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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

JUNE, 1943

S. D. KIRKPATRICK, *Editor*

AFTER THE PIPELINES ARE FILLED

BEFORE "Big Inch" can deliver to the Eastern Seaboard its daily capacity of 300,000 bbl. of petroleum products, many times that volume will have been pumped into its Texas terminals. Almost two weeks will have been required to fill the huge pipeline with its 4,000,000 bbl. backlog. After that, of course, its operations will be geared to the actual needs of the consuming market.

Something comparable to this process has been underway in the plants and industries supplying war goods. Most of them have been working at full speed and straining their production facilities in order to turn out the tremendous quantities of supplies needed to equip our troops in many widely scattered theatres of war. That these great stores or stockpiles are essential to any successful military campaign was gloriously demonstrated in North Africa. It was both the quantitative as well as the qualitative superiority of American weapons and supplies that overwhelmed the Nazi Afrika Korps.

But, again, once the pipelines have been filled—and we are already approaching that fortunate position in some lines—then our munitions production will have to be geared to the actual demands of the consuming market. Some have estimated that by the end of 1943 we will have been equipped to meet the basic needs of a 10,000,000-man army of our own as well as the probable requirements of our Allies. Certainly by the middle of 1944 we shall have passed the peak of production and may expect some tapering off—if not drastic reductions—in war orders. There have already been cutbacks in the tank program, and for some types of ammunition and explosives. There has even been a noticeable lessening of the pressure on magnesium and the suggestion made that it should be diverted to other uses—for example, to replace aluminum in plane wings and fuselages. In some quarters this has aroused hope for revival of civilian supplies or at least the release of sufficient metal for research on postwar products.

Such thinking, we feel, is still premature. The Army and the Navy are determined that production schedules in the war industries are to be adjusted to their changing needs without easing up on the allotments of critical materials for civilian uses. Some military authorities argue that in time of war we can't have too much of anything. Others are fighting to put across the principle of "the fluidity of war," i.e., that the art of fighting changes so rapidly that we can never hope for accurate anticipation of its exact needs. Weapons can become obsolete almost overnight and must be redesigned and improved. The same theory applies to explosives and chemical munitions.

All this is naturally confusing to most of us. On the one side we see cutbacks and shutdowns and on the other the insistence that competing projects be completed and new ones launched. Lacking the whole picture, the parts just don't seem to make good sense. So we must, for the time being, rely on the judgment and policies established by the military authorities. We must continue to build stockpiles where and in the volume wanted. We must be prepared to readjust and even cancel our contracts to meet the changing demands of war. But as technical men interested in the future as well as the present, we can start thinking and planning now for the creative and constructive achievements that must follow our present job of death and destruction. Filling the pipelines is just the first long step toward the inevitable victory.

FREE TRADE vs FREE INITIATIVE

Congress has been debating the way in which the President is to continue negotiations of reciprocal trade agreements. That question has long-time significance because agreements negotiated from now on will undoubtedly extend beyond the war period and largely influence postwar trade and international relations.

At that later time it is to be expected that many agreements will be reached permitting much more extensive movement of goods throughout the world. Many have come to believe that trade barriers are a cause of war; and that tariffs are of relatively less importance for the protection of domestic industries. Hence American enterprise can probably expect much more competition from imports, and may face the prospect of much lower tariff rates than in any time during the present generation.

If international trade is stimulated constructively for the benefit of all peoples, it will ultimately help the United States as well as the rest of the world. But there is no gain in having the standard of wages, and the standard of living, in the United States lowered simply because other parts of the world have not been successful in equaling our standards. It is going to be a difficult thing to steer between creating unreasonable competition for American wage earners on the one hand, and unfair restriction of international business on the other.

Chemical enterprise demonstrates one important possibility for escape from both of these difficulties. It lies in the stimulation of large-scale low-cost American production with highly paid labor using heavy investments in engineering and plants. If the American government wishes to provide opportunity for success and survival of American enterprise without unfair treatment of the rest of the world, it will have to figure on providing freedom of initiative and free play to inventive genius and organized research and development work.

The rest of the world may safely use older methods where lower standards of wages prevail. This country dare not. Not only industry, but also the workers' standard of living, will collapse if not supported by enterprise which has every opportunity for lowering of costs and lowering of prices without cutting of wages. This is not a new principle but it is one much too often forgotten in governmental circles.

WATCH PILOT-PLANT COSTS

Investment in engineering equipment for development work in pilot plants is often of substantial magnitude. The bookkeeping methods used by a company may at times largely affect the overall net cost of the work. In the long run this may determine the quantity of research and development that can be financed. It thus has significance for the stockholders and the public, both of which will benefit from successful projects.

In some cases the entire cost of research can be charged off as an operating expense of the company. This, of course, is an advantage because it means that the immediate burden can be assumed before taxes are calculated, just like labor or raw material costs.

But that is not always practical when development work extends into pilot plants which become, in fact, small manufacturing units. There the cost keeping must for tax-return reasons be comparable with other production procedures. However, there remain essential differences that are not always adequately taken into account. For example, there is the fact that such capacity in a small pilot plant has a very short life and the depreciation or obsolescence rate is extremely high.

Generalizations on this subject are difficult, but one broad principle is clear. Investment in equipment for pilot-plant manufacture should be depreciated at a much higher rate than standard equipment in a going concern of a permanent nature. Perhaps some research executives have not appreciated how the overall net cost to the company, taking account of taxes, is substantially affected by this procedure. It is worthy of careful review.

O.P.R.D.'s INSURANCE POLICY

Extensive chemical engineering development is being carried out on new processes for making alumina and magnesia as raw materials for the manufacture of light metals. Some of the new procedures for processing unusual raw materials or those of low grade formerly rejected, are very promising from both technical and economic viewpoints. Others are less attractive but still worthy of early study on a pilot-plant scale.

Some of this work is being planned, and partly financed, by the Office of Production Research and Development. (See pp. 112-113 of this issue.) That agency is wisely taking the stand that it must anticipate troubles, not merely seeking to escape from them after they have arrived. The alumina program well illustrates this policy, which is worthy of careful consideration by many other divisions of industry.

It is obvious that high-grade bauxite from Dutch Guiana cannot continue to come in at all times in indefinite quantities. Good sense demands that alternate raw materials be studied. Much domestic bauxite of low grade, alunite, the "red mud" discarded by alumina operations of the past, and other aluminum-bearing rocks and minerals, all are being considered. A wide variety of processes for these various raw materials has been reviewed. Even a few "long-shot" plans are being tested. The overall program may well give government officials some assurance of fundamental scientific knowledge and sound engineering practice.

If and when a serious bauxite shortage should develop, chemical engineers will have ready alternate raw materials and methods to use them. It is most unfortunate that we did not adopt this policy of technologic insurance years ago with respect to many mineral raw materials and various chemical-engineering methods. The investment that formerly seemed a bit extravagant now appears to have been an unused opportunity for very cheap insurance against great difficulties that have since proved vastly more costly than any amount of early research and development would have been. (We might even mention synthetic rubber as another example.)

SOWING FOR THE POSTWAR HARVEST

It would be immensely helpful to the war production program, as well as to postwar readjustments, if representatives of chemical management and labor would now insist upon inserting in every collective bargaining contract certain standard provisions that would require impartial umpires for settlement of all labor disputes.

A recent report of the U. S. Bureau of Labor Statistics has shown that of some 84 agreements in chemical companies, only 56 (covering about 50 percent of the workers under agreement) provide for automatic, impartial arbitration of unsettled disputes. It is assumed that in most of the remaining 28 contracts, irreconcilable disputes are expected to be settled by the primitive methods of Mr. John L. Lewis. For such a condition to continue to exist unchallenged in one of our most progressive industries reflects adversely on our decency and our intelligence.

It is crystal clear to all but the prejudiced that, with arbitration as a final step, both management and labor can still retain full control over their own rights under their labor agreements. Local labor relations problems may thus be amicably settled by an umpire on the scene who can, by and large, do a better and quicker job than can be done by distant agencies. There is no compulsion nor any use of economic force connected with such a policy of arbitration. It is purely a voluntary method based on the use of intelligence.

Voluntary arbitration would not only give industry greater stability, but it would also sow the seed for a new crop of more friendly relations between labor and management. Such seed now sown and properly cultivated will mature in time to yield a golden harvest for chemical industries in the postwar reconstruction period.

WASHINGTON HIGHLIGHTS

PLACEMENT of professional and technical personnel is "assured" by the U. S. Employment Service, according to publicity emanating from Mr. McNutt's office. All kinds of scientific and engineering specialists are promised jobs comparable with their train- and skill. One wishes that there were any real chances for the promiser to make good on this matter. Most professional personnel still available for essential work will probably shy away from this new placement division.

MINIMUM WAGES for a variety of process industries closely related to chemical manufacture will be set by the Wage-Hour Division's special "Industry Committee No. 60" if the Department of Labor has its way. This war-time effort seems to include one questionable motive. Some think that during a war period a much higher minimum wage for common labor can be set, especially in the South, than would be possible after the war.

COTTON LINTERS are now being offered for sale by Uncle Sam. High-quality material not needed by the government amounted to 4,500 bales for a first offering. This is another evidence that early estimates and raw material plans for smokeless powder manufacture were greater than the actual need which has developed. This fact was well disclosed previously in the curtailment of ammonia plant capacity by governmental orders. But no one can rightly infer that general manufacture of munitions has in any way slowed down. That result would not be expected until at least the continent of Europe is under Allied control.

COAL will cost more in the near future, probably indefinitely. The price floor under this fuel may not be continuous; but it is certain that a wage problem of such great social and political importance as this will not be forgotten even in the post-war era. Whether or not further nationalization of coal mining is achieved, an objective of some officials, the influence of federal management continues to raise costs, and hence prices. Those who now necessarily use coal for industry, instead of unavailable oil, may find a reversal of this trend very important in the postwar period.

MINERAL SUPPLY, including raw materials for chemical process industries, is to have further support from additional development of small domestic mining enterprises. The way in which this new policy has been publicized again demonstrates that preparation of materials for war usage is an important item in the political plan, especially for the Western mining states. The new policy formulated by WPB was announced by a group of Senators as a result of a letter from the President to Senator Murray of Montana. The need for certain of these raw materials is unquestioned. As much cannot be said for much of the technique of development. Already it is evident that building of stockpiles in the postwar period is likely to be a political venture of large economic significance. Perhaps user industries can take some comfort that stockpiling of important mineral products from domestic sources is at least less objectionable than the silver purchase policy previously used for like political purpose.

HOGS may yet eat the nation's corn cribs down to starvation levels. The alarming ratio between the price of pork on the hoof and the cost of feed is furnishing exaggerated inducements for raising hogs. The result will disturb the food industries and react on many other industrial fields where the processing of agricultural materials is effected. Hence, we should do all we can to support Chester Davis in his program for a more normal relationship.

EFFICIENCY is officially discouraged by an O.P.A. ruling that manufacturers of rayon products must pass on to their customers any and all savings made in manufacturing processes. The intent of O.P.A. apparently was to protect the public against getting an inferior product at the price ceiling formerly applicable to a superior article. There should be no quarrel with that intent but the unfortunate effect may well be to discourage any further improvements that would add to the efficiency or the economy of rayon production.

SAFETY LABELING cannot be ignored, even in war times. Thus the new American Standards Association recommendations for the marking of pressure cylinders containing chemical gases are a worthwhile effort that will have general usefulness. Also important are proper labeling and other precautionary measures for such household poisons as insecticides and disinfectants. Now that victory gardens are springing up everywhere there is an extra incentive for the industry to speed a sound national program for labeling and coloring of insecticides.

GR-S RUBBER

West Virginia's Synthetic Rubber Plantation

JAMES A. LEE *Managing Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

Here are descriptions of processes that have been closely guarded secrets. They are published with the approval of government officials. The process for making butadiene from alcohol was selected as the best of several developed by Carbide & Carbon. The styrene plant is of interest not only because of the use of this material in synthetic rubber, but also due to the promising future of polystyrene resins in our postwar economy. Production of the copolymer offers chemical engineers much that is new and interesting.—*Editors.*

THE INSTITUTE (W. Va.) Buna S plant is a symbol of the ingenuity of the American chemical engineer. Construction work was started in April, 1942. The first butadiene was produced in January, the first styrene in April, and the first rubber in March, less than a year from the date of the start of construction. The rated capacity of this plant is 90,000 long tons of synthetic rubber per year, which is about one-seventh of the rubber consumed by the American people in normal years. To produce this same quantity of natural rubber would demand a plantation of 270,000 acres, containing 24,000,000 trees, and requiring 90,000 employees.

The butadiene and styrene units were designed and constructed and are being operated for the government by Carbide and Carbon Chemicals Corp. The copolymer plant was constructed and is being operated by the United States Rubber Co. Ford, Bacon, and Davis, Inc., was the principal contractor and the equipment in the copolymer plant was fabricated and installed by Blaw-Knox Co.

The chemicals plant consists of four units for the production of butadiene from alcohol, each unit designed for a capacity of 20,000 short tons; and two units for styrene from ethylene and benzol, each having a rated capacity of 12,500 short tons per year.

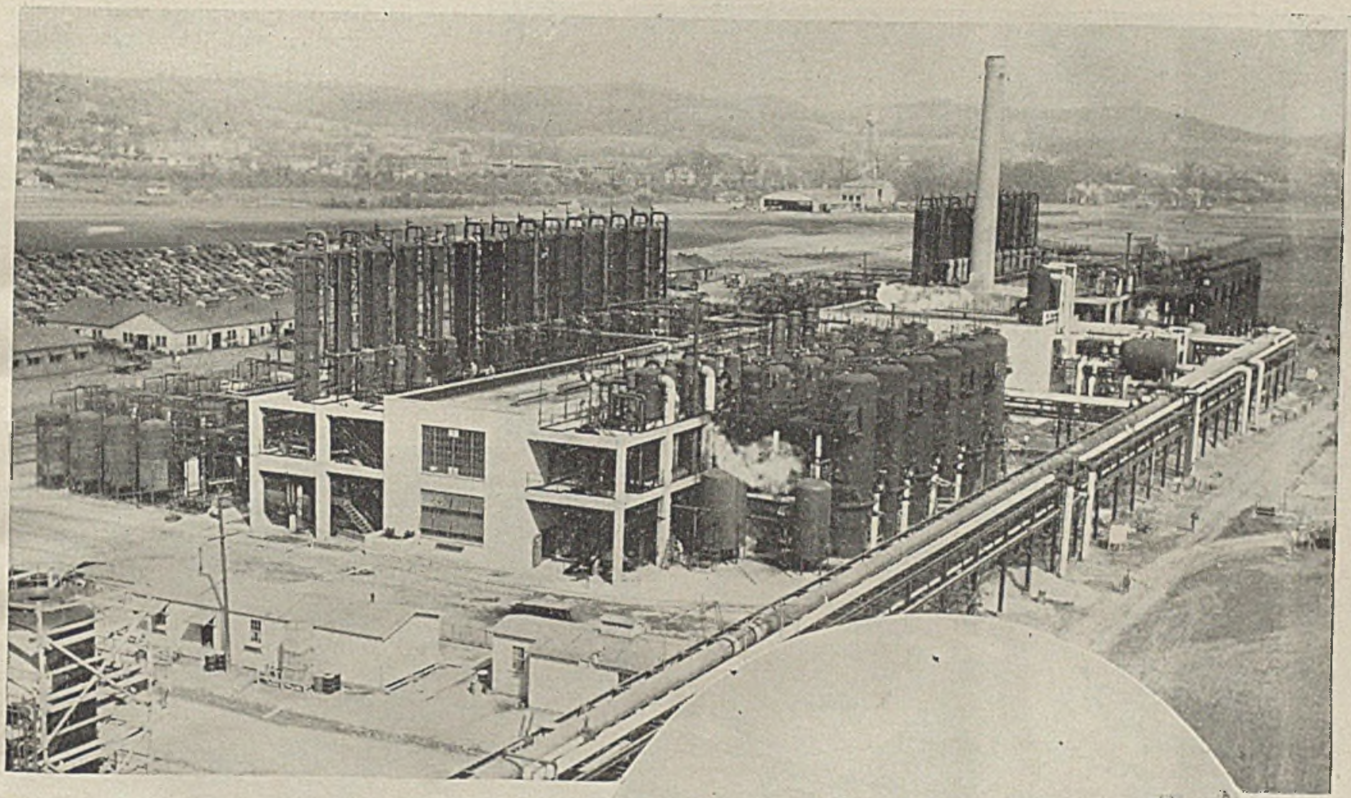
Carbide and Carbon Chemicals Corp. chose the process for making butadiene from alcohol as the best, under the existing circumstances, of several which it had developed through research. The chemical reactions involved in this process had been known for years, but their commercial development on a large scale basis under local conditions was new. The alcohol process, the company's engineers were convinced, had three important advantages, (1) It could be applied with the smallest volume of critical materials for the plant, (2) It could be put into production in the shortest possible time, (3) It would produce butadiene of exceptionally high purity.

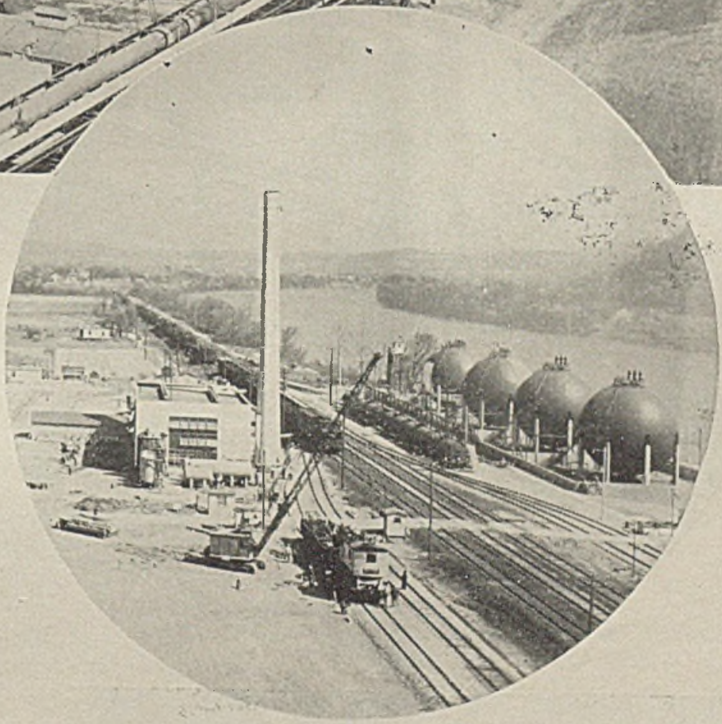
Carbide and Carbon put this new process to test and gave its engineers opportunities to learn all they could about butadiene plant construction and operation by building a pilot plant, which was put into operation in June, 1941. As experience was gained, this plant was frequently modified.

Present plans call for the major source of the alcohol used for producing butadiene at this plant to be that derived from the fermentation of grain. To supplement this, ethyl alcohol made from molasses, and some synthetic alcohol made from petroleum gas, can also be used when, and if, necessary. At present the alcohol is shipped in tank cars and an occasional tank truck to the Institute plant. It is expected that in the future it will also be delivered by barge as the plant is located on the navigable Kanawha River.

Alcohol is stored in five 1,500,000 gal. tanks. From these storage tanks it is pumped to the distillation system where it is vaporized and passed onto the converters, vertical tubular vessels. The tubes contain the catalyst. Several of the converters produce acetaldehyde which is then combined with the alcohol fed to the remaining converters. The product from all converters is cooled by heat exchangers and condensers. The uncondensed gas is scrubbed under pressure to recover the valuable materials. Condensate and scrubber liquor are combined and fed to a single set of continuous stills in which the butadiene and unreacted materials are purified. Butadiene which is more than 98.5 percent pure is stored in spherical pressure vessels holding 250,000 gal. each.

The butadiene condensers are located on the second level and the refluxes are pumped to the top of the column. The stills are heated by external, natural calandrias. Use is made of high boiling organic fluid to supply heat to the converters. The equipment is almost entirely plain carbon steel, no stainless is used, and a minimum of copper was specified, in





Two of the butadiene units at the Institute (W. Va.) plant with their source of process heat in between. The product is stored in Horton-spheres. A catalyst building is shown nearby

an effort to do without critical materials. It is interesting to note that for the pipe racks the company used a section of the Brooklyn elevated railroad structure, which had a short time previously been dismantled.

Just prior to the realization of the rubber emergency, a new process had been developed for producing styrene of high purity. This process was originally intended for making styrene for polystyrene resins for the Bakelite unit of Union Carbide and Carbon. It was as though made-to-order for the synthetic rubber program.

It was decided that a 25,000 ton a year styrene plant be built at Institute, even though actual construction had been started on a plant half that size at the Carbide and Carbon's South Charleston plant. Work began on the large styrene plant in July, 1942, and the first operation of the plant took place in April of this year, just nine months later.

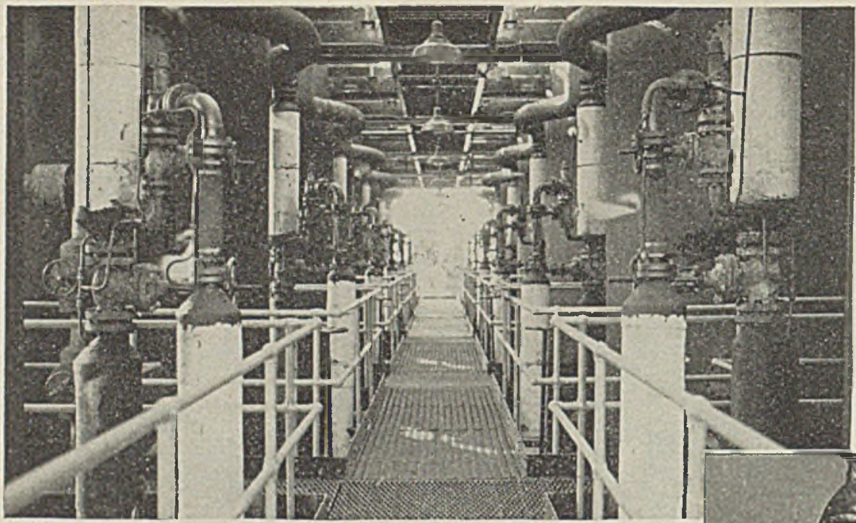
Raw materials for the styrene units consist of benzene which is brought to the plant from the Pittsburgh and other areas, and ethylene which is made in large volume at the South Charleston plant about six miles distant, and delivered to Institute by pipe line.

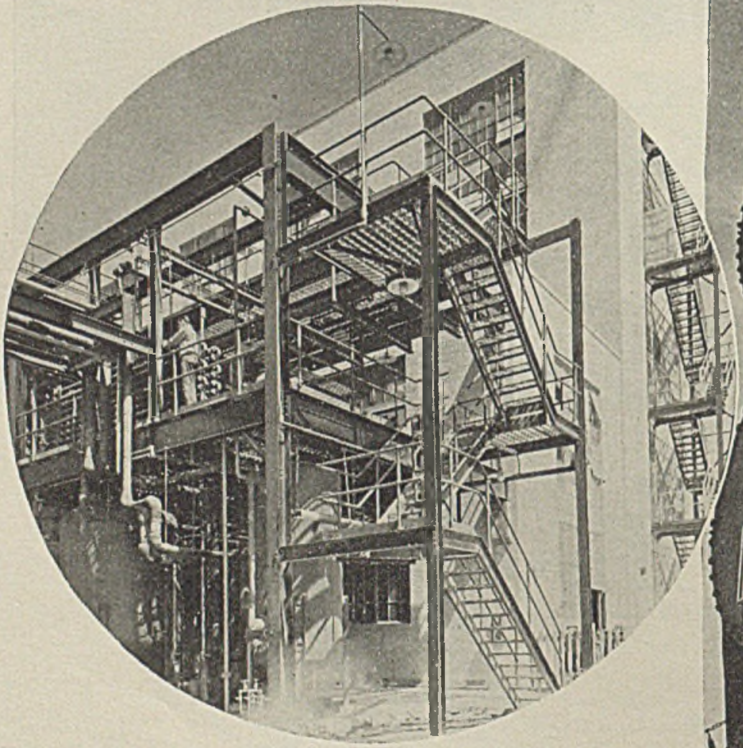
The benzene is first treated to remove the sulphur and sulphur compounds, principally thiophene. This is done with sulphuric acid in batch working tanks equipped with agitators and a small diameter settling chamber at the bottom. The purified benzene is next dehydrated by distillation and fed to continuous alkylation reactors where ethylene is added in the presence of a catalyst. Part of the benzene is converted to ethyl benzene and part to polyethyl benzene. The reaction product then flows to an alkylation reactor where more benzene is added and part of the polyethyl benzene is then reacted with fresh benzene to revert to ethyl benzene. This mixture is distilled to remove unreacted benzene and polyethyl benzene which are returned to the process.

