0.0044 at 68°
292	Ni Cr Fe W		Preferred to 290, 291	19.00		2%	0.0042-0.042 at 70°
300	Ni Cr Cu Mo I	To Dra:	Recommended	11		Water sol.; sp. g. 1.04	0.042-0.12 at 100°
000	111 01 04 110 1	Moist	Not recommended			Sat. sol.; exposed >4 hr.	Attacked at 70°
		Aqueous sol.	>0.125 at 70°	- NEXT		Standing solutions	Not recommended
308, 311,	Lond	sufficient some	Not recommended	5-8,	Stainless	Sat. sol.; exposed >4 hr.	Attacked at 70°
314 314	Liead	And a state of the	Teor recommended	and the second second	Blaimess	Dat. sol., exposed >4 m.	Attacked at 10
	Nickel Silver		Same as 244	10, 11 g	Stainless	20%	<0.0042 at 70°
	P Bronze		Same as 244	IJ	Statmesa		<0.0042 at 100°
			Severe attack	1		Water sol.; sp. g. 1.04	
	Copper D. J. D.		Same as 244	12112		150 g./l.1	<0.0044 at 68°
359	Red Brass			10.45	0 1	Standing solutions	Not recommended
364	Silver		Slowly at ordinary temp.	12, 15	Stainless	Sat. sol.	Attacked
370	Tantalum	Any conc.	None at any temp.	19	Stainless	2%	0.042-0.12 at 76°
			and the second of the second second			Water sol.; sp. g. 1.04	0.042-0.12 at 100°
				25	Stainless	Sat. sol.	Attacked
BUTY	L ACETA	TE		104	Fe Ni Cu Cr	and the second second	Rapid attack
		to Martin and the		129	High Si Iron	1.5%, bleach powder	<0.001 at room temp.
2, 9,	Stainless		Little or none	139	High Si Mo Ir	on Any conc.	Recom. to boiling
15, 19				142	High Si Iron	Any conc.	Recom. to boiling
104	Fe Ni Cu Cr		No attack	176	Fe Ni Cu Cr	0.07%	0.002 at room temp.
139	High Si Mo Ire	on Any conc.	Recom. to boiling	209	Fe Ni Cr Si M	lo Cu 3.5% available Cla	Satisfactory at cold
142	High Si Iron		Recom. to boiling		Al Bronze	Dil. sol. or at room temp.	Recommended
209	Fe Ni Cr Si M	and the second sec	<0.001 at cold	249	Cu Ni Zn		Same as 244
	All Cu - Base		Recommended	257	Admiralty		Slight to moderate
216	Al Alloy	In containers, 6 months	Stained only		, Copper		Same as 244
	Al Alloys	All Al alloys expected to be		266, 277			· Bart For Constants
		and a second sec	and the second sec	272, 273			Slight to moderate
							the second second second second
aur a		ODIDE		315, 343			
CALC	HUM CHI	ORIDE		344, 372			Same as 244
	a	Thilling and the second second	0.0019.0.019 -+ 7002		Cu Ni Alloy	the state of the s	
2	Stainless	Dilute or conc. sol.	0.0042-0.042 at 70°2		Cu Si Ma	Dial - I - U	Same as 244
5	Stainless	Conc. sol.	<0.04 at 70°3	and the second s	Ni Mo Fe	Bleach powder; all conc.	Not recom. at any temp.
9	Stainless	Dilute or cone. sol.	<0.0042 at 70°3	292	Ni Cr Fc W	Bleach powder; all conc.	Recom. to 105°
		Sat. sol. ¹	<6.0044 at 212°	293	Ni Si Cu	Bleach powder; all conc.	Not recom. at any temp.
12, 15	Stainless	Sat. sol.	Attacked at 70°	300		Fe 2% available Cl2	0.015-0.05 at 70°
19	Stainless	Dilute or conc. sol.	0.042-0.12 at 70°2	308	Sb Lead		Not recommended
20	Stainless	Sol.1	<0.0046 at 65°, boil.	311	Chem. Lead		Not recommended
25	Stainless	Sat. sol.	<0.1 at 70°	314	Te Lead		Not recommended
104	Fe Ni Cu Cr	25% sol.	0.0019 at 80°	316	Ni Cu Alloy	0.5 g./l. available Cl2	<0.001 at room temp.
139	High S. Mo Ire	and the second se	Recom. to boiling	128 32		2 g./l. available Cl2	<0.001 at room temp.
	High Si Iron		Recom. to boiling	1. 19 19 19		4 g./l. available Cl2	0.047 at room temp.
142	and the second s	Any cone.			120000	10 g./l. available Cl2	0.067 at room temp.
176	Fe Ni Cu Cr	5% sol.	0.005 at room temp.			25 g./l. available Cl ₂	0.405 at room temp.
209	Fe Ni Cr Si M	o Cu Sat. sol.	<0.001 at cold	007 000	NI-1-1 53	20 g./1. available Cl2	
211, 258	Admiralty		Recommended		Nickel Silver		Same as 244
	Aluminum	Pure sol.	Little at room temp.	and the second sec	P Bronze		Same as 244
			34 . La seconda de seconda de seconda	355, 371	Copper		Slight to moderate
		Add heavy-metal salts	May be severe, room temp.				
		Add heavy-metal salts Chromate inhibited	Commonly used	359	Red Brass	And Martin Stranger	Same as 244
213, 214	Al Bronze		the second se	359		Bleach powder; all conc.	Same as 244 Recom. at all temp.

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
CARE	BON BISU	IPHIDE	and the second second	259, 265	2, Copper	See Caleria and arrive (1)	Recommended
2, 5, 9, 10) Stainless	a tradicity of the second	<0.0042 at 70°	205, 21	Ni Cr Alloy		Recommended
139		on Any conc.	Recom. to boiling	1.000 - 1.000	3, Bronze		Slight to moderate
142	High Si Iron	Any conc.	Recom. to boiling	315, 34:			Tre resource in the second in the
209	Fe Ni Cr Si M	lo Cu	<0.001 at cold	344, 375			
	All Cu - Base	Alloya	Recommended	and the second s	5 Cu Ni Alloy		Recommended
213-222	Al Alloys		None expected		6 Cu Si Mn		Recommended
364	Silver	Vapors	No attack	302	Ni Cr Fe	5°CO2 % air	
				002	In or Pe	H2O sat. with 30 70	<0.001 at 150°
				Er al		H ₂ O sat. with 70 30	<0.001 at 158°
CARE	BON TETI	RACHLORIDE	The second secon	12		H2O sat. with 80 20	<0.001 at 133
				1928 315		H ₂ O sat. with 80 20	<0.001 at 275°
2	Stainless	C. P.	<0.0042 at 70°, boil.	200	CL T d	120 Sut. with 30 20	Not recommended
		Commercial purity	<0.004 at 70°2	308	Sb Lead	The second se	
		Moist	Attacked at high temp	311	Chem. Lead		Not recommended
5	Stainless	Pure	<0.004 at 70°	314	Te Lead	~~~~ .	Not recommended
		Commercial purity	<0.004 at 70°2	316	Ni Cu Alloy	%CO2 % air	
6-8	Stainless	Commercial purity	<0.004 at 70°2			H_2O sat. with 100 0	<0.001 at 60°
9	Stainless	C. P.	<0.0042 at 70°, boil.	mail the		H ₂ O sat. with 30 70	0.009 at 150°
	Duranted	Commercial purity	<0.004 at 70°	1- 1-		H ₂ O sat. with 70 30	0.060 at 158°
		Commercial + 1% water	0.0042-0.042 at boil.2	2010		H ₂ O sat. with 80 20	0.032 at 212°
				1000		H ₂ O sat. with S0 20	0.005 at 275°
10 11	Chainland	Commercial + 1% HCl	0.0042-0.042 at boil. ²	330	Nickel	H ₂ O sat. with 30 70	0.001 at 150°
	Stainless	Commercial purity	<0.004 at 70°			H ₂ O sat. with 70 30	0.032 at 158°
	Stainless	Pure	<0.004 at 70°			H2O sat. with 80 20	0.013 at 212°
19	Stainless	C. P.	<0.0042 at 70°			H ₂ O sat. with S0 20	0.005 at 275°
		Commercial purity	<0.004 at 70°2	332	Ni Ce Allou	2430 000 HILL 00 20	Recommended ¹
20, 21	Stainless	Pure	<0.004 at 70°	The second se	Ni Cr Alloy		
25	Stainless	Cominercial purity	<0.004 at 70°2		Ni Cr Steel		<0.004 at 68°1
104	Fe Ni Cu Cr		No attack		Nickel Silver		Recommended
139	High Si Mo Ir	on Any conc.	Recom. to boiling		P Bronze		Recommended
142	High Si Iron	Any conc.	Recom. to boiling	355, 371	Copper		Slight to moderate
176	Fe Ni Cu Cr	That is the second	<0.002 at 70-170°	359	Red Brass		Recommended
209	Fe Ni Cr Si M	o Cu 50%	0.0013 at 184°	364	Silver		Stable at ordinary temp:
	Al Alloys	Unstabilized	Severe at boiling	1			
	Al Bronze	o hora on hace	Recommended				
	Cu Ni Zn		Recommended	CHL	ORACETIC	L ACID	A MERTING TO THE PARTY
249			the second s	1.1.1.5			Cologonal Descriptions of a
257	Admiralty		Slight to moderate	2	Stainless		>0.12 at 70°
259, 262,	Copper		Recommended	5	Stainless		Not recom. at 70°
266, 277	1		and a second	9	Stainless		0.042-0.12 at 70°
272, 273,			Slight to moderate	15, 18	Stainless		Not recom. at 70°
315, 343,			a la	19	Stainless	the second s	>0.12 at 70°
344, 372			and the second second second second	20	Stainless		Not recom. at 70°
275, 276	Cu Ni Alloy		Recommended	129	High Si Iron	25%; quiet	<0.001 at room temp;
283-285	Cu Si Mn		Recommended	139	High Si Mo Ir	on Any conc.	Recom. to boiling
300	Ni Cr Cu Mo	Fe	<0.004 at boil.	142	High Si Iron	Auy conc.	Recom, to boiling
		Saturated with free S	<0.004 at boil.	244, 247	Al Bronze	No air	Recommended
		Plus 3% Bra by vol.	>0.125 at boil.	249	Cu Ni Zn	No air	Recommended
302	Ni Cr Fe	Vapor space of still	<0.001 at 165°	257	Admiralty	- Licenses	Severe
	The states	Storage tank	<0.001 at room temp.	259, 262	the second se	No air	Recommended
308	Sb Lead	Anhydrous	OK at ordinary temp.	266, 277	Copper	Noan	Recommended
311	Chem. Lead	and the second se	Same as 308		Duran		g
314	Te Lead		Same as 308	272, 273,			Severe
		Vapor space of still	The second se	315, 343,			
316	Ni Cu Alloy		<0.001 at 165°	344, 372	1000	the state of the second	
		Partially immersed in	0.004 .41. 11		Cu Ni Alloy	No air	Recommended
		carbon tet. mixture	and the second second second		Cu Si Mn	No air	Recommended
		Storage tank	<0.001 at room temp;	308	Sb Lead		Not recommended
330	Nickel	Vapor space of still	<0.001 at 165°	311	Chem. Lead		Not recommended
		Partially immersed in	in and the second	314	Te Lead		Not recommended
		carbon tet. mixture	C.002 at boiling	337, 338	Nickel Silver	No air	Recommended
		Storage tank	<0.001 at room temp.		P Bronze	No air	Recommended
337, 338	Nickel Silver		Recommended	355, 371		The supposed in the supposed in the	Severe
	P Bronze		Recommended	359	Red Brass	No air	Recommended
355, 371			Slight to moderate	370	Tantalum		None at any temp.
	Red Brass	The last the second second	Recommended	010	Augarutit	Any conc.	None at any temp.
	Silver		the second se				
		Anu cons	No attack	CHLC	DRINE		
010	Tantalum	Any conc.	None at any temp.	1	and a seal		
			L CONTRACTOR	2	Stainless	Dry gas	0.042-0.12 at 70°
		TT.				Moist gas	0.12-0.42 at 70°
CARR	ONIC AC					Gas	>0.42 at 212°
CARB	ONIC AC	ID				Contract of the second s	
	ONIC AC Stainless		<0.004 at 70°	5_9	Stainlow		
2	Stainless	Sat. sol.	<0.004 at 70°	5-8	Stainless	Deres	Attacked
2 5–11	Stainless Stainless	Sat. sol. Sat. sol.	<0.001 at 70°	5-8 9	Stainless Stainless	Dry gas	0.0042-0.042 at 70°
2 5–11 12, 15	Stainless Stainless Stainless	Sat. sol. Sat. sol. Sat. sol.	<0.004 at 70° <0.005 at 70°			Moist gas	0.0042-0.042 at 70° 0.042-0.12 at 70°
2 5–11 12, 15 19–21	Stainless Stainless Stainless Stainless	Sat. sol. Sat. sol. Sat. sol. Sat. sol.	<0.004 at 70° <0.005 at 70° <0.004 at 70°			Moist gas Gas	0.0042-0.042 at 70°
2 5–11 12, 15 19–21 25	Stainless Stainless Stainless Stainless Stainless	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol.	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70°			Moist gas	0.0042-0.042 at 70° 0.042-0.12 at 70°
2 5-11 12, 15 19-21 25 139	Stainless Stainless Stainless Stainless Stainless High Si Mo Irc	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. an Any conc.	<0.004 at 70° <0.005 at 70° <0.004 at 70°	9		Moist gas Gas	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212°
2 5-11 12, 15 19-21 25 139	Stainless Stainless Stainless Stainless Stainless	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. n Any conc.	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70°	9 10, 11	Stainless Stainless	Moist gas Gas	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked
2 5-11 12, 15 19-21 25 139 142	Stainless Stainless Stainless Stainless Stainless High Si Mo Irc	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. n Any conc. Any conc.	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling	9 10. 11 15, 18	Stainless Stainless Stainless	Moist gas Gas	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked Not recom. at 70°
2 5-11 12, 15 19-21 25 139 142 176	Stainless Stainless Stainless Stainless Stainless High Si Mo Irco High Si Iron	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. Any conc.	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling 0.001 at room temp.	9 10, 11 15, 18 19	Stainless Stainless Stainless Stainless	Moist gas Gas	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 08° Attacked Not recom. at 70° Same as 2
2 5-11 12, 15 19-21 25 139 142 176 209	Stainless Stainless Stainless Stainless Stainless High Si Mo Irco High Si Iron Fe Ni Cu Cr Fe Ni Cr Si Mo	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. Any conc. Any conc.	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling 0.001 at room temp. No loss at cold	9 10, 11 15, 18 19 20, 25	Stainless Stainless Stainless Stainless Stainless	Moist gas Gas Sat. sol. ¹	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked Not recom. at 70° Same as 2 Not recom. at 70°
2 5-11 12, 15 19-21 25 139 142 176 209 211, 258	Stainless Stainless Stainless Stainless Stainless High Si Mo Irc High Si Iron Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cr Si Mo Admiralty	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. n. Any conc. Any conc.	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling 0.001 at room temp. No loss at cold Recommended	9 10, 11 15, 18 19	Stainless Stainless Stainless Stainless	Moist gas Gas Sat. sol. ¹ Dry	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked Not recom. at 70° Same as 2 Not recom. at 70° No attack
2 5-11 12, 15 19-21 25 139 442 476 209 211, 258	Stainless Stainless Stainless Stainless Stainless High Si Mo Iree High Si Iron Fe Ni Cu Cr Fe Ni Cr Si Ma Admiralty Aluminum	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. n. Any conc. Any conc.	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling 0.001 at room temp. No loss at cold Recommended <0.001	9 10, 11 15, 18 19 20, 25 104	Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr	Moist gas Gas Sat. sol. ¹ Dry Wet	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked Not recom. at 70° Same as 2 Not recom. at 70° No attack Rapid attack
2 5-11 12, 15 19-21 25 139 142 176 209 211, 258 213 213	Stainless Stainless Stainless Stainless Stainless High Si Mo Ire High Si Iron Fe Ni Cu Cr Fe Ni Cr Si Mo Admiralty Aluminum Al Bronze	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. on Any conc. Any conc. O Cu Carbonated tap water	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling 0.001 at room temp. No loss at cold Recommended <0.001 Recommended	9 10, 11 15, 18 19 20, 25 104 139	Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr	Moist gas Gas Sat. sol. ¹ Dry	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked Not recom. at 70° Same as 2 Not recom. at 70° No attack
2 5-11 12, 15 19-21 25 139 142 176 209 211, 258 213 213 244, 247 248	Stainless Stainless Stainless Stainless Stainless High Si Mo Irc High Si Iron Fe Ni Cu Cr Fe Ni Cr Si Mo Admiralty Aluminum Al Bronze Al Brass	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. on Any conc. Any conc. O Cu Carbonated tap water	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling 0.001 at room temp. No loss at cold Recommended <0.001	9 10, 11 15, 18 19 20, 25 104	Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr	Moist gas Gas Sat. sol. ¹ Dry Wet	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked Not recom. at 70° Same as 2 Not recom. at 70° No attack Rapid attack
2 5-11 12, 15 19-21 25 139 142 176 209 211, 258 213 213 244, 247 248	Stainless Stainless Stainless Stainless Stainless High Si Mo Ire High Si Iron Fe Ni Cu Cr Fe Ni Cr Si Mo Admiralty Aluminum Al Bronze	Sat. sol. Sat. sol. Sat. sol. Sat. sol. Sat. sol. an Any cone. Any cone. o Cu Carbonated tap water	<0.004 at 70° <0.005 at 70° <0.004 at 70° <0.004 at 70° Recom. to boiling Recom. to boiling 0.001 at room temp. No loss at cold Recommended <0.001 Recommended	9 10, 11 15, 18 19 20, 25 104 139	Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro High Si Iron	Moist gas Gas Sat. sol. ¹ Dry Wet	0.0042-0.042 at 70° 0.042-0.12 at 70° 0.12-0.42 at 212° <0.0437 at 68° Attacked Not recom. at 70° Same as 2 Not recom. at 70° No attack Rapid attack Recom. at room temp,

No.	Material	Exposure Conditions	Corresion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
209		lo Cu Cl ₂ water; 100 ppm.	No loss at cold	2	Stainless	10, 15%	0.0042-0.042 at boil.
	2 Al Alloys 7 Al Bronze	Dry Defectly des see	None expected at room temp:	1.5-1		25, 50%	0.12-0.42 at boil.
244, 24, 24, 249	Cu Ni Zn	Perfectly dry gas Perfectly dry gas	Recommended Recommended			Conc. 5% sol. at 45 psi.	0.042-0.12 at boil.
257	Admiralty	Actively ally gaa	Severe			Sat. sol.	0.12-0.42 at 284° <0.004 at 70°
	2, Copper	Perfectly dry gas	Recommended	1-7-		25% sol. + 0.6% H2 SO41	<0.004 at 68°
266, 277			La transfer and the set with the set of the set			25% sol. + 0.75% H2 SO41	<0.131 at 68°
	, Bronze		Severe	17.18.3		50% sol. + 0.6% H2 SO41	<0.0044 at 68°
315, 343			The second second second	5	Stainless	15% sol., sat. sol.	<0.004 nt 70°
344, 372			State of the state	1 State		15% sol.	<0.040 at boil.
275, 276	Cu Ni Alloy	Perfectly dry gas	Recommended	6, 7,	8 Stainless	Sat. sol.	<0.004 at 70°
283-285	Cu Si Mn	Perfectly dry gas	Recommended	9	Stainless	5% quiet	<0.0042 at 70°-150°
	Ni Mo Fe	Wet gas	Not recom, at any temp.	18.20		10-50%	<0.0042 at 70° - boil.
292	Ni Cr Fe W	Wet gas	<0.038 at 70°	1		Conc.	0.0042-0.042 at boil.
293	Ni Si Cu	Wet gas	Not recom. at any temp.			5% sol. at 45 psi.	0.0042-0.042 at 284°
300	Ni Cr Cu Mo	a second and a second sec	Recommended	10.11		Sat. sol.	<0.004 at 70°
000	NO D	Moist	>0.125 at 200°		Stainless	Sat. sol.	<0.004 at 70°
302	Ni Cr Fe	0.1 g. avail. Cl ₂ /l. H ₂ O	0.002 at 40°	12	Stainless	Sat. sol. ²	<0.005 at 70°
1		3.3 g. avail. Cl ₂ /l. H ₂ O 6.5 g. avail. Cl ₂ /l. H ₂ O	0.005 at 40° 0.012 at 40°	15	Stainless	5% quiet	<0.0042 at 70°-150°
No.		Wet vapors	0.012 at 40 0.095 at 190°	18	Stainless	Sat. sol. ² 6% sol. ¹	<0.005 at 70°
308	Sb Lead	Anhydrous	OK	19	Stainless		0.005 at 64°
			OK	19	Stamess	5% quiet	<0.0042 at 70°-150°
311 314	Chem. Lead Te Lead	Anhydrous Anhydrous	OK	- P		10%	<0.0042 at 70°
314 316	Ni Cu Alloy	0.1 g. avail. Cl ₂ /l. H ₂ O	0.004 at 40°	1		15% 33% ¹	<0.0042 at boil. 0.007 at 64°
010	In Ou Alloy	3.3 g. avail. Cl ₂ /1. H ₂ O	0.004 at 40°	20	Stainless	1-50%1	
		6.5 g. avail. Cl ₂ /l. H ₂ O	0.113 at 40°	20	Stainless	1-50%	<0.0046 at 68°, boil. <0.004 at 70°
330	Nickel	0.1 g. avail. Cl2/l. H2O	0.004 at 40°	104	Fe Ni Cu Cr	5%	0.067 at 80°
	- HONCE	3.3 g. avail. Cl ₂ /l. H ₂ O	0.030 at 40°	129	High Si Iron	25% quiet	<0.001 at room temp.
		6.5 g. avail. Cl2/l. H2O	0.052 at 40°	139	High Si Mo Ir		Recom. to boiling
335 336	Ni Cr Steel	Pure, H2O free 1	<0.004 at 68°	142	High Si Iron		Recom. to boiling
000, 000	and be been	Moist 1	<0.04 at 68°	176	Fe Ni Cu Cr	5%	0.09 at room temp.
337, 338	Nickel Silver	Perfectly dry gas	Recommended	190	Ni Steel	5%	0.018 at 65°
	P Bronze	Perfectly dry gas	Recommended	209		o Cu Strong water sol.	No loss at warm
355, 371			Severe		Al Alloys	10%	<0.001 at 86°
359	Red Brass	Perfectly dry gas	Recommended			10%	0.0055 at 122°
364	Silver	Dry	Slight at ordinary temp.	244, 247	Al Bronze		Recommended
	Co Cr W	All conc.	Recom. at all temp.	249	Cu Ni Zn		Recommended
370	Tantalum		None at any temp.	257	Admiralty		Slight to moderate
			and the second second second		Copper		Recommended
CHRC	DMIC ACI	D		266, 277			
			70° Boiling	272, 273	Bronze		Slight to moderate
2	Stainless	5% C. P.	<0.0042	315, 343,	S	Sand Land Contract	
		10, 50% C. P.	0.004-0.04 0.04-0.12	344, 372			The most
		50% commercial + SOa	<0.0042 >0.12	275, 276	Cu Ni Alloy		Recommended
5	Stainless	5%	<0.010	283-285	Cu Si Mn		Recommended
6-8	Stainless		Attacked	290, 291	Ni Mo Fe	All conc.	Recom. at all temp.
9	Stainless	5% C. P.	<0.0042	292	Ni Cr Fe W	All conc.	Recom. at all temp.
		10, 50% C. P.	0.004-0.04 0.004-0.04	293	Ni Si Cu	All conc.	Recom. at all temp.
		50% commercial + SOa	<0.0042 0.042-0.12	300	Ni Cr Cu Mo l		Recommended
10-12,15	Stainless		Attacked	302	Ni Cr Fe	7% sol.	0.004 at boiling
19	Stainless	10% sol.1	<0.0016 0.046	21.1%		Concentrating from 75% to	
		50% sol.1	>0.46 >0.46	and the second		90% sol. in vac. pan	0.002 at 126°
20	Stainless	10% sol.1	<0.0040 <0.0046	308	Sb Lead	al faith	Not recommended
		50% sol.1 d'	<0.46 >0.456	311	Chem. Lead	and a line - had a late	Not recommended
21	Stainless		Same as 191	314	Te Lead		Not recommended
25	Stainless	Contraction - have	Attacked at 70°	316	Ni Cu Alloy	1% sol., aerated	0.001 at 77°
139	High Si Mo Ire		Recom. to boiling	100 60		5% sol., acrated	0.001 at 60°
142	High Si Iron		Recom. to boiling	10000		15% sol., exposed to air	0.003 at 149°
209	Fe Ni Cr Si M	o Cu Weak; plating sol.	Satisfactory at warm	12515		30% sol., unaerated	0.001 at atmos. temp. 0.007 at 140°
-		Anodizing sol.	Satisfactory	0000		30% sol., unaerated	· · · · · · · · · · · · · · · · · · ·
	All Cu-Base Al	TOAR	Severe attack	Service State		58% sol.	0.006 at boiling <0.001 at 80-150°
	Ni Ma Fe		Not recommended	220	Viskal	60-62%, some acration	<0.001 at 77°
	Ni Cr Fe W		Recommended	330	Nickel	1% sol., unaerated	0.002 at 77°
	Ni Si Cu	De DE EOC' ant	Not recommended	17172		1% sol., acrated 15% sol., exposed to air	0.004 at 149°
300	AI Cr Cu Mo I	Fe 25, 50% sol.	>0.125 at boiling	1000		58% sol.	0.017at boiling
	101 m 101	25% sol. + 5% by volume H	<0.004 at 70°	1=1-		60-62%, some aeration	<0.001 at 80-150°
		35% acid	Recommended at 70°	336	Ni Cr Steel	5% sol.1	>0.004 at 68°
200			<0.001 at room temp;	000	ALCI DICCI	20% sol.1	>0.004 at 68°
	Ni Cr Fe	B	OK to 120°	1		Sat. sol.1	>0.004 at 212°
	Sb Lead	20-40% 20-40%	OK to 120°	337 330	Nickel Silver	Juli Dul	Recommended
311	Chem. Lead Te Lead	20-40%	OK to 120°		P Bronze		Recommended
	Ni Cu Alloy	3.4% sol. + 2% Na: SO4	<0.001 at room temp:	355, 371		11 1 14 1 1	Slight to moderate
316	IN Ca Alloy	5% sol., unserated	0.001 at 86°	359	Red Brass.		Recommended
330	Nickel	3.4% sol., + 2% Ya2 SO4	<0.001 at room temp:	364	Silver		No attack
	Ni Cr Steel	50% sol.1	>0.03S at boiling		Co Cr W	All conc.	Record. at all temp.
220	ALCE DIGCI	3070 201-	Readily attacked	370	Tantalum	and while to	None at any temp.
	Silver			1.747	13 There !!		in a state of the state of the
364	Silver Co.Cr.W		Recommended				
364 365-36S	Co Cr W		Recommended 0 425 at 302°	4 2 3 9			
364 365-36S			0.425 at 302°	COPF	ER SULP	HATE	Participal - th
364 365-36S 370	Co Cr W Tantalum		the second s	COPF			and a set of the set o
364 365-36S 370	Co Cr W		0.425 at 302°	COPF 2	PER SULP. Stainless	50% saturated sol.	<0.0044 at 212°1
364 365-36S 370	Co Cr W Tantalum	5% quiet	the second s	1			<0.0044 at 212 ⁹¹ <0.0044 at 65 ⁹¹ <0.0046 at 68 ⁹¹

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
2	Stainless	5%, agitate or aerate	<0.0042 at 70°	139	High Si Mo I	ron Any conc.	Recom. to boiling
17/5/	1-1-11	Sat. sol.	<0.0042 at boiling	142	High Si Iron	Any conc.	Recom. to boiling
5	Stainless	Sat. sol.	<0.004 at 70°, boil.	209	Fe Ni Cr Si M	fo Cu	No loss at cold
6, 7, 8	8 Stainless	Sat. sol.	<0.004 at 70°	1.	All Cu-Base A	lloys	Recommended
9	Staiuless		Same as 2	218	Al Alloy	In storage container	Stained, etched only; at 70°
10, 11	Stainless	Sat. sol.	<0.004 at 70°		l Ni Mo Fe	All conc.	Recom. at all temp.
12, 15	Stainless	5%, agitate or acrate	<0.C042 at 70°	292	Ni Cr Fc W	All conc.	Recom. at all temp.
1230		Sat. sol.	<0.005 at 70°	293	Ni Si Cu	All conc.	Recom. at all temp.
Contraction of the	a	Sat. sol. (neutral) ¹	Recom. at high temp.	308	Sb Lead		Probably OK
19	Stainless	5%, agitate or aerate	<0.0012 at 70°	311	Chem. Lead		Probably OK
12 100		Sat. sol. Sat. sol. (neutral) ¹	<0.001 at 70°3	314 316	Te Lead	700% and hur wal amounted	Probably OK
20	Stainless	Sol. + 3% H ₂ SO ₄ ¹	Recom. at high temp. <0.0046 at 68°		Ni Cu Alloy	70% sol. by vol., unacrated	<0.001 at 104°
25	Stainless	Sat. sol.	<0.004 at 70°3		i Ni Cr Steel Co Cr W	96% sol. ¹ All conc.	<0.004 at 68° Recom. at all temp.
104	Fe Ni Cu Cr		Rapid attack	000-000	CUCIW	All cond.	recom. at an temp,
129	High Si Iron	25%, quiet	<0.001 at room temp.	1.			
139	High Si Mo Ire		Recom. to boiling	ETH	YLENE GI	LYCOL	
142	High Si Iron	Any conc.	Recom. to boiling	1976			
176	Fe Ni Cu Cr	0.1-10%	0.04-0.5 at room temp.	2	Stainless	Conc.	<0.003 at 70°
209	Fe Ni Cr Si M	o Cu Sat. sol.	No loss at cold	5-11	Stainless	Conc.	<0.003 at 70°
The second		Sat. sol + 10% H2 SO4	Satisfactory at 200°	12, 15	Stainless	Conc.	<0.005 at 70°
213	Aluminum	10% sol.	0.011 at room temp.	104	Fe Ni Cu Cr	LE AT TALIATING	No attack
		1% sol.	0.011 at room temp.	139		on Any cone.	Recom. to boiling
the loss		0.1% sol.	0.0027 at room temp.	142	High Si Iron		Recom. to boiling
	Al Alloys		Expect to be same as 213	209	Fe Ni Cr Si M		No loss at cold
	Al Bronzo	11	Recommended	010	All Cu-Base A	and the second se	Recommended
249	Cu Ni Zn		Recommended	213	Aluminum	In container 9 mo.	Only mild stain at 70° Only mild stain at 70°
257	Admiralty		Slight to moderate	218	Al Alloy	In container 9 mo.	the second
	Copper		Recommended	308	Sb Lead		Probably OK Probably OK
266, 277		the second of the second s		311	Chem. Lead		Probably OK Probably OK
272, 273	and the second s		Slight to moderate	014	Te Lead		From the second se
315, 343,	1.17	1 In Addition		1			
344, 372			- mark in the	FAT	TY ACIDS		
	Cu Ni Alloy		Recommended	+1000	Contraction of the	127 (D = 15 / 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	
And and a second	Cu Si Mn	Contraction of the second	Recommended	2	Stainless		<0.004 at 70°
	Ni Mo Fe	All conc.	Not recom. at any temp.	5-11			<0.004 at 70°
292	Ni Cr Fe W	All conc.	Recom. at all temp.	20	Stainless		<0.00461
000		292 increases with increase of		139	High Si Mo Ir		Recom. to boiling
293	Ni Si Cu Ni Ca Cu Mal	All conc.	Not recom. at any temp. <0.004 at 70°	142	High Si Iron	Any conc.	Recom. to boiling
300	Ni Cr Cu Mo	9-18% sol.	<0.004 at boiling	176	Fe Ni Cu Cr	the second second second	0.008-0.03 at 200° - boil.
1.5		25% + 12.5% H ₂ SO ₄	0.004-0.015 at boil.	209	Fe Ni Cr Si M	o Cu	<0.001 at 180° .
Va jur		5% + 12.5% H ₂ SO ₄	0.001-0.015 at boll.		Al Bronze4		Recommended
13.34		2.5% + 12.5% H ₂ SO4	0.004-0.015 at boil.	249	Cu Ni Zn4		Recommended
308	Sb Lead	Strongly acid - H2 SO4	OK	257	Admiralty		Slight to moderate
311	Chem. Lead	buongij acia in oos	Same as 308		, Copper ⁴		Recommended
314	Te Lead		Same as 308	266. 277	Deven		Slight to moderate
316	Ni Cu Alloy	0.1% sol., acrated	<0.001 at 60°	315, 343			Singht to moderate
1.5		0.5% sol., acrated	0.002 at 60°	344. 372	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Wat Plant Willer	
1.00		10% sol., nerated	0.004 at 60°		Cu Ni Alloys		Recommended
and the		20% sol., some acration	0.002 at room temp.		Cu Si Mn4		Recommended
Charles -		20% sol., unacrated	0.044 at 214°	300	Ni Cr Cu Mo	Fe	Recommended
337, 338	Nickel Silver		Recommended	302	Ni Cr Fe	Storage of conc. acids from fis	
350-353	P Bronze		Recommended	111. 37		Distillation acids from fish oil	
	Copper	Vuoto anti anti	Slight to moderate	1.1.1.1	112 348	Distillation acids from cotton	seed 0.002 at 530°
359	Red Brass		Recommended	1421 = 0		Distillation acid 'rom linseed	< 0.001 at 700°
364	Silver	and the second	Recommended	308	Sb Lead	In absence of O2	OK
365-368	Co Cr W	All conc.	Recom. at all temp.	311	Chem. Lead	In absence of O2	OK
		creases with increase in conc.		314	Te Lead	In absence of O2	OK
370	Tantalum		None at any temp.	316	Ni Cu Alloy	Storage of conc. acids from fis	h oils 0.002 at 200°
BACK I				Par Car		Distillation acids from fish oil	
ETHY	L ACETA	TE		1.3.3		Distillation acids from fish oil	
135	1720 21	CIENTING IN THE T		10	-	Distillation acids from linseed	
2	Stainless	Cone. sol.	<0.003 at 70°	330	Nickel	Storage of conc. acids from fis	
5-11	Stainless	Conc. sol.	<0.003 at 70°	1 - 1		Distillation acids from fish oil	
12, 15	Stainless	Conc. sol.	<0.005 at 70°	11-1-1		Distillation acids from cotton	
104	Fe Ni Cu Cr		No attack			Distillation acids from linseed	
139	High Si Mo Ire		Recom. to boiling		Nickel Silver		Recommended
142	High Si Iron		Recom. to boiling	and the second second	P Bronze ⁴	and the sea	Re nded
209	Fe Ni Cr Si M		No loss at cold	355, 371			tori te
102 2	All Cu-Base Al		Recommended	359	Red Brass ⁴		1.4
218	Al Alloy	In storage container	None at room temp.	364	Silver		Resister_
300	Ni Cr Cu Mo H		0.004-0.015 at 167°	370	Tantalum		None at any temp.
		Distillation of crude	0.004-0.015 at 212°	Stan			
		INTERNAL STREET		FFDD	CHIO	RIDE	
ETHN	L ALCOH	IOI		TERN	RIC CHLO	NIDE	
SIIII	L ALCON	UL		2	Stainless	1072,3	0.0042-0.042 at 70°
2	Stainless		<0.0042 at 70°, boil.	D		1% 2.3	0.12-0.42 at boil.
Tel 19		10-100% alcohol1	<0.6044 at 68°			Sat. sol.	Attacked at 70°
5-11	Stainless	Conc.	<0.004 at 70°	5	Stainless	5%	Not recom. at 70°
9	Stainless	Cardina and	<0.0042 at 70°, boil.		- surray cits	Sat. sol.	Attacked at 70°
12, 15	Stainless		<0.005 at 70°	6,7,8	Stainless	Sat. sol.	Attacked at 70°
19-21	Stainless		<0.0042 at 70°, boil.	9	Stainless	1% ^{2,2}	<0.0042 at 70°
104	Fe Ni Cu Cr		No attack		244101000	1%2.1	0.042-0.12 at boil.
6 1 1 1 2 ST		A CHARLEN AND AND AND AND AND AND AND AND AND AN	Strengthere and the second	3.	and the second	- 70	COLOR OT DE DOM:

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
		10%2.3	<0.004 at 70°	364	Silver		Attacked at boiling
9	Stainless	10%2.3.	<0.004 at 70°	365-368	Co Cr W	All conc.	Recom. to 105°
	Stainless	Sat. sol.	Attacked at 70°	373	Tobin Bronze		Attacked
	8 Stainless	5%, sat. sol.	Not recom, at 70°	10 00			
19	Stainless	1%2.3	0.0042-0.042 at 70°	FER	ROUS CH	LORIDE	
		1%01.3	0.12-0.42 at 70°	1-			
00 95	Stainless	5%, sat. sol. 5%, sat. sol.	Not recom. at 70° Not recom. at 70°	9	Stainless	Sat. sol.	<0.004 at 70°
20, 25	Fe Ni Cu Cr	070, Sat. 301.	Attacked	139		on Any conc.	Recom. to boiling
129	High Si Iron	48%, quiet	0.0041 at room temp:	142	High Si Iron	Any conc.	Recom. to boiling
139		on Consult manufacturer	oloon at room empt		7 Al Bronze Cu Ni Zn		Recommended
142		Consult manufacturer		249 257	Admiralty		Recommended
209	Fe Ni Cr Si M	o Cu	Not recom. at cold	and the second sec	2, Copper		Slight to moderate Recommended
	All Cu - Base	Alloys	Attacked	260, 277			Recommended
213	Aluminum	0.1%	0.002 at room temp.		B. Bronzo		Slight to moderate
		1.0%	0.11 at room temp.	315, 343			angle to moderate
1977		10%	0.053 at room temp.	344, 372	1 1 - 2 L		
	Al Alloys	Expected to be same as 213.	A STATE A POINT OF	275, 276	Cu Ni Alloy		Recommended
	Ni Mo Fe	All conc.	Not recom, at any temp.	283-295	Cu Si Mn		Recommended
292	Ni Mo Fe Cr		Recom. to 158°		Nickel Silver		Recommended
293		292 increases with increase in All cone.	Not recom. at any temp.		P Bronzo		Recommended
300	Ni Si Cu Ni Cr Cu Mo F		>0.125 at 176°		Copper		Slight to moderate
302	Ni Cr Fe	10%, complete immersion	1.2 at \$5°	359	Red Brass		Recommended
.308	Sb Lead	10701 complete municipion	Not recommended	370	Tantalum		None at any temp.
311	Chem, Lead	trut-man	Not recommended	15 3 - 1 -			A STATE AND A STAT
314	Te Lead		Not recommended	FEDT	OUS SUI	DUATE	
316	Ni Cu Alloy	10%, alternate immersion	3.2 at atmos. temp.	TERI	ROUS SUL		
330	Nickel	10%, alternate immersion	2.9 at atmos. temp.	2	Stainless	10% sol.2	<0.0042 at 70° - boil:
336	Ni Cr Steel	50% sol.1	>0.038 at 122°	2 11 2	1	Sat. sol.	<0.004 at 70°
364	Silver	10% C. P., refluxed	0.020 at boiling	5	Stainless	Dil. sol.	<0.004 at 70°
365-368	Co Cr W	All conc.	Recom. to 105°	1		Sat. sol.	<0.004 at 70°
	Corrosion of	305-368 increases with increa	se in conc. or temp.	6-8	Stainless	Sat. sol.	<0.004 at 70°
370	Tautalum		None at any temp.	9	Stainless	Dil. sol.	<0.004 at 70°
			April 1			10% sol.	<0.0042 at 70° - boil;
			- 1045 - D45			Sat. sol.	<0.004 at 70°
			a landad E	10, 11	Stainless	Sat. sol.	<0.004 at 70°
FERH	IC SULPH	HATE	parallel and the state of	12, 15	Stainless	Dil. sol.	<0.004 at 70°
	0. 1 1	A PCT		1	- Alexanda	Sat. sol.	<0.005 at 70°
2	Stainless	1, 5% quiet, agitated, or acra	<0.0042 at boiling	18	Stainless	Dil. sol.	<0.004 at 70°
		10% Sat. sol.	<0.0042 at bolung <0.004 at 70°	19, 20,	Stainless	Dil. sol. ²	<0.004 at 70°
5	Stainless	5% ²	<0.004 at 70°	25	E M O O	Sat. sol.	<0.004 at 70°
0	1344101035	Sat. sol.	<0.004 at 70°	104 139	Fe Ni Cu Cr High Si Mo In	10% sol.	0.059 at 80° Recom. to boiling
6-S	Stainless	Sat. sol.	<0.004 at 70°	139	High Si Iron	Any conc.	Recom. to boiling
9	Stainless	1, 5% quiet, agitated, or acrat	the second se	213	Aluminum	0.1% sol.	<0.001 at room temp.
		10%	<0.0042 at boiling	~10		1% sol.	0.001 at room temp.
		Sat. sol.	<0.004 at 70°			10% sol.	0.0026 at room temp.
10, 11	Stainless	Sat. sol.	<0.004 at 70°	214-222	Al alloys	All Al alloys expected to be a	and a set of a factor of the set
15, 18	Stainless	5%	<0.004 at 70°	244, 247	Al Bronze		Recommended
	Stainless	1, 5% quiet, agitated, or aera		249	Cu Ni Zn		Recommended
21, 25	1	Sat. sol.	<0.004 at 70°	257	Admiralty	HELMOR Dame	Slight to moderate
104	Fe Ni Cu Cr	Mar and Lord and	Attacked	259, 262,	Copper		Recommended
129	High Si Iron	50%, quiet	<0.001 at room temp:	266, 277			
139	High Si Mo Iro		Recom. to boiling	272, 273,			Slight to moderate
142	High Si Iron		Recom. to boiling	315, 343,			
209	re NI Gr SI M	Io Cu 0.5% + 10% H SO: Ferrisul Inhibitor	0.0010 at 212°	344, 372			
	1. are	5% + 10% H2SO4 Ferrisul	0.0010 at 212		Cu Ni Alloy		Recommended
		Inhibitor	0.0016 at 212°		Cu Si Mn Ni Mo Fe	All cong	Recommended • Recom. at all temp.
211. 258	Admiralty	72 24 24 24 24 24 24 24 24 24 24 24 24 24	Attacked	290, 291 292	Ni Mo Fe Ni Cr Fe W	All cone:	Preferred to 290, 291, 293
-	Al Bronze		Attacked	292 293	Ni Si Cu	All conc.	Recom. at all temp.
248	Al Brass		Attacked	300		'e 2.5% + 5% H2 SO4	<0.004 at boiling
249	Cu Ni Zu		Attacked	000	In or ou mor	2.5% + 12.5% H2 SO4	<0.004 at boiling
257	Admiralty		Slight to moderate			5% + 5% H2 SO4	<0.004 at boiling
259, 262,			Attacked			Sat. sol.; equal parts with	
260, 277			a station of the state of the s			25% H2 SO4	0.004-0.015 at boiling
272, 273,	Bronze		Slight to moderate	305	Sb Lead	the contract of the	ОК
315, 343,			The second state	311	Chem. Lead		OK
344, 372		1	The second second	314	Te Lead		ОК
	Cu Ni Alloy	and the second second	Attacked	316	Ni Cu Alloy	20% sol;	0.040 at boiling
	Cu Si Mn	411	Attacked	337, 338	Nickel Silver		Recommended
		All conc.	Not recom. at any temp; Recome to 105°		P Bronze	E STOR HON IN	Recommended
292		All conc.	Recons. to 105°	355, 371			Slight to moderate
293		All conc.	Not recom. at any temp.	359	Red Brass		Recommended
207	High Brass		Attacked OK	364	Silver		Attacked on heating
	Sb Lead		OK				
308	Cham I a 1		OK	FOD	TATIOTT	DE	
30S 311	Chem. Lead			FUK	IALDEHY	DE	
308 311 314	Te Lead						
308 311 314 318	Te Lead Muntz		Attacked	2		40% sol.3	<0.004 at 70°
30S 311 314 318 32S	Te Lead Muntz Naval Brass		Attacked Attacked		Stainless	40% sol. ²	<0.004 at 70° <0.004 at 70°
308 311 314 318 328 337, 338	Te Lead Muntz Naval Brass Nickel Silver		Attacked Attacked Attacked	2		40% sol.1	<0.004 at 70°
308 311 314 318 328 337, 338	Te Lead Muntz Naval Brass Nickel Silver P Bronze		Attacked Attacked	2 5-8 9	Stainless Stainless		

.

No.	Material	Exposure Conditions		Corrosion r Year @ Deg. F
19, 20	Stainless	40% sol.2	<0.004 at 70°	
21, 25	Stainless	40% sol.2	<0.004 at 70°	
139	High Si Mo	Iron Any conc.	Recom. to boi	
142	High Si Iron	Any conc.	Recom. to hoi	ling
209	Fe Ni Cr Si	Mo Cu	Satisfactory a	t cold
	All Cu — Ba	se Alloys	Recommended	
216	Al Alloy	38% sol.	0.010 at room	temp.
213-222	AI Alloys	All Al alloys expected to b	e same as 216.	
290, 201	Ni Mo Fe	All conc.	Recom. at all	temp.
292	Ni Cr Fe W	All conc.	Recon. at all	temp.
293	Ni Si Cu	All conc.	Recom. at all	temp.
300	Ni Cr Cu Mo	Fe 40% sol.	< 0.004 at 70°	
302	Ni Cr Fe	37% sol., storage tank	<0.001 at 75°	
		Wet vapors	<0.001 at 148	0
308	Sb Lead		Not recommen	ided
311	Chem. Lead		Not recommen	ided
314	Te Lead		Not recommen	nded
316	Ni Cu Alloy		Same as 302	
330	Nickel		Same as 302	
364	Silver	Silver-lined containers	Highly resistan	nt
	Co Cr W	All conc.	Recom. to boil	
000 000	00 01 11			
FORM	IIC ACII)		
		SPANES IS C	Room temp.	Boiling
	Stainless	5% sol.	< 0.0042	0.004-0.040
		10% sol.	< 0.0042	0.004-0.040
		50% sol.	< 0.0042	0.004-0.040
		90% sol.	< 0.0042	
		100%	< 0.0042	0.004-0.040
5-8	Stainless	5% вој.	<0.001	
9	Stainless	5% sol.	< 0.0042	
		10% sol.	< 0.0042	< 0.0042
		50% sol.	< 0.0042	< 0.0042
		90% sol.		< 0.0042
		100%	<0.0042	0.004-0.040
10, 11	Stainless	5% sol.	< 0.004	
12, 15	Stainless	and the second se	Attacked	Attacked
19	Stainless	5% sol.	0.004-0.040	
10	Etamineea	10% sol.	0.004-0.040	>0.42
		50% sol.	0.004-0.040	>0.42
20	Stainless	10% sol.1	<0.0046	<0.0046
20	Duminetos	50% sol.1	<0.0046	<0.0046
		80% sol 1	<0.0046	< 0.0046
		100%1	<0.0046	<0.0046
	T- NI Co. C-	· · · ·	0.0577 -+ 002	
104	Fe Ni Cu Cr	are al with	0.0577 at \$0°	- 459
129	High Si Iron	25% sol., quiet	<0.001 at room	
139		on Any cone.	Recom. to boili	
142	High Si Iron	Any conc.	Recom. to boili	and the second se
209	Fe Ni Cr Si M	lo Cu	Satisfactory at	cold
	Al Bronze		Recommended	
249	Cu Ni Zn	- mant	Recommended	
257	Admiralty		Slight to moder	ato
259, 262,	Copper		Recommended	
266, 277	un - Sala			
265	Ni Cr Alloy	0.34% sol.1	0.011 nt 65°	
.00		85% sol.1	0.009 at 68°	13. 5-2
	mail - shill	8070 501		ate
272, 273,	Bronze	6070 501	Slight to moder	
272, 273, 115, 343	Bronze	6070 5011	Slight to moder	
272, 273, 815, 343, 844, 372		0070 501		
272, 273, 115, 343, 144, 372 275, 276	Cu Ni Alloy	0070000	Recommended	
272, 273, 815, 343 844, 372 875, 276 283-285	Cu Ni Alloy Cu Si Mn		Recommended Recommended	
272, 273, 815, 343 844, 372 875, 276 283-285	Cu Ni Alloy	10% sol., aerated	Recommended Recommended 0.028 at 155°	
272, 273, 815, 343 844, 372 875, 276 283-285	Cu Ni Alloy Cu Si Mn	10% sol., acrated 60% sol., acrated	Recommended Recommended 0.02S at 155° 0.040 at 155°	
272, 273, 315, 343, 344, 372 275, 276 283–285 290	Cu Ni Alloy Cu Si Mn Ni Mo Fe	10% sol., acrated 60% sol., acrated 85% (conc.), acrated	Recommended Recommended 0.028 at 155° 0.040 at 155° 0.036 at 155°	
272, 273, 315, 343, 344, 372 275, 276 283–285 290	Cu Ni Alloy Cu Si Mn	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.036 at 155° <0.001 at 155°	
272, 273, 315, 343, 344, 372 275, 276 283–285 290	Cu Ni Alloy Cu Si Mn Ni Mo Fe	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated	Recommended Recommended 0.028 at 155° 0.040 at 155° 0.036 at 155°	
272, 273, 315, 343 344, 372 275, 276 283–285 290	Cu Ni Alloy Cu Si Mn Ni Mo Fe	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.036 at 155° <0.001 at 155°	
272, 273, 315, 343 344, 372 275, 276 283–285 290	Cu Ni Alloy Cu Si Mn Ni Mo Fe	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated	Recommended 0.025 at 155° 0.030 at 155° 0.036 at 155° <0.001 at 155° 0.0012 at 155°	
272, 273, 315, 343 3144, 372 275, 276 283–285 290	Cu Ni Alloy Cu Si Mn Ni Mo Fc Ni Cr Fe W	10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 60% sol., aerated 85% (conc.), aerated	Recommended Recommended 0.028 at 155° 0.040 at 155° 0.036 at 155° 0.001 at 155° 0.0012 at 155° 0.0012 at 155°	1 + 白武 二)里际
272, 273, 315, 343 344, 372 275, 276 283–285 290	Cu Ni Alloy Cu Si Mn Ni Mo Fc Ni Cr Fe W	10% sol., acrated 60% sol., acrated 55% (conc.), acrated 10% sol., acrated 60% sol., acrated 55% (conc.), acrated 10% sol., acrated	Recommended Recommended 0.028 at 155° 0.040 at 155° 0.036 at 155° 0.001 at 155° 0.0012 at 155° 0.0012 at 155°	2 + Oak 2 2 Fr.
272, 273, 315, 343, 344, 372 275, 276 283–285 290 292	Cu Ni Alloy Cu Si Mn Ni Mo Fc Ni Cr Fe W	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.001 at 155° 0.0012 at 155° 0.0012 at 155° 0.015 at 155° 0.013 at 155°	2 + 2 al
272, 273, 315, 343, 344, 372 275, 276 283–285 290 292	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.001 at 155° 0.0012 at 155° 0.0012 at 155° 0.013 at 155° 0.031 at 155°	ana y
272, 273, 115, 343, 344, 372 275, 276 283–255 290 292 293	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu	10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 85% (conc.), aerated 85% (conc.), aerated Fe 25% sol.	Recommended Recommended 0.025 at 155° 0.040 at 155° 0.001 at 155° 0.0012 at 155° 0.012 at 155° 0.012 at 155° 0.031 at 155° 0.031 at 155° 0.015 at 155°	ng
272, 273, 115, 343, 344, 372 275, 276 283–255 290 292 293	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu Ni Si Cu	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 85% (conc.), acrated 85% (conc.), acrated 80% sol. 90% sol., storage tank	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.001 at 155° 0.0012 at 155° 0.0012 at 155° 0.013 at 155° 0.013 at 155° 0.013 at 155° 0.014 at 55° 0.004 at 50°l	ng
272, 273, 315, 343, 344, 372 275, 276 283–285 290 292 293 000 02	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu Ni Cr Cu Mo Ni Cr Fe	10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 85% (conc.), aerated 85% (conc.), aerated Fe 25% sol.	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.001 at 155° 0.0012 at 155° 0.0012 at 155° 0.013 at 155° 0.013 at 155° 0.013 at 155° 0.014 at 155° 0.014 at 155° 0.014 at 155° 0.004 at 500 <0.004 at 500 0.005 at room t 0.000 at 212°	ng emp.
272, 273, 315, 343, 344, 372 275, 276 283–285 290 292 293 000 02 08	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fe W Ni Si Cu Ni Cr Cu Mo Ni Cr Fe Sb Lead	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 85% (conc.), acrated 85% (conc.), acrated 80% sol. 90% sol., storage tank	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.001 at 155° 0.0012 at 155° 0.0012 at 155° 0.012 at 155° 0.013 at 155° 0.013 at 155° 0.014 at 55° 0.014 at 55° 0.014 at 55° 0.004 at 50° 0.004 at 50° 0.006 at 50° 0.000 at 212° Not recommend	ng emp. led
272, 273, 815, 343, 814, 372 275, 276 283–285 290 292 293 000 02 08 11	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu Ni Cr Cu Mo Ni Cr Fe Sb Lead Chem. Lead	10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 10% sol., acrated 60% sol., acrated 85% (conc.), acrated 85% (conc.), acrated 85% (conc.), acrated 80% sol. 90% sol., storage tank	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.036 at 155° 0.0012 at 155° 0.0012 at 155° 0.012 at 155° 0.013 at 155° 0.013 at 155° 0.014 at 55° 0.014 at 155° 0.004 at 70° <0.004 at 5001 0.006 at room t 0.020 at 212° Not recommend	ng emp. led led
272, 273, 115, 344, 372 275, 276 283–285 190 292 293 00 02 08 11 14	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu Ni Cr Cu Mo Ni Cr Fe Sb Lead Chem. Lead Te Lead	10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 85% (conc.), aerated 85% (conc.), aerated 85% (conc.), aerated Fe 25% sol. 80% sol. 90% sol., storage tank 90% sol., in still	Recommended Recommended 0.025 at 155° 0.040 at 155° 0.036 at 155° 0.0012 at 155° 0.0012 at 155° 0.012 at 155° 0.013 at 155° 0.013 at 155° 0.014 at 155° 0.014 at 155° 0.014 at 155° 0.014 at 155° 0.004 at 70° <0.004 at 70° <0.004 at 70° Not recommend Not recommend Not recommend	ng emp. led led led
272, 273, 115, 344, 372 275, 276 283–285 190 292 293 00 02 08 11 14	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu Ni Cr Cu Mo Ni Cr Fe Sb Lead Chem. Lead	10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 85% (conc.), aerated 85% (conc.), aerated 85% (conc.), aerated 85% (conc.), aerated 85% sol. 90% sol. storage tank 90% sol., in still	Recommended Recommended 0.023 at 155° 0.040 at 155° 0.036 at 155° 0.001 at 155° 0.0012 at 155° 0.012 at 155° 0.013 at 155° 0.013 at 155° 0.013 at 155° 0.014 at 55° 0.004 at boili 0.006 at room t 0.020 at 212° Not recommend Not recommend Not recommend 0.016 at boiling	ng emp. led led led
272, 273, 315, 344, 372 275, 276 283–285 290 292 293 000 02 08 11 14	Cu Ni Alloy Cu Si Mn Ni Mo Fe Ni Cr Fo W Ni Si Cu Ni Cr Cu Mo Ni Cr Fe Sb Lead Chem. Lead Te Lead	10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 60% sol., aerated 85% (conc.), aerated 10% sol., aerated 85% (conc.), aerated 85% (conc.), aerated 85% (conc.), aerated Fe 25% sol. 80% sol. 90% sol., storage tank 90% sol., in still	Recommended Recommended 0.025 at 155° 0.040 at 155° 0.036 at 155° 0.0012 at 155° 0.0012 at 155° 0.012 at 155° 0.013 at 155° 0.013 at 155° 0.014 at 155° 0.014 at 155° 0.014 at 155° 0.014 at 155° 0.004 at 70° <0.004 at 70° <0.004 at 70° Not recommend Not recommend Not recommend	ng emp. led led

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Dey. F.)
-	- 11	10-10-11	
316	Ni Cu Alloy	90% sol., in still	0.013 at 212°
330	Nickel	90% sol., storage tank	0.004 at room temp.
		90% sol., in still	0.018 at 212°
	Nickel Silver		Recommended
	P Bronze Copper		Recommended Slight to moderate
359	Red Brass		Recommended
364	Silver	In dyestuff plants	Highly resistant
370	Tantalum	and a second second	None at any temp.
FUR	FURAL	the half the plue of	
5,-9	Stainless		<0.004 at 70°
139	High Si Mo Ire	an Any cone	Recom. to boiling
142	High Si Iron	Any conc.	Recom, to boiling
209	Fe Ni Cr Si M		No loss at cold
	Admiralty		Recommended
216	Al Alloy	In storage container 6 mo.	Only stained, room temp.
	Al Alloys	All Al alloys expected to be	
	Al Bronze		Recommended
248	Al Brass		Recommended
249	Cu Ni Zn		Recommended
257	Admiralty		Slight to moderate
	, Copper		Recommended
266, 277			
	, Bronze		Slight to moderate
315, 343 344, 372			
	Cu Ni Alloy		Recommended
	Cu Si Mn		Recommended
	Nickel Silver		Recommended
	P Bronze		Recommended
355, 371	Copper		Slight to moderate
359	Red Brass		Recommended
GELA 2, 9,	Stainless	ar a than a' la tao ar anns	Little or none
15, 19	E. VI C. C.		Vesting
104 139	Fe Ni Cu Cr High Si Mo Iro	u Any cona	No attack Recom. to boiling
139	High Si Iron		Recom, to boiling
		Alloys except High Brass and	
200		Cu pH 4.0-4.5 with HCl	
302		Cooking 15-20% animal gel.	
-1. 2	10 2 2 7 2	Conc. sol. from 4 to 20% in	
316	Ni Cu Alloy	Cooking 15-20% animal gel.	
330	Nickel	Cooking 15-20% animal gel.	
		Conc. sol. from 4 to 20% in e	
364	Silver		No attack
GLUE	in a start		
2	Stainless	Dry	<0.0042 at 70°
-	oranno3	Acid sol.2	0.0042-0.042 at 70 & 140°
5	Stainless	Acid sol. ²	<0.004 at 70 & 150°
6-8		Sol.	<0.004 at 70°2
9		Dry	<0.0042 at 70°
1	it is a second	Acid sol.	<0.0042 nt 70 & 140°
10, 11	Stainless	Sol.	<0.004 at 70°2
12, 15	Stainless	Dry	<0.0012 at 70°
		Sol.	<0.005 at 70°2
19-21		Dry	<0.0042 at 70°
1200		Sol.1	<0.0046 at 68°
04	Fe Ni Cu Cr	- at Seven	No attack
39	High Si Mo Iron		Recom. to boiling
42			Recom, to boiling
76		5% sol.	<0.001 at 140-190°
		Alloys except High Brass and	
02		6% animal glue sol.	<0.001 at 180°
10		12.5% glue size sol.	0.001 at 120°
16 30	Ni Cu Alloy Nickel	CCT animal alua ant	Same as 302
	AMERCI	6% animal glue sol.	<0.001 at 180°
30		12.5% glue size sol.	0.003 at 120°

In ordinary glue

Silver

GLYCERINE

2-21 Stainless

Fe Ni Cu Cr

High Si Mo Iron Any conc.

364

104

139

CHEMICAL & METALLURGICAL ENGINEERING · SEPTEMBER 1944 ·

0.010 at room temp.