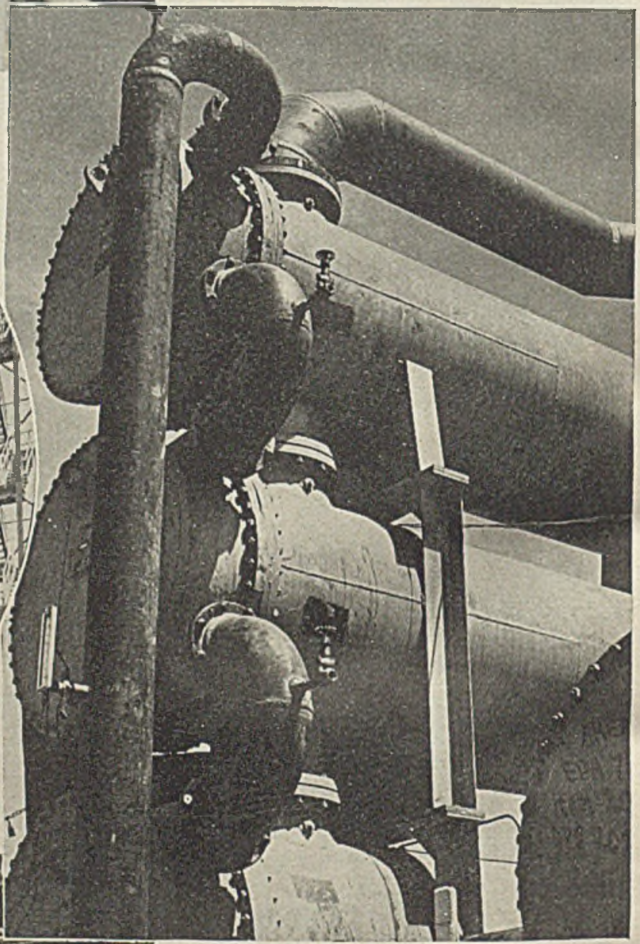
Purified ethyl benzene is then converted to styrene by a unique process which avoids the troubles and difficult separation of ethyl benzene from styrene by distillation. The entire process is continuous except for the first step of benzene purification. The final styrene product has a purity over 99 percent. It is stored in refrigerated tanks.

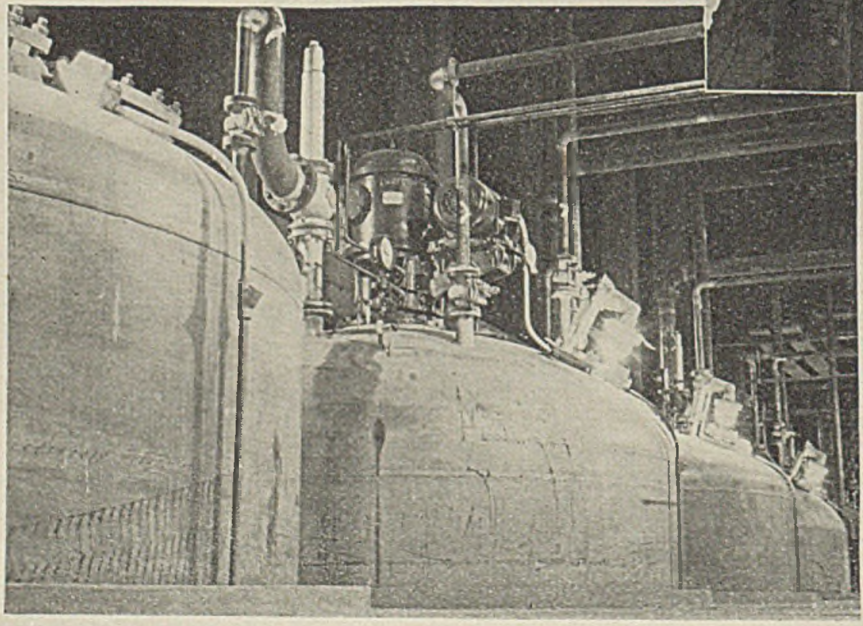
The stills in the styrene units are made of both copper and stainless steel. This is necessary as some of the byproducts are corrosive. Styrene is handled and stored in plain steel. In conjunction with the styrene units a heating furnace is operated in which a high boiling organic liquid is vaporized to provide process heat. The stills, compressors and most pumps are indoors. Reactors and storage tanks for intermediates are out of doors.

The polymerization plant was built and is being operated by the United States Rubber Co. for the Defense Plant Corp. It is essentially a standard plant constructed to plans de-









Operating level between rows of conversion vessels in a butadiene unit

One of the converters in a styrene unit appears at left. Stills, compressors and most pumps are under cover

Unreacted butadiene is flashed off from the rubber latex in the rubber plant. It is condensed in the condensers shown above

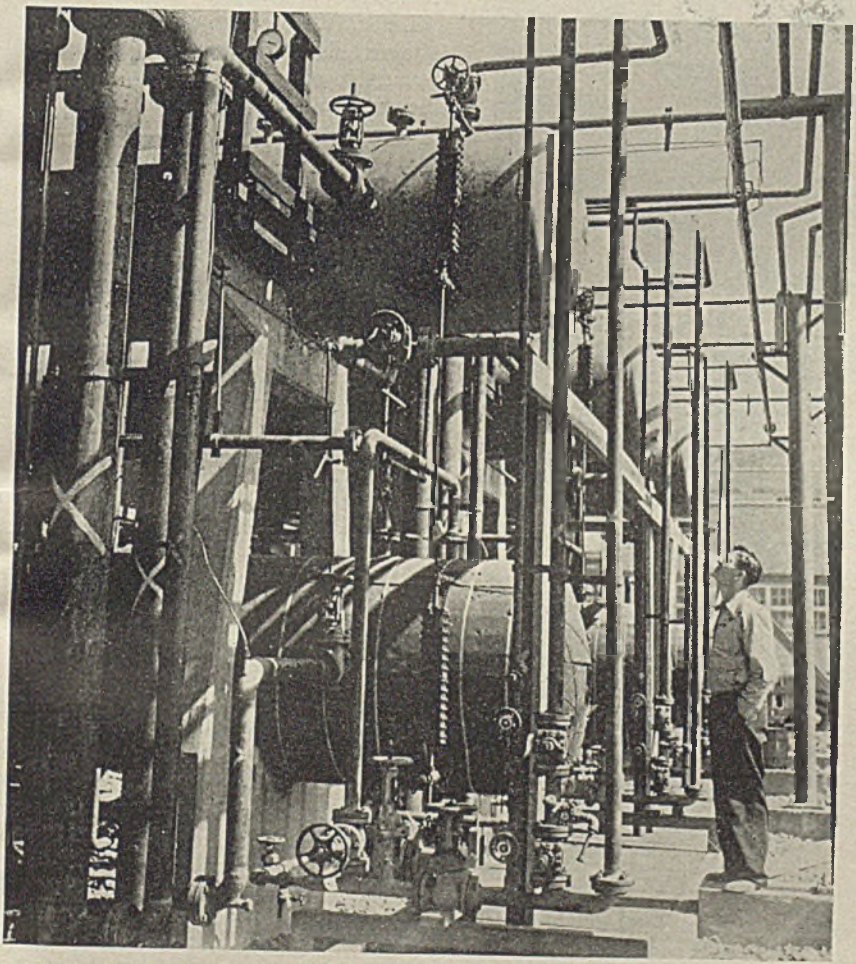
Polymerization takes place in large glass-lined reactors. There are 72 such reactors for the annual production of 90,000 long tons of synthetic rubber veloped by a committee of engineers from four rubber companies, and fabricated and installed by Blaw-Knox Co. This plant is composed of three identical units, each with a capacity of 30,000 long tons of rubber annually.

The butadiene and styrene are pumped through a pipe line from the adjacent chemicals plant and as they enter the grounds of the polymerization plant they are metered. The storage tanks at this plant, because of the nearness of the source, were designed to have capacity for only a few days operation.

All tankage containing butadiene is provided with safety valves. These discharge through a collecting system of pipes into a main line which terminates in a water seal at the base of a 150 ft. stack. A perpetual flame burns at the top of the stack to ignite combustible materials which may issue from safety valves throughout the plant. Inert gas is bled into this collector system so that at all times the entire safety flare will be filled with inert gas to avoid the forming of explosive mixtures. The water seal at the base of the safety flare serves as a flame arrester between the top of this device and the collector pipe.

All of the styrene storage in the tank farm is vented through a separate collector line which terminates over a dyked basin with approximately one and one-half times the holding capacity of the total styrene storage facilities. The entire hydrocarbon storage is dyked and provided with a fire protection system.

Other ingredients such as soap, catalyst, salt, acid and caustic are delivered to the plant by rail. Some of these raw materials are stored in a building at one end of the unit. Adjoining this storage is the chemical make-up building. Here the catalyst for the polymerization is prepared, and the antioxidant, the soap solution and the reaction arresters are made. From here these materials are transferred by means of pumps to the meter room in the reaction area.



An inhibitor is added to butadiene in storage to prevent premature polymerization. It must be removed before butadiene is pumped to the reaction area

The rock salt is delivered to the plant in gondola cars and is dumped into underground concrete storage pits. The salt is flooded with water to prepare a saturated brine which is treated in a purification system to remove the calcium and magnesium contents of the brine. If these impurities of the brine were not removed they would eventually be precipitated in the synthetic rubber as salts of fatty acids and would interfere with the electrical quality of the rubber. They are considered by some operators to be the cause also of poor processing quality in tire building operations.

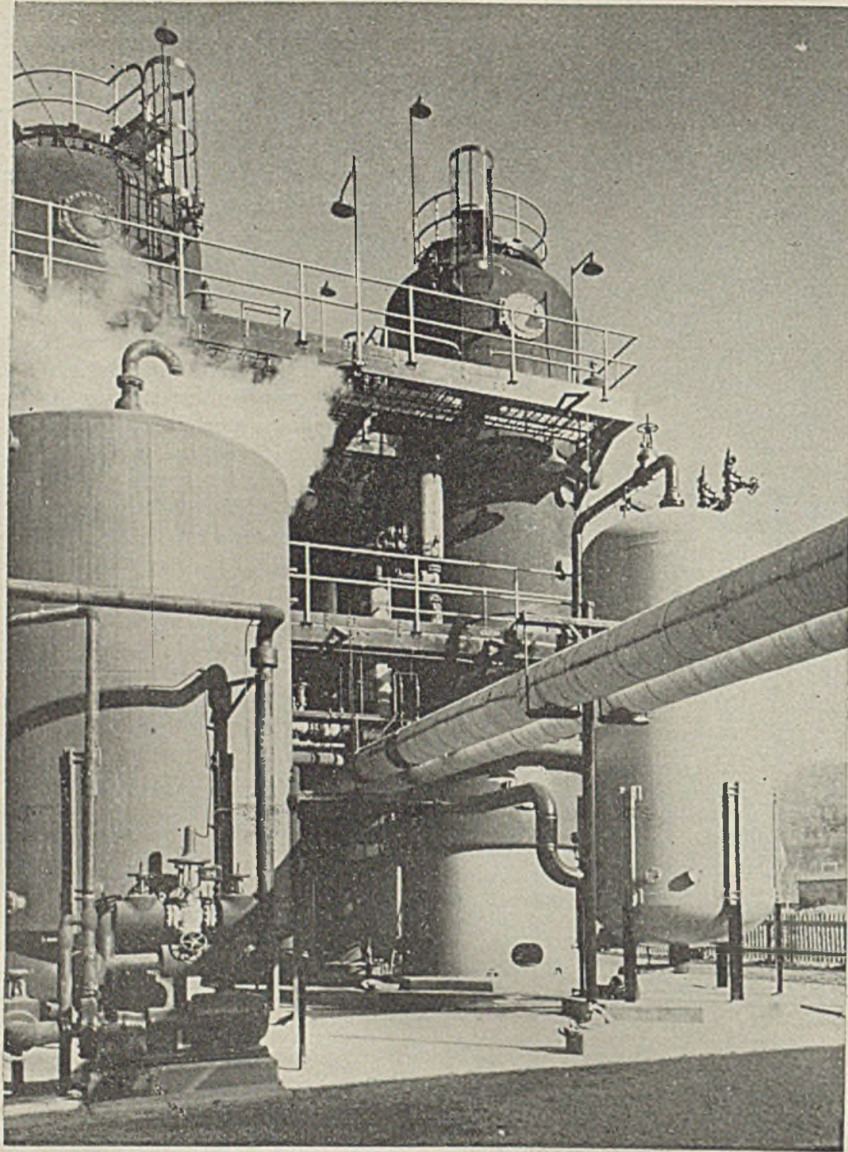
The reactors are water jacketed, glass-lined and equipped with agitators. They are provided with hot and cold water circulating system for the exact control of reaction temperature. Cooling water circulates through stainless steel coils inside the vessel. In order to seal the volatile butadiene against loss from stuffing boxes, a special Dura-metallic seal is used which operates on the principle of sliding metallic rings, working under a positive 100 lb. oil pressure to prevent the loss of volatile material. Each reactor is provided with a combination fangible disk and spring tension type of pressure relief value discharging through a collector system of pipes to the safety flare. The agitators are of special design which conserved a substantial amount of stainless steel. Throughout the plant, the use of special steels containing chromium and nickel has been held at an absolute minimum.

The charge of butadiene, styrene and soap solution emulsion is passed through liquid displacement meters, while the catalyst and other materials are measured in weigh tanks. All except the catalyst passes through a common header in order to prevent charging the several materials in layers. Conditions of reaction are controlled by means of a group of temperature and pressure recording controlling devices. The control room and meter room are held under a small positive air pressure as a safety measure, since instruments of the type in use are not spark proof.

Each set of 12 reactors is provided with a tank which is located between the collector system of the safety relief valves and the safety flare. This is simply an emergency provision which will prevent large volumes of soapy, foamy reaction mixture from entering the safety flare lines.

When the proper stage of polymerization has been reached the latex in the reactors is blown down by its own pressure to blow-down tanks in which the polymerization reaction is arrested by addition of certain agents. Each one of these tanks is large enough to hold the contents of three reactors. From this point the process becomes continuous.

The latex is pumped to glass-lined



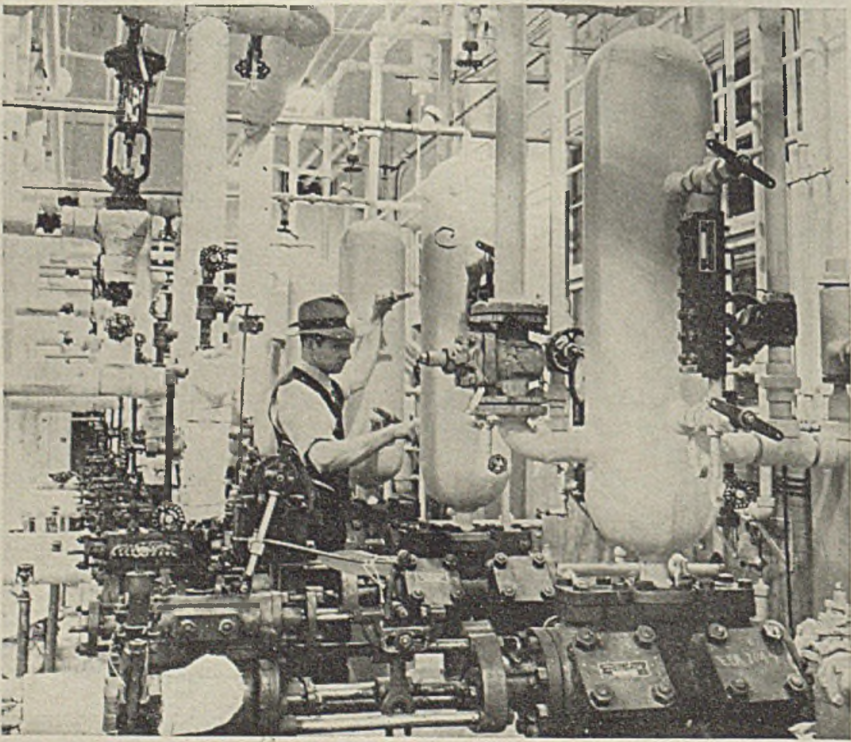
Steam and hot diphenyl vapors enter a butadiene unit through these pipe lines. This is a corner of one of four such units operated by Carbide & Carbon at Institute, W. Va.

flash tanks where the unreacted butadiene is removed in two stages. The butadiene is collected in a receiver and recycled until no longer useful. From the flash tanks the latex passes to a series of strippers where the unreacted styrene is separated. These glass-lined tanks are operated at various temperatures and degrees of vacuum. The styrene, like the recovered butadiene, is recycled.

Latex, free from butadiene and styrene, is conveyed by diaphragm pumps to several 30,000 gal. concrete blending vats, where it is mixed with many other batches for the sake of uniformity. Here the antioxidants are added in the line by means of proportioning pumps as the latex enters the vat.

From the blending vats the latex is pumped to a wooden creaming tank where brine is added to flocculate the rubber particles. Next it goes to the coagulation tank and the soap conversion tank where acid is added and the soap is converted to fatty acid. The mass is transferred by Duriron pumps to the riffler box above an Oliver rotary filter equipped with squeeze press rolls. The mass as it reaches the filter contains about 5 percent solid rubber. The dilute acid solution is first removed and stored for reuse. The rubber crumbs are then washed free of acid and conveyed by a rubber belt to a large disintegrator. It then enters a tunnel dryer and is conveyed the length of the dryer three times. The product is fed to the top belt and transferred progressively to the second and third belts for complete drying. From here it falls onto a screw conveyor and is elevated to a belt which feeds the scales. From these it is compressed into 75 lb. blocks in an automatic baler and placed in cardboard containers for storage and shipping. The bales of Buna S are shipped to rubber factories for processing into finished articles on the same machinery as is employed for natural rubber.

A *Chem. & Met.* pictured flowsheet covering these operations appears on pages 140-143 of this issue.



The raw materials, butadiene and styrene and many special chemicals, are moved by pumps from storage to the reactor areas at the plant operated for the government by the United States Rubber Co. at Institute

Rebuilding Used Equipment For The Process Industries

NORMAN G. FARQUHAR *Assistant Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

Wartime shortages are bringing to light some sources of chemical process equipment which hitherto have been little known. Not the least of these are the reputable second-hand machinery dealers who are prepared to do a thorough job of rebuilding and reconditioning practically all types of plant equipment for the chemical process industries.—*Editors.*

It is natural that when metals and machinery are scarce, the reconditioning of used equipment should take on added significance, for here is one way to put back quickly into the production line those badly needed units which otherwise would be sent through the long costly cycle of scrapping, remelting and refabrication. Companies engaged in the reconditioning of process equipment now find themselves filling high priority orders for government arsenals and defense plant corporations as well as private industrial plants. Some plants have required expansion during recent years to handle this increased volume of business.

Among the various sources of used equipment are plants which have made changes in their processes or have actually ceased operations entirely. Often complete process plants are purchased and the machinery rebuilt and sold separately to individual purchasers. In general, the customer's order and specifications are received before rebuilding is begun. This procedure permits the buyer to get exactly what he needs, even to extensive variations from, or additions to, the original piece of equipment. It also prevents accumulating an excessive inventory of reconditioned equipment. Considerable work is done in motorizing and otherwise bringing up to date the used pieces. Occasionally, an item may be sold "as is," but this is not general practice, especially in the case of equipment such as finely balanced centrifugals. If careful inspection reveals worn or damaged parts which could not be satisfactorily repaired or replaced, the machine is scrapped.

Rebuilt equipment is usually guaranteed to perform as it did when new. The used equipment dealer through long contact with the process industries may recommend equipment for certain jobs, but, of course, cannot guarantee satisfactory application of the equipment as the original manufacturer may have done. In other words, he is not a consulting process engineer, but does endeavor to make the used machine perform as well as the original product. Minor revisions in design may provide the buyer with a custom job specially suited to his requirements.

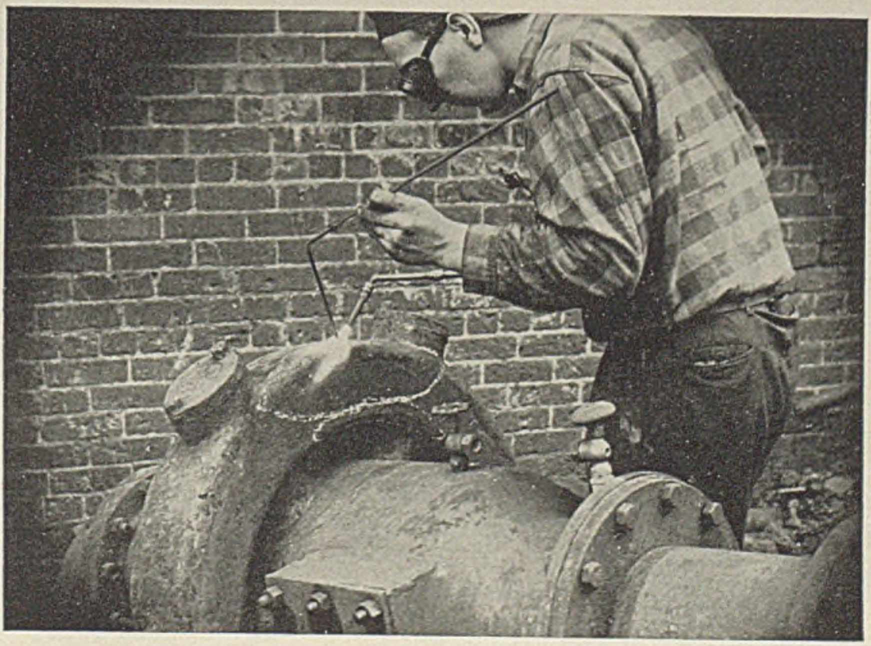
The reconditioning plant presents the usual outlay of tools and equipment which are necessary for quick efficient restoration of all types and sizes of process units. Caustic soda tanks are provided for dissolving grease or old product which may be adhering to the used parts. Sandblasting and oxyacetylene burning equipment are also used. There are large and small lathes, radial drill presses, shapers and planers, hydraulic rams, grinders, huge cranes for heavy equipment, gas and arc welding outfits, metallizing guns and electrical testing meters. A few shops are also doing their own motor rebuilding. Every effort is made to keep up to date on new materials as well as new methods of repair. Types of equipment which are handled run all the way from ball mills, kettles and pumps to vacuum shelf dryers, bottling and labeling machines.

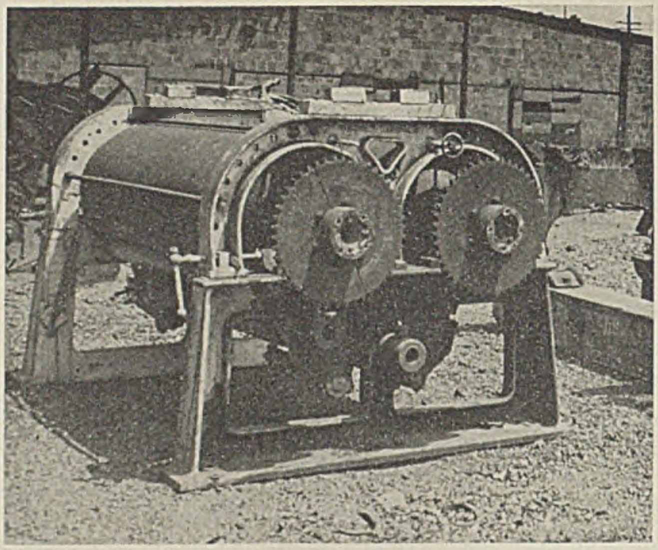
A typical example is a cracked Sweetland filter press which came into one shop. This presented a delicate job, for in making a pattern to cast this 12-ft. piece it was necessary to make an allowance for 1⅝ in. shrinkage. The rough casting obtained from a nearby foundry was then accurately machined to fit the other section of the press.

When plate and frame presses are reconditioned, sand-blasting is an effective cleaning method. Sometimes the surfaces are badly corroded and then planing is necessary to insure smooth tight joints.

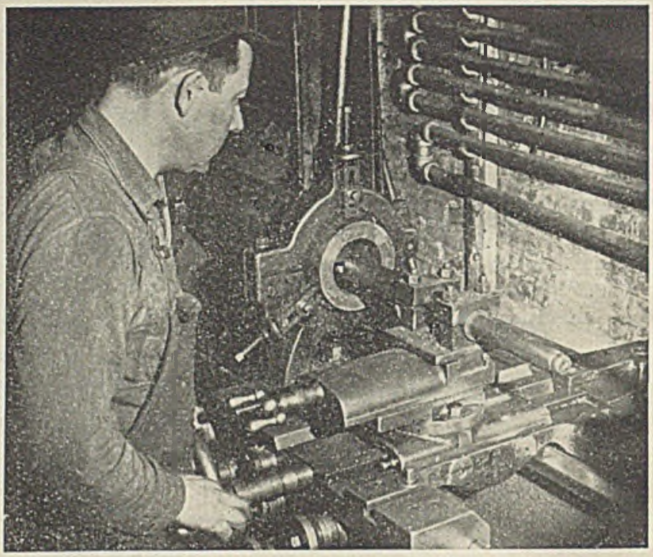
Vacuum pumps are thoroughly torn down and all necessary machine work done before reassembling. Single stage pumps are tested to a minimum of 28½ in. and two stage pumps to 29½ in., but will pull a higher vacuum

This jet condenser has a cracked casting which will be repaired by brazing





When a used double drum dryer comes into the plant it is completely dismantled and inspected before rebuilding is begun. Inspection may reveal that new driving shafts, gears, sprockets, V-belts, etc., are required



Approximately 80 percent of the bearings in dryers need new bronze bushings which are made from a piece of bronze stock by boring in a lathe as shown above. Fittings for proper lubrication must also be provided

than the minimum requirement. One rotary vacuum pump after rebuilding was tested to within 3 mm. of perfect vacuum. This particular pump, in addition to being completely overhauled, was mounted on a new base with V-belt drive, motor and slide rails.

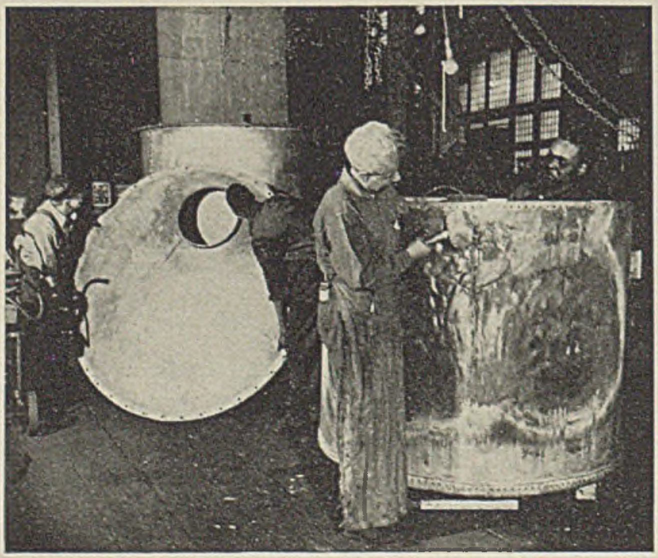
In the course of rebuilding a vacuum pan it was necessary to braze and reform a copper coil to withstand a hydrostatic pressure of 100 lb. Other alterations included the installation of agitators and new inlet and outlet connections.

Sometimes equipment which was originally well designed and constructed may be worthwhile rebuilding even though it has seen long service in some process plant. This was the case with one heavy duty mixer whose main drive shaft had to be replaced with an entirely new $3\frac{7}{16}$ in. shaft complete with keyway and key. (Equipment rebuilders generally use standard size shafts, bolts, etc. which make it easier to do further maintenance if and when required). New grooved bronze bushings were made and the main bearings were reinstalled with take-up shims and grease cups. Countershaft bearings were rebored and a new pinion gear installed (shown in illustration below). One of the two agitator shafts was replaced, two new stuffing boxes were made and glands were repacked. The chain drive required a new sprocket. From the original manufacturer a new friction clutch was obtained to complete the large replacements. With the rest of the parts carefully overhauled and guards installed around the gears, this mixer was thoroughly reconditioned and ready for long heavy duty service.

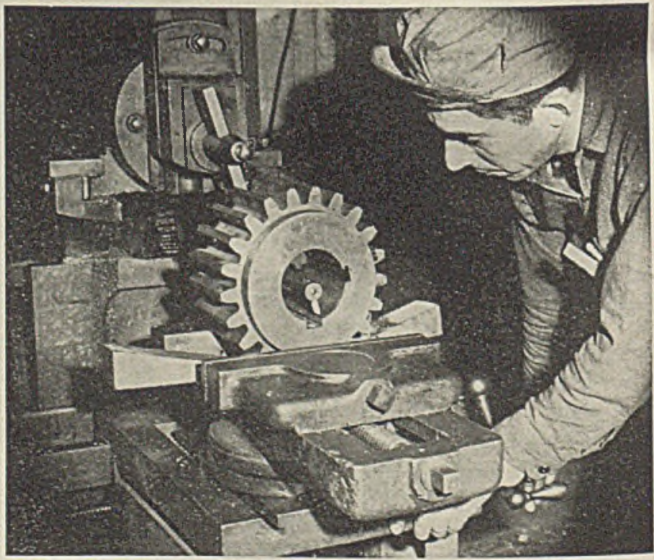
Inspection of a portable electric stacker indicated that the cable, brake and drive parts needed repairing before the machine could be put in first class operating condition. A rebuilt motor with the proper torque characteristics was also required.

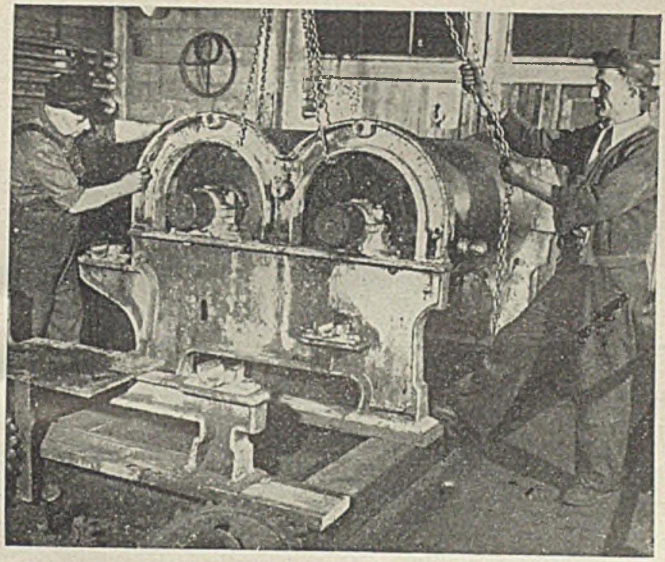
Specifications of one customer resulted in completely altering a square tank made of four nickel sheets. In order to make it absolutely leakproof the joints were cleaned and soldered. Pipe coils to provide for heat exchange requirements were fabricated, copper tinned and installed in the bottom of

One copper tank is assembled for shipment while workmen continue repairs on another

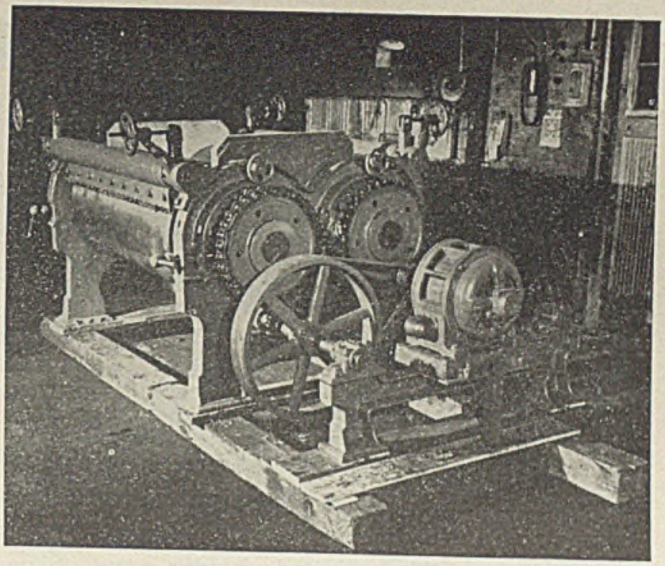


In the machine shop a keyway is cut in pinion gear required for drive on a heavy duty mixer





After cutting and grinding the rolls, they are reinstalled and miked to a clearance of 0.0015 in. This particular dryer required four new drum heads, but generally the original heads are satisfactory and are not replaced



Here the dryer is completely assembled and ready for shipment. The drums have been subjected to a hydrostatic pressure test of 120 lb., and the motor has been hooked up to permit inspection of the unit under operation

the tank. In this case the existing tank outlets did not have standard threads and were therefore replaced to facilitate piping connections. To complete the customer's specifications a thermometer well and a sight glass were installed.

The double drum dryer illustrated above was reconditioned to be used for drying yeast recovered from breweries. This type of equipment is particularly difficult to repair as its parts are large and heavy yet must be machined to close tolerances. Most of the smaller parts were replaced such as knife holders, knives, eccentrics for knife holders, end boards, end board wheels, screws, etc.

After the war is over, or when new plant equipment becomes available once more, the large chemical companies will probably revert to their policy of buying new equipment for their normal needs. However, a sizable market for the used machinery dealer will probably continue.

Most plant engineers prefer a better grade machine, even though somewhat used, to a less substantial new one. In some cases, therefore, where finances are limited, an engineer may turn to rebuilt equipment. Immediate delivery may furnish another good reason for consulting the second-hand dealer.

Temporarily increased production schedules sometimes find all the available units unable to carry the extra load. If the production is urgent and new equipment is too expensive to justify its purchase under the circumstances, a used machine may meet the requirements for the period.

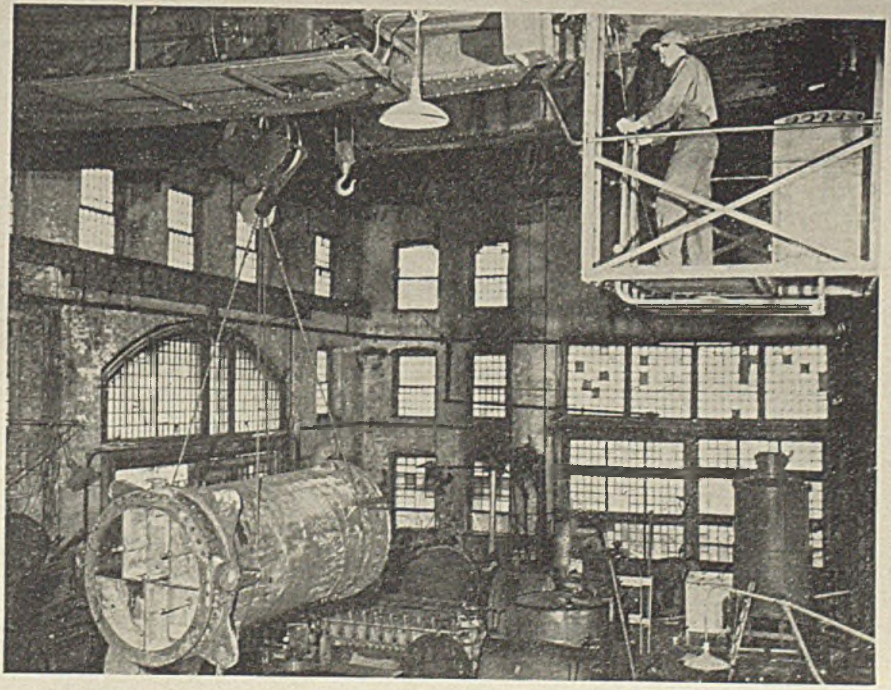
Engineering research men who have the responsibility of pilot plant research should find the used machinery market helpful in meeting their equipment needs. Often research groups are on a limited budget and cannot afford to purchase new plant-size units which may never produce for profits. Even if the equipment is to be used for scheduled production, it may only be infrequently operated, in which case a rebuilt unit might be the most economical choice.

Maintenance men in chemical process plants are already familiar with the used machinery dealer as a source of replacement items.

Some equipment rebuilders were making a few items of new plant equipment before the present emergency curtailed the amount of materials available for new construction. Perhaps this will be started again when the materials situation permits. At present, all the critical materials that can be obtained are going into the job of rebuilding used machinery, and all men and facilities are occupied to this end.

The writer gratefully acknowledges the cooperation given in the preparation of this material and illustrations by reputable used machinery dealers located in the greater New York area.

Heavy process equipment, such as this tubular heat exchanger, is easily handled in the repair shop by a 30-ton rolling crane



Modernizing Chemical Color Manufacture

JOHN R. CALLAHAM *Assistant Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

This is the story of how one progressive concern took over a typical, tank-burdened, batchwise dry color plant and proceeded to streamline processes and equipment to a remarkable degree. In fact, this plant only awaits the end of the war to put most of its operations on a continuous or semi-continuous basis. Believed to be the first such move in the industry, this will undoubtedly prove to be a major post-war development in the field of chemical color manufacture.—*Editors.*

Manufacture of chemical colors is one of the oldest activities in the heavy chemical field, and the industry was flourishing in this country by the end of the 19th century. It was in the Germany of Bismarck, however, that production of Prussian blue and other inorganic dry colors first reached large-scale proportions. The early German pigment plants were full of colorful wooden tanks, small filter presses and drying ovens. All operations were batchwise, discontinuous, and inefficient. All processes were governed by guess and by rule-of-thumb. The master technicians of the times stirred and steamed and swore, hoping that the brew would somehow turn out a pigment acceptable to their customers, who were not yet quality-conscious.

This industry, such as it was, was introduced into this country. For the past half century improvements have been made in equipment and processes, but always slowly. The chemical pigment industry is still largely characterized by batch processes, discontinuous operations, batteries of wooden tanks and filter presses, multitudinous products and standards and an unscientific nomenclature. Rule-of-thumb methods and semi-controlled "arts" have been preserved by secrecy and confusion more than by patents. Research has largely been subordinated to short-term improvements rather than to broad advances. There has been progress, of course, but no revolutions in the field, and until very recently many color plants were still more like replicas of 19th century German chemical shops than 20th century American process efficiency.

STREAMLINING THE INDUSTRY

In recent years, however, progressive men in the field have begun to take a new and objective attitude toward accepted principles and practices. Efforts are now being made to streamline processes, reduce the number of standards, put nomenclature on a scientific basis, and to realign research to its only proper course.

Among the leaders of this movement for rejuvenation of the industry have been the engineers, chemists and executives of Reichhold Chemicals, Inc. These men were new to the pigment field, since it was only in 1938 that the large and venerable Fred L. Lavanburg Co. dry color plant in Brooklyn, N. Y., was acquired and became the Chemical Color Division of Reichhold Chemicals, Inc. The Lavanburg concern, founded in 1886 under the name of Pfeiffer & Lavanburg, had from the very first been a leader in the field and had pioneered in the manufacture of English vermilions and other chemical colors in this country.

Almost immediately, Reichhold research chemists and engineers began to improve processes by determining optimum conditions of temperature, pH, proportions, and other factors and by installing instruments for automatically recording and controlling these variables. Radical changes have already been incorporated into the processes and improvements are still being made.

Now, for almost four years, engineers at the Brooklyn plant have been streamlining equipment and layout that will eventually make most of the processes and operations continuous or semi-continuous. Although production is still batchwise, it is believed that this method of operation has been developed to its ultimate efficiency and that further efforts along this line would result in rapidly diminishing

Table I—Comparative Operating Data Showing Results of Streamlining Operations and Processes—Previous Practice Under Lavanburg as Compared to Present Practice Under Reichhold Chemicals, Inc.[1]

	Iron Blues		Chrome Greens		Chrome Yellows		Totals	
	Lavanburg	Reichhold	Lavanburg	Reichhold	Lavanburg	Reichhold	Lavanburg	Reichhold
Total pigment production, lb. per mo.	40,000	100,000	100,000	200,000	200,000	900,000	340,000	1,200,000
Making capacity, gal.	198,100	70,100	40,000	25,000	70,800	80,000	308,900	175,100
Number of tanks	32	5	10	1	23	5	65	11
Average capacity, gal. per tank	6,200	14,000	4,000	25,000	3,100	16,000	4,750	15,900
Pigment production, lb. per 1000 gal. per mo.	200	1,430	2,500	8,000	2,830	11,250	1,100	68,500
Producing space, sq. ft.	4,876	1,080	1,080	324	2,107	1,152	8,063	2,556
Pigment production, lb. per 100 sq. ft. per mo.	820	9,260	9,260	61,720	9,520	78,250	4,210	47,050
Man-hours per mo.	3,500	3,280	2,500	3,280	3,320	8,550	8,320	15,000
Pigment production, lb. per 1000 man-hr. per mo.	11,400	30,500	40,000	61,000	60,250	105,200	40,900	80,000

[1] Prepared especially for this article by H. B. Kirkpatrick, plant superintendent, Reichhold Chemicals, Inc., Brooklyn, N. Y. Similar improvements to those shown above have been made in facilities for producing organic pigments, but these figures have been omitted since they are difficult to put on a comparable basis.

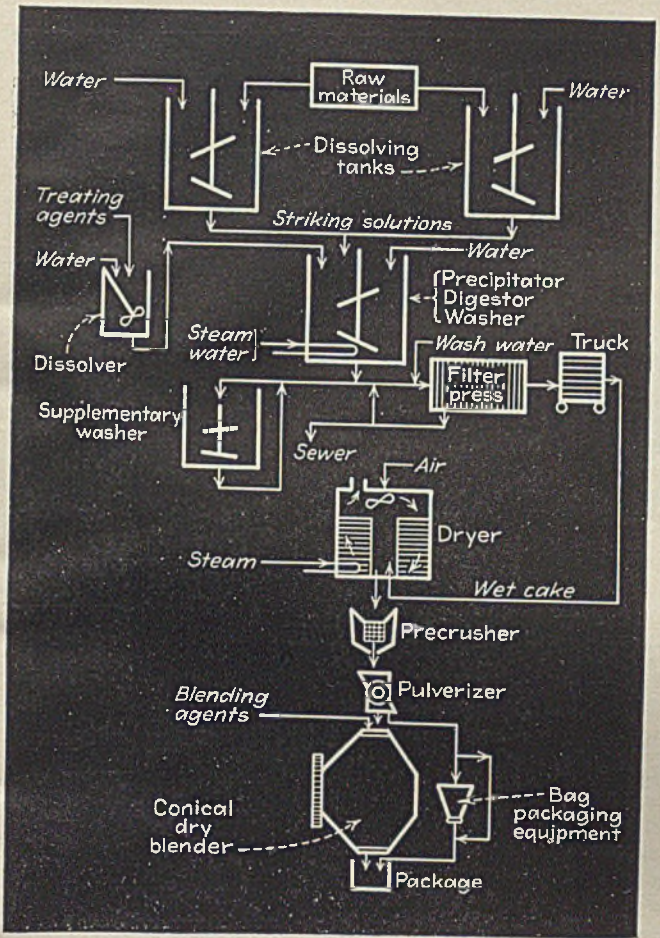


Fig. 1—This master equipment flow sheet shows present Reichhold practice in processing and handling dry colors

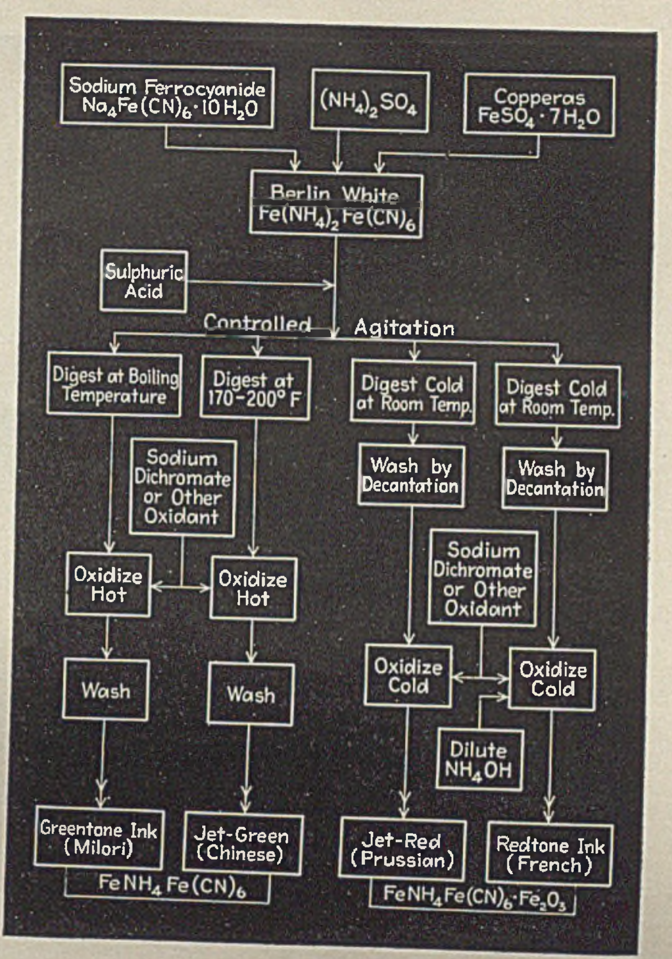


Fig. 2—Flow sheet showing Reichhold Chemical Co. operations for manufacture of the four basic types of iron blues

returns. In fact, all long-range planning of Reichhold engineers points to continuous operations. Indeed, actual methods of primary processing such as precipitation have already been largely reduced to a single basic principle and it can even now be said that all major processing problems involved in the conversion to continuous operations have been solved and that engineering work for such a change-over is now in the preliminary blue-print stage of development.

Results of these streamlining changes at the Brooklyn plant are shown very strikingly in the case of iron blues, chrome greens and chrome yellows by Table I, which gives operating data for these units under the old Lavanburg set-up as compared to the present Reichhold practice.

Pigments manufactured at Reichhold's Brooklyn plant include the chrome yellows and oranges, iron blues and chrome greens. These "Big Three" were industrially the most important of the inorganic dry colors until recently when zinc chromate, because of its usefulness in our aircraft and naval programs, assumed first place in tonnage and value. In addition to these inorganic colors, the Brooklyn plant also produces a large line of organic toners and lakes.

BASIC EQUIPMENT

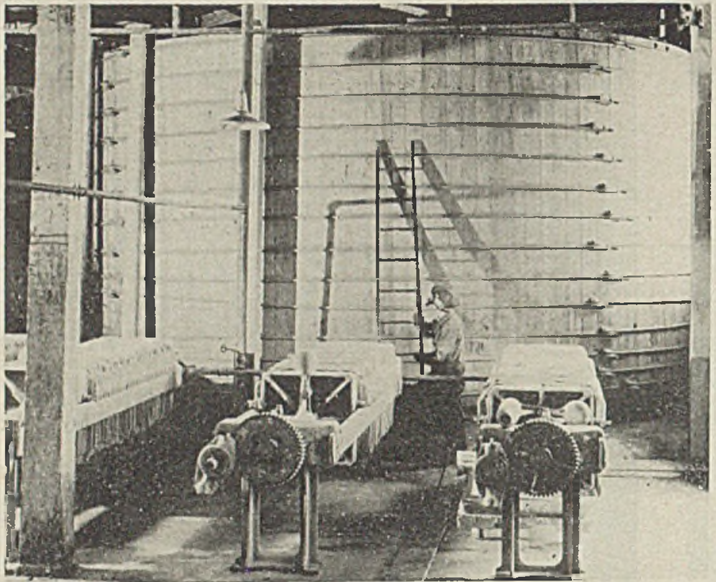
Basic equipment used in the manufacture of all the principal dry colors is fundamentally the same, although slight modifications in the processing procedure result in some changes in layout. However, because of the danger of color contamination, each of the basic pigments has a separate equipment set-up. Iron blues, for instance, are never made in equipment previously used for preparation of chrome yellows.

A master equipment flow sheet of the processes as now practiced in the Reichhold plant is shown in Fig. 1. The open dissolving or "striking" solution tanks are of wooden construction with two wooden cross blades and baffles on the sides for more effective agitation. These stirring devices, formerly all belt driven, are now direct gear drives. Here the basic raw materials are dissolved to a definite and controlled concentration with or without the aid of steam coils, and are then pumped at a controlled rate by centrifugal pumps of 200-300 gal. per min. capacity into another similar wooden tank of larger size where precipitation of the basic pigment occurs.

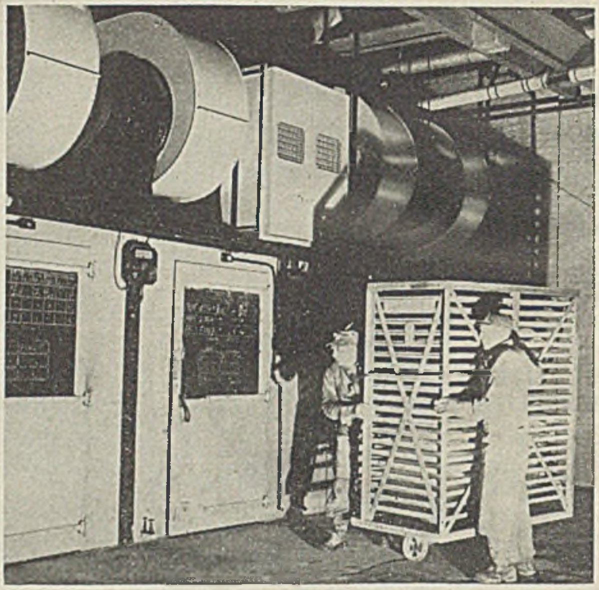
Size of the precipitators varies from a capacity of 6,700 gal. of slurry in the case of certain organic blues or purples to 40,000 gal. for zinc yellow. Single batch yields are 16,000 lb. of dry C. P. pigment for medium chrome yellow, 40,000 lb. for zinc yellow, 15,000 lb. for chrome greens, and 6,000 lb. for iron blues.

Treating agents, which may be acids or alkalis, oxidizing agents or other chemicals, are dissolved in small open tanks, usually lead-lined or acid resistant, and provided with a small high-speed, side impeller agitator. Small centrifugals pump the treating solutions into the precipitator at a predetermined rate and during agitation.

A major improvement in processing instituted by Reichhold engineers is that of accurate pH and temperature control throughout the precipitating and digesting steps. All production in each department is regulated from a single control panel equipped with multi-point pH and temperature control instruments. Flow rates of all solutions are controlled by flow meters and adjusted by valves located on the



This giant 40,000-gal. wooden tank, probably the largest ever built in the dry color industry, is used in producing zinc chromate pigment for aircraft and ship priming paints



Trucks of moist cake are here being wheeled into the dryers, where hot air circulates to reduce the moisture content to 1-2 percent within 20-30 hours

central panel. Drying temperatures are carefully controlled by automatic instruments equipped with dial and pointer adjustment. All dryer temperatures throughout the plant are continuously recorded on a single multipoint temperature recorder of the continuous roll type located in the laboratory.