30% sol., unaerated 90% sol., storage tank

0.003 at 120°

No attack

<0.004 at 70°

Recom. to boiling

No attack

No.	• Material	Exposure Conditions	Corrosion (Inches per Year @ D	eg. F.) No.	Material	Exposure Condition		Corrosi es per Year	
142	High Si'lron	Any conc.	Recorn. to boiling		a. 21. a. 1		70°	N.S.E.E	- decinity
.76	Fe Ni Cu Cr	(1)) · · · · ·	0.002 at 130°	175	Cr Ni Steel	Conc. sol.	R		
09		o Cu Recovery from spent		176	Fe Ni Cu Cr	5-50% sol.	0.01-0.04		
		Alloys except High Brass as		and the second		75% sol.	0.12		
13	Aluminum	30% glycerine	0.001 at room temp.			Conc. sol.	0.37		
		Pure glycerine, 4 days	No attack at 300°	206	Fo Cr Ni Mo		R	176°	
	Al Alloys	All Al alloys expected to be		209	Fe Ni Cr Si M	lo Cu 2% sol.	0.025	0.089	
02	Ni Cr Fe	Crude	<0.001 at 240°					140°	deres .
		Conc. and sat. with salt	<0.001 at 300°	1- 1215 B - 7 -		5% sol.	0.028	0.094	
16	Ni Cu Alloy	50% water sol.	<0.001 at boiling					176°	
		Crude	<0.001 at 240°			5% sol.		0.692	
		Conc. and sat. with salt	0.002 at 300°		in a start of the	10% sol.	0.042		
310	Nickel	50% water sol.	0.002 at boiling	THE FREE CONTRACTOR		15% sol.	0.036		
		Crude	<0.001 at 240°			20% sol.	0.034		Boil
		Conc. and sat. with salt	0.002 at 300°	12 . S. 18 . S. 1		25% sol.	0.140		
4	Silver	In Ag-lined barrels	No attack	211	Admiralty	0.25-5% sol.	R		R
				THE REAL PROPERTY IN		20% воl.	R	41 11 m	
				213	Aluminum	0.25% sol.	0.005		
				the last of		1% sol.	0.017		
				La la contra		5% sol.	0.075		
vn	DOCITI OD	IC LCID		214	Al Alloy	0.25% sol.	0.011		
TD1	ROCHLOR	IC ACID		417		1% sol.	0.011		
2-25	Stainless	All conc.	>0.42 at 70°	ST TE - CAVE					
1-33	Stainless			015	A1 Allow	5% sol.	0.061		
		1, 5% sol.	>0.5 st 95°	215	Al Alloy	0.25% sol.	0.012	CTT VI	
5	Stainless	1% sol.	0.080 at room temp.	the fact of the		1% sol.	0.036	and the second	
	1	1% sol.	0.1-0.5 at 95°	Dimitical And		5% sol.	0.089		
		5% sol.	>0.5 at 95°	216	Al Alloy	0.25% sol.	0.015		
8	Stainless	0.25% sol.	Recom. at room temp.	Charles and the		1% sol.	0.036		
7	Stainles	0.25% sol.	Recom. at room temp.	MARCE LINE		5% sol.	0.18		
		1% sol.	Recom. at room temp.	224	Al Bronze	0.25, 1% sol.	R.		
		1, 5% sol.	0.1-0.2 at 95°	225	Ni Cr Si	0.25, 1% sol	R		R
		1, 5% sol.	>0.5 at boiling	20 47 1 24 1 44		5, 20% sol.	R		
8	Stainless	0.25, 1% sol	Recom. at room temp.	226, 227	Ni Cr Si	0.25% sol.	R		R
2	Stainless	0.25% sol.	Recom. at room temp.	and the second		1, 5, 20% sol.	R		The second
	Contained a	1% sol.	>0.001 at room temp.	229		0.25, 1% sol	R		R
2	Stainless	0.25, 1% sol.	Recom. at room temp.	240	IN OF ANO.	5, 20%, conc. sol;	R		10
;	Stainless	0.25% sol.	Recom. at room temp.		AL Deseres				
105	branness			244	Al Bronze	0.25-20% sol.	R		R
		1% sol.	0.060 at room temp.		~	Conc. sol.	R		
		1% sol.	0.067 at 95°	249	Cu Ni Zu	0.25-20% sol.	R		R
30	2.29	1% sol.	>0.5 at boiling	11610 - 52	2010	Conc. sol.	R		12 - 1
8	Stainless	0.25% sol.	Recom. at room temp., boi	257	Admiralty	0.25% sol.	R		R
		1% sol.	Recom. at room temp.	STAN PERSON		1% sol.	R		
		1% sol.	0.003 at boiling	266, 277	Copper	0.25-20% sol.	R		R
9	Stainless	0.25% sol.	Recom. at room temp., boi	il.		Conc. sol.	R		
		1% sol.	<0.001 at room temp.	273		0.25, 1% sol.	R		
		1% sol.	0.004 at boiling	276	Cu Ni Alloy	A Charles and	Same as 20	36	
1	Stainless	1% sol.	0.13-0.14 at 95°			0.25-20% sol.	R		R
		1% sol.	>0.5 at boiling	200 200	ou or mu	Couc.	R		
		5% sol.	0.11-0.16 at 95°	289	Gold	0.25%-conc. sol.	R		R
2	Stainless	1% sol.	0.15 at 95°	205	Goid	0.2070	70°	158°	Boiling
13.1	Digitareeo	5% sol.	0.18 at 95°	Le Mar Barriel		17 - TANK	a contraction of the local sector	acrated	
0	Stainless	0.25, 1% sol.	Recom. at room temp., boi	1 000	N. 14 D.	107 1	uerated		unaerate
,	DISTRUTIONS			1. 290	Ni Mo Fe	1% воl.	0.040	0.089	0.083
		5, 20%, conc. sol.	Recom. at room temp.	192 193-		5% sol.	0.028	0.13	0.37
		and a start of the start of the		oiling -		15% sol.	0.014	0.16	>0.5
÷	Ni Steel	3% sol.	0.011 >0.1	251 12 3		25% sol.	0.0049	0.041	0.13
		20% sol.	0.014 >0.1	1055 B7 105-100		37% sol., (conc.)	0.004	0.035	0.370
		40% sol.	0.032 >0.1	291		1% sol.	0.0036	0.023	0.0088
	Cr Ni Stoel	0.25, 1% воl.	R R			5% sol.	0.0089	0.032	0.012
		5% sol.	R	and a second		15% sol.	0.0042	0.043	0.014
	Fo Ni Cu Cr		Severe	- TOPAC - MARCH		25% sol.	0.0036	0.018	0.020
	Ni Cr Steel	0.25-5% sol.	R R	1-2-4 4-2-2-2-1		37% sol., (conc.)	0.0018	0.019	0.017
	Sale - Cont	20%, conc. sol.	R	292		1% sol.	< 0.001	0.0017	0.10
2	Fo Ni Cr Cu M		0.0084	282			0.0071	0.16	0.49
	Fe Ni Cr Mo			Martin Fruit		5% sol.		0.10	
		0.25, 1% sol.	P	Charles and the second		15% sol.	0.022		>0.5
	TIRE OF LOD		R R	State Instate		25% воі.	0.014	>0.5	>0.5
1	NO. O Y	5% sol., quiet	0.0015	10		37% sol., (conc.)	0.018	>0.5	>0.5
50	Ni Cr Cast Iron			142 293		1% sol.	0.023	0.064	0.010
	High Si Mo Iro		0.050	1		5% sol.	0.026	0.160	>0.50
		u 0.25%-conc. sol.	R	En Plant Ch		15% sol.	0.037	0.490	>0.50
		to 0.25%-conc. sol.	R	Sun Lines Co.	-1-1-1-	25% sol.	0.059	0.440	>0.50
	High Si Iron	0.25-1% sol.	R	Con the same hard		37% sol., (conc.)	0.140	0.350	>0.50
		5% sol.	0.003	295		0.25-5% sol.		70° & boil.	
		20% sol.	0.006			20%, conc. sol.	Recom. at		
		Conc. sol.	0.010 180°	296		0.25%-conc. sol.	Recon. at		
	Ni Cr Steel	3% sol.	0.0273 >0.1	300			Recommen		
	THE OF DICOL		0.0337 >0.1	300	MICT CU.MO F	'e 1% sol., wash liquor			
	1	20% sol.		·		5% sol.	<0.004 at		
		40% sol.	0.0647 >0.1	The second second		7% sol.	0.004-0.01		
	Fe Ni Cr W	3% sol.	0.0173 >0.1			7% sol.	>0.125 at	120°	
		20% sol.	0.0242 >0.1			10% sol.	<0.004 at		
		40% sol.	0.0414 >0.1	20122 2232		10% sol., aerated	0.015-0.05		
	Fe Ni Cr Cu	3% sol.	0.039 >0.1			16% sol.	>0.125 at		
			0.060 >0.1	TYARP SS		22% sol.	0.050-0.12		
						/g out.	0.030-0.12	O BL (U	
		20% sol.		all and the second second					
		20% sol. 40% sol. 0.25, 1% sol.	>0.1 >0.1 R. R. R	121		22% sol. 32% sol.	>0.125 at >0.125 at	120°	

No.	Material	Exposure Conditions	Corresion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
300	NiCrCuMoFo	Conc. sol.	>0.125 at 100 ⁶	316	Ni Cu Alloy	25% sol., sat. with air	0.011 at 176°
Se	Contraction in	Conc. fumes	<0.004 at 113°			25% sol., unaerated	0.002 at 176°
302	Ni Cr Fe	2% sol., apple washer	0.076 at 80-120°	1.2.	THE PLAT	50% sol., sat. with air	0.008 at 86°
		5% sol., aerated	0.098 at 86°	1		50% sol., sat. with air	0.039 at 176°
		5% sol., sat. with H2	0.013 at 86°	1. 2. 4		50% sol., unaerated 98% sol., unaerated	<0.001 at 176°
-107 207	To Distingues	5% sol., aerated	1.6 at 185° Recom. at 70° & boil.	330	Nickel	6% sol., pickling tank	0.002 at 100° 0.352 at 170°
	Ir Platinum Sh Lead	0.25%-conc. sol.	Not recommended	000	INICKCI	10% sol., pickling tank	<0.001 at 50-70°
308 311	Chem. Lead	C D D D D D D D D D D D D D D D D D D D	Not recommended	MALSH		98% sol., unacrated	0.002 at 100°
314	Te Lead		Not recommended	336	Ni Cr Steel	40% sol.1	<0.001 at 68°
316	Ni Cu Alloy	0.5% sol., acrated	0.016 at boiling		Nickel Silver	10 /0 1011	Recommended
010	in ou moy	2% sol., apple washer	0.073 nt 80-120°		P Bronze		Recommended
		3.6% sol., unaerated	0.036 at 140°	355, 371	Copper		Severe
		5% sol., unaerated	0.005 at 77°	359	Red Brass		Recontinended
		5% sol., acrated	0.083 at 86°	364	Silver	Aqueous sol.	Little or none
	- U.	10% sol., unscrated	0.416 at 165°	11-23		48% sol., C. P.	<0.001
		20% sol., unaerated	0.022 at 77°	365-368	Co Cr W	All conc.	Recom. at 70°
		25% sol., unaerated	0.15 at atm. temp.		Corrosion of	365-368 is more severe in v	rapor phase than in liquid when allo
329	Ni Cr Alloy	0.25, 1% sol.	Recom. at 70° & boil.			is partly immersed.	
		5% sol.	Recom. at 70°	370	Tantalum		Attacked
		15% sol.1	0.0144 at 77°				
	A LA CALENDARIA	37% sol.1	0.0108 at 77°	HVD	POCEN P	EROXIDE	ala al internation
330	Nickel	2% sol., apple washer	0.074 at 80-120°	ALLD	ROOLIN I	EROAIDE	
e i in		3.6% sol., unaerated	0.089 at 140°	2	Stainless	In absence of H ₂ SO ₄	<0.0042 at 70°
		5% sol., unaerated	6.012 at 77°	12 11 15		In absence of H ₂ SO ₄	0.0042-0.042 at boil.
		5% sol., acrated	0.052 at 86°	5-8	Stainless	Acid free	<0.001 at 70°
	M. C. Card	20% sol., unaerated	0.023 at 77°	9	Stainless		<0.004 at 70° & boil.
335	Ni Cr Steel Nickel Silver	3.3% sol.1	<0.004 at 68°	10-12,	15 Stainless	Acid free	<0.004 at 70°
001.000	MICKEI SHVEI	0.25-20% sol.	Recom. at 70° & boil. Recom. at 70°	19	Stainless	In absence of H2SO4	<0.0042 at 70°
343	Bronze	Conc. sol. 0.25% sol.	and the second proof of the second seco	500		In absence of H ₂ SO ₄	0.0042-0.042 at boil.
040	DIOLAR	1% sol:	Recom. at 70° & boil. Recom. at:70°:	20, 21,	25 Stainless	Acid free	<0.001 at 70°
346	Palladium	0.25-20% sol.	Recom. at 70% & boil.	104	Fe Ni Cu Cr		0.000 at 80?
010	1 minutum **	Conc. sol.	Recoin. at 70°	139.	High Si Mo In	on 5 Any cone.	Recom. to boiling
350 352	P. Bronze	0.25-20% sol.	Recom. at 70° & boil.	142	High Si Iron	Any conc.	Recom. to boiling
353	IT DIVING	Conc. sol.	Recom. at 70°	209		lo Cu Bleaching sol.	No loss at cold
	Platinum	0.25%-conc. sol.	Recom. at 70° & boil.		Al Bronze		Recommended
361	Rh Platinum		Same as 357	249	Cu Ni Zn		Recommended
363	Silver	0.25%-conc. sol.	Recom. at 70°	257	Admiralty		Severe
364	Silver	0.25%-conc. sol.	Recom. at 70° & Boil.		, Copper		Recommended
		15% sol., C. P.	0.012 at 77°	266, 277			
370	Tantalum	Any conc.	None at any temp.		, Bronzo		Severe
				315, 343			
IIVO	DOFLUOD	IC ACID			Cu Ni Alloy		Recommended
HIDI	ROFLUOR	IC ACID			Cu Si Ma		Recommended
2-25	Stainless		Attacked	300	Ni Cr Cu Mo	Fe	Recommended
104	Fe Ni Cu Cr		Rapid attack	311	Chem. Lead	Dilute sol.	Fair resist.; ordinary temp.
139	High Si Mo Ir	on	Not recommended	314	Te Lead	Dilute sol.	Fair resist.; ordinary temp.
142	High Si Iron		Not recommended	328	Naval Brass		Recommended
176	Fe Ni Cu Cr	10% sol.	0.001 at 60°	337, 338	Nickel Silver		Recommended
209	Fe Ni Cr Si M	o Cu 0.5% in 4% H_PO4	0.001 at cold		P Bronze		Recommended
		0.5% in 4% H3PO4	0.055 at 176°	355, 371	Copper		Severe
213	Aluminum	0.1% sol.	0.7 at room temp.	359	Red Brass		Recommended
		1% sol.	1.6 at room temp.	370	-Tautalum	He and the second	None at any temp.
		10% sol.	8.3 at room temp.	373	Tobin Bronze		Recommended
	Al Alloys	All Al alloys expected to be		1			
	Al Bronze		Recommended	IODI	NE		
249	Cu Ni Zn		Recommended		The state of the		
257	Admiralty		Severe	2-8	Stainless		>0.42 at 70°
	Copper		Recommended	9	Stainless		0.12-0.42 at 70°
266, 277			-	10-25	Stainless		>0.42 at 70°
272, 273			Severe	139	High Si Mo I	on	Not recommended
315, 343				142	High Si Iron		Not recommended
344, 372			D 11		Al Bronze	Perfectly dry	Recommended
	Cu Ni Alloy		Recommended	249	Cu Ni Zn	Perfectly dry *	Recommended
	Cu Si Mn	111	Recommended	257	Admiralty	111120-1-19	Severe
the second se	Ni Mo Fe	All conc.	Recom. at 70°	and the second se	Copper	Perfectly dry	Recommended
292	Ni Cr Fe W	All conc.	Recom, at all temp.	266, 277			CARSEN TRUE STATE OF THE
293	Ni Si Cu	All conc.	Recom. at 70°		Bronze		Severe
		nimersed.	sapor phase than in liquid when alloy	315, 343			
300	and the second s	Fe Anhydrous	<0.004 at 70°	344, 372		D C d A	
000	NI CI CU NIO		<0.004 at 70° f 98% H ₂ SO ₄ <0.004 at 70°		Cu Ni Alloy	Perfectly dry	Recommended
5		Anhydrous + 570% by vol. 0	of 98% H ₂ SO ₄ <0.004 at 70°		Cu Si Mn	Perfectly dry	Recommended
		Anhydrous + 770/ by vol.	of 98% H ₂ SO ₄ <0.004 at 70° of 98% H ₂ SO ₄ <0.004 at 70°	292	Ni Cr Fe W	All conc.	Recom. at all temp.
				300		Fe Evaporating H ₂ O sol.	Not recom. at boil.
302	Ni Cr Fe	5% sol. 6% sol., pickling tank	<0.004 at 70°	308	Sb Lead		Not recommended
004	TH OF FC		0.063 at 170°	311	Chem. Lead		Not recommended
		10% sol., pickling tank	<0.001 at 50-70°	314	Te Lead	POINT OF THE POINT	Not recommended
311	Chem Lord	98% sol., unacrated	0.002 at 100°	316	Ni Cu Alloy	5% U. S. P. tinc. in H ₂ O	0.037 at atm. temp.
314	Chem. Lead Te Lead	Dil. sol.	Fair resist.; ordinary temp.			5% U. S. P. tine. in H ₂ O	0.035 at 140°
314		Dil. sol.	Fair resist.; ordinary temp.		Nickel-Silver	Perfectly dry	Recommended
010	Ni Cu Alloy	<50% sol., unaerated	<0.001 at 86°		P Bronze	Perfectly dry	Recommended
		6% sol., pickling tank	0.001 at 170°	355,371	Copper		Severe
		25% sol., sat. with air	0.037 at 86°	359	Red Brass	Perfectly dry	Recommended

	Material	Exposure Conditions	Corrosion (Inches per Year (@	Deg. F.)	No.	Material	Exposure Condi	itions Corrosion (Inches per Year @ Deg. F.)
365-368	Co Cr W	All cone,	Recom. at all temp.		104	Fe Ni Cu Cr	al service	Suitable
370	Tantalum		None at any temp.		129	High Si Iron	25% sol., quiet	<0.001 at room temp:
			o.		139	High Si Mo I	ron	Consult mfgr.
LACI	FIC ACID				142	High Si Iron		Not recommended
					187	Steel	1% sol.1	0.0021 at 68°
			70° 150°	Boil.	189	Steel	1% sol.1	0.0022 at 68°
2	Stainless	1% sol.	<0.004	< 0.004	190	Ni-Steel	1% sol.1	0.0021 at 68°
		5% sol.		0.004-0.04	209	Fe Ni Cr Si M	10 Cu 40% sol.	0.0029 nt 274°
		10% sol.	<0.004 0.04-0.12	0.12-0.42	0		35% (6% H2O); pH	
		Conc. sol.	<0.004	0.042-0.12		All Bronze	- ar - Million	Recommended
5-8	Stainless	5% sol.	<0.004	au court	249	Cu Ni Zu		Recommended
9	Stainless	1% sol.	<0.004	<0.004	257	Admiralty		Slight to moderate
		5% sol.	<0.004 <0.004	< 0.004	266, 277	2, Copper		Recommended
		10% sol.		0.004-0.01	1	, Bronze	the same of L	011 14 4
10.11	Chalalan	Conc. sol.	<0.004	0.004-0.04	315, 343		THE TRACE IN LA	Slight to moderate
10, 11	Stainless Stainless		<0.004		344, 372			faite standa (the standard of the standard
12, 13	Stainless	107 and	<0.1	0.001.0.01		Cu Ni Alloy		Recommended
10	ounness	1% sol.	<0.004	0.004-0.04		Cu Si Mn		Recommended
		5% sol. 10% sol.	0.004-0.04 0.004-0.04	0.004-0.04		Ni Mo Fe	All conc.	Recon, at all temp;
20	Stainless	10% sol. ¹	<0.004	>0.4	292	Ni Cr Fo W	All conc.	Recon. at all temp.
20	estannesa	Conc. sol.1		<0.005	293	Ni Si Cu	All conc.	Recom, at all temp.
21	Stainless	10^{or}_{i0} sol. ³	<0.005 <0.05	<0.005	302	Ni Cr Fe	42%, acrated, refluxed	· · · · · · · · · · · · · · · · · · ·
	Pranificas	Conc. sol. ¹		<0.05	002	in or re	42%, acrated, renuxed	0.005 at 330°
25	Stainless	10% sol.	<0.05 <0.04	<0.5	305	Sb Lead	1070, uncatated	Not recommended
129	High Si Iron		<0.04 <0.001 at room temp.		311	Chem. Lead	1940 100 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Not recommended
129	_	ron Any conc.	Recom. to bailing		314	Te Lead	Store the owner and	Not recommended
139	High Si Iron				314	Ni Cu Alloy	5% sol., aerated	<0.001 at 60°
142		Any conc. 10-25% sol.	Recom. to boiling 0.67 at 130°		010	ALCU MILLY	42% acrated, refluxed	
209	Fe Ni Cr Si M		<0.001 at cold				42% sol., unaerated	<0.001 at 275°
	Al Bronze	10 Cu	Recommended		6.000		48% sol., unaerated	0.006 at 330°
249, 247	Cu Ni Zn		Recommended		330	Nickel	42%, aerated, refluxed	
257	Admiralty		Slight to moderate		0.50	THORE	48%, unaerated	0.004 at 330°
259, 262,			Recommended		335 336	Cr Ni Steel	10-30% sol.1	0.004 at 68°
266, 277	Copper		recontiniended			Nickel Silver	10 00 /0 301.	Recommended
265	Ni Cr Alloy	25% sol.1	0.0058 at 67°			P Bronze		Recommended
272, 273,		20 78 301.	Slight to moderate			Copper		Slight to moderate
315, 343,	DIDILL		Dulline to moderate		359	Red Brass		Recommended
344, 372				34.4	364	Silver	In dyestuff plant	No attack
	Cu Ni Alloy		Recommended		370	Tantalum	an ajtoran plane	None at any temp.
	Cu Si Mn		Recommended					
	Ni Mo Fe	All conc.	Recom. at all temp.	and and				
292	Ni Cr Fe W	All cone.	Recom, at all temp,					
293	Ni Si Cu	All conc.			METH	HANOL		- CHARLE PATOLOGI STATION /
293 300	Ni Si Cu Ni Cr Cu Mo	All conc. Fe 10% sol.	Recom. at all temp.		METH	HANOL		arpy course where
293 300 302	Ni Si Cu Ni Cr Cu Mo Ni Cr Fe	Fe 10% sol.	Recom. at all temp. <0.004 at 70-160°		METH 2	HANOL Stainless		<0.0042 at 70°
300	Ni Cr Cu Mo	Fe 10% sol. Cone. 5% to 48% in evapor	Recom. at all temp. <0.004 at 70-160° ator 0.004 under vacuum		2	Stainless		<0.0042 at 70° 0.042-0.12 at 150°2
300	Ni Cr Cu Mo	Fe 10% sol.	Recom. at all temp. <0.004 at 70-160° ator 0.004 under vacuum		2 5-8	Stainless Stainless		<0.0042 at 70° 0.042-0.12 at 150° <0.004 at 70°
300	Ni Cr Cu Mo Ni Cr Fe	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated	Recom. at all temp. <0.004 at 70-160° ator 0.004 under vacuum prator 0.008 at 130° <0.001 at atm. temp. <0.001 at atm. temp.		2	Stainless		$<0.0042 \text{ at } 70^{\circ}$ $0.042-0.12 \text{ at } 150^{\circ}$ $<0.004 \text{ at } 70^{\circ}$ $<0.0042 \text{ at } 70^{\circ}$
300	Ni Cr Cu Mo Ni Cr Fe	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated	Recom. at all temp. <0.004 at 70-160° ator 0.004 under vacuum prator 0.008 at 130° <0.001 at atm. temp. <0.001 at atm. temp.		2 5-8 9	Stainless Stainless Stainless		
300 302	Ni Cr Cu Mo	Fe 10% sol. Conc. 5% to 48% in evapor Conc. 10% to 22% in evapor 45% sol., acrated	Recom. at all temp. <0.004 at 70-160 ³ ator 0.004 under vacuum orator 0.005 at 130 ³ <0.001 at atm. temp.		2 5-8 9 10, 11	Stainless Stainless Stainless Stainless	a coloria e coloria contantanta contantanta contantanta contantanta contantanta contantantanta contantantantanta contantantantanta contantantantanta contantantantanta contantantantanta contantantantantantantantantantantantantan	
300 302	Ni Cr Cu Mo Ni Cr Fe	Fe 10% sol. Conc. 5% to 48% in evapor Conc. 10% to 22% in evapor 45% sol., acrated 45% sol., unacrated Conc. 5% to 48% in evapor	Recom. at all temp. <0.004 at 70-160 ³ ator 0.004 under vacuum orator 0.005 at 130 ³ <0.001 at atm. temp.		2 5-8 9 10, 11 12, 15,	Stainless Stainless Stainless Stainless 18 Stainless		
300 302	Ni Cr Cu Mo Ni Cr Fe	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unaerated	Recom. at all temp. <0.004 at $70-160^{\circ}$ ator 0.004 under vacuum yrator 0.008 at 130° <0.001 at atm. temp. <0.005 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp.		2 5-8 9 10, 11	Stainless Stainless Stainless Stainless		
300 302 316	Ni Cr Cu Mo Ni Cr Fe	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unaerated Cone. 5% to 48% in evapor	Recom. at all temp. <0.004 at 70–160 ³ ator 0.004 under vacuum orator 0.008 at 130 ⁹ <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ³ 0.020 at atm. temp. 0.008 at atm. temp. ator 0.005 under vacuum ator 0.005 under vacuum		2 5-8 9 10, 11 12, 15, 19	Stainless Stainless Stainless Stainless 18 Stainless Stainless	na faith an thain an an thain an an thain an tha	
300 302 316	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy	Fe 10% sol. Conc. 5% to 48% in evapor Conc. 10% to 22% in evapor 45% sol., acrated 45% sol., unacrated Conc. 5% to 48% in evapor Conc. 10% to 22% in evapor 45% sol., acrated 45% sol., unacrated Conc. 5% to 48% in evapor Conc. 10% to 22% in evapor	Recom. at all temp. <0.004 at 70–160 ³ ator 0.004 under vacuum orator 0.008 at 130 ⁹ <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ³ 0.020 at atm. temp. 0.008 at atm. temp. ator 0.005 under vacuum ator 0.005 under vacuum		2 5-8 9 10, 11 12, 15, 19 20, 21, 2	Stainless Stainless Stainless Stainless 18 Stainless Stainless 25 Stainless		
300 302 316	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., aerated	Recom. at all temp. <0.004 at 70–160 ³ ator 0.004 under vacuum orator 0.008 at 130 ⁹ <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ³ 0.020 at atm. temp. 0.008 at atm. temp. ator 0.005 under vacuum ator 0.005 under vacuum		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104	Stainless Stainless Stainless Stainless 18 Stainless Stainless 25 Stainless Fe Ni Cu Cr		<0.0042 at 70° 0.042-0.12 at 150° ³ <0.004 at 70° <0.0042 at 70° 0.0042-0.042 at 150° <0.004 at 70° <0.004 at 70° <0.004 at 70° <0.0042 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack
300 302 316 330	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor 45% sol., unaerated 45% sol., aerated 45% sol., unaerated	Recom. at all temp. <0.004 at 70-160 ³ ator 0.004 under vacuum orator 0.008 at 130 ³ <0.001 at atm. temp. <0.001 at atm. temp. alor 0.006 under vacuum wator 0.056 at 130 ³ 0.020 at atm. temp. 0.005 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ⁹ 0.021 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp.		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro		
300 302 316 330	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., unaerated 45% sol., unaerated 45% sol., aerated 45% sol., aerated 45% sol., unaerated 45% sol., unaerated 1.5% sol. ¹	Recom. at all temp. $<0.004 \text{ at } 70-160^3$ ator 0.004 under vacuum rator 0.008 at 130^3 <0.001 at atm. temp. ator 0.006 under vacuum rator 0.006 under vacuum rator 0.005 at 130^3 0.020 at atm. temp. 0.008 at atm. temp. ator 0.051 under vacuum rator 0.051 under vacuum rator 0.051 under vacuum rator 0.051 at 130° 0.021 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp. 0.003 at atm. temp. 0.004 at 67°		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142	Stainless Stainless Stainless Stainless IS Stainless Stainless Fe Ni Cu Cr High Si Mo Iro High Si Iron	Any conc.	<0.0042 at 70° 0.042-0.12 at 150°2' <0.004 at 70° <0.0042 at 70° 0.0042-0.042 at 150° <0.004 at 70° <0.004 at 70° <0.004 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack Recom. to boiling Recom. to boiling
300 302 316 330	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., acrated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unacrated Cone. 5% to 48% in evapor 45% sol., acrated 45% sol., acrated 45% sol., unacrated 1.5% sol. ¹	Recom. at all temp. <0.004 at 70–160 ³ ator 0.004 under vacuum orator 0.008 at 130 ⁹ <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ⁹ 0.020 at atm. temp. 0.002 at atm. temp. ator 0.051 at 130 ⁹ 0.021 at atm. temp. <0.003 at atm. temp. <0.003 at atm. temp. <0.003 at atm. temp. <0.003 at atm. temp. <0.004 at 67 ⁹		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161	Stainless Stainless Stainless IS Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro High Si Iron Cr Steel	Any conc. 100%	<0.0042 at 70° 0.042-0.12 at 150°3 <0.004 at 70° <0.0042 at 70° 0.0042 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack Recom. to boiling Recom. to boiling <0.001 at 70°
300 302 316 330 330	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., unaerated 45% sol., unaerated 45% sol., aerated 45% sol., aerated 45% sol., unaerated 45% sol., unaerated 1.5% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp. <0.004 at 67 ² <0.040 at 194 ²		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Iron Cr Steel Fe Ni Cu Cr	Any cone. 100% Crude	<0.0042 at 70° 0.042-0.12 at 150° <0.004 at 70° <0.0042 at 70° 0.0042 at 70° <0.004 at 70° <0.004 at 70° <0.004 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack Recom. to boiling Recom. to boiling <0.001 at 70° 0.004 at 160°
300 302 316 330 336 337, 335	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., acrated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unacrated Cone. 5% to 48% in evapor 45% sol., acrated 45% sol., acrated 45% sol., unacrated 1.5% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. alor 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.004 at 67 ² <0.004 at 194 ⁹ Recommended		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Irr High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr	Any cone. 100% Crude Io Cu Commercial	<0.0042 at 70° 0.042-0.12 at 150° ³ <0.004 at 70° <0.0042 at 70° 0.0042-0.042 at 150° <0.004 at 70° <0.004 at 70° <0.0042 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack Recom. to boiling Recom. to boiling Recom. to boiling No attack No 01 at 70° 0.004 at 160° No loss at cold
300 302 316 330 336 337, 338 350–353	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., acrated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unacrated Cone. 5% to 48% in evapor 45% sol., acrated 45% sol., acrated 45% sol., unacrated 1.5% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.005 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. alor 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. 0.008 at atm. temp. 0.004 at 67 ² <0.004 at 194 ⁹ Recommended Recommended		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr Steel Stainless All Cu—Base -	Any cone. 100% Crude Io Cu Commercia\ Alloys	
300 302 316 330 336 337, 338 350-353 355, 371	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., acrated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., acrated 45% sol., unacrated Cone. 5% to 48% in evapor 45% sol., acrated 45% sol., acrated 45% sol., unacrated 1.5% sol. ¹	Recom. at all temp. <0.004 at 70–160 ³ ator 0.004 under vacuum orator 0.008 at 130 ³ <0.001 at atm. temp. <0.001 at atm. temp. alor 0.006 under vacuum wator 0.056 at 130 ³ 0.020 at atm. temp. 0.008 at atm. temp. 0.003 at atm. temp. 0.004 at 67 ³ <0.004 at 67 ² <0.004 at 194 ⁹ Recommended Slight to moderate		2 5-8 9 10, 11 12, 15, 19 20, 21, 5 104 139 142 161 176 209 213	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Fe Ni Cu Cr High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cr. Si M All Cu—Base - Aluminum	Any conc. 100% Crude to Cu Commercial Alloys Exposed 3 mo.	
300 302 316 330 336 337, 338 350–353 355, 371 359	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., aerated 1.5% sol. ¹ 10% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.004 at 67 ² <0.004 at 67 ² <0.004 at 194 ⁹ Recommended Recommended Recommended Recommended		2 5-8 9 10, 11 12, 15, 19 20, 21, 5 104 139 142 161 176 209 213 290, 291	Stainless Stainless Stainless IS Stainless Stainless Stainless Fe Ni Cu Cr High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr Steel Fe Ni Cu Cr Fe Si Cr. Si M All Cu—Base Aluminum Ni Mo Fe	Any cone. 100% Crude Io Cu Commercial Alloys Exposed 3 mo. All cone.	
300 302 316 330 336 337, 338 350, 353 355, 371 359 364	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 5% sol., aerated 1.5% sol. ¹ 10% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp. <0.004 at 67 ² <0.040 at 194 ² Recommended Recommended Bight to moderate Recommended 0.010 at boiling		2 5-8 9 10, 11 12, 15, 19 20, 21, 5 104 139 142 161 176 209 213 200, 291 292	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr Fe Ni Cu Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Steel Steel Fe Ni Cu Cr Steel Fe Ni Cu Cr Steel Stee	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 mo. All cone.	
300 302 316 330 336 337, 338 350, 353 355, 371 359 364	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., aerated 1.5% sol. ¹ 10% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.004 at 67 ² <0.004 at 67 ² <0.004 at 194 ⁹ Recommended Recommended Recommended Recommended		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 290, 291 292 233	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Es Ni Cu Cr High Si Mo Irr High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cr. Si M All Cu—Base - Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 uno. All cone. All cone. All cone.	<0.0042 at 70° 0.042-0.12 at 150° <0.004 at 70° <0.0042 at 70° 0.0042 at 70° <0.0042 at 70° <0.004 at 70° <0.004 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack Recom. to boiling Recom. to boiling Recom. to boiling <0.001 at 70° 0.004 at 160° No loss at cold Recommended No attack Recom, at all temp. Recom, at all temp. Recom, at all temp.
300 302 316 330 336 337, 338 350, 353 355, 371 359 364	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 5% sol., aerated 1.5% sol. ¹ 10% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp. <0.004 at 67 ² <0.040 at 194 ² Recommended Recommended Bight to moderate Recommended 0.010 at boiling		2 5-8 9 10, 11 12, 15, 19 20, 21, 1 104 139 142 161 176 209 213 290, 291 292 233 365–368	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Es Ni Cu Cr High Si Mo Ire High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Stainless Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 mo. All cone.	$< 0.0042 \text{ at } 70^\circ$ $0.042-0.12 \text{ at } 150^{\circ 1}$ $< 0.004 \text{ at } 70^\circ$ $< 0.0042 \text{ at } 70^\circ$ $0.0042-0.042 \text{ at } 150^\circ$ $< 0.004 \text{ at } 70^\circ$ $< 0.004 \text{ at } 70^\circ$ $< 0.0042 \text{ at } 70^\circ$ $< 0.0042 \text{ at } 70^\circ$ $< 0.0042 \text{ at } 70^\circ$ $< 0.004 \text{ at } 160^\circ$ No loss at cold Recommended No attack Recom, at all temp.
300 302 316 330 336 337, 335 350, 353 355, 371 359 364 365–368	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 50% by vol. All cone.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp. <0.004 at 67 ² <0.040 at 194 ² Recommended Recommended Bight to moderate Recommended 0.010 at boiling		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 290, 291 292 233	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Es Ni Cu Cr High Si Mo Irr High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cr. Si M All Cu—Base - Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 uno. All cone. All cone. All cone.	<0.0042 at 70° 0.042-0.12 at 150° <0.004 at 70° <0.0042 at 70° 0.0042 at 70° <0.0042 at 70° <0.004 at 70° <0.004 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack Recom. to boiling Recom. to boiling Recom. to boiling <0.001 at 70° 0.004 at 160° No loss at cold Recommended No attack Recom, at all temp. Recom, at all temp. Recom, at all temp.
300 302 316 330 336 337, 338 350, 353 355, 371 355 359 364 365–368	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 5% sol., aerated 1.5% sol. ¹ 10% sol. ¹	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp. <0.004 at 67 ² <0.040 at 194 ² Recommended Recommended Bight to moderate Recommended 0.010 at boiling		2 5-8 9 10, 11 12, 15, 19 20, 21, 1 104 139 142 161 176 209 213 290, 291 292 233 365–368	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Es Ni Cu Cr High Si Mo Ire High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Stainless Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 uno. All cone. All cone. All cone.	<0.0042 at 70° $0.042-0.12$ at 150° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 160° No loss at cold Recommended No attack Recom, at all temp.
300 302 316 330 336 337, 338 350, 353 355, 371 359 364 365–368	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 50% by vol. All cone.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp. <0.004 at 67 ² <0.040 at 194 ² Recommended Recommended Bight to moderate Recommended 0.010 at boiling		2 5-8 9 10, 11 12, 15, 19 20, 21, 1 104 139 142 161 176 209 213 290, 291 292 233 365–368	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Es Ni Cu Cr High Si Mo Ire High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Stainless Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 uno. All cone. All cone. All cone.	<0.0042 at 70° $0.042-0.12$ at 150° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 160° No loss at cold Recommended No attack Recom, at all temp.
300 302 316 330 336 337, 338 355, 371 359 364 365–368 MAGI	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol. ¹ 16% sol. ¹ 16% sol. ² 50% by vol. All cone.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum orator 0.005 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum orator 0.056 at 130 ² 0.020 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.004 at 67 ² <0.004 at 67 ² <0.004 at 67 ² <0.004 at 194 ⁹ Recommended Slight to moderate Recommended Slight to moderate Slight to moderate		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 290, 291 292 233 365-368 370	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Es Stainless Fe Ni Cu Cr High Si Mo Ire High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cr. Si M All Cu—Base - Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 uno. All cone. All cone. All cone. All cone. All cone.	<0.0042 at 70° $0.042-0.12$ at 150° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 160° No loss at cold Recommended No attack Recom, at all temp.
300 302 316 330 336 337, 338 350-353 355, 371 359 364 365-368 MAGI	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 50% by vol. All cone. CHLORIDE 1, 5% sol., quict	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 ander vacuum mator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum mator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. 0.008 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.004 at 67 ² <0.040 at 194 ⁹ Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0042 at 70^{24}		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 290, 291 292 233 365-368 370	Stainless Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Es Ni Cu Cr High Si Mo Ire High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Stainless Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 uno. All cone. All cone. All cone. All cone. All cone.	<0.0042 at 70° $0.042-0.12$ at 150° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 160° No loss at cold Recommended No attack Recom, at all temp.
300 302 316 330 336 337, 338 355, 371 359 364 365–368 MAGI	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., aerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 56% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 1.5% sol. ¹ 10% sol. ¹ 50% by vol. All cone. CHLORIDE 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol., quiet	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum rator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.004 at 67 ² <0.004 at 67 ² <0.004 at 67 ² <0.004 at 194 ⁹ Recommended Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0042 at 70 ²² 0.042-0.12 at hot ²		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 290, 291 292 233 365-368 370	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Es Stainless Fe Ni Cu Cr High Si Mo Ire High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cr. Si M All Cu—Base - Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 uno. All cone. All cone. All cone. All cone. All cone.	<0.0042 at 70° $0.042-0.12$ at $150^{\circ}i^{\circ}$ <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 160° No attack Recom. to boiling Recom. to boiling Recom. to boiling <0.001 at 160° No loss at cold Recom. at all temp. Recom. at all temp. Recom. at all temp. Recom. at all temp. None at any temp.
300 302 316 330 336 337, 338 355, 371 364 365–368 MACI 2	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., unaerated 45% sol., unaerated 45% sol., unaerated 1.5% sol., aeruted 45% sol., aeruted 45% sol., unaerated 1.5% sol., unaerated 1.5% sol., quiet 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol., autor Sol.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum rator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ⁹ 0.021 at atm. temp. ator 0.005 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp. <0.008 at atm. temp. <0.004 at 67 ² <0.040 at 194 ⁹ Recommended Recommended Recommended Recommended 0.010 at boiling Recom. at all temp. <0.0042 at 70 ⁹² 0.042-0.12 at hot ² <0.0044 at 08 ⁹³		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 290, 291 292 233 365-368 370	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Es Stainless Fe Ni Cu Cr High Si Mo Ire High Si Iron Cr Steel Fe Ni Cu Cr Fe Ni Cr. Si M All Cu—Base - Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 mo. All cone. All cone. All cone. All cone.	<0.0042 at 70° $0.042-0.12$ at $150^{\circ}i^{\circ}$ <0.004 at 70° <0.0042 at 70° <0.0042 at 70° <0.004 at 160° No attack Recom. to boiling Recom. to boiling Recom. to boiling <0.001 at 160° No loss at cold Recom. at all temp. Recom. at all temp. Recom. at all temp. Recom. at all temp. None at any temp.
300 302 316 330 336 337, 338 355, 371 359 364 365–368 MAGI	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W VESIUM Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 50% by vol. All coue. CHLORIDE 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130° <0.001 at atm. temp. <0.001 at atm. temp. ator 0.056 at 130° 0.020 at atm. temp. ator 0.056 at 130° 0.005 under vacuum rator 0.051 under vacuum rator 0.051 under vacuum rator 0.051 at 130° 0.021 at atm. temp. 0.005 at atm. temp. 0.008 at atm. temp. 0.008 at atm. temp. 0.004 at 67° <0.040 at 67° <0.040 at 194° Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0042 at 70° ² 0.042-0.12 at hot ² <0.0044 at 08° ³ <0.0044 at 70° ²		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 mo. All cone. All cone. All cone. All cone. All cone. HasO4, % HNO4.	<0.0042 at 70° 0.042-0.12 at $150^{\circ 2}$ <0.004 at 70° 0.0042 at 70° 0.0042 at 70° <0.004 at 70° <0.004 at 70° 0.042-0.12 at 150° <0.004 at 70° 0.042-0.12 at 150° <0.004 at 70° No attack Recom. to boiling <0.001 at 70° 0.004 at 160° No loss at cold Recommended No loss at cold Recom. at all temp. Recom. at all temp. Recom. at all temp. None at any temp.
300 302 316 330 336 337, 338 355, 371 359 364 365–368 MAGI 2 2	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W NESIUM Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 10% sol. ¹ 50% by vol. All cone. CHLORIDE 1, 5% sol., quiet 1, 5% sol., action to the solution of the soluti	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130° <0.001 at atm. temp. <0.001 at atm. temp. ator 0.056 at 130° 0.020 at atm. temp. ator 0.056 at 130° 0.005 at atm. temp. ator 0.051 at 130° 0.021 at atm. temp. 0.005 at atm. temp. 0.005 at atm. temp. 0.005 at atm. temp. 0.004 at 67° <0.004 at 80° Recommended Recommended Recommended 0.010 at boiling Recom. at all temp. <0.0042 at 70° ² <0.0044 at 08° ² <0.0044 at 08° ² <0.004 at 70° ²		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercis! Alloys Exposed 3 mo. All cone. All cone. All cone. All cone. All cone. All cone. All cone. All cone. All cone. All cone. 5 5	<0.0042 at 70° 0.042-0.12 at 150° ³ <0.004 at 70° 0.0042 at 70° 0.0042 at 70° 0.0042 at 70° 0.004 at 70° 0.004 at 70° 0.042-0.12 at 150° 0.004 at 70° 0.042-0.12 at 150° 0.004 at 70° 0.004 at 70° 0.004 at 70° 0.004 at 160° No loss at cold Recom. to boiling C.001 at 70° 0.004 at 160° No loss at cold Recom. at all temp. Recom. at all temp. Recom. at all temp. Recom. at all temp. None at any temp.
300 302 316 330 336 337, 338 350-353 355, 371 359 364 365-368 MAGI 2 5 6-8	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W VESIUM Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 50% by vol. All cone. CHLORIDE 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol. Sat. sol. Sat. sol. Sat. sol.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 ander vacuum mator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum mator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.004 at 67 ² <0.040 at 194 ⁹ Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0044 at 05^{23} <0.0044 at 05^{23} <0.0044 at 05^{23} <0.004 at 70^{22} <0.004 at 70^{23}		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude Io Cu Commercial Alloys Exposed 3 mo. All cone. All cone. All cone. All cone. HaSO4, % HNO4. 15 5 30 5	$ \begin{array}{l} < 0.0042 \mbox{ at } 70^{\circ} \\ 0.042 \mbox{ -} 0.12 \mbox{ at } 150^{\circ 2} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.0042 \mbox{ at } 70^{\circ} \\ < 0.0041 \mbox{ at } 70^{\circ} \\ < 0.0041 \mbox{ at } 70^{\circ} \\ < 0.0042 \mbox{ at } 70^{\circ} \\ < 0.0041 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ at tack} \\ Recom. to \mbox{ boiling} \\ Recom. to \mbox{ boiling} \\ < 0.001 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ attack} \\ Recom. at \mbox{ at all temp.} \\ Recom. at \mbox{ all temp.} \\ Recom. at \mbox{ at all temp.} \\ None \mbox{ at any temp.} \\ None \mbox{ at any temp.} \\ \end{array} $
300 302 316 330 336 337, 338 350-353 355, 371 359 364 305-308 MAGI 2 5	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W NESIUM Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 50% by vol. All cone. CHLORIDE 1, 5% sol. quiet 1, 5% sol. quiet 10-30% sol. ¹ Sat. sol. Sat. sol. 1, 5% sol., quiet	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. <0.001 at atm. temp. ator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ⁹ 0.021 at atm. temp. 0.008 at atm. temp. 0.004 at 67 ² <0.004 at 67 ² <0.004 at 67 ² <0.004 at 194 ⁹ Recommended Recommended 0.010 at boiling Recommended 0.010 at boiling Recom. at all temp. <0.0042 at 70 ²² <0.004 at 70 ²³ <0.004 at 70 ²³ <0.004 at 70 ²² <0.0042 at 70 ²		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude Io Cu Commercial Miloys Exposed 3 mo. All cone. All cone. All cone. All cone. All cone. All cone. All cone. Solution for the second seco	$ \begin{array}{c} < 0.0042 \text{ at } 70^{\circ} \\ 0.042 - 0.12 \text{ at } 150^{\circ 2} \\ < 0.004 \text{ at } 70^{\circ} \\ < 0.0042 \text{ at } 70^{\circ} \\ 0.0042 \text{ at } 70^{\circ} \\ < 0.004 \text{ at } 160^{\circ} \\ \text{No attack} \\ \text{Recom. to boiling} \\ < 0.001 \text{ at } 160^{\circ} \\ \text{No less at cold} \\ \text{Recom. at all temp.} \\ \text{None at any temp.} \\ \text{None at any temp.} \\ \end{array} $
300 302 316 330 336 337, 338 350-353 355, 371 359 364 365-368 MAGI 2 5 6-S	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W VESIUM Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Alf% sol., aerated 45% sol., unaerated 1.5% sol., aerated 45% sol., unaerated 1.5% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 45% sol., aerated 1.5% sol., aerated 1.5% sol., quiet 1.5% sol., quiet	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum rator 0.056 at 130 ² 0.020 at atm. temp. ator 0.051 under vacuum rator 0.051 under vacuum rator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. <0.004 at 67 ² <0.004 at 67 ² <0.040 at 194 ² Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0044 at 68 ²³ <0.0044 at 70 ²² <0.0044 at 70 ²³ <0.0044 at 70 ²³ <0.0044 at 70 ²³ <0.0044 at 70 ²³ <0.0044 at 70 ² <0.00442 at 70 ⁹ <0.0042 at 70 ⁹ <0.0042 at 70 ⁹ <0.0042 at 70 ⁹		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 mo. All cone. All cone. All cone. All cone. All cone. H ₃ SO ₄ % HNO ₄ , 15 5 30 5 30 5 58 40	$ \begin{array}{l} < 0.0042 \ at 70^{\circ} \\ 0.042 - 0.12 \ at 150^{\circ 2} \\ < 0.004 \ at 70^{\circ} \\ < 0.0042 \ at 70^{\circ} \\ 0.0042 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.0042 \ at 70^{\circ} \\ < 0.0042 \ at 70^{\circ} \\ < 0.0042 \ at 70^{\circ} \\ < 0.004 \ at 160^{\circ} \\ \\ No \ attack \\ Recom. to boiling \\ Recom. to boiling \\ < 0.001 \ at 70^{\circ} \\ < 0.004 \ at 160^{\circ} \\ \\ No \ attack \\ Recom, at all \ temp. \\ None \ at any \ temp. \\ \\ \end{array} $
300 302 316 330 336 337, 338 355, 371 359 364 365–368 MAGI 2 5 6–8 9	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W NESIUM Stainless Stainless Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol., aerated 45% sol., unaerated 1.5% sol., aerated 45% sol., aerated 45% sol., unaerated 1.5% sol., aerated 45% sol., aerat	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130° <0.001 at atm. temp. <0.001 at atm. temp. ator 0.056 at 130° 0.020 at atm. temp. ator 0.056 at 130° 0.005 under vacuum rator 0.051 at 130° 0.021 at atm. temp. 0.005 at atm. temp. 0.005 at atm. temp. 0.005 at atm. temp. 0.004 at 67° <0.004 at 67° <0.004 at 67° <0.004 at 67° <0.040 at 194° Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0044 at 00^{23} <0.0044 at 00^{23} <0.0044 at 00^{23} <0.0044 at 00^{23} <0.004 at 70^{23} <0.004 at 70^{23} <0.004 at 70^{23} <0.004 at 70^{23} <0.004 at 70^{2} <0.0044 at 70^{2}		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercia\ Alloys Exposed 3 mo. All cone. All cone. All cone. All cone. All cone. All cone. All cone. Solution 5 30 5 3	$ \begin{array}{c} < 0.0042 \mbox{ at } 70^{\circ} \\ 0.042 - 0.12 \mbox{ at } 150^{\circ 2} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.0042 \mbox{ at } 70^{\circ} \\ < 0.0042 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.0042 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ at at } bolding \\ Recom. to \mbox{ bolding} \\ Recom. to \mbox{ bolding} \\ Recom. to \mbox{ bolding} \\ < 0.001 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ at ack} \\ Recom. to \mbox{ bolding} \\ Recom. at \mbox{ all temp}. \\ Rccom. at \mbox{ all temp}. \\ Rccom. at \mbox{ all temp}. \\ Recom. at \mbox{ all temp}. \\ None \mbox{ at any temp}. \\ None \mbox{ at any temp}. \\ \end{array} $
300 302 316 330 336 337, 338 350-353 355, 371 359 364 365-368 MAGI 2 5 6-S 9 10, 11	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W NESIUM Stainless Stainless Stainless Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., unaerated 45% sol., unaerated 45% sol., unaerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 10% sol. ² 50% by vol. All cone. CHLORIDE 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol. quiet 1, 5% sol., quiet 50% sol. Sat. sol. Sat. sol. Sat. sol.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 ander vacuum mator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum mator 0.056 at 130 ² 0.020 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.004 at 67 ² <0.004 at 194 ⁹ Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0044 at 05^{23} <0.0044 at 05^{23} <0.004 at 70^{23} <0.0044 at 70^{23} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0044 at 70^{2}		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercial Alloys Exposed 3 mo. All cone. All cone. A	$ \begin{array}{c} < 0.0042 \mbox{ at } 70^{\circ} \\ 0.042 - 0.12 \mbox{ at } 150^{\circ 2} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.0042 \mbox{ at } 70^{\circ} \\ 0.0042 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ at tack} \\ Recom. \mbox{ to boiling} \\ < 0.001 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ at tack} \\ Recom, \mbox{ at all \mbox{ temp.}} \\ None \mbox{ at any \mbox{ temp.}} \\ None \mbox{ at any \mbox{ temp.}} \\ < 0.0044 \mbox{ at } 200^{\circ 1} \\ < 0.0044 \mbox{ at } 140^{\circ 1} \\ < 0.0044 \mbox{ at } 140^{\circ} \\ > 0.131 \mbox{ at } 200^{\circ 1} \\ < 0.0044 \mbox{ at } 140^{\circ} \end{array} $
300 302 316 330 336 337, 338 350-353 355, 371 359 364 365-368 MAGI 2 5 6-S 9 10, 11	Ni Cr Cu Mo Ni Cr Fø Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W NESIUM Stainless Stainless Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 10% to 48% in evapor Cone. 10% to 48% in evapor 45% sol., aerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 10% sol. ¹ 50% by vol. All cone. CHLORIDE 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol. Sat. sol. S% sol.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 under vacuum prator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum rator 0.056 at 130 ² 0.020 at atm. temp. ator 0.005 under vacuum rator 0.051 at 130 ⁹ 0.021 at atm. temp. ator 0.051 at 130 ⁹ 0.021 at atm. temp. <0.004 at 67 ² <0.004 at 194 ⁹ Recommended Recommended Recommended 0.010 at boiling Recommended 0.010 at boiling Recommended 0.010 at boiling Recommended 0.010 at boiling Recommended 0.010 at boiling Recommended 0.010 at boiling Recommended 0.004 at 70 ²⁵ <0.004 at 70 ²⁵		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude to Cu Commercial All cone. All cone. All cone. All cone. All cone. All cone. All cone. All cone. Solution Soluti	$ \begin{array}{c} < 0.0042 \ at 70^{\circ} \\ 0.042 - 0.12 \ at 150^{\circ 2} \\ < 0.004 \ at 70^{\circ} \\ < 0.0042 \ at 70^{\circ} \\ 0.0042 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.0042 \ at 70^{\circ} \\ 0.042 \ at 70^{\circ} \\ 0.042 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.004 \ at 70^{\circ} \\ < 0.004 \ at 160^{\circ} \\ No \ attack \\ Recom. to boiling \\ Recom. at all temp. \\ Rocom. at all temp. \\ None \ at any \ temp. \\ None \ at any \ temp. \\ \hline \\ & < 0.0044 \ at 203^{\circ 1} \\ < 0.0044 \ at 203^{\circ 1} \\ < 0.0044 \ at 10^{\circ 1} \\ < 0.0044 \ at 20^{\circ 1} \\ < 0.0044 \$
300 302 316 330 336 337, 338 350, 331 355, 371 355 364 365–368 MACI 2 5 6–8 9 10, 11 12, 15	Ni Cr Cu Mo Ni Cr Fe Ni Cu Alloy Nickel Ni Cr Steel Nickel Silver P Bronze Copper Red Brass Silver Co Cr W NESIUM Stainless Stainless Stainless Stainless Stainless	Fe 10% sol. Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., aerated 45% sol., unaerated Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor Cone. 10% to 22% in evapor Cone. 5% to 48% in evapor Cone. 10% to 22% in evapor 45% sol., unaerated 45% sol., unaerated 45% sol., unaerated 45% sol., unaerated 1.5% sol. ¹ 10% sol. ¹ 10% sol. ² 50% by vol. All cone. CHLORIDE 1, 5% sol., quiet 1, 5% sol., quiet 1, 5% sol. quiet 1, 5% sol., quiet 50% sol. Sat. sol. Sat. sol. Sat. sol.	Recom. at all temp. <0.004 at 70–160 ² ator 0.004 ander vacuum mator 0.008 at 130 ² <0.001 at atm. temp. <0.001 at atm. temp. <0.001 at atm. temp. ator 0.006 under vacuum mator 0.056 at 130 ² 0.020 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. ator 0.051 at 130 ² 0.021 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.003 at atm. temp. 0.004 at 67 ² <0.004 at 194 ⁹ Recommended Slight to moderate Recommended 0.010 at boiling Recom. at all temp. <0.0044 at 05^{23} <0.0044 at 05^{23} <0.004 at 70^{23} <0.0044 at 70^{23} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0042 at 70^{2} <0.0044 at 70^{2}		2 5-8 9 10, 11 12, 15, 19 20, 21, 2 104 139 142 161 176 209 213 200, 291 292 233 365-368 370 MIXI	Stainless Stainless Stainless IS Stainless Stainless Stainless Stainless Stainless Fe Ni Cu Cr High Si Mo Iro Cr Steel Fe Ni Cu Cr Fe Ni Cu Cr Mall Cu—Base- Aluminum Ni Mo Fe Ni Cr Fe W Ni Si Cu Co Cr W Tantalum	Any cone. 100% Crude Io Cu Commercial Illoys Exposed 3 mo. All cone. All cone. All cone. All cone. All cone. All cone. All cone. Solution Statement State	$ \begin{array}{c} < 0.0042 \mbox{ at } 70^{\circ} \\ 0.042 - 0.12 \mbox{ at } 150^{\circ 2} \\ < 0.004 \mbox{ at } 70^{\circ} \\ < 0.0042 \mbox{ at } 70^{\circ} \\ 0.0042 \mbox{ at } 70^{\circ} \\ < 0.004 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ at tack} \\ Recom. \mbox{ to boiling} \\ < 0.001 \mbox{ at } 160^{\circ} \\ \\ No \mbox{ at tack} \\ Recom, \mbox{ at all \mbox{ temp.}} \\ None \mbox{ at any \mbox{ temp.}} \\ None \mbox{ at any \mbox{ temp.}} \\ < 0.0044 \mbox{ at } 200^{\circ 1} \\ < 0.0044 \mbox{ at } 140^{\circ 1} \\ < 0.0044 \mbox{ at } 140^{\circ} \\ > 0.131 \mbox{ at } 200^{\circ 1} \\ < 0.0044 \mbox{ at } 140^{\circ} \end{array} $

No.	Material	Exposure Conditi		Corrosion per Year @		Na.	Material	Exposure Conditions	(Inche	Corrosions per Year	
142	High Si Iron	Any conc.	Recom. to			1.01			70°	Sites	Boiling
209	Fe Ni Cr Si M All Cu-Base	lo Cu 61% H ₂ SO ₄ + 3 Alloys	36% HNO ₄ <0.00 Attacked	01 nt 176°		58 59	Stainless Stainless	05% 0.5-20%	R R		0.018 R
213	Aluminum	H ₂ SO ₄ , % HNO ₃ , 90 4	% 0.90 at roo	m temn.		61	Stainless	05% 0.5-20%	R R	176°	0.010 R
210	7144 Million	85 S	1.0 at room	n temp.		1	in the second	65%	<0.001		007 0.01-0.03
		80 20 80 5	0.45 at roo 1.24 at roo			62 67,68	Stainless 71 Stainless	05% 0.5-65%	R		0.042 R
		60 40	0.47 at roo	m temp.		80	Stainless	0.5, 5%	R		R
		60 26 40 60	0.95 at roo 0.38 at roo			81	Stainless	20, 65% 0.5-65%	R R		R
		20 80	0.09 at roo			91	Cr Ni Steel	0.5-65%	R	S	R
		20 55 14 60	0.14 at roo 0.095 at ro			104	Fe Ni Cu Cr Ni Cr Steel	0.5, 5% sol.	Rapid att R	ack	R
300	Ni Cr Cu Mo	Fe 12.5 12.5 12.5 5	0.004-0.01			122	E.N. C. C.	20, 65% sol.	R		0.0002
		02.5 7.5	<0.004 at			122	Cr Steel	Mo 65% sol. 0.5-65% sol.	R		0.0086 R
311	Chem. Lead Te Lead	Mixed acid sol. Mixed acid sol.	Fair resist. Fair resist.			129 136		* 0.5-70% sol.	R R		R R
	Te Deau	Mixed and sol.	Pair realat.			130		0.5-65% sol. 0.5-65% sol.	R		R
		1				139 140		ron Any conc. Cu 0.5-65% sol.	R R		R R
NITI	RIC ACID					141		Mo 0.5-65% sol.	R		R
			70°	110°	· Boil.	142 150	High Si Iron Cr Mo Steel	Any conc. 20% sol., aerated	R >0.5		R
2	Stainless	5-50% sol. 65% sol.	<0.0042 <0.0042		0.0042	151	Cr Mo Steel	20% sol., aerated	0.4	110°	
		Conc. sol.	< 0.0042		0.04-0.12	163 164	Cr Ni Steel Cr Ni Steel	5% sol. 0.5-05% sol.	R	<0.001	R
5	Stainless	Fuming conc. 5% sol.	<0.004 <0.004	<0.004 0.013	0.12-0.42	171	Cr Steel	20, 65% sol.	R *		
- Lee	にというま	20% sol.	<0.004		-	172	Ni Fe Cr	0.5, 5% sol. 20, 65% sol.	R R		R
		65% sol. Conc. sol.	<0.004		<0.030	175	Cr Ni Steel	0.5-20% sol.	R		R
6, 7	Stainless	Cone. sol.	<0.004	0.000/		176	Fe Ni Cu Cr	65% sol. 5%—conc. sol.	R 0.75-2.0		
8	Stainless	5% sol. Conc. sol.	<0.004	0.0084		1S0 1SS	Cr Cast Iron Steel	0.5, 5, 65% sol.	R 4.9		R
9	Stainless	5-50% sol. 05% sol.	<0.0042		<0.0042	200	Ni Cr Fe	50% sol. ¹ 0.5-05% sol.	4.9 R		R
		Conc. sol.	<0.0042 <0.004		0.004-0.04 0.04-0.12	205 206	Cr Ni Steel Fe Cr Ni Mo	0.5-65% sol.	R R	176°	R R
10, 11	Stainless	Funning conc. Conc. sol.	<0.004 <0.004	< 0.004	0.12-0.42	209	Fe Ni Cr Si M	lo Cu Commercial, all conc.		< 0.001	K
10, 11	Stainless	5% sol.	<0.020			213	All Cu-Base . Aluminum	Allovs 0.5% sol.	Attacked 0.005		
		20% sol. 65% sol.	<0.020		NR			5% sol.	0.041		
	191155	Conc. sol.	<0.005		1110	1		20% sol. 65% sol.	0.11 0.049	135°	
18	Stainless	5% sol. 20% sol.	<0.020 <0.020			1		93% sol.		0.004	
		65% sol.			>0.42	214	Al Alloy	95% sol. 0.5% sol.	0.005	<0.001	
19	Stainless	Conc. sol. 5% sol.	<0.0042 <0.0042		>0.42 0.042-0.12	1 - 1 - 1		5% sol.	0.061		
		20-50% sol.	<0.0042		0.004-0.04			20% sol. 65% sol.	0.15 0.049		
		65% sol. Conc. sol.	<0.0042 <0.0042		0.042-0.12 0.12-0.42			93% sol. 95% sol.		0.014 0.005	
20, 21	Stainless	Furning conc. 10% sol. ¹	<0.004 <0.0046	< 0.004	0.12-0.42	215	Al Alloy	0.5% sol.	0.010	0.005	
20, 21	Dramiess	25% sol.1	< 0.0046		<0.046			5% sol. 20% sol.	0.065 0.14		
25	Stainless	50%-conc. sol. ¹ Conc. sol.	<0.0046 <0.004		<0.46		1000	65% sol.	0.055		
25 30	Stainless	20% sol.	R			216	Al Alloy	0.5% sol. 5% sol.	0.001 0.020		
31	Stainless	65% sol. 20% sol.	R R		0.13-0.16			20% sol.	0.16		
		65% sol.	R		0.45 D	218	Al Alloy	65% sol. 95% sol. in tank car	0.108 Unaffected		
32	Stainless	0.5-20% sol. 65% sol.	R R		R 0.20	and the second s	Ni Cr Si	0.5-20% sol.	R		R
33	Stainless	0.5-20% sol.	R R		R	220	Ni Cr Alloy	65% sol. 0.5-65% sol.	R R		R
34	Stainless	65% sol. 0.5-65% sol.	R		0.02-0.04 R	282	Ni Cr Cu Mo V	W 0.5-65% sol.	R	1500	R
35	Stainless	0.5-20% sol. 65% sol.	R R		R 0.020	289 292	Gold Ni Cr Fe W	0.5-65% sol. 10%	R 0.0115	158° 0.038	R 0.043
36	Stainless	0.5-20% sol.	R		R			20%	0.050		0.18
37	Stainless	65% sol. 0.5-20% sol.	R R		0.003 R			50% 70%	0.0092	0.140 0.120	1.980
		65% sol.	R		0.02-0.03	300	Ni Cr Cu Mo F	?e 0.5% sol.			R
38 39		0.5-65% sol. 0.5-20% sol.	R R		R R			7.5-30% sol. 35% sol.		100°	<0.004 0.004-0.015
		65% sol.	R		0.05-0.4	1.5		50% sol.	<0.004	<0.004	
41 42		0.5–65% sol. 0.5–20% sol.	R R		R R			62% sol. 70% sol.	<0.004 <0.004	109° <0.004	0.05-0.125
		65% sol.	R		0.018	000		Conc. sol.	R	R	
44, 46, 50, 52,	Stainless	0.5-65% sol.	R	-	R	302	Ni Cr Fe	5% sol., aerated 25% sol., aerated	0.006 at atr 0.002 at atr		
53, 55			1-		D. Constant)	5		25% sol., unacrated	0.001 at at	n. temp.	
56		0.5–20% sol. 65% sol.	R F.		R 0.016	305-307	Ir Platinum	65% sol., unaerated 0.5-65% sol.	0.003 at atr Recom. at	n. temp. room temp.,	boil.
58		0.5-20% sol.	R		R	308	Sb Lead		Not recom		

No.	Material	Exposure Conditions	Corrosion (Inchos per Year @ Deg.	. F.)	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. I	F.):
311	Chem. Lead	and the second second	Not recommended	129	High Si Iron	2.1-7.9% sol., quiet	<0.001 at room temp.	12
314	Te Lead		Not recommended	139	High Si Mo In	on Any conc.	Recon. to boiling	
316	Ni Cu Alloy	5% sol., aerated	0.065 at atm. temp.	142	High Si Iron	Any conc.	Recorn. to boiling	
		25% sol., unaerated	0.331 at atm. temp.	209	Fe Ni Cr Si M	lo Cu	<0.001 at cold	
329	Ni Cr Alloy	0.5, 5% sol.	Recom, at room temp., boil.	. 244, 247	Al Bronze		Recommended	
		20, 65% воl.	Recom. at room temp.	249	Cu Ni Zn		Recommended	
330	Nickel	5% sol., acrated	0.135 at atm. temp.	257	Admiralty		Slight to moderate	
335, 336	Ni Cr Steel	1-65% sol.1	<0.0038 at 68°	the second se	Copper		Recommended	
346	Palladium	0.5, 5% sol.	Recom. at room temp., boil.	and the second s			Accounting	
		20, 65% sol.	Recom. at room temp.	272, 273			Slight to moderate	
357. 358	Platinum	0.5-65% sol.	Recom. at room temp., boil.			, martine states	SuBur to moderate	
361	Rh Platinum	0.5-65% sol.	Recoin. at room temp., boil.	and the second se				
364	Silver	010 00 /0 0011	Readily attacked	and the second sec	Cu Ni Alloy		Decemental	
	Co Cr W	All conc.	Recom. at all temp.				Recommended	
				the second s	Cu Si Ma	D 907 1	Recommended	
370	Tantalum	0.5-65% sol.	None at any temp.	300	Ni Cr Cu Mo		<0.004 at 70°	
374	Ni Cr Alloy	0.5-65% sol.	Recom. at room temp., boil.	CONCLUSION OF THE OWNER.		15% sol.	0.004-0.015 at boiling	
			A - Sat and the	305	Sb Lead		Not recommended	
TEL	C ACID			311	Chem. Lead		Not recommended	
OLEI	C ACID			314	Te Lead		Not recommended	
2	Stainless		<0.0042 at 70-400°2	310	Ni Cu Alloy	30% sol.	<0.001 at room temp140°	
5-8	Stainless		<0.004 at 70°	337, 338	Nickel Silver	the state of the	Recommended	
				350-353	P Bronze		Recommended	
9	Stainless		<0.0042 at 70-400°	355, 371			Slight to moderate	
10, 11	Stainless		<0.004 at 70°	359	Red Brass		Recommended	
	Stainless		<0.004 at 70°	364	Silver		Slight attack	
19	Stainless		0.004-0.04 at 70° & 300°2	104	Suver		ought attack	
20, 21	Stainless		<0.004 at 70°	1. AL				
101	Fe Ni Cu Cr	Technical grade	0.0066 at 150°	2.92	Carl - Tate			
129	High Si Iron	Commercial	None at room temp.	PHEN	IOL	a surfluent - h-		
139	High Si Mo Ir	on Any conc.	Recom. to boiling			and the second second		
142	High Si Iron	Any conc.	Recom, to boiling	2	Stainless	C. P.+ 10% water	<0.0042 at boiling	
176	Fe Ni Cu Cr		0.001 at room temp., boil.	-112/-0		C. P.	<0.0042 at 70° - boiling	
200		o Cu In fatty acids	<0.001 at 176°	- 1994		Crude	<0.0042 at 212°	
216	Al Alloy	In storage container	<0.001 at room temp.			Crude	<0.0042 at boiling	
		In storage container	Recommended4	5-8	Stainless	Commercial grade 2	<0.004 at 70°	
	Al Bronze		Recommended ⁴	9	Stainless	C. P.+ 10% water	<0.0042 at boiling	
249	Cu Ni Zn		Slight to moderate	The state		C. P.	<0.0042 at 70° - boiling	
257	Admiralty		Recommended ⁴	S. T. S. T. S.L. U		Crude	<0.0042 at 212°	
259, 262,	Copper		Recommended.			Crude	<0.0042 at boiling	
266, 277				10 11	Stainless	Commercial grade ²	<0.004 at 70°	
272, 273,	Bronze		Slight to moderate		Stainless	Commercial grade -	<0.040	
315, 343,						O D 1 100/ motor		
344, 372				19	Stainless	C. P. + 10% water	<0.0042 at boiling	
275, 276	Cu Ni Alloy		Recommended ⁴	10. 1		C. P.	<0.0042 at 70°	
283-285	Cu Si Mn		Recommended4			Commercial grade 2	<0.004 at 70°	
300	Ni Cr Cu Mo	Fe Commercial grade	<0:004 at 70°		Stainless	Sol.1	<0.0046 at 68° - boil.	
302	Ni Cr Fe		H2SO4 <0.001 at atm. temp	p. 25	Stainless	Commercial grade ²	<0.004 at 70°	
	1.0128	Oleic + linolenic, linoleic, al		104	Fe Ni Cu Cr	U. S. P.	No attack at 80°	
308	Sb Lead	and a second and a second	Not recommended	139	High Si Mo Ire	n Any conc.	Recom. to boiling	
311	Chem. Lead		Not recommended	142	High Si Iron	Any conc.	Recom. to boiling	
314	Te Lead		Not recommended	176	Fe Ni Cu Cr	15% sol	0.009 at 60°	
316	Ni Cu Alloy	In washing oleie with 0.75%	H2SO4 <0.001 at atm. temp	n. 209	Fe Ni Cr Si Me	o Cu	<0.001 at 370°	
010	iti cu moy	Olcic + linolenic, linoleic, ab		p.	Al Alloys	Solid phenol	No attach at room temp.	
	Michael		H2SO4 0.001 at atm. temp.		Al Brouze	- and	Recommended	
330	Nickel			249	Cu Ni Zn		Recommended	
1		Oleic + linolenic, linoleic, ab		257	Admiralty		Severe	
	Nickel Silver		Recommended4	259, 262,	and the second states of the second	and the second second	Recommended	
	P Bronze		Recommended ⁴		Copper		Trecommended	
355, 371	Copper		Slight to moderate	266, 277	1		Course	
359	Red Brass	- I PEL	Recommended	272, 273,	Isronze		Severc	
364	Silver		No attack	315, 343,				
				344, 372				
	TO LOTD				Cu-Ni Alloy	the state of the	Recommended	
UAAI	LIC ACID				Cu Si Mn		Recommended	
			70° 104°	290, 291	Ni Mo Fe	All conc.	Recom. at all temp.	
		P.07 1		Boil. 292	Ni Cr Fe W	Ali conc.	Recom. at all temp.	
2	Stainless	5% sol.		0.0042 293	Ni Si Cu	All conc.	Recom. at all temp.	
		10% sol.		2-0.42 302	Ni Cr Fe	Storage tank, unaerated	<0.001 at 365°	
		50% sol.	0.12	2-0.42 305	Sb Lead	a Solita a state of the	OK	
		Sat. sol.1	<0.0044 <0.0044 >	0.44 311	Chem. Lead		OK	
5	Stainless	10% sol.	<0.004 NR	314	Te Lead		OK	
		Sat. sol.2	<0.004	and the second sec		5% aerated	<0.001 at 60°	
6-S	Stainless	Sat. sol.2	<0.004	316	Ni Cu Alloy		<0.001 at 104°	
9	Stainless	5% sol.		0.004 220	THE ISSUE	5% unacrated		
2	Dumine 33			1.0.19 000	Nickel	Storage tank, unaerated	<0.001 at 365°	
		10% sol.		1.0.19	Nickel Silver		Recommended	
		50% sol.		4-0.12 350-353	P Bronze		Recommended	
and a		Sat. sol.1	<0.004 <0.004 0.14	46 355, 371	Copper		Severe	
	Stainless	Sat. sol. ²	< 0.004	359	Red Brass		Recommended	
12, 15	Stainless	5% sol.	0.004-0.04 at hot or cold	364	Silver	Water-free; partly immersed	<0.001	
		10% sol.1	<0.046 at 68°		Co Cr W	All conc.	Recom. at all temp.	
		10% sol.1	>0.46 at boiling	The second se			None at any temp.	
19	Stainless	5% sol.	<0.0042 at 70°, boil.	370	Tantalum		rione as any tempt	
1	1	10% sol.	0.0042-0.042 at 70°	A THE THE P	and a series of the			
				DITO	DITODIC	1 CID		
		10% sol.	>0.42 at boiling	PHOS	SPHORIC	ACID		
	0.11	Sat. sol.	<0.004 at 70°				P09 D-111-	
00	A Marine Lana	10% sol.1	<0.0046 at 70°		1	STORE NO STORE	70° Boilin	
20	Stainless		a second s					
20 25	Stainless	10-50% sol. ¹ Sat. sol. ²	<0.46 at boiling	2	Stainless	1, 5% sol. 10% sol., quiet	<0.0042 <0.00 0.004-0.04	042