MATERIALS HANDLING

After color precipitation, digestion and washing by decantation, the slurry is pumped into batteries of wooden plate-and-frame filter presses, each about 10 ft. long and having 40 plates. Heavy cotton canvas is used as the filtering medium. The batteries, one for each basic pigment, contain from 10 to 20 individual presses. Cakes of about 1.5 in. are built up and then washed free of soluble salts by water.

Throughout the steps of precipitation as well as digestion and washing, processing conditions for the basic colors and for some of the different shades all differ, for it is in these phases that the fundamental characteristics of the pigment are developed. These variations in processing are discussed briefly in a later section. However, handling operations which involve filtering, drying, pulverizing, blending and packaging are fundamentally the same for all products, so that the following paragraphs may be applied equally well to iron blues, chrome yellows and oranges, chrome greens, zinc chromate and organics.

Filter presses are opened by hand, the cakes of wet pigment placed in shallow aluminum or enameled steel trays and loaded on small frame trucks about 6×5×2.5 ft. equipped with wheels. Each truck holds 40 trays with an air space of about 3 in. between trays. These are pushed by hand to a battery of centrifugal fan-type dryers, each of which holds six such trucks, or the cakes from six filter presses. Here air, heated to 185 - 212 deg. F. by steam coils, is circulated until the moisture content of the cakes is reduced to the neighborhood of 1.0-2.0 percent, a process usually requiring some 20-30 hours. Huge centrifugal fans exhaust the moist air, while control instruments record temperatures.

The trucks of dried colors are returned to an upper floor where the trays are dumped into pre-crushers provided with exhaust hoods, where lumps are broken up. The material is then fed into high-speed (6,000 r.p.m.) hammer mills of the Micro-pulverizer type. These are run by squirrel-cage motors and charge large conical blenders located on the floor below. Some of these mills are portable and can easily be moved to feed more than one conical blender. There are three such mill rooms, one for organic reds, another for the greens, blues and purples, while the third is used for the chrome yellows and oranges.

All material is ground to pass 100 percent through a 325-mesh screen. Some materials which do not require blending are pre-crushed into the hoppers on the ground floor directly into barrels or other containers.

If, after grinding, a batch is slightly off shade or if other materials are to be blended in, the pigment is charged into one of the two double-cone mixers rotated on trunnions, as shown in an accompanying illustration, and provided with a magnetic brake mechanism. Thorough mixing is usually attained within 15-20 min., and power consumption seldom exceeds 1.5 hp. per 1,000 lb. of charge. Blenders vary in capacity from 2,500-10,000 lb. of dry color. For special blends, a double-helical ribbon mixer is provided. Zinc chromate, now a major part of Reichhold's pigment production, is for the most part packaged in multiwall paper bags from bag packing equipment.

IRON BLUES

Iron blue pigments fall naturally into four separate general classifications, depending upon their outstanding shade characteristics. These classes with the old nomenclature and that introduced by Reichhold technicians are given in Table II. Fig. 2, modified after that by Brown*, shows the principal steps in manufacturing these pigments as practiced at the Brooklyn plant.

All basic iron blues are obtained from sodium ferrocyanide, ammonium sulphate and ferrous sulphate raw materials with sulphuric acid and an oxidizing material as treating agents. They are all alike in that the white base or ferrous ammonium ferrocyanide (often called Berlin white) is precipitated by mixing dilute solutions of sodium ferrocyanide and ammonium sulphate with a solution of copperas. Actually, it makes little difference which solution is run into the other.

* This description of iron blue manufacture is based to a large extent upon the article by T. P. Brown, *American Ink Maker*, p. 23–26, 43, Dec. 1939. An excellent discussion of the nomenclature of dry colors and proposed improvements has been given by H. B. Kirkpatrick, p. 47–49, 53 of the Sept. 1939 issue of the same magazine.

It is very important that the ferrous sulphate and other materials be free of ferric salts, otherwise a very hard, crystalline product without pigment properties will be formed. The basic reaction for the formation of the pure white base is as follows:

$$Na_4Fe(CN)_6 \cdot 10H_2O + FeSO_4 \cdot 7H_2O + (NH_4)_2SO_4 \longrightarrow Fe(NH_4)_2Fe(CN)_6 + 2Na_2SO_4 + 17H_2O$$

At this stage the relative amount of ammonium sulphate, concentration of striking solutions, temperature of reaction and rate of agitation are all important in determining the quality of the final product. For instance, when Prussian or Jet-Red blue is desired, the temperature of the reactants is held to about 70-100 deg. F. Reichhold chemists have done much work on determining the effect of each of these factors, as a result of which numerous control devices have been installed to guarantee absolute uniformity in quality of the final pigment.

After precipitation of the white base an acid, usually sulphuric, is added. The amount of acid determines to a large extent the texture and oil absorption of the final product.

At this point it is well to remember that the basic iron blues can be divided into two broad classifications: the green-shade blues and the red-shade blues. The shade of the product will depend primarily upon the conditions in the digesting, oxidizing and washing steps, variations of which are shown in Fig. 2. The one fundamental difference in treatment is that while the green shades are digested hot and oxidized before washing, the red shades are digested cold and washed by decantation before oxidation. Since oxidation releases ferrous sulphate which is retained as a ferric oxide if washing is conducted after oxidation, the red shades retain this iron oxide and as a result have a characteristic tint.

In the case of Greentone Ink blue (Milori), the acidified white base is boiled for several hours, after which an oxidizing agent such as sodium dichromate or chlorate is added to convert the Berlin white base to the ferric condition:

$$Fe(NH_4)_2Fe(CN)_6 \longrightarrow FeNH_4Fe(CN)_6$$

The color is now washed several times by decantation, filtered, the cake washed in the presses, and finally dried by hot air.

The essential differences in processing Greentone Ink blue and Jet-Green blue are that in the latter more ammonium salt is used and digestion temperature is lower, being held at 170-200 deg. F. instead of at a boil. Alteration of the acidity, concentrations, temperature and time of oxidation all cause variations in the shade of blue secured.

Jet-Red and Redtone Ink blues (Prussian and French) differ from the green-shade blues in that they receive less, and in some cases no heat treatment. They are also oxidized after washing by decantation to a very low acid concentration rather than in the hot, strongly acid state. Thus the ferrous sulphate oxidation product is retained in the blue molecule as ferric oxide to give a red tint. Usually ammonia is added to the slurry before it is filtered in order to increase the redness of tone. In general, Jet-Red may be made in the same manner as the Redtone Ink except that the amount of ammonium sulphate during precipitation of the base white is increased considerably.

Table II—Nomenclature and Composition of C.P. Iron Blues

New Descriptive Name	Historical Name	Composition	Formula
Greentone Ink	Milori	ferric amm. ferrocyanide	$FeNH_4Fe(CN)_6$
Jet-Green	Chinese	ferric amm. ferrocyanide	$FeNH_4Fe(CN)_6$
Redtone Ink	French	basic ferric amm. ferrocyanide	$FeNH_4Fe(CN)_6.nFe_2O$
Jet-Red	Prussian	basic ferric amm. ferrocyanide	$FeNH_4Fe(CN)_6.nFe_2O$

Yields of iron blues on the basis of sodium ferrocyanide vary considerably, being highest in the red shades since these contain varying amounts of red ferric oxide or hydrate and lowest in the green tones. Yields of the red-shade blues may go up to 80 percent of the sodium ferrocyanide raw material, while those of the green shades rarely surpass 65 percent and may often be as low as 60 percent. Thus 155-210 lb. of sodium ferrocyanide (decahydrate) and 75 lb. of copperas may be required to produce 100 lb. of dry iron blue pigment.

Reichhold also produces a potash blue at its Brooklyn plant. This pigment, restricted in its use because of its higher cost, is made more or less in the same manner as the soda-ammonium varieties already described except that the primary raw material is potassium ferrocyanide and the use of ammonium sulphate is unnecessary.

CHROME YELLOWS

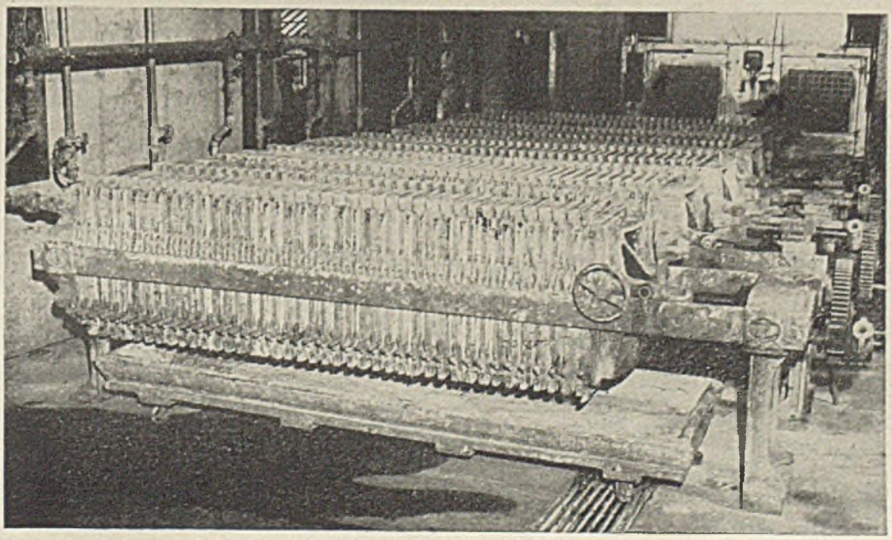
Chrome yellows fall into three classes, according to redness of tone, as follows: Primrose, Light and Medium. The Medium shade approaches pure normal lead chromate in composition, whereas the Primrose and Light types consist of lead sulphate in combination with lead chromate in mixed crystals or solid solution. Approximate composition of the three types of chrome yellows are given in Table III. This class of pigments normally represents Reichhold's largest color tonnage.

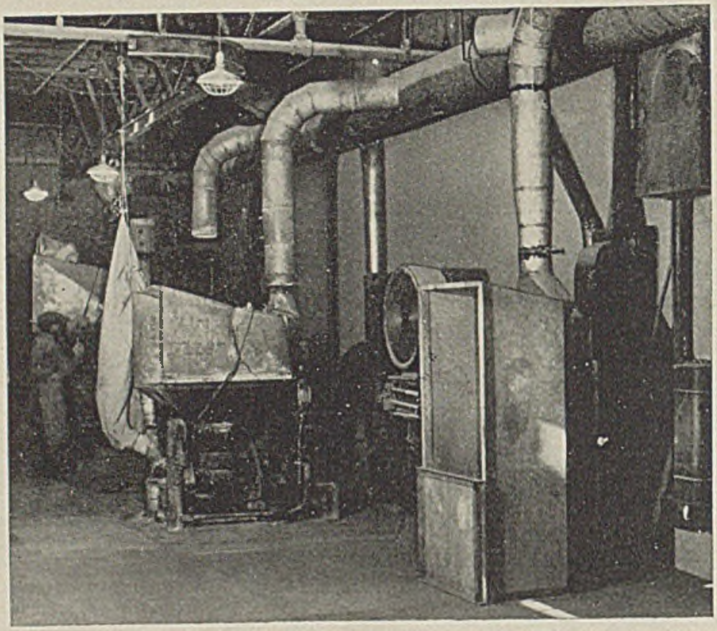
Basic raw materials used in chrome yellow manufacture are litharge, bichromate of soda and nitric, acetic and sulphuric acids. Relatively small quantities of other acids and metallic salts are used for crystal fixation and to impart special properties to individual products.

Generally, a solution of litharge in dilute nitric or acetic acid is made up in a 10,000-gal. reaction tank equipped with a direct-drive double crossblade agitator. Bichromate of soda solution, containing the amount of sulphuric acid required for the shade of product being made, is then added at a controlled rate. Throughout the operation, the pH of the slurry is controlled by addition of small amounts of acid or alkali as required. In general, an increase in the pH increases the redness of color of the final product. Thus, chrome yellow Medium is always formed under less acid conditions than the other two shades.

The crystal form of Primrose yellow is rhombic, an unstable pale form which is fixed by precipitation with a small amount of aluminum hydroxide and/or phosphate. This prevents recrystallization to the stable monoclinic form, which would result in profound changes in color shade and other properties. Both the Primrose and Light yellows are always formed at 70-80 deg. F. in the presence of excess soluble lead, since in a medium containing excess soluble

Such batteries of wooden plate-and-frame filter presses can turn out every month over 600 tons of iron blues, chrome greens and chrome yellows at the Reichhold dry color plant in Brooklyn. Four years of streamlining has increased productive capacity almost four-fold and has reduced floor space, equipment and labor costs





The trays of dried colors are dumped into pre-crushers, after which the material is fed to hammer mills of 6,000 r.p.m. The Reichhold plant has three such mill rooms for different colors

Double-cone mixers like this can blend other inert agents into the pure pigment to produce 2,500–10,000 lb. of "reduced" color for each blending operation

chromate the color develops instantaneously into the darker monoclinic crystal form.

Light yellow is also precipitated as rhombic crystals of a pale yellow shade. However, no fixing agents are added to this, so that upon digestion and washing by decantation the crystal passes to the monoclinic form and the color develops to a rich, lemon shade, high in tinctorial strength and possessing superior lightfastness. This shade contains about 30 percent of lead sulphate coprecipitate as compared to about 50 percent for the Primrose grade.

Chrome yellow Medium forms directly as the golden monoclinic crystals which are characteristic of pure or nearly pure normal lead chromate. Therefore, this type may be made either by addition of lead solution to chromate solution or by the reverse addition and the precipitation temperature may range up to 120 deg. F. No crystal fixatives are required for this shade. Precise pH control and vigorous agitation are necessary to produce a uniformly high quality of product for the pigment trade.

CHROME ORANGES

Chrome oranges are basic lead chromates as contrasted to chrome yellows, which are normal lead chromate or lead sulpho-chromate. The empirical formula of chrome oranges is $PbCrO_4 \cdot nPbO$, in which n varies from 0.5 for the extra light shade to 1.5 for the very deep shade, sometimes known as chrome red. Thus the following series can be developed:

Primrose chrome yellow.... $PbCrO_4 \cdot PbSO_4$
Medium chrome yellow.......... $PbCrO_4$
Extra light chrome orange $PbCrO_4 \cdot 0.5\ PbO$
Extra deep chrome orange $PbCrO_4 \cdot 1.5\ PbO$

Both equipment and processes used for the manufacture of chrome yellows and oranges are similar in the Reichhold plant. The chief difference lies in the fact that the chrome oranges are precipitated in hot alkaline medium and are boiled after precipitation for complete development of brilliant reddish shades. As in the case of Medium chrome yellow, it matters little whether the soluble lead salt used is the nitrate or acetate, though the latter is more generally used by Reichhold because of its greater availability.

Chrome oranges are made in 10,000-gal. precipitating tanks at the Brooklyn plant. To a concentrated solution of sodium dichromate in the making vat, caustic soda is added until the desired alkalinity is obtained, which varies from pH of 7.0-10.0 and is dependent upon the shade being produced. Hot, dilute lead solution is then run in at a controlled flow rate, after which the slurry is digested at a boil for 5-10 min., the darker shades requiring the longer digestion period.

CHROME GREENS

In the paint industry, chrome green is more extensively used than any other green pigment. The generic term applies to an intimate physical mixture of chrome yellow and iron blue produced by precipitation of lead chromate or lead sulpho-chromate in an aqueous medium containing finely dispersed green shade iron blue.

Reichhold produces three basic type[s] of chrome greens, each in a wide rang[e] of shades, varying in blue content fro[m] 3-50 percent. First and most importan[t] because of their great brilliance, opac-ity, hiding power and permanence, com[e] the Nitrate greens, so called because lea[d] nitrate is used in their manufacture[.] When reduced with white, these yiel[d] a very bluish tint, and for this reaso[n] are sometimes called "blue-tint" green[s].

Acetate chrome greens made, as th[e] name implies, with lead acetate are les[s] brilliant and considerably more trans-parent than the Nitrates and for equa[l] depth of masstone reduce with white t[o] a much yellower tint. Nomenclatur[e] and approximate composition of th[e] blue-tint (Ferndale) and the yellow[-]tint (Neptune) greens are given i[n] Table IV.

The chrome yellow constituent of bot[h] the Acetate and Nitrate greens is simila[r] in manufacturing process, chemical com-position and general properties to chrom[e] yellow Primrose, but with somewha[t] less sulphate than is generally co[...]

Table III—Nomenclature and Composition of C.P. Chrome Yellows

Commercial Name	Shade	Approximate Percentage Composition: Lead Chromate	Lead Sulphate	Other Lead Salts
Primrose...	pale.....	45	50	5
Light......	lemon....	67	33	..
Medium....	golden...	98	..	2

Table IV—Nomenclature and Compositio[n] of C.P. Chrome Greens (Iron Blue—Chrom[e] Yellow Co-Precipitates)

Commercial Name	Approximate Percentage Composition: Ferric Ferrocyanide	Lead Sulphate	Lead Chroma[te]
Blue Tint or Ferndale Greens			
Light........	24	10	66
Medium......	31	9	60
Dark........	36	8	56
Yellow Tint or Neptune Greens			
Extra Light..	8	88	4 [1]
Light........	18	2	80
Medium......	27	3	70
Dark...... ..	47	3	50

[1] Lead tartrate.

tained in the latter. As in Primrose yellow, these greens are always formed in an excess of soluble lead, and are "fixed" by formation of aluminum hydroxide and/or phosphate in the green slurry.

The third series produced by Reichhold is the Olive greens, so called because of their characteristic olive-drab cast in full tone. The yellow counterpart of the Olive greens is Medium chrome yellow. The process for making Olive green is similar to that for the Medium yellow except, of course, that finely divided iron blue is added to the lead solution for making the green.

Reichhold greens are produced in 25,000-gal. precipitating tanks, which are probably the largest units ever employed in this country in green manufacture. Each batch yields about 10,000 lb. of dry C.P. pigment.

ZINC CHROMATE

For many years zinc chromate, a pale yellow approximating the shade of chrome yellow Primrose in full tone, was used to a limited extent in combination with iron blue for making very clean, permanent greens. In recent years, however, it has gained wide prominence as a rust inhibitive pigment for metal priming paints, and is now used in large quantities by the Army and Navy for aircraft and ship primers. In its contribution to the war effort, zinc chromate stands as the most important single pigment produced today.

Commercial zinc chromate is actually a zinc-potassium-chromate complex salt of the empirical formula $5ZnO \cdot 4CrO_3 \cdot K_2O \cdot 3H_2O$. It is slightly soluble in water, the readily available chromate ions exerting a retardant effect upon formation of metal oxides. Reichhold manufactures two types of zinc chromate, the common sulphate-containing variety and a new type entirely free of sulphates.

Raw materials used in the manufacture of zinc chromate are zinc oxide, bichromate of potash and sulphuric acid. One of the most important quality control factors is the type of zinc oxide employed. This must be carefully controlled for particle size and distribution as well as for chemical reactivity.

The manufacturing process commonly consists of slurrying zinc oxide in water, addition of potassium bichromate solution and subsequent acidification with sulphuric acid to a pH of 6.0-6.5. Concentration of reactants, rate of agitation, temperature, and reaction times must be very accurately controlled. After pressing in recessed-plate iron filter presses, the pigment is dried at 175 deg. F. for 36 hours to a free moisture content of 0.1 percent. It is then pulverized and packaged in multiwall paper bags.

Zinc chromate is produced at the Brooklyn plant in a giant 40,000-gal. reaction tank. Here, as also in the case of the other inorganic dry colors, the plant engineers believe that the upper practical limit for a batchwise process has been reached. Laboratory work is now in process to develop continuous processes and the end of the war will undoubtedly see final development of these to a plant scale.

ORGANIC PIGMENTS

Nomenclature of organic pigments has been somewhat ambiguous in the past and this difficulty persists in many quarters today. Table V gives one convenient form of classification. However, a logical analysis of this problem based on the chemistry involved permits a definition of terms entirely without contradiction. Thus "toner" will refer to any organic pigment not reduced in strength with an inert extender. "Lake" will refer to a pigment resulting from precipitation of a soluble dye which has been adsorbed by and at least *partially combined chemically* with a suitable "active" extender.

This criterion of partial combination thus eliminates from the category of "lakes" such a pigment as results from precipitation of methyl violet by phosphotungstic acid in the presence of alumina hydrate. This pigment is simply a "reduced toner" because basic dyes do not *combine* with alumina hydrate but are only adsorbed by it. Of course it is possible to have both reduced toners and reduced lakes.

By far the largest proportion of organic pigments are of the azo type. This makes the chemical reactions involved in the preparation of the azo structure the most important ones in the technology of organic pigments. In brief, this process involves the following steps:

(1) Preparation at a low temperature of a diazonium salt by the reaction of nitrous acid on a water solution of the mineral acid salt (usually the hydrochloride) of a primary aryl amine. The nitrous acid is normally prepared in place from sodium nitrite and excess mineral acid.

(2) Coupling of the diazonium salt with a phenolic substance (e.g. B-naphthol) to produce the coloring matter containing the azo group.

In the case of pigment dyestuffs (refer to Table V), the colored compound happens to be insoluble in water and in oils and differs widely in index of refraction from the usual paint and printing ink vehicles, thus giving it pigment properties.

In the case of salt type pigments, the products may be the metal salts (usually alkaline earth metals or lead) of acid dyestuffs, or the heteropoly acid salts (phosphotungstic, phosphomolybdic or mixtures) or other acid salts (silicic, tannic, arsenic, antimonic) of basis dyestuffs.

The newest group of pigments or that which contains the coordinated complexes, involves a different technology. Phthalocyanines are formed only at elevated temperatures (about 500 deg. F) and hence the process for their manufacture involves non-aqueous fusion. However, Para Brown, which is chemically a member of this group, may be prepared in aqueous medium. It is the copper coordination complex of Para Red.

Factors governing the quality of the products obtained have long been well known. They include the concentration, temperature, and acidity of the reacting solutions; rate of precipitation and crystal formation of the product; ionic environment during the actual color formation; relative vigor of the agitation used; and drying temperature.

More important, however, are the means taken to ensure adequate reproducibility of the values of these factors, especially when the unit batch size may be four to ten times that usually prepared in the dry color industry. The value of such a single batch may approach \$5,000 and hence exceptional precautions must be taken to ensure its quality. This modern plant in Brooklyn uses for this purpose many devices not heretofore widely used in the industry, such as liquid flow meters, matched delivery pumps, multiple station centralized pH control and recording, accurate recording thermometers, and constant speed stirring mechanisms.

In conclusion, the writer would like to express appreciation for the aid extended by Reichhold Chemicals, Inc. and specifically by Mr. H. B. Kirkpatrick, superintendent of the Brooklyn plant, Mr. T. P. Brown, general manager of the Chemical Color Division and director of the Eastern Research Division, and Mr. P. L. Swisher, sales manager of the company. This concern and its individuals have consistently shown a broad-minded and progressive attitude and a cooperative spirit in the development of this information and manuscript.

Table V—Classification of Organic Pigments

	Examples
Pigment Dyestuffs	
Azo type	Paratoner, Toluidine toner
Vat, sulphur, thioindigo, etc.	Indanthrene Blue
Salt Type Pigments	
Toners	
(1) Of acid dyestuffs	
Azo type	Lithol toners, Red Lake C
Triphenyl methane derivatives	Phloxine toners
Others	Various
(2) Of basic dyestuffs	Heteropoly acid salts of Methyl Violet, Victoria Blue
Lakes (acid dyestuffs only)	
(1) Of azo dyes	Persian Orange, Acid Scarlet
(2) Of triphenyl methane derivatives	Peacock Blue
(3) Of anthraquinone dyes	Madder Lake
(4) Others	Various
Coordinated Complexes	Phthalocyanines, Para Brown

Chemical Industries Branch, O. P. R. D. What It is and How It Functions

DONALD B. KEYES, *Chief of the Chemical Industries Branch, Office of Production Research and Development, W.P.B.*

Chem. & Met. INTERPRETATION

What has been aptly called the Research and Development Department of the War Production Board is outlined here as to purpose, functions and personnel. Within a matter of months O.P.R.D. has become an extremely useful agency for bringing a fuller impact of science and technology to bear on the problems of war industries. Chemical engineers and executives are urged to make more use of the facilities and personnel of its Chemical Industries Branch.—*Editors.*

Broadly speaking, the purpose of the Office of Production Research and Development is the mobilization of our technological personnel and facilities for the production of war goods. Its functions are distinct from those of the Office of Scientific Research and Development which is charged with the improvement of the actual instrumentalities of war. O.P.R.D.'s primary concern is with the maximum production of needed critical materials. Its field embraces all war materials, both crude and processed, with the exception of synthetic rubber which is handled by W.P.B.'s Office of the Rubber Director.

O.P.R.D. is headed by Dr. Harvey N. Davis, president of Stevens Institute of Technology. It consists of a director, his staff and four branches: (1) Metals and Minerals, (2) Chemical Industries, (3) Industrial Processes and Products, and (4) Consumer Products. The Chemical Industries Branch consists of its chief and the headquarters staff in Washington, approximately forty official consultants who are chiefly $1-a-year men, about 160 liaison men who are mostly industrial research directors designated by their companies as O.P.R.D. contacts, and, finally, many unofficial consultants connected with other governmental agencies in Washington. (Personnel roster given here is as of June 1.)