No.	Material	Exposure Conditions	(Inche	Corrosion s per Year @		No.	Material	Exposure Conditions	(Inch	Corrosio os per Year	
- 12		Richman States	70°	1. 19	Hue Is				70°		Boil.
2	Stainless	10% sol., agitated 10% sol., aerated	0.04-0.12			211	Admiralty	10% sol. 50, 85% sol.	R R		R
5	Stainless	1% sol.	<0.0042			213	Aluminum	10% sol.	0.074		
		10% sol., agitated	<0.12		Boil			50% sol.	0.20		
6-8	Stainless	1 1 101 11 11 1	< 0.0012		1211. 521	History		85% sol.	0.24		
9	Stainless	1, 10% sol.	<0.0042 <0.0042		<0.0042 0.004-0.04	214	Al Alloy	10% sol.	0.09		
		25, 50% sol. 85%	<0.0042		0.004-0.04			50% sol.	0.25		
		Attack on 9 in cold sol. m		used to 0.042		215	tt Ulau	85% sol. 10% sol.	0.27 0.095		
-	1000	or aeration.	So the			215	Al Alloy	50% sol.	0.095		
	Stainless 18 Stainless	1 5071	<0.0012					85% sol.	0.26		
14, 10,	10 artituress	1, 5% sol. 10% sol.	<0.0042 0.12-0.42			216	Al Alloy	10% sol.	0.175		
19	Stainless	1, 5% sol.	< 0.0042		< 0.040 1	1.00		50% sol.	1.0		
		10% sol., quiet	0.04-0.12		0.12-0.42	244	Al Bronze	85% sol. 10, 50% sol.	1.2 R		R
		10% sol., agitated	0.04-0.12		0.12-0.42		III DIGUDO	85% sol.	R		
20	Stainless	10% sol., nerated 1-45% sol.1	0.04-0.12 <0.0046		0.12-0.42 <0.0046	245	Al Bronze	10% sol.	R		3.43.90
	O MATARCOS	Conc. sol.1	<0.0046		<0.46	249	Cu Ni Zn	10-85% sol.	R		R
21	Stainless	1-10% sol.1	< 0.0016		<0.0046	257	Admiralty	10.97 mol	Severo R		R
		45% sol.1	<0.046	1-120	<0.46	200, 211	Copper	10% sol. 50, 85% sol.	R		n
05	Chainland	Conc. sol.1	<0.046		>0.46	275, 276	Cu Ni Alloy	Sol.	R		
25 32	Stainless Stainless	5% sol. 10-85% sol.	<0.0042 R		R	1000	Cu Si Mn	10% sol.	R		R
33	Stainless	50% sol.	R	95°	Hat A			50, 85% sol.	R		0.000
15 6	-0 - C - 3 -	85% sol.	R	<0.001	>1.0	290	Ni Mo Fe	10% sol., C. P.	0.0022 0.0016		0.026
34	Stainless	10, 50% sol.	R		R	12U		10% sol., technical 50% sol., C. P.	< 0.0010		0.0003
35	Stainless	85% sol. 10, 50% sol.	R R		ALLE N	121		50% sol., technical	0.0058		0.032
00	Dunness	S5% sol.	R		>1.0	1.7-36		85% sol., C. P.	< 0.001		0.82
36	Stainless	10% sol.	R		R			\$5% sol., technical	1100.0		0.047
		50% sol.	R		West -	201	Ni Mo Fe	10% sol., C. P.	0.0016 0.0035		0.0015 0.0036
17	Ct. i. i.m.	85% sol.	0.001 D		2	1000		10% sol., technical 50% sol., C. P.	<0.0035		0.0030
17	Stainless	10, 50% sol. 85% sol.	R R	<0.001	R >1.0	1924		50% sol., technical	0.0041		0.022
38	Stainless	10, 50% sol.	R	C0.001	R	12/2/20		85% sol., C. P.	<0.001		0.0016
		85% sol.	R			000		85% sol., technical	0.0030		0.034
¥1	Stainless	10-85% sol.	R			292	Ni Cr Fe W	10% sol., C. P. 10% sol., technical	< 0.001		0.0014
12	Stainless	10, 50% sol.	R		R	100 C 20		50% sol., C. P.	<0.001 <0.601		0.0036
14	Stainless	85% sol. 10, 50% sol.	<0.001 R		R	12		50% sol., technical	< 0.001		0.022
12.05		85% sol.	R					85% sol., C. P.	<0.001		0.480
16	Stainless	10-85% sol.	R			000		85% sol., technical	<0.001		0.030
17, 50	Stainless	10, 50% sol.	R		R	203	Ni Si Cu	10% sol., C. P. 10% sol., technical	0.0014 0.0014	THE AND	0.0028
	Stainless	85% sol. 10-85% sol.	R R					50% sol., C. P.	<0.001		0.0053 0.049
52 53	Stainless	10, 50% sol.	R		R R	a star		50% sol., technical	0.0043		0.024
		85% sol.	R		556 44	10 2 0		85% sol., C. P.	< 0.001		0.320
56	Stainless	10% sol.	R		R	300	Ni Cr Cu Mo	85% sol., technical	0.0029		0.037
30		50% sol. 85% sol.	R R	95°	. 10	000	AT CI CU MO	25% sol.			<0.004 <0.004
58, 59	Stainless	10, 50% sol.	R	nil	>1.0 R			50% sol.		212°	0.001-0.0
	2.00	85% sol.	R			125		57% sol.	< 0.004	0.004-0.01	5
31	Stainless	85% sol.	R	nil	>1.0	190		85% sol.	<0.001.	220°	
37	Stainless	10% sol.	R			1000		90% sol.	< 0.004	<0.034 Hot	
58, 81 91	Stainless Cr Ni Steel	10-85% sol. 10-85% sol.	R R	80°	R	1 File		Conc. sol.		R	0.05-0.123
	Fe Ni Cu Cr			0.0042	n	1.3.5	14.000			190°	
	Fe Ni Cr Cu M			2 4 6	0.037	302	Ni Cr Fe	1.5% sol.	14	<0.001	
		10-87% sol.	<0.001		R	1.25		10, 50% sol. 85% sol.	<0.005	0:02	
6	Fe Cr Ni Mo		R		R	308	Sb Lead	85% sol. 1-80% sol.	<0.010 R	250° R	
8	Fo Cr Ni Mo	85% sol.	R R			310	Lead	10% sol.	0.001		0.001
		n C. P.; 10-85% sol.	R		R			50% sol.	0.001		0.002
	3511 m 1212	Crude, containing HF	NR		NR	014	01- T 1	85% sol.	0.002	392°	0.004
		u 10-85% sol.	R		R	311 312	Chem. Lead Chem. Lead	1-80% sol. 10, 50% sol.	R	R	D
		0 10-85% sol.	R		R	312	Te Lead	10, 50% sol. 1-80% sol.	R R	R	R-
2	rugu St 1ron	C. P.; 10-85% sol. Crude, containing HF	R NR		R NR		12 P			1903	
5	Cr Ni Steel	10% sol.	R	86°		316	Ni Cu Alloy	1.5% sol.		0.007	
		5-25% sol.		0.04-0.12	L- ATU	Al-State		0701 .1		205°	
				190°		12302		25% sol., aerated 25% sol., unaerated		0.045	
" the		5-25% sol.	D	0.28-0.76				85% sol., unacrated		0.004 0.002	
-		50, 85% sol.	R			1-2				190°	
		50, 85% sol.	R			330	Nickel	1.5% sol.		0.013	
		10% sol. 10, 50% sol.	R R		R	1. 1. 1.		10, 50% sol.	< 0.005		
	Fe Cr Ni Mo		R		R	337	Niekel Silver	85% sol.	<0.015 P		D
2		\$5% sol.	R	176°	11203	337 338	Nickel Silver Nickel Silver	10-85% sol. 10, 50% sol.	R R		R R
		Cu 10-50% sol.	<0.001	< 0.001	<0.001	000	-maci briver	85% sol.	R		10
) 1	Le IM OI DI MO		and the second se		CARLES AND						
) :		50-70% sol.	< 0.001	< 0.001		350-353	P Bronze	10% sol.	R		R

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F	.) No.	Material *	Exposure Conditions	Corrosien (Inches per Year @ Deg.	. F.)
			70° Boil.		Stainless	10% - sat. sol.1	<0.0046 at 68-212°	
361	Rh Platinum	10-85% sol.	R R	104	Fe Ni Cu Cr	5% sol.	No attack at 150°	
362	Lead	10% sol.	0.001	100	Wigh Ct T-	20% sol.	0.0014 at 150°	
		50% sol.	0.002	129		19.4% sol., quiet	<0.001 at room temp	
		85% sol.	0.003	139		ron Any conc.	Recom. to boiling	
363	Silver	10% sol.	R R	142	High Si Iron		Recom. to boiling	
		50, 85% sol.,	R	209		Io Cu Solvay process	No loss at 176°	
364	Silver	10-85% sol.	Recom. at room temp.			lloys except 297 & 318	Recommended	
		85% sol., C. P.	Nil at 170°-185°	213	Aluminum	0.1% sol.	0.0022 at \$6°	
		85% sol., C. P.	0.004 at 230°-250°			1% sol.	0.014 at 86°	
		85% sol., C. P.	0.049-0.096 at 430-450°	-1- 10 - 11- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1-		10% sol.	0.33 at 86°	
866	Co Cr W	All cone.	Recom. at all temp.	214	Al Alloy	0.1% sol.	0.0022 at 86°	
170	Tantalum	10, 50% sol.	None at room temp., boil.	Star -		1% sol.	0.012 at 86°	
		85% sol.	Recom. at room temp.			10% sol.	0.22 at 86°	
		Conc. sol.	0.467 at 293°	215	Al Alloy	0.1% sol.	0.0026 at 80°	
371	Ni Cr Alloy	10% sol.	Recom. at room temp.			1% sol.	0.012 at 86°	
				2 5 12 11		10% sol.	0.47 at 86°	
PROI	PYLENE T	DICHLORIDE		216	Al Alloy	0.1% sol.	0.0025 at 86°	
						1% sol.	0.013 at 86°	
30	High Si Mo Ir	on Any conc.	Recom. to boiling			10% sol.	0.46 at 86°	
42	High Si Iron	Any conc.	Recont. to boiling	221	Al Alloy	0.1% sol.	0.001 at 86°	
209	Fe Ni Cr Si M		No loss at cold			1% sol.	<0.001 at 86°	
	Admiralty		Recommended			10% sol.	0.0031 at 86°	
	Al Bronze		Recommended	290, 291	Ni Mo Fe	All cone.	Recom. at all temp.	
248	Al Brass		Recommended	292	Ni Cr Fe W	All conc.	Recom, at all temp.	
49	Cu Ni Zn		Recommended	293	Ni Si Cu	All conc.	Recom. at all temp.	
	Copper		Recommended	305	Sb Lead	E - F - 1 - 24 - 4	Probably OK	
266, 277				311	Chem, Lead		Probably OK	
	Cu Ni Alloy		Recommended	314	Te Lead		Probably OK	
			Recommended	316	Ni Cu Alloy	0.07% sol., aerated	<0.001 at 200°	
	Cu Si Mn		Recommended	010	ou niloy	10% sol., aerated	<0.001 at 60°	
	Nickel Silver		Recommended	364	Silver	Sol.	None	
	P Bronze		Recommended	201	Saret	Fused salt	Attacked 930°	
59	Red Brass		THEOLINE BUCK	365-309	Co Cr W	All conc.	Recom. at all temp	
	UM BISU	Трнате		000 000	co er n		Account at an eculy	
	Uni moo			Sont		DIDE		
2	Stainless	10% sol.1	<0.0044 at 68-212°	SODI	UM CHLO	DRIDE		200
		Sat. sol.	Attacked				F02 1F00 F	
5	Staipless	Sol.	<0.004 at 70°		a	F.CT 10		Boil.
		Sat sol.	Attacked	2	Stainless	5% sol.2	<0.0042 <0.0042	
6-8	Stainless	Sat sol.	Attacked			20% sol., aerated 2	<0.0042	
9	Stainless	2g. + 1g. H2SO4 per l.	<0.0044 at 68°1	1 13 20 20		Sat. sol. ²		04-0.0
°.	L'INTERIO	2g. + 1g. H ₂ SO, per l.	<0.044 at 212°1	and the second	a	Sea water and brine 2	<0.004	
		Sol,	<0.004 at 70°	5-8	Stainless	Sea water and brine 2	<0.004	
10-15	Stainless	Sat. sol.	Attacked	9	Stainless	5% sol.	<0.0042 <0.0042	
104	Fe Ni Cu Cr		Rapid attack			20% sol., aerated	<0.0042	
39	High Si Mo Ir	on Any conc.	Recom. to boiling			Sat. sol.	and a second as a second the second sec	.0042
42	High Si Iron		Recons. to boiling			Sea water and brine 2	<0.004	
76	Fe Ni Cu Cr		None at 60°		Stainless	Sea water and brine 2	< 0.004	
209	Fe Ni Cr Si M		<0.001	12	Stainless	Sea water and brine 2	Attacked	
	Al Bronze		Recommended	15	Stainless	5% sol.2	0.001-0.01 0.001-0.01	
49	Cu Ni Zn		Recommended	12		Sea water and brine ²	Attacked	
57	Admiralty		Slight to moderate	18	Stainless		NR	
	, Copper	4.	Recommended	19	Stainless	5% sol.2	0.004-0.04 0.004-0.04	
		and the second	Teconinended	1.3 A 72		Sea water and brine 2	<0.1	
86, 277			Slight to moderate	104	Fe Ni Cu Cr	Sea water and brine	Suitable	
	, Bronze		cerRue to modelard	129	High Si Iron	the second se	<0.001 at room temp.	
15, 343			and the state of the state of the	139	High Si Mo Ir	on Any cone.	Recom. to boiling	
314, 372			December 1-1	142	High Si Iron	Any conc.	Recom. to boiling	
	Cu Ni Alloy		Recommended	150	Cr Mo Steel	Sea water spray	0.007	
	Cu Si Mn	Da 19407 and	Recommended	151	Cr Mo Steel	Sea water spray	0.0024	
300	Ni Cr Cu Mo		<0.004 at 104°	161	Cr Steel	10% salt spray	0.0132 at 70°	
311	Chem. Lead	All cone.	OK at hot or cold	176	Fe Ni Cu Cr		<0.001-0.01 at 180-200°	
314	Te Lead	All conc.	OK at hot or cold	209		o Cu Oil field salt water	<0.001 at 60° avg. temp.	
	Nickel Silver		Recommended				Sea water and brine Recom.	
	P Bronze		Recommended	213	Aluminum	Dichromate inhibited	Satisfactory	
	Copper		Slight to moderate	300		Fe 16% salt spray	<0.004 at 85°	
359	Red Brass		Recommended			36% sol. + trace free Cla	0.004-0.015 at 122°	
					Configuration of	Conc. sol.; alkaline with Na		
SODI	UM CARI	BONATE				Sat. sol.	0.015-0.050 at 70°	
		10		302	Ni Cr Fe	Alternate brine, air	<0.001 at 200°	
2	Stainless	5-50% sol.	<0.0042 at 70° - boils			Sat. sol.+ steam and air	0.001 at 200°	
1111		Sat. sol.	<0.004 at 70°			Sea water	<0.001	
		Molten	>0.42 at 1650°	305	Sb Lead	Sea water and brine	OK at hot or cold	
5	Stainless	5% sol.	<0.004 at 70-150°	303	Chem. Lead	Sea water and brine.	OK at hot or cold	
		Sat. sol.	<0.004 at 70°	the second se				
6-8	Stainless	Sat. sol.	<0.004 at 70°	314	Te Lead	Sea water and brine	OK at hot or cold	
0-3 9	Stainless		Same as 2	316	Ni Cu Alloy	Alternate brine, air	<0.001 at 200°	
	Stainless	Sat. sol.	<0.004 at 70°			Sat. sol.+ steam and air	0.003 at 200°	
10 11		10% - sat. sol.1	<0.0016 at 68-212°	220	Mi-L-1	Sea water	<0.001	
	CUMUICSS	10% - sit, sol, 5% sol.		330	Nickel	Alternate brine, air	<0.001 at 200°	
12, 15			<0.004 at 70-150°			Sat. sol.+ steam and air	0.002 at 200°	
12, 15 18	Stainless		<0.0019 at 702 L.1					
12, 15		5% sol.	<0.0042 at 70° - boil,			Sea water	<0.001	
12, 15 18 19	Stainless Stainless	5% sol. 10% — sat. sol.1	<0.0046 at 68-212°	336	Ni Cr Steel	10% - sat. sol.1	<0.001 <0.004 at 68-212°	
12, 15 18	Stainless	5% sol.		336 364 370	Ni Cr Steel Silver Tantalum			

No.	Material	Exposure Conditions	Corrosia (Inches per Year (No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.))
SOD	IUM FERI	RICYANIDE	and the get the set	di nu	011	(destantes	0.507	70° Boil. R R	-
130	High Si Mo In	ron Any cone.	Recom. to boiling		211	Admiralty	0.5% sol. 50, 70% sol.	R	
142	High Si Iron		Recom. to boiling		213	Aluminum	0.01% sol.	<0.001	
	Al Bronze		Recommended		213	Arginingin		0.021	
249	Cu Ni Zn		Recommended		12 1 2 2 2 2		0.1% sol.	4.0	
257	Admiralty		Severe		014	11.11.	1% sol.	<0.001	
	, Copper		Recommended		214	Al Alloy	0.01% sol.		
266, 277			Arecontiniended		Strates.		0.1% sol.	0.023	
	Bronze		Severe				1% sol.	3.06	
315, 343			DEVELE		215	Al Alloy	0.01% sol.	<0.001	
344, 372					DE SAL		0.1% sol.	0.0087	
	Cu Ni Alloy		Recommended				1% sol.	5.91	
	Cu Si Mn		Recommended		216	Al Alloy	0.01% sol.	<0.001	
	Nickel Silver		Recommended				0.1% sol.	0.013	
-					L TEEL		1% sol.	5.38	
	P Bronze		Recommended		221	Al Alloy	0.01% sol.	<0.001	
and the second se	Copper	apple in a second second	Severe	NUL CONTRACTOR	1		0.1% sol.	<0.001	
359	Red Brass		Recommended				1% sol.	0.153	
					224	Al Bronze	0.5% sol.	R	
GOD		DOMINE			225-227	Ni Cr Si	0.5-70% sol.	R R	
SODI	UM HYD	RUXIDE			229	Ni Cr Alloy	0.5-70% sol.	R R	
	0.11	0000	* 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		244	Al Bronze	0.5% sol.	R R	
2	Stainless	20% sol.	<0.0042 at boiling		1		50, 70% sol.	R	
1		30% sol.	0.0042-0.042 at boilin	g .	249	Cu Ni Zn	0.5-70% sol.	R R	
13 77 65	G , 1.1	Molten	0.0042-0.042 at 600°		257	Admiralty	The state of the state of the	Slight to moderate	
5-8	Stainless		<0.004 at 70°		266, 277	Copper	0.5% sol.	R R	
9	Stainless		Same as 2		1 275 1	11:	50, 70% sol.	R ·	
10, 11	Stainless		<0.004 at 70°		273	Bronze	0.5-70% sol.	R R	
12, 15	Stainless		<0.005 at 70°		the state of the second second	Cu Ni Alloy	- Start	R	
18-27	Stainless		<0.004 at 70°	11- in-	278-281	Mg Alloys	0.5% sol.	R R	
	Stainless	0.007 1	70°	Boil.			50, 70% sol.	R	
30	Stainless	0.5% sol.	R		283-285	Cu Si Mn	0.5% sol.	R R	
32	Stainless	0.5-70% sol.	R	-	1 Same		50, 70% sol.	R	
33	otannesa	0.5% sol. 50, 70% sol.	R R	R	290, 291	Ni Mo Fe	All conc.	R R	
	Qu. tala	A Loss of The Loss			292	Ni Cr Fe W	All conc.	R R	
34	Stainless Stainless	70% sol. 0.5, 50% sol.	R R	R	293	Ni Si Cu	All conc.	R R	
35, 36	Statutesa	70% sol.	R	R	295	Cu Si Mn Sn	0.5% sol.	R	
27 20	Stainless	0.5-70% sol.	R	m	296	Cu Si Sn	0.5% sol.	R	
37, 38	Stainless	0.5% sol.	R	R	297	High Brass	0.5% sol.	R R	
39	Stainless	0.5, 50% sol.	R	R	300	Ni Cr Cu Mo	Fe 5% sol.	<0.004 at 100°	
41	Stanness			-	A STREET		25% sol.	<0.004 at 70°	23
10	Cialalana	70% sol.	R	R	1 in		36% sol.	<0.004 at 80°	
42	Stainless	0.5-70% sol.	R	R			48% sol.	<0.001	
44, 46		0.5, 50% sol.	R	R	1		70% sol.	<0.004 at 194°	
and the second se	Stainless	0.5-70% sol.	R	R			Conc. sol. + Na SO4, NaCl,	NaClO ₃ <0.004 at 160°	
53	Stainless	0.5, 50% sol. 0.5-70% sol.	R	R	302	Ni Cr Fe	0.5, 50% sol.	<0.001 at 70° — boil.	
56, 58, 59, 61	Stainless	0.3-10% sol.	R	R		111 01 10	70% sol., storage tank	<0.001 at 195-240°	
	Stainless	0.5% sol.	R	D	1.20		70% sol.	<0.005 at boiling	
71 80	Stainless	0.5-70% sol.	R	R R	305-307	Ir Platinum	0.5-70% sol.	Recom. to boiling	
81	Stainless	0.5, 50% sol.	R		308	Sb Lead	15% sol.	OK to 200°	
01	Diamicas	70% sol.	R	R	1 2-15		30% sol.	OK at cold	
91	Cr Ni Steel	0.5-70% sol.	R	R	309	Sb Lead	0.5-70% sol.	Recorn. to boiling	
104	Fe Ni Cu Cr	0.5-70% sol.	R 150°	R	311	Chem. Lend	15% sol.	OK to 200°	
1.01		50% sol.	0.0014	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		at min i	30% sol.	OK at cold	1
105	Ni Cr Steel	0.5-70% sol.	R 0.0014	R	312	Chem. Lead	0.5% sol.	Recom. at 70°	
125	Cr Steel	0.5, 50% sol.	R	R	313	Te Lcad	0.5% sol.	Recom. at 70°	
129	High Si Iron	0.5% sol.	R	R	314	Te Lead	15% sol.	OK to 200°	
1. 1. 1.		25% sol., quiet	<0.001	The sector			30% sol.	OK at cold	
51215	and the state	50% sol.	R		315, 344,	Bronze		Slight to moderate	
136	Fe Cr Ni Mo		R	R	372				5
1.40		50, 70% sol.	R	ANT SPA	316	Ni Cu Alloy	0.5, 50% sol.	<0.001 at 70° — boil.	100
137	Ni Cr Cast Iro	A REAL PROPERTY AND A REAL	< 0.001	<0.001	12		70% sol., storage tank	0.001 at 195-240°	
138	Fe Cr Ni Mo		R				70% sol.	<0.005 at boiling	
139	High Si Mo Ire		R	R	329	Ni Cr Alloy	0.5-70% sol.	Recom. to boiling	
100		50, 70% sol.	R	NR	330	Nickel	0.5, 50% sol.	<0.001 at 70° — boil.	
140	Fe Ni Cr Mo C	Cu 0.5-70%	R	R	1		70% sol., storage tank	<0.001 at 195-240°	
141	Fe Ni Cr Cu M		R	R			70% sol.	<0.005 at boiling	
142	High Si Iron		R	R	1. 1. 1.		Concentrating to 70% in eva	porator 0.002 at 194-239°	
	- inter	50, 70% sol.	R	NR			95% sol.	0.002 at 600°	
172	Ni Fe Cr	0.5-70% sol.	R	R	335, 336	Ni Cr Steel	20% sol.1	<0.004 at boiling	13
175	Cr Ni Steel	0.5-70% sol.	R	all and			Fused 1	<0.004 at 604°	
176	Fe Ni Cu Cr	0.5-70% sol.	R Hot	R	337	Nickel Silver	0.5-70% sol.	Recom. at 70° - boil.	
10120	- The state	50% sol.	<0.006		338	Nickel Silver	0.5, 50% sol.	Recom. at 70° — boil.	
CAR		70% sol.	0.02-0.09		343	Bronze	0.5-70% sol.	Recom. at 70° — boil.	
15,00			1, 240°		346	Palladium	0.5-70% sol.	Recom. at 70° — boil.	
1 a		Molten	0.25			P Bronze	0.5% sol.	Recorn. at 70° — boil.	
180	Cr Cast Iron	0.5-70% sol.	R		000 000		50, 70% sol.	Recom. at 70° — Don.	
200	Ni Cr Fe	0.5-70% sol.	R	R	355, 271	Conner	00, 10 /0 501.	Slight to moderate	
205	Cr Ni Steel	0.5-70% sol.	R	R		Platinum	0.5-70% sol.	Recom. at 70° — boil.	
206	Fe Cr Ni Mo		R 176°	R	359	Red Brass	0.0-10 /0 501.	Recommended	100
209		o Cu 0.5-70% sol.	<0.001 <0.001	1 2.00	361	Rh Platinum	0.5-70% sol.	Recom. at 70° — boil.	
205	TO MI OF DI MI	· · · · · · · · / · bus.	200°		363	Silver			
100		50% sol., commercial	None		364	Silver	0.5-70% sol.	Recom. at 70° - boil.	
210	Wrought Iron		R	R	00%	DIACI.	0.5-70% sol. Fused	Recom. at 70° - boil.	
		10 10 /0 001	and the state of t		1	-	T. MOČN	0.001 at 900°	

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No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Carrosion (Inches per Year @ Deg. F.)
365-368	Co Cr W	All conc.	Recom. at all temp.	302	Ni Cr Fe	See Calcium hypochlorite	
370	Tantalun	120 201 1 - 1 - 2 - 2 2	Attacked	305	Ir Platinum	5, 20% free Cl2	Recom. at 70°- boil.
374	Ni Cr Alloy	0.5-70% sol.	Recoin. at 70° — boil.	306	Ir Platinum	5, 20% free Cl ₂	Recom. at 70°
1 2 4				307 308	Ir Platinum Sb Lead	5, 20% free Cl ₂	Recom. at 70°- boil. Not recommended
SODI	UM HYD	ROSULPHITE		311	Chem. Lead		Not recommended
139	High Si Mo Ir	an Austanna	Recom. to boiling	314	Te Lead		Not recommended
142	High Si Iron		Recom. to boiling		Bronze		Slight to moderate
209	0	o Cu In dye liquors	No loss	372		A State of the second	
244, 247	Al Bronze	all the second second	Recommended	316	Ni Cu Alloy	See Calcium hypochlorite	
249	Cu Ni Zu		Recommended	330	Nickel	See Calcium hypochlorite	
257	Admiralty		Severe	337	Nickel Silver	5% free Cl ₂ 20% free Cl ₂	Recom. at 70°— boil. Recom. at 70°
	, Copper		Recommended	338	Nickel Silver	5% free Cl ₂	Recom. at 70°
266, 277 272, 273			Severe	343	Brouze	5% free Cla	Recom. at 70° - boil.
315, 343			Devere	346	Palladium	5, 20% free Cla	Recom. at 70°— boil.
344, 372	1.2		the same in the same in the		P Bronze	5% free Cl ₂	Recom. at 70°
	Cu Ni Alloy		Recommended		Copper	174 2 Y 1 1 1 1 1 1 1 1	Slight to moderate
283-285	Cu Si Mn		Recommended	357	Platinum	5, 20% free Cl ₂	Recom. at 70°— boi'
302	Ni Cr Fe	40% sol. +SO1 + suspended		358	Platinum Red Brass	5, 20% free Cl ₂ Dil. sol. or at room temp.	Recom. at 70° Recommended
308	Sb Lead	20% sol.	OK at 75°	361	Rh Platinum	5, 20% free Cl ₁	Recom, at 70°- boil.
311 314	Chem. Lead Te Lead	20% sol. 20% sol.	OK at 75° OK at 75°	365	Co Cr W	20% free Cl ₂	None at 70°
316	Ni Cu Alloy	1% sol.	0.014 at boiling	370 .	Tantalum	5, 20% free Cla	None at 70°- boil.
010	In Ou may	40% sol. + SO ₂ + suspended		1.15			
330	Nickel ·		Same as 302	SODI	UM NITR	ATE	
	Nickel Silver		Recommended	Course		ne want to the to the	
1	P Bronze		Recommended	2	Stainless	Sat. sol.	<0.004 at 70°
355, 371			Severe			Fused	0.0042-0.042
359	Red Brass		Recommended	5-8	Stainless	Sat. sol.	<0.001 at 70°
12001-				9	Stainless	Sat. sol.	<0.004 at 70°
SODI	UM HYPO	OCHLORITE		10 11	Stainless	Fused Sat. sol.	<0.0042 <0.004 at 70°
2	Stainless	5% sol.	0.0042-0.042 at 70°	12, 15		Sat. sol.	<0.003 at 70°
4	Branness	Sat. sol.	Attacked except for short periods	19	Stainless	Sat. sol.	<0.004 at 70°
5-8	Stainless	Sat. sol.	Same as 2	1-2-1		Fused	0.042-0.12
0	Stainless	5%, sat. sol.	<0.004 at 70°		Stainless	Sol.1	<0.0046 at 68°
10, 11	Stainless	Sat. sol.	Same as 2	25	Stainless	Sat. sol.	<0.004 at 70°
12, 15	Stainless	Sat. sol.	Attacked	104	Fe Ni Cu Cr	and the second sec	No attack
19	Stainless	5% sol.	0.042-0.12 at 70°	139 142	High Si Mo Iro Iligh Si Iron		Recom. to boiling
	Stainless	Short immersions only	OK at 70°	209	Fe Ni Cr Si M		Recom. to boiling No loss
35	Stainless Stainless	5% free Cl: 5, 20% free Cl:	Recom. at 70° Recom. at 70°	213	Aluminum	0.1% sol.	0.0012 at room temp.
36 37, 38	Stainless	5, 20% free Cl ₂	Recom. at 70°— boil.			1% sol.	<0.001 at room temp.
42, 44		5, 20% free Cl2	Recom. at 70°	1000		10% sol.	<0.001 at room temp.
46	Stainless	5% free Cla	Recom. at 70°	1	Al Bronze		Recommended
50, 52	Stainless	5, 20% free Cl ₂	Recom. at 70°- boil.	219	Cu Ni Zn		Recommended
53	Stainless	5, 20% free Cl2	Recom. at 70°	257 259, 262	Admiralty		Slight to moderate
56	Stainless	5% free Cl ₂	Recom. at 70°— boil.	266, 277			Recommended
59	Stainless	5% free Cla	Recoin. at 70° Boil. Recom. at 70°	272, 273,			Slight to moderate
61	Stainless	20% free Cl ₂ 5% free Cl ₂	Recom. at 70°	315, 343,			Subucto anothere
91	Cr Ni Steel	5% free Cl ₂	Recom. at 70°	344, 372			
104	Fe Ni Cu Cr	241114/4	Rapid attack	275, 276	Cu Ni Alloy		Recommended
125	Cr Steel	5% free Cl2	Recom, at 70°- boil.		Cu Si Mn		Recommended
129	High Si Iron	5% free Cl2	Recom. at 70°	300	Ni Cr Cu Mo		<0.004 at 70°
136	Fo Cr Ni Mo	Short immersions only	OK at 70°	316	Ni Cu Alloy Nickel Silver	2/3 sat., aerated	<0.001 at 122°
138	Fe Cr Ni Mo		Recom. at 70°		P Bronze		Recommended Recommended
139 140	High Si Mo In	Cu 5, 20% free Cl ₂ , stable so	Recoin, to boiling	355, 371			Slight to moderate
141		Io 5, 20% free Cl2	Recon. at 70°	359	Red Brass		Recommended
142	High Si Iron	a de la d	Consult infgr.	364	Silver	Sol.	No attack
176	Fe Ni Cu Cr	0.1%	0.21 at 140°				
205	Cr Ni Steel	5, 20% free Cl ₂	Recom. at 70°- boil.	SODI	UM PHOS	SPHATE (TRIBAS	IC)
206		5, 20% free Cla	Recom. at 70° boil.	JUDI			
209		o Cu 3% free Cla	Satisfactory at cold	the second se	Stainless		<0.004 at 70°
213	Aluminum	5% free Cla	0.081 at 70°		Stainless		<0.004 at 70°
214	Al Alloy	5% free Cl ₂ 5% free Cl ₂	0.097 at 70° 0.104 at 70°	104	Fe Ni Cu Cr	an Anu anna	No attack Record to boiling
215 216	Al Alloy Al Alloy	5% free Cle	0.105 nt 70°	139	High Si Mo Ir High Si Iron	Any conc.	Recom. to boiling Recom. to boiling
	Ni Cr Si	5, 20% free Cl2	Recom. at 70°	142		5% sol.	<0.001 at 60°
227	Ni Cr Si	5% free Cla	Recom. at 70°	the second se	Al Bronze		Recommended
	Al Bronze	5% free Cl2	Recom. at 70°	249	Cu Ni Zn		Recommended
249	Cu Ni Zn	5% free Cl2	Recom. at 70°- boil.	and the second sec	Copper		Recommended
	- Galante	20% free Cla	Recom. at 70°	266, 277			at and the second second
257	Admiralty	5% free Cl ₂	Recom. at 70°— boil.		Cu Ni Alloy		Recommended
	Copper	5% free Cla	Recom. at 70° Recom. at 70°— boil.		Cu Si Mn		Recommended
273	Bronze	5% free Cl ₂ Dil col or at room temp	Recommended	30S 311	Sb Lead		Probably OK Brobably OK
the second second second second	Cu Ni Alloy	Dil. sol. or at room temp. 5% free Cl ₂	Recom. at 70°	311 314	Chem. Lead To Lead		Probably OK Probably OK
283-285	Gold	5, 20% free Cla	Recom, at 70°— boil.	316	Ni Cu Alloy	<8% sol., aerated	Probably OK <0.001 at 60°
239	Ni Cr Fe W	All conc.	Recom. to 105°	330	Nickel	<8% sol., aerated	<0.001 at 60°
300	NiCr Cu Mo F		Not recom. at 70°		Nickel Silver		Recommended
10000	The Carlos	15% free Cl2	>0.125 at 87°	350-353	P Bronze		Recommended
-			and and the second s	11 CT	and the state of the		

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
359	Red Brass		Recommended	SODI	IUM SULI	HITE	and a state of the state
364	Silver	Sol. Fused salt	Slight attack Attacked	2	Stainless	5% sol.	<0.0042 at 70°
		I USCU SAID	ALBOALD	1212		10% sol.	<0.0042 at 150°
CODI	DAL OTH D	TTATE	- more automotion	221		25% sol.	<0.6042 at boiling
SODI	UM SULP	HAIE				50% sol.	<0.0042 at boiling
2	Stainless	5% - sat. sol.	<0.0042 at 70°	5	Stainless	Sat. sol. 5% sol.	<0.004 at 70°
Hug		Sat. sol.	<0.0042 at boiling	0	Stainless	0% sol. 10% sol.	<0.004 at 70° <0.004 at 150°
5-8	Stainless	Sat. sol.	<0.004 at 70°	E-120		Sat. sol.	<0.004 at 70°
9	Stainless		Same as 2	6-8	Stainless	Sat. sol.	<0.004 at 70°
10, 11	Stainless Stainless	Sat. sol.	<0.004 at 70° No attack	9	Stainless		Same as 2
12, 15 10	Stainless	5% sol. 5% sol.	<0.0042 at 70°	10, 11		Sat. sol.	<0.004 at 70°
10	Granness	Conc. sol.	0.042-0.12 at 70°	12, 15	Stainless	Sat. sol.2	<0.005 at 70°
25	Stainless	Sat. sol.	<0.004 at 70°	19	Stainless	5% sol. 25% sol.	0.042-0.12 at 70° <0.0042 at boiling
103	Cast Iron	10% sol.1	0.0015 at 68°	T Dech		Sat. sol.	<0.0042 at boining <0.004 at 70°
139	High Si Mo Ire		Recom. to boiling	25	Stainless	Sat. sol.	<0.004 at 70°
142	High Si Iron	Any conc.	Recom. to boiling	139	High Si Mo Ir	011	Not recommended
190	Ni Steel	10% sol.1	0.0014 at 08°	142	High Si Iron		Not recommended
209		o Cu Saturated; slurry oys except 297 & 318	No loss at 180° Recommended	209		o Cu Photodeveloper	No loss
213	Aluminum	0.1-10% sol.	<0.001 at room temp.		Al Bronzo		Recommended
265	Ni Cr Alloy	Sol.1	Recommended	249	Cu Ni Zn Admiralty		Recommended Slight to moderate
300		5% or 10% sol. + equal par	rt of 25% H2SO4 0.004-0.015 at boil.	257	. Copper		Recommended
302	Ni Cr Fe	In hot vapors from evap.	<0.001	266, 277			Incommended
308	Sb Lead	All conc.	OK at 70-250°		Bronze		Slight to moderate
311	Chem. Lead	All conc.	OK at all temp.	315, 343			
314 316	Te Lead Ni Cu Alloy	All conc.	OK at all temp.	344, 372			
310	MI Cu Alloy	8% sol., aerated In hot vapors from evap.	<0.001 at atm. temp. <0.001		Cu Ni Alloy		Recommended
S. M. MILL	- 1. • 51 621 1	In high conc. of liquor	<0.001 nt 200°		Cu Si Mn	Automation of the second	Recommended
329	Ni Cr Alloy	Sol.1	Recommended	308	Sb Lead	<20% sol.	OK at ordinary temp:
330	Nickel	8% sol., aerated	None at atm. temp.	311 314	Chem, Lead Te Lead	<20% sol. <20% sol.	OK at ordinary temp. OK at ordinary temp:
1000		In hot vapors from evap.	0.001		Nickel Silver	2070 501	Recommended
332	Ni Cr Alloy	Sol.1	Recommended		P Bronze		Recommended
	Ni Cr Steel	Sat. sol.1	<0.004 at 140°	355, 371	Copper		Slight to moderate
364	Silver	In dyestuff plant	No attack	359	Red Brass		Recommended
SODI 2	UM SULP Stainless	FIIDE 5% sol.	Little or none at 70° ^a	SODI	UM THIC	SULPHATE (HYP	0)
		50% sol.1	<0.001 at 194° ²	2	Stainless	25% sol.3	<0.0042 at 70°- boil.
2824	AL 1.1	Sat. sol.	0.004-0.04 at 70° *		Durinicua	Hypo (acid fixing bath)	<0.0042 at 70°
5-8	Stainless Stainless	Sat. sol.	<0.004 at 70°			Sat. sol.3	<0.004 at 70°
9	Stamiess	5% sol. 50% sol. ¹	Little or none at 70° <0.001 at 194°	5-8	Stainless	Sat. sol.	<0.004 at 70°
Sic. L		Sat. sol.	<0.0012 at 70°	9	Stainless		Same as 2
10, 11	Stainless	Sat. sol.	<0.004 at 70°	10, 11		Sat. sol.	<0.001 at 70°
12, 15	Stainless	5% sol.	Slight at 70°		Stainless Fo Ni Cu Ca	Sat. sol.	<0.005 at 70°
71-12		Sat. sol.2	<0.005 at 70°	104	Fe Ni Cu Cr High Si Mo Ir	on Any conc.	Tarnished Recom. to boiling
19	Stainless	5% sol.	Slight at 70°	142	High Si Iron		Recom. to boiling
Frends.		50% sol. ¹ Sat. sol.	>0.46 at boiling <0.004 at 70°	209		o Cu Std. fixing sol.	No loss at cold
00 91	Stainless	Sat. sol.	<0.004 at 70 <0.004 at 70°	211, 258	Admiralty	Dil. sol. or at room temp.	Recommended
20, 21, 25	Junitadi	Lat. cont		214	Al Alloy	1, 5% sol.	None at room temp:
139	High Si Mo Ire	on Any conc.	Recom. to boiling	248	Al Brass		Same as 211
142	High Si Iron	Any conc.	Recom. to boiling	257	Admiralty Bronze	inten state and more	Slight to moderate Slight to moderate
209		o Cu Digestion	<0.001 at 200°	315, 343			Sught to moderate
and the second second	Admiralty	Dil. sol. or at room temp.	Recommended	344, 372			
218	Al Brass		Same as 211 Severe	297	High Brass		Same as 211
257 272, 273	Admiralty Bronze		Severe	300		Fe Commercial	Recommended
315, 343			the second second second	308	Sb Lead	All conc.	OK at ordinary temp.
344, 372				311	Chem. Lead	All cone.	OK at ordinary temp.
297	High Brass		Same as 211	314 318	Te Lead Muntz	All conc.	OK at ordinary temp. Same as 211
300	Ni Cr Cu Mo I		Recom. at 70°	323	Naval Brass		Same as 211
302	Ni Cr Fe	0.4% sol. unaerated	<0.001 at 108°		Copper		Slight to moderate
12.20		In evaporator conc. from 25		364	Silver		Strong attack
200	Sb Lead	50% sol., unaerated Dil. sol.	0.004 at 320° OK	373	Tobin Bronze		Same as 211
308 311	Chem. Lead	Dil. sol.	OK				
314	Te Lead	Dil. sol.	OK				
316	Ni Cu Alloy	0.4% sol., unacrated	<0.001 at 103°	STEA	RIC ACH		
		In evaporator cone. from 25				malt all	and a could be could be could be a could be a could be a could be a could be
		50% sol., unaerated	0.013 at 320°	2	Stainless		<0.0044 at 176°1
318	Muntz		Same as 211			Concentrated	Little or none at 200°
328	Naval Brass	0.101 1	Same as 211	5-8	Stainless		<0.004
330	Nickel	0.4% sol., unacrated	<0.001 at 108°	9	Stainless	to BUR LEASTANT	Same as 2
1.5		In evaporator conc. from 25		10, 11		and the second s	<0.001
255 944	Connor	50% sol., unacrated	0.022 at 320° Severe	12, 15	Stainless	Concentrated	<0.004 Little or none at 200°
355, 371 364	Silver	Sol.	Slow attack	1.305		100% commercial	>0.1 at 420°
001	SHICE	Fused salt	Rapid attack	19-21	Stainless		<0.004
373	Tobin Bronze	Louis	Same as 211	139		on Any conc.	Record. to boiling
Chart C					- Indiana and a line	the set of	

142 161 209 244, 247 249 257	High Si Iron Cr Steel Fe Ni Cr Si M	Any conc. 100% commercial	Recom. to boiling >0.1 at 420°	365-368	Co Cr W	Wet gas	Recom. at		1= The
209 244, 247 249		100% commercial	>0.1 at 420°	070	m 1 . n				
244, 247 249	Fe Ni Cr Si M		- 0.1 46 140	313	Tobin Bronze	Perfectly dry gas	Recommen	ded	
249		lo Cu In fatty acids	No loss at 200°	-					
249	Al Bronze		Recommended 4	1 Martin					
	Cu Ni Zn		Recommended 4	SUL	HURIC A	CID		or the	
	Admiralty		Slight to moderate	50.50	monite A	CID			
							70°		Boil,
	, Copper		Recommended 4	2	Stainless	5% sol.	0.04-0.12		
66, 277				4	Stanness				>0.42
72, 273	, Bronzo		Slight to moderate	64 352 C		10% Fol.	0.04-0.12	a state of	>0.42
15, 343	 			1.1.1.1		50% sol.	0.12-0.42	300°	>0.42
44, 372						Conc. sol.	<0.004	>0.42	0.12-0.42
	Cu Ni Alloy		Recommended 4	and a state of		Fuming	0.04-0.12		
	Cu Si Mn		Recommended 4	5	Stainless	3% sol.	0.049	180°	
02	Ni Cr Fe	In distillation of mixed stear				3-40% sol.	>0.10	>0.10	
							- 0110	110°	
16	Ni Cu Alloy	In distillation of mixed stear				5% воl.			
		Pure acid, dry	0.002 at atm. temp.					>0.10	
			0.009 at 338°		120123	Conc. sol.	< 0.004		
30	Nickel	In distillation of mixed stear	c and oleic 0.016 at 475°	6, 7	Stainless	Conc. sol.	<0.004		
35, 336	Ni Cr Steel		<0.004 at 176°1	8	Stainless	5% sol.		0.078	
	Nickel Silver		Recommended 4	1. 5. 5. 5		Conc. sol.	<0.004		
	P Bronze		Recommended 4	9	Stainless	5% sol.	0.004-0.04		0.01-0.12
	Copper		Slight to moderate	1. 120		10% sol.	0.004-0.04		-0.12-0.42
						50% sol.	0.04-0.12	300°	0.12-0.42
59	Red Brass		Recommended 4			Conc. sol.			
64	Silver	and the second sec	Resistant	1 HALLAND			< 0.004	>0.42	0.12-0.42
70	Tantalum		None at any temp.		Q. 1.1	Fuming	0.004-0.04		
				10, 11		Conc. sol.	< 0.004		
				12, 15	Stainless	Conc. sol.	< 0.005		
ULP	HUR DIC	XIDE		19	Stainless	5% sol.	0.04-0.12		>0.42
	mon pro	ALLOL		1		10% sol.	0.04-0.12		>0.42
2	Stainless	Moist gas 2	0.0042-0.042 at 70°	1 11-2		50% sol.	0.01 0.12	300°	>0.42
3.0	6700111Cobd	Dry gas	<0.0042 at 575°	19 19 19		Conc. sol.	-0.004	>0.42 ·	
-			<0.010 at 70°	0.5	a		< 0.004		0.12-0.42
5	Stainless	Moist gas		25	Stainless	Conc. sol.	<0.004	95°	
		Dry gas	<0.004 at 575°	31	Stainless	2-10% sol.		>1.0	
6-8	Stainless		<0.004 at 70° 2	32	Stainless	2% sol.		0.88	
9	Stainless	Moist gas	<0.0042 at 70°	and the second		10% sol.		>1.0	
		Dry gas	<0.0042 at 575°	33	Stainless	0.5% sol.	R		
10, 11	Stainless	up and and	<0.004 at 70° 2			2% sol.		0.29	
19	Stainless	Moist gas	0.012-0.12 at 70°	at the state					
19	istannesa		<0.0012 at 575°		0. 1.1	10% sol.	-	>1:0	
	0.11	Dry gas		34	Stainless	0.5% sol.	R		R
25	Stainless		<0.004 at 70° 2			2.5% sol.	R		R
39	High Si Mo Ir		Not recommended	-		60, 95% sol.	R		
42	High Si Iron		Not recommended	35	Stainless	0.5% sol.	R		
00	Ni Steel		0.55 at 1292°	1.000		2% sol.		<0.003	>1.0
09	Fe Ni Cr Si M	o Cu 6% water sol.	No loss at cold	200323		2.5% sol.	0.004		
		6% water sol.	<0.001 at 175°					0,03	510
11 050	Admiralty		Recommended	-	0	10% sol.	0.03	0,03	>1.0
		reneetty uty gas		36	Stainless	0.5% sol.	R		
14	Al Alloy	the local sector of the	<0.001 at room temp.	2 M		2.5% sol.	0.2		
	Al Bronze		Recommended	177 17	a start of the	10% sol.	0.7		
48	Al Brass		Recommended	37	Stainless	2% sol.		0.001-0.2	>1.0
49	Cu Ni Zn	Wet or dry gas	Recommended	- 1		10% sol.		0.7	>1.0
57	Admiralty		Slight to moderate	38	Stainless	0.5-10%	R		
	Copper	Wet or dry gas	Recommended	39	Stainless	2% sol.	10	0.001-0.002	
66, 277			the second se	0.5	Dualingas				
	Bronze		Slight to moderate	7 9 9 5 3		10% sol.		0.02-1.0	
			Sugut to moderate	1		A A A A A A A A A A A A A A A A A A A		131°	
15, 343,				10.55		2% sol.		0.004-0.5	
44, 372		and the second sec	the specific to the second	6 10 10 10		10% sol.		>0.5	
75, 276	Cu Ni Alloy	Wet or dry gas	Recommended	41	Stainless	0.5, 2.5, 95% sol.	R		
83-285	Cu Si Mn	Wet or dry gas	Recommended	42		0.5% sol.	R		
92	Ni Cr Fe W	Wet gas	Preferred to 293	1		2.5% sol.	0.002		R
93	Ni Si Cu		Recom. to 155°	7-2 05			0.002		
	High Brass		Recommended	40	01.11	10% sol.			
97				43		0.5-10% sol.	R		D
00	NI CF CU MO		Not recom. at 1,800°	44		0.5% sol.	R		R,
			0.004-0.015 at 150°	10000		2.5-95% sol.	R		
)2	Ni Cr Fe	1% sol.	0.011 at 68°	46, 47, 50	Stainless	0.5, 2.5, 95% sol.	R		
		5-6% sol.	0.024 at 65°	52		0.5-95% sol.	R		
			<0.001 at 68°	53	and the second sec	0.5% sol.	R		R
		Gas: little SO2, solids, and mo		00	C. Validices				
10	Sh Load				a	2.5-95% sol.	R		
08	Sb Lead		OK at 70-250°	55		0.5, 2.5, 95% sol.	R	1010	
1	Chem. Lead		OK at 70-392°	56	Stainless	0.5% sol.	R	131°	
14	Te Lead		OK at 70-392°	1 395		2% sol.	< 0.001	0.002-0.01	0.7-3.0
16	Ni Cu Alloy	1% sol.	0.062 at 68°	1.				95°	
		7% sol.	0.004 at 65°	8		10% sol.	0.005	0.004-0.02	>1.0
			0.047 at 120°	58	Stainless	0.5-95% sol.	<0.004	T. Prod In	1.1
		Gas: little SO2, solids, and mo	the second	59	Stainless	0.5% sol.	R		R
	Munta			00	Pourint 22				
	Muntz		Recommended	- 0000-		2.5% sol.	<0.001		0.05
	Naval Brass		Recommended	1 - 100		10% sol.	0.001		0.4
	Nickel	1% sol.	0.054 at 68°			95% sol.	R		
10			0.013 at 68°	61	Stainless	0.5% sol:	R	95°	
10		Gas: little SO2, solids, and mo		S 26 -		2% sol.	R	0.16	11
10		una, nuc DOZ BUIUS, and mo		1			16		1.1
	NT 1 1 01	117. 4 J	Development and a second						
7, 338	Nickel Silver		Recommended	1 22 21		10% sol.	and the second	0.12	>1.0
7, 338	Nickel Silver P Bronze		Recommended Recommended		the start	95% sol.	R	0.12	>1.0
17, 338 10-353		Wet or dry gas		80	Stainless		R R	0.12	
17, 338 10-353 15, 371	P Bronze Copper	Wet or dry gas	Recommended Slight to moderate	80	Stainless	95% sol. 0.5–2.5% sol.	R		>1.0 R
7, 338 0-353 5, 371 9	P Bronze	Wet or dry gas	Recommended	80 83	Stainless Ni Steel	95% sol.		0.12 180° >0.1	

No.	Material	Exposure Conditions	(Inches	Corrosion per Year @		No.	Material	Exposure Conditions	(Inche	Corrosion s per Year @	
	NT 04 1		70°	180°	Boil.				70°		
83 91	Ni Steel Cr Ni Steel	40% sol. 0.5% sol.	0.018 R	>0.1	R	214-216	Al Alloys	0.5 % sol. 2.5% sol.	0.011-0.013		
	Or the block	2.5% sol.	R			15 21		10% sol.	0.043-0.04		
102	Cast Iron	48% sol.1	0.279					25% sol.	0.059-0.08		
		61% sol.1	0.007 0.003					60% sol.	0.12-0.22		
1.50		73% sol.1 84% sol.1	0.003			224	Al Bronze	95% sol. 0.5-25% sol.	0.41-0.48 R		Boil.
1	and the	91% sol.1	0.008				Ni Cr Si	0.5, 2.5% sol.	R		R
		94% sol.1	0.003			1 /-	in the	10-95% sol.	R		
		99% sol.1	0.003			229	Ni Cr Alloy	0.5% sol.	R		R
104	Fe Ni Cu Cr	100% ¹ All conc. except fuming	0.004 Suitable at	80°		244	Al Bronze	2.5, 10% sol. 0.5-25% sol.	R R	1	R
	1011100001	All conc. <60Be'	Suitable to				In Dionac	60, 95% воl.	R		7.6
105	Ni Cr Steel	0.5-2.5% sol.	R		R	245	Al Bronze	0.5, 2.5% sol.	R		R
100	E. M. C. C. J	10-95% sol.	R		0.020	0.0	0. 1. 1.	18, 25% sol.	R		m
122 129	Fe Ni Cr Cu M High Si Iron		R	1	0.036 R	249	Cu Ni Zn	0.5-25% sol. 60, 95% sol.	R R		R
1.00	ABER OF MOR	10% sol.	<0.001		R	257	Admiralty	0.5% sol.	R		R
		25% sol.	< 0.001		R		23.8 4	2.5% sol.	R		
1		25-95% sol.	R		R	266, 277	Copper	0.5-25% sol.	R		R
137	Ni Cr Cast Iro	95% sol.	<0.001 0.012		R 0.022	273	Bronze	60, 95% sol. 0.5, 2.5% sol.	R R		R
138	Fe Cr Ni Mo	0.5% sol.	R		R	276	Cu Ni Alloy	0.5-2.5% sol.	R		R
1		2.5, 95% sol.	R			1 3 3 1 2 1 2		60, 95% sol.	R		
139 140	High Si Mo Ire		R		R	282	Ni Cr Cu Mo	W 0.5-25% sol.	R		R
140	Fe NI CF MIO (Си 0.5-10% воі. 25, 60% воі.	R R		R	1-457		60% sol.	R R		D
1		95% sol.	R	176°	R	283-285	Cu Si Mn	95% sol. 0.5-25% sol.	R		R R
141	Fe Ni Cr Cu M	Io 0.5-25% sol.	R	R	R	122.00		60, 95% sol.	R		
1	The Ci Ison	60, 95% sol.	R	R	A. 1915	286	Al Bronze	0.5-95% sol.	R		R
142	High Si Iron Cr Mo Steel	Any conc. 2% sol., acrated	R >1.0		R	289 290	Gold Ni Mo Fe	0.5-95% sol. 10% sol.	R 0.0028	158° 0.028	R 0.036
151	Cr Mo Steel	2% sol., acrated	0.55	180°		200	NI MO PO	25% sol.	0.0025	0.023	0.038
157	Ni Cr Steel	3% sol.	0.023	>0.1				60% sol.	<0.001	0.012	3.8
		20% sol.	0.031	>0.1				85% sol.	0.0011	0.019	2.4
158	Fe Ni Cr W	40% sol. 3% sol.	0.025 0.041	>0.1 >0.1		291	Ni Mo Fe	96% sol. 10% sol.	<0.001 0.0018	0.0079 0.022	7.7
100	Ferrior	20% sol.	0.045			201	MINIO PO	25% sol.	0.0012	0.0022	0.0024 0.0018
1		40% sol.	0.042	>0.1		1- 1-		60% sol.	<0.001	0.0022	0.037
159	Fe Ni Cr Cu	3% sol.	0.023	>0.1				85% sol.	0.0012	<0.001	0.840
5.4		20% sol. 40% sol.	0.025 0.028	>0.1 >0.1		500	W. C. P. W	96% sol.	<0.001	0.0012	0.460
161	Cr Steel	10% sol.	>0.1	110°		292	Ni Cr Fe W	10% sol. 25% sol.	Nonc <0.001	0.6038 0.0077	0.050 0.047
163	Cr Ni Steel	5% sol.		>0.1				60% sol.	None	0.012	3.6
172	Ni Fe Cr	0.5, 2.5%	R		R			85% sol.	< 0.001	0.0014	2.2
176	Fe Ni Cu Cr	10-95% 0.5% sol.	R Recom at	70°-boiling		293	Ni Si Cu	96% sol.	None	0.0025	0.31
110	FE IN OU OF	5-80% sol.	0.02-0.09 a		the the sale	293	NIBICU	10% sol. 25% sol.	0.0023 0.0013	0.018 0.013	0.013 0.0089
12.		5-30% sol.	0.38-2.5 at	194°				60% sol.	< 0.001	0.0031	0.089
(10% sol.	0.0044 at 7			1 Sunta		85% sol.	0.0023	0.047	0.30
425		25% sol. 80% sol.	0.001 at 70 0.25-0.5 at			1 7.5%		96% sol.	<0.001	0.0084	0.42
1		0070 501.	70°	194	Boil.	295	Cu Si Mn Sn	Evaporated to fumes 0.5-25% sol.	0.054 R		R
180	Cr Cast Iron	0.5% sol.	R		Don	230	Ou bi mu ba	60, 95% sol.	R		r
		60, 95% sol.	R		R	296	Cu Si Sn	0.5-95% sol.	R	170°	
188	Steel	10% sol.1	0.133 0.007			300	Ni Cr Cu Mo	Fe 10% sol.	< 0.004	<0.004	0.004-0.015
200	Ni Cr Fe	Conc. sol. ¹ 95% sol.	0.007 R			in standing		25% sol.		100° <0.004	0.004.0.045
200	Fe Cr Ni Mo	- I I I I I I I I I I I I I I I I I I I	R	Children and		19 7.53		50% sol.	< 0.004	180°	0.004-0.015 0.015-0.05
209		o Cu All conc.	<0.001 at			100 20		75% sol.	< 0.004	0.015-0.05	>0.125
		0.5% sol.	<0.001 at					95% sol.	<0.004 at		
100		3% sol., C. P. 5% sol., C. P.	<0.015 at 0.0274 at 1			1		95% sol. 98% and furning (109%)	>0.125 at		
13		5% + 0.5% H ₂ SO ₃	No loss at			302	Ni Cr Fe	0.5% sol.	Recom. at <0.005	100	<0.005
1		10% sol., C. P.	<0.0031 at	200°			soft, she	2.5% sol.	<0.005	86°	0.01-0.03
ALC-		20, 40, 50% sol., C. P.	<0.030 at					5% sol., aerated		0.081	
		65% sol., C. P. 93% sol., C. P.	Not satisfa 0.020 at 14	ctory at 176	TUN TU	1 20.12		5% sol., unaerated		0.008	
1 Car		93% sol., C. P.		etory at 176		- mais		5% sol., acrated		180° 0.147	
17-24			125°	160°	200°	1. 1. 1. 1.		5% sol., sat. with H ₂		0.045	
1		94% sol.	0.0076	0.050	0.006	102		10% sol.	<0.01		0.24
010	Wannelt Your	95% sol.	0.0097 Research	0.032	0.060	-		19% sol.			0.64
210	wrought from	In >77.6% sol.	Reasonably 70°	y good to bo	Boil.	14.95		25% sol. 60% sol.	<0.01 0.046	86°	0.64
211	Admiralty	0.5-10% sol.	R		R R	114450		93% sol., aerated	0.030	0.01	
1		25-95% sol.	R		I te da la	305-307	Ir Platinum	0.5-95% sol.	R	250°	R
213	Aluminum	0.5% вој.	0.012			308	Sb Lead	0.5-80% sol.	R	R	
154		2.5% sol.	· 0.022			200	Ch T	80-95% sol.	R		D
5100		10% sol. 25% sol.	0.033 0.060			309	Sb Lead	0.5-10% sol.	R R		R
1.1		60% sol.	0.000		in the second	310	Lead	25-95% sol. 0.5% sol.	R <0.001		<0.001
	1= 12 1-1	95% sol.	0.37					10, 25% sol.	0.001		0.002
TRE		100%	0.002		and the second			60% sol.	0.001		0.003
		105%	0.004		Europe			95% sol.	0.001		R

No.	Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)	No. Material	Exposure Conditions	Corrosion (Inches per Year @ Deg. F.)
	Wing the State	and the second second	70° Boil.	292 Ni Cr Fo W	All conc.	Preferred to 293
311	Chem. Lead	0.5-80% sol.	R R	293 Ni Si Cu	All cone:	Recom. at all temp.
	~ · · ·	80-95% sol.	R	308 Sb Lead		OK below 250°
312	Chem. Lead	0.5-60% sol.	R R R	311 Chem. Lead 314 Te Lead		OK below 428°
313	Te Lead	95% sol. 0.5-60% sol.	R R	314 Te Lead 337, 338 Nickel Silver		OK below 428° Recommended
919	Te Dead	95% sol.	R	350-353 P Bronze		Recommended
314	Te Lead	0.5-80% sol.	R R	355, 371 Copper		Slight to moderate
		80-95% sol.	R	359 Red Brass		Recommended
	, Bronze	0.5-5% sol.	Slight to moderate		the is a set is	
372	Nº On Allen	FOT and annotad	0.039 at 86°	TANNIC ACIE	15 4 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
316	Ni Cu Alloy	5% sol., aerated 5% sol., unacrated	0.007 at 86°	2 Stainless	Sol.	<0.0042 at 70°
		5% sol., aerated	0.117 at 180°	1 2 - 1 U	Sol.	0.0042-0.042 at 150°
		5% sol., sat. with H2	0.01 at 180°		10% sol.1	<0.0046 at 68°
		19% sol.	0.008 at boiling		10% sol. ¹ 50% sol. ¹	<0.131 at boiling <0.0046 at 68°- boil.
		50% sol.	0.65 at boiling	5 Stainless	Sol.	<0.004 at 70-150°
		70% sol., unacrated	0.016 at 100°	6-8 Stainless	Sol.	<0.004 at 70°
320	Ni Cr Alloy	93% sol., acrated 0.5, 2.5% sol.	0.11 at 86° Recom. at 70°— boil:	9 Stainless	Sol.	<0.0042 at 70-150°
020	NI CE Alloy	10-95% sol.	Recom. at 70°	2	10% sol.1	Same as 2
330	Nickel	5% sol., aerated	0.087 at 86°		50% sol.1	Same as 2
	anser	5% sol., unaerated	0.003 at 86°	10, 11 Stainless	Sol.	<0.001 at 70°
		5% sol., aerated	0.103 at 170°	15 Stainless	Sol.	0.0042-0.042 at 70°
		19% sol.	0.11 at boiling	19 Stainless	Sol. Sol.	0.042-0.12 at 150° <0.0042 at 70-150°
		70% sol., unaerated	0.029 at 100°	10 Statilless	Sol. ¹	<0.042 at 70-150°
007 70-	NI 1 1 01	95% sol., aerated	0.047 at 70°	104 Fe Ni Cu Cr		Tarnished only
337. 338	Nickel Silver	0.5-25% sol.	Recom. at 70°— boil: Recom. at 70°		lo Cu Tannin extract	No loss at cold
343	Bronze	60, 95% sol. 0.5, 2.5% sol.	Recom. at 70° boil	All Cu - Bas		Recommended
346	Palladium	0.5-00% sol.	Recom. at 70° boils	219 Al Alloy	10% sol.	<0.001 at room temp.
010		95% sol.	Recom. at 70°	308 Sb Lead		Not recommended
350-353	P Bronze	0.5-25% sol.	Recom. at 70° - boil:	311 Chem. Lead		Not recommended
		00, 95% sol.	Recom. at 70°	314 Te Lead 316 Ni Cu Alloy	107	Not recommended 0.003 at boiling
	Copper	0.5-5% sol.	Slight to moderate	310 NI CU Alloy	1% sol. 10, 123% sol.	None at boiling
	Platinum	0.5-95% sol.	Recom. at 70° - boil.	335, 336 Ni Cr Steel	Sol.	<0.004 at 68°
359 362	Red Brass Lead	0.5-10% sol.	Sometimes suitable <0.001 at 70°			A STATE N FILME OF
302	Tierra	25-95% sol.	0.002-0.004 at 70°	TRICHLORET	HYLENE	
363	Silver	0.5-25% sol.	Recom. at 70°- boil.	2 Stainless	Pure	<0.0044 at 68-189°
		60, 95% sol.	Recom. at 70°	5-11 Stainless		<0.004 at 70° 1
364	Silver	>60% sol.	Severe at ordinary temp.	15, 19 Stainless		Little or none at 70°
		Dil. sol.	Slight attack	104 Fe Ni Cu Cr		No attack
		5% sol:	<0.001 at room temp.		on Any conc.	Recom. to boiling
		5% sol. 10% sol.	0.004 at 160° 0.0047 at 160°	142 High Si Iron	Any couc.	Recorn. to boiling
		45.5% (sp. gr. 1.355)	C.03 at 253°	211, 258 Admiralty 213 Aluminum	Challend Bandd	Recommended Suitable at boiling
		85% (sp. gr. 1.80)	Dissolved at once, 520°	213 Aluminum 244, 247 Al Bronze	Stablized liquid	Recommended
365-368	Co Cr W	Any cone.	Recom. at room temp.	248 Al Brass		Recommended
370	Tantalum	0.5-25% sol.	None at 70° boil.	249 Cu Ni Zn		Recommended
		00% sol.	None at 70°	257 Admiralty		Slight to moderate
		60% sol.	Recom. at boiling None at 70°	259, 262, Copper		Recommended
		95% sol.	None at 70°	266, 277		
				272, 273, Bronze		Slight to moderate
SULP	HUROUS	ACID		315, 343, 344, 372		and the house of the second
			1	275, 276 Cu Ni Alloy		Recommended
	Stainless	material are listed under Sulp Sat. sol. ²	0.042-0.12 at 70°	283-285 Cu Si Mn		Recommended
-	Dumess	Sat. sol. ²	0.042-0.12 at 375°, 150 pai.	302 Ni Cr Fe	Alternate exposure to solver	
		Spray *	0.12-0.42 at 70°	the second is The	+ H:O, and solvent vapo	70
5	Stainless	VENTRE CLU	Not recom. at 250°	The second second	+ steam	<0.002 at 212°
9	Stainless	Sat. sol.2	0.0042-0.042 at 70°	C Start and	Vapor + entrained liquid +	
		Sat. sol.2	0.0042-0.042 at 250°, 60 psi.	316 M: C. Ula	steam	<0.001 at 169–198° Same as 302
		Sat. sol.2	0.042-0.12 at 310°, 70-125 psi.	316 Ni Cu Alloy 330 Nickel		Same as 302 Same as 302
		Sat. sol. ² Spray ²	0.042-0.12 at 375°, 150 psi.	337, 338 Nickel Silver		Recommended
15, 18	Stainless	ohisk-	0.12-0.42 at 70° Not recom. at 250°	350-353 P Bronze		Recommended
19, 18	Stainless	ALTER THE STAR	Same as 2	355, 371 Copper		Slight to moderate
20	Stainless		Not recom, at 250°	359 Red Brass		Recommended
139	High Si Mo Ir	on	Not recommended	- 07		the set of the set
142	High Si Iron	10/12 -1 -1	Not recommended	CAUTIONI Teles	atory tests made with a	hemically pure reagents under
1\$8	Steel	Conc. sol. ¹	0.13 at 64°	carefully controlle	d conditions seldom if e	ver approach actual operating
213 215	Aluminum Al Alloy	3% sol. 3% sol.	0.0096 at room temp. 0.011 at room temp.	for the most part	laboratory data and as	ere by the manufacturers are such are to be used only as
	Al Alloy Al Bronze	0 /0 SM.	Recommended	an indication as	to whether or not servi-	ce tests or trial installations
249	Cu Ni Zn		Recommended	rate or to estimat	e the life of equipment.	used to calculate depreciation
257	Admiralty		Slight to moderate	In writing to m	auufacturers for supplem	y recommends the submission
	Copper		Recommended	OF the very fulles	t information in regard	to the actual conditions en-
266, 277	11-11-		SO THE WAY LOUDE WE			
72, 273,			Slight to modrate	and temperature,	may result in the selec	tion of an improper material
15, 343,		Particular 170		FOOTNOTES :	to the user Editors.	ition, agitation, concentration tion of an improper material
				Brothers, Inc. An	"Korrosionstabellen metal	llischer Werkstoffe," Edwards g may occur when allowed to level. ³ Attack may occur if tin-costed Ca and Cu alloys.
14, 372	C. M. 10.					
275. 276	Cu Ni Alloy Cu Si Mn		Recommended Recommended	dry, by condensat	ion, or at the air-liquid	level. 3 Attack may occur it

NON-METALLIC MATERIALS

STRUCTURAL CARBON AND GRAPHITE

Makers of Structural Carbon and Graphite Products

MANUFACTURER (Name and Address)	Products	MANUFACTURER (Name and Address)	Products
Acheson Graphite Corp., New York, N. Y International Graphite & Electrode Corp., St.		Speer Carbon Co., St. Mary's, Pa	Carbon and graphite brick, plates, blocks, tubes, cylinders, bushings, shapes
Mary's, Pa National Carbon Co., Inc., Cleveland, Ohio	Graphite electrodes and various shapes Carbon and graphite brick, tile, tower pack- ing, tubes, pipe, special shapes, electrodes		Various carbon and graphite products

CHEMICAL STONEWARE, PORCELAIN. CEMENTS

Physical Properties of Chemical Stoneware and Porcelainware

Chemical Stoneware

The accompanying table, which has been prepared for us by the General Ceramies Co., gives the physical properties of an average grade of chemical stoneware. It should be emphasized here that "chemical stoneware" is not the name of a definite material, such as an alloy, but a generic term applied to a wide variety of ceramic compositions, and hence that in any particular composition designed to give optimum properties in one respect, it will ordinarily be impossible to secure optimum properties in all other respects.

Ultimate tensile strength, lb. per sq. in 2,000-3,000 Thermal cond., B.t.u. per hr., sq. ft., °F., in Ultimate compressive strength, lb. per sq. in. 80.000 Linear thermal expansion, per °F.....

10 - 350.0000020 Modulus of rupture, lb. per sq. in 5,000-13,000 Water absorption, percent. 0 - 2 Chemical Porcelainware

Data supplied by Lapp Insulator Co).
Specific gravity	2.41
Ultimate tensile strength, lb. per sq. in	5,-8,000
Ultimate compressive strength, lb. per sq. in	100,000
Modulus of rupture, lb. per sq. in	12,-15,000
Modulus of clasticity, lb. per sq. in	10,400,000
Specific heat	0.2
Thermal cond., B.t.u. per hr., sq. ft., °F., in	8.4
Linear thermal expansion, per °F	0.0000023
Water absorption, percent	0

Makers of Chemical Stoneware, Porcelain, Acidproof Brick and Stone

MANUFACTURER (Name and Address)	Materials	MANUFACTURER (Name and Address)	Materials
Chemical Stoneware			and all stands and stand and stands
General Ceramics Co., New York, N. Y	Complete line, see note below	Harbison-Walker Refractories Co., Pitts-	
Maurice A. Knight, Akron, Ohio	Complete line, see note below	burgh, Pa	Acidproof brick and tile, tower linings, and
United States Stonewaro Co., Akron, Ohio	Complete line, see note below	a callent to a prover the work out	tower packings
		B. Mifflin Hood Co., Daisy, Tenn	Acidproof brick tower packings, flooring tiles
Chemical Porcelain	- Contraction of the second	Keagler Brick Co., Steubenville, Ohio	Acidproof brick, acidproof paving block, and
Coors Porcelain Co., Golden, Colo	Porcelain laboratory ware		acidproof flooring tile
Illinois Electric Porcelain Co., Macomb, Ill.	Chemical porcelain ware of all types	Kewaunce Mfg. Co., Kewaunce, Wis	Karcite acidproof ceramic ware, and Kemrock
Lapp Insulator Co., LeRoy, N. Y.	Chemical porcelain ware of all types	south Leaders and the owners	chemical resistant stone
General Ceramics Co., Keasbey, N. J.	Chemical porcelain ware of all types	Laclede-Christy Clay Prod. Co., St. Louis,	
Official Celamics Co., Reasbey, N. C	Chemical porceiant wate of an types	Mo	Acidproof brick
Acidproof Brick and Other	The United States of the United States	McLain Fire Brick Co., Pittsburgh, Pa	Acidproof brick
and a second sec	Constraint and should	McLeod & Henry Co., Troy, N. Y	Acidproof brick
Acme Brick Co., Forth Worth, Tex	Acidproof brick	Metropolitan Paving Brick Co., Canton, Ohio	
Alabama Clay Products Co., Birmingham, Ala.	Acidproof brick	National Carbon Co., Inc., Cleveland, Ohio.	Carbon brick
Alberene Stone Corp. of Va., New York, N. Y.	Acidproof stone	Nukem Products Corp., Buffalo, N. Y	Acid and alkali proof construction
Atlas Mineral Products Co., Mertztown, Pa	Acidproof brick construction	Parker-Russell Mining & Mfg. Co., St. Louis,	and the second second second second
Belden Brick Co., Canton, Ohio	Acidproof brick and tile, rings	Mo	Acidproof brick
Charlotte Chemical Labs., Charlotte, N. C	Acidproof brick, rings	Patterson Foundry & Mashine Co., East	
Claycraft Co., Columbus, Ohio	Acidproof brick, floor brick	Liverpool, Ohio	Acidproof lining blocks and grinding balls
Custodia Construction Co., New York, N. Y	Acidproof brick construction, towers, tanks	Quigley Co., New York, N. Y	Acidproof brick
Electro-Chemical Supply & Engineering Co.,	tex a section change out on real	Robinson Clay Product Co. of N. Y., New	
Paoli, Pa	Acidproof brick and masonry materials	York, N. Y	Acidproof and vitrified sewer tile
Filtros, Inc., East Rochester, N. Y	Acidproof mineral as plates, cylinders, etc.	Southern Clay Mfg. Co., Chattanooga, Tenn.	Acidproof brick
General Refractories Co., Philadelphia, Pa	Acidproof tower packing, and acidproof brick	Thornton Fire Brick Co., Clarksburg, W. Va	Acidproof brick
and the second s		Uhl Pottery Co., Huntingburg, Ind	Acidproof ceramics

CHEMICAL & METALLURGICAL ENGINEERING • SEPTEMBER 1944 •

Makers of Cements and Putties for Acidproof Brick and Stoneware

(Name and Address)	Trade Names	Compositions, Applications, Types		
Anti-Hydro Waterproofing Co., Newark, N. J.	Anti-Hydro	Water-, acid-, alkali-, oil-resisting concrete mix		
Atlas Lumnite Cement Co., New York, N. Y	Lumnite cement	Cement for corrosion and tempresistant concrete		
Atlas Mineral Products Co., Mertztown, Pa	Tegul-Vitrobond, Minoralead, Tileset, Korez, Alkor, Vitrex and Neolson cements	Thiokol-sulphur, chemical-setting silicate and resin cements, synthetic rubber and resin linings for all acid and alkali-proof construction		
Charlotte Chemical Labs., Charlotte, N. C	Carolina Acid-Proof Cement. Acid-proof putty	Acid-proof cements and putty		
Chemical Construction Corp., New York, N. Y	Acipruf.	Acidproof cement		
Custodis Construction Co., Inc., New York, N. Y	Custodis resin cement, Penchlor, Asplit	Synthetic resin, sodium silicate & phenolic base cements, resp.		
Electro-Chemical Supply & Engineering Co., Paoli, Pa	Duro Standard, Triple X, Syntho, Brimsto, Kemitite, Alk-Li-Pruf	Cements for all acid and alkali conditions; also water and steam		
Filtros, Inc., East Rochester, N. Y	Filtros	Acidproof cement		
General Ceramics Co., Keasbey, N. J.	Ceramet Nos. 1, 2, 3, 4, 5, 6, 7, 8	Plasticized-sulphur base and silicate cement of all types, and resin-base acid-proof cements		
3. F. Goodrich Rubber Co., Akron, Ohio	Plastikon	Rubber-base putty		
The Haveg Corp., Newark, Del	Havegit 41, 43, 50.	Self-hardening phenolic resin coments for acids and alkali Acidproof coment		
Maurice A. Knight, Akron, Ohio	Knight. Acidproof Nos. 1 to 10	Silicate cements for strong acids. Resin cements		
Jukem Products Co., Buffalo, N. Y	Basolit, Plasul, Basolit, Hydro-Plasul, Nukem Resinous Cements, Nu-Mastic, Nukem Primer, Nukem Enamel	Rubberized Sulphur Cements, acid and alkali resin base cements and others for complete acid-proof construction and protection		
Paraffine Cos., San Francisco, Calif		Acidproof cement		
Patterson Foundry & Machine Co., East Liverpool, Ohio	Porox Cement	Silicate cement for strong acids		
Pecora Paint Co., Philadelphia, Pa	Acitite, Acichlor, Cushion Putty	Slow- and quick-drying cements and elastic putties for acids		
Pennsylvania Salt Mfg. Co., Special Chemicals Division, Phila- delphia, Pa.	Penchlor Acid-Proof, Penchlor Fire-Proof, Electric Heater, SWD, Asplit, Asplit F, Asplit FK, Causplit, and S-25 cements	Chemical-setting silicate coments, self hardening resin coments, for both acids and alkalis		
hiladelphia Quartz Co., Philadelphia, Pa	"S" Brand and N 380 Sodium Silicates	Sodium silicates for regular and quick-setting acidproof cements		
Quigley Co., New York, N. Y.	Acid-proof, black gray, quick setting	Silicate cements for acid gases and mineral acids		
Reardon Cement Co., Cincinnati, Ohio	Bedford.	Acid and alkali resisting coments and plastics		
The Sullivan Co., Memphis, Tenn	Acidol, Sulsilo	Pouring coments and pre-mixed silicate coments for strong acids		
auereisen Cements Co., Sharpsburg, Pa	Insa-Lute Nos. 31, 48, 46, 44.	Quick-setting, air-drying, sulphur and bitumastic cements		
Inited States Stoneware Co., Akron, Ohio	Portite, Pre-Mixt, Calktite and others	Silicate cements of all types, resin cements, putties, etc.		
Jnion Bay State Co., Cambridge, Mass	N Series (ncoprene base) cements, and special base			

GLASS, GLASS-LINED AND FUSED SILICA

Physical Properties of Low-Expansion Glasses, Fused Quartz and Fused Silica

MATERIAL	Specific Gravity	Specific Volume, Cu. in per lb.	Tensile Strength, Lb. per sq. in,	Modulus of Elasticity, Lb. per sq. in. (Multiply by 10%)	Hardness*	Thermal Expansion Per °C. (Multiply by 10-4)	Thermal Cond., Cal. per sec., cm. ² , °C., cm., (Multiply by 10*)	Specific Heat, Cal. per °C., gm.	Softening Point, °F,	Breakdown Voltage, 60 cycles, v. per mil	Dielectric Constant, 60 cycles	Refractive Index, n. A. D.	Transparency†	Forms Ayailablo.
Borosilicate glass	2.23	12.4	10,000	98		0.32	24.5	0.20	1,505	3,200 (0.1 in.)	4.6	1.47	T, TL	S, R, T, other
96% silica glass	2.18	12.7				0.080	·i.c.		$2,750 \pm 90$	3,000	4.0	1.458	Т	R. T, other
	0.00	12.6	1.000	105 100	1.0	0.054			1-500-1-0-1	- in the	Approx.	Section 1	1 pasta	
Fused quartz	2.20		4,000	105-126	4.9	0.054	33.2	0.25	2,600	500 (1/4 in.)	3.8	1.459	Т	S, R, T, other
Fused silica,	2.07	13.4	400-800	94-114		0.054	33.1		2,600	250 (1/4 in.)	3.7		TL, O	S, R, T, other
Fused silica	2.07	13.4	400-800	94-114		0.054	33.1		2,600	250 (14 in.)	3.7		TL, O	

• Hardness: 2.5 mm. ball, 25 kg, load, depth in 1/209 mm. + T= transparent; TL=translucent; O=opaque. •• S=sheets; R=rods; T=tubes.

Makers of Glass, Glass-Lined and Fused Silica Equipment

Manufacturers (Name and Address)	Composition, Forms Available	Manufacturers (Name and Address)	Composition, Forms Available
Alsop Engineering Co., Milldale, Conn	Glass-lined steel tanks and mixers	Hanovia Chemical & Mfg. Co., Newark, N. J.	Transparent fused quartz in all shapes
Amersil Corp., New York, N. Y		Owens-Corning Fiberglas Corp., Toledo, Ohio	Fibrous glass filter cloths and dust filters
and the second second	coolers, absorbers, quartz insulators, tubes and plates	The Pfaudler Co., Rochester, N. Y	Wide variety of standard and special glass- enameled steel equipment various for-
Corning Glass Works, Corning, N. Y	Special heat and corrosion-resisting boro-		mulas
A STATE OF A		A. O. Smith Corp., Milwaukee, Wis	Glass-lined steel equipment
		The Thermal Syndicate, Ltd., New York,	the second and a second second second
- the barrens of the	silica glassware now available for laboratory use	N. Y	Fused silica (non-transparent) supplied in various large forms; fused quartz (trans-
Ertel Engineering Co., New York, N. Y	Glass-enameled tanks	Vitreous Enameling & Stamping Co., New	parent) in s naller sizes
General Electric Co., Schenectady, N. Y	Transparent fused quartz in various small sized articles	York, N. Y Vitreous Steel Products Co., Cleveland, Ohio.	Enameled specialities, tanks Enameled drying trays and specialities
Glascote Products, Inc., Euclid, Ohio	Glass-enameled steel equipment		in the state of the state of the

PLASTICS AS ENGINEERING MATERIALS Effect on Plastics of Immersion for 7 Days in Chemical Reagents at 25 Deg. C.

	Phenol-	Phenol-	Phenol- Formal-	Urea-	Urea- Formal-	Vinyl		Methyl						
	Formal-	Formal-	dehyde	Formal-	dehyde	Chloride-	Vinyl	Metha-	Styrene			Ethyl-	Cold-	
									Resin	Cellulose	Cellulose	Cellulose	Molded	Casein
	dehyde Molded	dehyde	Lami- nated	dehyde Molded	Lami-	Acetate	Butyral Resin	crylate Resin	Molded	Nitrate	Acetate	No. 1	Phenolic	Plastic
17- Terration Law	Morded	Cast	nateu	Molded	nated	Resin	Aesin	Resin	Monded	Mitrate	Acetate	NU. 1	Fnenone	Fissue
30% Sulphuric acid	Surface	None	Edges	Surface	Surface	None	None	None	None	None	Crazed;	None	None	Rubbery
the sea our realists	roughened		swollen	roughened	attacked						softened			
3% Sulphuric acid	Surface	None	Edges	Surface	Surface	None	Cloudy	None	None	None	Swollen	None	None	Swollen;
	roughened		swollen	roughened	attacked									rubbery
10% Nitric acid	Surface	None	Edges	Surface	Delami-	None	Cloudy	None	None	None	Deconi-	None	None	Swollen;
	roughened		swollen	roughened	nated						posed			cracked
10% Hydrochloric acid	Surface	None	Edges	Surface	Delami-	None	Cloudy	None	None	None	Decom-	None	Cracked	Swollen;
	roughened		swollen	roughened	nated						posed		on drying	cracked
5% Acetic acid	None	None	Edges	None	None	None	Cloudy	None	None	None	Swollen	None	None	Rubbery
			swollen											split
Oleic acid	None	None	None	None	None	None	Tacky	None	None	None	None	Decom-	None	None
												posed		
10% Sodium hydroxide	Decom-	Decom-	Delami-	None	Surface	None	None	None	None	Crazed	Deconi-	None	Decom-	Decom-
	posed	posed	nated		attacked						posed		posed	posed
1% Sodium hydroxide	Surface	Decom-	Edges	None	None	None	Slightly	None	None	Crazed	Surface	None	Decom-	Broken
	roughened	posed	swollen				cloudy				attacked		posed	up
10% Ammonium hydroxide	Surface	Dis-	Dis-	None	None	None	Opaque	None	Dis-	Crazed;	Opaque;	None	None	Swollen;
	dulled	colored	colored;						colored	dis-	soft			split
			edges							colored				
			swollen											
2% Sodium carbonate	Nono	Dis-	Dis-	None	None	None	Slightly	None	None	None	Swollen	None	None	Swollen
		colored	colored				cloudy							rubbery
10% Sodium chloride	None	None	Edges	None	None	None	None	None	None	None	None	None	None	None
the second states			swollen											
3% Hydrogen peroxide	None	Dis-	None	Surface	Delami-	None	Cloudy	None	None	None	None	None	None	Swollen;
		colored		dulled	nated									rubbery
Distilled water	None	None	None	None	None	None	Cloudy	None	None	None	None	None	None	Swollen;
			1-10-											rubbery
50% Ethyl alcohol	None	None	None	None	None	None	Swollen;	Slightly	None	None	Partly	Swollen;	None	Swollen;
			15%				rubbery	swollen			dissolved	cracked		rubbery
95% Ethyl alcohol	None	None	None	None	None	None	Dissolved	Surface	None	Dissolved	Partly	Dissolved	None	None
								attacked			dissolved			
Acetone	None	Softened	Blistered	None	None	Dissolved	Swollen;	Dissolved	Dissolved	Dissolved	Dissolved	Dissolved	None	None
							opaque							
Ethyl acetate	None	None	None	None	None	Decom-	Decom-	Dissolved	Dissolved	Dissolved	Dissolved	Dissolved	None	None
						posed	posed							
Ethylene chloride	None	None	None	None	None	Dissolved	Decom-	Dissolved	Dissolved	Partly	Soft;	Dissolved	None	None
							posed			dissolved	swollen			
Carbon tetrachloride	None	None	None	None	None	None	Swollen;	Surface	D'ssolved	None	None	Dissolved	None	None
							rubbery	attacked						
Toluene	None	None	None	None	None	Soft;	Swollen;	Dissolved	Dissolved	Partly	None	Dissolved	None	None
						rubbery	rubbery			dissolved	1 caria	01-51		
Gasoline	None	None	None	None	None	None	None	None	Partly	None	None	Swollen;	None	None
								-	dissolved			cracked		

From a paper, Resistance of Plastics to Chemical Reagents, by G. M. Kline, R. C. Rinker and H. F. Meindl presented before Chicago meeting of A.S.T.M. June 24, 1941.

Types, Trade Names and Manufacturers of Principal Plastics*

Types	Trade Names	Manufacturers	Types	Trade Names	Manufacturers
Polyethylene Organo-Silicon Phenolic materials	Polyethylene Poly thene Silicone Bakelite Cardolite Celeron Coltrock Durez	Carbide & Carbon Chemicals Corp., N. Y. E. I. du Pont de Nemours & Co., Wilmington, Del. Dow Chemical Co., Midland, Mich. Bakelite Corp., New York, N. Y. Irvington Varnish & Ins. Co., Irvingtou, N. J. Continental Diamond Fibre Co., Newark, Del. Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. Durez Plastics & Chemicals, Inc., N. Touawanda, N. Y.	Urea Melamines Acrylics	Bakclite Beetle Cibanoid Plaskon Uformite Melamae Malamine Crystalite	Bakelite Corp., N. Y. American Cyanamid Co., N. Y. Ciba Corp., N. Y. Plaskon Co., Toledo, Ohio Resinous Products & Chemicals Co., Phila., Pa. American Cyanamid Co., N. Y. Plaskon Co., Toledo, Ohio Rohm & Haas, Phila., Pa.
Phenolie, cast	Durite Haveg Heresite Indur Insurok Makalot Resinox Templus Textolite Bakelite Catalin Gemstone Marblette Opalon Prystal	N. Y. Durite Plastics, Philadelphia, Pa. Haveg Corp., E. Newark, Del. Heresite & Chemical Corp., Indianapolis, Ind. Richardson Co., McIrose Park, Ill. Makalot Corp., Boston, Mass. Monsanto Chemical Co., E. Springfield, Mass. Bryant Electric Co., Pittsfield, Mass. Bakelite Corp., New York, N. Y. Catalin Corp., New York, N. Y. A. Knoedler Co., Lancaster, Pa. Marblette's Corp., L. I. City, N. Y. Monsanto Chemical Co., E. Springfield, Mass. Catalin Corp., N. Y.	Vinyls Vinylidene Chloride Polystyrene	Lucite Plexiglas Alvar Butacite Butvar Formvar Gelva Koroseal Resistoflex Tygon Vinylite Saran Bakelite Loalin Lustron Styron	 E. I. duPont do Nemours Co., Arlington, N. J. Rohm & Haas, Philà., Pa. Shawinigan Prod. Corp., N. Y. E. I. duPont de Nemours Co., Wilmington, Del. Shawinigan Prod. Corp., N. Y. B. F. Goodrich Co., Akron, Ohio Resistoflex Corp., Belleville, N. J. U. S. Stonewear Co., Akron, Ohio Carbide & Carbon Chemicals Corp., N. Y. Dow Chemical Co., Midland, Mich. Bakelite Corp., N. Y. Catalin Corp., N. Y. Monsanto Chemical Co., E. Springfield, Mass. Dow Chemical Co., Midland, Mich.

Types, Trade Names and Manufacturers of Principal Plastics (Continued)

Types	Trade Names	Manufacturers	Types	Trade Names	Manufacturers
Cellulose Acetate	Bakelite	Bakelite Corp., N. Y.	Laminated Materials.	Corresito	S. Blickman, Inc., Weehawken, N. J.
	Cellulate	National Plastics Co., Detroit, Mich.		Dilecto	Continental Diamond Fibre Co., Newark, Del.
	Fibestes	Monsanto Chemical Co., E. Springfield, Mass.		Dilectene	Continental Diamond Fibre Co., Newark, Del.
	Gemloid	Gemloid Corp., N. Y.		Duraloy	Detroit Paper Products Co., Detroit, Mich.
	Lumarith	Celanese Cellulo id Corp., N. Y.		Formica	Formica Insulation Co., Cincinnati, Ohio
	Macite	Manufacturers Chemical Corp., Jersey City, N. J.		Insurok	Richardson Co., Melrose Park, Ill.
	Nixonite	Nixon Nitration Works, Nixon, N. J.	The same les	Lamicoid	Mica Insulation Co., N. Y.
	Plastacele	E. I. du Pont de Nemours & Co., Arlington, N. J.	WA - Intell - a	Lamitex	Franklin Fibre-Lamitex Corp., Wilmington, Del.
	Tenite I	Tennessee Eastman Corp., Kingsport, Tenn.	inter and	Micarta	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa
Cellulose Acetate Buty-		And a set of the set o	ton stopping	Panelyte	Panelyte Corp., N. Y.
rate	Tenite II	Tennessee Eastman Corp., Kingsport, Tenn.		Ohmoid	Wilmington Fibre Specialty Co., Wilmington, Del
Ethyl Cellulose	Ethocel	Dow Chemical Co., Midland, Mich.	- A LA LENG	Phenolite	National Vulcanized Fibre Co., Wilmington, Del.
in the second second	Hercules	Hercules Powder Co., Wilmington, Del.		Spauldite	Spaulding Fibre Co., Tonawanda, N. Y.
aminated Materials	Aqualite	National Vulcanized Fibre Co., Wilmington, Del.		Synthane	Synthane Corp., Oaks, Pa.
	Cellanito	Continental Diamond Fibre Co., Newark, Del.		Taylor	Taylor Fibre Co., Norristown, Pa.
	Celeron	Continental Diamond Fibre Co., Newark, Del.		Textolite	General Electric Co., Pittsfield, Mass.
	Coffite	Formica Insulation Co., Cincinnati, Ohio		Ucinite	Ucinite Co., Newtonville, Mass.
				Vulcoid	Continental Diamond Fibre Co., Newark, Del.

* In this table only the more usual engineering plastics materials are listed by trade name and manufacturers. No attempt has been made to include all types of plastics materials, as that is beyond the scope of this issue of Chem, \pounds Met., which is concerned primarily with materials of construction for chemical engineering equipment. The engineer may find listings of molders and extruders as well as other valuable data in the book by John Sasso. "Plastics for Industrial Use," McGraw-Hill Co., (1942), from which this list was largely compiled.

RUBBER AND LIKE PRODUCTS

Physical Properties of Synthetic and Natural Rubbers

Material	Specific Gravity of Base Material	Tensile Strength, Ib./sq. in.	Hardness, Shore Durometer	Maximum Temp. for Use, °F. ²	Dielectric Strength, v./mm.	Effect of Heat	Abrasion Resistance	Effect of Sunlight ³	Effect of Aging	Machining Qualities
Chemigum, oil resistant	1.0-1,5	800-4,000	30–90	300		Stiffens	Excellent	Equal to rubber	Stiffens	Can bo ground
Chemigum, tire	1.0-1.15	1,000-4,000	50-65	450		Stiffens	Good	None	Better than rubber	
GR-I (Butyl)	0.91	506 3,000	15-90	250-300	25,000	Stiffens slightly	Excellent	None	Highly resistant	Can be ground
GR-M (Neoprene)	1.25-1.30	1,000-4,500	1095	300		Stiffens slightly	Excellent	None	Highly resistant	Can be ground
GR-N (Perbunan)	0.96	500-5,000	30–90	300		Stiffens	Excellent	Slight	Highly resistant	Can be ground
GR-P (Thickol FA)	1.34	1,400	25-90	200		Hardness slightly	Fairly	None	None	Excellent
GR-P (Thiokol ST)	1.27	500-2,000	30-90	250-300		Hardens	Good	None	None	Excellent
GR-S (Buna S), hard	0.94	4,000-11,000	70-951	220				·	Highly resistant	Excellent
GR-S (Buna S), soft	0.94	500-3,000	25-95	300		Stiffens	Excellent	Deteriorates	Highly resistant	Can be ground
Hyear OR-15, soft	1.00	500-4,000	20-95	300		Stiffens	Excellent	Slightly better than natural	Highly resistant	Can be ground
Hy OR-25, soft	0.99	500-3,000	20-95	300		Stiffens	Excellent	rubber Slightly better than natural rubber	Highly resistant	Can be ground
Hycar OR-15, hard	1.00	4,000-11,000	70-95	275					Highly resistant	Excellent
Hycar OS-10, soft	0.98	500-3,500	20-95	300		Stiffens	Excellent	Deteriorates	Highly resistant	Can be ground
Koroseal, soft	1.40	500-2,500	30-50	190	15,000-30,000	Softens	Good	None	Highly resistant	Can be ground
Koroseal, hard	1.40	2,000-9,000	80-100	212	30,000-50,000	Softens	Excellent	None	Highly resistant	Good
Pliolite, No. 40 Resistaflex	1.06	4,000-5,000 2,000-5,000	55-95	160-24S 250	6,000-10,000	Softens Softens	Good	None	None None	
Tygon T	1.33-1.36	9,000		175	35,000-50,000	Softens	Good	None	110100	Excellent
Vistanex, medium,	0.9	200						None	Better than rubber	Cannot be machined
Vistanex, high	0.9	550						None	Better than rubber	Cannot be machined
Natural rubber, hard,	0.93	4,000-11,000	70-95 ¹	220					Highly resistant	Excellent
Natural rubber, soft	0.93	500-5,000	20-95	300		Softens	Excellent	Deteriorates	Moderately resistant	Can be ground

¹ Type "D". ² Maximum temperature suitable for service depends greatly upon the exact service conditions. Maximum temperature for use as a packing can be much higher than the maximum temperature suitable for tank lining. Individual cases should be referred to the supplier for recommendations. ³ Effect of exposure to sunlight under tension.

Representative Makers of Industrial Rubber Products and Rubber-Like Materials

	Wanufacturers (Name and Address)	Products	Manufacturers (Name and Address)	Products
An	nerican Hard Rubber Co., New York, N. Y.	Hard and soft rubber, neoprene and Thiokol linings, pipe, fittings, shapes, pails, pumps,	The Osborn Mfg. Co., Johns Conveyor Div., Cleveland, Ohio	Johns rubber and synthetic rubber "moving
An	nerican Wringer Co., Woonsocket, R. I	rubber paint, anode process, etc. Tensilgrip natural and synthetic rubber lined tanks, vats, pipe, buckets, propellers, shafts,	Maurice A. Knight, Akron, Ohio	pipe-line" conveyors All-rubber acid shipping drums. Pyrofler resin-base tank linings
12		stacks, flues, pumps, impellers, filter press frames, etc.	Linear Packing & Rubber Co., Philadelphia, Pa	Rubber and synthetic rubber packings
	las Mineral Products Co. of Pa., Mcrtz- town, Pa	Rewbon seamless rubber linings, Neobon and Zerok synthetic resin linings	Luzerne Rubber Co., Trenton, N. J.	Hard rubber pipe, fittings, valves, shapes tanks, rayon apparatus and other equip ment
	ston Woven Hose & Rubber Co., Boston, Mass	Conveyor and transmission belts, hose,	Manhattan Rubber Mfg. Div., Passaie, N. J	Transmission and conveyor belting, blocks hese, piping, rolls, brake lining, bearings
Cr	ane Packing Co., Chicago, Ill	mechanical rubber goods Rubber and synthetic rubber packings and mechanical seals		Rubber and synthetic rubber hydrautic of packings and scals
	istodis Construction Co., New York, N. Y	linings	Paramount Rubber Co., Detroit, Mich	Neoprene tank linings and rack coatings masking stop-off parts, plastic laminate
	ayton Rubber Mfg. Co., Dayton, Ohio I. du Pont de Nemours & Co., Neoprene	Oilproof rubber belts, transmission belting, synthetic rubber products	Resistoflex Corp., Belleville, N. J	products Rubber-like oil-resisting resin — tubing, hose sheets, molded shapes, gloves, aprons
	Div., Wilmington, Del restone Tire & Rubber Co., Akron, Ohio		Self-Vulcanizing Rubber Co., Chicago, Ill	solutions, gaskets, Liquid and plastic rubber self-vulcanizin coatings and lining materials
		plastic products, rubber to metal bonded products, vibration dampeners, adhesives, sheet stock, friction tape, hose, V-belting, Velen woven fabric, plastic moisture-vapor proof film	Standard Oil Development Co., Elizabeth, N. J Jos. Stokes Rubber Co., Trenten, N. J	Perbunan synthetic rubber Hard rubber and synthetic, molded an extruded products, hard rubber pipes
	arlock Packing Co., Pa'myra, N. Y	Rubber and synthetic rubber packings, gas- kets, Klozure oil scals and molded goods	Thermoid Rubber Div., Thermoid Co., Tren-	valves, fittings, buckets, funnels and dipper
L.	ates Rubber Co., Denver, Colo H. Gilmer Co., Tacony, Philadelphia, Pa., F. Goodrich Co., Akren, Ohio	V-belts, molded rubber goods, hose Transmission belting and special molded parts Acid and abrasion-resistant linings, hose, con- veyor and transmission belting, packing and gaskets, hard rubber pipe and molded	ton, N. J	Transmission belting, F.H.P. and multiple V-belts and drives, conveyor and clevato belting, wrapped and molded hose packings, industrial brake linings and frie tion products
		goods, vibration insulators and dampeners, adhesives, corrosion resisting paints, Koro- seal, anode process products, Ameripol	Thiokal Corp., Trenton, N. J	Thiokol olefine polysulphide synthetic rubben — crudo sheet, molding powder and liquid dispersions
Go	oodyear Tire & Rubber Co., Akron, Ohio	products Hose, conveyor and transmission belting, packings, linings, Plioweld rubber lined tanks, pipe, etc., mechanical rubber goods, molded goods, Pliolite modified rubber	U. S. Rubber Co., New York, N. Y	Hose: conveyor, elevator and power trans- mission belting; packings; molded and extruded rubber; rubber bonded to metal rubber linings (hard, semi-hard, soft for tanka, pipe, fittings, chutes and valves)
	cene, Tweed & Co., New York, N. Y witt Rubber Corp., Buffalo, N. Y	plastic, Chemigum Rubber packings, gaskets and sheet. Hose, transmission, conveyor and elevator belting, packings, molded goods, extruded items	U. S. Stoneware Co., Akron, Ohio	Tygon synthetic resin products: tank linings, gaskets, tubing, acid-proof paints, cements, molded or extruded goods. Melded or extruded mechanical rubber goods, rubber linings
Ho	odgman Rubber Co., Framingham, Mass	Rubber mechanical rolls and rubber lined tanks	Union Bay State Co., Cambridge, Mass	Gacco (noprene base) compounds for tank surfacing and similar corresion proofing
	rear Chemical Co., Akron, Ohio, hkins Bros. Rubber Div., Bridgeport, Conn	Mechanical rubbers (Hycar) Mechanical rubber goods, rubber and syn- thetic rubber packings, valve discs, molded and extruded products, friction and rubber	Vulcanized Rubber Co., New York, N. Y	purposes Hard and semi-hard rubber molded products

WOOD FOR CHEMICAL EQUIPMENT

Manufacturers of Wooden Tanks, Towers and Pipes

Manufacturers (Name and Address)	Products	Manufacturers (Name and Address)	Products
Acme Tank Mfg. Co., Los Angeles, Calif American Wood Pipe Co., Tacoma, Wash Armoo Drainage Products Association, Mid- dletown, Ohio Arrow Tank Co., Bufialo, N. Y Atlantie Tank Corp., North Bergen, N. J Axtell Co., Fort Worth, Tex Baltimore Cooperage Tank and Tower Co., Baltimore, Md M. C. Bascom and Co., Bolivar, N. Y	Tanks and stave pipe Tanks and stave pipe Pipe Pipe Tanks and stave pipe Tanks and stave pipe Tanks and pipe Tanks and stave pipe Tanks and pipe Tanks and pipe Tanks and stave pipe	Beall Pipe and Tank Corp., Portland, Ore Beaver Silo and Box Mfg. Co., Beaver Dam, Wis Beckman Bros., Des Moines, Iowa Belait Iron Wks., Beloit, Wis Black-Clawson Co., Hamilton, Ohio Black, Sivalls and B-yson, Inc., Oklahoma City, Okla Breyer Bros., Waupan, Wis Brooks Lumber Co., Bellingham, Wash Brown Lumber Co., Massilon, Ohio	Tanks and pipe Tanks and pipe Tanks and pipe Tanks and pipe Tanks and pipe Tanks Tanks Tanks Tanks and pipe Pickling tanks

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Manufacturers of Wooden Tanks, Towers and Pipes (Continued)

Manufacturers (Name and Address)	Products	Manufacturers (Name and Address)	Products
V. E. Caldwell Co., Inc., Louisville, Ky	Tanks and stave pipe	Moran Tank Co., Shreveport, La	Tanks and pipe
California Redwood Dist., Chicago, Ill	Redwood pipe	Nashua Milling Corp., Nashua, N. H	Towers
Carley Heater Co., Inc., Olcan, N. Y	Tanks and stave pipe	National Tank Co., Tulsa, Okla	Oil tanks
Carlton Lumber Co., Portland, Ore	Towers	National Tank and Pipe Co., Portland, Ore	Tanks, and wrapped pipe and continuou
Cascade Pipe and Flume Co., Seattle, Wash	Pipe	and the state of the state of the	stave pipe
Challenge Co., Batavia, Ill.	Tanks and stave pipe	Nebraska Bridge Supply and Lumber Co.,	
Chicago Wooden Tank Co., Chicago, Ill A. J. Corcoran Inc., Jersey City, N. J	Tanks and stave pipe Tanks and stave pipe	Omaha, Neb.	Pipe
Cottage Grove Lumber Co., Cottage Grove,	Tanks and start pipe	New England Tank and Tower Co., Evcrett,	m. t
Ore	Tanks and pipe	Mass	Tanks, stave pipe, agitators and agitato
. M. Davis and Sons, Palatka, Fla	Cypress tanks		equipment
Drane Tank Co., Ft. Worth, Tex	Oil tanks	Pacific Tank and Pipe Co., Oakland, Calif	Tanks and wrapped, continuous stave an solid bored pipe
Dunck Tank Wks., Inc., Milwaukee, Wis	Tanks and stave pipe	Deside Ward That Gen Co. Desid	sona oorea pipe
Eagle Tank Co., Chicago, Ill	Tanks and stave pipe	Pacific Wood Tank Corp., San Francisco Calif	Tanks and stave pipe
Eastern Wood Products Co., Williamsport,	Warmed antinuous stars on solid horad	Parkersburg Rig and Reel Co., Parkersburg,	Tanks and stave pipe
Ра	Wrapped, continuous stave and solid bored pipe	West Va.	Oil tanks
The second Mile on Frederick Mile		Peerless Tank and Tower Co., New York,	and the state of the second second
Economy Silo and Mfg. Co., Frederick, Md ohn Eppler Co., Baltimore, Md	Tanks Tanks and towers	N. Y	Tanks and pipe
Cverett Forest Products Co., Everett, Pa	Wrapped pipe and continuous stave pipe	Perdue Tank Co., Witchita, Kan	Tanks and pipe
cderal Tank Co., Houston, Tex	Tanks and pipe	Plattner Co., Denver, Colo	Tanks
ederal Pipe and Tank Co., Seattle, Wash	Tanks, and wrapped and continuous stave	Plymold Corp., Lawrence, Mass	Tanks and pipe
	pipe	Pope and Talbot, Inc., Portland, and San Francisco	Towars and sine
leming Tank Co., Pittsburgh, Pa	Tanks and stave pipe	Prefabricated Products Co., Scattle, Wash.	Towers and pipe Towers
luor Corp., Los Angeles, Calif	Cooling towers	Producers Tank Co., Seminole, Okla	Tanks and pipe
leischel Lumber Co., St. Louis, Mo	Red cypress equipment	J. F. Prichard & Co., Kansas City, Mo	Tanks
ordyce-Crossett Sales Co., Fordyce, Ark	Towers	Redwood Mfg. Co., San Francisco, Calif	Redwood tanks; wrapped, continuous stav
orest Products Treating Co., Portland, Ore.	Towers	Not when the set of the state	and solid bered pipe
oster Wheeler Corp., New York. N. Y General Tank Corp., Kearny, N. J	Cooling towers Tanks and stave pipe	Riggs and Lombard, Inc., Lowell, Mass	Dyo tubs and paper mill equipment
mos H. Hall and Sons, Philadelphia, Pa	Tanks and stave pipe	Rilco Laminated Products, St. Paul, Minn.,	
Janson-Van Winkle-Munning Co., Matawan,	Autor and prace hele.	Wilkes-Barre, Pa.	Towers
N. J	Platers tanks	Roof Structures, Inc., Webster Groves, Mo., New York, N. Y.	Towers
Iarder Silo, Inc., Cobleskill, N. Y	Tanks	J. C. Roy Lumber Co., Chicopee, Mass	Tanks and pipe
lauser-Stander Tank Co., Cincinnati, Ohio	Tanks and stave pipe	San Matelo Planing Mill, San Francisco, Calif.	Tanks and pipe
Iaywood Tank Co., Greggton, Tex	Tanks and pipe	James E. Stark Co., Memphis, Tenn	Tanks and pipo
Ienry Mill and Timber Co., Tacoma, Wash	Towers	E. F. Schlichter Co., Philadelphia, Pa	Tanks and stave pipe
. Holland and Sons, Brooklyn, N. Y Iorizontal Stave Tank Co., Seattle, Wash	Plating tanks Tanks and pipe	E. W. Schmeling and Sons, Rockford, Ill	Tanks and pipo
Ioward Wood Tank Co., Brooklyn, N. Y	Tanks and pipe	Alexander Schroeder Co., Houston, Tex	Tanks and pipe
. E. Hudson and Sons, Buffalo, N. Y	Tanks and pipe	A. F. Schwerd Mfg. Co., Pittsburgh, Pa	Wrapped pipe
Rodney Hunt Machine Co., Orange, Mass	Dyo tubs	Harry J. Simons Lumber and Mfg. Co., St. Paul, Minn	Tanks
ames Hunter Machine Co., North Adams,		Smith Fabricating Shop, Hot Springs Nat'l	1 ADAS
Mass	Dye tubs	Park, Ark.	Towers
lydro and Chemical Tank Co., New York,		Souder Tank Co., Madison, Kan	Tanks and pipe
N. Y	Tanks and pipe	James E. Stark Co., Memphis, Tenn	Tanks and pipe
N. H	Tanks and pipe	Charles H. S chling Co., Milwaukee, Wis	Tannery drums and paddles
owa Wind Mill and Pump Co., Cedar Rapids,	Tunna and pipo	Stearns Tanks, Boston, Mass	Tanks and stave pipe
Iowa	Tanks and pipe	Stevens Tank Co., Wichita, Kan	Tanks and pipe
sseks Bros., New York, N. Y	Tanks and pipe	Stevens Tank and Tower Co., Auburn, Mc Summerbell Roof Structures, Springfield, Ore.	Tanks and stave pipe Towers
David Isseks and Sons, Brooklyn, N. Y	Tanks and stave pipe	Terminal Mfg. Co., St. Paul, Minn	Tanks
Jacobsen and Co., Chicago, Ill	Tanks and pipe	Tex Well Equipment Mfg. Co., Ft. Worth,	
ohnson and Carlson, Chicago, Ill.	Tanks and stave pipe	Tex	Oil tanks
D. Jones and Sous Co., Pittsfield, Mass	Tanks and pipe	Timber Fabrications, Miami, Fla., Houston,	
Kalamazoo Tank and Silo Co., Kalamazoo,	Tanks and stave pipe	Tex	Towers
Mich iretchmer Mfg. Co., Council Bluffs, Iowa	Tanks and pipe	Timber Structures, New York, N. Y.	Towers
eird Lumber Co., Little Rock, Ark	Towers	Twin City Tank, Silo and Specialty Co.,	
incoln Tank Co., Shreveport, La	Oil tanks	Minneapolis, Minn Union Lumber Co., San Francisco, Calif	Tanks Redwood tanks and stave pipe
larvey Lochr Lumber Co., Canton, Ohio	Pickling tanks	Unit Structures, Inc., Peshtigo, Wis	Towers
ord and Bushnell Lumber Co., Chicago, Ill.	Pipe	U. S. Plywood Corp., New York, N. Y	Plywood pipe
I. and V. Tank Co., Witchita Falls, Tex	Oil tanks	Valley Iron Works, Appleton, Wis	Tanks and pipe
fangold Stave and Cooperage Co., St. Louis,	A state of the sta	Wauna Lumber Co., Wauna, Ore	Towers
Mo	Tanks and stave pipe	Well Machinery and Supply Co., Ft. Worth,	
H. H. Manville Pattern and Model Co.,	Tenks and size	Tex	Oil tanks
Waterbury, Conn farket Mfg. Co., Syracuse, N. Y	Tanks and pipe Tanks and pipe	Wendnagel Co., Chicago, Ill.	Tanks and stave pipe
Iarley Co., Kansas City, Kan	Cooling towers	Wenneis Tank Co., New York, N. Y	Tanks and stave pipe
lartin Tank Co., Corsicana, Tex	Tanks and pipe	Weyerhaeuser Sales Co., Newark, N. J., Balti- more, Md., Tacoma, Wash	Towers
layer Tank Mfg. Co., Inc., Brooklyn, N. Y	Tanks and stave pipe	Whatcom Falls Mill Co., Bellingham, Wash.	Tanks and pipe
AcGarr-Turner Co., Cordele, Ga	Tanks and pipe	Wheeler Lumber, Bridge and Supply Co., Des	
deGuffin Tank Co., Shreveport, La	Tanks and pipe	Moines, lows	Pipes
Ackeown Bros. Co., Chicago, Ill	Towers	Wilborne Bros. Co., Amarillo, Tex	Tanks and pipe
lichigan Pipe Co., Bay City, Mich	Toncan clad, wrapped, solid bored and con-	Wilcox-Johnson Tank Co., Victor, N. Y	Tanks and stave pipe
When the second second	tinuous stave pipe	George Windeler Co., Ltd., San Francisco,	
dodolow Lumber and Building Co., Seattle-	and the second s	Calif	Tanks and stave pipe
Wash		Woolford Wood Tanks, Darby, Pa	Tanks and stave pipe

CHEM. & MET. PLANT NOTEBOOK-

THEODORE R. OLIVE, Associate Editor

\$50 WAR BOND FOR A GOOD IDEA!

Until further notice the editors of *Chem.* & *Met.* will award a \$50 Series E War Bond each month to the author of the best short article received during the *preceding* month and accepted for publication in the "*Chem.* & *Met.* Plant Notebook." Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem.* & *Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department.

Any reader of Chem. & Met., other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

July Contest Prize Winner

SLIDE RULE NOMOGRAPH USEFUL FOR CALCULATIONS BY UNTRAINED OPERATING PERSONNEL

J. A. MAY Technical Foreman Styrene Div., The Dow Chemical Co. Lake Jackson, Texas

B ELOW is a chart which I have termed a slide rule nomograph, since it performs the same sort of calculations as can be handled with a slide rule. It is handy when a slide rule is not available, and particularly useful for operating personnel in making routine control calculations and in establishing rates involving ratios. At the loss of some accuracy and convenience in operation as compared with a slide rule in the hands of someone who has used it for years, the slide rule nomograph can be mastered much more quickly than the slide rule itself. Furthermore,

it can readily be constructed to any size and fineness of division desired, simply by plotting logarithms to any desired scale. If for any reason it is desired to do so, additional scales of more than two cycles can be added for higher roots.

As will readily be seen the nomograph consists of three logarithmic scales, the upper and lower being single-cycle and the middle, a two-cycle scale. To multiply, the multiplicand is set on the "A" scale and the multiplier on the "C" scale, or vice-versa, and the two connected with a straightedge, giving the answer on the

AUGUST WINNER!

A \$50 Series E War Bond will be issued in the name of

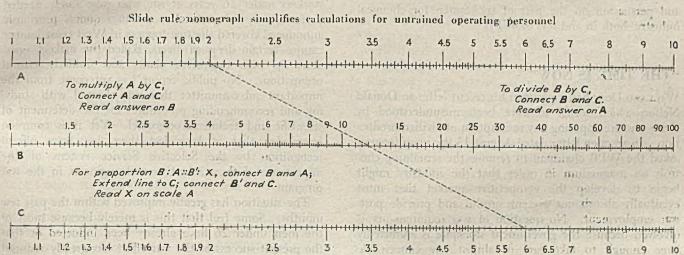
> L. D. ANDERSON Consulting Engineer Potash Co. of America Carlsbad, N. M.

For an article dealing with a new method of using wood flooring for corrosion prevention, which has been adjudged the winner of our August contest.

This article will appear in our October issue. Watch for it!

"B" scale at the point cut. Division is accomplished by setting the dividend on the "B" scale and the divisor on the "A" or "C" scale, and reading the quotient on the other of these last two. For proportion $B \oplus A :: B' : X$, with X the unknown, connect the "B" scale (for B) to the "A" scale, noting the resulting ratio on the "C" scale. Then connect the "B" scale (for B') to the "C" scale, reading the value of X on the "A" scale. For squares and square roots, it is obvious that the results are indicated by vertical lines.

sults are indicated by vertical lines. The principle of the nomograph is simple. Since the two-cycle "B" scale is midway between the "A" and "C" scales, then a line joining points on "A" and "C" determines the average value on the "B" scale. That is, the length along the "B" scale equals the length along "A" plus that along "C", divided by 2. Mathematically, the point on "B" is (log "A" $+\log$ "C") \div 2, but since "B" is two cycle, this multiplies the result by 2, giving on "B" the result which is log "A" $+ \log$ "C".



FROM THE VIEWPOINT OF THE EDITORS-

S. D. KIRKPATRICK, Editor • JAMES A. LEE, Managing Editor • THEODORE R. OLIVE, Associate Editor • HENRY M. BATTERS, Market Editor J. R. CALLAHAM, Assistant Editor • L. B. POPE, Assistant Editor • R. S. McBRIDE, Consulting Editor

POSTWAR MODELS vs. PILOT PLANTS

UNDER certain fairly restrictive limitations, any manufacturer is now permitted by WPB to produce a "postwar model" of whatever he intends to make when peace-time production can be resumed. The restriction we hear most about is one to prevent the diversion of essential manpower but an existing order also puts a practical ban on any new building or plant construction. The latter is not a serious handicap in the automobile and most metal. working industries but it is proving an almost insurmountable obstacle in the path of certain chemical and process industries.

Suppose your postwar planning calls for the production of a new plastic. You have completed the small-scale research and have been able to turn out a few pounds of the product in laboratory glassware. Does such a sample constitute a "postwar model"? Actually, of course, it is not at all comparable with the hand-made automobile, electrical refrigerator or washing machine which the WPB order seems to have been designed to cover. In most chemical industries the pilot plant comes the nearest to being the "model" for postwar production. Most processes must be developed at least that far before one can know whether or not large-scale manufacture is technically feasible and economically practicable. Hence if the process industries are to receive equitable treatment by WPB and not be further handicapped in their reconversion programs, they should be permitted to build pilot plants large enough to demonstrate their manufacturing procedures but not of sufficient size to produce on a commercial scale. This means that the WPB order will have to be modified or its official interpretation broadened to permit granting of the priorities required to complete such small-scale construction. It seems a simple and logical move but because of the highly charged political atmosphere surrounding the entire reconversion program, we are sure that it is going to require a lot of education and persuasion on the part of spokesmen for chemical industry, both in and out of WPB

"THE TIME IS NOW"

WILLARD Dow had a point in his recent letter to Donald Nelson which seems to have been misunderstood by those who are opposing any resumption of civilian production. In an open letter dated August 13 the manufacturer usked the WPB chairman to remove the remaining controls on magnesium in order that the industry might begin to develop the competitive market that must eventually absorb our present surplus and provide postwar employment. No question of war requirements is involved because the government stockpile is admittedly large enough to take care of almost any conceivable needs. But Dr. Dow's critics implied that he was merely trying to get a head start on his competition and to recapture his company's prewar position in the magnesium industry. Actually something much more fundamental was involved.

Magnesium, in its present proportions, is one of our great war-born, or war-proven, industries. The nation looks to it as a postwar promise of new things to come. Those of us in the process industries know, however, that these new applications cannot possibly be developed without months of research and experimentation. Much of this can be done only in the plants of the users, working with their engineers and designers on their peculiar problems of application and fabrication. Then come long periods of trial and testing, followed finally by the approval or disapproval of the ultimate consumer. All this takes time. It is a slow process and the sooner it is started and the more thorough the testing, the surer we can be about the future of this industry and the jobs that will depend upon it.

By this time we should all know that mere capacity to produce a hundred times our prewar consumption does not mean that we have created a magnesium industry of that proportion. Since the very beginning, the technique of application has always lagged behind production No useful purpose can be served by continuing to pile up surplus stocks and at the same time insisting on keep ing magnesium ingots under allocation. Ultimately the industry must be allowed to stand on its own feet. The man who has most reason to know says: "The time, I submit, is now!"

RECOGNITION AT LAST

RECENTLY the Iron and Steel Division of the WPB announced that the Inter-Agency Committee on Occupational Deferments had approved a quota of 500 key workers under 26 years of age who were sorely needed to maintain steel production. Other quotas previously announced covered the tree toppers in West coast lumber camps, certain deep-sea divers, skilled tire makers, operators for high explosives plants and similarly critical occupations. No public report has yet come from the important sub-committee that was charged with studying and recommending procedures for the deferment of scientific and technical personnel. Yet it is common knowledge that at long last there has been official recognition by the Selective Service system of the importance of these scientists and engineers in the war program.

The situation has greatly improved within the past few months. Some feel that this is merely because most of the men under 26 have already been inducted or that the present success of the war effort has greatly reduced

• SEPTEMBER 1944 • CHEMICAL & METALLURGICAL ENGINEERING

the quotas sought by the local boards. To some extent, both have been factors but those who have been closest to the technical manpower problem also realize that there has been a decided change in attitude on the part of top officialdom in Washington. High-grade scientific and engineering personnel, in increasing numbers, have received stays of induction. More recently it has come to be known that the Armed Services, the commodity divisions of WPB, Petroleum Administration for War, OPRD, OSRD, War Food Administration and Maritime Commission have been authorized to endorse the deferment claims of technical personnel in war industries, always with the provision, however, that there are no comparable personnel now engaged on postwar projects who might be substituted for the registrants. Employers in war work wishing to claim deferment for technical employees under 26 who meet these requirements of essentiality must submit their cases on Form 42-a, refer them in the usual way to the claimant agency for which the work is being done. In the chemical process industries this is usually the appropriate commodity division of WPB, the Army, Navy or PAW. If and when that endorsement has been obtained, the case is submitted to the State Director and appropriate action will be taken. At least that seems to be the procedure and it is getting results.

A MATTER OF TIMING

RUBBER RESERVE, which since the inception of the government's synthetic-rubber program, has had actual charge of plant operations, is now faced with some difficult problems of control and correlation. One of the most serious of these is the further adjustment of butadiene supply. If the program is to be administered most economically, we must gradually transfer the responsibility for making this basic component of GR-S from the alcohol processors to the petroleum refiners. This should be done in the public interest because butadiene from petroleum is substantially cheaper. But hasty or illconsidered action could dangerously affect the war effort.

Butylenes and other petroleum hydrocarbons needed for butadiene are also the basis for aviation gasoline and are used for other war purposes. These needs will not end with the German collapse. Some of them will continue at high levels until the last of the Pacific air fighting is finished. Thus it will require highly skilled technical guidance on the part of Rubber Reserve to make sure that the change-over occurs at exactly the right time. If it is made too soon, it will hamper the afr program. If made too late it delays the lowering of costs that are essential if synthetic rubber is to stand on its own feet.

CONSERVE CHROME

ELSEWHERE in this issue are many references to the valuable role that chromium and its alloys are playing and must continue to play in the battle against corrosion. Occasional reference is made to chrome plate as a protective coating for many surfaces. Ket just as we go to press there comes a bulletin from the Navy Bureau of Aeronautics and its Operating Committee on Aircraft Materials Conservation warning us that the immediate requirements for chromic acid and sodium dichromate are such as to make a supply of these basic chemicals extremely critical at this time. Furthermore, there is little hope for an immediate increase in their production and there are no large stockpiles to meet mounting demands. Fortunately, some alternative treatments are available for the aircraft industry and all who are concerned with this problem would benefit by securing from the Aircraft Production Board of WPB its Conservation Bulletin No. 16 that outlines these in some detail.

THE MIRAGE OF LOWER TAXES

FROM now until election time there will be much loose talk about lower taxes. Each of us by wishful thinking can see a beautiful mirage. Each of us will hopefully picture certain hypothetical cases where it would seem logical to expect relief, either individually or in a corporate sense, from the heavy tax burdens of wartime.

Postwar tax collections by Uncle Sam will not be as great as are current levies. That is both politically and socially necessary. Postwar industry will not be able to pay Uncle Sam between \$40 and \$50 billion per year.

But the more conservative students of the tax problem. such as the Research Committee of the Committee for Economic Development, believe that \$20 billion must be collected annually by the Federal Government in early postwar years to meet the costs of the readjustment period. Such a levy, which is more than twice that of 1939, cannot be achieved unless high rates are imposed on the then lower taxable incomes.

Regardless of the occupant of the White House during the next four years, our chemical engineering cost calculations must assume high taxes on both corporate and personal incomes. It is to be hoped, however, that the next Congress can work out some measure of relief to provide an urgently needed incentive for venture capital Ultimately this must be followed by a conservative reduction in corporate taxes, thus providing relief from the double taxation of corporation income, now taxed both at the corporation and at the stockholder levels. But, the important point now is that despite the campaign promises, no big cuts in these taxes can be expected for several years after the war. Our forecasts of postwar costs for the products of the chemical process industries must be calculated on that basis.

THE COST THAT COUNTS

COMPARING the usefulness of two materials of construction requires more than a comparison of the primary cost of the parts or device itself. A good example of this was recently described as a "sore spot" in a certain dryer feed line handling a hard abrasive ore. The wear at an elbow in the spout caused steel castings to wear out in from two to four weeks. A high chromium iron casting for this elbow lasted from six to eight months, or eight to twelve times as long as ordinary steel.

Suppose this particular part cost five dollars in plain steel or ten to twenty dollars in alloy steel. But in estimating the relative merit of various materials of construction, it is the relative cost of the parts in place and ready to go, including the loss thraugh shut-downs, which must be compared. Many times a more expensive part will prove much the more economical in place when comparison is made on the proper basis.

PROCESS EQUIPMENT NEWS-

THEODORE R. OLIVE, Associate Editor

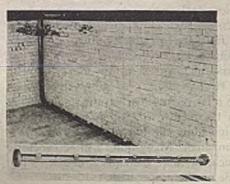
JET AGITATOR

DEVELOPED for the heating of liquids in tanks, a new type steam-jet heater has been announced by the Heil Engineering Co., 12901 Elmwood Ave., Cleveland, Ohio. The jet is furnished in flanged sections which can be coupled together to provide any desired length and to extend the agitating and heating effect to any part of a tank. The jet can be adapted to square, rectangular or round tanks. The sections are usually made in lengths of about 10 ft. and are coupled with lead bolts, with blind flanges to close the open ends. Nozzles are spaced along the tank bottom on 15-in, centers unless other-wise specified. A series of such nozzles along the entire length of a long tank, such as a pickling tank, creates a rolling, agitating effect, causing the liquid to circulate above and around the parts im-mersed. The effect is increased, according to the manufacturer, by placing jets on either side or all around the bottom of the tank, with nozzles set at angles to produce the maximum rolling effect. The nozzle is constructed of graphitic carbon to resist the corrosive attack of most chemical solutions. Several modifications of this type jet are available. Jets are furnished with a steam flange and bolts to connect to a standard 6-in. O.D. flange reduced from a 1-in. steam supply line. Recom-mended steam pressure is 80 lb., although a maximum pressure of 125 lb. can be used.

NEW ROTAMETERS

SEVERAL important features which are claimed to be exclusive are mentioned by the Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia 32, Pa., in announcing the company's new line of Series R-100 rotameters. These rotameters which are of the indicating area meter type, are available in sizes from $\frac{1}{8}$ to 3 in., with both free and guided floats. The floats may be compensated for viscosity or density variations. The metering tubes are of extra-heavy-walled Pyrex

Jet agitator for acid tanks



glass, formed on mandrels, annealed, polariscope-inspected and check-gaged by precision ball testing.

Among the features may be mentioned spring-stop floats to prevent damage to the float by sudden surges of the liquid; highpressure stuffing boxes permitting use of corrosive liquids under high operating pressures; a single external adjustment of the stuffing boxes by wrench, instead of by taking up successively a number of bolts or screws; a white-backed metering tube for easy reading; interchangeable calibra-tion scales for quick and inexpensive change from one service to another; and special features in the design of the guide rod to insure accurate centering and uniform tension regardless of repeated stuffing box adjustment. The new line includes such types of rotameters as portable types, types for pulsating flows and opaque liquids, remote indicators, recorders, integrators, automatic controllers and automatic proportioners.

FILTER UNIT

DEVELOPMENT of a line of factoryassembled vacuum filter units has been announced by the Einco Corp., Salt Lake City 8, Utah. The feature of this equipment is that it is completely assembled during manufacture, mounted on a steel base, and provided with all necessary pipe and fittings in place, as well as with clea wiring and the starter panel connection. Hence the filter is ready to go to work immediately upon arrival at the point of use. It is claimed that these self-contained units, such as the 4x4 ft. unit shown in the accompanying view, are designed to withstand severe corrosive properties of materials filtered; and that they are compact but with all parts readily accessible. The equipment shown includes the filter. vacuum pump, weak liquor pump, strong

New Type R-100 rotameter

liquor pump, blower, agitator, cleaners, mufflers, variable speed drive, receivers and control panel. Specific details, however, are of course varied to meet the requirements of particular installations.

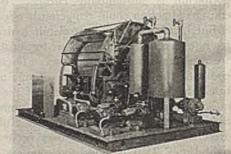
LARGE DIESEL

WHAT IS BELIEVED to be the largest single-acting diesel engine so far built in the United States, a 6,000-hp. design, has recently been tested successfully by Nordberg Mfg. Co., Milwaukee 7, Wis. Although it was built for ship propulsion, the manufacturer states that the same design is equally applicable for stationary service. The engine will be available in sizes for stationary applications from 3,-000 to 6,000 kw. in 6- to 12-cylinder models. The engine is of the two-cycle single-acting, crosshead type, having 29x 40-in. cylinders.

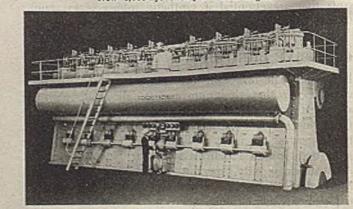
In general the design follows the lines of other two-cycle diescls built in recent years by this company, except in the camshaft drive and reversing mechanism which have been located overhead because of the much greater physical dimensions of the engine. Simplicity of design, rugged construction, streamlined appearance and accessibility of all working parts are important characteristics. Large oil-tight, light-weight covers which are easily han-

(Continued on page 149)

- Factory-assembled filter unit

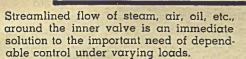


New 6,000-hp. two-cycle diesel engine



PLANNING Hour **CONTINUOUS PROCESSES** INCLUDE **STRAIGHT LINE FLOW Valve Advantages** treamlined

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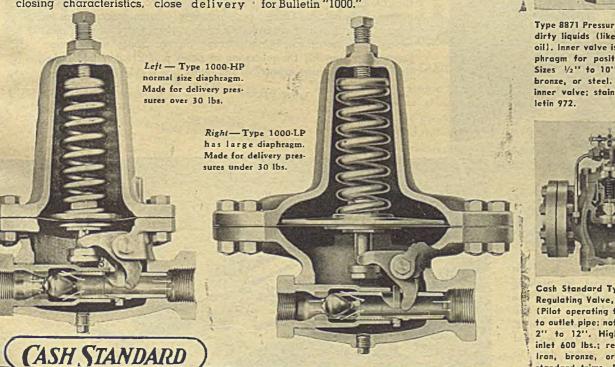
Continuous processes can be depend-ably protected against slow downs, failures, and maintenance ordinarily due to valve inefficiencies. The STREAMLINED "1000" Valve with ample capacity, tight closing characteristics, close delivery

CONTROLS...

VALVES

pressure control, and with a wide range of adjustment makes possible speedier production, smooth operation and no spoilage.