The Referee Board, organized last summer by the Chemical Division of the W.P.B., (See *Chem. & Met.*, Aug. 1942, p. 129) now acts as the Chemical Referee Board for O.P.R.D. This group of 14 impartial scientists and engineers meets once a month and prepares opinions on the granting of money and priorities on specific projects brought to its attention by the investigators in Washington.

The main function of the Chemical Industries Branch is to evaluate developments and make recommendations for the allocation of O.P.R.D. funds or the giving of necessary priorities by the W.P.B. for specific projects. Emphasis is placed on the war demands for the end products and the speed with which a commercial plant can be built and put in operation. The amount of critical material required for plant construction per pound of product is the chief criterion.

Requests for these evaluations come largely from the Chemical Division, W.P.B., but many come from corporations, individuals and other governmental agencies, such as the Defense Plant Corporation, the Smaller War Plants Corporation, and technical groups within the armed services.

Sometimes it has been felt justifiable to encourage the building of large pilot plants or even small commercial units to produce chemicals which are not badly needed at the moment but will be needed in case of a long war. Such "insurance-policy" unit plants will provide the necessary engineering

Based in part on an address to the American Institute of Chemical Engineers in New York City, May 10, 1943.

Who's Who in Chemical Industries Branch, O.P.R.D.

Washington Headquarters Staff

Donald B. Keyes, Chief
W. L. Faith
L. A. Monroe
J. E. Underwood
J. P. Wilkins

Consultants Including Referee Board

Baldwin, Ira L., Madison, Wis. (Fermentologist)
Boelter, L. M. K., Berkeley, Cal. (Chemical Engineer)
Bogert, Marston T., New York, N. Y. (Consulting Organic Chemist; Referee Board)
Brown, Charles O., New York, N. Y. (Chemical Engineer; Referee Board)
Daniels, Farrington, Madison, Wis. (Physical Chemist)
Downs, Charles R., New York, N. Y. (Consulting Chemical Engineer; Referee Board)
Elder, Albert L., Washington, D. C. (Chemist, Liaison with Chem. Division, W.P.B.)
Esselen, Gustavus J., Boston, Mass. (Consulting Chemist; Referee Board)
Falk, K. George, New York, N. Y. (Chemist; Biologist)
Fulmer, Ellis I., Ames, Iowa (Chemist)
Glockler, George, Iowa City, Ia. (Physical Chemist)
Halvorsen, H. Orin, St. Paul, Minn. (Bacteriologist)
Hasche, R. L., Kingsport, Tenn. (Chemical Engineer)
Hildebrand, Joel H., Berkeley, Cal. (Chemist; Referee Board)
Hougen, Olaf A., Madison, Wis. (Chemical Engineer)
Killeffer, David H., New York, N. Y. (Chemist; Editor)
Kirkpatrick, Sidney D., New York, N. Y. (Chemical Engineer; Referee Board)
Langdon, Wm. H., Urbana, Ill. (Chemical Engineer)
Lawson, George, New York, N. Y. (Chemist; part time in Washington)
Lewis, Warren K., Cambridge, Mass. (Chemical Engineer; Referee Board)
Lind, S. C., Minneapolis, Minn. (Chemist; Referee Board)
Miner, Carl S., Chicago, Ill. (Consulting Chemist; Referee Board)
Moore, Wm. C., New York, N. Y. (Chemist; part time in Washington)
Nelson, John M., New York, N. Y. (Organic Chemist)
O'Brien, Morrough, Berkeley, Calif. (Mechanical Engineer)
Othmer, Donald F., Brooklyn, N. Y. (Chemical Engineer)
Perry, John H., Wilmington, Del. (Chemical Engineer; part time in Washington)
Read, Wm. T., New Brunswick, N. J. (Chemist; part time in Washington)
Reid, Ernest W., Macksville, Kan. (Chemist, Referee Board)
Rhodes, Fred H., Ithaca, N. Y. (Chemical Engineer; Referee Board)
Shreve, R. Norris, W. Lafayette, Ind. (Chemical Engineer)
Snell, Foster D., Brooklyn N. Y. (Consulting Chemist; Referee Board)
Stark, Wm. H., Arroya, P. R. (Fermentologist)
Straub, Frederick G., Urbana, Ill. (Chemical Engineer)
Sullivan, Frederick W., Chicago, Ill. (Chemist)
Swann, Sherlock, Jr., Urbana, Ill. (Electrochemist)
Sweeney, Orlando R., Ames, Ia. (Chemical Engineer)
Tour, Reuben S., Cincinnati, O. (Chemical Engineer)
Tyler, Stephen L., New York, N. Y. (Chemical Engineer)
Watson, Kenneth M., Madison, Wis. (Chemical Engineer)
Wilson, Wm. Courtney, Chicago, Ill. (Containers Expert)
Whitmore, Frank C., State College, Pa. (Organic Chemist; Referee Board)
Werkman, Chester H., Ames, Ia. (Biochemist)
Wynd, Clarence L. A., Rochester, N. Y. (Chemical Engineer; part time in Washington)

data and experience to construct quickly any needed number of commercial units.

Requests for funds for research and development usually come from university laboratories which do not have money available for such purposes or from industrial laboratories which have been specifically asked to undertake certain work purely of war-time significance. In such cases the project may have been already evaluated and it is a question of locating the organization or organizations best equipped to carry on the work and obtain results in a minimum time.

These investigations involve conferences with the project advocates, inspection of laboratories, review of patent and other literature, conferences with consultants and telephone conversations with liaison men. When the study has been completed the final report together with supporting data is sent to the Chemical Referee Board for consideration at its next monthly meeting. The Board's recommendation is sent to the Chemicals Division of W.P.B. If it is an approval of priorities, then the action of the Referee Board together with the approval of the Chemical Division of W.P.B. is passed on to the Facilities Review Committee for final approval. In urgent cases this procedure can be substantially shortened by telephone or telegraph vote of the Referee Board.

The Chemical Industries Branch has few specific problems for assignment but will welcome the opportunity to consider any new process to make any chemical badly needed in our war program, particularly if the new process does not require excessive amounts of critical materials and equipment for plant construction. The branch would also welcome any knowledge of either new or old products that can be made easily available and which may be used as substitutes for very critical materials. Examples of new processes already considered by the branch are as follows: acetylene from hydrocarbons, formaldehyde from hydrocarbons, benzene from petroleum, nonelectrolytic chlorine processes, low-pressure fixation of nitrogen, hydrolysis of wood, ethyl alcohol from wheat, glycerine by fermentation of molasses, and gasoline additives.

O. P. R. D. Liaison Men in Chemical Industries

Abbott Laboratories
Ernest H. Volwiler
Air Reduction Co.
Floyd J. Metzger
Allied Chemical and Dye Corp.
Solvay Process Co.
Joseph M. Braham
Paul A. Keene
Bates Torrey
Barrett Division
S. P. Miller
General Chemical Co.
John Donleavy
National Aniline Division
Walter M. Ralph
Alox Corp.
D. F. Evans
Aluminum Company of America
Francis C. Frary
Junius D. Edwards
American Cyanamid Co.
M. C. Whitaker
Norman A. Shepard
Louis C. Jones
M. L. Crossley
American Potash and Chemical Corp.
Frank R. Bridgeford
American Viscose Corp.
Charles S. Venable
Armour and Co.
Victor Conquest
Edwin W. Colt
Armstrong Cork Co.
Edmund Claxton
Atlantic Refining Co.
H. W. Field
Richard B. Chillas, Jr.
Atlas Powder Co.
W. E. Fletcher
Badger and Sons Co., E. B.
Elwood J. Clapp
Joseph R. Minevitch
George P. Lunt
Bakelite Corp.
Archie J. Weith
Robert J. Moore
Bancroft and Sons Co., Joseph
W. R. MacIntyre
Borden Co., The
William Calian
Brown Co.
Wentworth Brown
Buffalo Electro-Chemical Co., Inc.
Max E. Bretschger
Cabot Inc., Godfrey L.
Fred H. Amon
Carbide and Carbon Chemicals Corp.
George O. Curme, Jr.
A. B. Ray
Catalytic Development Co.
Albert G. Peterkin
Celanese Corporation of America
George V. Schneider
Bjorn Andersen
Champion Paper and Fibre Co.
Donald B. Bradner
H. R. Murdock
Ciba Pharmaceutical Products, Inc.
M. Donauer

Cities Service Oil Co.
J. C. Walker
Colgate-Palmolive-Peet Co.
Martin H. Ittner
E. F. Dreger
Columbia Chemical Division
Dwight R. Means
Frederick W. Adams
Columbian Carbon Co.
W. B. Weigand
Commercial Solvents Corp.
Kenneth H. Hoover
Consolidated Edison Co. of New York
Charles A. Lunn
Corn Products Refining Co.
W. B. Newkirk
Derby Co., The
Roland Derby
Devoe and Raynolds Co.
J. S. Long
Dewey and Almy Chemical Co.
C. H. Egan
Dorr Co., The
J. V. N. Dorr
Chester L. Knowles
Dow Chemical Co.
Mark E. Putnam
J. J. Grebe
Edgar C. Britton
DuPont de Nemours & Co., Inc., E. I.
Elmer K. Bolton
Ivan Gubelmann
John C. Woodhouse
John S. Beekley
E. R. Bridgwater
Walter E. Lawson
Durez Plastics and Chemicals, Inc.
A. F. Shepard
Eastman Kodak Co.
Emmett K. Carver
Geo. A. Richter
C. F. H. Allen
Ethyl Corp., The
George Calingaert
Foote Mineral Co.
Ernest G. Enck
Forest Products Laboratory
Carlile P. Winslow
Foster-Wheeler Corp., The
D. K. Dean
Freeport Sulphur Co.
Donald B. Mason
General Aniline and Film Corp.
E. C. Williams
Wm. F. Zimmerli
General Electric Co.
A. L. Marshall
General Motors Corp.
Harry C. Mougey
General Printing Ink Co.
William F. Talbot
General Refractories Co.
R. G. Abbey
Glidden Co., The
William N. Pritchard
Gulf Research and Development Co.
Eugene Ayres
Harshaw Chemical Co.
K. E. Long

Hercules Powder Co.
Emil Ott
J. L. Bennett
Heyden Chemical Corp.
Blythe M. Reynolds
Hooker Electrochemical Co.
R. L. Murray
Humble Oil and Refining Co.
H. D. Wilde, Jr.
Institute of Paper Chemistry
Harry F. Lewis
Interchemical Corp.
A. E. Gessler
International Minerals and Chemical Co.
Paul D. V. Manning
Kellogg Co., The M. W.
P. C. Keith
Howard Dimmig
Kimberley-Clark Corp.
John R. Fanselow
Koppers Co., The
B. J. C. van der Hoeven
Fred Denig
Lawrence Leather Co., A. C.
Kenneth E. Bell
Lever Brothers Co.
J. W. Bodman
Lummus Co., The
R. M. Torrey
Maas Chemical Co., A. R.
Fred C. Bowman
Marathon Paper Mills Co.
Allen Abrams
Carlyle Harmon
Mathieson Alkali Works, Inc.
Ralph E. Gage
Mead Corp.
John Traquair
Merck and Co., Inc.
Randolph T. Major
W. H. Engels
Monsanto Chemical Co.
Gaston DuBois
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John J. Healy
Charles A. Thomas
Carroll A. Hochwalt
Lucas P. Kyrides
Thomas S. Carswell
National Aluminate Corp.
Paul G. Bird
National Carbon Co., Inc.
H. D. Batchelor
National Lead Co.
R. L. Hallet
National Oil Products Co.
Edwin A. Robinson
Naugatuck Chemical Division
Morris G. Shepard
Newport Industries, Inc.
Robert C. Palmer
Niacet Chemicals Corp.
C. J. Herrly
Niagara Alkali Co.
H. P. Wells
Norton Co., The
S. S. Kistler
Oldbury Electrochemical Co.
F. A. Lidbury
Orthmann Laboratories, Inc.
August C. Orthmann
Peoples Gas Light and Coke Co.
Robert B. Harper
Pfizer, Chas. and Co., Inc.
Richard Pasternack

Philadelphia Quartz Co.
Chester L. Baker
Pittsburgh Coke and Iron Co.
Wm. B. Brown
Pittsburgh Plate Glass Co.
F. W. Adams
Procter and Gamble Co.
H. S. Colth
F. W. Blair
Prophylactic Brush Co.
Gaetano F. D'Alelio
Quaker Oats Co.
F. M. Peters, Jr.
Reichhold Chemicals, Inc.
A. G. Hovey
Reilly Tar and Chemical Co.
Francis E. Cislak
Rohm & Haas Co., Inc.
Lloyd W. Covert
Charles S. Hollander
Rumford Chemical Works
Albert E. Marshall
Seagram, Jos. E. and Sons, Inc.
H. F. Willkie
Sharples Solvents Corp.
Jos. J. Schaefer
Shell Development Co.
Theodore W. Evans
Sherwin-Williams Co.
Robert F. Ruthruff
Spencer Kellogg and Sons, Inc.
A. Schwarcman
Standard Oil Co. of California
Ralph A. Halloran
Standard Oil Co. (Indiana)
J. K. Roberts
Standard Oil Co. of Ohio
Robert E. Burk
Standard Oil Development Co.
E. V. Murphree
Sun Oil Co.
J. Bennett Hill
Swift and Co.
Roy C. Newton
Tennessee Eastman Corp.
R. Leonard Hasche
Tennessee Valley Authority
Raymond L. Copson
Texas Co., The
L. C. Kemp, Jr.
Texas Gulf Sulphur Co.
W. W. Duecker
Union Oil Co.
Basil Hopper
United Gas Improvement Co.
N. K. Chaney
U. S. Industrial Chemicals, Inc.
Glenn Haskell
F. M. Hildebrandt
Universal Oil Products Co.
Gustav Egloff
Vanderbilt, Co., R. T.
Paul I. Murrill
Victor Chemical Works
Robert E. Zinn
Walker and Sons, Inc., Hiram
C. S. Boruff
West Virginia Pulp and Paper Co.
John W. Hassler
Westvaco Chlorine Products Co.
William T. Nichols
Weyerhaeuser Timber Co.
C. C. Heritage
Wyandotte Chemicals Corp.
H. F. Roderick

Rediscover the Rainbow

Dr. Willard H. Dow, president and general manager of the Dow Chemical Company, was awarded the 1943 Chandler Medal "for his dynamic and successful leadership in the American chemical industry . . . his accomplishment in expanding a chemical industry which depended upon Michigan salt brines, his daring enterprise in the direction of the extraction of bromine and of magnesium from sea water, the production of synthetic plastics and synthetic rubber . . ." Excerpts from his classic address of acceptance, presented at Columbia University in New York City, May 20, 1943, are included here.

THROUGH COUNTLESS centuries our forbears marvelled at the beauty and glory of the rainbow; the ancients often worshipped it as a manifest from Heaven. But the ancients, like so many in recent times, could not conceive of a Deity as other than a mere provider to man's material wants. They conjured up a pot of gold at the rainbow's end. In their simple and artless thinking they envisioned a real pot of real gold and thus a means to wealth and happiness. But the rainbow is not nature's way of pointing a shortcut to wealth. It is nature's way of indicating how we might better work for the wealth which nature has in store for us but will not give us merely for the asking. . . . I ask you to chase the rainbow with me, not so much for love of the chase but for the revelation of scientific percepts that will contribute to the betterment of all peoples.

We are in the midst of a holocaust of destruction in which apparently nothing is sacred or inviolate. The war, if it demonstrates anything, demonstrates that mankind as a whole is morally and politically unfit to apply the knowledge which science has placed at its command. Indeed, the thin veneer of civilization is easily rubbed off. Are we not today applying against mankind nearly all the forces and laws of nature which science has uncovered for the making of a better and happier living? Nowhere in nature do we find nature's laws operating for the exclusive benefit of a single group. The gifts of nature are available for each and all and when we attempt to limit their benefits or reverse their directions, we are recklessly opposing nature.

We know the applications of physics and chemistry follow natural laws, fundamentally so. On the other hand, it is a practical joke in industry to ask a highly trained, young, theoretical chemist to figure out the thermo-dynamics of some reaction. The answer usually comes back negative. However, the process is operating even if the theory does not fit. The point is that, generally speaking, the period of time for the particular reaction has not been taken into consideration—another natural law based upon a new variable often overlooked. A typical example of this is in the conversion of ethylene to butadiene. The skeptic might argue that these examples show the limitation of universal application of natural laws. Quite the reverse is the case. Man-made theories may encompass most of nature's laws but when they overlook any single factor they will invariably lead to false answers.

Nature's laws are immutable. We must learn and relearn that for every effect there is a cause. Does not everything have to work in order to reproduce its kind—with bacteria, insects, trees and humans, the same laws prevail. Always the results will be in proportion to the efforts put forth—an obvious natural law.

Is there a scientist who does not appreciate the concept of an omnipotent plan? Each synthesis, each reaction and all processing, the scientist watches with keen appreciation, hoping to discover some new phenomena. Our lives and all we direct are successful only in so far as we are able properly to interpret the magnificent plan.

The idea of one scientific development being a tool which helps in another development is clearly understood and appreciated by those with scientific experience and but slightly understood by others. . . . The extraction of bromine from ocean water was not a commercial economic process until comparatively a few years ago; and that was only because in earlier days we did not have the equipment with which to make possible the careful and exacting acidity control of the ocean water. For the first time in world experience we found how to handle enormous volumes of ocean water in continuous flow and at the same time control the acidity within narrow limits. That was the real key that opened commercially in 1934 the first lock of the vast resources of the ocean. Today thousands of tons of bromine are extracted annually from the ocean to the tremendous advantage of the Allies in aviation alone. What body politic a score of years ago could have directed or even wisely suggested the solution to such a problem? What "directive" could have substituted for unfettered imagination, the desire of the human being to show self-expression and to carry on against all kinds of obstacles?

MAGNESIUM'S STORY

Magnesium is an interesting story and perfectly simple. Perhaps that is the principal reason it is so difficult to understand. Magnesium is found in ample quantities in many localities, always in a combined state such as dolomite limestone or some other compound such as magnesium chloride, occurring in ocean water and native brines. In most localities where dolomite is found, fuel costs are fairly high or transportation charges constitute a large factor. The problem, therefore, quickly resolves itself into one of determining the relative cost of mining rock or pumping ocean water. We chose the ocean—deciding the volume was large enough to justify the investment. We made our decision and started plans within a few months, as the general method of isolating magnesium from brine had been in operation with us for 25 years.

When we first decided to extract bromine from the ocean, some of us were concerned about the possible contamination of organic matter and its effect on final recovery. This finally proved to be a will-o'-the-wisp, for the organic matter remained aloof. Thus our fears were dissipated.

On the other hand, many precautions were taken in the magnesium-from-sea-water extraction process. When the plant was finally started, we found it necessary to make some radical changes in order to prevent the concentration of borates from becoming too great in the electrolytic cells. Boron has the property in this electrolysis of being an active agent capable of reducing the yield of magnesium to practically nothing. Thus boron had to be controlled partly by elimination and partly by leaving the iron and manganese, naturally present, to control the boron. Here was an outstanding example of nature's elements in small quantities laying down a definite rule of operation; a control which none of us at that time thoroughly understood.

When one considers the chemical industry, its capacity is not measured in terms of machines, dies, jigs, etc. The chemical industry is measured in terms of physicists, chemists, chemical engineers, technicians and specialized equipment, including storage tanks, reaction vessels, fractionating columns and specialty items beyond number. The American public is apt to think of all production in mechanical terms, with little regard for the men who have made mechanical production possible. It is quite the old story, repeated again and again! In learning the meaning of natural laws and being guided by them we attain success. But the glamor of successful accomplishment is ofttimes confused by the milestones we pass on the way. There is probably no other industry in the country that touches as many phases of human endeavor as the chemical industry. Under all probability the chemists and physicists contribute basically more toward winning a war than any other group; they constitute the baker, the grocer and the candlestick maker all in one, in both war and peace-time. More than that, in these United States you cannot find a scientist, who is rightfully entitled to the name, who ever wanted war—he is too well aware of the consequences. Furthermore, true scientific progress can best be accomplished in peace-time.

WHAT OF THE FUTURE?

On the contrary, you will hear of war time developments and accomplishments which otherwise would have taken years to attain. What are we to believe? Shall we teach our children that it takes a war emergency to create real advance? Of course not! War emergency is one thing, peace is another. The two are not to be confused. There is no comparison. We also hear of highly placed men preaching that inventions should be curbed for the good of society. They are grotesquely misinformed. To invent is one of the freedoms of America. Every child has been taught to believe he may become an Edison of his day, and why not?

The ultimate changes in this world are infinite and, therefore, beyond human imagination. They are infinite because nature's laws are infinite. The bright spots of progress merely reflect the operation of natural laws. Every milestone of progress is but a period of more basic and clearer understanding, with the aid of the physical and chemical sciences, of the forces of nature and their laws. Finite milestones serve only to define nature. In no way does nature become less infinite. There are always greater possibilities and new horizons ahead of us. Nature attends. We must conform . . . Again, I ask you, consider the rainbow.

Training Women Operators for Chemical Industry

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Chem. & Met. INTERPRETATION

Manpower shortages in some of our important war industries are likely to become acute unless provisions are made to train women in even greater numbers than has hitherto been done. This is especially true of chemical industries, which have largely been operated by male employees. In this article, the author gives some good pointers on training programs by outlining the course given by the University of Pittsburgh to train women operators for the new butadiene-styrene plant of Koppers United Co. at Kobuta. —*Editors.*

The chemical engineering department of the University of Pittsburgh was recently called upon to train a large group of women operators for a new butadiene-styrene plant shortly to go into production in this area. Because of the specific nature of our assignment, some details of its execution will no doubt be of interest to those in other localities who might be faced with similar requests.

It is recognized and important to remember that a distinction must be made between chemical engineering education and that of training routine plant operators for a particular industry. The problem in the latter case can be stated in terms of limited vocational objectives. It is for this reason that a high degree of cooperation is necessary between the plant and the engineering school.

SELECTION OF TRAINEES

Inasmuch as the majority selected for training are to become operators of a particular plant, the company personnel division should be given the first opportunity to interview and select the candidates. Health examinations will eliminate the physically unfit. Intelligence testing has developed to the point where aptitudes can be evaluated and may, therefore, be used to good advantage. Statutory provision makes it necessary that all accepted candidates shall be high school graduates if the training course is under E.S.M.W.T. sponsorship. Mathematics, science, physics or chemistry are subjects which can be used, because of their discipline, in deciding between one high school graduate and another, especially in cases where the number wishing to take the course greatly exceeds the capacity for accommodation. The latter seems invariably to be the case. As in many E.S.M.W.T. courses, it is sometimes difficult to weed out those who feel entitled to attend merely for the educational value afforded. Interviewing of applicants by personnel officials will eliminate this group.

Because of competition between war plants for properly qualified or even potentially suitable workers, candidates accepted for the course may be immediately placed on the company payroll and paid at an hourly rate while attending school. This helps greatly not only in keeping enrollment high but in securing an economic advantage helpful to the educational process.

Recruitment of women for a training course must also be considered in relation to housing conditions in the immediate neighborhod of the plant they are to operate. As far as possible, the majority should be selected from the settled families in the vicinity of the plant.

These are but a few of the problems which must be worked out largely by the personnel officials in their selection of suitable student employees.

Before undertaking organization of the course, it is desirable to get a statement from the plant engineers as to the duties of the operators. Such a statement of broad objectives for a butadiene-styrene plant, suitably condensed, has proved helpful in organizing our program.

STATEMENT OF OBJECTIVES

Operations exclusive of maintenance and utilities may be divided into three steps:

(1) Distillation
  (a) Continuous
  (b) Batch
(2) Catalytic or converter operations
(3) Chemical treating or agitator operations

Continuous still operators will be required to check periodically the readings of instruments, such as flow meters on feed, reflux, bottoms and product lines, as well as gage pressures on column; temperatures on column, feed and reflux, etc. Recording, indicating, and control instruments will be placed on a panel board suitably located.

Operators must know how to adjust feed rate to prevent slowing down of operation at other steps in production. Periodic checking will be necessary during shift to ensure that pumps are operating properly, that vapors and liquids are not leaking through packing glands, etc., thus constituting a

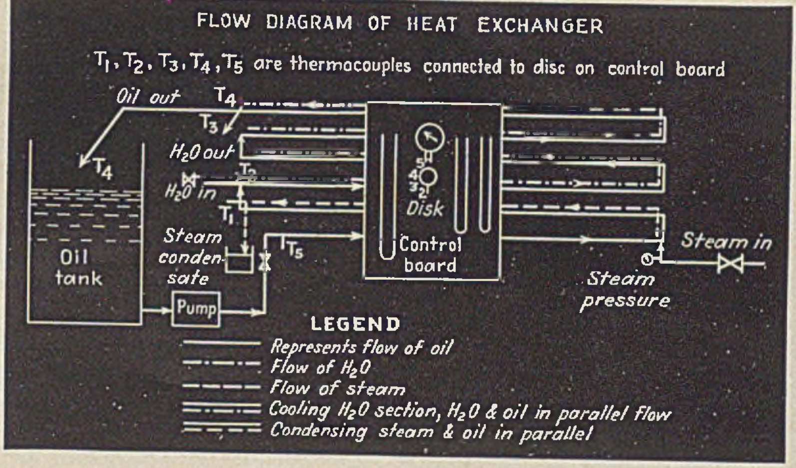
Here two women in training to become operators in a synthetic rubber plant are being shown how to read a mercury manometer

Courtesy Koppers United Co.

fire hazard. Continuous still operators will be required to draw samples for analyses from the various streams and to keep records, during shift, of operating conditions. They will be required to report any defects noted in operating equipment.