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ASH

DECATUR,

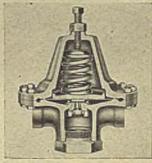
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OTHER VALVES from the <

CASH STANDARD LINE



Type 8871 Pressure Regulator for dirty liquids (like Bunker C fuel oil). Inner valve is bolted to diaphragm for positive movement. Sizes 1/2" to 10". Bodies; iron, bronze, or steel. Seat ring and inner valve; stainless steel. Bul-



Regulating Valve, pilot operated. (Pilot operating fluid discharges to outlet pipe; not wasted).Sizes: 2" to 12". Highest pressures; inlet 600 lbs.; reduced 250 lbs, Iron, bronze, or steel bodies; standard trims. For water, air, non-corrosive gases and oils. Get interesting Bulletin 966.



CHEMICAL & METALLURGICAL ENGINEERING • SEPTEMBER 1944 •

A.



Oranges below fresh fruit standards are used in making pectin, oil and concentrates at the plant of Exchange Orange Products Co., Ontario, Calif. Processing of fruits has reached 100,000 tons a year due to demand for juices

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Orange Products

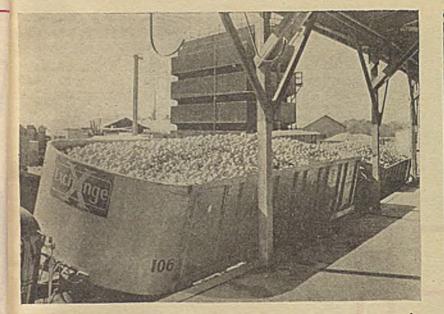
UTILIZATION of surplus fruit in the orange industry has created an interesting array of products with expanding commercial uses, possibly of great importance in the future; products such as oil well drilling compounds, synthetic rubber antistick agents, and concentrates of vitamins found in citrus fruits. Continued research portends further interesting developments in this branch of the field of chemurgy.

Processing has greatly increased in volume in the last few years due to the demands for concentrated fruit juices. The former yearly average of 50,000 tons of fruit processed has increased to 100,000. This has required expansion of plant facilities at Exchange Orange Products Co., Ontario, Calif., affiliate of the California Fruit Growers Exchange. The fruit is first washed and then reamed or pressed to yield juice and pulp. Part of the latter is subjected to steam distillation for recovery of orange oil. Formerly a waste product, the pulp remaining after juice, oil and pectin are removed is shredded and passed through a gas-fired rotary kiln. Fine particles are collected by means of a cyclone and bagged as such, or portions may be mixed with the coarser dried pulp. The coarse material passes through storage bins and weighing hoppers for bagging as feeds.

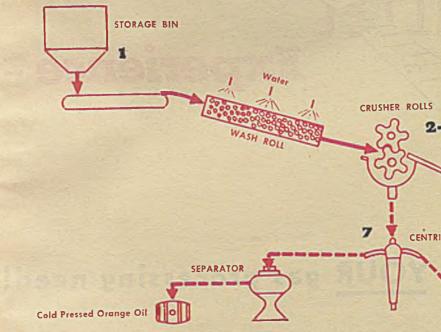
In order to obtain pectin the pulp is treated with a solution of hydrochloric acid. The mass is conveyed to a hydraulic press from which the fiber residue goes to the gas-fired rotary dryer and later is bagged as fine or coarse orange pulp for feed. The liquid from the press is passed through a filter press. The filtrate is concentrated and treated with alcohol to yield a jelly-like precipitate. After separation of the alcohol by means of a drain tank, the precipitate goes to a screw press in which the mass is broken up. The pieces are then hardened by action of isopropyl alcohol in a tank. These pieces go to a hydraulic press. The pressed cakes are ground in a cake grinder, dried in a tunnel dryer, again ground and finally bagged for shipment.

Treatment of the juice consists first in centrifuging for separation of the cold-pressed orange oil which is further clarified before barreling by means of separators. Orange juice passes to vacuum concentrators for preparation into a food product. Chemicals which today have no commercial usage are existent in citrus fruits. Science creates many changes however and possibly the processing of citrus products may lead rather than follow the citrus industry of the future.



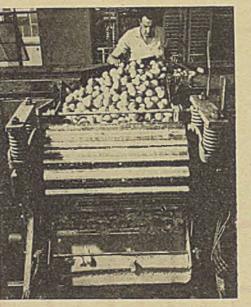


1 Surplus oranges delivered to the Ontario plant are inspected, soaked in a soapy solution, scrubbed and rinsed before processing.

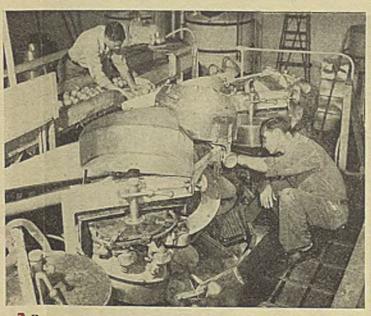


7 Separating orange oil (2 lb. from a ton of fruit) and juice

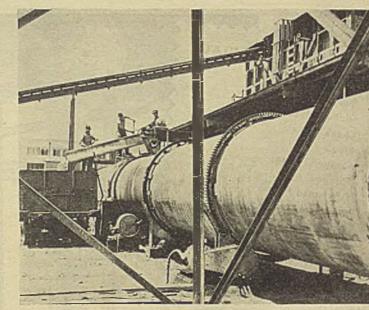




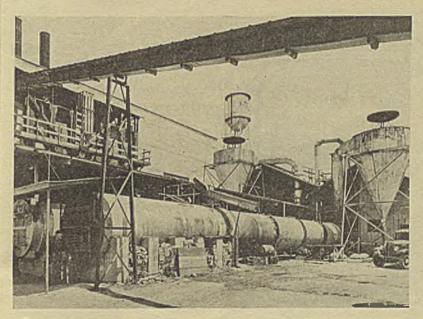
2 Fruit can be pressed between heavy corrugated rollers shown here



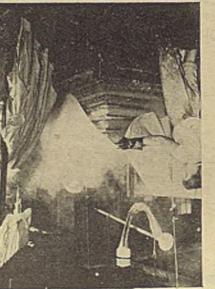
3 Reamers are also used to separate juice and pulp. Rubber cups press orange halves down over revolving reamers

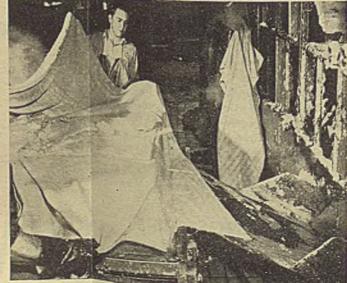


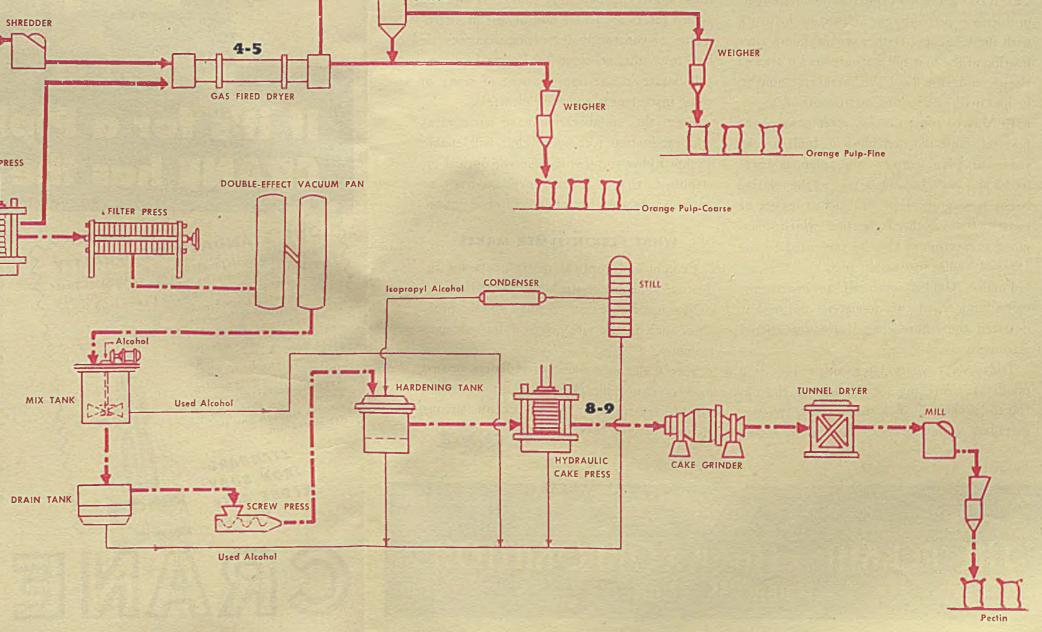
4 Halves are ground and the oil extracted. The pulp then goes to the pectin plant or to the dehydrator shown



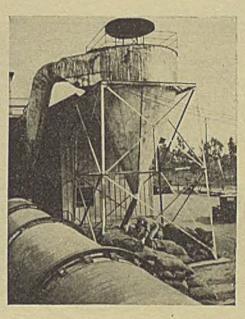
CLONE DISTILLATION COLUMN SHREDDER 4-5 CONDENSATOR 2-3 GAS FIRED DRYER OIL COLLECTOR Steam Distilled Orange Oil HYDRAULIC PRESS DOUBLE-EFFECT VACUUM PAN Hydrochloric Acid CENTRIFUGE FILTER PRESS - - - - - - - Orange Juice to concentrators MIX TANK sopropyl Alcoho 9 The material leaving the hydraulic press goes into a chute 8 Hydraulic press in the pectin plant



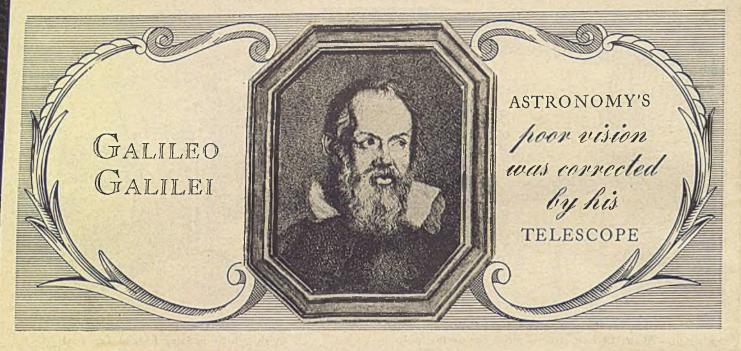


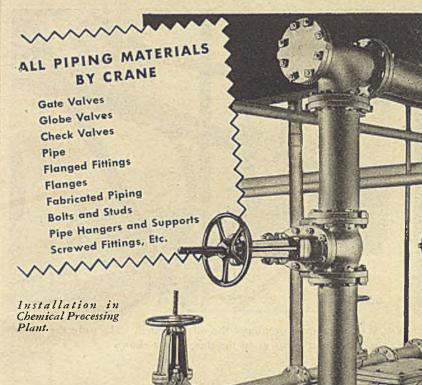


5 Gas-fired kilns 70 ft. long and 7 ft. in diameter rotate slowly at 5 r.p.m. About 12 min. are required for drying pulp



6 Cyclone dust collectors catch fine pulp which is later bagged for feed





GALILEO's genius for rapid solution of difficult problems is perfectly exemplified by his work with the telescope. Within several hours after hearing of the first telescope, he had mastered the principles involved. Within several months, he had made a scientific instrument of it.

In May of 1609, the day after news of the first telescope reached him, he built a telescope of plano-convex and plano-concave lenses and later, having arrived at the relation between magnification and foci of lenses, he constructed another telescope which magnified eight times. This he presented to the Doge of Venice in August, 1609.

Finally, Galileo produced an instrument magnifying thirty-two diameters, and with it initiated the future course of observational astronomy.

Today, 335 years later, other inquiring minds are searching for answers to the unsolved problems of astronomy, chemistry, metallurgy, photography, and vision. Aiding

these leaders in industry, education and the armed forces are lenses and prisms in instruments of constantly increasing accuracy. It has been the privilege of Perkin-Elmer to collaborate in the improvement of many of those instruments and their elements.

From this collaboration have come ideas and production techniques that will enable Perkin-Elmer to provide post-war optical instruments that will bring new accuracy to analysis, control, inspection and observation.

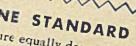
WHAT PERKIN-ELMER MAKES

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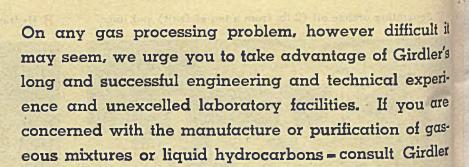
Help yourself to better piping installations by starting with materials whose quality and craftsmanship are backed by single responsibility. Ordering, maintenance work, keeping of parts stocks-all such operations are simplified by Crane complete materials service. And you're sure of getting all the benefits of Crane Co.'s 89 years' experience and leadership in the piping equipment field. Crane Co., General Offices: 836 South Michigan Avenue, Chicago 5, Illinois.

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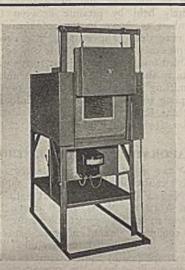
carbon dioxide, natural 593,

refinery gases, liquid hydro-

carbons, hydrogen, nitrogen.

Originators of the Girbotol Process

The GIRDLER CORPORATION ENGINEERS Gas Processes Division · Louisville 1. Ky CONSTRUCTORS EQUIPMENT NEWS (Continued from page 140)



Series 16 electric furnace

dled by one man are used to inclose the spaces between the A-frames on both sides of the engine. When these are removed they admit men into the crankcase from either side of the engine for inspection and maintenance. The overhead location of the camshaft greatly enhances accessibility to the crankcase. Fuel pumps, governor and control shaft are readily accessible from the engine platform. The fuel system, which is of the mechanical injection type, is designed for the application of this company's system of gas injection, if desired, to permit burning natural or manufactured gas with the thermal efficiency of the diesel cycle.

ELECTRIC FURNACE

AN ENTIRE new series of floor-model electric furnaces, available in five basic designs, each of which is produced in five variations dealing particularly with the inside depth of the furnace, has been announced by K. H. Huppert Co., 6830 Cottage Grove Ave., Chicago 37, Ill. These furnaces are intended primarily for heat treatment of metals but are also suitable for other purposes. The furnace body is constructed of 14-ga. steel reinforced on all corners. The heating elements have totally inclosed contacts and connecting wiring is brought through the back of the furnace into a special compartment. This company's principle of "multi-insulation" is used on all furnaces of the line. All types can be operated on 220-volt, singleor three-phase lines. Standard equipment on all types includes the necessary controls, fuses and switch box.

GOGGLE LENS CLEANER

A SYSTEM for the cleaning of goggle lenses recently announced by the Brite-Ize Co., 1218 Pratt Boulevard, Chicago 26, Ill., includes a special concentrated detergent for cleaning, and a system of dispensing. The detergent concentrate is supplied in hermetically sealed ampoules, each of which when mixed with distilled



New heavy duty steel heater



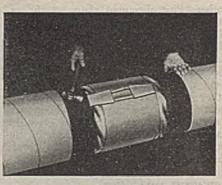
Goggle cleaning equipment

water, makes a full gallon of lens cleaner capable, according to the manufacturer, of cleaning 250 goggles every day for one month. The diluted solution can be sprayed on the lens by means of one of the company's pressure type dispensers shown in the accompanying illustration. The smaller one, having a capacity of $\frac{1}{2}$ pint, and the larger, of 1 quart, are charged with air either with a small hand pump or from any standard 50-lb. air line. At a touch of the lever they release the solution as a fine mist spray. Since they are entirely self-contained they can be set on any shelf or attached to any pillar convenient to the point of work, thus saving time expended in going to washrooms to clean goggles with soap and water.

SIMPLIFIED COUPLER

To FACILITATE making the final field connections on prefabricated insulated pipe conduit of its manufacture, the RicwiL Co., 1572 Union Commerce Bldg., Cleveland, Ohio, has developed a new drive coupling which is said to eliminate the need for skilled workmen and materially to reduce installation time. The coupling is adaptable to either mechanical or welded closures, the operations in either case being much simpler than former methods.

This company's insulated conduit is shipped to the job site in 21-ft. sections, prefabricated with pipe or pipes, insulation and aligning pipe supports. The ends of the helical corrugated conduit are expanded smooth at the factory, removing corrugations for a distance of 3 in. The bare pipe within the conduit extends beyond the ends of the conduit for 3 in.



Simplified closure for prefabricated conduit

more. After the pipe has been coupled or welded and insulation applied over the exposed portions, the smoothed ends of the conduit are coated with a waterproof sealing cement. A heavy-gage split connector sleeve is then slipped over the opening. As in the accompanying illustration, clamps are driven on to wedge-shaped channels over the lapped joint, quickly making a strong, watertight mechanical coupling. When a welded closure is required, the cement is omitted, the ends of the sleeves are lap welded to the conduit after the clamps have been applied, and the clamps are then removed and the longitudinal seam is lap-welded. For extra strength the clamps may again be driven on to the channels after the weld is made. When the conduit coupling is completed, an asphalt blanket, applied with heat over the entire closure area, fuses with the factory-applied asphalt on the conduit cover proper, providing protection at all points.

HEAVY-DUTY HEATER

HEAVY-DUTY HEATING applications in air conditioning, vapor absorption, drying and other processing work is the function of a new steel heater, announced by B. F. Sturtevant Co., Hyde Park, Boston, Mass. The new heater is said to possess the advantages from a maintenance and repair standpoint of the old pipe-coil heater but, at the same time, to give performance equal to modern heating surfaces which have increased heat capacity of about ten times, owing to the addition of fins to the heater pipes. These heaters are con-structed of 1-in. standard steel pipe threaded into cast-iron headers. Inside these pipes are 3 in. steel pipes which carry the steam from the header, distributing it uniformly to all heater pipes, pre-venting air binding and providing non-freeze characteristics. Wound around the heater pipes are spiral fins of soft carbon steel strips, 9/32 in. wide and tapered from 0.035 in. thickness at the edge at-tached to the pipe to 0.012 in. at the outside edge. The tapered construction is said to provide greater heat transfer than with the usual fin of uniform thickness. Absence of crimping is said to effect marked reduction in resistance to air flow. After assembling, fins and pipe are passed through a metallic bath to assure a permanent bond between pipes and fins and to protect against corrosion.

Each finned pipe is anchored at one end only, permitting the pipes to expand and contract freely, independently of each

NEW PRODUCTS AND MATERIALS-

JAMES A. LEE, Managing Editor

ALIPHATIC DERIVATIVES

ALIPHATIC compounds consisting of the even-numbered normal hydrocarbons from C_a through C_{1a} and the corresponding olefins, alcohols, ethers, mercaptans, thioethers, disulphides and sulphonic acids have been developed by the chemical division of the Connecticut Hard Rubber Co., New Haven. Most of these chemicals are available in commercial quantities and are supplied in various grades from technical to "fine chemical."

The saturated n-alkanes are suggested for use as organic intermediates, laboratory solvents and as standard hydrocarbons. The olefins, with the double bond at the first carbon, are interesting in organic synthesis, particularly as a starting material for dispersing agents, resins, oil additives, pharmaceuticals and insecticides. Certain branch chain olefins, isomeric with the n-compounds of this series are available for laboratory research. The alcohols are also suggested as intermediates for chemical synthesis and for use in cosmetic preparations.

The aliphatic ethers, according to the company, can be used as plasticizers, impregnating agents, solvents, heat transfer liquids, as well as in the cosmetic field. The high-purity aliphatic mercaptans present possibilities as polymerization conditioners, intermediates for synthesis, corrosion inhibitors, oil additives, insecticides, flotation agents and alarm odorants. The thioethers and disulphides are suggested for uses along the same lines while the aliphatic sulphonic acids, available only in experimental quantities, are of interest as hydrogen soaps and the salts as stabilizers, dispersing agents, wetting agents and oil additives. The corresponding sulphones are obtainable in limited amounts for experimental work.

LATEX INSULATION

SYNTHETIC rubber of the standard GR-S composition does not ordinarily lend itself to the coating of wire and cable by the latex continuous dip method nor are its electrical and physical properties entirely satisfactory for use as insulation. Recognizing these limitations, the United States Rubber Co. initiated research several years ago which has resulted in a new synthetic rubber latex insulation called Nubun, which permits the design of new types of power, lighting and communication cables.

As announced in New York Aug. 3, by C. W. Higbee, manager of the Wire and Cable Department, the new insulation is produced by modifying the composition and process of polymerizing the basic buna S before it is applied in latex form. "The standard GR-S rubber found most advantageous for the greater part of the Govern-

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ment's program and for most military applications is based on a 75 percent butadiene and 25 percent styrene composition." Mr. Higbee then explained that "The modified polymer has a special styrene ratio and is prepared by a modified reaction technique which gives it improved processing and insulating properties." As will be noted from the following tabulation, the special synthetic rubber compound is low in specific conductive capacity, has good aging qualities because of the presence of special anti-oxidants, and since it can be applied by the latex process, the rubber particles are not distorted or broken down by milling.

Physical and Electric Characteristics of Nubun Latex

Physical tests Tensile strength, lb Elongation, in Set, in	210 12	After 96 hr. aging in oxygen bomb 2,000 2 to 11
Voltage breakdown after sub-		
mersion in water at room temperature, volts per mil. Insulation resistance constant K after submersion in water	650	•
at room temperature Specific inductive capacity at 70 deg. C.	54,000	
After one day in water After three days in water	3.0 3.2	
COPPER COATING		

TO BE USED in coating copper alloys, a process has been announced by the Enthone Co., New Haven, Conn. The Ebonol "C" process is said to produce a stable, adherent, nonreactive cupric oxide coating which gives high adhesion of lacquers, paints and enamels under severe weathering conditions. Its inert nature prevents reaction between it and the organic finish. The finish obtained is naplike, presenting a relatively absorbent base to which the paint may be anchored. The process is suitable for treating alloys containing from 60 to 100 percent copper. The lower copper alloys are colored a mahogany brown and alloys containing more than 65 percent copper are black ened. The Ebonol "C" finish, therefore. is not appropriate as a base for clear lacquers or for one coating of white pigmented lacquer due to its dark color. The finish is applied by immersion of the work in a dilute solution of the salts operated near 210 deg. F. The treating time is approximately 10 min.

DEGREASER COMPOUND

DEVELOPMENT of an emulsifying degreaser, characterized by the fact that it gains in strength with dilution, has been announced by Gaybex Corp., Nutley, N. J. G-Bex 45-A has a fresh, clean odor and despite its detergent action, it will not corrode metals nor harm the skin. The alkaline factor of this compound is pH-7 (neutral) and its flash point 150 deg. F.

To be used for the cleaning, degreasing and dewaxing of machinery, motors, equipment, floors and parts which are being processed—prior to finishing or assembling, this product can be applied with a brush or a spray gun. It may also be used in standard emulsion degreasing tanks either cold or heated. When the dirt, oil and grease are thoroughly saturated they are removed by flushing or hosing with water. A trace of the residual compound minimizes rusting after the washing process.

SELF-SEALING PLASTIC

SHATTER-RESISTANT plastic which selfseals bullets and flak holes and makes possible the installation of pressure cabins where crews can function without oxygen masks, has been developed by E. I. du Pont de Nemours and Co., Wilmington, Del. The three-ply plastic, used in the B-29 Superfortress, is a "sandwich" of laminated lucite-butacite. Army and Navy tests showed that under some circumstances bullet holes close almost completely because of the rubber-like nature of the plastic.

PROTECTIVE CREAM

WATER-RESISTING hand protective cream for workers whose jobs bring them into contact with water-soluble cutting oils, dilute acids. alkalis and other water-chemical

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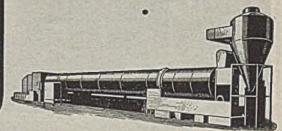
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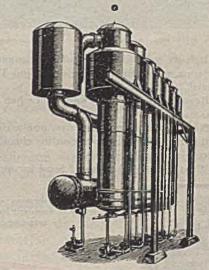
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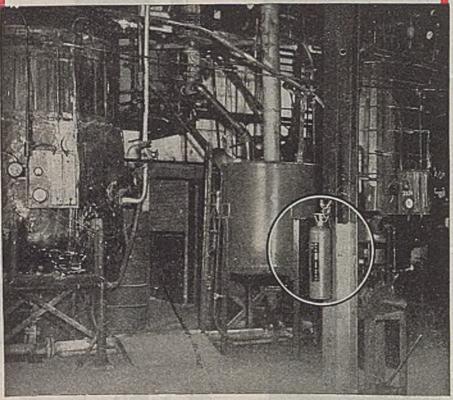


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mixtures has been announced by the Finishes Division of E. I. du Pont de Nemours and Co., Wilmington, Del. Known as Pro-Tek No. 2 it is a companion to Pro-Tek and intended for operations where water is present and the standard watersoluble Pro-Tek is unsuitable. Pro-Tek No. 2 is applied to the hands and arms before starting work and forms a flexible, slightly greasy film which acts like an invisible glove. One application lasts from 3 to 4 hr. and may be removed by using an industrial hand cleaner or washing in hot water with a mild soap. It contains a high percentage of lanolin and is neutral in reaction and non-irritating.

SYNTHETIC RUBBER TACKIFIER

To BE used in softening and tackifying synthetic rubbers, especially GR-S, Pentacizer 344 has been developed by the Heyden Chemical Corp., New York, N. Y. A brown, resinous, friable solid, the new product is soluble in ketones, aromatic hydrocarbons, vegetable and mineral oils, and synthetic rubbers. When up to 40 percent of Pentacizer 344 is employed, the tack will remain to a considerable extent after vulcanization. When less than 25 percent is used the uncured stock will possess ample tack but the cured rubber will not be sticky and will maintain a good nerve.

PLASTIC DYE

THE development of Kriegr-O-Dip-V, a new addition to their line of plastic dyes, is announced by the Krieger Color and Chemical Co., Hollywood, Calif. The dye is for the purpose of coloring Vinylite plastic sheet stock by the dipping method. Absolute cleanliness of the plastic is essential before dipping it into the dye. The length of time for immersion depends on the condition of the plastic; five to ten seconds for pastel shades; 20 to 30 seconds for medium shades and 30 seconds to one minute for heavy shades. Kriegr-O-Dip-V is commercially available in four colors; yellow, orange, green and rose.

WETTING AGENT AND DETERGENT

DESIGNED primarily for use in the textile trade as a powerful wetting agent and detergent, Triton N-100 developed by Rohm & Haas Co., Philadelphia, Pa., is now finding vital wartime uses as an industrial cleaner, in priming compounds, electroplating and pickling baths, in the manufacture of rubber life rafts and mine trap covers. N-100 is soluble in most organic compounds excepting aliphatic hydrocarbons. It is sold as a concentrated material, containing less than 0.5 percent water. It has a specific gravity approximately that of water and is an aryl alkyl polyether alcohol, soluble in all proportions in cold water. It is miscible with alcohol in all proportions and readily soluble in 50 percent glycerine.

SYNTHETIC CEMENTS

GENERALLY speaking, synthetic cements will not satisfactorily bond to rubber. The B. F. Goodrich Co., Akron, Ohio, is at the present time developing new cements of this type. Cement A-75-B is tan color, GR-M synthetic base, for adhering neoprene to neoprene, fabric to neoprene, or fabric to fabric. It is an air drying cement with a strong bond. Cement A-68-B-A-53-B is air curing, 2-part, black cement of GR-M synthetic base, used for neoprene barrage balloons. It is useful for any neoprene to neoprene adhesion. It is a good leather adhesive and should have potential uses in a large number of fields, according to the company.

VULCANIZING CEMENT

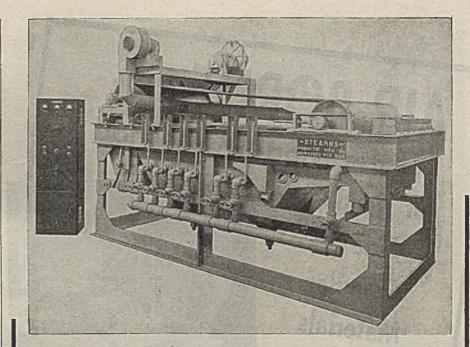
WHEN equal portions of C-80-S and C-81-S, produced by the B. F. Goodrich Co., Akron, Ohio, are mixed, they form a true air-curing or self-vulcanizing cement. They are mixed just prior to use as vulcanizing scts in immediately and renders the product unfit for use within about six hours after mixing. In cool weather the mixed cement requires about seven days to become fully vulcanized, but the process is greatly accelerated as temperature increases. At the temperature of boiling water, complete cure is obtained within 25 min. The mixed cement is of brushing consistency. B. F. Goodrich R-464-T and R-465-T are the same as C-80-S and C-81-S, except they are in less toxic petroleum solvent.

PLYWOOD TUBING

PLYWOOD tubing fabricated from thin veneers and urea-formaldehyde resin by Plymold Corp., Lawrence, Mass., is known as Plytube. Because of the resin bonding agent, it is rendered waterproof, flameproof, splinterproof and rotproof. It has been used, according to the manufacturers, to convey chemicals, as well as gasoline and oil. This tubing can be threaded on the job with ordinary pipe dies. It may be cut with regular woodmarking machinery. The strength and weight characteristics of the tubing render it especially adapted to the replacement of war materials wherever weight is a factor. This is true in aircraft.

SYNTHETIC INSULATING RESINS

For 20 years the electrical industry has talked about the ideal impregnating material for insulation in coils and apparatus. It is quite evident that solvent type var-nishes which are 50 percent solvent can-not give more than 50 percent fill. The two most desirable but elusive properties of such materials are (1) usability with-out a solvent and (2) a 100 percent filling of all once within the insulation. It is of all space within the insulation. It is said that these properties have now been obtained in a new resin, Fosterite, devel-oped by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. During the impregnation of a coil or device, Fosterite is in a liquid state but the solvent reacts with another resin dissolved in it, and the whole mass turns to a tough solid. It is solventless in that the whole of the liquid resin reacts under heat to form the infusible solid. There are no byproducts of the reaction that must escape as in most resin reactions. The additional problem of keeping the resin from running out while it is being polymerized to a solid has also been solved and there is now a satisfactory material and a satisfactory processing method. Actually, this resin transported by air.



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tion, for increasing and improving production, lowering costs.

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Kobinson Air-Activated Conveyor System bandling sugar in the National Sugar Refining Co., Long Island City Plant.

It's so simple, this Robinson Air-Activated System for handling bulk materials. Just the activator, compressed air and, the necessary piping and receiving bin. Robinson Systems are handling a variety of products over distances up to 3500 feet and elevations up to 600 feet.

First, operating and maintenance costs are low; friction practically eliminated, little degradation of product and little wear on the system; flexibility; rapid handling of product; no continuously moving parts . . . these are its advantages.

If you are handling in bulk such products as the following, investigate the Robinson Air-Activated Conveyor System:

Alum Arsenic Asbestos Dust Bauxite Borax Calcium Acetate Carbon Black Cement Clays Flour Fullers Earth Grain Gypsum Kaolin Lime Pigments Plastics Precipitator Dust Pulverized Coal Resins Rock Dust Salt Silica Soda Ash Starch Sugar Whiting Wood Chips

ROBINSON Air-Activated CONVEYER SYSTEMS Division of MORSE FOULGER DESTRUCTOR CO. 211-A East 42nd Street New York 17, N. Y.

Representatives in all Principal Cities

is not just one resin, but a family which makes it possible to obtain a wide range of properties by suitable modifications.

This family of resins is giving some very interesting results in application, both for the filling and coating of insulation. The complete filling allows much higher voltage gradients to be used than for normal materials. On one small radio transformer, for example, Fosterite is said to provide 4 to 5 times the dielectric strength that was obtained with former materials. This permits a radical reduction in size and weight.

SYNTHETIC RUBBER ADHESIVES

THE "100" series of Plastilock adhesives developed by B. F. Goodrich Co., Akron, Ohio, was designed primarily as an aromatic, oil-resistant adhesive for bonding cured or uncured Ameripol to itself, metal, wood, plastics, etc. It has also been found useful in bonding cured natural or other synthetic rubbers. This series does not require heat to establish a bond, although elevated temperatures cause the bond to form more quickly. With proper heat treatment, a non-thermoplastic bond is formed permitting service temperatures up to 200 deg. F.

The "500" Plastilock series was designed primarily as a non-thermoplastic, water and aromatic oil-resistant adhesive for bonding metals, wood, plastics, and ceramic materials to themselves or to each other. Heating alone will give some degree of adhesion. However, heat with pressure is recommended for best results. The purpose of pressure is to get a good surface contact.

THIALDINE

THIALDINE, a heterocyclic intermediate containing both sulphur and nitrogen in the ring, has recently been developed by Carbide and Carbon Chemicals Corp., New York, N. Y., and is currently available in commercial quantities. It is a colorless, crystalline solid that is soluble in alcohol, ether, and hydrocarbons, but relatively insoluble in water. It exhibits reactions typical of secondary amines. Thialdine has a powerful odor resembling ammonium sulphide, but readily forms salts that are comparatively odorless. This amine has possible application as an intermediate for dyestuffs, insecticides, rubber chemicals, pharmaceuticals, and ore-flotation opera-Thialdine has interesting msections ticidal properties even when used in aqueous solutions in concentrations as low as one part by weight to about 7.000 parts of water.

SYNTHETIC ADHESIVE

A LOW-TEMPERATURE-CURING adhesive of the phenol-formaldehyde type for bonding a wide variety of heavy lumber and timber constructions, is made by the Resinous Products & Chemical Co., Philadefphia, Pa., Known as Ambedite PR-75-B, this new resin is useful in the manufacture of oak ship keels and laminated structural members for columns, timbers, arches and trusses.

This new Amberlite is supplied as a viscous teddish-brown solution, which is infinitely dilutable with alcohol, and can

• SEPTEMBER 1944 • CHEMICAL & METALLURGICAL ENGINEERING

3-MB-3

also be diluted with water to any practical spreading consistency needed. Amberlite PR-75-B has a storage life of a year at room temperature. It is used with Catalyst P-79 which is added at the time of use to effect proper cure. The cured glue line exhibits a pH in the range 6–7 and meets the strength and durability requirements of Army-Navy Specification AN-NN-P-511b (Plywood, Aircraft, Flat Panel) as well as the strength, durability and acidity requirements of Bureau of Ships Specification 52-G-12 (Interim) (Glue, Phenol-Formaldehyde, Low Temperature Setting) and the new Army Air Force Specification 14124 (Glue; Low Temperature Setting).

Preparation of the glue is a relatively simple operation, requiring no special equipment nor unusual techniques. The resin solution is first weighed into a suitable container, the catalyst is then added, and the mixture is stirred until the catalyst is uniformly dispersed. Water at normal room temperature is added to the mixture, and after brief stirring the glue is ready for use.

GENERAL PURPOSE PHENOLIC

A REFORMATION of its general purpose material, brought about through the use of a newly developed phenolic resin, has been effected by Durez Plastics and Chemicals Inc., North Tonawanda, N. Y. 791 Black General Purpose Durez has long flow properties, and yet a fast cure, making it widely adaptable, especially in drilling and tapping.

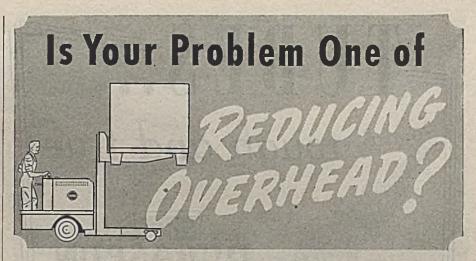
Specifications

Powder properties		
Bulk factor		2.7
Apparent densit	y	50-54
Screening USS r	nesh	16
Form of materia	1	Granular
Pourability		13
Preforming		
Plasticity		6-14
Recommended		
Recommended		
		2000-6000
		2000 0000
Malantalana	ATAN	
Mechanical proper		1 00 1 04
Specific gravity .		1.32-1.34
Molding shrinks		.006009
Water absorptio		0.7
Flexural strengt		9000-11,000
Impact strength		U.G. AT GL
	ak FP	.1518
Per in. of note	h FP	.3036
Tensile strength	PSI	7000-8000
Compressive str	ength PSI	25,000
Mod. of elasticit	y X 10 ⁶	1
Heat resistance	deg. F.	
Hot oil 1 hr		340
Electrical propertie	24	
Dielectric stren		
Dicice Lito Stien	Bru 1/111-0/ Y	

R.T	300-	-400
Dielectric fatigue V/M-S/S	250-	-300
Vol. resistance meg. cm	$2 \times$	105
Insulation resistance meg. R.T.	3 X	103
Power factor R.T. 1000 KC	.05	
Dielectric constant R.T. 1000		
KC	5-6	

MOLDING COMPOUND

A SERIES of new molding compounds derived from farm waste, called Noreplast, has been developed ir the U. S. Dept. of Agriculture's Northern Regional Research Laboratory, Peoria, Ill. Most significant is the fact that Noreplase can be made with one-half the phenol-formaldehyde resin commonly required in the manufacture of this type of plastic. All form-



• A survey of your material handling operations may reveal methods for substantially reducing your plant overhead. The new Baker Catalog contains actual case histories of many companies who have accomplished this with Baker Trucks. A few of them are listed below.







Faced with the need for doubling his storage space a large publisher avoided adding warehouse rent to his overhead by installing a Baker Hy-Lift Truck. Tiering skid loads of paper stock multiplied the effectiveness of available floor space and on rental savings alone he paid for his truck in 18 months. (See illustration at left.)

The world's largest manufacturer of domestic ranges cut handling costs 75% and speeded plant production with a fleet of 8 Baker Trucks. On one operation, that of carrying steel sheets from shearing department to press room, costs were cut from 14¢ to 1.6¢ per ton. (See illustration at right.)

A leading producer of wall board for prefabricated homes found Baker Low-Lift Trucks ideal for handling large quantities of 8×14 ft. panels. Besides effecting substantial savings in handling costs, this company reduced overhead by conserving manpower and minimizing damage to material transported. (See illustration at left.)

Overhead costs for material handling are kept to a minimum in a large aircraft plant by using Baker Trucks for a wide variety of operations such as carrying cylinders, crankcases, and other heavy parts to assembly lines, carloading, unloading, etc. Illustration at right shows truck carrying service tanks of cutting oils to production departments for machining operations.

On the recommendations of a Baker Material Handling Engineer a warehouse installed a handling system using a Baker Fork Truck. Handling costs were reduced from 67ϕ to 50ϕ per ton-a saving of 25.4%. Overhead was thus reduced \$153.00 per week or \$7956.00 per year. (See illustration at left.)

A Baker Crane Truck made additional inside floor space available for production in the plant of a machine tool manufacturer, by storing large machine beds and other heavy castings in the factory yard. Increased production was thus achieved with a minimum increase in plant overhead. (See illustration at right.)

*







WRITE FOR YOUR COPY Plant and production managers, traffic managers, superintendents, purchasing agents and any others concerned with material handling will find the new Baker Catalog No. 52 a valuable reference.

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BAKER INDUSTRIAL TRUCK DIVISION of The Baker-Raulang Company 2145 WEST 25th STREET • CLEVELAND, OHIO In Canada: Railway and Power Engineering Corporation, Ltd.



ulas contain 50 percent or more ground agricultural residues, such as wheat straw, flax shives, cornstalks, peanut shells, and some are mixtures of these. The formulas differ specially in the amount of phenolformaldehyde resin, either liquid or dry form, and in the percent of a speical placticizer designed specifically to produce rapid flow during the molding operation. The percent of phenolic resin varies from 47 to 25 and the plasticizer from zero to 15 percent.

Any of these Noroplast formulas will mold in the regular commercial molding cycle and will produce articles having strength and finish characteristics approximately equal to general purpose phenolic resins containing approximately 50 percent phenol-formaldehyde and 50 percent wood flour.

To prepare Noreplast, finely-ground agricultural residue is mixed with the dry or liquid phenolic resin, the powdered plasticizer, catalyst, lubricant, and coloring agents in a dough mixer or other machine capable of producing a uniform mixture. The mixture is then rolled between heated differential rolls to obtain the desired characteristics of density, flow and setting time. The rolled sheets are then ground and screened to produce the molding compound ready for use. In experimental molding tests to ascertain the molding speed of the new plastic, it took about $2\frac{1}{2}$ min. to mold a pencil tray, pin tray or a cup; about 23 sec. for a bottle cap, $2\frac{1}{3}$ min. for a safety razor and 3 to 4 min. for the distributor head for an automobile.

The natural color of the plastic ranges from light brown to black, but products ranging from ivory or very light tan through light blues, greens, reds. browns, blacks or mixtures of these colors can be made by the use of appropriate dyes and pigments. Flax shives, wheat straw comstalks, tobacco stalks, tobacco stems, peanut shells and soybcan hulls are the agricultural residues which have been compounded and examined. The particular residue to be used depends upon which one is the most economically available to the producer.

HOT FORMING MICARTA

LAMINATED phenolic was for many years believed to be virtually inert at temperatures below decomposition. Recently Westinghouse Electric & Mfg. Co., East Pittsburgh. Pa., has developed a hot forming laminated plastic which when heated rapidly to a temperature of about 275 deg. F. passes through a stage of considerable flexibility and when cooled to ordinary temperatures recovers its average physical properties. This hot forming material is known as Micarta 444. It has a tensile strength of 13,000 psi., a flexural strength of 19,000 psi, and a compressive strength of 30.000 psi. It has a density of about one-half that of aluminum, and a thermal conductivity of 6x10-4. Unlike most of the thermoplastics, it does not become as brittle as glass at temperatures below zero. It maintains 85 percent of its impact strength and gains 25 percent in ultimate strength at -4 deg. F. It does not wilt at elevated temperatures, but maintains 60 percent of its tensile and

DURASPUN Castings bring to the industry all the benefits of high alloy metals, plus greater dimensional accuracy and higher density of metal.

= IUBES.=

tough and true

Tubes, shells, sleeves, almost any cylindrical shape, when DURASPUN, have a uniformity of wall section and freedom from casting imperfections seldom obtainable from static castings.

While concentricity is characteristic of most DURASPUN Castings, out-of-round castings, with irregular exteriors—fins, grooves, lands, and other protuberances—are frequently produced centrifugally. An approximate cylindrical shape and a circular hole running through the center are the only two "musts" for this method.

DURALOY was one of the first foundries to offer centrifugal castings. Added to this was the prior experience of pioneering in the high alloy castings. Today, DURALOY has men and facilities to turn out the best high alloy castings, static or centrifugal, weighing from a pound or so to 8000 pounds.

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S-DU-6

gains 50 percent in impact at 170 deg. F. which is about the softening point of the average thermosplastic.

Drawing and shaping of this new plastic without a draw ring is possible, indicating its formability. A mold for this type of work may be set for a draw of 10 percent in either grain direction of the cloth and as much as 40 percent on the diagonal. The inside radius of a bend may be as little as $\frac{1}{32}$ in. for $\frac{1}{32}$ -in. thickness or $\frac{1}{32}$ in for $\frac{1}{37}$ -in. thickness. The clearance between the sides of the pressing block, and the sides of the forming block should be 0.010 in. greater than the maximum thickness of the Micarta. Both blocks are greased before using, unless hot oil has been used as the source of heat.

Unlike the thermoplastics, it is highly significant that after cooling to room temperature this hot formed plastic retains the strength characteristics of the flat laminate. Furthermore, the general appearance of the material does not change.

SEALING COMPOUND

AFTER several months of laboratory research and development work, Presstite Engineering Co., St. Louis, Mo., announces the production of sealing compound known as Galco. This material is a thiokol compound of the latex type, designed for spray, brush, or slush application. It has a low diffusion rate, low solubility in aromatic fuel and water, and very high adhesion to aluminum. steel, wood and other surfaces. Galco will maintain a tight seal at high and low temperatures, it is claimed.

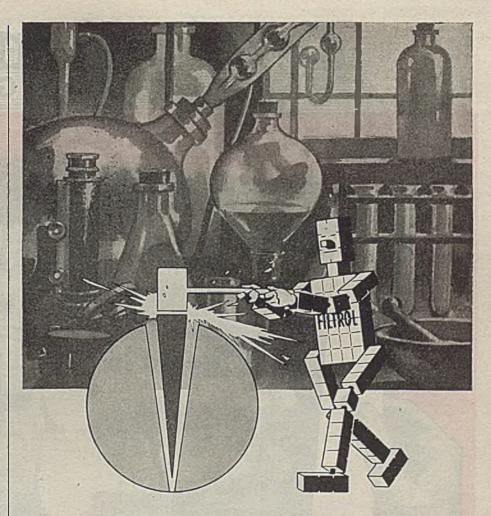
RESIN

USED IN the formulation of flameproof and waterproof coatings for textiles and flameproof paints and adhesives, Clorafin 70 has been developed by Hercules Pow-der Co., Wilmington, Del. A light-yellow to amber colored solid with a compara-tively high melting point, this resin is more stable than most chlorinated filmformers and resins. It loses only 0.6 percent hydrogen chloride when heated to 175 deg. C. for 4 hr. (Jeffersonville Quartermaster Depot procedure). The product is soluble in aromatic hydrocarbons, chlorinated hydrocarbons, esters and ketones and terpene solvents, and is insoluble in alcohols, aliphatic hydrocarbons and ethers. Clorafin 70 is compatible with all types of plasticizers with the exception of those made of mineral oil, with all types of resins and chlorinated products and with many waxes. It shows limited compatibility with high polymers such as cellulose derivatives, vinyl compounds and synthetic rubbers.

Specific Properties

69-72
Yellow to amb
1.60 to 1.65
Approx. 0.6
10-20
Pulverized
90-100

¹ The color is based on the solid material. When pulverized it has a cream color. ² Max. percent HCI liberated. Determined by measuring the percent of HCI freed on bubbling air through a 20-g. sample contained in a 22-mm. by 175-mm. test tube while being heated for 4 hr. at 175 deg. C. in conformity with the method of the Jeffersonville Quartermaster Depot. ³ Ball and ring method, deg. C.



PROBLEM ... LET "Monty *" HELP YOU!

Take the lead of the petroleum industry, where "Monty" – the symbol of Filtrol – is carrying the vital load of war production. More catalysts made by Filtrol are used in petroleum conversion than all other types combined.

More and more chemists in all fields of hydrocarbon conversion are looking to Filtrol to solve their conversion problems.

Filtrol Catalysts are flexible – they are being "tailor made" to fit the individual conversion problem to be solved.

Just as Filtrol has worked with the petroleum industry in developing the world's most economical and efficient catalysts, so will Filtrol's Research and Development Departments help you to apply a Filtrol Catalyst to your individual hydrocarbon conversion problem.

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CATALYSTS AND ADSORBENTS

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DOY TO CO HEAT EXCENSE



Devine



Thoroughly experienced in the problems of heat transfer in the chemical industry, Devine Engineers are prepared to design units specifically engineered for any particular heatexchanging operation. Built in an up-to-date plant by expert workmen with every modern facility at their disposal, Devine Heat Exchangers achieve an unusually high degree of efficiency and mechanical simplicity. Low initial investment and minimum maintenance costs are characteristic of Devine Equipment. If you have a heat transfer problem, Devine Engineers will help you solve it.

Devine

Devine

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CHEMICAL ENGINEERING NEWS_

JOINT LUNCHEON WILL OPEN CHICAGO CHEMICAL SHOW

THE Third National Chemical Exposition which will be held in the Coliseum, Chicago, Nov. 15-19, will be opened with a joint luncheon at noon on Nov. 15. The luncheon will be held at the Palmer House and will be a joint gathering of The Chicago Chamber of Commerce and the Chicago Section of the American Chemical Society. Three prominent directors of research from the Chicago area will talk on current research achievements.

The Industrial Chemical Conference will be devoted to a discussion of the manifold research contributions by chemists and chemical engineers. On the evening of Nov. 15, mctals will be discussed with P. V. Faragher, Aluminum Co. of America talking about aluminum; L. B. Grant, Dow Chemical Co., about magnesium; and John Mitchell, Carnegie Illinois Steel Co., about steel and its alloys. On the next afternoon, pharmaceuticals will be the main topic of discussion with C. R. Addinall, Merck & Co., presenting a paper on the synthesis and production of vitamins. Other speakers will tell of the development of penicillin and sulfa-drugs.

The evening program for Nov. 16 will be given over to addresses on the role of the chemical engineer in industry highlighted by a talk on the work of the chemical engineer in petroleum refining by George Granger Brown, president of the American Institute of Chemical Engineers and on chemical engineering in the synthetic rubber industry by a speaker not yet selected. The dinner meeting on Nov. 17 will be the occasion of the November meeting of the Chicago Section of the American Chemical Society and the principal speaker will be C. F. Kettering, General Motors Corp.

On Saturday morning high school students and their teachers are invited to a session at which a talk will be given defining the work of the chemist and the chemical engineer. Later they will be taken on a personally conducted tour of the Exposition.

PORTABLE PLANT FOR CARBON DIOXIDE AND HYDROGEN

A PORTABLE hydrogen-carbon dioxide generating plant, mounted on a 16-ton Army trailer, has passed acceptance tests and will soon be exported to battle areas. It was designed last December for the U. S. Engineers Corps by the Gas Processes Division of The Girdler Corp., Louisville. Two of the twenty-seven units in production will be kept in this country for training purposes.

This mobile plant has all the component controls and essential operating features to be found in permanent installations, despite the limitations on weight and dimensions. Each trailer carries the following equipment: three heaters, fired with oil; a high temperature catalytic conversion chamber in which hydrogen and carbon dioxide are formed by reaction of water and alcohol; four pumps; three air blower fans; and a high pressure compressor—all powered by a 50-hp. gasoline engine by a compact system of belt drives.

Completed plants, mounted on 12-wheel trailers, are approximately 23 ft. long, 8½ ft. wide, and 11 ft. high and weigh about 36,000 lb. They will be employed to generate hydrogen for barrage balloons, used to discourage low-level bombing attacks. The carbon dioxide produced, compressed into cylinders at about 1,000 lb. pressure, will be available for fire fighting, medicinal purposes, and for making carbonated water or beverages.

PLASTICS SOCIETY WILL MEET IN NOVEMBER

THE annual fall meeting of The Society of the Plastics Industry will be held Nov. 13-14 at the Waldorf-Astoria Hotel, New York. As has been the case with all national meetings of the Society since the war, the major objective of the gathering is to promote the interchange of information among industry members and others interested in war and civilian uses of plastics.

Many new plastic materials and manufacturing technique have been developed to meet war-time demands and these will be discussed in papers delivered before the meeting by outstanding authoritics. The speaking programs and other arrangements are being handled by a committee headed by C. S. Shoemaker, Dow Chemical Co. Truman Handy, Celanese-Celluloid Corp., is arranging the various group meetings which incluide injection molders, machinery manufacturers, button manufacturers, merchandising, fabricators, extruders and compression molders. One of the features of the conference is to be a large exhibit which will include hundreds of plastics, items which have contributed toward the superiority of allied arms and equipment. Manufacturers will find special interest in that section of the exhibit which is to provide a view of plastics in the postwar period.

FERRO ENAMEL WILL BUILD PLANT ON WEST COAST

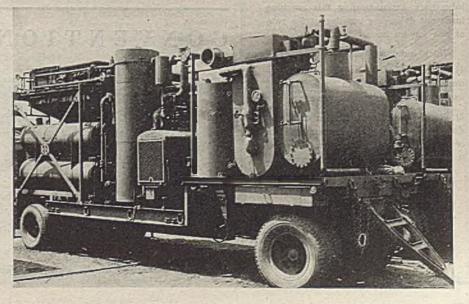
PLANS for a new manufacturing plant to be located in the Los Angeles area were announced last month by Robert A. Weaver, president of Ferro Enamel Corp. The new plant will produce enamel frit and synthetic-enamel industrial paints. In addition warehouse facilities will be provided for all other products made by the company in its other plants, for distribution throughout the western states and for export. John A. Rumer, who has been representing the company on the West Coast, is in charge of the new development.

For the past two years, the company has operated a small plant at Modesto, Calif., to provide vital war materials for the Chemical Warfare Service but no decision has been reached regarding postwar operation of this plant.

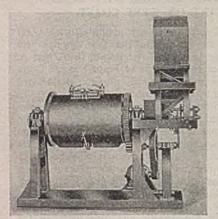
STANDARD CHEMICAL WILL REBUILD ACID PLANT

LAST spring the sulphuric acid plant of the Standard Chemical Co., Inc., of Troy, Ala., was largely destroyed by a tornado. Plans have now been made for rebuilding the plant. Andrew M. Fairlie, consulting chemical engineer of Atlanta, Ga., is in charge of the design. Mills-Packard watercooled chambers embodying the latest patented features and capable of operating at from 2.5 to 3 cu. ft. of chamber space per lb. of sulphur burned per day, will be one of the main features of the new plant.

Compact new mobile hydrogen-carbon dioxide generating plant







Cooties, lice, or whatever you wish to call them spread typhus.

The army doesn't like them, nor do the "G. I. Joes" and civilians either.

So the U. S. Medical Corps delouses all clothes in which cooties may find lodgment, which called for a machine to mix and blend the ingredients perfectly — but quickly, too, for there were millions of cooties to be liquidated and typhus won't wait.

Answering a hurry call, Paul O. Abbé drew up the drawings and built the machine to do the job. It was tested and working successfully within a few short weeks. While meant only for laboratory experimenting this machine turns out delousing powder at the rate of one ton an hour.

Which indicates that ----

1) Paul O. Abbé has the experience and engineering skill to solve any unusual grinding or mixing problem.

2) Paul O. Abbé can design and produce the machine to meet your problem of continuous mixing, no matter what it requires — maybe this very machine.

PAUL D. ABBE :

of Little Falls, New Jersey 375 Center Ave.

CHARCOAL-JRON PLANT FOR TEXAS

A PHOSPHORUS blast furnace and an old wood chemical plant from Michigan are being moved to Rusk, Texas, to be used in a new charcoal-iron plant which will have a rated daily capacity of 100 tons of pig iron. The plants being dismantled for the new establishment are the Delta Chemical & Iron Co. of Wells, Mich., long a producer of wood chemicals and charcoal iron, and the blast furnace-phosphorus plant at Pembroke, Fla., which has been idle since 1931. The latter blast furnace was built to make elemental phosphorus by fuel-fired furnacing of Florida phosphate rock.

The new plant in Texas will smelt limonite ore which is available from deposits in East Texas. The charcoal used as furnace fuel will be obtained, with methanol and acetic acid, as byproducts of the distillation of hardwood from nearby forests. The new undertaking is being organized by Col. E. F. McCrossin of the McCrossin Engineering Co. of New York, and Ralph H. Sweetser, also of New York, is serving as its consulting engineer. The plant, which is reported to cost about \$2,500,000 will be leased to McCrossin Engineering Co. by the Defense Plant Corp.

MONTANA PHOSPHATE MINE IN OPERATION

UNDER the direction of E. C. Anderson, chief engineer, the International Minerals & Chemical Corp. of Chicago, has placed in commercial operation, the phosphate mine south of Hall, Mont. The corporation had constructed a pilot plant there and found results so promising that it was decided to establish full-scale operations as a permanent development. The new plant has a 24-hr. capacity of 450 tons.

I. M. LcBaron, chemical engineer, who designed the pilot plant, is in charge of research and the company has established offices at Drummond and at the mill site. The Northern Pacific Railroad has run a spur. line from the Church siding and the Montana Power Co. has built a two and one-half mile transmission line to serve the mill. The company itself is building seven miles of road to connect with the main highway.

OAKLAND PLANT TO PRODUCE TARTARIC ACID

WHAT is described as the largest tartrate and tartaric acid plant in the United States is expected to be in operation at Oakland, Calif., by next October. The Alloychemical Corp. is converting a steamelectric generator plant into a manufacturing establishment. About \$750,000 is the amount reported as being spent by the corporation to convert and equip the plant. Production schedules call for the processing of 45,000 tons of grape pomace under normal conditions in a 10-month period of operation. The returns are estimated at about 3,000,000 lb. of pure tartaric acid, 500,000 wi. gal. of potable alcohol, 4,000 tons of grape seeds, 3,600 tons of stock feed, and fusel oil.

ANNUAL BOSTON CONFERENCE ON DISTRIBUTION

THE sixteenth annual Boston Conference on Distribution will be held at the Hotel Statler, Boston, Mass., Oct. 16-17. The Conference will deal with vital problems in the field of distribution of immediate concern to business and government in handling the period of transition from war to peace. Leading government and industrial authorities are scheduled to address the gathering.

IMPROVED TECHNOLOGY FOR SYNTHETIC RUBBER

THE General Tire & Rubber Co. has developed a process which permits the addition of carbon black to the rubber latex in the manufacture of synthetic rubber. This is said to cut milling time by 35 percent, reduce power consumption by 20 percent, and result in a material reduction in production costs. Another report from Akron states that rubber technologists have reduced the Banbury mill cycle by 20 percent or more by the addition of such plasticizing materials as naphthol and naphthylene sulphides.

CONVENTION CALENDAR

American Association of Textile Chemists and Colorists, annual meeting, Claridge Hotel, Atlantic City, N. J., Oct. 12–14.

Electrochemical Society, Inc., fall meeting, Hotel Statler, Buffalo, N. Y., Oct. 12-14.

- Boston Conference on Distribution, annual conference, Hotel Statler, Boston, Mass., Oct. 16-17.
- American Oil Chemists' Society, annual meeting, Hotel LaSalle, Chicago, Ill., Oct. 25-27.
- The Society of the Plastics Industry, fall meeting, Waldorf-Astoria Hotel, New York, N. Y., Nov. 13-14.

Third National Chemical Exposition, Chicago Coliseum, Chicago, Ill., Nov. 15-19.

American Institute of Chemical Engineers, fall meeting, St. Louis, Mo., Nov. 19-21.

Technical Association of the Pulp and Paper Industry, annual meeting, New York, N. Y., Feb. 1945. Regular fall meeting will not be held this year.

Examine Your Filter's Performance in the Light of Future Needs

- Is your filter old or worn out?
- Have you developed new or improved products for which your existing equipment is unsuitable or uneconomical to operate?
- Have you considered how new developments in the art of filtration may improve your product or lower its cost of production?

Here at Shriver's we have been making many interesting discoveries about expanded uses for filter presses, especially on many materials never filtered

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before or difficult to filter in other types of equipment. We have learned how to employ some of the newer materials of construction, how to combine in one filter several operations which generally require separate pieces of equipment.

> The Shriver Filter Press has long been graduated from its simple function as a pressure filter. It is a versatile, multiple purpose production machine that can recover solids, clarify, decolorize, wash, dry, extract, thicken, re-dissolve or cause oxidizing, reducing, catalytic or other reactions. There is a multitude of other applica-tions at high or low temperatures and pressure worthy of your consideration.

> Let us help you on your problem. The Shriver Laboratory is ready for that service - without obligation.

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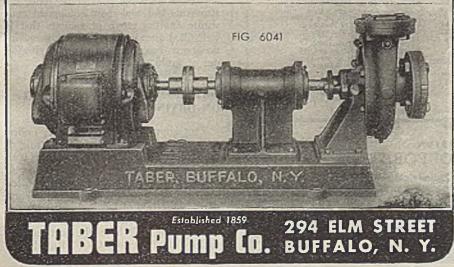
Shriver

FILTER PRESSES

AD NO 5417



industry. It is flexible because the pump easily adapted to there are several impellers for many jobs. Oversize ball bearthe same casing or one may ings, extra shaft diameter, deeper stuffing box. Helpful secure several size casings for the same yoke ... to make bulletin CLVS-339 on request. Please write on your letterhead.





that presents special drying problems -

apply the knowledge and experience of a quarter century that is possessed by



Your product, old or new, can probably be improved with a ROSS Chemical Dryer, designed and built to meet your particular conditions and requirements.

Here's what we mean-

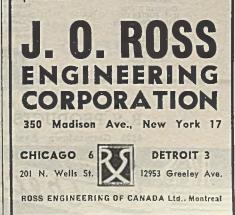
Your product might best be treated by ROSS Low Temperature Drying with dehumidified air ----------

More efficiently handled in con-tinuous ROSS Zone Controlled Ovens-or

Improved by heating air or other gases by means of ROSS Air Heaters.

Laboratory Testing

Our modern Testing Laboratory affords the most complete facilities for determining correct conditions for treatment of your product.



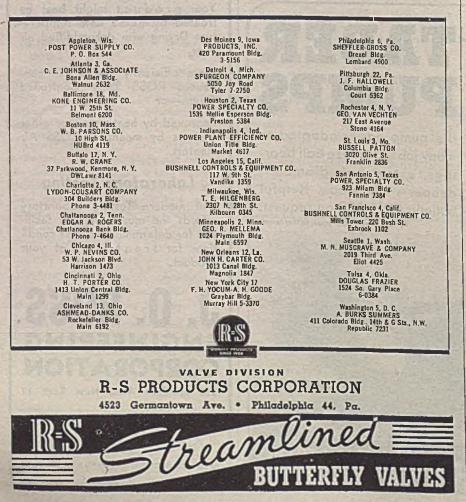


No. 579. Direct action floatvalve with counterweight assembly.

From coast to coast in strategically located cities, there are thoroughly experienced R-S Engineers who have made numerous R-S Valve installations that have effected outstanding efficiency and economy.

Practically universal in application, the R-S Butterfly Valve offers *simplified* control and shutoff of volume and pressure for any material that flows or is forced through a pipe-adapted to manual, float or power operation under high or low pressure and temperature. 15 to 900 psi.

The R-S representative is at your beck and call. Telephone the one nearest you for prompt service or write for catalog.



PRODUCTION OF SULPHUR AND PYRITES IN 1943

DOMESTIC production of sulphur dropped sharply last year according to the annual report of the Bureau of Mines. The output of crude sulphur is given at 2,538,786 long tons. In addition to this production of relatively pure sulphur, a small amount of sulphur ore containing from 10 percent to 50 percent sulphur, was mined in Texas and Colorado and sold for agricultural purposes. The equivalent of 270,000 long tons of sulphur was recovered at smelters, 5,101 long tons from gases, and hydrogen sulphite recovcred contained 17,591 long tons.

Shipments of sulphur reached a total of 3,460,686 long tons and domestic consumption made a new record, the apparent total being 2,525,237 long tons as compared with 2,472,396 long tons in 1942. The greater part of domestic consumption goes into the manufacture of sulphuric acid and acid production last year is estimated to have increased about 11 percent over that for 1942.

Producer-owned stocks declined 13 percent to 4,462,000 long tons.

Domestic production of pyrites last year amounted to 802,384 long tons valued at \$2,844,000. The average sulphur content was 40.9 percent. In 1942, production was 720,363 long tons with an average sulphur content of 42.6 percent.

POWER SHOW WILL BE HELD IN MADISON SQUARE GARDEN

PROBLEMS uppermost in times of industrial change involve primarily those concerned with the supply and distribution of power and those involving tools, especially the more mobile types of machine tools for production in volume. The industrial change which lies ahead as a result of the conversion of plants from wartime work to their regular lines of manufacture, has increased interest in the 16th National Exposition of Power and Mechanical Engineering which will be held in Madison Square Garden, New York, Nov. 27-Dec. 2.

Power plant equipment, well represented on the exhibitors' list, includes the many lines of materials, supplies, equipment and instruments which afford the means for converting existing plants to serve new and larger demands. Machine tools, instruments and tool room equipment constitute another group of exhibits that is well filled already and promises many innovations based on experience growing out of world war production.

OKLAHOMA STARTS RESEARCH ON DRYING OF GASES

THE University of Oklahoma is undertaking a research project on the drying of gases by activated alumina, from a chemical engineering point of view. The investigation, which is financially supported by the Aluminum Co. of America, is under the direction of Dr. R. L. Huntington, chairman of the School of Chemical Engincering. He will have the part-time assistance of Professors G. F. Russell and F. F. Blankenship.

HELSER SELECTED TO DIRECT MAGNESIUM ASSOCIATION

The recently-formed Magnesium Association has completed its organization by the selection of Perrv D. Helser as secretary-director. Mr. Helser had been serving as chief of the Magnesium Branch of WPB in Washington. Membership in the Association takes in a substantial part of the industry including producers, fabricators, smelters, and consumers. Its purpose is to develop and increase the use of magnesium and its products and to correlate technological progress in the industry. Officers are E. S. Christiansen, vice president, Apex Smelting Co., Chicago, president; C. C. Loomis, president, New England Lime Co., Canaan, Conn., vice president; and C. E. Larson, manager of operations, White Metal Rolling & Stamping Co., Brooklyn, treasurer. Headquarters are at 30 Rockefeller Plaza, New York.

The Association already has arranged to hold its first annual meeting at the Waldorf-Astoria Hotel. New York. Oct. 3-4 The morning session on Oct. 3 will be addressed by leading members of the industry and in the afternoon a business meeting will be held. The Sand Cast Division is working on a program for the entire day of Oct. 4.

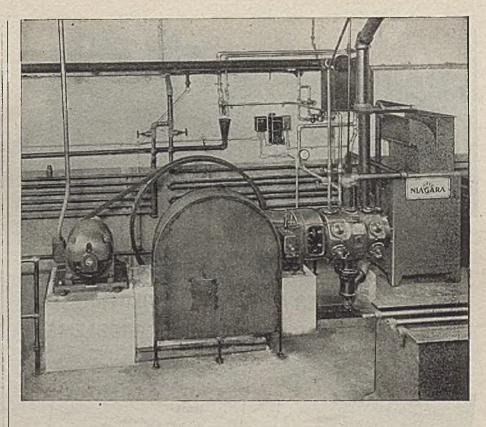
LENINGRAD LIBRARY ASKS FOR TECHNICAL JOURNALS

THE Committee on Aid to Libraries in War Areas has received a request for assistance on behalf of the library of the Leningrad Scientific and Design Metallurgical Institute. This library was bombed twice in the same day, and nearly all its books and periodicals were lost. A letter from P. L. Litvin, formerly connected with the library says they are interested in metallurgical periodicals which are being published in the United States, preferably for the last ten years, but those for the last four or five years would be a fair start for rehabilitation of the library.

The Committee has agreed to furnish storage space for such periodicals until they can be sent to Russia. The Committee can pay transportation costs. If you have material to donate, write to Miss Dorothy J. Comins, executive assistant to the Committee on Aid to Libraries in War Areas, Library of Congress Annex, Study 251, Washington 25, D. C.