The operator should be trained in the proper and safe operation of the unit and should be safety conscious. The safety of subordinates is a direct responsibility of the operator and applies in large measure to the safety of those working in the unit zone, servicing and maintenance crews.

Batch still operators will perform duties similar to those of the continuous still operators with the provision in this case that more complex mixtures will be separated. Stepwise cuts will be made on the batch under suitably controlled conditions as to boiling range, purity, etc. Special attention must also be paid to changing reflux conditions while distillation of the batch proceeds.



Simple diagrams such as this are used at the University of Pittsburgh to instruct prospective women operators in the fundamentals of heat exchangers

CONVERTER OPERATION

For butadiene-styrene plants using as primary raw materials ethanol and benzene, there are a number of catalytic converter operations. These reactions take place by passing the vapors over the catalyst at elevated temperatures. Many of the converters are large vessels containing tubes filled with catalyst. In certain cases, activity of the catalyst diminishes because of carbon deposit and the unit must be taken out of production pending reactivation of the catalyst with steam and air.

Specifically, the duties of a converter operator are governed directly by recording instrument readings. The operator must maintain a close control of the catalyst bed temperature by regulating the outside heating medium or heating appliances. Pressures and flow rate to the converter must also be regulated. Samples of the product are taken periodically on each shift to determine converter efficiency as an aid to the establishment of the operating temperatures.

Converters that can be reactivated in place require additional supervision and close control of temperature. Operators will be required to take gas samples and manipulate a gas analysis apparatus in order to adjust the degree of reactivation.

Where an outside heating medium is provided, simple adjustment of valves will serve to control temperature of catalyst bed. Converter operators must be on the alert at all times. They will be required to keep an accurate log of operations, adhere rigorously to temperature schedule, take samples during production for laboratory, make simple analyses during reactivation, operate controllers or regulating valves and be on the alert for fire or explosion hazards. Converter operators will be selected from those who show the highest ability during their training course.

Main agitator operations will be mainly concerned with the benzene refining unit. Two types of washings will be performed: washing an unpurified benzene with concentrated sulphuric acid, and washing purified benzene with a dilute oleum. The former removes unsaturated materials from the crude and the latter is effective in removing thiophene from the refined stock. The charge is treated stepwise with the acid, agitated, and then settled.

COURSE OUTLINE

It is obvious that any attempt to duplicate the layout of a butadiene-styrene plant in a chemical engineering laboratory would not only be costly in time and money but also of doubtful value. On the other hand, a sufficient number of regular laboratory units must be available if the course is to be worthwhile. These units are already available in most chemical engineering departments and have been built or purchased over a period of years. Institutions wishing to undertake similar courses but who lack the necessary items of equipment would be well advised not to entertain the idea. It is our opinion that lectures on the chemistry of butadiene-styrene production, however well organized and illustrated, will in no way be a substitute for the lack of engineering equipment. Because of the objectives already stated, the academic approach is without much value.

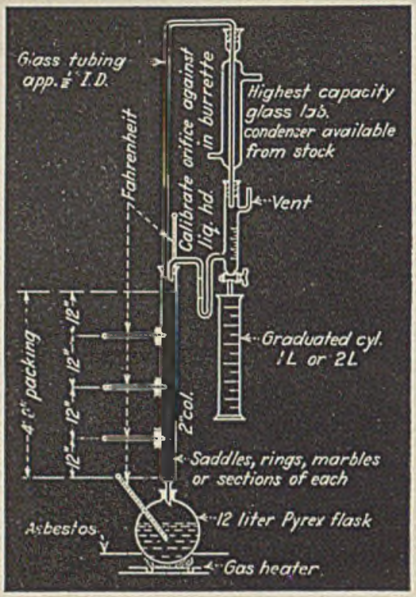
Consider a typical group of women students, medium age 24, age limits 18 to 40, who come in for training. They are from widely different occupational levels—housewives, secretaries, stenographers, saleswomen, school teachers, beauty parlor operators, and factory assistants—eager to serve in the war of production. Our laboratory facilities permit the accommodation of 60 in a group of day students working 32.5 hr. per week, and a group of 60 at night working 9 hr. per week, each for a total of 227½ hr.

Students are divided first into groups of 12 per instructor, and then subdivided according to the work being done. During the first two weeks of the day program the elements of operation are considered. These comprise weighing, measurement of volume, pressure, flow of fluids, temperature, machine shop, and others.

In the weighing group, a woman will handle materials and items of plant interest from a gram to one-half ton. She will also recognize the difference between copper, brass, cast iron and steel valves and fittings. Her log sheet will require measurement of items being weighed so that they may be classified in terms of nominal sizes. No formal lecture is given on the theory of errors; the instructor has merely to await the inevitable discussion as to who is right.

In volume work, a number of commercial containers have been assembled which range from glass cylinders to 55-gal. drums. Linear measurements are taken on tanks in the laboratory and calculations made to determine the weight and volume of solutions and pure liquids.

Pressure measuring devices such as draft gages, Bourdon gages and manometers are studied in carefully constructed set-ups. Principles of operation and calibration in the case of



Principles of distillation are easily demonstrated to prospective women chemical operators by such set-ups as shown in this drawing

Bourdon gages by dead weight testing are fully explained by actual handling. Students are then required to inspect regular units of equipment and to identify the placement of pressure indicating devices.

The section on temperature is required to study thermometers, thermocouples, recorders and indicating controlling pyrometers. They will be concerned with the placement of thermocouples in flues, columns, vapor and liquid lines.

Elements of flow as measured by orifices, rotameters, wet and dry meters and other instruments provide a well coordinated activity.

MACHINE SHOP GROUPS

Machine shop groups may be assigned to a variety of occupations such as cutting and threading pipe, sorting and classifying fittings, assisting in installation of pieces of equipment, pumps, valves, tees, etc., checking valves for tightness or handing out stock as needed. A log sheet is required of each student mechanic group so that time on the job is duly accounted for. The laboratory mechanic is largely responsible for seeing that tools are handled properly. The instructor usually devotes his time to explaining the different types of valves, fittings, tools, machines in the shop, and also lays out the repair job.

At the end of the second week each group has completed the first set of assignments. Because of differences in ability to perform computations, a continuous session is held during the first week to assist the weaker members of the group. In this type of work where time is an important factor, the instructions for each assignment should be clearly stated. The purpose of the course will be defeated if the entire mimeographed set of instructions is handed out at the first meeting. This is especially true of the first two critical weeks when discouragement may seriously jeopardize enrollment. By having mimeographed items for each assignment, clearly stated and as brief as possible, this feeling will be offset.

The third week may be split up to meet different needs: the slower ones can catch up on items missed; the smarter ones can get the control unit organized to test the material to be used in regular production units.

PILOT PLANT STUDIES

At the beginning of the fourth week, work is started on the pilot plant equipment in the chemical engineering laboratory. The present items in use at this laboratory include:

(a) Distillation unit: eight foot packed column (6 in. diameter), with feed and reflux pumps, rotameters, thermocouples and sample taps, atmospheric pressure operation, system isopropanol-water. Controls on continuous operation on feed, product and bottoms by gravity measurements.

(b) Converter, unit, electrically heated and controlled: reaction, dehydration of hexanol, catalyst alumina. Percentage conversion to hexene for given rate of throughput at fixed temperatures between 650-850 deg. F. determined by batch distillation of small samples.

(c) Hydrogenation of co-dimer is also studied under similar conditions.

(d) Heat exchanger operation: commercial size unit using 5 lb. steam for heating straw oil, provided with orifice meters, thermocouples, and centrifugal pump. Control of conditions to produce specified temperature. Cooling of batch by circulating oil countercurrent to water. Heat balance on unit.

(e) Cabinet drier: humidity and temperature controlled 6 trays. Records kept of temperature, air velocity over trays, humidity and weight of material on each tray during run. The switch from automatic instrumentation to manual control is readily demonstrated by this unit.

(f) Absorption unit: operation of countercurrent air and water sprays in glass-packed column. Demonstration and correction of flooding conditions by each operator when called upon by instructor.

(g) Evaporator units: long tube atmospheric type, basket type, vacuum operated.

The above units are laid out on a production basis and not as is usual in the chemical engineering course to demonstrate principles. There should be enough activity to keep a simple type of control lab operating and a sufficient amount of reconstruction going on to keep a repair crew busy. Operators report directly to a squad leader who is responsible for the smooth running of the unit. It is not difficult to pick out those who can take their share of responsibility, and information of this sort is valuable to the plant engineers and company officials. Emergencies also arise where quick thinking is needed and the remedial measures adopted can be used to pick out the valuable operators.

LENGTH OF COURSE

Any discussion on the most desirable length of a training program is highly controversial. If, however, the objectives are clearly stated and the duties of the operators to be trained properly defined, the problem is greatly simplified. Local conditions must be studied. If the plant is built and ready to operate, the university should discharge its responsibility as quickly as possible and provide the operators needed. Draft boards in the past have granted six months deferment to men of military age in chemical plants to allow for training substitutes for their replacement. This is a generous allowance in many cases and there is no assurance that it will be continued. In the Pittsburgh district, representatives of the W.M.C. have warned employers that they face the loss of draftable men on short notice, regardless of their occupational status.

Company needs will, therefore, be the main determining factor in controlling the length of the training program. In these days, time is precious; and if, by eliminating all that will not be used, we can train women to replace men in the chemical industries, a distinct service will be rendered to the war program.

The university or engineering school can render a distinct service in this field because of experience and facilities. The program, however, should be initiated by the particular plant or industry rather than by the school itself. Exact needs are largely known accurately by the plant engineers who are, therefore, in a position to specify and initiate the training program. This type of training in no way resembles the regular chemical engineering course. It is a separate and distinct enterprise calling for different treatment and having objectives not at all related to our normal peacetime activity.

Industrial Hygiene Problems in the Synthetic Rubber Industry

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Chem. & Met. INTERPRETATION

New processes and raw materials, we well as inexperienced personnel, always tend to emphasize hazardous situations, and the greatest enemy of industrial health, as well as industrial safety, is ignorance. This statement might well apply to our synthetic rubber industry now being created, our newest and soon to be one of our largest process industries. The highlights of hazardous operations in the manufacture of various synthetic rubbers are given in this article, intended especially for supervisory and operating chemical engineers working or planning to work in the industry.—*Editors.*

NEOPRENE manufacture has been thoroughly worked out in this country and there has been more experience with it than with most rubber substitutes. The chief hazardous materials in the synthesis are acetylene, vinyl acetylene, and chloroprene.

Acetylene may be classified with the asphyxiant gases. In fairly high concentrations it has a depressant effect on the circulation and respiration and is somewhat narcotic. In the few recorded cases of industrial poisoning there is question as to whether the harm was done by the acetylene itself or by hydrogen sulphide or phosphine which it commonly contains as impurities. Vinyl acetylene is probably somewhat more toxic than acetylene, but still would be an asphyxiant.

Like many other chlorinated compounds, chloroprene (a liquid boiling at 138 deg F.) is considerably more toxic than its parent hydrocarbon. When inhaled in comparatively low concentrations it causes irritation of the respiratory tract. Continued exposure may produce a fall in blood pressure, reduction in the respiratory rate and cyanosis. The most serious effects are damage to the liver, kidneys, and testicles, and internal hemorrhage due to the hemolytic action. Von Oettingen suggests that concentrations of 0.3 milligrams per liter, corresponding to about 100 p.p.m., may cause toxic effects on long exposure. The maximum safe concentration will, consequently, be something below this value. Chloroprene may be absorbed directly through the intact skin and produce about the same effects as it does by inhalation.

Processes involved in these syntheses will be carried on in closed systems and the materials handled through pumps and piping. The dangers to be considered, therefore, are due to leaks in the systems and to acute exposures from cleaning tanks and piping. One of the larger rubber companies suggests the following precautions in handling processes of this sort where toxic and highly explosive liquids and gases are used:

(1) Escaping vapors must be removed at their source by exhaust ventilation. Coupled with this they recommend general ventilation at the rate of 20 air changes per hour.

(2) Exhaust ducts should be located at points where vapors are likely to be released, such as valves, gauge glasses and similar locations and also in pits and other dead air spaces where vapors might collect.

(3) Skin contact with the liquid should be prevented by proper protective clothing.

Safety rules for cleaning out pressure vessels cannot be too strict; the following precautions must be taken:

(1) All valves should be closed and sealed unless a safety man is stationed at such points to prevent their being opened.

(2) Any agitators or other moving equipment must be locked out.

(3) Before entering any such vessel it must be thoroughly purged. This can be done by filling the vessel with water, steaming, applying vacuum, and exhausting. Before opening, evacuate to as much vacuum as possible, bring to zero gauge pressure with nitrogen, and repeat this process a second time.

(4) Workman entering such a vessel must be provided with suitable safety equipment such as goggles, rubber gloves, and forced air masks.

(5) Any extension light used must be of the approved vapor-proof type.

(6) The workman must wear a manhole harness with a strong lanyard attached, and another workman must remain on the outside and retain hold of the lanyard. In some cases where the manhole is near the bottom of the tank it may be practical to omit the manhole harness but there still must be another workman detailed to the specific duty of observing the workman who is inside.

(7) The workman in the vessel must be instructed to come out at the first indication of dizziness or illness and removed to clean air.

(8) It must be borne in mind that the vapors of many of the materials used in these processes when mixed with air are highly explosive.

Except for the production of chloroprene vapors, no further hazards should be experienced in the polymerization of chloroprene. The phenyl beta naphthylamine added to the polymer to retard aging or further polymerization, is not generally considered to be very toxic. We feel, however, that exposure to it should be avoided because of the possible long-range effects. Beta naphthylamine has been cited as a cause of bladder tumors in dye workers, and the addition of the phenyl group would probably not decrease its carcinogenic activity.

BUTADIENE AND STYRENE

What directly concerns the manufacturer of rubber substitutes is the materials he receives to polymerize. The material handled in greatest volume will be butadiene. This is a liquid at 26.6 deg. F. It may produce irritation of the eyes, nose and throat, but apparently has no cumulative effect. Below the lower explosive limit of two percent it is mildly narcotic and strongly so in higher concentrations. There is very little information in the literature on the physiological effects of butadiene. The recorded observations, mainly concerned with the

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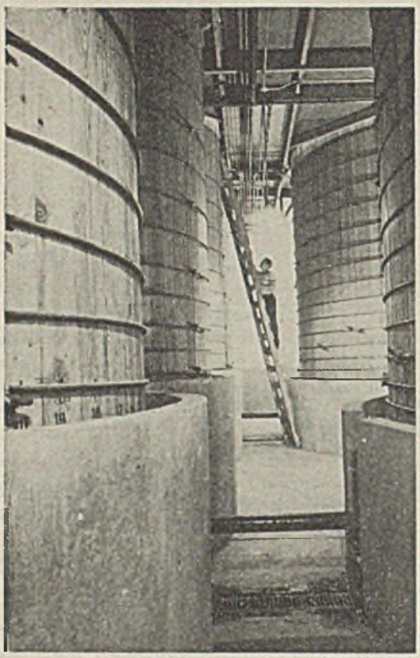
This article is a condensation by the editors of a paper delivered by the authors before the Rubber Section of the Thirty-First National Safety Congress, Chicago, Ill., Oct. 27-29, 1942.



Courtesy U. S. Rubber Co.

Buna S latex is bulked and blended in these huge wooden tanks

effects of repeated heavy exposures, may have to be modified when there has been a more complete study of the effects of continued exposure to low concentrations. It should be obvious that skin contact with the liquid is dangerous, due to its low boiling point.

Styrene is a liquid boiling at 293 deg. F. It has a powerful odor which will prevent prolonged contact with large concentrations if the man involved is a free agent. This cannot be relied on as a control measure, however, as the senses are usually dulled when the sense of smell is offended for a long period. Exposure to the vapors may cause skin irritation and conjunctivitis. The vapor is also narcotic in comparatively small concentrations. Irritation of the lungs and liver and kidney damage will follow heavy exposures. Concentrations of 200 p.p.m. are said to be about the safe maximum.

ACRYLONITRILE

Acrylonitrile is a liquid boiling at 172-174 deg. F. The toxic effects are apparently due to formation of hydrogen cyanide in the body after absorption. According to the U, S. Public Health Service, a typical cyanide reaction follows absorption. The safe limit should be 20 p.p.m. or less. This is by far the most dangerous substance so far discussed and should be handled only with the most extreme precautions. The effects are apt to be acute and anyone who shows the slightest symptoms should receive immediate medical attention. Cyanides are easily absorbed through the skin and it would be well to consider the same occurs with this compound, at least until there is evidence to the contrary.

Polymerization is usually carried out in a water emulsion, with the addition of soaps as emulsifying agents, catalysts (such as peroxides, persulphates or peracids), and modifying agents which may be halogenated hydrocarbons, nitriles or sulphur compounds. These modifying agents are generally materials of known high toxicity and should be handled with care. The point of maximum hazard would probably be the removal of modifying agents from the latex resulting from polymerization.

The member of this group which will be commercially important is the copolymer of butadiene with isobutylene. This introduces the new hazard of butenes, which are probably below butadiene in toxicity. Butenes are colorless gases with boiling points between 21-36 deg. F. There is no reason to believe that control measures should be other than those recommended for butadiene. In polymerizing butene with butadiene to form butyl rubber, two highly volatile and flammable gases are being handled at the same time, which would make fire and explosion hazards greater than with other copolymers thus far discussed.

THIOKOLS AND VINYL POLYMERS

Thiokols are made by condensing sodium polysulphide with chlorinated hydrocarbons. Depending upon which chlorinated derivative is chosen, a variety of rubbery materials can be obtained. The two chlorinated derivatives most frequently used are ethylene dichloride and dichlorethyl ether, both highly toxic.

Etheylene dichloride is a liquid boiling at 183 deg. F. with vapors of the same degree of toxicity as those of carbon tetrachloride. The suggested maximum permissible concentration is 100 p.p.m. Irritation of the throat, coughing and vomiting have been reported as initial symptoms. The possibility of liver damage and other effects of prolonged exposure to moderate concentration indicates the need for keeping the vapors out of the breathing zone of workers. Dichlorethyl ether is a liquid boiling at 352 deg. F. Its close relation to the war gas, dichlorethyl ether, suggests that it too may cause irritation to the eyes and lungs. One state has set a maximum permissible concentration for the vapors at 15 p.p.m.

Because the reaction takes place in aqueous medium and the product is coagulated with acid, the hazard of hydrogen sulphide must be considered in both parts of the process. Past experience has shown that hydrogen sulphide may cause nausea, headache, and irritation of the eyes, as well as loss of appetite and loss of weight when workers are exposed even to moderate amounts day after day. Therefore, hydrogen sulphide should be removed at the source of generation so that the concentration in the workroom air does not exceed 20 p.p.m. At least one article has appeared in which the source of Thiokol odors has been discussed. It is believed that ethylene mercaptan and other sulphide-containing compounds are formed. These may be highly toxic as well as disagreeable. Efforts to keep the hydrogen sulphide out of the workroom air should be just as effective with these other compounds.

Two of the most important members of the vinyls are polyvinyl butyral and polyvinylidene chloride (Saran). Common to all of these compounds is the hazard of acetylene, the basis for synthesis of the monomers. The monomer for polyvinylidene chloride is made by treating dichlorethane with alkali.

Among harmful materials involved in making other monomers and in polymerization may be mentioned hydrogen chloride, butyraldehyde, and several catalysts such as mercuric sulphate, benzoyl chloride and uranyl acetate in methanol. The various processes are carried on in a closed system. Therefore, the precautions given previously for such handling, proper ventilation and avoidance of skin contact, should be observed.

MIXING AND VULCANIZING

Synthetic rubbers which will be most important commercially will be compounded and handled in much the same manner as natural rubber. This is more than a coincidence, for otherwise the rubber fabrication machinery now available would be useless.

Most of us are familiar with the early history of the rubber industry with regard to hazards from accelerators and antioxidants. Aniline and some of its derivatives, "hexa" (hexamethylenetetramine), the toluidines and paraphenylenediamine caused so many cases of poisoning and dermatitis that there was a rush to develop harmless or less harmful substitutes. With some of the newcomers there have been no reports of harmful effects, but much of this information has come from direct questioning of manufacturers rather than from toxicological experiments.

Agents most frequently mentioned in the fabrication of synthetic rubber are diphenylguanidine (D.P.G.), phenyl betanaphthylamine (Agerite powder), phenyl alphanaphthylamine (Neozone), mercaptobenzothiazole (Captax), tetramethylthiuramdisulphide (Tuads), the dihydroquinoline derivatives (Flectols, Agerite syrup), hexamethyleneammonium dithiocarbamate (Latec), dinitrophenyldimethyldithiocarbamate (Safex). Because some of these materials may contain known toxic substances as impurities (Neozone D contains free aniline) and because of the possibility of harmful effects after long exposure, direct contact with these materials by inhalation or skin contact should be avoided.

Among the plasticizers commonly used with synthetic rubbers, dibenzyl ether and tributyl phosphate have caused irritation to the respiratory tract, even nose bleeds. The chlorinated naphthalenes have a long history of serious dermatitis and of poisonings which may be fatal. They have been recommended as plasticizers, especially for the extrusion of neoprene, but should be used very cautiously. This means avoiding contact either by skin or by inhalation of condensed vapors. One of the more obvious means of preventing harm from these materials, which are poisonous by skin contact, is personal cleanliness.

Although no dust should be promiscuously disseminated into the atmosphere, toxic dusts should be especially avoided. The inorganic accelerators most frequently recommended are the oxides of zinc and magnesium; these may create a nuisance but have not been shown to have any definite harmful effects. However, lead and mercuric oxides have been recommended and used for special properties. These should be most carefully controlled both in weighing out and incorporating on the mill. Lead has also found use in the form of a soap during polymerization by emulsification. Of course, such use also calls for extreme caution in handling.

SOLVENTS

A variety of solvents are used for preparation of cements and extrusion mixtures, coating fabrics and other materials, and forming seams in some of these coated materials. The synthetic rubbers have the outstanding property of resistance to many solvents which cause swelling and disintegration in natural rubber. Therefore, we must use special solvents when cements and other soft products are made. Coal-tar solvents are especially popular. Some have recommended coal-tar naphtha (solvent naphtha), a mixture of benzol, toluol and xylol, having definite toxic properties.

Benzol itself is being used to a great extent, especially since the so-called safe substitute, toluol, has been restricted by other war needs. The controversy about toluol as a safe solvent seems to be unending. We do not feel that it has been conducted from an unbiased or scientific viewpoint. Our opinion is that boiling point alone does not determine relative toxicity; one must know the actual concentration of vapor in the air. We do know that toluol has an appreciable vapor pressure at room temperature and that severe poisoning and at least one death have resulted from its promiscuous use.

Nothing will be gained by seeing how much the worker can absorb before blood changes are observed. The fact that there have been cases of chronic poisoning from exposure to relatively low concentrations of toluol would indicate that safe practice requires keeping the concentration as far below the suggested safe limits of 100—200 p.p.m. as is practicable. Several years ago a limit of 75 p.p.m. was suggested for benzol. The A.S.A. has raised this to 100 p.p.m.; why we do not know.

Ethylene dichloride and monochlorbenzene are the most common of the chlorinated solvents. Both are highly toxic, suggested limits being 100 p.p.m. for ethylene dichloride and 75 p.p.m. for the monochlorbenzene compound.

Other solvents frequently used, especially for vinyl polymers, are methyl ethyl ketone and butanol. Methyl ethyl ketone is considered probably more toxic than acetone; therefore the safe limit would appear to be somewhere below 200 p.p.m. The suggested safe limit for butanol has been set at 100 p.p.m.

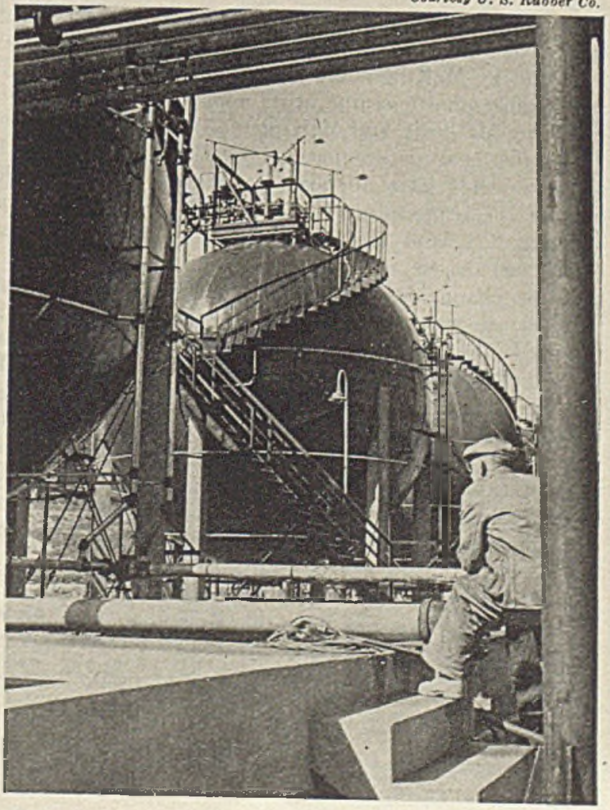
Buna S and the butyl rubbers appear to be the only common synthetic rubbers which are appreciably soluble in aliphatic hydrocarbons. If the petroleum naphthas used for dissolving these contain aromatics, as many have been found to do, the suggested safe limit of 1000 p.p.m. must be scaled downward. Before using solvents, or for that matter accelerators or anti-oxidants which are identified only by trade name, it is wise to learn what they really contain.

Because so many instances have been observed in industry where a window exhaust fan or wall fan is considered proper ventilation, we mention here that we do not generally approve such installations. Positive control of solvent vapors calls for removal of vapors as close to the point of generation as possible, and in such a way as to carry the exhausted air away from the worker. Nor is the current rage for down-draft exhaust entirely justified. The vapors of most of these solvents are heavier than air and should fall, but it should be obvious that a down-draft exhaust beneath a table cannot possibly remove solvent vapor from the top without the workers along the edge of the table getting it first. This does not mean that ventilation near the floor should not be used to reduce fire hazard, but it does mean that it is not necessarily effective in protecting workmen from inhalation of vapors.

Vulcanization processes can give rise to a number of toxic gases, such as hydrogen sulphide, carbon disulphide and mercaptans. When neoprene was introduced into fabrication processes there were frequent complaints of a "tear gas" generated during vulcanization. Most processors claim that recent grades give no obnoxious gases.

Butadiene gas, which may produce eye and nasal irritation, is stored in liquid form under pressure in giant spherical tanks such as these

Courtesy U. S. Rubber Co.



Specific Heats of Mixed Acids at Higher Temperatures

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Chem. & Met. INTERPRETATION

War uses of mixed acids in explosives manufacture have greatly stimulated the need for more basic data on thermal properties, particularly specific heats of nitric and sulphuric acids in various strengths and mixtures and at other than room temperatures. The authors here describe work at temperatures in the range of 104 to 212 deg. F. and show that change in specific heat of mixed nitration acids with temperature is small. —*Editors.*

Basic data for calculations of the heat involved in the preparation and use of mixed acids for nitration processes include the measurement of heats of dilution by Rhodes and Nelson (6),[3] and the determination of specific heats of nitric and sulphuric acids in various strengths and mixtures by Biron (1) and Pascal and Garner (5). The specific heats have been correlated and made more available to American readers by Zeisberg (10) and Craig and Vinal (2). More recently these data have been presented in an enthalpy and specific heat plot by McKinley and Brown (4) and in an enthalpy-temperature nomograph by McCurdy and McKinley (3).

Specific heat determinations previously reported have all been made at or near the temperature of 68 deg. F. (20 deg. C.), and the enthalpy plots have been based on the assumption that the change in specific heat with temperature was negligible. The work reported here was well under way before the enthalpy plot of McKinley and Brown appeared. On account of the difficulties in the calibration of the apparatus and in the determinations of heat capacities at higher temperatures the results may not represent the same degree of accuracy as some of those given for 20 deg. C. (1), (5), (7). However, they do represent data obtained with fair accuracy at four temperatures in the range from 40 deg. C. to 100 deg. C. (104 deg. F. to 212 deg. F.), and they do show that within this range the change in specific heat of mixed nitration acids with temperature is small.

The authors made use of a calorimeter in which the sample of mixed acid was placed in a glass jar through the cover of which a heating element, stirrer and thermometer were introduced. The heating element consisted of a nichrome coil inserted into a glass tube which was then bent to an appropriate shape. The calorimeter jar was well insulated from a jacket which was heated by another coil and kept at a temperature somewhat above but close enough to the temperature in the calorimeter jar so that the heat leakage through the insulation was negligible. The calorimeter heater was designed so that when operated continuously it caused a temperature rise of 0.5 to 1.0 deg. C. per min. in the weight of sample (255 cc.) used.

In starting a determination the jacket temperature was adjusted and the stirrers allowed to run at least ten minutes to get constant conditions before the initial temperature reading was taken and the calorimeter heater turned on. Thereafter readings of the calorimeter temperature to 0.01 deg. C., and of the heater current to 0.05 v. and 0.0025 amp. were taken at regular intervals until the temperature rose to 100 deg. C. The rise in temperature (ΔT) for a 5.00 minute interval was then plotted against the calorimeter temperature. From the average curve for this plot ΔT for the standard time interval was read for each desired temperature.

In the calculation of results the following modification of the ideal calorimeter equation (8) was used:

$$C_p = \frac{KAVt}{W\Delta T}.$$

In this equation, C_p is heat capacity in calories per gram; K, calorimeter constant including the conversion factor 0.239 calories per joule; ΔT, rise in temperature for time t; V, average voltage; A, average current in amperes; and t, time in seconds.

K in this equation is constant only at a given temperature and in the determination of its value it was found that the viscosity of the standard liquid influences the value found for K. Wilson and McCabe (9) have likewise reported that water gave results 3 to 4 percent higher than caustic soda solutions in the calibration of a bomb. In the present work water and glycerine were also tried, but ethylene glycol was chosen for the determination of the values for K, because it has a low vapor pressure at the desired temperatures and its viscosity approaches that of the acids studied.

The method used in systematically exploring the mixtures of acids may be explained by use of Fig. 1, a triangular diagram for the composition of mixtures of three components. The line B represents the composition of mixtures in all proportions of 91.9 percent sulphuric acid and 68.5 percent nitric acid. Determination of the heat capacities of these acids and a number of the mixtures of the two in varying proportions give data which were plotted for each desired temperature as shown in Fig. 2. From the average curve of the plot in Fig. 2 there could be read for different mixtures the heat capacities in calories per gm. per deg. C., or specific heat at this temperature. This gave data as shown in the accompanying table.

(*Please turn to page* 124)

Specific Heats at 80 deg. C. of Mixtures along Line *B* of Fig. 1

Composition, Percent					
91.9% H_2SO_4	68.5% HNO_3	H_2SO_4	HNO_3	H_2O	Specific Heat
0.0	100.0	0.0	68.5	31.5	0.57
9.0	91.0	8.3	63.0	28.7	0.55
32.0	68.0	29.4	46.6	24.0	0.50
60.0	40.0	55.1	27.4	17.5	0.45
88.0	12.0	80.9	8.2	10.9	0.40
100.0	0.0	91.9	0.0	8.1	0.38

[1] Present address: E. I. duPont De Nemours & Co., Wilmington, Del.
[2] Present address: Floridin Company, Warren, Pa.
[3] Refer to bibliography at end of article.

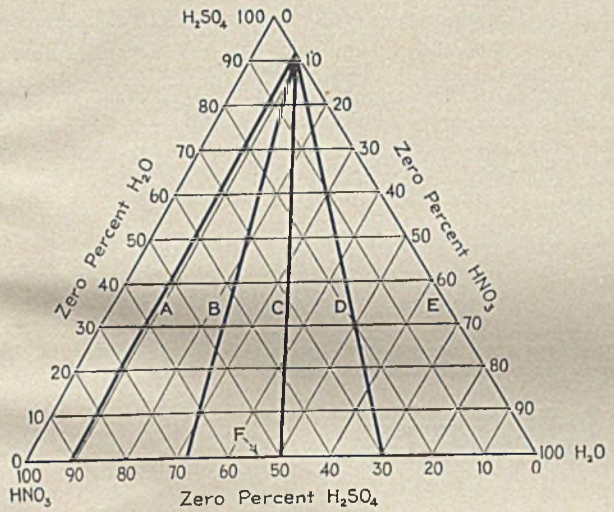

FIG. 1 — Typical Compositions for 3-component Mixtures

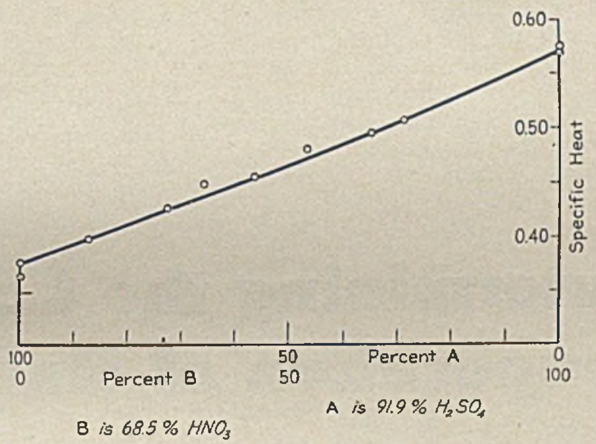

FIG. 2 — Specific Heats of Mixtures Along Line B of Fig. 1, 80° C.

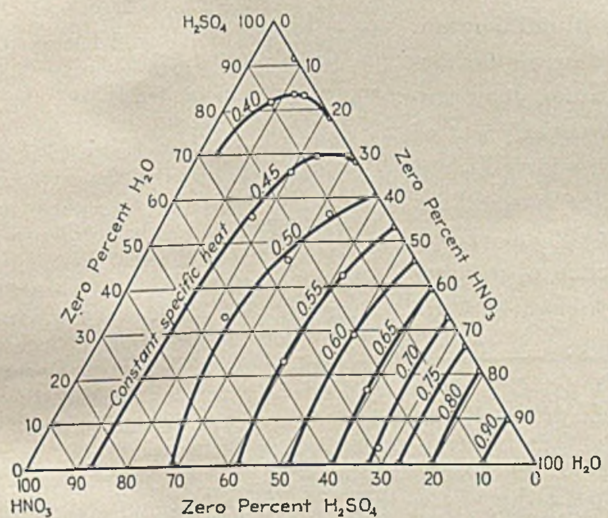

FIG. 3 — Specific Heats at 40° C.

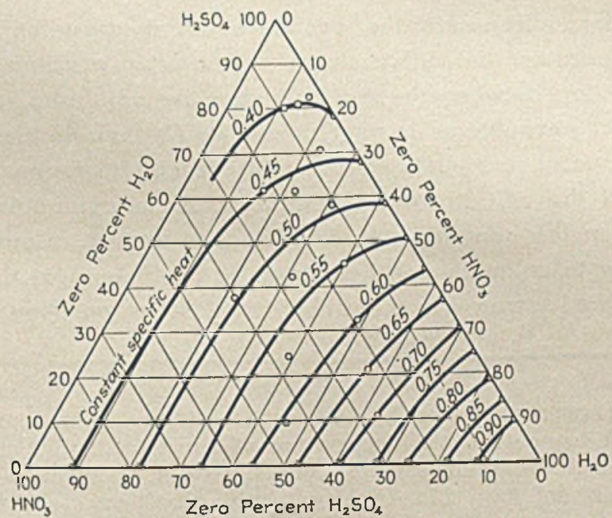

FIG. 4 — Specific Heats at 60° C.

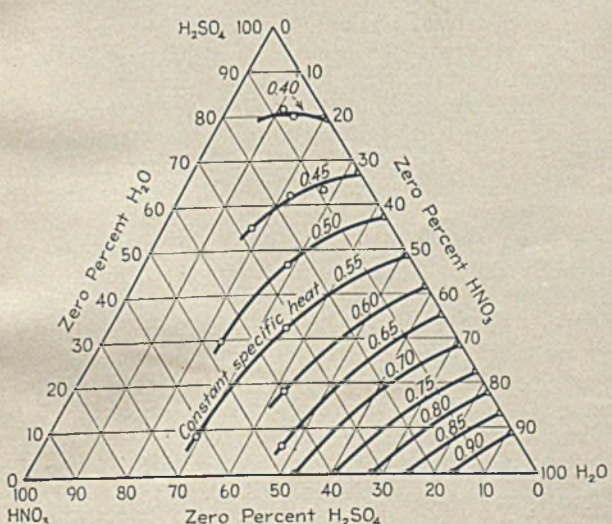

FIG. 5 — Specific Heats at 80° C.

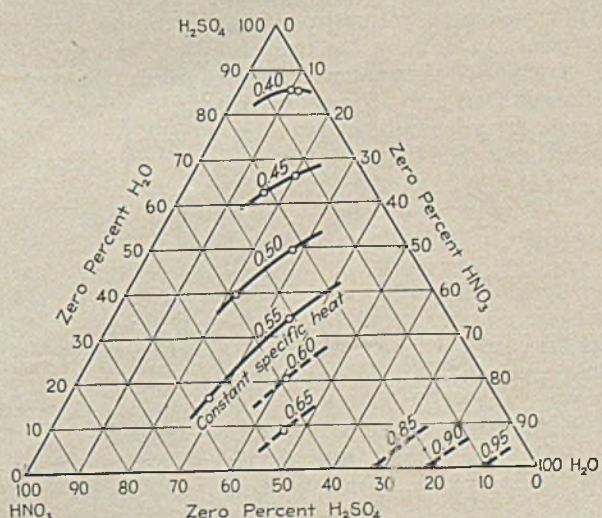

FIG. 6 — Specific Heats at 100° C.

By a repetition of this process, data were obtained for specific heats at 40, 60, 80, and 100 deg. C. for mixtures of acids with the compositions fixed by the different lines shown in Fig. 1. These data are summarized in the curves of equal specific heats on the triangular composition charts of Figs. 3, 4, 5 and 6, from which the specific heats of most mixtures of sulphuric acid, nitric acid and water from 104 to 212 deg. F. may be estimated.

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Determining the Coefficient of Evaporation of Humidifiers

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Chem. & Met. INTERPRETATION

Before discussing the coefficient of evaporation of humidification apparatus, the author clears up the often puzzling matter of the distinction between the wet-bulb and the adiabatic saturation temperatures encountered in psychrometry. He then defines the coefficient of evaporation in both exact and approximate forms, and shows how it and the exit absolute humidity can be determined for humidifiers when the heat transfer coefficient is known. Conversely, he shows how to calculate the heat transfer coefficient for the case of a coke-packed tower, when the coefficient of evaporation is known.—*Editors.*

Before discussing the coefficient of evaporation, the temperature of adiabatic saturation must be correctly defined and its relation to the wet-bulb temperature made clear, since the validity of the method of determination given hereafter rests upon this relation, while the accuracy of determination is dependent upon the exactitude of the adiabatic saturation curves.

The equation defining the temperature of adiabatic saturation t_s of an unsaturated mixture of any carrier gas and any vapor at temperature t and absolute vapor content w is:

$$\overset{(A)}{Ct} + \overset{(B)}{L'w} + \overset{(C)}{c_{pv}(t - t')w} = \overset{(D)}{Ct_s} + \overset{(E)}{L_s w_s} \qquad (1)$$

where term (A) is the sensible heat in the carrier gas; term (B) is the latent heat in the vapor; term (C) is the sensible heat in the vapor (superheat); term (D) is the sensible heat in the carrier at saturation; and term (E) is the latent heat in the vapor at saturation. The lefthand side of the equation, terms $(A) + (B) + (C)$, represent the total heat in the unsaturated mixture; while the terms on the righthand side, terms $(D) + (E)$, represent the total heat in the saturated mixture. In this relation of Equation (1), L' and L_s are the latent heats of vaporization of the vapor at the dewpoint and at saturation, respectively, in B.t.u. per pound of carrier gas, t' is the dewpoint temperature of the unsaturated mixture, w_s is the absolute vapor content at saturation in pounds per pound of carrier gas, and C and c_{pv} are respectively the specific heats at constant pressure of the carrier and the vapor in B.t.u. per lb. It will be noted that the vapor present in the unsaturated mixture was vaporized at the dewpoint.

If the above relation is plotted on the psychrometric chart for different values of t_s (see Fig. 1), the result is a family of curves called adiabatic saturation lines, which are the locuses of all unsaturated conditions having the same adiabatic temperature. The curvatures of these lines, which are concave upward, increase with the corresponding value of t_s.

Rearranging Equation (1), after adding the quantity $L_s w$ to both sides, gives the equivalent equation of the adiabatic saturation lines:

$$C(t - t_s) + c_{pv}(t - t')w + (L' - L_s)w = L_s(w_s - w) \qquad (2)$$

Under this form, it will be seen that the heat required to vaporize the added vapor (righthand term) is supplied by: (a) the decrease in sensible heat of the carrier (first term on left), (b) the disappearance of the superheat in the original vapor (second term on the left), and (c) the disappearance of the extra latent heat in the original vapor due to the change in dewpoint. The added vapor is vaporized at temperature t_s and since the expressions of total heat in Equation (1) do not include the heat in the liquid, any makeup water must be supplied at this temperature.

Equation (1), or more simply the adiabatic curves which express it, will permit the determination of the absolute vapor content of an unsaturated mixture for a given value of its temperature if t_s is known. The dry-bulb temperature t can readily be determined by means of an ordinary thermometer. Is it then possible to measure t_s by any simple method?

Let us place in a current of unsaturated carrier gas various evaporation surfaces differing both in shape and size (Fig. 2). The carrier gas picks up vapor as it contacts the wetted surface, despite the fact that no outside heat will be supplied for vaporization except by radiation from the surroundings. Furthermore, if the velocity of flow is sufficient, radiation effects will be negligible and the experiments can be considered adiabatic. The thermometers in each case will give the temperature of the liquid being vaporized. Runs are made not only with different surfaces but also with different velocities and different unsaturated mixture conditions. In all cases an equilibrium will be reached when the temperature of the liquid stabilizes at a definite value t_w called the wet-bulb temperature.

WET-BULB TEMPERATURE

These experiments show that in the particular case of air-water vapor mixtures, for given unsaturated conditions, t_w remains the same whatever the velocity or size and shape of the surface. For all practical purposes it is equal to the temperature of adiabatic saturation t_s. However, these experiments also show that this fortunate fact is not general and does not apply to all carrier-vapor mixtures. In the particular case of air-water vapor mixtures, the temperature of adiabatic saturation and therefore the absolute humidity can be determined by the wet-bulb method, but this is not true of all carrier-vapor mixtures.

From the fact that the wet-bulb temperature is independent of velocity and evaporation surface results the fact that the coefficient of heat transfer in this process and the coefficient of evaporation are bound by a constant ratio dependent solely on the unsaturated mixture conditions. Effectively, the condition for adiabatic vaporization can be written:

$$h(t - t_s) = L_w K(w_s - w)$$

or

$$\frac{h}{K} = L_w \frac{w_w - w}{t - t_w} \qquad (3)$$

in which K is the coefficient of evaporation in pounds per sq.ft. per hr. per pound difference in absolute vapor content and h is the coefficient of heat transfer in the process in B.t.u. per sq.ft., hr. and deg. F. It is important to note that the latter is not simply a coefficient of convection since it includes, along with the heat transfer from the carrier, the disappearance of superheat and extra latent heat in the original vapor. If the carrier is dry at the inlet, the coefficient reduces to that of convection, h_c, between the carrier gas and the surface. For dry gas, $h = h_c$.

Equation (3) shows that if the wet-bulb conditions are independent of velocity and evaporation surface then, although K and h individually vary with these factors, their ratio does not. The ratio depends solely on the conditions of the mixture in the manner determined by Equation (3) which, in the case of air-water vapor mixtures, becomes:

$$\frac{h}{K} = L_s \frac{w_s - w}{t - t_s} \qquad (4)$$

In the light of Equation (2) defining t_s

$$\frac{h}{K} = \frac{0.24}{1 - \dfrac{0.48(t - t')w + (L' - L_s)w}{L_s\,(w_s - w)}} \qquad (5)$$

The fraction in the denominator is the ratio between the heat in the vapor and the heat required for vaporization. This ratio tends toward a definite limit function of t_s as inlet conditions approach saturation. For instance, if $t_s = 86$ deg. F., the limit is 0.15.

If instead of using the exact Equation (2) we use the approximate one:

$$0.24\,(t - t_s) + 0.48\,(t - t_s)\,w = L_s\,(w_s - w) \qquad (6)$$

we have the approximate relation independent of t often found in the literature[1]:

$$\frac{h}{K} = 0.24 + 0.48\,w \qquad (6a)$$

in which h and $(0.24 + 0.48w)$ are respectively the coefficient of convection and the specific heat of the humid mixture.

For dry air, both the exact and approximate relations reduce to:

$$\frac{h_c}{K} = 0.24 \qquad (7)$$

Elimination of K between Equations (7) and (5) gives the relation between h and h_c:

$$h = \frac{h_c}{1 - \dfrac{0.48(t - t')w + (L' - L_s)w}{L_s\,(w_s - w)}} \qquad (8)$$

It is thanks to the constancy of the ratio h/K that radiation effects can be rendered negligible during wet-bulb readings. This is accounted for by the fact that increasing the velocity of flow considerably increases the rate of evaporation, while the amount of heat radiated to the evaporation surface is independent of the air velocity, hence remaining constant so that its percentage effect on the result can be made negligible.

Equation (7) will permit calculation of the coefficient of vapor transfer of a surface is its coefficient independent of the nature of the surface is known, and conversely, the calculation of h_c if K is known.

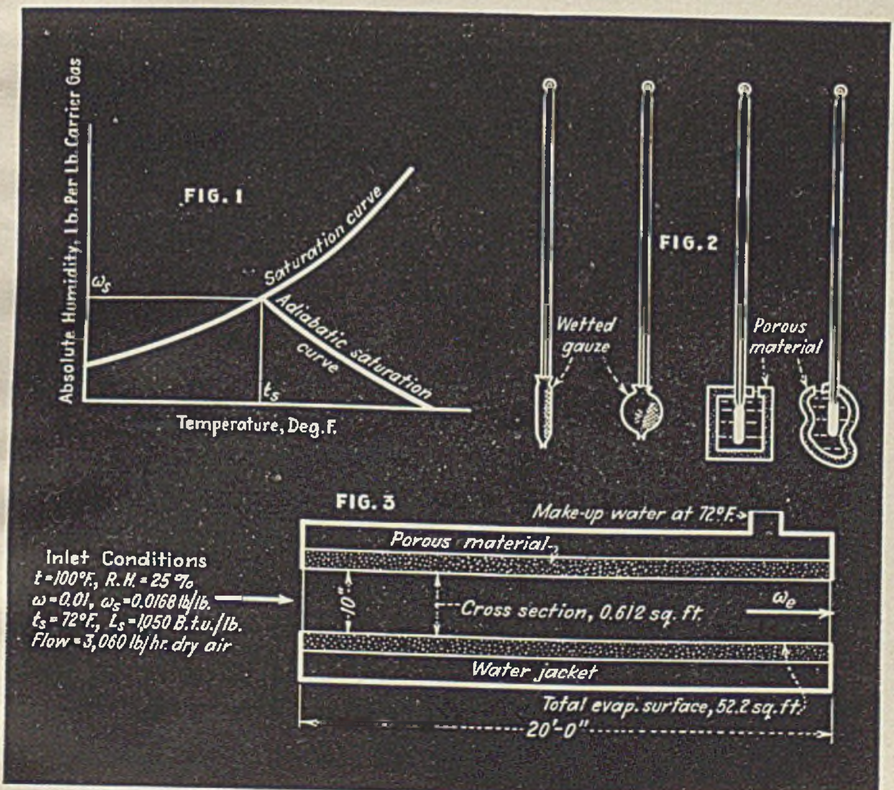
Numerical Example 1—Determine coefficient of evaporation of the humidifier shown in Fig. 3 and the exit absolute humidity resulting from adiabatic humidification for a flow of 3,060 lb. per hr. (dry air basis) when the inlet conditions are 100 deg. F. and 0.01 lb. per lb. abs. humidity (t_s = 72 deg. F., $w_s = 0.0168$).

According to Walker, Lewis and McAdams ("Principles of Chemical Engineering," McGraw-Hill Book Co., Inc.) the coefficient of heat transfer by

Fig. 1—Skeleton psychrometric diagram showing adiabatic saturation line

Fig. 2—Several types of wet bulbs, illustrating independence of wet-bulb temperature of type of wetted surface

Fig. 3—Cylindrical humidifier used to illustrate calculation of coefficient of evaporation



[1] For instance, see Perry's "Chemical Engineers' Handbook," 2d Edition, McGraw-Hill Book Co., Inc. (1941).

convection for gases flowing in pipes is:

$$h_c = 0.22\, c_p\, T_f^{2/3} \frac{V^{0.8}}{D^{0.2}} \qquad (9)$$

in which V is mass velocity (here equal to 3,060 × [(1+0.01)/1] ÷ (0.612 × 3,600) = 1.4 lb. per sec. and sq.ft.); D is the inside diameter in inches; T_f is the average absolute temperature in deg. F.; and c_p is the specific heat of the gas in B.t.u. per lb.

In the present case, the average temperature will be about 98 deg. F. (558 deg. abs.) and the coefficient of heat transfer for the considered pipe will be $h_c = 0.22 \times 0.24 \times 558^{\frac{2}{3}}\, 1.4^{0.8}/10^{0.2} = 2.97$ B.t.u. per hr., sq.ft. and deg. F.

From Equation (7), the coefficient of evaporation will therefore be $K = 2.97/0.24 = 12.4$ lb. per hr., sq.ft. and lb. difference in absolute humidity.

The humidification efficiency will be:

$$E = \frac{w_e - w_i}{w_s - w_i} = 1 - e^{-KS/F}$$

$$= 1 - e^{-\frac{12.4 \times 52.2}{3,060}} = 0.19$$

and the exit absolute humidity will be given by:

$$\frac{w_e - 0.01}{0.0168 - 0.01} = 0.19$$

whence

$$w_e = 0.01129 \text{ lb. per lb.}$$

From the psychrometric chart the exit temperature will be $t_e = 95$ deg. F. on the 72 deg. F. adiabatic saturation curve.