RESEARCH ON INSECTICIDES TO CONTINUE AT DELAWARE

CONTINUATION of the fellowship in the Department of Entomology at the University of Delaware has been announced by G. L. Schuster, director of the Agricultural Experiment Station. The fellowship carries a grant of \$10,000 this year. Work on the fellowship, which is sponsored by Hercules Powder Co., will be under the direction of Dr. Paul L. Rice, acting head of the entomology department and will be concerned primarily with screening tests on new compounds developed at Hercules Experiment Station. Arnold Mallis, Hercules Fellow, and his associates will handle the research work.



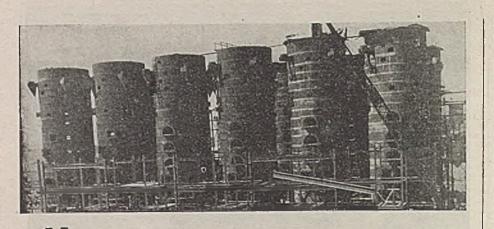
PROTECT YOUR AIR TOOLS

• The moisture that is condensed from compressed air is the chief source of trouble with air lines, tools and equipment. It may freeze in the lines; it may rust or damage products exposed to the air stream; it washes the lubricants out of your tools and causes rusting and more rapid wearing out of parts, especially in rotary tools.

To protect this equipment, take the excess moisture out of compressed air by using the NIAGARA AERO AFTER-COOLER. It produces lower compressed air temperatures and the resulting air contains only one-half to threefourths as much moisture as air cooled by conventional methods. Because it is an evaporative cooler, it uses atmospheric air as the cooling medium and pays for itself by saving water costs.

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NICHOLS HERRESHOFF MULTIPLE HEARTH FURNACES OFFER A PRACTICAL SOLUTION TO SPECIFIC THERMAL PROCESSING PROBLEMS

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A typical Nichols Herreshoff Multiple Nicaro Nickel Company has installed 12 Nichols Hearth Furnace. Herreshoff Multiple Hearth Known the world over for economical Furnaces for roasting and efficient thermal limonite and serpentine processing of ores for the economical many materials. production of NICKEL. 2 Basic Magnesium, Inc. uses 4 Nichels Herreshoff furnaces for the first

step in the production of MAGNESIUM from carbonate ore.

NICHOLS HERRESHOFF Multiple Hearth Furnaces because of their flexibility of design, compactness, small space requirements and low power consumption have established remarkable performance records in the processing of many materials. Thousands of furnaces have been installed to process ZINC, COPPER, IRON, MOLYBDENUM, TUNGSTEN, MERCURY, QUICKSILVER ores and concentrates, etc.

The benefits of fifty-five years of experience in designing and constructing furnaces for roasting, calcining and drying are at the disposal of engineers having specific processing problems.



SOURCES OF ENZYMES FOR HYDROLYZING STARCHES

Basic information on the use of enzymes from sources other than barley malt for the hydrolysis of starches has been made available by recent work of Dr. W. W. Pigman at the National Bureau of Standards. At the request of the Wheat-Alcohol Committee of the War Production Board, Dr. Pigman undertook a study of various types of enzyme preparations that might be used to convert starches into substances fermentable by yeasts.

As a result of the Bureau's studies it has been found that enzymes prepared from certain molds are able to break down starches completely to fermentable sugars in the presence of yeasts. On the other hand, enzyme preparations made from some bacteria and from pancreases do not break down starches completely to fermentable sugars, even if yeasts are present. The enzymcs found particularly in wheat and soy beans, also do not bring about complete saccharification. For certain of these enzyme types, complete hydrolysis to fermentable sugars probably does not take place because certain unfermentable materials are formed from the products of hydrolysis. The synthesis of such substances by the action of the enzyme preparations on maltose, for instance, has been demonstrated. The nature of the actions of the various types of enzymes that hydrolyze starch has been considered in relation to the structures of the various starch substances, and procedure for liquefying starch suspensions without the intermediate formation of gels has been developed.

HIGH ALUMINA IRON ORE FOUND IN OREGON

SIZABLE deposits of high alumina iron ore and high iron bauxite in northern Washington Co., Ore., have been confirmed by investigations of the Oregon State Department of Geology, with chemical analysis revealing the ore averages 20 to $25 \cdot$ percent iron, 25 to 35 percent alumina, 6 to 12 percent silica and 0.15 percent phosphorus. Though there are no commercial operations treating this type of ore in the United States at present, a department report indicated similar ore found in Norway has been reduced in electric furnaces, producing high grade pig iron and calcium aluminate slag, on a commercial scale.

ORONITE CHEMICAL TO MAKE PHTHALIC ANHYDRIDE

ACCORDING to a recent announcement by R. G. Follis, chairman of the board of the Oronite Chemical Co., a plant to manufacture phthalic anhydride will be built by his company at Richmond, Calif. Construction on the plant is expected to start by Oct. 1 and the cost is estimated at a million dollars. When completed this will be the first phathalic anhydride plant west of St. Louis and the output will go to other manufacturers who use phthalic anhydride as a raw material, since present plans do not call for use of this product within the Oronite company.

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Ever since B&W produced first seamless alloy steel tubing commercially back in 1922, it has continued to pioneer important improvements in tubing for high temperature, high pressure, oxidation and corrosion-resistant services. Day in day out in B&W large, complete tube laboratories, engineers and technicians are diligently and constantly searching, for better alloys or how to improve present alloys that will extend the life, reduce maintenance, and increase dependability of tubing in refineries, synthetic rubber plants and chemical plants.

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B&W TUBES SEAMLESS. Complete range of carbon and alloy

steels. Sizes: 1/2 in. to 85/4 in. O.D. ELECTRIC-Resistance Welded Carbon grades. Sizes: 3/4 in. to 4 in. O.D.

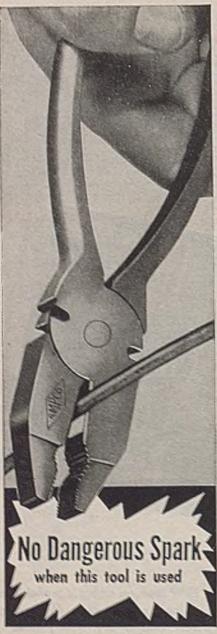
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Welded Tube Division Alliance, Ohio

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TA-1300



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NEWS FROM ABROAD

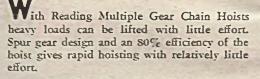
RAW MATERIAL SUPPLIES OFFER PROBLEM IN BRITISH CHEMICAL POSTWAR PLANNING

Special Correspondence

NEXT TO THE enforced neglect of plant repair and overhaul, the exhaustion of raw material stocks in private hands is probably the most serious obstacle to a prompt resumption of civilian production lines after the war. This at least is a view widely held in British industrial circles and has had the result of focusing considerable attention on raw material supply problems. As far as import commodities are concerned, the Board of Trade has from time to time made estimates of the requirements of different industries for the main raw materials. These estimates were based on various assumptions regarding the date of termination of the war and are subject to constant revision in the light of new knowledge and information on conditions likely to prevuil in future periods. Every cfort is being made, so the president of the Board of Trade assured the House of Commons, to ensure sufficient supplies of materials, but this will not everywhere be possible, and where there is not a sufficiency of supplies to go round, the intention is to distribute the available quantities in accordance with essential needs. In other words, control will stay in these fields until supplies are sufficiently large.

From the point of view of the British chemical industry, availability of raw ma-terials is not enough. They must be obtainable at a sufficiently low cost to allow the industry to compete effectively in contested markets. In general economic de-bates the argument has lately often been put forward that Great Britain, through war expenditures transformed into a debtor country, will not be able to afford import-ing all the commodities she used to buy abroad and that the anticipated unfavorable balance of payments will force the country to develop its domestic raw material sources to the best of its abilities, even if such a policy is not in accordance with ordinary economic considerations. Evidence of such ideas is provided, for instance, by suggestions for the utilization of Scottish raw materials, such as seaweed, peat, clavs, shales. dolomite, felspar, and diatomite, possibly with power generated in the proposed hydroelectric stations.

Neither the government nor the manu facturing industries seem to be greatly impressed by these arguments, and while the research organizations have gone into the question of the utilization of domestic raw materials, the majority view still remains



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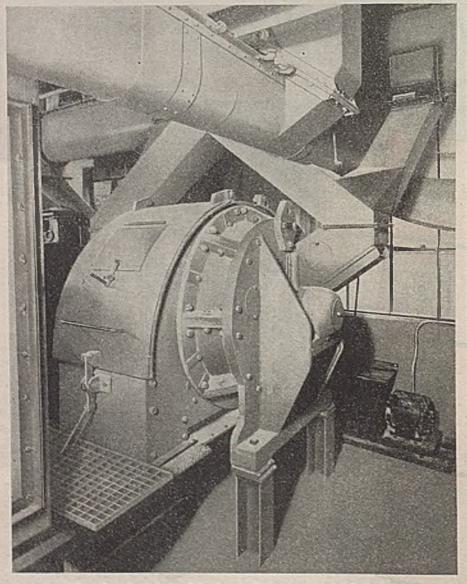
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that Britain, thanks to her industrial experience, commercial tradition, geographical position, and advantages in the field of shipping and international finance, will fare better by a policy of widest possible participation in world trade. Yet, opportunities for development of new raw materials in the British Isles are not neglected, and the immense demands likely to be made by the building trades after the war makes reliance on unorthodox construction materials imperative. Slag from iron fur-names is now "foamed" at two works, and it is intended to install more plants of a similar type at other blast furnaces where suitable slag will be available. These new plants are to be ready for operation by the time the housing program can be started. Considerable experience in the use of substitutes, some supplied by chemical producers, for building has been gained during wartime, and this knowledge will be put to good advantage.

Home-produced tar has replaced imported bitumen for many building purposes. Two simple black tar paints have been standarized for iron and steel protection, and refined tar can be used for coating ground pipes. Incorporation of fillers and vegetable plasticizing oils, reported G. H. Fuidge to the Association of Coke Oven Managers, results in improved paints. Progress has also been made with tarimpregnated roofing felts, and laminated pitch felt has been used for static water tanks built of bricks. Pitch mastics for flooring made under a wartime standard specification have been very successful, and experiments are now in progress with a view to the development of a pitch mastic for roofing. Tar products have also been used for impregnating the wrappings of electric cables. Special refined tars and soft pitches prepared from washed oils verv low in content of phenols and tar bases have been found quite suitable by cable makers. All these new developments are due to wartime conditions and may find less favor under peacetime conditions, but since there is normally a surplus of pitch and certain other coal-tar products, the efforts for their utilization for building purposes will certainly be continued.

As another example, though of an entirely different kind. of wartime developments in the utilization of domestic raw materials in the British Isles mention may be made of the plastics industry. As far as phenol, cresol, benzene, etc., and methanol, formaldehyde, urea, and nitric acid are concerned, adequate quantities at com-petitive prices can be obtained by tar distillation and nitrogen synthesis, accord-ing to a survey by Dr. W. J. Worboys to the Institute of the Plastic Industry. Acetylene for the vinyl group is now available from carbide made in two British plants of doubtful profitability, while alcohol for ethylene required for polythene and styrene can be made from various raw materials. Without going into details of wartime progress, it can be said that considerable progress in the utilization of these various materials for the manufacture of plastics has been made and that there are no insuperable technical or operational difficulties provided the primary raw material can be made available at a sufficiently low cost and manufacture of the materials which the plastics industry requires can be fitted in economically with other productions.

While not all observers agree that petroleum refining is the most valuable source for the organic chemicals required, all seem to agree that in the case of Britain an efficient and competitive organic chemical industry must be based primarily on coal. And further that it is not even so much the producing cost of the coal as the way in which it is used for chemical purposes, what importance is attached to byproducts, and what allowance is made for the needs of the chemical trades in comparison with those of other customers of an expanded postwar coal processing industry, which will determine the progress of this side of chemical production. At present public discussion cannot be taken further than to indicate the great possibilities open for processing and manufacturing industries based on domestic coal. A case of careful investigations has certainly been made out, and the authorities actively support the research work now going on. Even the research workers, however, seem at present to concentrate on a few widely separated individual problems and for the rest content themselves with defining and delineat-ing the potential field of development. Economic considerations must be postponed until more is known of the basic facts of the industrial application of war-time research and of the conditions under which production will have to be carried on after the war.

Nevertheless it seems certain that, while the chemical industries in the British Isles, especially the organic section, will to an even greater extent than in the past rely on domestic coal and coal derivatives for its raw material supply, narrow selfsufficiency arguments will not be allowed to affect their raw material policy. On the other hand, it is clear that where domestic resources are available, where, e.g., limestone is found near coal deposits, more use will be made of the potentialities of such combinations than in the past. But this will not affect Britain's absorptive capacity for overseas raw materials. The investigations of the Board of Trade show quite clearly that these facts are fully appreciated in official quarters.

HYDROELECTRIC PROJECT UNDER WAY IN PERU

SEVERAL chemical and metallurgical projects are reported to be considering use of 2-mill electric power that will be available within 18 months from a hydroelectric development now under construction some 85 miles inland from Chimbote, Peru, the best port on the west coast of South America. The \$5,000,000 required for the development is being provided by the Peruvian government. A government organization has been established specially to handle this and other power and irrigation projects. Two other large hydroelectric projects, for which preliminary surveys have been made, are planned to be undertaken after the one near Chimbote is more nearly completed.

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POOR. Gas pockets in filler metal reduce strength of weld. Pock-marks are visible on the weld surface.



POOR. Improper matching. Plates are not even with each other.



POOR. Part of the filler metal surface is below the surface of the sheets. This forms a recess in which foreign matter may collect. When this type of weld is ground flush, the undercut appears as a crevice in the flat surface.



GOOD The filler metal fully occupies the space between the welded sheets, completely eliminating all possibility of crevices.



*

POOR. This seam has not been fully penetrated by the filler metal. Consequently, the joint is weaker and a crevice is formed on the under side.



GOOD. The filler metal has fused clear down to the battom of the space between the sheets, making a strong clean joint



POOR. Excess grinding down to the level of an undercut to eliminate the crevice has thinned the parent metal and weakened it.



GOOD. Proper grinding flush with the original surface, maintains the full thickness of the parent sheet and provides a smooth surface with the weld practically invisible.





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site near Chimbote at very low cost. After the preliminary construction, engineers estimate that energy may be generated at less than a mill per kilowatt hour, including all charges. Early shipment from the United States of the construction machinery and equipment required to complete the project, is assured. With a full crew of experienced workmen already on the project, the estimated time for completion within 18 months is considered conservative

Originally started to supply power for a projected steel mill at Chimbote, the low-cost electric energy has attracted several other industrial projects. Among these are a cement mill, at least one electricsmelting undertaking and a chemical plant utilizing nearby raw materials.

Barton M. Jones, an American engineer with wide experience in the control and development of stream flow, is engineermanager of the hydroelectric development. David Dasso, a Peruvian engineer who was educated in the United States, heads the government organization.

NEW ZEALAND INCREASES AGAR PRODUCTION

A PLANT for the production of agar was established in New Zealand in 1943 and the rate of production has been steadily increasing. At present the output is suf-ficient to take care of all home requirements and, as production is still growing, it is expected that considerable quantities will be available for the export market.

AUSTRALIA PRODUCES AND **CONSUMES MORE TALC**

PRIOR to the war, consuming requirements for talc in Australia were relatively light and production was held down accordingly with the total output for 1910-1943 amounting to about 41,012 tons. In 1943 production was reported at 4,933 tons with consumption close to that figure. Most of the Australian talc goes in lump form from the mines and quarries to processing firms in Sydney and Melbourne where it is ground to about 200 or 250 mesh.

GOOD PROSPECTS FOR TUNG PRODUCTION IN BRAZIL

PROSPECTS for a good yield of tung nuts for the 1945 season are reported in Brazil with the trees in good condition so far. No estimate for possible production can be made before the September flowering. Last September while the trees were in flower, a freeze was experienced and the crop of nuts failed to come up to earlier expectations. The crop was estimated at 500,000 kg. from which 75 tons of good quality tung oil may be obtained. A carryover of about 30 tons of oil from the 1943 crop is said to be available for shipment but scarcity of drums is restricting trading.

TANNING OPERATIONS IN SOUTHERN RHODESIA

A NEW tannery has been established at Gwelo, Southern Rhodesia, and it is expected to produce enough leather to meet not only the major part of the colony's requirements but allow an exportable surplus of certain items. Another tannery in Salisbury plans to produce high-grade leathers for all purposes as well as finished leather products. The Industrial Development Advisory Committee is favoring a movement to establish wattle growing and the manufacture of wattle extract in the castern districts of Southern Rhodesia.

JAPAN TO BUILD PAPER **MILLS IN INDOCHINA**

According to the Department of Commerce, German and Scandinavian newspapers have carried stories to the effect that the Japanese Government plans to build two large paper mills in French Indochina. One will use timber as its primary raw material and the other will make use of such native materials as rushes and bamboo. At present there is only one paper mill in the entire area and it supplies about one-ninth of the country's normal requirements.

SWEDEN PRODUCES MORE PAINT MATERIALS

WITH the spread of the war area, Sweden has found difficulty in maintaining imports of many materials used in the manufacture of paints. As a result domestic production has been extended to many of these materials. Dry colors are not produced in any large way but new solvents have been turned out to take the place of those formerly brought in from Germany and the United States and their quality is said to be high. Manufacture of synthetic paint materials has made progress and this is expected to reduce import competition in the paint and varnish field in the postwar period.

NEW INSECTICIDE TURNED **OUT IN PERU**

Use of calcium arsenate for dusting the cotton plant is being superseded in Peru. A new company, Insecticida Babbini, S. A., is producing an insecticide powder known as Babbini at an annual rate of 1,000,000 lb. with plans to step this up to 4,000,000 lb. a year. It is intended for use against pests attacking the cotton plant. It is com-posed of chili pepper, sabadilla, arsenic, and quicklime. Sabadilla is imported while the other materials are found in Peru. It is offered to replace calcium arsenate and calcium arsenate-paris green mixtures.

MEXICO INCREASES EXPORTS OF OILCAKE AND MEAL

PRODUCTION of oilcake and meal in Mexico is expected to reach 156,194 metric tons this year, nearly one-half of which is from cottonseed. Production has increased nearly 100 percent since 1938. A drop in output is anticipated for next year owing to the cut in acreage sown to peanuts and sesame. Exports of these products from Jan. 1 to June 1 this year amounted to about 30,000 metric tons or about one-half of what is expected to be shipped out of the country for the full calendar year.



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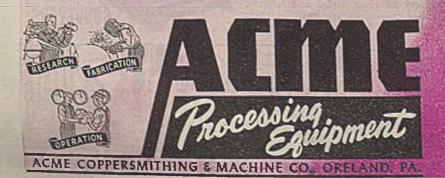
PNEUMATIC TUBE SYSTEMS

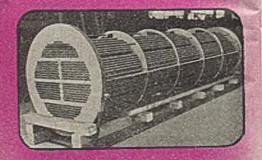


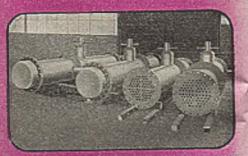
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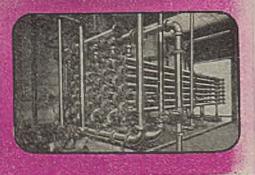
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FROM THE LOG OF EXPERIENCE-

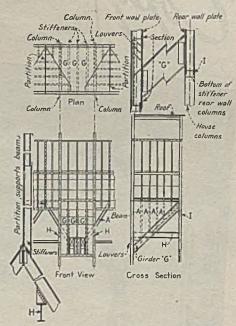
DAN GUTLEBEN, Engineer

BINS DISPOSED strategically promote continuity of operation. They function for dry materials as tanks do for liquids. In the case of finished sugar they allow 24-hr. production while packing and shipping is accomplished during the day-shift when delivery can be made direct to waiting trucks without intermediate storage. There is some choice of shape and position. The shape should achieve complete discharge, especially in the case of high-volatile coal subject to spontaneous combustion. Besides having a bottom slope slightly in excess of the angle of repose of the material, the hopper bottom should have one or two vertical sides to facilitate flow to the outlet. A conical or pyramidal hopper with the apex in the center exhibits greater tendency to form a bridge above the outlet than a hopper with at least one vertical side. Louvres should be arranged just above the outlet gate to admit a poker in case of need. It is usually preferable to locate the bins above the equipment that they supply.

In some refineries the raw sugar bin is located on the dock floor. Thus the continuity of operation of the minglers, necessarily located on an upper floor above the centrifugals, is dependent upon the elevators. The high position allows uniform feed to the minglers through the gates and furthermore tides over a temporary breakdown of the elevator. The 1,000-ton steel bin built above the melter house roof in 1926 cost \$30,000. Its position added \$23,000 for reinforcement of the columns and foundations plus two months of vigorous effort against an uncomfortable job of underpinning. On the other hand, in return for this short period of discomfort, the operating department has for 18 years since then enjoyed the convenience that the high position affords. The difference between a satisfactory installation and a makeshift is extra personal effort. There is of course another bulk bin of large capacity on the ground floor to supplement the live storage operating bin. The structural design of the supports presents no problem that arithmetic cannot solve, being limited only by the cost that the job warrants.

The design of bins built in existing buildings is modified to some extent by the building structure. An economical device is to make the steel plates as wide as possible and long enough to reach in horizontal courses from column to column. The plates are then riveted or welded to the columns and stiffened with vertical girts which project below the side walls to carry the floor beams. The bin walls, acting like plate girders, then deliver the load of the bottom directly to the columns.

Plate thickness is arrived at more or less by the snap of the fingers. For the bottom of the coal-bin, having a load of 1.15 tons per sq.ft. and a beam spacing (wide flange beams) of 4 ft. $\$^{+}$ in., a thickness of $\$^{-}$ in. was selected for structural sufficiency and to this was added $\frac{1}{8}$ in. to anticipate weakening through corrosion that is, to satisfy the old master mechanic's facetious formula "to make it last as long as we're here!" The bottom of the raw sugar bin with a load of 1.35 tons per sq.ft. and a beam spacing of 2 ft. 10 $\frac{1}{2}$ in. is made of $\frac{1}{2}$ -in. steel plates. There is no tendency to corrode with sugar. In both cases the maximum deflection at full load is from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. For some refined



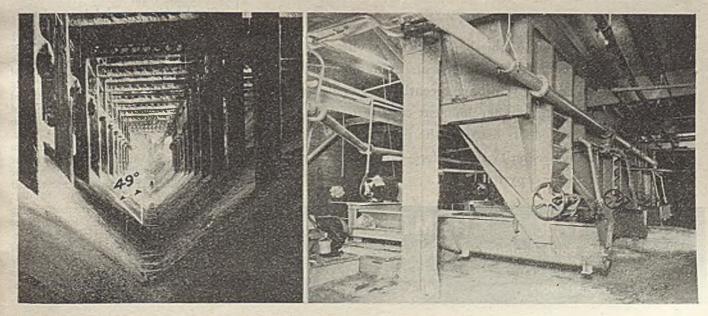
Stiffened bin walls support bottom and carry load to columns

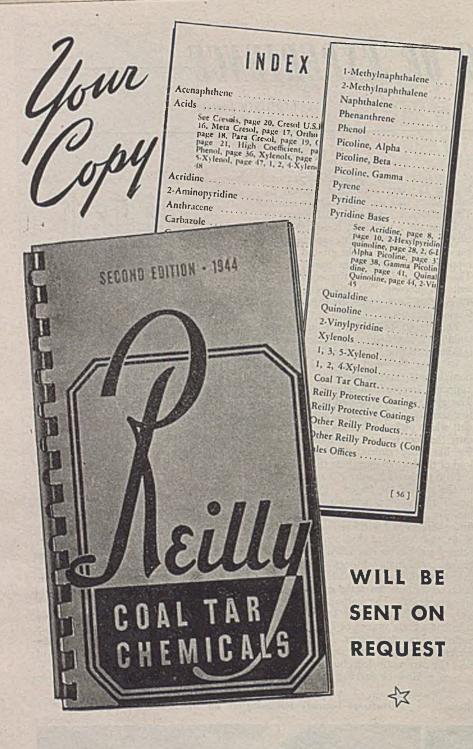
sugar bins No. 10 galvanized sheets are used stiffened with 4-in. I's using a factor of safety of a "good big one," although for the girders that support these, the conventional 4 is applied. These plates and small I's deflect as much as $\frac{3}{4}$ in. which shows that they are earning interest on their cost. The deflected plate approaches in action the effect of a catenary suspension cable in which the entite cross section of the steel is effectively used in tension.

Circular bins have been built 13 ft. in

Raw sugar storage bins located on dock floor

Discharge hoppers and minglers on 5th floor of melter house



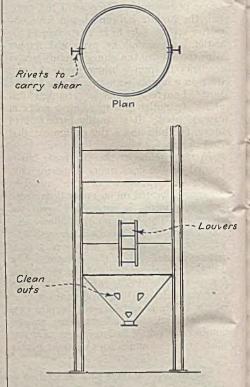


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500 FIFTH AVENUE NEW YORK 18, NEW YORK diameter to fit in between 12 in. H house columns spaced 14 ft. center to center. The plates were of No. 10 galvanized steel at the bottoms and No. 14 in the upper portion. These bins were riveted to two columns respectively at the ends of the diameter and had no other support. When the Old Man contemplated the thin plates, he became jittery. The drafting room then made a 1-in. scale model of the bin of heavy drawing paper with two 1 in. square wooden posts glued on to represent the columns. This model was filled with sand, covered with a steel disk and set up on its columns on a platform scale. A screw jack was placed on the disk on top of the sand and a load pressed down into the bin. When the scale beam indicated one ton, one of the wooden posts failed and wrecked the bin but reassured the Old Man. When the bins in the plant were eventually loaded with 180,000 lb. of sugar, no deflection or signs of distress could be detected.



Circular bin suspended from columns

Tanks for hot liquids are frequently hung in the same manner to save floor beams. In this case the bottoms are made conical or dished. In the construction of the circular shell of the bins, the plate thickness and vertical joints were designed for a liquid load equal to the weight of the sugar and sufficient rivets driven through the columns to take the shear. As the depth of the bin was greater than the diameter, no thought was given to the possibility of collapse, especially as the sugar would tend to maintain the circular shape.

The Old Man, possessing outstanding skill not only in attaining happiness for the stockholders but also in fostering originality and initiative in his men, did not possess the patience to visualize the complex drawing of the new raw sugar bin and the equipment re-arrangement accompanying it. The drafting room, therefore. made a scale model of drawing paper and thereby provided perspiculty in the presensation of the proposition.

Tight bins for food products improve sanitary conditions and impart to the food a more palatable prospect. The famous old advertising slogan, "untouched by human hands," has been obsolete for many years. For a small plant to produce 4,000,000 lb. daily of any chemically pure food product at a nickel a pound where the raw material costs 4c., would leave little margin for manual touching at the price of \$1 per hr. per pair of hands. The old family sauerkraut barrel in Lancaster County around 1865 may not have been touched by human hands but the feet were discretely unmentioned.

IN HIS PROGRESS towards the goal of eminence in steam plant engineering, "J. P." served a wearisome period as a draftsman. It was drudgery to him. He hated the job and he hated the boss. His work reflected his feelings and thus he merited and received his discharge. As he left the drafting room, his parting shot was to express his appreciation. He thanked the boss for firing him as he feared that prolonged association with such a boss might develop in himself the same hateful characteristics that the boss exhibited.

FAITHFUL OLD MICHEL was mustered out of the Polish army at the conclusion of the last war with a strong desire to emmigrate to the land of milk and honey. In the course of time he drifted to our corner and was assigned to the good old repititious job of operating the granulators. The job required little activity either physical or mental. On occasion Michel could even stroll away to other stations if the foreman chanced to be out of sight. For some strange reason, Michel with all his good qualities developed an irresistable kleptomaniacal tendency. The watchman, following a scent, found a large quantity of tools bearing assorted names cached in his cellar. Michel returned the tools and got himself a job in another plant where lack of acquaintance avoided prejudice. In some other respects Michel exhibited practicality of unusual quality. In the fatherland his religious persuasion fol-lowed the ritual of the Catholic community. In Philadelphia he observed that the nearest church of his own faith and language was ten blocks away while there was a Baptist church, where the Polish language was used, a half block distant from his house. He thercupon betook himself to the near-by house of worship and accomplished his purpose to his satisfaction.

PAN HOUSE FOREMAN Jake Sondheimer routed the chronicler out of bed at low twelve to impart the important intelligence that it was raining down at the refinery. In fact it was a gully washer and the water was coming through the monitor over the pan house roof to the discomfort of the sugar boilers. In the traditional engineering department spirit of helpfulness we promised to take the matter up with the weather bureau at once but suggested that in the meantime Jake try closing the windows!



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Safe! Randolph carbon dioxide does not conduct electricity or damage equipment. Dry and odorless ... it disappears after the fire is out. Does a neat job!

Efficient! Carbon dioxide will not deteriorate. It remains effective even in extreme temperatures. Keeps maintenance at a minimum ... eliminates annual refilling problem.

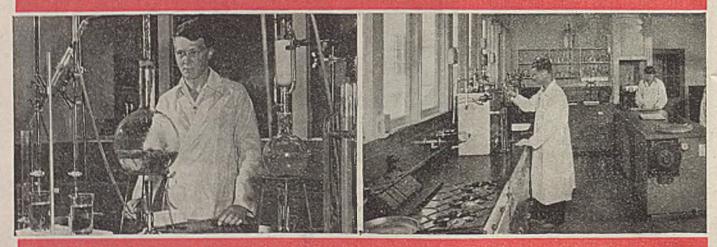
Rancloph"2" Ready to combat sudden "flash" fires. This compact, small unit with exclusive Randolph design, is especially adapted for BUSES, TRUCKS, MARINE CRAFT. Ideal, instant protection for HOTELS, HOSPITALS, INDUS-TRIAL KITCHENS.

SEND NOW for free booktet "Sharpshooting at Flames." Illustrates latest techniques in carbon dioxide fire fighting. NAME_____



DICALITE FILTERAIDS carefully controlled for quality and performance

Processed to exact technical standards



Research keeps pace with needs

Laboratory control insures quality



SEND FOR YOUR COPY of this latest publication on use of diatomaceous filteraids. Ask for Bulletin B-10. No charge or obligation.

insuring improved filtration at lower cost in Chemical Process Industries

Production of Dicalite filteraids is closely controlled to insure the uniform quality expected in a material so widely used by the chemical process industries. Once selected for a given use, a particular grade of Dicalite filteraid can be relied upon for a consistent good performance. In filtration of all types of liquors, Dicalite filteraids give brilliant clarity, positive separation of impurities, and higher flowrates. Maximum production and uniform quality of the product is attained at lower cost. A Dicalite Filtration Engineer will be glad to supply details.

THE DICALITE COMPANY CHICAGO, 11 . NEW YORK, 5 . LOS ANGELES, 14

• SEPTEMBER 1944 • CHEMICAL & METALLURGICAL ENGINEERING

DICALITE FILTERAIDS

NAMES IN THE NEWS_



Lauren B. Hitchcock

Lauren B. Hitchcock has been named manager of the newly formed Chemicals Department of the Quaker Oats Co. Dr. Hitchcock will be located in the company's general offices in Chicago. He was formerly with Hooker Electrochemical Co.

C. F. Cummins, formerly of the Chicago office of Dow Chemical Co., has been transferred to Midland where he has charge of plastic engineering activities in molding powders. P. W. Simmons, transferred from the New York office, will handle protective coating materials.

H. W. Christoffers, L. T. Dupree and R. B. Schneider have joined the staff of Arthur D. Little, Inc., in Cambridge.

William A, LaLande, Jr., formerly director of research of Attapulgus Clay Co., has joined the Research and Development Department of Pennsylvania Salt Manufacturing Co. as director of research.

Orlan McGrew Arnold, formerly a professor of chemistry at Rensselaer Polytechnic Institute, has been employed by Chrysler Corp.'s Engineering Division to set up a new special laboratory to be devoted to physical-chemistry research.

Maurice L. Macht has been appointed to the technical service group of the Plastics Department of E. I. du Pont de Nemours & Co.

Thomas O. Armstrong, of Westinghouse Electric and Manufacturing Co., East Springfield, Mass., has been reelected president of the National Association of Personnel Directors.

Earl T. Anderson, formerly with Todd & Brown, Inc., La Porte, Ind., has become affiliated with the Kraft Cheese Co. as a chemical engineer in the Development and Research Department.

Carl Christiansen has been appointed to the engineering staff of the John C. Dolph Co., Newark, N. J.



E. E. LeVan

E. E. LeVan has been elected president of Haynes Stellite Co., a unit of Union Carbide and Carbon Corp., to succeed the late Francis P. Gormely.

Almon G. Hovey has been appointed executive in charge of the New Chemicals Development Section of the Research Laboratories of General Mills.

T. L. Nelson has been placed in charge of the reorganized and enlarged Electrode Service Engineering Department of the National Carbon Co., Inc. The enlarged department will consist of two divisions, and Neal J. Johnson has been named to head the department's electrolytic service division, while Charles H. Chappell is in charge of the electrothermic service division.

August Heuser has retired from his position of control manager of the Electrochemicals Department of E. I. du Pont de Nemours & Co. He has been succeeded by J. H. Hildreth.

Charles H. Brooks, formerly with Sun Oil Co., has been promoted from lieutenant (USNR) to lieutenant commander (USNR). He is attached to the Ammunition Section, Production Division, Bureau of Ordnance.

Edward B. Yancey has been clected a vice president and member of the Executive Committee of the E. I. du Pont de Nemours & Co. William H. Ward succeeds Mr. Yancey as general manager of the Explosives Department.

Martin B. Williams, who had previously been with Tennessee Copper Co. and the Cullendale, Ark., mill of the International Paper Co., has resigned from the Navy to accept an appointment with the Foreign Economic Administration in Washington.

William Bausch has been elected chairman of the board of Bausch & Lomb, to succeed the late Edward Bausch.



Frank E. Boll

Frank E. Bell has been appointed technical service engineer for Hycar Chemical Co. Mr. Bell, who has had 13 years' experience in the rubber industry, comes to Hycar from the Barrett division of Allied Chemical & Dye Corp.

Paul E. Kuhl, associate manager of the process division of the Standard Oil Development Co.'s Esso Laboratorics, has been made assistant manager of the southern refineries and the Baltimore printing plant of the Standard Oil Co. of N. J. Norval F. Myers, assistant manager of the process division, will succeed Mr. Kuhl as the new associate manager.

Edward A. Willson has been named resident supervisor of the synthetic rubber laboratories operated by the B. F. Goodrich Co. at Kent State University.

Thomas McLean Jasper has been appointed technical and research director for the General American Transportation Corp. with headquarters in Chicago. Mr. Jasper was previously associated with A. O. Smith Corp. as director of research.

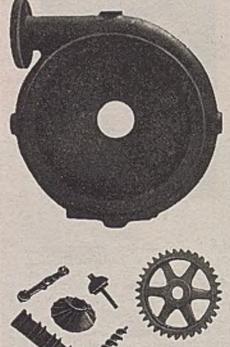
C. Stewart Comeaux has returned to civilian life and again resumed his dutics as secretary-treasurer of two trade associations: Institute of Makers of Explosives and Ammunition Manufacturers' Institute. Major Comeaux was in the Office of the Chief of Ordnance.

Henry L. Cox has been appointed general manager of the Chemical Division, Corn Products Refining Co. Dr. Cox was recently assistant to the vice president, Rubber Reserve Co., Washington.

James T. Settlemeyer has been named head of the mechanical engineering division of General Foods Corp.'s Central Laboratories at Hoboken, N. J.

Frank P. Bleier, who has been with Ilg Ventilating Co., Chicago, since 1942, has been named director of the new Ilg Research Laboratory.

STAINLESS STEEL CASTINGS Resistant to Acid Corrosion and Heat



In the manufacture of Stainless Steel Castings it is important to know how! Atlas metallurgists have been specializing in the casting of corrosion resistant alloys for over 20 years, and have pioneered many of the revolutionary methods used today for casting corrosion resisting alloys. Every Atlas Stainless Steel casting is designed purposely for the particular job. Atlas foundrymen do know how! Your inquiries are invited.

Write for illustrated bulletin.





Clark B. Kingery

Clark B. Kingery, assistant manager of Hercules Powder Co.'s Parlin chemical plant, has been promoted to manager of the Cellulose Products Department plant just established at Hopewell, Va. Mr. Kingery has been with Hercules for 19 years.

G. F. D'Alelio has been made vice-president of the Pho-phy-lac-tic Brush Co. Since March, 1943, he has been director of chemical research, which position he will continue to hold. Dr. D'Alelio was formerly with General Electric Co. at Pittsfield, Mass.

E. J. Cunningham, assistant controller of the Monsanto Chemical Co., has been elected vice-president of the St. Louis Control of the Controllers Institute of America. M. L. Jarbee, secretary of the Diamond Alkali Co., was similarly honored by the organization's Pittsburg Control, and E. F. Campbell, of The Fyr-Fyter Co., was chosen president of the chapter in Dayton.

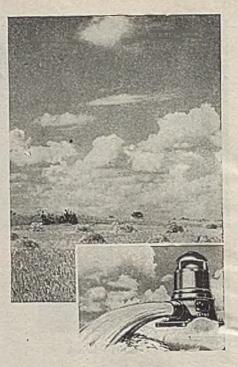
Zola G. Deutsch and Alfred C. Loonam have formed a partnership as consulting chemical engineers and metallurgists specializing in the alkali and related industrics, and in non-ferrous metal process and product research and development.

Benjamin Levitt has joined the Chemical Manufacturing & Distributing Co., Easton, Pa., in the capacity of consultant and head of research and development.

Fred S. Carpenter, factory manager of the Los Angeles tire plant of United States Rubber Co. was recently appointed manager of the company's synthetic rubber plant in that city.

A. E. Jury, until recently manager of the synthetic rubber plant at Los Angeles of the United States Rubber Co., will return to the textile division of the company as manager of new products. Mr. Jury will establish headquarters in both Winnsboro, S. C., and New York, N. Y.

Walter P. Konrad of the phosphate sales department, Monsanto Chemical Co., has been made branch manager of the phosphate division of the sales department in Chicago.



It's The "Pay Off" That REALLY COUNTS

Getting right down to facts, you can't count a farm's yield by its acreage; a factory's output by its floor area, nor a water system's gallon capacity by its well diameter. It's the "pay off" in each that really counts.

It just so happens that Layne Well Water Systems have the very best "pay off" that engineering skill has yet achieved. For such efficiency there are many good sound reasons. First and foremost is the sixty-two year record of constant endeavor in the well-drilling and pump building field. Second is the meticulous care with which each system is built and installed, and third is Layne's unbroken policy of making no compromise with quality.

Many are the cities, factories, paper mills, chemical plants, packing houses, breweries, irrigation projects and mines who use Layne Well Water Systems almost exclusively. They all know that back of every Layne Well Water System there stands the largest, most widely experienced and constantly dependable ground water developing organization in the world.

If in a Well Water System it is the "pay off" in which you are interested, write for late literature. Address Layne & Bowler, Inc., General Offices, Memphis 8, Tennessee.

AFFILIATED COMPANIES: Layne-Arkansas Co.-Stutigart. Ark. * Layne-Atlantic Co., Nortolk Layne-Northern Co., Mishawaka, Ind. Louisiana Co., Lake Charles, Lawer York Co., New York Co., Monroe, L., The Louisiana Well Co., Monroe, L., The Northwest Co., Mit-New York Co., The Charles, Layne-York Co., New York Co., The Charles Co., Mit-Welly Co., Kansas City, Mo. * Layne-Western Co., Kansas City, Mo. * Layne-Western Co. of Minnesola, Minne-s International Water Supply Lid., London, Ontario, Cranda



WELL WATER SYSTEMS DEEP WELL PUMPS

BUILDERS OF WELL WATER SYSTEMS FOR INDUSTRIES AND MUNICIPALITIES



Being made of similar metals, there is no electrolysis to cause cor-rosion, breakdowns or heating failures.

That's why GRID Unit Heaters will outlast other types of heating equipment, without maintenance expense. After 8 years of operation one large chemical plant reports. "We have found cast iron construction stands up very well against the corrosive fumes of HCl, Cls, etc., and there has been no maintenance on the units. We certainly recommend GRID for installation where corrosive fumes exist." GRID Unit Heaters are engineered and tested to operate on steam pressures up to 250 lbs. Complete data and capacity tables upon request.

BLAST SECTIONS



The same high efficiency and lasting qualities as GRID Unit Heaters—one piece construction "fin" sections of high test cast sections of high test cast iron. No tortuous air pas-sages . . . complete ab-sence of ruptures, strains, and warping. Guaranteed for steam pressures up to 250 lbs. Complete in-formation upon request.

D. J. Murray Manufacturing Co.



Lawrence B. Steele, Jr., research chemist in the Acetate Research Section of the Du Pont Co., at Waynesboro, Va., has been named research supervisor in the section. He will supervise work on problems relating to high-tenacity rayon yarn.

Eugene M. Smith, metallurgist, has been appointed to the staff of Battelle Memorial Institute, Columbus, where he will be engaged in research in non-ferrous metallurgy.

M. J. Gavin and J. G. Detwiler have been appointed assistant directors of the Foreign Refining Division of the Petroleum Administration for War. Mr. Gavin's dutics will relate to the facilities side of the division, while Mr. Detwiler's primary responsibilities will relate to the operations of foreign refineries.

Henry G. Boon has resigned from his position as assistant director of the War Production Board's Paper Division in order to resume his duties with the Kimberly-Clark Corp., of Neenah, Wis..

J. B. Willis has returned to the Technical Laboratories of the Pemco Corp. in Baltimore. Capt. Willis returned to Pemco after nearly four years of active service with the armed forces.

Arthur Crago has been appointed manager of phosphate rock production operations for American Cyanamid Co. He will be in charge of and have full responsibility for all of the company's activities in the Florida phosphate rock field, with headquarters at Brewster, Fla.

Ralph E. Menzel has been promoted from assistant to associate professor of chemistry and E. R. Epperson from instructor to assistant research professor of chemical engineering at the Michigan College of Mining and Technology in Houghton, Mich.

C. W. La Pierre, who since 1936 has been in charge of the electro-mechanical sections of the General Electric general engineering laboratory, has been appointed assistant engineer.

Louis G. Gemmell has joined the American Cyanamid & Chemical Corp. as cntomologist. Dr. Gemmell was formerly with the Insecticide Division of Sherwin-Williams Co.

John E. McMillan, formerly with the Packard Motor Car Co., Toledo, has been appointed to the technical staff of Battelle Memorial Institute, Columbus, where he will be engaged in research in the field of organic chemistry.

Robert B. Semple, associate director of development, Monsanto Chemical Co., St. Louis, Mo., has been loaned to the Office of Production Research and Development of WPB for special work in connection with the technical manpower problem in the chemical industry.

A. B. Grafius has retired as vice president of the Coronet Phosphate Co. after 27



perature, pressure, flow ing and closing of valves, or level measuring instrument equipped with use a two-con "High"and "Low"contacts. button station.

use a two-contact push

***For inaccessible locations *Easily** installed in vertical or horizontal pipe lines

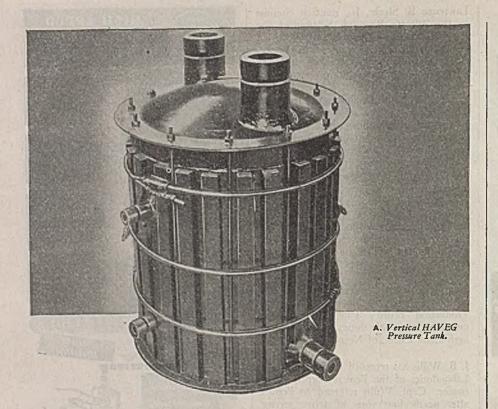
★Complete Line



- your application . . .
 - Weather-proof
 - Explosion proof
 - Acid-proof
 - Water-jacketed
 - Minimum Flow
- *****General Specifications

Universal, reversible motor drives a power screw thru a sturdy gear reduction. Limit switch built-in. Operates slip-stem valves for any medium, up to 12" size and normally used pressures.





HAVEG RESISTS ACIDS AND ALKALIES

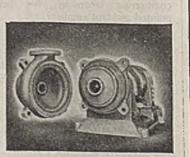
HAVEG Chemical Equipment is molded from an asbestos base plastic. It is made in seamless one-piece units as large as 10 feet in diameter by 12 feet high. HAVEG Equipment is acid and alkali resistant throughout its entire mass. Its resistance is not simply in a coating or lining.

> HAVEG Equipment has strength, toughness and durability. It is unaffected by rapid temperature changes. It may be used continuously at temperatures up to and including, 265°F.

Bulletin F-3 gives complete en-



gineering, design and application data on standard and special types of HAVEG equipment, pipe, valves and fittings. Send for a copy today.



B. Ten Foot Diameter Tank.



years of service. He will continue to act as a director of the company.

Leon J. Willien has been appointed associate director of the Institute of Gas Technology at Illinois Institute of Technology. He has been associated with the Public Utility Engineering & Service Corp., Chicago, as a gas engineer.

OBITUARIES

Frederic J. LeMaistre, 75, who was executive secretary of the American Institute of Chemical Engineers 1930-37, died August 25. A native of Quebec and a graduate of McGill University, most of his career was with the Du Pont Co. until 1920 when he became a consulting engineer in Philadelphia.

Frederick Kraissel, 76, chemical adviser to the Corning Glass Co. of Corning, N. Y., died August 4.

Joseph C. W. Frazer, 68, research professor of chemistry at Johns Hopkins University, died in Baltimore July 28.

Harry S. Wherrett, 68, chairman of the board of directors of the Pittsburgh Plate Glass Co., died August 13.

Frank G. Hall, 73, died July 31 at Hanlover, N. H. Mr. Hall was president of Stem-Hall & Co., manufacturers of vegetable adhesives.

William S. Stowell, 60, a director of the American Cyanamid Co. and president of the subsidiary unit, the Chemical Construction Corp., died August 6, at his home in New York.

Edward Bausch, 89, chairman of the board of the Bausch & Lomb Optical Co., died in his home in Rochester.

Eugene C. Schwarzenbek, 60, former manager of the Newark district office of the Electrochemicals Department of E. I. du Pont de Nemours & Co., died July 23.

Edmund H. Lunken, 83, chairman of the board of the Lunkenheimer Co., Cincinnati, died July 19 at his summer home in Michigan as the result of a cerebral hemorrhage.

George A. Gahles, assistant control manager of the Grasselli Chemicals Department, E. I. du Pont de Nemours & Co., died July 23 of a heart attack while vacationing at his home town of Beaver Falls, Pa. Mr. Gahles had a record of 45 years service with the Du Pont Co. and the Grasselli Chemical Co.

Edgar H. Bristol, 73, president and one of the founders of the Foxboro Co., died July 24 at his summer home, Falmouth Heights, Mass.

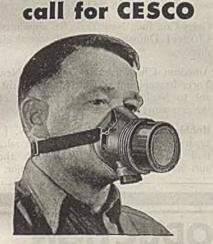
William B. Marvin, 64, secretary of the Farrel-Birmingham Co., died August 13.

Albert H. Killinger, 49, vice president and director of Laclede-Christy Clay Products Co., died in Colorado August 18.

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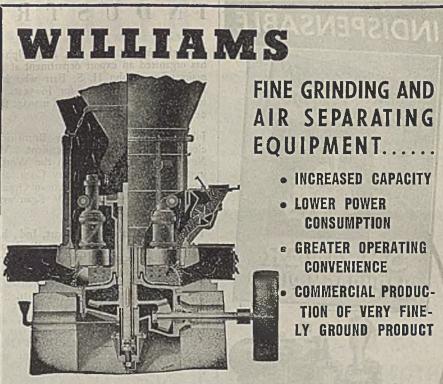
Treacherous FUMES

Chemical fumes threaten life and health of workers. Full protection is a necessity. That's why it pays to...



A worker wearing this CESCO Fume Respirator is a safe worker . . . and a better employee. The extra large filter unit cleanses contaminated air. The positive-acting valve system automatically expels and prevents rebreathing of exhaled air. For comfort, the respirator is light in weight and has a soft, face-shaped rubber cushion. Just a slight headband tension provides an air-tight facial seal.





GRINDING and **DRYING** ONE OPERATION

The Williams Roller Mill has been used for a number of years on all types of medium to extremely fine grinding and is generally conceded to be the most economical for work in this field, both in lower power consumption and maintenance. Our unusually accurate air separators provide a positive check on the size of the finished product. Only material of the desired fineness passes through the air separators—all oversize particles are returned to the mill for re-grinding.

From the standpoint of economical and correct processing, drying and grinding is now logically One Operation. By combining these operations you effect a saving not only in a high purchase price and installation expense of separate drying equipment, but also in the final cost per ton of material handled.

Write today for bulletin 621 describing Williams Fine Grinding and Air Separating Equipment.





Are the materials that must be pumped in your plant corrosive, abrasive, viscous, heavy, delicate, hazardous or otherwise likely to injure or be contaminated by the pump mechanism? Is your present pump giving you trouble because of excessive wear, leakage and frequent attention?

You can help cut your pumping troubles on those so-called "tough" fluids with a Shriver Diaphragm Pump. Its amazing performance (where other types fail so frequently) on such widely diversified materials as heavy metallurgical slurries, acid sludges, clays, synthetic latex, colors, chemical salts, flavors and juices, pastes and sizes the kind of stuff that wears out or gums up a pump much too quickly makes it an outstanding unit for you to consider.

The Shriver Pump is a double-acting reciprocating piston pump in which the working mechanism is separated from the fluid by heavy diaphragms. It is positive acting; has no packing—hence no leakage; is easy to clean, can be built of any metal or of rubber covered plastic or enamel coated metal. Its maintenance cost is low and its performance at any pressures to 100 p.s.i. is foel-proof.

Write for Bulletin No. 112



INDUSTRIAL NOTES

Pennsylvania Salt Mfg. Co., Philadelphia, has organized an export department at its main office. John H. S. Barr who has been with the company for 15 years in technical and sales capacity will manage the new department.

John Waldron Corp., New Brunswick, elected B. R. Newcomb president. Mr. Newcomb formerly was with the Worthington Pump and Machinery Corp. and more recently with the American Optical Co. S. N. Finney and F. W. Egan were elected vice presidents.

The LaBour Co., Inc., Elkhart, Ind., has moved William K. Sims from the home office to the company's branch at 24 Commerce St., Newark, N. J., where he will serve as engineering sales representative in the New York and New Jersey district.

Welco Instrument Co., Chicago, announces that Charles L. Saunders has resigned as branch chief of the WPB Office of Civilian Requirements to become vice president of the company.

Mechanical Handling Systems, Inc., Detroit, has opened a branch office in the Commercial Trust Bldg., Philadelphia, with J. F. O'Hora in charge.

American Machine and Metals, Inc., East Moline, Ill., has appointed Guy E. Heirston manager of its Atlanta district sales territory. The Atlanta office is in the Candler Bldg.

Tube Turns, Louisville, has reopened its Los Angeles office in the Van Nuys Bldg., with James H. Withers in charge. Wilbur E. Geiser, on loan to WPB has returned as manager of the Philadelphia office, located in the Broad Street Station Bldg.

D. D. Foster Co., Peoples Gas Bldg., Pittsburgh, has been formed by D. D. Foster, formerly connected with the Pittsburgh Equitable Meter Co.-Merco Nordstrom Valve Co. The company will handle engineering sales of Hills-McCanna Co.

The Reliance Electric & Engineering Co., Cleveland, has formed a sales promotion department headed by Roscoe H. Smith who also will act as advertising manager assisted by Kenneth F. Ertell.

Geigy Co., Inc., New York, has appointed Charles J. Dumas manager of its insecticide division.

American Chain Ladder Co., Inc., New York, has appointed Eric Morrell assistant to Noel L. Dahlander, president of the company.

Robbins Conveyors, Inc., Passaic, N. J., again has Maurice B. Bradley on its sales staff after serving two years with the anti-aircraft artillery with rank of major.



FLETCHER LARGER BASKETS naturally take a larger load. Also they are easier to load and to unload. FLETCHER CENTRIFUGALS accelerate quickly and run at higher speed. These three provable facts spell "more output per hour; per day; per month; per year."

Larger output means not only lowered output costs; but, also fewer centrifugals for the total amount of processing to be done. . . . LOWER INSTALLATION INVESTMENT AND MAINTENANCE COSTS.

These great advantages were not accidentally obtained. They were achieved by CORRECT DESIGN, the outcome of high engineering skill, specifically and purposefully applied.

Look into the design, structure and operative details of FLETCHER CEN-TRIFUGALS and you'll be convinced that they will save you money. Send for the "Evidence."

FLETCHER WORKS, Glenwood Avenue & Second Street, Philadelphia



- CARBON DIOXIDE in flue gases and inert gas producers.
- CARBON MONOXIDE, NI-TROGEN, ARGON and many other gases.

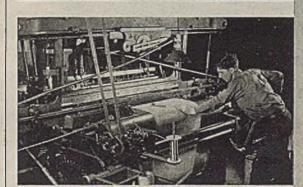
Cambridge Gas Analysers are designed to meet specific industrial conditions providing single or multi-point records on as many as four gases. They give continuous records, accurate and automatic without the use of chemicals or intermittent sampling.

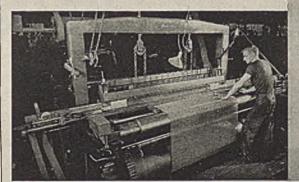
Send for Literature

CAMBRIDGE INSTRUMENT CO., INC. 3732 Grand Central Terminal, New York, N. Y.

CAMBRIDGE GAS ANALYSERS

SKILLED WORKMEN







*

Making MEDIUM MESH HEAVY CLOTH

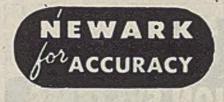


*

M achines are wonderful creations but in the making of wire cloth the hand of the skilled workman still sets up and controls the product of the loom. He's more than a watchman. At Newark, he's the creator of an accurately-made product.

We lay great stress on accuracy and rightly so, we believe. Of what use for screening is a woven wire screen if it is not accurate to begin with or cannot maintain its mesh count or spacing throughout its life?

NEWARK WIRE CLOTH COMPANY



350 Verona Avenue

The hundreds of N E W A R K Wire Cloth users also believe that "accuracy in wire cloth" counts heavily.

Newark 4, N. J.



Because Norblo Dust Collection is Fitted to the Job you can buy Guaranteed Efficiency

Guaranteed efficiency of fume and dust collection systems engineered and built by Norblo is obtainable because Norblo equipment includes automatic bag-type, improved centrifugal and hydraulic types, which can be combined in one system tailored to fit the total situation exactly. Norblo exhaust fans have been specially developed for dust collecting and air handling. The latest development by Norblo is self-contained or portable bag and filter type units for localized or intermittent use in mining and chemical laboratories, pilot plants, etc. Write for Norblo bulletins illustrated below. Or state your problem so that we can send literature on equipment applicable.



Pressed Steel Tank Co., Milwaukee, has reopened its branch offices at Chicago and Los Angeles. Kenneth Cole will be in charge at Chicago with headquarters at 208 S. LaSalle St. and James Barr will manage the Los Angeles office at 727 West 7th St.

Jessop Steel Co., Washington, Pa., has appointed G. F. Golby manager of its office md warehouses in Toronto, Canada. W. J. Henderson has been made manager of the warehouse in Montreal.

H. K. Porter Co., Inc., Pittsburgh, has purchused the Fort Pitt Steel Casting Co. of McKeesport, Pa.

The Foxboro Co., Foxboro, Mass., has idded Paul Torre to its sales engineering t.ff covering the New England territory. His headquarters will be at the main effice.

The Whitlock Mfg. Co., Hartford, Conn., has appointed Norman W. Stirling, forferly with the M. W. Kellogg Co., maniger of sales.

Hercules Filter Corp., Paterson, N. J., has been formed by C. E. Hunziker, R. L. Reardin, C. Stalter, H. T. Jones, Jr., G. Zebora, all of whom had been associated with Republic Filters, Inc.

Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has appointed E. M. Dunlap manager of distributor sales and Rudolf Beck chief engineer of the American instrument division.

L. Sonneborn Sons, Inc., New York, has added J. N. Conover to its staff as assistant to R. W. Bjork, sales manager of the white oil division.

The American Air Filter Co., Inc., Louisville, has made W. G. Frank assistant to the president and has appointed H. C. Murphy, vice president, to serve as general sales director.

United States Rubber Co., New York, announces that Stanley W. MacKenzie has been made director of purchases to succeed George M. Tisdale, recently elected a vice president and member of the executive committee.

American Cyanamid Co., Calco Chemical Division, Bound Brook, N. J., has announced that products for the paper trade made by the pigment department will be sold by the Heller & Merz department, with J. H. Loomis as sales manager.

Olin Corp., East Alton, Ill., has placed Col. Walter F. Siegmund in charge of general sales. Colonel Siegmund formerly was sales manager of its subsidiary, the Western Cartridge Co., and was retired from active duty in the Army Air Corps on Aug. 9.

Allis-Chalmers, Milwaukee, has appointed Frank C. Angle manager of all the company's field sales offices of the general machinery division. He will continue to supervise operations in the Pacific Coast area.

Brown Instrument Co., Philadelphia, has named V. H. Hiermeier to succeed I. K. Farley as industrial manager of its office in St. Louis. Mr. Hiermeier had been connected with the Chicago office.

Orbis Products Corp., New York, has purchased the plant at Matawan, N. J., formerly operated by the Catalin Corp. of America. The Orbis plant at Newark will be operated as before.

The United States Steel Products Co., Chicago, has acquired the manufacturing assets of Bennett Mfg. Co., makers of steel drums with plants at Chicago and New Orleans. Stevens A. Bennett has been appointed a vice president of the steel company in charge of the Bennett Mfg. division.

Eagle-Picher Sales Co., Cincinnati, has appointed Douglas Via industrial insulation sales manager. Andrew L. Harris has joined the company and is serving as manager of sales promotion.

The Eimco Corp., Salt Lake City, has opened a branch office in the Paul Brown Bldg., St. Louis, with James K. Russell in charge.

The Quaker Oats Co., Chicago, has formed a chemicals department which will take over the functions of sales, research, and production heretofore carried out by several divisions of the company. The furfural and technical divisions become merged in the chemicals department and their former designations discontinued.

Allen-Bradley Co., Milwaukce, has added Frank D. Popowics to the sales engineering staff of its New York office and Charles W. McCoombs to serve in a similar capacity at Boston.

The Warren Refining & Chemical Co., Cleveland, has moved its general offices to 308 Euclid Ave.

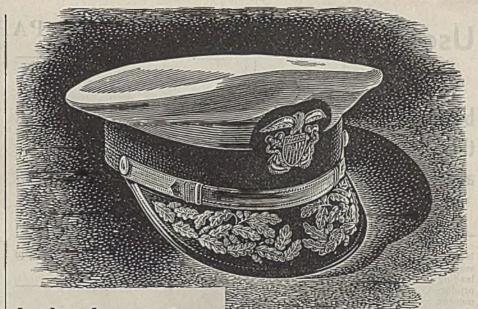
The Osborn Mfg. Co., Cleveland, has promoted Ralph W. Hisey to the position of vice president in charge of all manufacturing and engineering of the brush and machine divisions of the company. Hugh M. Little has been appointed works manager for both divisions.

The Ohio Crankshaft Co., Cleveland, has appointed The Anderson Machine Tool Co. of St. Paul as distributor of its induction equipment in the Wisconsin-Minnesota area.

J. O. Ross Engineering Corp., New York, has elected S. W. Fletcher president. For many years Mr. Fletcher had served as executive vice president. A. E. Montgomery continues as vice president with headquarters in the Chicago office.

Stein, Hall & Co., New York, has elected Edwin Stein president to succeed the late Frank G. Hall. M. S. Rosenthal succeeds Mr. Stein as executive vice president.

Schering Corp., Bloomfield, N. J., has appointed Herman W. Leitzow manager of its eastern territory. Carl H. Suding at Chicago is in charge of the central division; James D. Booth at Atlanta, in charge of the southern division; and Franklin K. Johnson at San Francisco, in charge of the western division.



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CHEMICAL ENGINEERS FOR THE SMALLER INDUSTRIES

WITH THE closing of deferments for technical students, civilian chemical engineering instruction has practically ceased. This is the time for taking stock, and schools all over the country are laying plans for a postwar resumption of teaching activities.

There has been a good demand for chemical engineering graduates. In most schools this demand comes chiefly from the large, well-known processing com-panies. While there has been no lack of opportunity in the larger concerns, there

are reasons why the schools should en-courage some oraduates to go into smaller industries. There are, of course, some dis-

advantages in entering these industries. Possibly the most cogent reason for placing more men in the smaller industries in the postwar period is the necessity for broadening the base. An industry or a profession which limits its field of vision is in danger of atrophy through obsolescence. Two dangers appear. The large influx of postwar students may not find sufficient opportunity if all are to enter the large national concerns. The other danger is a corollary. If the schools train only for the large industries and permit accrediting agencies to mold curricula for this purpose, the profession may find itself straightjacketed by its own market. Happily, large industry has insisted in

the past that the chemical engineer be trained in fundamentals. This policy, if adhered to, should allow the utilization of chemical engineers to the fullest extent in the newer industries based on physics and biology.

From the viewpoint of the region, more graduates should be placed in smaller industry. These men, in time, take their places as leaders in local communities. There are compelling forces which make local leaders in industry expand their field of activities. In the case of large companies, because of the presence of a number of co-workers, the interests of the workers tend to look in, not out, of the





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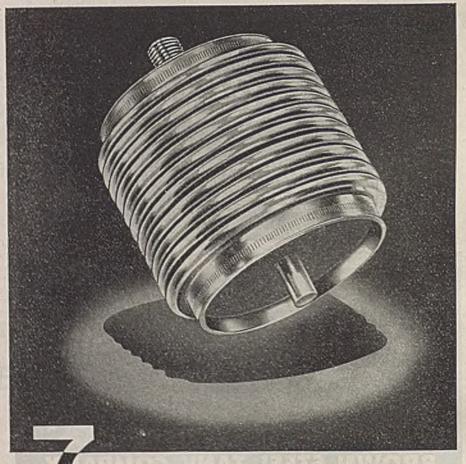


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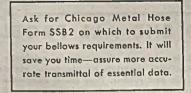
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company. The policy of transferring men from plant to plant favors this company introspection.

From the viewpoint of the graduate, work in smaller industries often carries a more diversified work program, quick responsibility, and the entry into management at an earlier date. Competition too, is sometimes less strenuous. Disadvantages are usually lower starting sclaries, difficulty of sceing the path of advancement, and the absence of clear-cut chemical engincering work.

From another viewpoint, smaller industry has an advantage which is professionally important but less tangible. The engineering graduate in smaller industry is almost always recognized as part of management and the question of unionization is not a personal issue.

Robert M. Boarts, University of Tennessee, before Chemical Engineering Division, S.P.E.E., Cincinnati meeting, June 22-25, 1944.

MOLASSES STILLAGE

IN THE manufacture of ethyl alcohol from molasses, the stillage in solid content is 3 to 5 Brix. Approximately one-quarter of the non-sugars is ash while the remainder is mostly organic non-sugars. The potash ($K_{s}O$) and nitrogen (N) are present in great dilution. Therefore, an economical process for their recovery is very desirable. Low-temperature carbonization yields a carbonaceous nonhygroscopic product with a high K_sO content. Sometimes the K_sO as subplate is preferable to chloride for fertilizer.

By the use of ammonium sulphate, potassium sulphate and ammonium chloride are obtained which can be separated easily by means of a 60 percent alcohol solution. A stationary retort, while somewhat cumbersome, can be used for the production of a nonhygroscopic product high in K_2O content and consequently desirable for fertilizer purposes.

G. T. Reich, Pennsylvania Sugar Co., before Division of Sugar Chemistry and Technology, American Chemical Society, New York, Sept. 15, 1944.

SAFETY AS A MANAGEMENT RESPONSIBILITY

IN LOOKING at safety problems, management must take into consideration its three definite phases. These are education, economics and human relations. Too much stress upon any of the three will render the program ineffective and worthless.

Education in safe practices, education in knowing how to make any operation more safe is expensive and management, almost without exception, is willing to make the investment. Training in safety in the modern industrial set-up has been recognized as having equal importance with all other types of employee training.

all other types of employee training. Management has learned to count the cost of accidents both direct and indirect. Management has learned the ratio of costs and has found that, indirectly, excessive accidents to men, equipment and materials can ruin an otherwise profitable business venture.

Recognizing safety as an economically sound policy of American business, management must, therefore, look to its third

SEPTEMBER 1944
 CHEMICAL & METALLURGICAL ENGINEERING

phase, that of human relations, for the success of any safety movement. True it is that the education and economic phases can be effectively sponsored by disinterested management, but certain it is that lack of attention by management to the human relations phase will cause the program to fail.

Management's responsibility seems to lie in an active, sincere and continuing interest in this third phase of the safety problem. Wise management will reinsure its investment in dollars and in training by accepting its full share of responsibilities.

Warren Whitney, manager, National Cast Iron Pipe Div., James B. Clow & Sons, Birmingham, Ala., before 32nd National Safety Congress, National Safety Council, Chicago.

FIBROUS PLASTIC

THE MOLDED pulp industry has for many years employed a vacuum process for forming or felting pulp to shape. These shapes, depending on the use to which they are to be put, have been dried by various methods without upsetting the felting structure formed by the vacuum process. There have been some attempts in the past to impregnate such articles after manufacture in an effort to develop a strong, dense product. While this effort has been successful in some cases, it is expensive and slow. Incorporation of synthetic resin into the molded product has been accomplished and a preform produced not unlike the regular molded pulp shapes in appearance, but carrying sufficient resin content so that when this preform is subjected to heat and pressure, the resultant article of this secondary step is a plastic product of unusual strength and excellent appearance.

These resin bearing pulp preforms are made by the mixing of pulp and synthetic resin in regular pulp beating engines similar to those used throughout the pulp and paper industry. The relative amounts of pulp and resin are varied to meet the need of the particular article to be produced. After a uniform mixture has been accomplished in the beater, the stock is pumped to automatic molding machines on which the regular pulp shapes are formed. The resultant preform is then dried on a travelling belt passing through a tunnel dryer. The article is then placed between compression molds and cured in the usual manner.

The fibrous plastic preform is approximately the shape of the finished article, although the bulk is considerably greater. The product after curing retains the preform shape unchanged except for compacting but has the added strength of the interlocking fibers in its structure.

If desired, such articles can be made from layers of material containing varying quantities of resin. The body layers or cores may contain a large percentage of fiber and a low percentage of resin. Likewise, the surface layers may be rich in resin, thereby giving excellent outside appearance and a protective coating of high resistance against wear or anything that may come in contact with it. When the article is finally cured the effect is that of a monolithic piece of material, since the resin content in all layers flows in every



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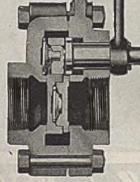
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direction, completely binding the product into one piece. The result of the combination of these two layers in certain articles gives great impact strength and rigidity to the final product, as well as considerable flexibility without danger of fracture. It can almost be said that the fibrous plastic article which has been produced in this manner is as much a product of the pulp molding technique as it is a product of the plastic industry.

W. E. Parsons Keyes Fibre Co., before 10th Annual Chemurgic Conference, St. Louis, Mar. 29, 1944.

TREATMENT OF INDUSTRIAL WASTES

IN SOME localities the draft on wells is critically taxing these limited water supplies with the alternative of treating river water or purchase from utilities.

water or purchase from utilities. A pollution-abatement program should be designed to restore and maintain waterways in that state of purity which may be economically feasible. The demand for varied uses of water courses makes it impossible to maintain all streams in a state of pristine purity, but to permit their indiscriminate use for disposal of wastes is unthinkable.

A comprehensive pollution-abatement program must be practical, formulated on a reasonable and equitable basis, with full advantage taken of natural self-purification processes. A rational classification of all streams, based on their potential use, individually or collectively, should be established and standards of purity set for each classification with sufficient flexibility for proper administration.

Treatment processes should be developed on a watershed basis designed to meet the standards contemplated in the classification. Methods of treatment vary greatly among such wastes as metallurgical, textile, paper, leather, chemical, distillery, etc. Some wastes contain products of value recoverable at a comparatively low cost; others are not amenable to high degrees of purification except at a high cost.

The standard set for each classification should be based on a balance between that which is physically possible of attainment and that which is economically practicable. A pollution-abatement program can be carried out at a cost commensurate with the benefits received, even though these cannot be evaluated on a monetary basis.

W. S. Wise, Connecticut State Water Commission, before Division of Water, Sewage and Sanitation Chemistry, American Chemical Society, New York, Sept. 14. 1944.

GOVERNMENT AND INDUSTRY

GOVERNMENT has long found it desirable to intervene in some phases of our business. For the most part in the past this intervention, while sometimes inconvenient or possibly annoying, has nevertheless been helpful in the long run.

The extent to which Government should invade the fields of private business, or assume direction of it, has been a growing problem for many years. It will never be less of a problem, no matter which political party is in power. The difference will be one of the tempo of invasion. During the past twelve years it might be said that that tempo has been a swift allegro. Many of us hope that in the near future it will slow down to the spirit of a conservative andante.

As far as is necessary, Government should be the source of sound general rules for the conduct of all business but it should leave the actual operation of business to private enterprises under whose direction the most efficient and the most beneficent industrial economy in history has been

developed in this country. It should promote the interests of American agriculture by research, experimentation, education, and demonstration -not by engaging in the business of manufacture and distribution of commodities for farm use.

It should take proper and adequate steps to provide for future national defense needs, keeping war plants in standby con-dition to whatever extent may be necessary. Competent engineering skill is available in the military staffs to determine what is surplus.

Surplus property, acquired for war purposes but no longer needed for the war emergency, should be disposed of according to law. Great business skill, a deep sense of public responsibility, expert con-sideration of the true public interest, and a determination to do what, on balance, is best for the public welfare in the long run must govern the officials upon whom Con-

gress imposes the duty of surplus disposal. Government is in the labor relations field to stay. We should do our part to see that sound policies, fair to all concerned, are worked out and then followed without unfair discrimination. Certainly the future welfare and domestic peace of our country make the finding of right solutions for labor problems imperative. They will call for give and take, forbearance, fairness, frankness, mutually sympathetic under-standing, and honesty in all dealings with one another.

Government must tax. There is no common sense in crying out, wildly and indiscriminately, against taxation. So we should take a citizen's part and responsibility to see that taxes are laid wisely and well, and not discriminatively and destructively. We must also fearlessly do the citizens' part to insist that expenditures of every kind be made prudently and to satisfy real needs where real governmental responsibility exists and not in realms of political, economic, and social reform.

Charles J. Brand, executive secretary and treasurer, before National Fertilizer Association, Atlanta, June 21, 1944.

ARMY FIELD WATER SUPPLY

THERE are few items of Army supply more important than potable water and global mechanized warfare has introduced innumerable water supply and treatment problems heretofore not conceived.

Although basic principles of water puri-fication are well established, their adaptation to field Army requirements presents many problems which do not normally concern water works men. Full cognizance is taken of the fact that proven design factors and operation procedures for water purification in fixed installations may be relied upon to produce a safe treated water. These same principles, however, when ap-plied to portable equipment, frequently

Under Corrosive Processes Amsco Alloy Stands Up ...

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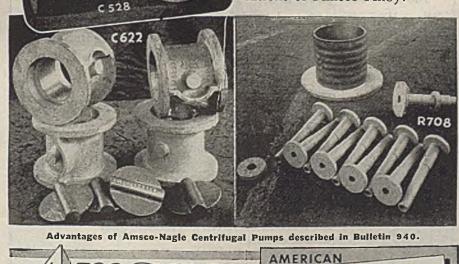
Amsco Alloy F-8, for resisting corrosion in the hot oil pumps of an Illinois refinery. This alloy, which contains 20-22% chro- [mium and 8-10% nickel, is primarily employed to withstand erosion, pitting, etc., from the corrosive action of acids, acid solutions and gases; and is also serviceable under temperatures up to 1600° F.

Picture C-622 shows some valves and valve bodies employed by an aluminum producer in handling corrosive liquids. These castings are of Amsco Alloy F-10, containing 26-28% chromium and 10-12% nickel, which is also an excellent corrosion resistant metal in many uses and is, additionally, more efficient under high temperatures than F-8.

Picture R-708 shows several of Picture C-528 shows pistons of a number of Amsco Alloy parts for the wood pulp digester at a sulphite paper mill. An excess of free sulphur dioxide in the solution makes it essential that the metallic fittings of the digester be made of a corrosion resistant material, like the Amsco Alloy F-10N formula, which contains approximately 29% chromium and 9% nickel.

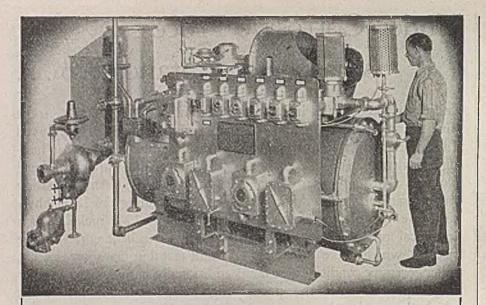
> If you have a corrosion problem, with or without the incidence of high temperatures, where castings can be used, it will prove profitable to consult Amsco.

> Bulletin 108 describes all applications of Amsco Alloy.





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introduce complications. It will be appreciated that the multiplicity of Army field water supply problems invite and occasionally result in deviations from standard water works practice.

Possible denial of field water supplies through their contamination with toxic materials has long been a source of concern to the responsible agencies. That the situation has never really arisen makes the problem only more complex since it must be handled entirely on a speculative basis, theorizing such matters as possible contaminants, amounts expected, and practicality of treatments. Yet insurance measures against this potential danger cannot be neglected.

A vast number of poisonous compounds are known, especially in the organic field, but a critical survey of these substances indicates that most could not be successfully employed as water contaminants.

Much work has been done during the past few years investigating the removal of different toxic materials from water. For Army use a simple universal method is required, it being impractical to adopt several specific treatment processes for use with individual contaminants. Standard water works procedures alone are of value here, and throughout past work, activated carbon has received the preferential consideration for this purpose. Activated carbon will absorb toxic organic contaminants from water although it is not effective in the removal of inorganic cyanides, arsenic, or heavy metals. These, however, were discounted from consideration on other grounds.

The carbon treatment of contaminated water is not ideal, requiring as it does large amounts of carbon. It has, however, the virtues of simplicity, effectiveness with the most probable contaminants, and familiarity to water personnel. Many types of activated carbons are produced commercially for different uses, exhibiting high specificities which cause a wide variance in their removals of different materials. Of these only the finely ground grades are applicable to existing equipment.

H. H. Black, Captain, Corps of Engineers, before Engineering Section, American Public Health Association, New York, Oct. 13, 1943.

CELLULOSE PLASTICS

CELLULOSE is an alcohol and will react chemically like other alcohols to form esters or ethers. Inorganic esters such as cellulose carbonate, sulphate, nitrate, or phosphate can be made; or organic esters like cellulose formate, acetate, stearate or butyrate; or mixed esters as cellulose nitrate acetate, cellulose acetate butyrate or cellulose acetate phthalate. Any number of ethers can likewise be made, as methyl cellulose, ethyl cellulose, benzyl cellulose. One can even make mixed ether-esters as ethyl cellulose stearate. Of all these possible products only a few are of commercial importance and only four are widely used in plastics. These are cellulose nitrate, cellulose acetate, cellulose acetate butyrate and ethyl cellulose. The use of these materials in plastics developed in the order listed. As each new member of the series was added the total importance of the series increased. Perhaps in time to come new derivatives will be added to the list but

KEMP

there is no such advance to announce today except in-so-far as ethyl cellulose may be considered a recent arrival.

It is not necessary to describe these products individually. They are all characterized by high impact strength, the ability to absorb a sudden shock. They are all true thermoplastics and will soften when heated and harden when cooled through as many cycles as one wants to go. People have talked about some sort of cross * between thermoplastic and thermosetting properties, the object being to have all the advantages of thermoplastic during processing. So far this has not been done commercially with cellulose derivatives.

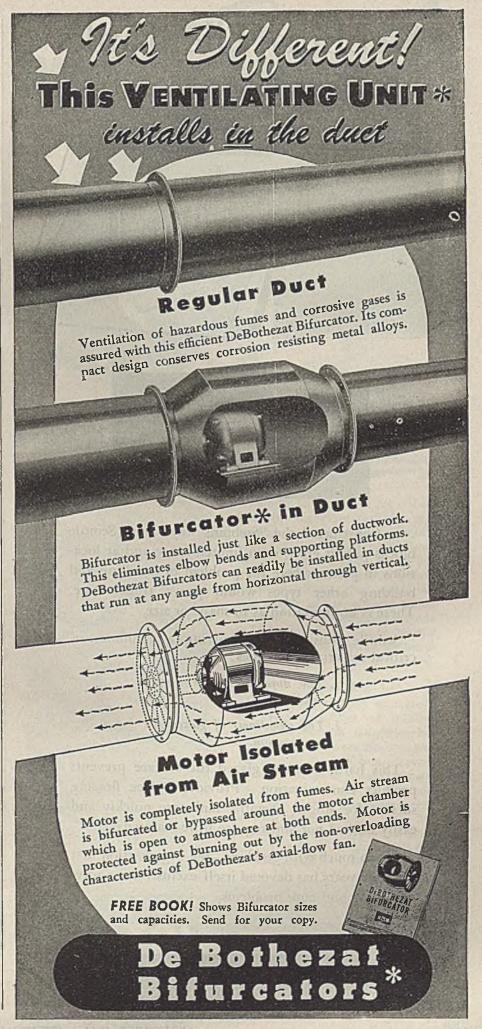
There are really three types of tests applied to plastics. First, the simple merchandising tests for customer appeal; second, what we choose to call functional tests which determine by trial under adverse conditions whether the finished product will perform as expected; and third, engineering tests to determine fundamental strength characteristics. Considerable advance has been made in determining these engineering properties.

Cellulose plastics in general have very high impact strength. They will absorb a lot of sudden shock without breaking. Under a sustained heavy load, however, they all tend to give some cold flow, particularly if the temperature is a little high. Methods have been sought to reinforce these plastics in some way to reduce cold flow and further improve impact strength if possible. This objective has been accomplished to a considerable extent by laminating with fabric. Laminates made of cotton fabric and cellulose acetate or ethyl cellulose plastic have remarkable shock resistance and hold their shape rather well under fairly adverse conditions. Such laminates can be made and used as flat sheets, they can be made as flat sheets and then subsequently formed and drawn hot, or they can be built up around a form or mandrel.

The fact that flat sheets of thermoplastic laminate can be drawn is of particular interest since it offers a possibility of manufacturing the laminates in a few plants best equipped for the process, and shaping or fabricating them in numerous smaller plants where the finished products are being made. Deep draws and other forming operations can be made with very simple equipment. The plastic when heated forms its own adhesive so that sections can be joined by heat, or if desired a solvent-sealing process may be used. Combinations of plywood with cellulose plastic and fabric can be made and offer some promise.

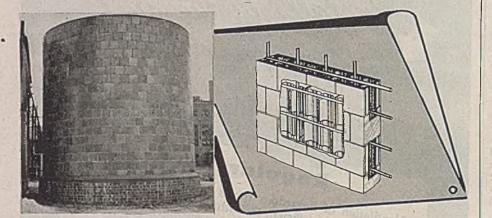
Ethyl cellulose is the newest of the cellulose plastics. It has been well publicized. However, the effect of ethyl cellulose on the plastics business is just beginning to be felt and the marked increase in its importance during the past year may well be considered a recent advance. Since this has been a wartime development the uses of ethyl cellulose are strictly functional, that is, they depend on the fact that ethyl cellulose has properties which make it the only material which will do certain jobs well.

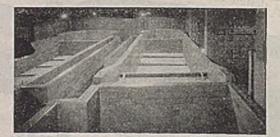
Fortunately for the country, but unfortunately for purposes of public discus-



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Stebbins Engineering and Manufacturing Company 367 EASTERN BOULEVARD, WATERTOWN, NEW YORK sion, most of these new uses of ethyl cellulose are of a military nature. However, the fundamental properties which dictate the use of ethyl cellulose are no secret. One is the wide useful temperature range. Dimensional stability is another feature in which ethyl cellulose is definitely better than either acetate or acetate butyrate. The good properties of ethyl cellulose as an electric insulator recommend it for use in cleetric equipment.

J. K. Speicher, Hercules Powder Co., before joint Plastics-Douglas Fir Plywbod conference, Seattle, July 13, 1944.

TRANSITION PHENOMENA IN HIGH POLYMERS

ORGANIC polymers of high molecular weight exhibit a variety of changes in state which profoundly affect their physical and mechanical properties, and are thus of both theoretical and practical interest. Temperature and external stress are, as expected, the principal determinants of these transitions. Delicate and subtle changes in structure govern the physical behavior of natural and synthetic high polymers.

The most general transition of essentially linear macromolecules is between high elasticity and ordinary elasticity; room temperature is above this transition point for rubber but is below it for polystyrene. These changes in state occur unsharply, as indicated by changes in slope but not discontinuities in the curves of specific heat, coefficient of thermal expansion, dielectric constant, modulus of elasticity, etc. vs. temperature. A great deal of their quantitative interpretation remains to be done.

constant, modulus of elasticity, etc. vs. temperature. A great deal of their quantitative interpretation remains to be done. A great many high polymers possess such geometrical regularity that at least portions of their long chains form ordered, crystal-like arrangements spontaneously above room temperature (polyethylene, polyesters, polyvinylidenc chloride), or especially under particular conditions of cooling or annealing (polyamides, cellulose triesters). Others undergo such ordering at lower temperatures (natural rubber). Some polymers "crystallize" under external stress such as stretching, at higher temperatures than those at which they order spontaneously (natural rubber), or only under stress, and not spontaneously at any temperature (polyisobutylene). Many of these transitions, which X-ray and electron diffraction show to involve quite sharp changes in local order, have been lately found to possess high latent heats, or discontinuities in heat content-temperature curve, and are strikingly abrupt considering the great range of molecular weights, and presumably, of overall chain configurations, contained in the polydisperse samples investigated. The low temperature side of these first order transitions is distinguished by the strongest molecular interaction of any state or polymers. Indeed, the molecular packing appears often to be so efficient that characteristic high polymeric strength and toughness are attained at one-tenth the average molecular weight of similar molecular structures which do not show such first order transformations (polyethylene, ordered, compared to polystyrene, disordered.)

Recent studies on simple condensation polymers suggest that either the regular occurrence of points of strong van der Waals' attraction along a given chain (polyvinyl alcohol, polyamides, polyesters, cellulose triesters, etc.) or such composition that the chain has a sort of rod-like, cylindrical symmetry around its axis (polyethylene, polyvinylidene chloride, polyisobutylene) is necessary for transformation to states of high local order. Attempts at de-tailed theories do not yet justify review. Evidently, transition temperatures influence greatly the particular utility of high polymers in the form of rubbers, plastics or fibers. Problems like the insolubility at room temperature of simple polymers such as polyethylene and polyvinylidene chloride have been enlightened by evidence that these substances gain sufficient rotational entropy in the solid to make dissolution thermodynamically unattractive. On the other hand, the decrease in entropy caused by orientation (fibering) of an already ordered polymer seems to be too slight to entitle orientation per se to classification as a separate state. Perhaps transition phenomena in high polymers are best summarized as being highly probable events for, actually, a given polymer solid usually contains several states of order simultaneously, never being all ordered, nor entirely disordered. These states are likely to be changing more or less continuously, much like the traditional changes in ancient glass.

W. O. Baker, Bell Telephone Laboratorles, before Division of High Polymer Plastics, American Physical Society, Rochester, June, 1944.

RESIN ADHESIVES AND THE NEW PLYWOOD PROGRAM

RESIN ADHESIVES have become commercially important in the United States during the last decade. Their successful use has been responsible for fundamental changes in the technique of manufacturing plywood as well as in many other problems of wood adhesion. Synthetic resin adhesives have brought about the greatest advances that have occurred in the plywood industry in the last quarter of a century.

The earliest known glue was animal glue made from the bones and hides that eventually became important byproducts of the meat packing industry. Other conventional glues that followed the animal glues were vegetable (cassava flour), silicate of soda, casein, blood albumin, etc., developed progressively since about 1900. There were several rather serious limitations in most of these older glues, among which two of the major handicaps were their lack of endurance under severe weather and moisture exposure and the length of time required under pressure to secure a durable bond.

The durability of the heat-cured resin bond was its first outstanding improvement over the earlier glues. The process of heating a resin adhesive produces an irreversible chemical and physical change which was first recognized in blood albumin glue during the time of the first World War. The older animal and vegetable glues hardened by means of evaporation of the solvent and they were more or less resoluble when exposed to water. In the case of the synthetic resin adhesives the chemical and physical changes produced by heat render them distinctly non-



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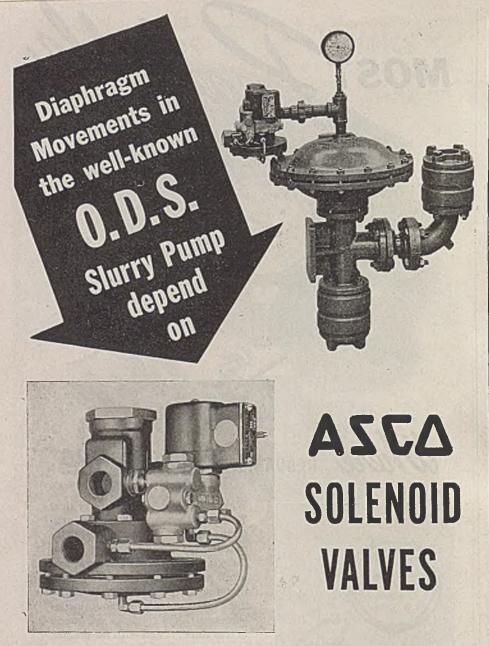
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CHEMICAL & METALLURGICAL ENGINEERING . SEPTEMBER 1944 .



Timing of operations is all-important in many types of process equipment and for this type of work many companies have turned to ASCO Solenoid Valves.

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resoluble under exposure to moisture. Resin adhesives, when properly chosen, efficiently applied and cured under heat, will produce a bond that is more durable than the wood layers which are thus joined together. This was an important adhesive development and was found to be of substantial help in the plywood requirements of the second World War.

In addition to the waterproofness of the resin adhesives, experience demonstrated that practically all of these types of resin adhesives are strongly resistant and repellant to mold and fungi growth. The resin adhesives themselves will not support mold or fungi growths, and effectively inoculate the wood for a considerable distance from the glue joints. These parasitic developments had always been found troublesome with the older conventional glues when plywood was exposed in warm, humid climates, such as the tropics, and even casein and blood albumin were seriously weakened under such conditions.

ously weakened under such conditions. Another of the important factors in establishing the success of the synthetic resin industry was the shortening of clamping time for a satisfactory setting of the adhesive from a matter of hours to a few minutes. And within the last two or three years radio-frequency heating equipment has been developed to apply heat to the cure of resin adhesives. The most useful adhesive application of radio-frequency heat is its ability to heat thick wood assemblies through and through with a reasonable degree of uniformity in the entire assembly and within a surprisingly short interval of time.

There are two major classifications of synthetic resin adhesives, the phenolics and the ureas. The phenol-formaldehyde resin adhesives are the most durable type of synthetic resins for woodwork. They are thermosetting and possess durability superior to those resulting from any of the other resin adhesives. Phenol-formalde-hyde resin adhesives are available in film, powder and liquid form. The films and powder have better storage life than the liquid type. From the standpoint of pres-ent knowledge, substantial heat seems essential to obtain a satisfactory cure with the phenol-formaldehyde types. However, studies now in progress would indicate that these temperatures can be considerably modified without appreciable sacrifice of durability and it seems reasonable to expect that moderate temperature phenolics, between 175 and 225 F., may soon be-come commercially important, and possibly supersede the higher temperature types in certain applications.

The other important class of synthetic resin adhesives is that of the urea-formaldehyde type, which is also thermosetting and is available in powder and liquid form, but is not available in film form. The ureas in general require lower temperatures and shorter curing cycles than the phenolics and with certain catalysts can be satisfactorily cured at room temperature of approximately 75 deg. F. The urea resin adhesives differ from the phenolics in their adaptability to the addition of high ratios of low cost extenders, such as wheat flours, while still possessing substantial water resistance. The urea resins are not as durable under moisture and heat exposure as are the phenolics but their durability characteristics are much better than the other conventional glues. This compatibility with extenders makes it possible to secure urea resin bonds in cost ranges that approach those of the early glues but with far better durability.

Cure of urca resin adhesives is usually facilitated by catalysts, commonly acidic in character. There is a considerable range of formula as well as of adjustments in required temperatures and in clamping periods. Urca resins are also available in fortified form. This requires the addition of chemical ingredients with the catalyst that increase the durability of the urea bond so that it approaches more nearly to the durability of phenolics.

There are several other types of resin adhesives, less important at the moment. which are just emerging from the development stage and may become commercially available in the future, although at the present time there seem to be serious limitations of cost which may prevent their economic comparison with the ureas and the phenolics. In the main, these lesser known resins, such as melamine and resorcinol, are used in combination with the ureas and the phenolics, since this affords the advantages while maintaining the cost factors within moderate limits. Whether these resins will be used by themselves remains for the future to determine. The melamine resins are chemically similar to the ureas, while the resorcinol is a particular type of phenol and both are thermosetting.

T. D. Perry, Resinous Products & Chemical Co., Philadelphia, before 10th Annual Chemurgic Conference, St. Louis, March, 1944.

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Engineers utilize their knowledge of nature and experience in handling materials to convert natural resources and energy into products, power, and wealth, for the benefit of all mankind, thereby raising the standard of living of everybody. In China, we have a big job to do; engineers are the key men to do it. In order to carry on our work, we need a total of 2,000,000 more engineers. However, the new graduates cannot shoulder the responsibility of the gigantic job of industrialization. The only possibility of carrying on this work is to invite to China engineers of achievement and of high experience who will design, install, operate, manage and develop our machineries of production.

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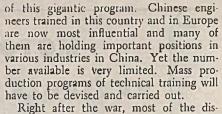
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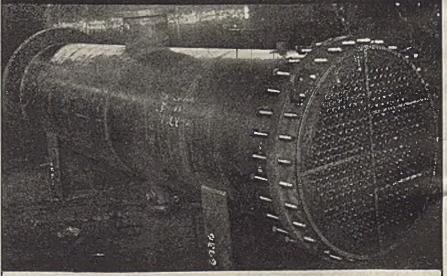


placed populace will return to their home-land and find that their houses have been demolished or destroyed by the war. They must be sheltered. At first we plan to give them temporary sheds with three rooms each. For this simple project alone, we would need 2,000,000,000 cubic feet of wood and 100,000 tons of hardware. Later on, when living conditions return to normal, more decent and comfortable homes, more public and administrative buildings will be built. Cement factories, brick factories, stone quarries, lumber mills, furniture factories, hardware fac-tories, glass factories, paint factories, etc., are bound to come to exist in order to supply the demand. Household appliances such as refrigerators, vacuum cleaners, washing machines will also come in time. Public utilities such as city transportation, sewerage, water, lighting and gas are in-dustries to be developed parallel with housing. We also must have the all im-portant basic heavy industries such as coal, oil, steel, power, ship building, and basic machinery. China is so big and the industries to be developed are so many that the Central Planning Office will have to study and ascertain what kinds of industries are most suitable to certain localitics. We will have to have raw materials, labor, capital and technical skill. We have an abundance of raw materials and manpower. What we are in need of and hope for from our friendly nations are capital and technical skill.

China has enormous resources; if she has sufficient capital, she can develop her in-dustries. At the beginning of her industrialization, she will pay her loans by her usual export of raw materials such as tungsten, tin, antimony, silk, tea, tung oil, and some other farm products. She can also pay a part of her debts by exporting products of handicrafts. Later on, when the finished products roll out, they will be exported to pay her debts. Loans or capital investments may be in the form of material, machinery or equip-ment. For this war, billions of dollars and pounds have been spent to establish new manufacturing plants in U. S. A. and in England. After the war, these new machineries are bound to lay idle and deteriorate. Your statesmen, economists and industrialists are now busily engaged in investigating and planning the post-war utilization of such a tremendous amount of machinery and equipment. Well, here is one of the possible solu-tions. They can be sold or loaned to Chica carving a a basis for building up China serving as a basis for building up her industry. We will leave the details of such capital or investment to the financial experts.

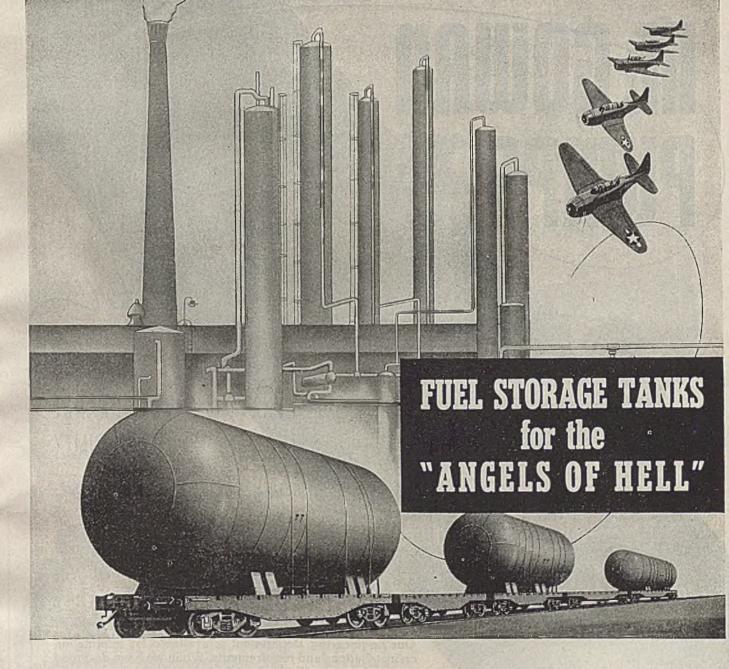
K. Y. Chen assistant Chief, Far Eastern Division, UNRRA, before American Society of Mechanical Engineers, Washington, D. C., June 21, 1944.

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FOREIGN LITERATURE ABSTRACTS

DETERMINATION OF ALKALI METALS IN PORTLAND CEMENT

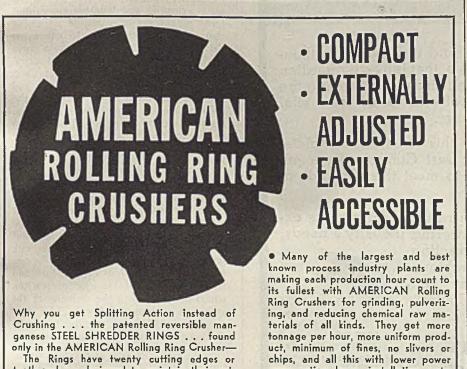
A METHOD for determining alkali metals in Portland cement has been developed which is superior to the method recommended by the American Society for Testing Materials in that the reagents used are very simple and considerably less time is required.

Method of analysis is roughly as fol-lows: a mixture of 5 g. cement, 1 g. am-monium chloride and 5 g. calcium carbonate is heated in a platinum crucible up to 500 deg. in a 15 min. period and up to approximately 900 deg. in the next 45 min. The resulting mass is transferred to another dish, treated with boiling distilled water several times and washed, and then concentrated to about 50 cc. Ammonium carbonate (3 g.) is added gradually, the mixture boiled for several seconds, filtered and washed with 50 cc. of a solution of ammonium hydroxide and ammonium carbonate in distilled water. This liquor is then concentrated to 20 cc., neutralized with concentrated ammonium hydroxide and the last traces of calcium precipitated out with 5 cc, of an am-monium oxalate solution. Ammonium compounds are then eliminated by neutralization and heating, the residue is dissolved in 10 cc. water, washed, and the SO, ion eliminated with 10 percent barium chloride. After further treatment the residue is treated with 15 cc. of an alcoholic solution of perchloric acid, washed, dried, etc. The weight of the residue multiplied by the factor 0.34 gives the quantity of potassium (in K.O) contained in 5 g. of the sample analyzed. After further treatment, 6 drops of sulphuric acid arc added to the residue and the residue calcined and weighed. Its weight, multi-plied by the factor 0.4366, gives the quantity of sodium oxide contained in 5 g. of sample analyzed.

Digest from "Determination of Alkall Metals in Portland Cement." by Jose Jorge Noguelra and Francisco J. Maffei. Anais da Associaca Quimica do Brasil III, No. 1, 8-12, 1944. (Published in Brazil.)

CATALYTIC OXIDATION OF ACETYLENE

OXIDATION of acetylene, using active manganese dioxide as catalyst, was carried out in connection with the problem of purifying air of low concentrations of acetylene. Technical acetylene was used in a concentration of 0.04-0.57 percent of the air-acetylene mixture. The commercial active manganese dioxide used as catalyst, was pressed into tablets, crushed and screened into fractions of the desired fineness. The air came through a blower outside the building, was passed through a layer of cotton and activated carbon to remove traces of oil and dried with cal-cium chloride. The air and acetylene were passed through flow meters, mixed, heated by passage through a coil and made

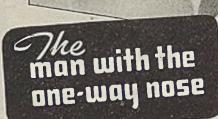


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to flow at the rate of 30-100 l. per hr. per cc. of catalyst. The temperature was also raised by the heat of reaction in the tube. The heat liberated per hour, q, can be calculated from $\Delta t V \rho C p$, Δt being the difference in temperature of the entering and of the exit gas, ρ the density and Cp the heat capacity. The amount of heat liberated per hour when all the acetylene was completely oxidized could also be calculated. The temperatures shown by the thermocouple indicating the value of At and the mercury thermometer in the catalyst mass showed that heat exchange between the catalyst and the gas was slow, an indication of diffusion kinetics. The temperature of the catalyst mass was taken as the temperature of the experiment. Comparison of the results calculated for percentage of acetylene oxidized with the results from photo-colorimetric analysis indicated that the authors' thermochemical method was more exact.

Apparent order of the reaction depended upon temperature, a characteristic of reactions taking place on porous materials. According to Zeldovich (1939), if it is assumed that the reaction takes place in the region of diffusion at 220 deg. and in the inner kinetic region at 142 deg., the order of the reaction 0.75 found at 190 deg. corresponds to the occurrence of the reaction in the transitional or inner diffusion region. The order of the reaction in this region should be equal to the arithemetical mean of the orders of reaction in the kinetic and the diffusion regions.

Velocity-temperature curves for varying space velocities and temperatures exhibit turns or changes in curvature indicating change in mechanism accompanying change in temperature. Breaks in a curve mark changes in apparent energy of activation. In one case no dependence upon temperature appeared above 219 deg. and this was considered to correspond to the diffusion region. There was a transitional region or region of inner diffusion down to 170 dcg. and below 170 deg. the energy of activation rose in jumps, this being the kinetic region. A rise in velocity shifted the limit of the diffusion region toward higher temperatures, in accordance with theory. At lower temperatures, the rate of reaction was practically independent of grain size; but upon transition into the diffusion region, increased grain size was accompanied by marked increase in rate of reaction. This was confirmed by experiments with catalysts of different grain size. Reduction of the rate of reaction which occurred when the diameter of the grain was reduced to below 1.25-1.5 mm. is not explained, unless it is due to greater resistance to the flow of the gas mixture.

Digest from "Kinetics of Catalytic Oridation of Acetylene on Active Manganese Dioxide." by V. Rolter and M. Rusov. Zhurnal Fizicheskoi Khimii 17, 87-96, 1943. (Published in Russia.)

MONOPHENYL THIOUREA PRODUCTION

A METHOD for the direct production of monophenyl thiourea from aniline hydrochloride and ammonium thiocyanate has been developed recently in Germany. Aniline hydrochloride is added to ammonium thiocyanate in aqueous solution, and the aniline thiocyanate formed in quantitative yield is readily converted into monophenyl thiourea by application of heat. Since the latter can react further with aniline hydrochloride to form diphenyl thiourea, which is not suitable for making synthetic resins, it is necessary to use an excess of ammonium thiocyanate (25-30 percent). The latter remains in the mother liquor after separation of the monophenyl thiourea.

There is no difficulty in separating the monophenyl thiourea from the ammonium chloride formed simultaneously. On heating the reaction product to about 100 deg. C. the urea derivative separates out at the bottom of the vessel as an oily layer which can be run off and after solidification crystallized from alcohol with a 90 percent yield of pure monophenyl thiourea. From 5 to 8 percent more of a mixture of mono- and diphenyl thiourea is ob-tained by evaporation of the alcohol. The ammonium chloride separates out when the mother liquor is cooled so that it can be separated out and the mother liquor returned to the process. The ammonium chloride is washed with the alcohol subsequently used for the recrystallization of the monophenyl thiourea. Aniline sulphate can be used instead of aniline hydrochloride, the two solid reac-tants being mixed in the presence of alcohol in this case. Aniline thiocyanate is formed quantitatively by brief warming to 50-60 deg. C. The difficultly soluble ammonium sulphate is separated by filtration and the final conversion to monophenyl thiourea carried out in an alcoholic solution which is practically free of inorganic matter.

Either method permits continuous operation and yields of 95 percent of pure monophenyl thiourca with complete recovery of the alcohol used and with solid ammonium compounds as useful byproducts.

Digest from 'Thiourea from Ammonium Thiocyanate,' by W. Klempt, Dic Chemische Technik, Jan. 10, 1942, (Published in Germany.)

CHROMIUM PRODUCTION IN BRAZIL

THERE are five chromium producing regions in Brazil. Three are in the state of Baia, one in the state of Minas Gerais and one in the state of Goiaz. In normal times chromium mineral with a Cr_2O_a content or up to 48 percent and a chromiumiron proportion of approximately 3 is used for metallurgical purposes. When the chromium content is relatively low, the mineral is used in the chemical or refractory industries.

The Formoso mine in Baia is estimated to have a reserve of several tens of thousands of tons of mineral suitable for metallurgical purposes and two or three hundred tons of mineral which can be used as refractory. Brazil's total chromium mineral production in the last five years has been from the state of Baia and is as follows: 850 tons in 1937, 940 in 1938, 3,760 in 1939, 4,580 in 1940 and 4,450 tons in 1941.

Digest from "Brazil 1942, Mineral Resources," Bulletin No. 56, p. 30, 1943. (Published in Brazil.)

PQ silicates – to the aid of ore flotation

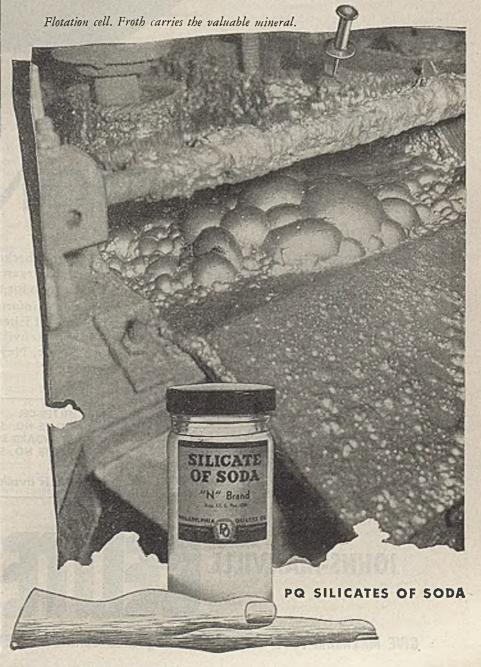
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POPULAR PLASTICS

PLASTIC HORIZONS. By B. H. Weil and Victor J. Anhorn. Published by The Jaques Cattell Press, Lancaster, Pa. 169 pages. Price \$2.50.

Reviewed by Chaplin Tyler

This compact little book on plastics was written primarily for the layman. However, the authors, who are staff members of the Gulf Research and Development Co., have said a great deal that could be read with profit by the scientific and technological fraternity.

After a lucid description of various major. plastic products, the authors present statistics showing the growth of the plastics industry and the quantities of raw materials consumed. Next there is an excellent account of war applications of plastics. This is followed by a review of synthetic fibers and synthetic rubber-like materials. The book concludes on future applications of plastics in construction, automobiles, air craft, home furnishings, and less welldefined fields. The authors have treated their subject sanely, avoiding wild predictions of a magical plastics age. They are optimistic, but do not foresee in plastics the doom of steel and other metals. They give credit generously to various companies in the industry.

Only in a few instances does the reviewer question the authors' technical accuracy: On p. 26 they refer to the casting of polymethyl methacrylate as though a "molten resin" is used. This not the case at least in layman's language. On p. 32, the authors refer to "polyvinyl alcohol—known as Resistoflex." That the two terms are synonymous is questioned. On p. 133 the price of cellulose nitrate plastic is given as \$28 per cubic foot of 92 pounds. In recent years the avcrage value at factory of sheets, rods, and tubes has been roundly three times this figure. Typographical errors were noted on pp. 16, 38, 61, and 99.

NOTHING NEW

PRINCIPLES OF POWDER METALLURGY. By Franz Skaupy. Published by Philosophical Library, New York, N. Y. 80 pages. Price \$3.

Reviewed by W. P. Sykes

THIS 80-page booklet deals almost exclusively with the properties of tungsten and molybdenum and the methods of their production. A few pages are devoted to the hard carbides. The introductory chapter consists mainly of theoretical speculations which are decidedly controversial in nature.

As indicated by the references and the limited scope of the subject matter this booklet is a translation of several German papers none of which were published later than 1930, and the few illustrations, especially the photomicrographs, are distinctly unilluminating.

Evidently the translator is sadly unfamiliar with metallurgical terms for not

RECENT BOOKS RECEIVED

The Burenvernt. By John H. Crider. B. Lippincott Co. \$3.

Dictionary of Organic Chemistry. Vol. I. Ed. by I. M. Heilbron, H. M. Bunbury, E. R. H. Jones & W. E. Jones. Oxford University Press. \$30.

Phosphates and Superphosphate. 2nd cd. By A. N. Gray. Lewis (London). 21s.

Thermodynamic Charts, 2nd ed. By F. O. Ellenwood & C. O. Mackey, Wiley, \$2,75.

a page is lacking in one or more amusing examples of inadequate translation. Throughout the text the word "wolfram" (or even "wolframite") is used in place of "tungsten." To speak of a wire drawing die as a "nozzle"; grain boundaries as "points of impact"; hydrochloric acid as "salt acid" and clamps as "manacles" may indeed introduce the desired element of humor but hardly contributes to clarity of exposition.

Perhaps something might be said to recommend the book for its historical value although this is not implied in the title. Taking all in all it does not appear to contribute anything new to the knowledge of powder metallurgy and certainly is not to be compared with other available books dealing with this subject.

FOR BULLETS AND BOMBS

THE SCIENCE OF EXPLOSIVES. By Martin Meyer. Published by Thomas Y. Crowell Co., New York, N. Y. 452 pages. Price \$4.50.

THERE has been, as Prof. Meyer admits, much written in the field of explosives. His purpose in adding further to this literature is to provide a single source of information on the chemistry, production and anaylsis of explosives. The book apparently was intended to serve as a text for courses in explosives since each of its 16 chapters concludes with a series of discussion questions and exercises. The exposition is clear and the whole field is well covered. Opening with a chapter on history, the book continues with discussions of the various explosives. In addition, there is considerable material on acids and nitration, initiators, explosive and initiating devices, inspection and analysis, applications and use, packing, shipping, storing and safety. On the whole, a competent job seems to have been done by the author and a worthwhile addition made to the literature of a subject of considerable wartime importance.

MICROSCOPE PLUS CAMERA

PHOTOMICROCRAPHY, THEORY & PRAC-TICE. By Charles Patten Shillaber. Published by John Wiley & Sons, New York, N. Y. 773 pages. Price \$10.

Reviewed by Richard W. Porter

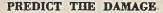
WHILE there are several good works on both microscopy and photography, the subject of photomicrography has never been thoroughly covered and this volume appears to fill a real need. It is a combination textbook and reference work on the application of photography to the compound microscope. The material given is basic and deals primarily with the actual problems encountered in this field. While the fundamental principles of microscopy are based on optics and mechanics, these subjects are treated only insofar as they have a practical value to the student of photomicrography. Such special phases as color photography, ultraviolet and infrared radiation, and polarized light are not considered.

Considerable detail is used by the author to describe the many phases of photomicrography and his method of treatment is logical and complete. Each subject is discussed in its component parts and the results summarized in tabular form. Laboratory experiments and exercises are outlined and each chapter contains a list of study questions. The book's 300 illustrations provide unusual clarity. Various kinds of microscopes, cameras and accessories are shown, along with examples of photo-graphic work. Included also is a glossary of some four hundred terms. Procedures and techniques involved in setting up and adjusting the microscope with its accessories are given. Evaluation, selection and care of all parts and materials used are thoroughly treated. The microscopist unfamiliar with photographic technique will welcome the discussion on cameras, film, exposure time, and other practical details. Theory of developing photosensitive materials and many formulas of developing solutions are included.

While six out of eight chapters deal almost wholly with equipment, accessories and materials used in photomicrography, the last two chapters deal with methods and materials used in preparing specimens, and with the analysis of photomicrographic problems. Mounting media, stains, reagents, and solvents are discussed in detail with respect to their use and application. All types of specimens are classified into eight groups. The problems dealing with each group are analyzed to acquaint the technician with the best methods of approach.

All things considered, the subject has been well treated to provide a real contribution as a textbook, reference and guide.

CHEMICAL & METALLURGICAL ENGINEERING • SEPTEMBER 1944 •



EXPLOSIONS THEIR ANATOMY AND DE-STRUCTIVENESS. By Clark Shove Robinson. Published by McGraw-Hill Book Co., New York, N. Y. 88 pages. Price \$1.50.

Reviewed by G. F. Kinney

This short study of explosions is based on lectures given to auditors from the Safety and Security Branch of the Office of Ordnance, Army Service Forces. Its purpose is to give some knowledge of the hazards involved in possible explosions.

Damage from explosions may be caused by the blast of hot gases, by the detona-tion wave, and by flying missiles. Each effect may be analyzed separately, the effective range predicted, and the total probable destruction then estimated. The hazards thus associated with a possible explosion prescribe the minimum distances for specified degrees of protection. The protection afforded by standard safety prac-tices is discussed, and it seems that minor modifications could perhaps be made in some of them.

The book contains much information that is not readily available from other sources. It is required reading for ordnance men, safety engineers, and others who work with explosives.

MAGNETIC METHODS

MAGNETOCHEMISTRY. By Pierce W. Selwood. Published by Interscience Pub-lishers, Inc., New York, N. Y. 287 pages. Price \$5.

Reviewed by Linus Pauling

MAGNETOCHEMISTRY is defined by the author of this book as the application of magnetic susceptibilities and of closely related quantities to the solution of chemical problems. The usefulness of magnetic methods in chemistry has not been very widely recognized. By his clear, simple discussion of the experimental methods of magnetochemistry and of the results which have been obtained by the application of these methods. Professor Selwood has made an important contribution to science, and has done his part in calling the usefulness and power of magnetic meth-ods to the attention of chemists. It is clear from his book that magnetochemistry is a most fertile and promising field of research, and that magnetic methods may be used for the solution of problems in industrial chemistry as well as pure chemistry.

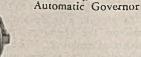
In successive chapters the author presents brief descriptions of the principal experimental methods of measurement of magnetic susceptibility, the theory and experimental information of the diamagnetism of atoms, ions, and molecules, the theory of atomic paramagnetism, experi-mental values of magnetic moments of ions, the paramagnetism of molecules and complexes, the diamagnetism and paramagnetism of metals, ferromagnetism, and the use of magnetic methods in analysis. The treatment throughout is experimental and practical rather than theoretical; the author is, of course, justified in keeping the discussion of magnetic theory brief because of the existence of the excellent book by J. H. Van Vleck on the theory of electric and magnetic susceptibilities.

A very satisfactory survey of the entire

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TROY, PENNSYLVANIA 9-TEM-5 field of the application of magnetic methods to chemistry is presented in the book—so far as the reviewer is aware, the author has omitted mention of no important magnetochemical study. 'The subject of magnetochemistry is so closely related to molecular structure that a decision must be made in the presentation of the subject as to where to stop the discussion of the structural interpretation of magnetic data. The author has made a reasonable compromise in this matter—he has included enough discussion of molecular structure to show the usefulness of magnetochemical data, without allowing molecular structure to assume primary importance. A feature of the book which will interest inorganic chemists is the discussion of the structure of complexes of the individual elements as indicated by their magnetic properties.

Reference is given to most of the original papers in which the results of magnetochemical investigations have been published; the number quoted is greater than 1,250.

EXPLOSIVES TESTING

LABORATORY MANUAL OF EXPLOSIVE CHEMISTRY. By A. L. Olsen and J. W. Greene. Published by John Wiley & Sons, New York, N. Y. 106 pages. Price \$1.75.

TEXTBOOK for a one-semester course in the testing of explosives and related materials, this small book is the result of the authors' experience in presenting ESMWT courses. Detailed directions are given and, since laboratory work with explosives entails certain hazards, adequate safety precautions are stressed throughout. Upon satisfactory completion of the work, the student is well acquainted with prescribed U. S. Army tests.

CRITICAL COMPILATION

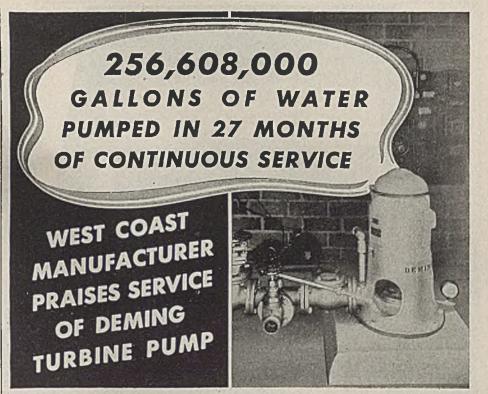
COLORIMETRIC DETERMINATION OF TRACES OF METALS. By E. B. Saudell. Published by Interscience Publishers, Inc., New York, N. Y. 487 pages. Price \$7.

Reviewed by F. C. Nachod

A GREAT number of papers have been written dealing with analysis of small traces but no critical compilation was available to the researcher. Thus, Dr. Sandell's book will be welcomed by many, and will save many hours of search for suitable methods.

The book is grouped into two main portions, a general part which discusses methods of trace analysis, separation and isolation methods, colorimetry and spectrophotometry, and specific reagents. There is also a special part in which the analytical procedures for the various metals are described. Each of these portions in the special part are subdivided into three sections; separations, methods of determination, and applications. The factual material of this special part is quite impressive, comprising methods of analysis for 45 elements (not including those for rare earths). Tables of logarithms, transmission-extinction values and atomic weights are appended.

A few minor criticisms are recorded: In the first lines of Chap. I, p. 3, the reader is referred to Fig. 1, after he has worked his way through to p. 10, he finds this



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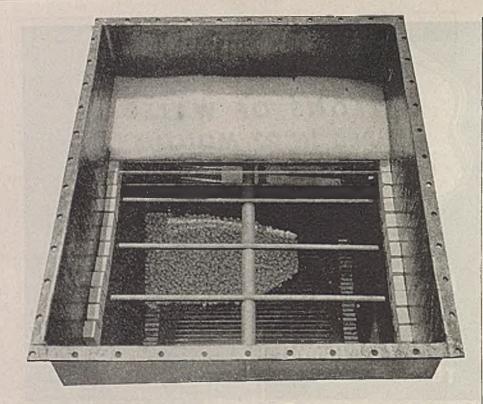


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MAURICE A. KNIGHT 109 Kelly Ave., Akron 9, 0. illustration. The style does not make easy reading throughout all the book and the first lines of the text bear this out. The term hexavalent is by far more common usage than sexivalent (p. 16). No complete consistency is shown in the use of the teminology, and both terms, γ and microgram are used on one page (19). Care should be taken to differentiate between density and optical density of solutions (p. 34). However, these are minor criticisms and the aim to "provide for a collection of modern methods in this field of analysis" seems to have been accomplished very well. Congratulations should go to the author as well as the publishers."

LABORATORY MANUAL

A LABORATORY MANUAL OF PLASTICS AND SYNTHETIC RESINS. By C. F. D'Alelio. Published by John Wiley & Sons, Inc., New York, N. Y. 134 pages. Price \$2.

CONTAINING 88 experiments and 26 test methods, this spiral bound manual is usable as a part of a laboratory course in plastics to be undertaken by students who have studied organic chemistry. Not designed as a signpost to manufacturing procedures, it is intended to illustrate the chemical principles underlying the preparation of plastics and synthetic resins, and is supplemented by such data as check-up lists, methods for testing and sources for chemical supplies. Most of the commonly known resins and plastics which are readily prepared, are treated in this manual, in order to serve as a guide to the demonstration of the chemical fundamentals in the field.

OPERATIONS AND APPARATUS

MODERN WOOD ADHESIVES. By Thomas D. Perry. Published by Pitman Publishing Corp., New York, N. Y. 208 pages. Price \$3.

Reviewed by Jerome Alexander THE 16 Chapters bear the following headings: Origin of Glues and Their Uses (10 pp.); Animal Glues (9 pp.); Vegetable Glues (9 pp.); Casein Glues (6 pp.); Soybcan Glues (10 pp.); Synthetic Resin Adhesives (22 pp.); Silicate of Soda Glues (5 pp.); Albumin Glues (6 pp.); Prepared Glues (4 pp.); Methods of Comparing Glues (17 pp.); Glue Mixing and Spreading Equipment (16 pp.); Pressure in Gluing (20 pp.); Adhesion Secured by Heat (13 pp.); Redriers for Glue Solvents (7 pp.); Impregnation (14 pp.); Glue Testing (18 pp.). The book opens with a 13-page Glossary of Trade Terms Used in the Wood-Adhesive Industry (many hardly require special definition), and closes with a 7-page Index of subjects. There is no author index, but each chapter has a "bibliography," followed by a series of "Questions" such as are often found in elementary textbooks.

As will be seen from the above epitome, the book is strongest in dealing with practical operations and apparatus; but it is weak scientifically, and can hardly be called (p.v.) "a reference book." The author is employed by a producer of resin glues and feels "especially indebted" to about 15 firms "who have given friendly cooperation in the preparation of the copy, and have granted permission to reprint excerpts or synopses of copyrighted material." Much of interest to the chemist is omitted, though it may be found in other books or in patents or other literature. For example: (p. 25) glues "are defoamed"—but how and with what?; (p. 50) in a formula there is a "waterproofing compound," with nothing further about it; (p. 62) in speaking of "Catalysts or Hardeners" they are referred to as "chemicals" which are "frequently combined with other chemicals for the better regulation of standard bonding cycles."..."It is important that resinadhesive users consult their suppliers to ascertain what extenders are compatible with specific resins and the exact ratios that can be used to secure the desired results."

While no one should expect that a hook of this kind will give scientific details of value to competitors, it should give at least a fair resumé of what is already public, and not expose the reader to a blackout. In the case of machinery and practical operations, however, the author gives much detail and useful illustrations, evidence of his experience.

In Chapter III on vegetable glues, even when it is stated that the processing of cassava is little practised at present, the processing is described as "subjecting the starch to chemical action, followed by washing out or neutralizing the chemicals, and these methods were mostly patented." Originally, in order to get a sufficiently concentrated yet workable starch dispersion, the starch, before treatment with caustic soda, was made thin-boiling by treatment with dilute mineral acid below the gelatinizing point, or by oxidizing agents like sodium peroxide. These patents have run out or were knocked out, and secrecy is no longer needed. However, in the formulas on pp. 37–38 the cassava flour is referred to as "blended," whatever that may mean.

In Chapter IV on Casein Glues, no mention is made of casein made by use of rennin, which is generally not used for making glue. But the author gives this insipid statement: "Raw caseins very considerably in quality, and certain types are more useful as glues than others. Experience is required to make suitable selection of types that possess gluing characteristics."

If, instead of depending so heavily upon suppliers of adhesives, the author had gone to the literature, books and patents for information, he could have added this to his own experience and made the "material" part of his book as useful as the "practical" part. As it is, the reader is left in the hands of the "suppliers."

DYE HISTORY

ANCIENT AND MEDIEVAL DYES. By W. F. Leggett. Published by Chemical Publishing Co., Brooklyn, N. Y. 94 pages. Price \$2.50.

Reviewed by S. Sussman

THIS little volume describes the discovery and development of vegetable, animal and mineral coloring materials by ancient and primitive peoples. While it cannot be considered a reference work on the subject, it will provide entertaining reading for those interested in the history of chemistry or in the origins of the dye industry.



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RECENT BOOKS

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PAMPHLETS

Transactions of the American Institute of Chemical Engineers, Vol. XXXIX, 1943. Pub-lished by the Institute, 50 E. 41st St., New York 17, N. Y. 857 pages. Containing all technical papers published during the year 943.

Contractors Guide. Pamphlet No. 34-2, is-sued by War Department, Washington 25, D. C. 48 pages. Suggestions to war con-tractors as to preparation for and methods of contract terminations applying to fixed-price supply contracts of the War Department.

Practical Design for Arc Welding. Vol. I. By R. E. Kinkead. Published by The Hobart Brothers Co., Troy 1, Ohio. Price \$3.50. First of three volumes. An illustrated working book of information and drawings showing how tubing, sheets, and other forms can be used to the product and the statement of the statement. fabricate products,

Principles of Heat Treating Steel. By H. L. Walker. Engineering Experiment Station Re-print Series No. 31, published by the University of Illinois. Urbaua, Ill. 45 pages. Price, 15 cents. A reprint from *Ceramic Industry*.

Industrial Recreation. Published by the P. Goldsmith Sons, Inc., Cincinnati 14, Ohio. 16 pages. An aid in planning off-time play for industrial employees.

Reconversion—The Job Ahead. By J. A. Livingston. Pamphlet No. 94 published by Public Affairs Committee, Inc., 30 Rocke-feller Plaza, New York 20, N. Y. 32 pages. Price 10 cents. An analysis by the editor of War Progress.

Practical Metallurgy for Engineers. Fourth edition. Published by E. F. Houghton & Co., Philadelphia, Pa. 4.19 pages. Price \$3. The experience_of members of the Houghton research staff made a matter of record.

Orienting the New Worker. Prepared by Policyholders Service Bureau, Metropolitan Life Insurance Co., New York 10, N. Y. 60 pages. Gratus when requested on business stationery. Plans and techniques designed to enhance friendly relations with new employees.

MAPI Accounting Manual. Published by Machinery and Allied Products Institute, Chi-cago, Ill. Price \$5. An accounting manual for use in capital goods industries. Broadly applicable to other lines of business.

A Summary of Data on Synthetic Rubber. Revised edition. Published by the Rubber Manufacturers Association, 444 Madison Ave., New York 22, N. Y. 36 pages. Digest of information and background data on the sub-ject of synthetic rubber.

Standard System of Nomenclature for Chemi-cal Engineering Unit Operations. Published by American Institute of Chemical Engineers, 15 E. 41st St., New York 17, N. Y. 18 pages. A listing of symbols and nomenclature with typical units and recommended abbreviations. Reprinted from Trans. A. I. Ch. E., corrected to July 1, 1944.

Handling and Storage of Paper Shipping Sacks. Manual B-1 published by Manufactur-ing Chemists' Association, 608 Woodward Bldg., Washington 5, D. C. 6 pages. Price 15 cents. Recommended practice in the hand-ling and storage of Multiwall paper bags when filled with chemicals or allied products.

Fiscal and Monetary Policy. By Beardsley Ruml and H. C. Sonne. Pamphlet No. 35, published by National Planning Association, 800-21st St., N.W., Washington 6, D. C. 42 pages. Price 25 cents. Recommendations for a national fiscal, monetary and tax program.

Koppers. Published by the Koppers Co., Pittsburgh 19, Pa. 32 pages. A profusely illustrated book commemorating the 50th anni-versary of the introduction of the first by-product coke ovens in the United States.

Stratigraphy of the Colorado Group, Upper Cretaceous, in Northern New Mexico. By C. H. Rankin. Bulletin No. 20, New Mexico School of Mines, Socorro, N. M. 30 pages. Price 25 cents.

Engineering Papers—Fourth Annual Contest. Published by Hydraulic Institute, 90 West St., New York 6, N. Y. Price \$1.50. Five engi-neering papers on subjects pertaining to pumps Special operating conditions of centrilugal pumps; A common language for hydraulic engineers; Critical speed; Direct-acting steam pumps; Effect of entrained or dissolved gas on rotary pump performance.

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The Stake of the United States in Expanding World Trade

7ITH the war in Europe racing to a climax, and with a sure pattern for the defeat of Japan already outlined, American business is confronted with the need for an immediate decision on long-term economic policy.

What is this country's foreign trade program to be after the war?

No intelligent appraisal of all the factors any longer can allow us to postpone considering the issue merely because, in the past, foreign trade absorbed barely eight per cent of our production.

Actually, a whole new set of conditions was injected into the picture by the first World War; but we persisted in ignoring these new factors.

Almost overnight, the United States was transformed from the largest debtor nation in the world to the second largest creditor nation. At the same time, we made faster technological progress than any other nation. Thus we created the need for more dollar exchange on the part of the rest of the world and simultaneously made it harder for other nations to earn dollars.

Today, as another, far vaster war is approaching its end, those changed circumstances are magnified. Americe has new responsibilities-to itself, and to the world.

Our war-inflated industrial capacity cannot be allowed to drop back to prewar levels without causing a domestic crisis which we dare not permit.

And, because so much of the world is geared to the American industrial machine, we can no longer contemplate calmly the repercussions of a largely self-sufficient trade program or of an unplanned foreign trade program. Either would inevitably set the stage for the next world war.

> 4 × +

If we are going to prepare ourselves intelligently to cope with this new problem, we must acknowledge certain basic principles.

World trade cannot be rebuilt simply by attempting to restore prewar flows of goods. The war has so completely changed the economic fiber of many countries that it is necessary to develop new trade relationships. The East Indies, for example, may find the demand for their rubber considerably reduced; the United States may, to a large extent, have to cease exporting cotton; Japan will need to find new substitutes for much of its exports of silk; the British will need new markets to replace the income which they formerly derived from their large overseas investments.

We cannot expand markets for our goods, at home or abroad, unless we find ways of buying more supplies from more people at home or abroad, so that they will have more dollars to spend.

And we probably cannot create increasing buying power abroad without first exporting more of our technical skills-our engineers, our production and management men-to build new markets for our own specialties.

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What is needed to rebuild the world's economic system?

- 1. Most basic of all, of course, are stable governments which command popular support. In the absence of strong governments, currency stability cannot be achieved.
- 2. Most war-stricken countries, for a year or two, will need rehabilitation loans, because they will require far more raw materials, equipment, and live stock than they can pay for out of current production.
- 3. Loans, however, are only a stop-gap, though often a necessary one. Far more important than rehabilitation loans will be the creation of better opportunities for warstricken countries to sell to the rest of the world, particularly to the United States, South America, South Africa, and India. The ravages of war do not completely destroy the ability of a country to sell. Indeed, it is surprising what large supplies of certain commodities war-torn countries have on hand even before devastated industries have been restored. The invading troops in Normandy found shoes almost non-existent, but they found food more plentiful than in Britain.

Better opportunities for war-stricken countries to sell would create opportunities for them to buy the things they will require to restore scattered industries and depleted farms, and would help those countries to get rid of the exchange controls which are now universal. So long as a country is able to expand its exports only slowly and painfully, and is dependent upon foreign loans to prevent the depreciation of its currency, so long will it carefully preserve exchange controls and other restric-tions in imports. That is why large advances, either through an International Monetary Fund or an International Investment Bank, can make only limited contribution to the removal of trade restrictions.

- 4. Permanent monetary and credit arrangements are needed to protect nations against temporary pressure upon their currencies, to permit necessary changes in exchange rates to be made in an orderly manner, and to assure that governments never again will repeat the "beggar-my-neighbor" policies of 1931 and 1932.
- 5. Finally, the world needs a reversal of the trend toward economic self-sufficiency, which received a strong impetus from the first World War and an even stronger one from the great depression of the Thirties. This does not mean that the efforts of many raw-material producing countries to diversify their industries should be opposed. During the late Nineteenth Century and the first part of

this century, the international specialization of production was carried too far, with the result that many countries became dependent for a large part of their standard of living upon the export of one or two raw materialscoffee, sugar, rubber, silk, wheat, wool, and meat. Between the two World Wars, however, the pendulum swung much too far in the direction of self-sufficiency. Some densely populated industrial countries of Europe (Italy, France, and Germany) even attempted to become selfsufficient in wheat, fats, and sugar. So limited are the natural resources and technical skills of most countries that each one finds many things which it can produce only at prohibitive costs. Between the extreme specialization of the late Nineteenth Century and the more recent trend toward extreme self-sufficiency, a happy medium should be sought.

What role should the United States play in reconstructing the world's international economic system?

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There are those who suggest that the United States be a more or less permanent Santa Claus. They believe that an excess of exports could be financed only by "loans"—loans that would eventually turn into gifts, after producing bitter controversy over why the "debtor" country did not meet its obligations. The persons who assert that full employment can be provided only by an excess of exports are in effect saying that our economy cannot become self-supporting. That is a confession of economic defeatism which a young and vigorous nation should not be willing to make.

The most immediate contribution which the United States can make to world reconstruction is to make itself prosperous.

Prosperity here means a large demand by our industries for imports. The more we import, the easier will it be for foreign countries to meet their large and urgent needs for goods. In 1939, with a gross national product of \$100 billion, our imports were \$3 billion. After the war, with 55 million people employed and a gross national product of \$155 billion, our imports would be about \$7 billion or \$8 billion.

Not only should the United States make itself prosperous, but it should keep itself prosperous. So important is the United States in the world economy that a depression here is bound to produce a disastrous drop in the price of raw materials throughout the world and to throw most countries into an economic tailspin.

The United States should support the principle of a large fund to protect the exchanges of the world from temporary pressure. We should not permit differences over the details to prevent its establishment in ample time to be available during the critical period when war-stricken countries will need goods far in excess of their immediate ability to pay for them. Some arrangement, even though imperfect in details, will be infinitely superior to no arrangement.

Finally, the United States should take the lead in breaking down barriers to trade. We are the logical country to do this, partly because of our immense domestic market, and partly because for most of the last twenty-five years this country has been able to sell other countries more goods than they have been able to sell to us. One of the greatest contributions which the United States could make to a sound and expanding world economy would be to bring our imports, as soon as practicable, up to our exports. In other words, the United States, in the long run, should be hard to borrow from but easy to sell to. The United States should implement this policy (1) by continuing the negotiation of reciprocal reductions in duty, and (2) by accepting exchange rates which make foreign currencies cheaper in dollars than they were in 1939. So great will be the world's need for goods that we can be sure that any dollar exchange earned by sales to us will be converted into American-made goods and will lead to larger exports.

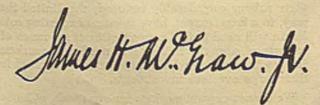
Time was when the United States obtained about eight per cent of its standard of living by sending goods abroad and bringing back other goods. Before the war, however, we were getting less than five per cent of our living by international trade. If, after the war, we were gradually to raise the proportion of our standard of living obtained by trading with other countries to ten per cent of domestic production, our imports would be about \$15 billion or \$16 billion a year. Our people would be able to buy many things which they now cannot afford, and scores of countries which export raw materials and luxury products would feel the stimulus of rapidly expanding markets. Their expanded demand for road building machinery, mining machinery, machine tools, agricultural implements, locomotives, railroad cars, electrical equipment, trucks, automobiles, and a multitude of products of our factories would create a million or more additional jobs in our factories.

Although the United States would raise its standard of living by increasing its imports and its exports, it should honestly face the fact that the resulting shifts in production and employment would temporarily be painful for some people. The increase in imports would be in commodities which other countries can produce for less than the cost at which much of our output is producedsuch as sugar, wool, copper, some fats and oils, wines, winter vegetables and fruits. The increase in our exports would come from those industries in which our superiority is greatest-particularly the manufacturing industries. Finally it would be advantageous, to the country as a whole, to shift a million or two workers from agriculture, where they earn about 60 cents an hour at best, to manufacturing, where they earn better than 80 cents an hour.

The very fact that in economic matters the rest of the world is dependent upon the United States, exposes our country to great demands and to envy and misunderstanding. The United States must be willing to help the rest of the world, but its help should take the form of assisting other countries to help themselves. Never in all history has one country had such an opportunity to give the world a rising standard of living, to foster conditions under which peace flourishes. What greater tragedy could there be than to make the sacrifices which we are now making and fail to seize this chance to create a world of hope and opportunity in which the spirit of goodwill among nations is able to flourish.

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GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering any publication noted in this list always give the complete title and the issuing office. Remittance should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper covers unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the Bureau responsible for its issue.

Hydrogen Generator ML-303/TM. War Department Technical Manual TM 11-2413. Price 10 cents.

Containers and Packages for Household Insecticides (Liquid Spray Type). National Bureau of Standards Simplified Practice Recommendation R203-44. Price 5 cents.

Standard Samples Issued or in Preparation by the National Bureau of Standards. National Bureau of Standards Supplement to Circular C398. Free on application to the Bureau.

Control of Humidity by Saturated Salt Solutions. National Bureau of Standards, Letter Circular LC 752. Mimeographed.

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Sweeping Compounds (Also Known as "Floor Sweep" and "Dust Down"). National Bureau of Standards, Letter Circular LC 754. Mimeographed.

Laboratory Studies on the Toxicity of Tartar Emetic to the Mexican Fruitfly. By C. C. Plummer. Bureau of Entomology and Plant Quarantine, Circular 697C. Price 5 cents.

Influence of Temperature on Effectiveness of Lead Arsenate Against Larvae of the Japanese Beetle in the Soil. By W. E. Fleming and W. W. Mains. Bureau of Entomology and Plant Quarantine, E-622. Mimeographed.

Curing and Storage Methods in Relation to Quality of Porto Rico Sweetpotatoes. By J. M. Lutz. Department of Agriculture, Circular No. 699. Price 5 cents.

Information on Noreseal-A New Cork Sub-

stitute. By S. I. Aronovsky, W. F. Talburt, and E. C. Lathrop. Bureau of Agricultural and Industrial Chemistry, AIC-44. Mimeographed.

Processing Soybeans for Oil and Meal. Bureau of Agricultural and Industrial Chemistry, AIC-45. Mimeographed.

Selected Bibliography on Freezing Preservation of Fruits and Vegetables 1920-1943. Bureau of Agricultural and Industrial Chemistry, AIC-46. Mimeographed.

The Background of Penicillin Production. By R. D. Coghill. Bureau of Agricultural and Industrial Chemistry, AIC-49. Mimeographed.

Wheat Flour—A Potential Raw Material for the Expanded Production of Starch and Sirups. By G. E. Hilbert, R. J. Dimler, and C. E. Rist. Burcau of Agricultural and Industrial Chemistry, AIC-50. Mimeographed.

Hydrolysis of Wood by Percolation With Dilute Sulfuric Acid and the Fermentation of the Resulting Wood Liquors. By E. E. Harris. Forest Products Laboratory, Madison, Wisconsin. FPL Mimeo. R1446, Mar. 1944.

Study of Factors Affecting the Hydrolysis of Wood: Progress Report. By J. F. Saeman. Forest Products Laboratory, Madison, Wisconsin. FPL Mimeo. R1446-A, Jan. 1944. A progress report covering early phases of the Laboratory investigation of the theory of wood hydrolysis.

Moisture Excluding Effectiveness and Weight of Aircraft Finishes on Papreg and on Plywood. By F. L. Browne and A. C. Schwebs. Forest Products Laboratory, Madison, Wisconsin. FPL 1598, May 1944. Results of a preliminary





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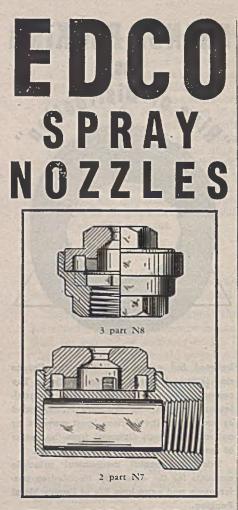
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Experiments with Preservatives for Soybean Glue and Soybean-Glued Plywood. By F. H. Kaufert and J. O. Blew, Forest Products Laboratory, Madison, Wisconsin. FPL Minuco. R1447, March 1944.

Effect of High and Low Temperatures on Resin Glue Joints in Birch Plywood. By R. F. Blomquist. Forest Products Laboratory, Madison, Wisconsin. FPL Mimeo. 1345, revised Jan. 1944.

Summary of Information on the Durability of Aircraft Glues. By F. F. Waugaard. Forest Products Laboratory, Madison, Wisconsin. FPL Mineo. 1530, May 1944. Brings together available Forest Products Laboratory data pertinent to the durability of those types of glues used in aircraft at the present time, or proposed for that purpose.

Weatherproof Solid Fiberboard: An evaluation of the quality of commercial boards and the development of an improved weatherproof board. By F. A. Simmonds, J. N. McGovern, and C. O. Seborg. Forest Products Laboratory, Madison, Wisconsin. FPL Mimeo. R1444, Feb. 1944.

Fiber-Saturation Point of Wood. Forest Products Laboratory, Madison, Wisconsin. FPL Tech. Note 252. June 1944.

Fire-Test Methods Used in Research at the Forest Products Laboratory. By G. C. Mc-Naughton and Arthur Van Kleeck. Forest Products Laboratory, Madison, Wisconsin. FPL Mineo. R1443, 1944. Describes seven fire test methods for wood and wood assemblies and presents data showing the effect of such variables as moisture content, density, species, types of fire-retardant treatment and details of fabrication upon test behavior.

Methods of Applying Wood Preservatives. Forest Products Laboratory, Madison, Wisconsin. FPL Mimeo. R154, revised April 1944. Discusses the preparation of wood for treatment and describes both nonpressure and pressure methods of applying preservatives; mentions various specifications covering treatments, the proper handling of wood after treatment, the effect of treatment on the strength of wood, and the inspection of treated forest products.

Treating Wood in Pentachlorphenol Solutions by the Cold-Soaking Method. By J. O. Blew. Forest Products Laboratory, Madison, Wisconsin. FPL Mimeo. R1445, March, 1944. Discusses a limited purpose treatment for fence posts and lumber in oil solutions of pentachlorphenol and preservatives of similar type. Coldsoaking can be used to advantage particularly in treating pine sapwood, where more thorough impregnation is impractical and where protection greater than that obtained by simple dipping is required.

When Preservative Treatment of Wood is an Economy. Forest Products Laboratory, Madison, Wisconsin. FPL Tech. Note 165, revised August 1943.

Estimating the Specific Gravity of Plywood. By B. H. Paul and J. P. Limbach. Forest Froducts Laboratory, Madison, Wisconsin, FPL Mineo. 1589, June 1944. A formula that takes into account the constants and variables involved in the manufacture of plywood, provides a value which represents the increase in specific gravity of plywood over the weighted average specific gravity of the constituent veneer. Use of a graphic representation of the formula eliminates computations.

Welding Instructions. U. S. Maritime Commission. Third Edition, Revised April 1944. Price 10 cents. For use by Welding Supervisors, Leadermen, etc., of all Crafts Concerned with Shipyard Welding.

Chemical Character of Surface Waters of Georgia. By William L. Lamar, Geological Survey Water-Supply Paper 889-E. Price 15 cents.

Exploratory Water-Well Drilling in the Houston District, Texas, By Nicholas A. Rose, W. N. White and Penn Livingston. Geological Survey Water-Supply Paper 889-D. Price 15 cents.

Water Levels and Artesian Pressure in Observation Wells in the United States in 1942, part 2, Southeastern States. By O. E. Meinzer, L. K. Wenzel, and others. Geological Survey Water-Supply Paper 945. Price 40 cents.

Mining in the Northern Copper River Region Alaska. By Fred H. Mofht. Geological Survey Bulletin 943-B. Price 10 cents.

Geology of the Hanover-York District Pennsylvania. By Anna Jonas Stose and George W.



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The Molluscan Fauna of the Alum Bluff Group of Florida. Part VII. Stenoglossa (in part). By Julia Gardner, Geological Survey Professional Paper 142-G, Price 25 cents.

Manganese Deposits in Costa Rica. By Ralph J. Roberts. Geological Survey Bulletin 935-H. Price 15 cents.

Observations on the Use of Cyclohexylamine in Steamheating Systems. By A. A. Berk, Bu-reau of Mines, Report of Investigations R.I. 3754. Mimcographed.

Technical and Economic Study of Packaged Fuel. By V. F. Parry. Bureau of Mines, Re-port of Investigations R. I. 3757. Mimeographed.

Domestic Storage of Subbituminous Coal and Its Performance in a Hand-fired Furnace. By W. S. Landers and V. F. Parry. Bureau of Mines Report of Investigations R. J. 3759. Mimeographed.

Work of the Survey of Carbonizing Proper-ties of American Coals. By J. D. Davis and D. A. Reynolds. Bureau of Mines, Report of Investigations R. I. 3760. Mimeographed.

The Preparation and Properties of Metal Carbides with Critical Comment as to Their Significance in the Fischer-Tropsch Synthesis. By I. J. E. Holer. Burcau of Mines Report of Investigations R. I. 3770. Mimeographed.

Influence of Humidity upon the Resistivity of Solid Dielectrics and Upon the Dissipation of Static Electricity. By E. M. Cohn and P. G. Guest. Burcau of Mines, Information Circular I. C. 7286. Mimeographed.

Precautions to be Taken When Approaching Old Mine Workings. By D. Harrington and R. G. Warncke. Bureau of Mines, Informa-tion Circular I. C. 7288. Minecographed.

Mineral Statistics. Preliminary figures for 1943 production of metals, minerals, and min-eral products have recently been released in the Mineral Market Reports of the U. S. Bureau of Mines as one or two-page mimeographed press releases of the "MMS" series. The fol-lowing subjects have been reported on: An-timony; Iron Ore; Secondary Aluminum; Sec-ondary Copper and Brass; Secondary Zine; Secondary Nickel; Magnesium; Pig Iron; Pennsylvania Anthracite; Zine; Lead; Asphalt; Coke and Byproducts; Lime; Fuller's Earth; Bentonite; Fire Clay; Ball Clay; Sulfur and Pyrites; Distribution of Clay; Zine Sulfate; Barite and Barium Chemicals; Portland and other Hydraulic Cements; Roofing Granules.

Workers in Subjects Pertaining to Agriculture in Land-Grant Colleges and Experiment Sta-tions, 1942-43. U. S. Department of Agri-culture, Miscellaneous Publication No. 510. Price 25 cents.

Agriculture Handbook. Sixteenth Census of the United States: 1940. This book shows the detailed information that may be obtained from the data of the Agriculture Census. Bureau of the Census. Price 45 cents.

Wood Aircraft Inspection and Fabrication, 1944. Army-Navy-Civil Committee on Air-craft Design Criteria, ANC Bulletin 19. Price \$1.00.

A Preview as to Women Workers in Tran-sition from War to Peace. By Mary Elizabeth Pidgeon. Women's Bureau, Special Bulletin No. 18. Price 10 cents.

Report No. FT 121. Imports from Canada and Mexico in country-by-commodity arrange-ment showing for each country the total value of all imports including strategic, critical and military commodities and the amount of each commodity imported except strategic, critical and military, available six months after the period covered. Calendar year 1943---total for year, individual calendar months not shown separately. Price 50 cents. Monthly, starting with figures for January 1944. Price per issue 30 cents. Yearly subscription, including 1944 calendar year annual, \$3,00. Available from Bureau of the Census, Washington 25, D. C.

Report No. FT 421. Exports to Canada and Mexico in country-by-commodity arrange-ment showing for each country the total value of all exports including strategic, critical and military commodities and the amount of each commodity exported except strategic, critical and military, available six months after the period covered. Calendar Year 1943—total for year, individual calendar months not shown separately. Price 60 cents. Monthly, starting with figures for January 1944. Price per issue 50 cents. Yearly subscription, including 1944 calendar vear annual, \$5.00. Available from Bureau of the Census. Washington 25, D. C.

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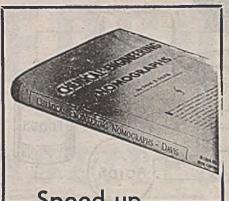
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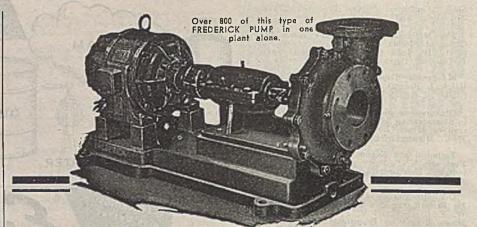
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Automatic Control. Johnson Service Co., Milwaukee 2, Wis.—4-page folder showing how the Duo-Stat for temperature regulation ties into the Government's effort to conserve fuel. Includes advantages and sketch. Bulletin No. 390A.

Cooling Towers. The Marley Co., Inc., Kansas City, Kan.—34-page brochure fully pic-turing double-flow horizontal induced-draft cooling towers, illustrating typical installations and their uses in industrial plants. Includes cross sections, advantages, capacity graphs. Bulletin No. 700-A.

Drive Equipment. The American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa.– 24-page catalog giving data on group drives; standard steel split pulleys; special purpose pulleys; standard split pulleys with list prices; steel split pulley bore sizes, hub lengths, ex-tras; standard split steel pulleys, face widths and weights; bushings; shaft collars; shaft hangars and bearings; conveyor pulleys; high-torque motor pulleys; flat leather belts; cord belts, and Econ-o-matic drives. Catalog No. FBD-44.

Electric Control. Leeds and Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.-16-page pamphlet describing the use of the Micromax electric control with a direct sighting Rayotube detector to enable open hearth furnaces to run for top production, without endangering roofs. Illustrates the Model S Micromax Controller and the Model R and gives maintenance, in-stallation data and detailed specifications. Bul-letin No. N-33B-643(1).

Engines and Compressors. Clark Bros. Co., Inc., Olean, N. Y.-Vol. I, No. 1 of a new employee's magazine, called "The Clark Angle," containing articles of general interest about the concern's war role, personal notes, sports, department news.

Film. Goetze Gasket & Packing Co., Inc., 17 Allen Ave., New Brunswick, N. J.—35-mm. color and sound film available to employee groups, technical societies, engineering schools, telling the story of the importance of "biggest little things" in industry. Deals with scaling joints in vital equipment.

Filters. Hungerford and Terry, Inc., Clay-ton, N. J.-Two-color bulletin illustrating the Ferrosand Filter, giving its qualifications, specifications and capacities. Bulletin No. FF.

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Gages. Watson-Stillman Co., Roselle, N. J. -4-page bulletin illustrating direct stem and flush mounted gages and giving specifications and construction. Bulletin No. 230-A.

Gear Reduction Units. The Cleveland Worm & Gear Co., Cleveland 4, Ohio—16-page bulle-tin discussing Speedaire fan-cooled worm-gear reduction units, illustrated by cutaway draw-ings; charts, diagrams and engineering tables containing unit ratings and dimensions. In-cludes detailed installation data and shipping wight information Contains No. 300 weight information. Catalog No. 300.

Heat Exchange. National Carbon Co., Inc., Carbon Sales Division, 30 East 42nd St., New York, N. Y.-24-page illustrated catalog set-ting forth data on heat conductivity and the physical and chemical properties of carbon, graphite and Karbate materials. Contains tech-nical data charts, tables and drawings indicat-ing the applications of these materials in heat-ing and cooling units. Cat. Sect. M-8802.

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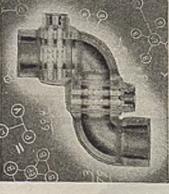
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Industrial Seeing Conditions. E. I. du Pont de Nemours & Co., Inc., Finishes Division, Wilmington 98, Del.—20-page illustrated booklet on "Three-Dimensional Seeing, The Science of Color and Light For Better Vision In Industry," containing information derived from color-conditioning installations in more than a thousand plants. Discusses the safety color code for industry and gives illustrated examples of the applications of this material.

Insulations. Simplex Wire and Cable Co., 79 Sidney St., Cambridge 39, Mass.—12-page report, designed for notebook insertion, dealing with synthetic rubber insulations, giving a progress report on buna S, (GR-S), with complete data tables.

Jar Mills. The U. S. Stoneware Co., Akron, Ohio-4-page booklet describing various types of jar mills, mill jars and other equipment for mixing, grinding and pulverizing chemicals. Gives specificaton tables for single, double and quadruple jar mills and mill jars. Bulletin No. 255.

Lubrication Systems. The Farval Corp., 3295 East 80th St., Cleveland 4, Ohio-16 page, three-color booklet portraying the theory and practice of mechanical lubrication, discussing the problems and the economies of this system, and explaining with cutaway drawings the operation of the lubrication system. Treats construction of both manual and automatic pumping units and installation details of various units. Bulletin No, 25.

Lubrication. The Farval Corp., 3248 East 80th St., Cleveland 4, Ohio-4-page leafet entitled "Aloft is no Place for A.W.O.L.," dealing with the elimination of hazards due to manual lubrication of presses, cranes and "off the floor" equipment and explaining this concern's lubrication system. Form No. 207.

Luminescence. The New Jersey Zinc Co., 160 Front St., New York, N. Y.-24-page booklet discussing the characteristics, properties, limitations and applications of luminescent inorganic pigments. Simplified form designed to clarify the subject, includes illustrations of various terms.

Plant Facilities. Montville Chemical Works, S. B. Penick & Co., 50 Church St., New York 7, N. Y.--B-page illustrated booklet setting forth the organization, products and facilities of this concern.

Plastics. The Hydraulic Press Mfg. Co., Mount Gilead, Ohio-18-page booklet aimed at postwar planners considering plastics, describing and illustrating with sketches and halftones the various materials, processes and equipment involved in plastic production. Bulletin No. 4404.

Refractories. Basic Refractories, Inc., 845 Hanna Bldg., Cleveland 15, Ohio-8-page booklet describing a new series of basic, acid and neutral refractories for use in furnace linings. Includes data on a cold-ramming magnesia refractory for new hearth construction and major repairs.

Refractory Lining. Ironton Fire Brick Co., Ironton, Ohio-4-page pamphlet describing the Ironton "Caro-line" monolithic refractory linings for foundry ladles, side-blow converters, acid electric furnaces and cupola breast and slag holes. Includes directions for preparation, uses, specifications.

Regulators. Victory Equipment Co., 844-54 Folsom St., San Francisco, Calif.—16-page brochure illustrating the design and construction features of single- and two-stage reduction regulators employed in welding, cutting and allied flame applications. Includes graphs of maximum flow rates for Models V, VN, SR, VTS, A, and SR44. Form No. 40.

Safety Valves. J. E. Lonergan Co., Second and Race Sts., Philadelphia 6, Pa.—8-page bulletin discussing new safety valve standards, including tables summarizing sizes, connections, service limits, and other standard specifications, for each type of valve. Includes blueprints of each design. Bulletin No. 501-A.

Scales. Yale and Towne Mfg. Co., Philadelphia Division, 4530 Tacony St., Philadelphia 24, Pa.—Catalog aimed at buyers of precision instruments, describing this concern's line of Kron scales for use in materials haudling programs. Discusses entire line from dormant and portable platform types to special counting, batching, tensile strength and dynamometer models. Catalog No. R-44.

Screens. Hendrick Mfg. Co., Carbondale, Pa.—4-page folder describing this concern's Wedge-Slot screen for industrial applications, giving its outstanding features, advantages, uses and specifications.

Shears. Watson-Stillman Co., Roselle, N. J. —8-page folder dealing with features of hydraulic and hand shears for cutting commercial grade wire rope, flat bars, round bars and varying shapes and metals. Discusses applications, specificatons, capacities, spare parts and prices. Bulletin No. A-6, Edition 3.

Speed-Jack Drives. The American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa.—4-page booklet dealing with structural features, industrial uses and applications of Speed-Jack variable-speed drives. Supplemented with installation sketches. Bulletin No. SJ-44.

Steam Equipment. Yarnall-Waring Co., Chestnut Hill, Philadelphia 18, Pa.—8-page Vol. 1, No. 1 of the "Yarway News," a new house organ to be issued quarterly, containing news, operating hints, new ideas and process information.

Storage. The Nicholson Co., Inc., 10 Rockefeller Plaza. New York 20, N. Y.-32-page, detailed booklet concerning the streamlining of storinge systems, with 20 examples of installations, reaching from abrasives' through water industries. Includes sketches of systems and capacities of circular bins for both authracite and bituminous coal, grain and cement.

Testing Price List. United States Testing Co., Inc., Hoboken, N. J.—27-page price list featuring specific test charges for bacteriological, textile, chemical, food, and engineering tests, supplemented by information on research service.

Thermal Control. Fenwal Inc., 200 Pleasant St., Ashland, Mass.—44-page thorough booklet detailing the complete line of thermoswitches for temperature regulation, and giving a 14 in cutaway drawing of the principle. Describes and gives modification tables for types of thermoswitches with scale sketches, includes section of accessories and modifications, and detailed data on selection and application. Bulletin No. G.C.—1.

Tubes. Wolverine Tube Division, Calumet and Hecla Consolidated Copper Co., 1411 Central Ave., Detroit, Mich.—6-page folder of engineering information on seamless copper and brass tubes, giving chemical and physical characteristics tables and safe working pressures charts. Bulletin No. 575.

Ventilators. Powermatic Ventilator Co., 4019 Prospect Ave., Cleveland 3, Ohio-2-page folder describing this company's new "Iron Lung" motor-operated roof ventilator for industrial plant application. Contains cut-away drawing and a part-by-part description.

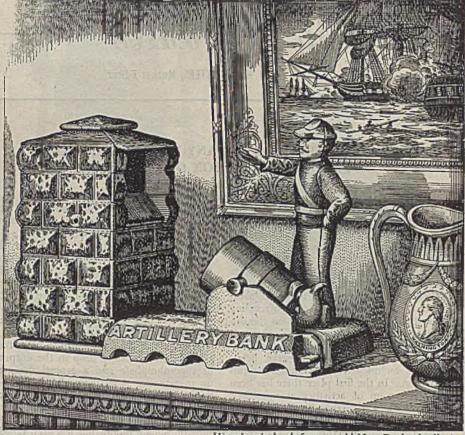
War Production. Worthington Pump & Machinery Corp., Harrison, N. J.-32-page illustrated booklet presenting a description of this concern's mobilization for war production, the uses of their products in the war machine, and their postwar plans.

Waste. George S. May Foundation, 111 South Dearborn St., Chicago 3, Ill.—12-page report called "How Waste Reduction Boosts Production," describing how production can be increased by elimination of common waste factors. Supplemented by a series of 225 questions aimed at management. Report No. 148.

Welding. Engineering Dept., Rm. 1113, Eutectic Welding Alloys Co., 40 Worth St., New York 13, N. Y. ---4-page leaflet called "The Theory of Soldering, Brazing and 'Low Temperature' Welding," describing the history and principle of the Eutectic process. Gives definitions relevant to the new process and applications. Technical release G.

Welding. The Lincoln Electric Company, Cleveland, Ohio.—A new calculator designed to readily determine the welding preheating and interpass temperatures of steels. 614 in. in diameter and consists of four movable sections of heavy cardboard stock. Contains complete instructions for use. Price \$.25.

X-Ray Unit. Picker X-Ray Corp., 300 Fourth Ave., New York, N. Y.-8-page booklet illustrating and describing a new KV Industrial X-Ray Unit for low kilovoltage X-Ray inspection. Discusses many applications, detailed information on size and installation, dimensional data and catalog listing. Bulletin No. 1444.



Historic coin bank from an old New England collection

BANK OF OUR FOREFATHERS

The early colonial was a stickler for thrift! Saving was made a game and banks like the one pictured here were a conspicuous part of every household. Ingeniously constructed they were, too, for they were made so that once the money was inside you could not take it out unless you broke the bank . . . and woe betide the one committing such a sin:

Thrift is playing its same important role in today's war and the pennies, dimes, and dollars of true Americans are shaping and powering mighty dreadnoughts, miracle Fortresses of the air and an endless stream of other Victory= making war material. Our country is dotted with hard= hitting production plants . . . monuments to the savings of each of us who, day after day, is helping to make America a better, a happier, and a safer place in which to live . . . savings that finance the war . . . with War Bonds.

War Bonds keep our Boys on the march... to Victory. Save for them. Start a family War Bond game in your home. Pool your pennies, nickels, dimes and dollars just as our forefathers did back in Revolutionary days. Set aside a specified time each week or month to turn this saved-up money into fighting War Bonds. Then, when the rainbow of Peace beautifies America's horizon, those dream things of tomorrow can be yours ... they can be paid for with the War Bonds you buy today.

A War Bond Message Designed and Contributed by Buell Engineering Company, Inc., New York



SPOTTY CONDITIONS IN MANY LARGE INDUSTRIES AFFECTS CONSUMPTION OF CHEMICALS

H. M. BATTERS, Market Editor

CHEMICAL ECONOMICS-

GENERAL production, as indicated by the indexes of the Federal Reserve Board, has fallen off somewhat in the last few months but the decline has been of moderate proportions and has not been general throughout industry as some lines have increased their operating rates while others have been subject to curtailment. This spotty condition in manufacturing industries has had its influence on the disappearance of chemicals with the net result registering a drop in volume for chemicals consumed in industrial fields. Various factors have contributed to this situation. In the first place there has been a speeding up of activities at munitions works with a corresponding rise in de-mand for the chemicals which are essential in such manufacture. This accounts for the current tightening in the market for nitric acid, for the curtailment of shipments of sulphuric acid and ammonia to the fertilizer trade, and for the probability that, later on, petroleum refineries may be forced to use spent sulphuric in order to satisfy their acid requirements.

The scarcity of sulphuric acid promises to be but temporary as new plant capacities get into operation. The new production, with annual additional capacities, and proposed completion dates are: Summers Fertilizer Co., Scarsport, Me., 25,200 tons, Sept. 1944; Virginia-Carolina Chemical Corp., Wilmington, N. C., 25,200 tons, Sept. 1944; Stauffer Chemical Co., Dominguez, Calif., 72,000 tons, Sept. 1944; Standard Wholesale Phosphate & Acid Works, Baltimore, 109,600 tons, Oct. 1944; General Chemical Co., Front Royal, Va., 65,000 tons, Nov. 1944, and 65,000 tons, Feb. 1945; Consolidated Chemical Industries, Houston, Tex., 108,000 tons, Nov. 1944 and Baton Rouge, La., 93,600 tons, Dec. 1944; Davison Chemical Co., Baltimore, 12,000 tons, Dec. 1944; and Garfield Chemical Co., Garfield, Utah, 54,000 tons, March 1945.

Increased ordnance requirements for nitric acid have resulted in a situation whereby none of this acid will be shipped to industry after Oct. 1 and preference for the acid made in industry will be given to end uses which have a direct or indirect bearing on the war effort. This may lead to the reopening of pot muffle processing plants which were closed a year ago. These plants use nitrate of soda and sulphuric acid as raw materials and the proposal to put them back in production has also 'brought the proposal that attempts be made to increase the volume of nitrate of soda imports so that fertilizer requirements of this material may not be impaired and arrangements all being made to import 850,000 tons.

The Chem. & Met. index for industrial consumption of chemicals dropped to 176.50 in July as compared with a revised figure of 185.29 for June. Last year the indexes for these two months were 172.42 and 177.35 respectively, hence the monthly ratings continue to hold well above those of the corresponding periods of last year. A good part of the decline in the index for July is due to a sharp drop in the output of superphosphate and a general slowing up in activities at fertilizer plants. Ordinarily seasonal conditions are responsible for reducing fertilizer outputs during the summer months but the schedules for superphosphate production has been raised to an extent where full monthly operations are necessary if the program is to be met. Hence it is probable that scarcity of some

Chem. & Met. Index for Industrial Consumption of Chemicals

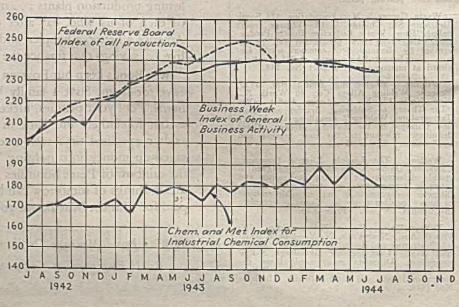
	June	
and the start the unit	revised	July
Fertilizers	39.44	36.00
Pulp and paper	19.65	18.70
Petroleum refining	18.28	18.70
Glass	21.40	19.70
Paint and varnish	18.47	16.80
Iron and steel	13,16	13.46
Rayon	16.82	15.75
Textiles	10,23	9.60
Coal products	, 9.93	10.29
Leather		4.00
Industrial explosives		5.30
Rubber		3.00
Plastics	5.20	5.20

185.29 176.50

important raw materials required in munitions manufacture was a factor in upsetting the schedule.

Record rate of operations in the fertilizer industry have been checked because of the curtailment in some of the important raw materials. For the present, ammonia has been diverted to other consuming fields and the same is true of nitrate of ammonia although fertilizer plants may still receive considerable of this material brought in from Canada. The munitions program likewise is responsible for a reduction in the supply of sulphuric acid made available for producing phosphate rock and earlier estimates for superphosphate output are being scaled down.

Reports on operations at cotton mills likewise have not been favorable and this industry continues to maintain a level far below that reported for 1942. Mill equipment has passed through a long period of forced operation with very little chance for overhauling and for replacements. Trained labor has been taken away for military service or has shifted to other fields of greater remuneration. This combination makes it difficult to heed recent requests that production be enlarged and tends to check optimistic views regarding the outlook for the remainder of the year. In the paper trade, uncertainty about the future supply of woodpulp is giving concern. It was recently announced that Army and Navy requirements for pulp used in the manufacture of explosives and ammunition will be more than twice as high in the third quarter of this year than in the first quarter and demands in the final quarter will exceed those of the third quarter. Without an increase in production, this is equivalent to a notice that civilian allotments of paper are likely to be cut down.





PROTECT YOUR STAINLESS STEEL PROCESS-ING EQUIPMENT FROM ACID ATTACK?

HERE is a suggestion based on experience in pickling steel cartridge cases that may help substantially to prolong the life of your hard-to-replace stainless steel equipment.

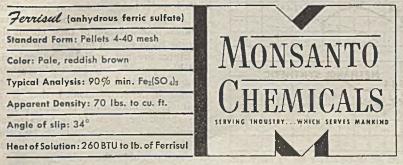
Producers of steel cartridge cases found that 1% to 3% Ferrisul (anhydrous ferric sulfate) in their 5% to 10% sulfuric acid pickling solutions acted as a passivating agent on their stainless steel pickling equipment, much of it originally designed for handling copper cases. As a result, the stainless steel was protected from sulfuric acid attack, yet the acid remained effective against the annealing scale on the cases themselves.

If any of *your* stainless steel equipment is exposed to similar attack ... and if small additions of ferric sulfate to the materials being processed in that equipment can be tolerated ... we will be glad to send samples of Ferrisul for your further investigation.

Ferrisul is widely used as a mild oxidizing agent in many metal finishing processes, as a highly efficient coagulant in the treatment of water and sewage and in various organic reactions. It contains a minimum of 90% soluble ferric sulfate with a maximum of approximately 5% insoluble. If the insoluble is undesirable, however, it can be removed with comparative ease.

A dry, granular powder, Ferrisul is easy to store, handle and use, is readily soluble in water and is now available in ample quantity.

For free sample quantities large enough for thorough trials, simply mail the coupon below: MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston 49, Massachusetts.



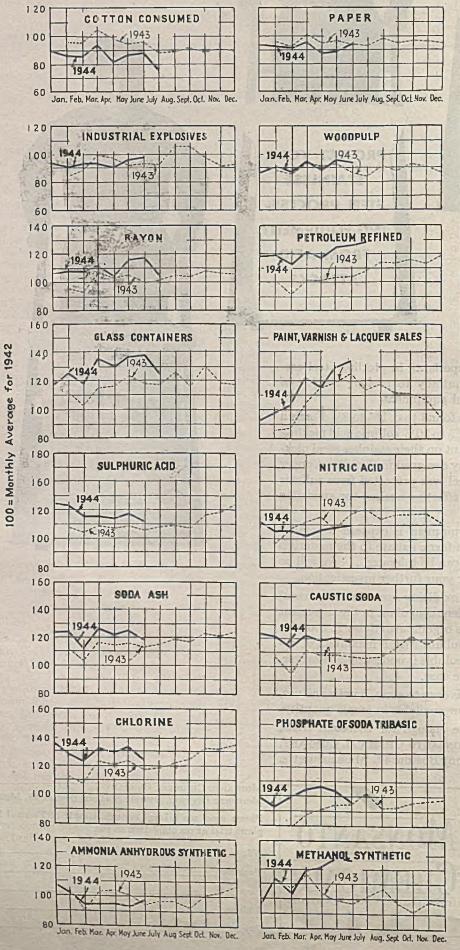


MONSANTO CHEMICAL COMPANY Merrimac Division, Everett Station, Boston 49, Mass. Please send me a large enough sample of Ferrisul for a plant trial at no obligation to me.

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CHEMICAL & METALLURGICAL ENGINEERING • SEPTEMBER 1944 •

PRODUCTION AND CONSUMPTION TRENDS



Most important factor on production of chemicals in recent weeks has been the speeding up of munitions production with a corresponding interest in the chemicals which enter into such manufacture. This was directly responsible for the reports about scarcities of sulphuric and nitric acids and ammonia. However the request for larger outputs of heavy explosives was followed by a similar request regarding high-octane gasoline. As toluol is an important raw material in both these lines of manufacture, it has found such a consumptive demand that the supply situation has given concern. Allotments for civilian use have been sharply lowered but there still is an inadequate supply for the most essential uses and, for a while at least, the oil industry may find the preference given to munitions manufacture.

Production data for certain synthetic organic chemicals have been made public. While the separate chemicals have been subject to varying influences, the data indicate that in general, production in June was a little off in volume from that for the preceding month but apparently this was due to the smaller number of working days and the industry seems to be moving along a steady coursé as far as operating rates are concerned. In some cases, notably butyl acetate, ethyl acetate, technical lactic acid, methyl chloride, refined naphthalene, and oxalic acid, the June totals actually were higher than those for May. Producers stocks also were lowered in the majority of cases which should reflect the status of consuming demands.

Latest figures for activities in the vegetable oil industry refer to July operations and record a moderate increase of crude oil over the June totals. This was accomplished despite drops in the outputs of cottonseed, peanut, and coconut oils. Refining data are not complete but from the figures made available it is probable that production of refined oil in July was a little less than in June. Total production of oils and fats in July fell below the June figures in spite of enlarged supplies of vegetable and fish oils. The reduction in animal fats was responsible for the unfavorable showing of the group as a whole.

A review of the chemical products which have been recently removed from allocation controls offers evidence that civilian needs can now be more fully met but among the chemicals which show a different status are chromic acid and bichromates. A survey made by WPB found that requirements for these products are such as to give them a critical rating. Little hope is held out for any immediate rise in production and stockpiles have dwindled. Conservation of these chemicals by using them only in processes for which substitutes are not available, by reclaiming where possible, and by avoiding waste is now advocated. As a conservation measure it is recommended that if a chromium chemical must be used, preference should be given to bichromate as chromic acid is so scarce as to warrant the use of two pounds of bichromate to conserve one pound of the acid.



After the war, the name Fairbanks-Morse will continue to mark performance-proved products only, as it has for 114 years. No race to get civilian products onto the market early will tempt us to break this pledge.



Features of the New Fairbanks-Morse General-Purpose Motor

• It is a 40° C. motor.

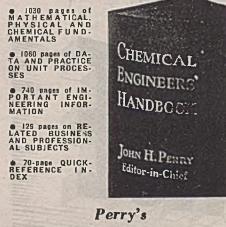
• It is a protected motor.

• It has an optional conduit box assembly.

- It has cross-flow ventilation.
- It has ball bearings, scaled in and protected.
- It has the exclusive Fairbanks-Morse Copperspun Rotor.

DIESEL LOCOMOTIVES & DIESEL ENGINES & GENERATORS & MOTORS & SCALES & PUMPS & STOKERS & RAILROAD AND FARM EQUIPMENT FAIRBANKS, MORSE & CO., CHICAGO 5, ILLINOIS

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Comparison of U. S. Production and Sales of Synthetic Organic Chemicals

(Average 1937-41, annual 1942 and 1943. Production and sales in thousands of pounds ; sales value in thousands of dollars. Data from U. S. Tariff Commission.)

Product	1937-41 Average	1942	1943	Percent Change 1943 over 1942
Cyclic chemicals:		A STATISTICS		CARLES MILLION
Intermediates:		100000000		
Production	679.399	11,243,754	1, 21, 524, 133	22.5
Sales	286,062	1097,054	1, 21,011,466	45.1
Sales value	42,102	93,905	2133,277	41.9
Finished cyclic products:	Land Diver			A CONTRACTOR OF A CONTRACTOR
Production	479,187	773,296	1,398,533	80.9
Sales	394,081	631,449	1,229,708	94.7
Sales value	168,307	307,795	454,612	47.7
Dyes:				El martin a la martina
Production	124,125	151,878	143,913	-5.2
Sales	123,962	144.847	145,392	0.4
Sales value	75,535	99,431	105,134	5.7
Medicals:		07 040	50 550	11.0
Production	17.815	35,840	50,550 45,333	41.0
Sales	14.734	32,581 59,921	45.555 99.020	65.3
Sales value	17,968	58,921	99,020	6.60
Flavors and perfume materials:	5,792	7,956	8.120	2.1
Production	5.353	7,245	7.073	10.0
Sales Sales value	4,891	9.846	9.799	-0.5
Cyclic resins:	4,091	0,010	0,110	-0.0
Production	199,935	297.020	378,846	27.5
Sales	147.887	249,777	337,800	35.2
Sales value	32.321	76,460	76.701	0.3
All other:	001001	10,100		
Production	131.520	280,602	817.104	191.2
Sales	102,145	196,996	693,210	251.9
Sales value	37.592	62,137	163,958	163.9
Non-cyclic chemicals:	The stand is a set of	Steel Constrained St	1 1187 ST (1993) [8	Contraction and
Production	3,386,021	7,202,902	9;346,228	29.8
Sales	1,704,724	3,682,964	5,317,661	44.4
Sales value	221,243	533,864	851,822	59.6

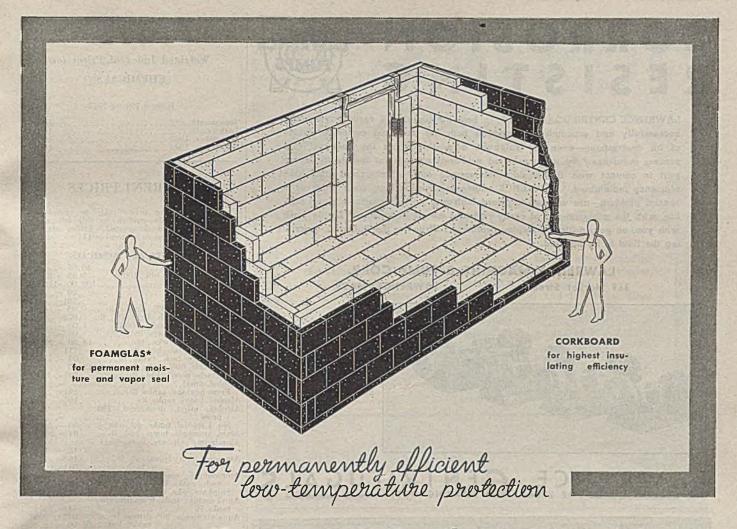
¹Includes intermediates produced from petroleum sources. ²Includes quantity and value of sales of inter-mediates reported to the Bureau of Mines. ³Includes color lakes, rubber chemicals, elastomers, and miscellaneous cyclic products not shown separately.

U. S. Production and Sales of Certain Plastics Materials in 1943

(Production and sales in thousands of pounds; sales value in thousands of dollars; unit value in cents per pound.)

Product Cyclic, total	Production Quantity 378.846	Sales Quantity 337,800	Sales ' Value 76.701	Unit Value 23
Alkyd resins (phthalic anhydride) ¹	154,385	124,992	23,649	19
For protective coatings For textiles. For molding and casting For miscellaneous uses	153,398 514 291 182	124,184 2 3 2	23,451	19
Phenolic resins, total	142,912	the try o	mer of	1. 2. 200 - 10
Phenol-formaldebyde	124,204	118,395	38,210	32
For molding For casting. For laminating. For protective coatings. For adhesives. For miscellaneous uses. Cresols or cresylic acid-formaldehyde	$\begin{array}{r} 61.424\\ 2.838\\ 22.606\\ 15.519\\ 10.290\\ 11.527\\ 16.805 \end{array}$	$\begin{array}{r} 60,371\\ 2,845\\ 18,353\\ 15,273\\ 10,247\\ 11,306\\ 13,192 \end{array}$	$\begin{array}{r} 21,971 \\ 1,270 \\ 4,478 \\ 5,140 \\ 2,079 \\ 3,272 \\ 3,986 \end{array}$	36 45 24 34 20 29 30
Other phenolic resins	1,904	3	3	
Mixed phenolic resins	21,395	18,567	3,915	21
Phenol-cresol-aldehyde	10,322	8,405	1,549	18
Cresol-xylenol-aldehyde	1.164	695	126	18
Other mixed phenolic resins	9,909	9,467	2,240	24
Polystyrene	6,737	6.374	2,239	35
Other cyclic resins4	53,416	56,280	4,702	8
Noncyclic, total	272,665	229,767	101,290	44
Alkyd resins, total	49,644	45,912	8,384	18
Abietic acid, abietic and maleio acids Furmaric acid Maleic anhydride Other alkyd resins. Nitrogen noncyclic resins: Urea-formaldehyde	11.789 9.035 24.803 4.017 53.859	12,263 6,222 23,420 4,007 51,733	1.416 1.815 4.122 1.031 13.288	44 29 18 26 26
For adhesives . For protective coatings Miscellancous uses	32,546 4,857 16,456	30,521 4,559 16,653	6.966 1,182 5,140	23 26 31
Alcohol polymerization resins ⁴	522	415	326	79
Polyvinyl alcohol-aldehyde	14,435	12,349	8,232	67
Other noncyclic resins	154,203	119,358	71,060 1	60
Unabudas ashedalile statist of showtoning it	C. A. C. C. Law		The state	the summittee -

¹Includes anhydride-atcordo-off chemically combined. ²Data are confidential. They are, however, included in alkyd resin total. ³Quantities included in "Other cyclic resins" total. ⁴Includes petroleum derived from cyclic resins. ³Includes walkyl alcohol and furfuryl alcohol polymerization resins.



Armstrong Offers a New Insulation Construction

ARMSTRONG has developed a new type of low-temperature insulation construction that combines Armstrong's Corkboard with Foamglas* and takes advantage of the best properties of both materials. This new construction furnishes a positive, permanent seal against infiltration of moisture and vapor—thus assuring permanently high insulating efficiency.

Since it is basically standard corkboard construction, the new combination retains corkboard's natural moisture resistance and exceptionally low thermal conductivity. This assures high efficiency for heavy-duty work.

However, the outer shell is Foamglas-to seal

Corkboard

out all moisture. This insulation material is glass in cellular form, with each tiny cell wholly isolated from the others. Hence, Foamglas is moistureproof, vaporproof, and fireproof.

The new construction is easy to erect since both materials are erected in accordance with standard specifications. Interior wall finishes are the same as for standard corkboard construction.

FOR COMPLETE INFORMATION about the new combination construction—including engineering drawings and erection specifications —write today to Armstrong Cork Co.,

Building Materials Division, 3309 Concord Street, Lancaster, Pennsylvania.

Foamglas"



Cork Covering

*Reg. U. S. Pat. Off. Product Mfg. by Pittsburgh Corning Corp.

Mineral Wool Board

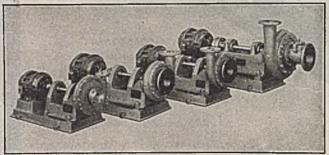


CORROSION RESISTING



LAWRENCE CENTRIFUGAL PUMPS, in both horizontal and vertical types, are successfully and economically handling both hot and cold corrosive liquids of all descriptions—even hot sulphuric acid—throughout the chemical and process industries. By using selected acid-or-alkali-resistant metals for every part in contact with the liquid, maintenance cost is minimized and high efficiency maintained. LAWRENCE engineers—approaching each order as a special problem—are enabled to afford high-duty pump performance and long life, with the minimum use of costly resistant metals and alloys. Let us work with you, on your difficult pumping problems. Write for the Bulletins, describing the fluid to be handled.

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An Order of Special Pumps in Bronze, Monel Metal, Stainless Steel, and Nickel Iron for a Bagasse Pulp Mill.

LAWRENCE CENTRIFUGALS

An Interpretation of the New... SAFETY VALVE STANDARDS

If you use safety valves, or design equipment using safety valves, this new Lonergan bulletin will be very helpful. The new official standard specifications are compactly shown in tabular form. Lonergan designs corresponding to the official standards are described and illustrated. Miniature "blueprints" of each design are included.

To get a copy of this handy reference, write for Information Bulletin #501-A.

SINCE 1872



CHEM. & MET.

Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month																							109.37
Last month																							
September,																							
September,	1942	• •	• •	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	109.30

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell fob works, quotations are so designated. Prices are corrected to September 11

INDUSTRIAL CHEMICALS

INDUSTRIAL CHEM	ICALS	1.1.2
Acetone, tanks, lb Acid, acetic, 28%, bbl., 100 lb Boric, bbl., ton Citric, kegs, lb.	\$0.07 3.38 - 109.00 -1	
Acid, acetic, 28%, bbl., 100 lb	3.38 -	\$3.63
Boric, bbl., ton	109.00 -1	13.00
Citric, kegs, lb.	.20 -	.23
Hudaofice 2007 dauma lb	.101-	11
Loctio diff. tooh light bbl lb	.08 -	.080
Formic, ebys, lb. Formic, ebys, lb. Lactic, 44%, tech., light, bbl., lb Muriatic, 18°, tanks, 100 lb Nitric, 36°, carboys, lb. Oleum, tanks, wks. ton. Oxalic, crystals, bbl., lb Phosphoric tech., tanks, lb. Subburic, 60°, tanks, con.	$\begin{array}{c} 109.00 \\ -101-\\ 08-\\ 073-\\ 1.05-\\ 0.05-\\ 18.50-\\ 111\\ 0.4-\\ 13.00-\\ .701-\\ .701-\\ \end{array}$	1010
Nitric, 36°, carboys, lb,	.05 -	051
Oleum, tanks, wks., ton,	18.50 -	20.00
Oxalic, crystals, bbl., lb	.111	12}
Phosphoric tech., tanks, lb	.04	
Sulphuric, 60°, tanks, ton	13.00 ~.	
Sulphuric, 60°, tanks, ton Tartaric, powd., bbl., lb	.701	
Alcohol, amyl From pentane, tanks, lb	.131	
Alashal hutul tanks, ID	.101	
Alcohol, butyl, tanks, lb	.10	.181
proof	-	
No. 1 special, tanks, gal, wks.	.50	
Alcohol, butyl, tanks, lb. Alcohol, ethyl, denatured, 190 proof. No. 1 special, tanks, gal, wks. Alum, ammonia, lump, bbl., lb. Aluminum, sulphate, com. bags 100 lb. Ammenia, anhydrous, eyl., lb. tanks, lb.	.04	
Aluminum, sulphate, com. bags	10000	
100 lb	1.15 - .16	1,40
Ammenia, anhydrous, cyl., lb	.16	
tanks, 10.	.041	
Ammonium carbonate, powd.	001.	10
tech., casks, lb	.091- 28.20	.12
Amyl acetate, tech., from pentane		
Anyl acetate, tech., from pentane tanks, lb	.145	1
Aqua ammonia, 26°, drums, lb	$\begin{array}{c} .145\\ .02\frac{1}{4}-\\ .0300\\ .04-\\ .04-\\ .0500-\\ .000-\\ .00\frac{1}{4}-\\ .000-\\ .0$.03
tanks, ton	65.00	
Arsenic, white, powd., bbl., lb	.04 -	.041
Barium carbonate, bbl., ton	65.00 -	75.00
Chloride, bhl., ton	75.00 -	78.00
Nitrate, casks, Ib	.094-	.11
Blanc hx, dry, bags, ton	00.00 -	70.00
Bleaching powder, 1.0.0., wks.	2 50 -	2 00
Borox gran hags ton	2.50 - 45.00 -.	9.00
Calcium acetate, hags, contraction	3.00	
Arsenate, dr. lb.	3.00	.08
Arsenate, dr. lb. Carbide, drums, ton Chloride, flake, bags, del., ton. Carbon bisulphide, drums, lb.		
Chloride, flake, bags, del., ton	18.50 -	25.00
Carbon bisulphide. drums, lb	.05 -	.051
Carbon bisulphide, druins, 10 Tetrachloride drums, gal Chlorine, liquid, tanks, wks., 100 ll Copperus, hgs., f. o. b., wks., ton Conper earbonate, bbl., lb Sulphate, bbl., 100 lb Cream of tartar, bbl., lb Dicthylene glycol, dr. lb.	50.00 - 18.50 - .05 - .73 - 0.1.75 - 17.00 - 193 -	.80
Chlorine, liquid, tanks, wks., 100 li	0. 1.75 -	2.00
Copperas, hgs., f. o. b., wks., ton.	17.00 -	18.00
Copper carbonate, bbl., 10	$ \begin{array}{r} .19\frac{1}{2} - \\ 5.00 - \\ .57 \end{array} $	$.20 \\ 5.50$
Cream of tarter bbl lb	57 -	0.00
Diethylene glycol dr lb	.141-	.151
Ensom salt, dom.; tech., bbl.	Tarrent d	1.01
100 lb	1.90 -	2.00
Ethyl acetate, tanks, lb	111	
Formaldehyde, 40%, tanks, lb	. 032	
Furfural, tanks, lb	.091 1.05 -	
Diethylene glycol, dr., b Diethylene glycol, dr., b Epsom salt, don.; tech., bbl. 100 b Ethyl acetate, tanks, b Formaldehyde, 40%, tanks, b Glaubers salt, bags, 100 b Glycerine en drums, extra lb.	1.05 -	1.10
in the second of the second se	.18?	
Lead:	D. 10.0.1018	
White, basic carbonate, dry		
Red, dry, sck. lb	.001	
casks, lb. Red, dry. sck. lb. Lead acetate, white crys., bbl., lb	121-	
Lead arsenate, powd., bag, lb	111-	.13
Lithopone, bags, lb	041-	.043
Lichopone, bazs, lb Maznesium carb., tech., bags, lb Maznesium carb., tech., bags, lb. Methanel, 95%, tanks, gal Synthetic, tanks, gal. Phosphorus, yellow, cases, lb Potassium bichromate, casks, lb. Chlorate, powd, lb.	061-	.041
Synthetic tarks, gal	.58 .24 .23 - .091-	
Phosphonic valley acces lb		
Potassium bichromata casks lb		,10
Chlorate, powd., lb.		.12
Hydroxide (c'stic notash) dr. 11	. 07 -	.01
Muriate, 60% bags, unit Nitrate, bbl., lb Permanganate, drums, lb	53 }	
Nitrate, bbl., lb	051-	06
Permanganate, drums, lb	193-	
Prussiate, vellow, casks, ID	17 -	.18
Sal ammoniac, white, casks, lb Salsoda, bbl., 100 lb	0515-	.00
Salt cake, bulk, ton	1.00 - 15.00 - 15.00 - 100 -	1.05
Soda ash, light, 58%, hars con	-	
tract, 100 lb.	1.05	22
Dense, bags. 100 lb	1.15	
Salt eake, bulk, ton Salt eake, bulk, ton Soda ash, light, 58%, bags, con tract, 100 lb Dense, bags, 100 lb Soda, caustic, 76%, solid, drums 100 lb		and Co.
100 lb	2.30 -	3.00
		.06
Acetate, del., bbl., lb.	.05 -	0 00
Acetate, del., bbl., lb Bicarbonate, bbl., 100 lb	1.70 - 071	2.00
Acetate, del., bbl., lb. Bicarbonate, bbl., 100 lb Bichromate, casks, lb Bishromate, bull.	05 - 1.700710	2.00
100 lb. Acetate, del., bbl., lb. Bicarbonate, bbl., 100 lb. Bichromate, casks, lb. Bisulphate, bulk, ton Bisulphite, bbl., lb.	0.05 - 1.70 - 0.071 - 16.00 - 0.03 - 0.03 - 0.03 - 0.05	2.00

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 193	37	
This month Last month September, 1943 September, 1942		145.04 145.24 145.55
September, 1942		141.01
A STATE AND	Tanta	ter.
Chlorate, kegs, lb. Cyanide, cases, dom., lb. Fluoride, bh., lb. Hyposulphite, bbl., 100 lb. Metasilicate, bbl., 100 lb. Nitrate, bulk, 100 lb. Nitrite, casks, lb. Phosphate, tribasic, bags, lb. Prussiate, vel. bags, lb. Siljeate (40°) dr., wks., 100 lb. Sulphide, bbl., lb. Sulphite, erys, bbl., lb. Sulphur, erude at mine, long ton.	.061-	.06}
Cyanide, cases, dom., lb	.061-	.15
Hyposulphite, bbl., 100 lb	2.40 -	2.50 2.65
Nitrate, bulk, 100 lb	07 - 2.40 - 2.50 - 1.35061 - 2.70 - 0.001 - 0.00	2.65
Nitrite, casks, lb	.061-	.07
Prussiate, yel. bags, lb	.091-	.10 .85
Silicate (40°) dr., wks., 100 lb	.80 -	.85
Sulphite, crys, bbl., lb.	.021-	.021
Dioxide, cyl., lb	.07 -	.08
Sulphure, crys, bill, ib Sulphur, crude at mine, long ton. Dioxide, cyl., lb Tin crystals, bbl., lb Zine chloride, gran, bbl., lb. Oxide, lead free, bag, lb. Oxide, 5% leaded, bags, lb. Sulphure, bbl., eut	.394-	
Oxide, lead free, bag, lb	.071-	.06
Oxide, 5% leaded, bags, lb Sulphate, bbl., cwt	.07 -	4.00
mary for totalizate selector in		
OILS AND FATS		00 141
Chinawood oil, tanks, lb.	\$0.131-	20.144
Castor oil, No. 3 bbl., lb Chinawood oil, tanks. lb Coconut oil, ceylon, dr. N. Y., lb Corn oil crude, tanks (f.o.b. mill),	.0885.	
Ib	.124	
Cottonseed oil, crude (f.o.b. mill), tanks lb	.123	
lb. Cottonseed oil, erude (f.o.b. mill), tanks, lb. Linseed oil, raw, ear lots, bbl., lb. Palm casks, lb. Peanut oil, erude, tanks (mill), lb Rapeseed oil, refined, bbl., lb. Sov bean tank lb.	.151	
Peanut oil, crude, tanks (mill), lb	.13	
Rapesced oil, refined, bbl., lb	nom	12
Muchaday light meaned de lb	. 126	
Grease, vellow, loose, lb.	.089	
Oleo stearine, lb	.091	
Crude, tanks (i.o.b. (actory) lb. Grease, yellow, loose, lb. Oleo stearine, lb. Oleo oil, No. 1, lb. Red oil, distilled, bbl., lb. Tallow stra loose lb	.12	· · · · · · · · · · · · · · · · · · ·
Tallow extra, loose, lb	.08]	
COAL-TAR PRODUC	CTS	
Alpha-napthol, crude, bbl., lb	\$0.52 -	\$0.55
Alpha-naphthylamine, bbl., lb	.32 -	.34 .16
Aniline salts, bbl., lb	.22 -	.24
Benzidine base, bbl., lb	.70 -	.75
Benzol 90% tonks works gal	.54 -	.56
Benzyl chloride, tech., dr., lb	.15 - .23 - .23 -	.25
Cresol, U. S. P., dr. lb.	.23 -	.24
Cresylic acid. dr., wks., gal	.81 -	.83
Diethylaniline, dr., lb.	.40 -	.45
Dinitrotoluol, bbl., lb.	.18 -	.19
Dip oil, 15%, dr., gal	.23 -	.25
H-acid. bbl., lb.	.60 -	.50
Hydroquinone, bbl., lb.	.90 -	
Nitrobenzene, dr., lb	.07 -	.071
COAL-TAR PRODUC Alpha-napthol, crude, bbl., lb Alpha-napthylamine, bbl., lb Aniline salts, bbl., lb. Benzaldehyde, U. S. P., dr., lb Benzoic acid, U. S. P., dr., lb Benzoic acid, U. S. P., kga., lb. Benzoi, 90%, tanks, works, gal. Benzyl chloride, tech., dr., lb. Beta-naphthol, tech., drums, lb Cresol, U. S. P., dr., lb. Diphenyl aniline, dr., lb. Diphenyl, bbl., lb. Dimitrotoluol, bbl., lb. Diphenylamine, dr., lb., b. Diphenylamine, dr., lb., b. Maphthalene, flake, bbl., lb. Nitrobenzene, dr., lb. Paraaresol, bbl., lb.	.41 -	.49



Prussian blue, bbl., lb	.36 -		.37
Ultramarine blue, bbl., lb	.11 -	E .	26
Chrome green, bbl., lb	.211-		.30
	4.60 -	4	75
Carmine, red. tins, lb	.75 -		80
Para toner, lb.	2.75 -		80
Vermilion, English, bbl., lb			154
Chrome, yellow, C. P., bbl., lb.	.141-		
Gum copal, Congo, bags, lb	.09 -		30
Manila, hags, lb	.09 -		15
Demar, Batavia, cases, lb	.10 -		22
Kauri, cases, lb	.18 -	Ξ.	60
Magnesite, calc., ton	64.00		
Pumice stone, lump, bbl., lb	.05 -		07
Rosin, H., 100 lb	6.10		
	.87		
Turpentine, gal	39		
Shellac, orange, fine, bags, lb	.39		
Bleached, honedry, bags, lb			
T. N. hags, Ib.	.31		



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CHEMICAL & METALLURGICAL ENGINEERING • SEPTEMBER 1944 •

NEW CONSTRUCTION

PROPOSED WORK

- Conn., Bridgeport-Bridgeport Deoxidized Bronze & Metal Co., 459 Iranistan Ave., plans to rebuild its plant recently destroyed by fire. Estimated cost \$40,000.
- Md., Baltimore-Tomke Aluminum Co., c/o Kubitz & Koenig, Engrs., Emerson Tower Bldg., plans to construct a 1 story, 80x260 ft. plant. Estimated cost \$75,000.
- N. J., Kearney-Congoleum-Nairn Co., 195 Belgrove Dr., is having plans prepared by Albert Kahn Associates, New Center Bldg., Detroit, Mich., for the construction of a factory. Estimated cost \$50,000.
- N. M., Eunice-Panhandle Carbon Co., Inc., Eunice, plans to construct addition to its plant. Estimated cost \$1,000,000.
- O., Brecksville-B. F. Goodrich Co., 500 South Main St., Akron, plans to con-struct a rubber research and development laboratory. Shreve, Lamb & Harmon, Associates, 11 East 44th St., New York, N. Y., Archts. Estimated . Ont., Toronto-Art Chemical Products, cost \$1,500,000. Ltd., c/o Ross Hossack, 302 Bay St.,
- O., Toledo-Libby-Owens-Ford Glass Co., Nicholas Bldg., plans to construct an addition to its factory. Estimated cost \$787,000.
- Okla., Ponca City-Continental Oil Co. plans to reconstruct portion of its plant recently destroyed by fire. Estimated cost will exceed \$40,000.
- Tex., Ark-Petroleum Dehydrating Co. plans the construction of a tank bottom treating unit at its plant here. Estimated cost will exceed \$40,000.
- Tex., Harlingen-Tom Gilcrease & Associates, Milan Bldg., San Antonio, plans improvements to its oil refinery. Esti-mated cost \$50,000.
- Tex., McGregor-Defense Plant Corp., Washington, D. C., plans to expand its ordnance plant here to be operated by National Cypsum Co., McGregor. Estimated cost \$3,000,000.
- Tex., Waco-Defense Plant Corp., Washington, D. C., plans to construct a plant here to be operated by General Tire & Rubber Co., 1708 East Market St., Akron, O. Estimated cost \$1,500,000.
- Wis., Merrimac-U. S. Eng., 408 Federal Bldg., Milwaukee, plans to construct addition to powder plant at Badger Ordnance Plant. Mason & Hangar Co., 500 Fifth Ave., New York, N. Y., Archts. & Engrs. Hercules Powder Co.,

	Current I	rojects	Cumulat	ve 1944
			Proposed	
	Work	Contracts	Work	Contracts
New England	\$40,000	\$40.000	\$850,000	\$1,762,000
Middle Atlantic,	125,000	100,000	7,227,000	10,573,000
South		4,600,000	12,207,000	24,431,000
Middle West	16.787,000	300.000	17,566,000	29,296,000
West of Mississippi	5,630,000	1,200,000	32,145,000	24,843,000
Far West		40,000	7.209.000	12,548,000
Canada	1.565,000		9.512.000	6,227.000
Total	\$24,147,000	\$6,280,000	\$86,806,000	\$109.678,000

Wilmington, Del., will operate. Esti-mated cost \$14,500,000.

- B. C., New Westminster-Alaska Pine Co., Ltd., 4th Ave. and 15th St., plans the construction of a wood distillation plant for the manufacture of wood alcohol, wood vinegar and other derivatives from waste material.
- B. C., Prince George-Eagle Lake Saw-mills, Ltd., Giscoma, contemplates the construction of a pulp mill here. Estimated cost \$1,000,000.
- Ont., Hawkesbury-Canadian International Paper Co., Ltd., Sun Life Bldg., Montreal, Que., plans the construction of additional buildings at its plant. Estimated cost \$485,000.
- plans the construction of a chemical products plant. Estimated cost \$40,000.

CONTRACTS AWARDED

- Ala., Childersburg-E. I. du Pont de Nemours & Co., Childersburg, has awarded the contract for the construction of a blending tower to Rust Engineering Co., Liberty Life Insurance Bldg., Birmingham. Estimated cost \$60,000.
- Calif., Richmond-Kinetic Chemicals, Inc., subsidiary of E. I. du Pont de Nemours & Co. and General Motors Corp., has awarded the contract for the construction of a combination repackaging station and warehouse to Sinerton & Walberg, 225 Bush St., San Francisco.
- Ga., Savannah-Union Bag & Paper Co., Lathrop Ave., has awarded the contract for the design and construction, of a pressure steam plant, new power and generating station, etc., to Rust Engi-neering Co., Liberty Life Insurance Bldg., Birmingham, Ala. Estimated cost \$1,500,000.
- La., Gretna-Gulf Distilling Corp., 135 Amelia St., New Orleans, has awarded the contract for foundation for distillery fermenter building to R. P. Farnsworth & Co., 1515 South Salcedo St., New Orleans. Estimated cost \$40,000.
- Me., Cumberland Mills-S. D. Warren Co., 102 Cumberland St., Westbrook, has awarded the contract for a soda re-

covery unit and turbine building to Tredenneck-Billings Co., 10 High St., Boston, Mass. Estimated cost will excecd \$40,000.

- Miss., West Point—Defense Plant Corp., Washington, D. C., has awarded the contract for loading facilities of Gulf Ordnance Plant, to be operated by Procter & Gamble Co., Gwynne Bldg, Cincinnati, O., to Foster & Creighton Co. and Oman Construction Co., American Bank Bldg., Nashville, Tenn. Estimated cost \$3,000,000.
- N. J., Paterson-Patent Chemicals, Inc., 57 Wilkenson Ave., Jersey City, has awarded the contract for the construction of a laboratory to James F. Mitchell, 40 Clinton St., Newark. Estimated cost \$50,000.
- N. J., Ridgefield—Union Ink Co., Route 17, East Rutherford, has awarded the contract for a 110x140 ft. manufacturing building and laboratory to C. A. Hunt Engineering Co., 485 Fort Lee Rd., Teancck. Estimated cost \$50,000.
- O., Akron-Rubber Reserve Co., c/o Goodyear Tire & Rubber Co., J. Hergett in charge, 1144 East Market St., has awarded the contract for a 1 and 2 story, 65x172 ft. cooling tower and buildings, etc., to Indiana Engineering & Construction Co., 109 North Union Ave.; cooling system and piping to Kaighin & Hughes, 125 South Huron St., Toledo. Estimated cost \$300,000.
- Okla., Oklahoma City-Peppers Gasoline Refining Co., First Natl. Bank Bldg., is constructing a natural gasoline plant with its own forces. Estimated cost \$250,000.
- Tex., Houston-Eastern States Petroleum Co., Inc., Second National Bank Bldg., has awarded the contract for converting existing Butadiene plant into feed stock unit for aviation gasoline to J. F. Pritchard & Co., Gulf Bldg. Project will be financed by Defense Plant Corp., Washington, D. C. Estimated cost \$200,000.
- Tex., Passadena-Southern Acid & Sulphur Co., 7621 Wallisville Rd., Houston, has awarded the contract for a chemical plant to United Engineers & Constructors c/o owner. Estimated cost, \$3,-750,000.

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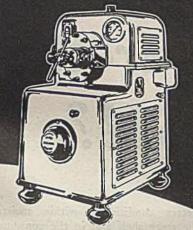
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Arlex can overcome these difficulties—with a plus-value to the smoker. At low humidities, Arlex gives off less moisture; at high humidities, it absorbs relatively little. It is a moisture stabilizer that gives the smoker cigarettes that stay in condition longer. This is a plus-value in itself—but more, Arlex is completely non-volatile, has no unpleasant taste, is non-toxic and does not produce throat-irritating acrolein.

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