Numerical Example 2—The following example will illustrate the reverse calculation of h_c when K is known.

Determine the coefficient of heat transfer for 3 in. coke packing.

According to the plot by Sherwood (in Perry's Handbook), showing the results of Whitman and Keats, the coefficient of evaporation for 3-in. coke packing can be expressed by:

$$\frac{K'}{40} = \left(\frac{V}{600}\right)^{0.8} \quad \text{or} \quad K' = 0.238\, V^{0.8}$$

In this relation K' is in pound mols per hr. and cu.ft. of packing per atmosphere of vapor pressure difference. Expressed in lb. per in. of vapor pressure difference, the expression is:

$$K' = 0.000315\, V^{0.8}$$

It can be shown that the relation between K' in lb. per in. and K is:

$$\frac{K}{K'} = \frac{29.92 - p}{0.623 + w_i}$$

in which p is the vapor pressure of the unsaturated mixture in inches. This shows that if K is independent of the inlet conditions, K' is not. In the case under consideration, the plot does not state the inlet conditions to which the coefficient refers so, for the sake of completing the present example, let us assume that it corresponds to dry air at 100 deg. F. ($p = 0$ and $w_i = 0.0102$). Then

$$K = \frac{29.92}{0.623 + 0.0102} \times 0.000315\, V^{0.8}$$
$$= 0.0148\, V^{0.8}$$

and $h_c = 0.24 \times 0.0148\, V^{0.8} = 0.00355\, V^{0.8}$ in B.t.u. per hr., deg. F. and cu.ft. of packing.

The general formula for the coefficient of heat transfer for beds of broken solids determined by C. C. Furnas[2] is more complicated:

$$h_c = A \frac{v^{0.7}\, T^{0.3}\, 10^{(1.68f - 3.56f^2)}}{d^{0.9}}$$

[2] C. C. Furnas, *Trans. Am. Inst. Chem. Eng.*, 24, 142 (1930).

In this expression h_c is in B.t.u. per sec., deg. F. and cu.ft. of packing, A is a constant characteristic of the solid and gas, f is the fractional value of voids in the bed, v is the flow in standard cu.ft. per sec. and sq.ft., and d is the particle diameter in ft. The constant A is probably introduced because, in the method of determination, the lag caused by conduction inside the solid is not taken into account.

Dividing the right-hand side by 0.24 will give the general formula for the coefficient of evaporation for broken solids wetted without excess in lb. per sec. and cu.ft. of packing per lb. absolute humidity difference.

Graphical Approach to Leaching Problems

C. A. LEE *Engineer, Evanston, Ill.*

Chem. & Met. INTERPRETATION

Leaching theory is still inadequate, although by various graphical and analytical methods, satisfactory results can usually be achieved, even though a certain amount of adaptation may be required after the equipment has been put into operation. Our author has worked out a simple graphical approach to leaching problems employing a countercurrent diffusion battery, which enables the problem to be visualized readily and gives a "framework and background" for the calculations, as he expresses it.—*Editors.*

Quite a good discussion of leaching is given in Badger and McCabe's "Elements of Chemical Engineering" (McGraw-Hill Book Co., Inc.). Although, as these authorities state, the theory so far is quite inadequate, analytical and graphical methods have been worked out. In this connection, see an article by Armstrong and Kammermeyer (*Ind. Eng. Chem.*, 34, 1228, Oct. 1942).

Such theory as is available does not make it easy to visualize the problem and a process engineer seeking aid in revising a present layout would probably feel somewhat at a loss. The diagrams given as a part of this article were developed to make the principles evident, and to give a framework and background for the actual calculations.

Assume a battery of closed tanks, as in Fig. 1, through three of which in series it is desired to pump hot water or some other solvent countercurrently. The possibility of pumping also through a fourth tank is being considered. Samples of the solvent can be taken during the cycle, but samples of the solid material being leached cannot be obtained until the tanks are finally opened at the end of the cycle. There is a question how much good is being done during the last hour of operation, and whether a fourth tank in the series would be worthwhile.

DIFFUSION BATTERY OPERATION

In a countercurrent diffusion battery the fresh solvent, which is at zero concentration, goes to the oldest tank first. The flow through one tank equals the flow through each following tank but the concentration increases along the way. Periodically, at intervals, the oldest tank is disconnected and opened up, while a fresh tank is hooked on to the line at the other end. The piping arrangement for doing this has been pretty well standardized.

The curves of Fig. 2 show the rise in concentration of solute in the sol-

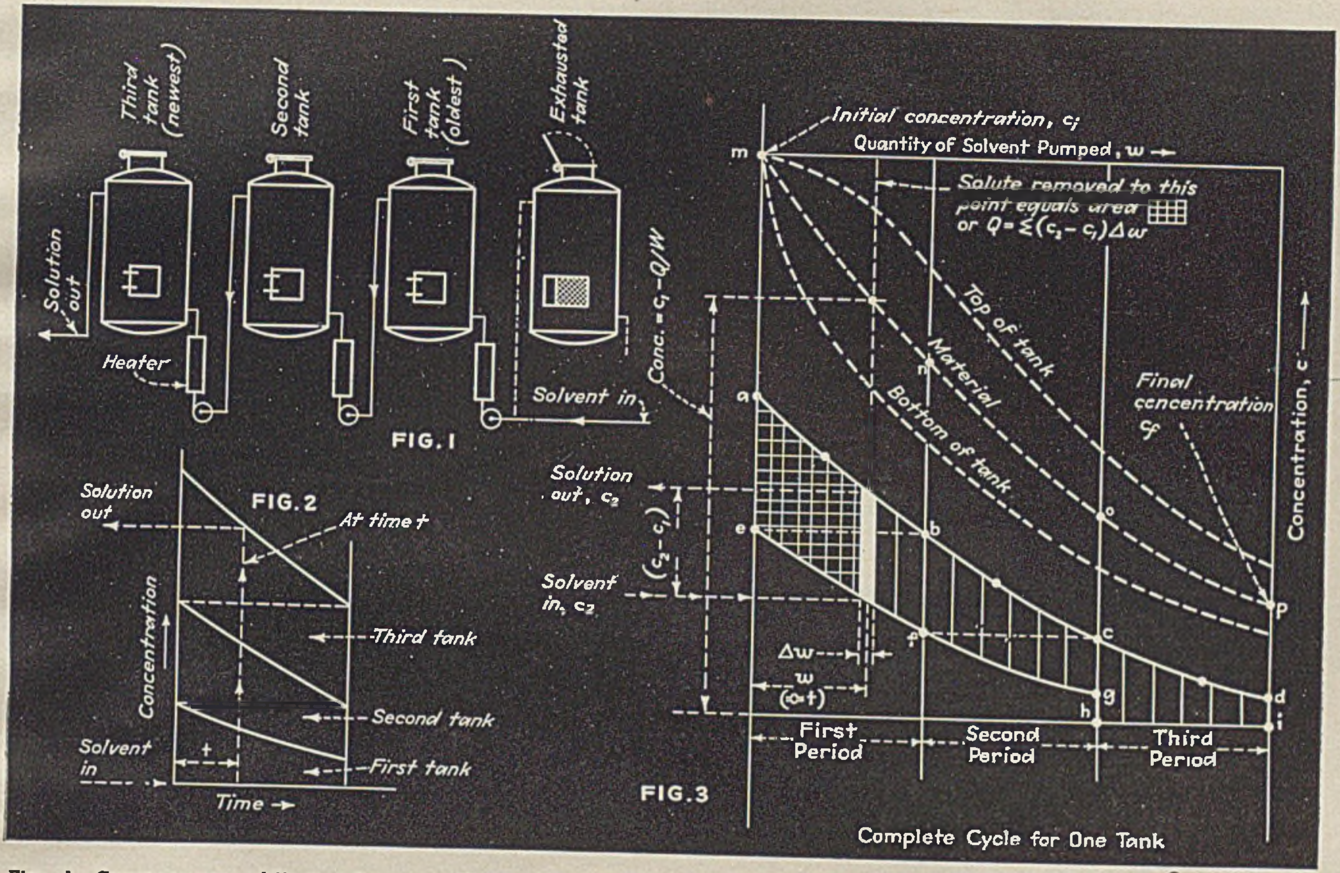


Fig. 1—Countercurrent diffusion battery of three tanks in line, with a fourth tank exhausted, ready for dumping

Fig. 2—Curves for a single cycle of three leaching tanks, showing concentration changes in each tank

Fig. 3—Concentrations of solute in solvent and material during three cycles in a single leaching tank

vent as it flows through the battery of three tanks. Obviously, concentration of the solvent leaving one tank equals the concentration of solvent entering the following tank. If we assume (as is not always the case) upward flow through the tanks, the concentration of solute retained by the material at the top of one tank tends to equal that at the bottom of the following tank. An equivalent statement is true for downward flow.

Fig. 2 was drawn for the variation in concentration of the solvent during a single period of the cycle. The changing concentration in the three tanks is shown for this one period. The curves showing the concentration in the three tanks during one period are also, correctly, the three parts of the curve for one tank through three periods of a cycle. In Fig. 3 let us draw a curve for the concentration of solvent leaving one tank and have it cover the entire cycle for that tank. We will use "concentration" as ordinates for the curve. For the horizontal scale it will be convenient, instead of using "time," to use the quantity of solvent pumped in that time. Then area on the diagram will represent solute removed from the material.

Fig. 3 shows a complete cycle for solvent passing through the tank. Curve *a b c d* shows the concentration leaving the tank at any instant, and Curve *e f g h i* shows the concentration entering the tank. The only data needed for drawing the curves are the concentrations of solvent leaving the one tank through a representative cycle. As the curve will be "smooth," half a dozen data should suffice. They need not be taken at regular intervals. It follows from the hook-up that curve *e f g* is identical with curve *b c d*, merely being displaced horizontally one period to the left.

SIGNIFICANCE OF AREA

Area between the two solvent-concentration curves, summed up to any point, gives the amount of solute removed in the solvent up to the corresponding time. As shown on the chart, this area Q is equal to $\Sigma (c_2 - c_1) \Delta w$, where Q is the pounds of solute removed in time t, c_2 and c_1 are the leaving and entering concentrations respectively, and w is the pounds of solvent pumped. It is simple then to figure the concentration of solute remaining in the material and to draw a curve showing average values for this concentration through the cycle. At any point on this curve the concentration of solute remaining in the material is $c_i - Q/W$, where c_i is the initial concentration and W is the total pounds of solute initially in the material in the tank. This curve is given as *m n o p* in Fig. 3. It is shown by a dotted line, since it is really only a reference line about which a series of curves can be centered to show concentrations of the solute left in the material at different levels in the tank. Two boundary curves are shown in dotted lines. One curve represents the concentration at the top of the tank and other shows concentration at the bottom.

Concentration is same throughout the tank at the start but (on original assumption of upward flow) concentration at the bottom comes down much faster for a while and tends to equal the value at the top of the tank from which solvent comes. In other words the two boundary curves tend to become identical, with the same horizontal displacement of one period as was observed in the case of the solvent. Incidentally, the area between the boundary curves has no significance.

Consideration of Fig. 3 shows that the practical effect of adding an additional tank in the line is to extend the righthand part of diagram, and in so doing, to accomplish two things with the same rate of pumping: (1) to extract more of the total solute; and (2) to make the top and bottom of the tank more nearly alike in final concentration.

This discussion has had in mind the revision of an existing set of tanks. So far as its applicability to original design is concerned, the practical value of the method lies in its ability to show graphically the nature of the operation. If one can actually visualize the operation itself, it should be possible to use such theory as is available in designing a system that will work fairly well from the start, even though certain improvements in operation may have to be brought about after putting the equipment into operation.

Relation of Harmonic and Logarithmic Means

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Chem. & Met. INTERPRETATION

The harmonic mean of two quantities, which equals twice their product, divided by their sum, is often met in calculations of engineering quantities. In other cases the log mean is encountered, and sometimes both means together. The author has derived a chart of the relation between the two means, by use of which it is often possible to employ the simpler arithmetic average of variable quantities, producing a correct result by a correction factor taken from the chart.—*Editors.*

The harmonic mean of two quantities is defined as twice their product divided by their sum. It may be encountered frequently, as for example in the calculation of the arithmetic average of either of the two variables related as follows.

$$xy = \text{constant} \quad (1)$$

For example, in the study of the flow of fluids the equation of continuity is often used. It has the form:

$$uA\rho = \frac{M}{\theta} \quad (2)$$

where $u =$ linear velocity, $A \doteq$ cross-sectional area of the channel, $\rho =$ density, $M =$ mass and $\theta =$ time. Of course M/θ has a fixed value for steady flow. For liquids, ρ normally undergoes only a slight variation so that one may write for this case

$$V_{A.Av.} = \frac{u_1 + u_2}{2} = \frac{M}{2\theta\rho}\left(\frac{1}{A_1} + \frac{1}{A_2}\right) \quad (3)$$

$$= \frac{M}{2\theta\rho}\left(\frac{A_1 + A_2}{A_1 \times A_2}\right) \quad (4)$$

$$= \frac{M}{\theta\rho A_{H.M.}} \quad (5)$$

where $V_{A.Av.}$ denotes the arithmetic average velocity of the fluid, and $A_{H.M.}$ denotes the harmonic mean of the two area values.

The log mean is encountered in many equations relating to flow of energy or of materials. Both the log and harmonic means are encountered in certain equations governing the isothermal behavior of a perfect gas, and it may be advantageous to know the relationship existing between the two means. The following equations demonstrate that whereas the true average pressure depends on the log mean of the terminal volume values, the arithmetic mean pressure is related to the harmonic mean of these volume values.

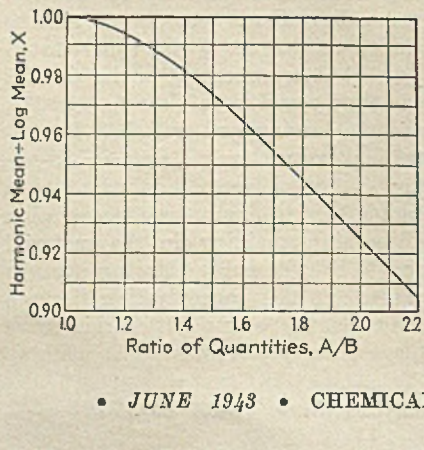
$$\int_{V_1}^{V_2} PdV = n\,R\,T \ln \frac{V_2}{V_1} \quad (6)$$

$$\int_{V_1}^{V_2} PdV = P_{Av.}(V_2 - V_1) \quad (7)$$

Equations (6) and (7) may be solved for $P_{Av.}$ and one obtains

$$P_{Av.} = \frac{n\,R\,T}{V_2 - V_1} \ln \frac{V_2}{V_1} \quad (8)$$

Chart showing relation of harmonic and log means for various ratios of the two quantities involved



$$= \frac{n\,R\,T}{V_{L.M.}} \quad (9)$$

where $V_{L.M.}$ denotes the log mean of the two volume values. If $V_{A.Av.}$ is used to indicate the arithmetic average of the terminal volume values and $V_{H.M.}$ stands for the harmonic mean of these values it can be shown that

$$P_{A.Av.} = \frac{1}{2}\left(\frac{n\,R\,T}{V_1} + \frac{n\,R\,T}{V_2}\right) \quad (10)$$

$$= \frac{n\,R\,T}{V_{H.M.}} \quad (11)$$

In the application of Bernoulli's Theorem to the isothermal flow of perfect gases one encounters the term $\int Vdp$, the evaluation of which will serve as another example. By analogy to Equations (6) to (11) inclusive, it may be shown that in this case

$$V_{Av.} = \frac{n\,R\,T}{P_{L.M.}} \quad (12)$$

and

$$V_{A.Av.} = \frac{n\,R\,T}{P_{H.M.}} \quad (13)$$

For the sake of simplifying calculations one may write

$$\int_{P_1}^{P_2} Vdp \cong V_{A.Av.}(P_2 - P_1) \quad (14)$$

Equation (14) is good only when P_1 and P_2 do not greatly differ. It may be made accurate by the introduction of a correction factor X which is equal to $V_{Av.}/V_{A.Av.}$

$$\int_{P_1}^{P_2} Vdp = V_{A.Av.}(P_2 - P_1)X \quad (15)$$

Inspection of Equations (12) and (13) reveal that

$$X = \frac{P_{H.M.}}{P_{L.M.}} \quad (16)$$

The usage of Equation (14) amounts to equating X to unity, and in general overlooking the difference between the harmonic and log means of the terminal pressures. For this reason a graphical representation of the relation between the two types of means will be given.

Let the quantities in question be designated by A and B, while M_H and M_L will stand for the harmonic and log means respectively.

$$M_H = \frac{2\,AB}{A + B} \quad (17)$$

$$M_L = \frac{A - B}{\ln (A/B)} \quad (18)$$

$$X = \frac{2\,(A/B) \ln (A/B)}{(A/B)^2 - 1} \quad (19)$$

A series of values of (A/B) can be assumed and the corresponding values of X calculated. The accompanying graph shows the relationship existing between these two variables. With the aid of this chart one may easily use Equation (15) for all values of P_1 and P_2 and thereby avoid the usage of the less accurate Equation (14). Since the graph is general one may compare the harmonic and log means of any two quantities.

High-Octane Aviation Gasoline Program Continues to Expand

EDITORIAL STAFF REPORT

Chem. & Met. INTERPRETATION

Development of this country's aviation fighting fuel program since 1941 reveals all the resourcefulness and persistence against obstacles that has always characterized American industrial enterprise. Allied aviators now have enough gasoline as well as high explosives to pry all Germany well off the map, but several times within the past three years mistakes of judgment reached the blue-print stage that, once committed, would have greatly prolonged the war and cost innumerable lives. Herein Mr. Ickes, Petroleum Administrator for War, reveals before the Truman Committee some of the difficulties encountered in realizing the program. At the same time, it is fitting that due credit be given to the Standard Oil Co. of Louisiana, whose Baton Rouge units are among those contributing so much to the aviation gasoline and synthetic rubber programs. These units, recently toured by a number of notables, are shown in the photographs.—*Editors.*

In the spring of 1941 this country was producing only approximately 24,000 barrels of 100-octane gasoline daily. During May of the same year, the Office of Petroleum Coordinator for National Defense was created by the President, and one of the first acts of this office was to set up committees of the oil industry throughout the country to work with the Coordinator on defense undertakings. At that time Mr. Ickes called for a doubling of 100-octane capacity, which would mean 80,000 bbl. daily, since at that time production was only approximately half of the capacity of the industry.

However, the Office of Production Management then held the view that this country was in a comfortable position for the forthcoming 12 or 15 months, or until the summer and fall of 1942. Nevertheless, it recommended that we should increase our facilities for 100-octane production over a period of 18 months by 25 percent. According to that plan, our industry would have been shooting at a capacity of 50,000 bbl. per day by the first of this year!

At the time the Office of Petroleum Coordinator for National Defense was created, the industry had almost twice the 100-octane capacity that was being utilized. Some plants were shut down and some were running at reduced capacity. Naturally, therefore, there was some reluctance on the part of industry to increase its investments in highly specialized equipment necessary to produce this material. It costs about $5,000,000 to build a 100-octane installation of any respectable size, and even in normal times it takes a year or more to complete a plant and get it into large-scale and full operation.

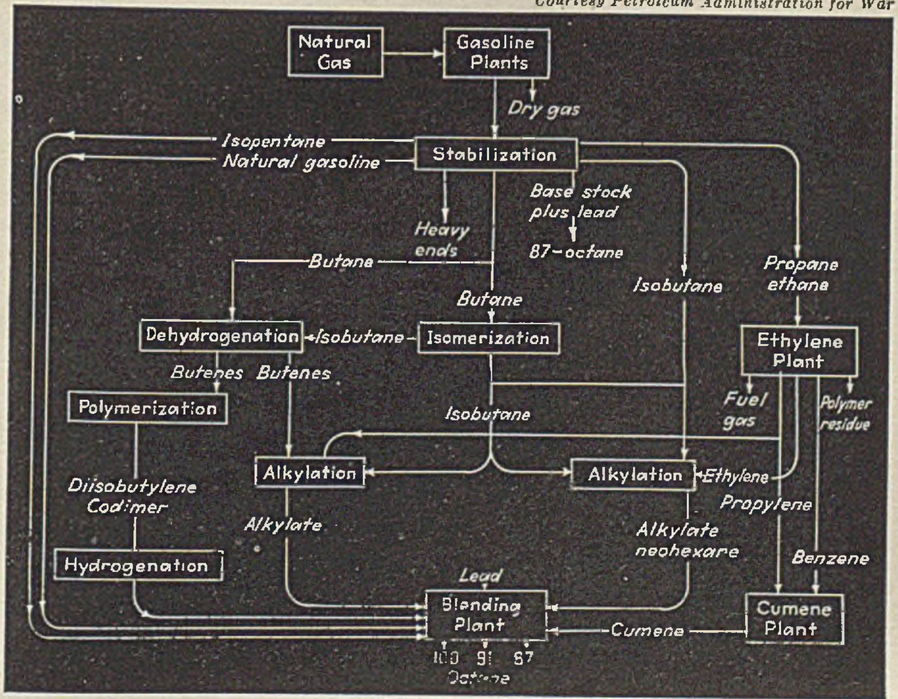
One reason why the petroleum industry was hesitant about a large-scale expansion of 100-octane capacity was that there was no assurance of a market for the product after it was made. The Army and Navy could not, under the law, make contracts for deliveries beyond one year. It would take that long to build the plants and several additional years to amortize the investment.

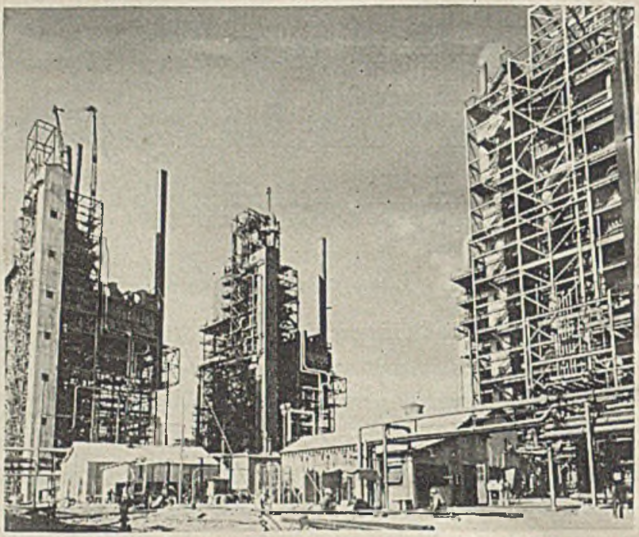
Consequently, in September 1941, the Petroleum Coordinator obtained an informal agreement from Secretary Jones that he would supply financial assistance to build the plants whenever that was necessary and would contract for the purchase of the output. At the same time, instead of nearly doubling capacity, he recommended that it be raised to 120,000 bbl. per day.

From that time until the present, tremendous difficulties have been encountered. The first was that there were only a few refiners in the entire country who knew how to make 100-octane gasoline. The second was that the steel, copper and other materials required for new refinery facilities were

Flow sheet illustrating the processes related to the production of aviation-grade gasoline from natural gas derivatives

Courtesy Petroleum Administration for War





Above—The fluid "cat" cracker at the right, first in this country, has operated at Baton Rouge for a year

Left—Gases processed in this debutanizer and splitter plant are produced by a fluid catalyst cracking unit

critically scarce. The third difficulty was that the refinery engineers estimated that it would take from 12 to 18 months to build the required new units.

In order to overcome in part the last difficulty, a survey of all of the 100-octane plants in the country was made to determine how much they were then producing and to learn whether there might be ways to step up that production. Simultaneously, other refineries were surveyed to ascertain in what ways they could contribute to the program. By November 1941, a comprehensive program was presented to the Supply Priorities and Allocations Board for new plant construction, for additions to existing plants, and for certain changes in refinery operations which would give an immediate increase in production. Before Pearl Harbor, there was also set up the Petroleum Industry Council for National Defense, the first meeting of which was held the day after the bombs fell on Honolulu. This Council then immediately became the Petroleum Industry War Council.

SINCE PEARL HARBOR

What has happened since Pearl Harbor is really amazing. Credit for this can justifiably be equally divided between the petroleum concerns and government officials in charge of the program. Included, of course, is how the oil companies agreed to pool patents and processes that had been worked out over many years at huge expense; how the experts of the Office of the Petroleum Coordinator and of the industry literally wrought magic in squeezing out two barrels of 100-octane gasoline where only one had flowed before; how rival companies shared their raw materials, their blending agents, their facilities and their knowledge.

Success was attained notwithstanding a lack of understanding by many persons in high authority, despite a frightening drain by the armed forces upon the technical talent of the industry, and in spite of the fact that the program had to be cleared through many government agencies in competition with other pressing programs.

It was only in October 1941, that those in authority agreed to the doubling of the productive capacity of aviation gasoline to some 80,000 bbl. daily. In December it was decided to raise the original capacity to 120,000 bbl. daily. A further expansion to 180,000 bbl. was authorized in February 1942, and another to 250,000 bbl. in March of that year. Additional productive capacity was authorized in May.

Official figures of military requirements, meanwhile, had been almost impossible to obtain. It was not until May 1942 that a semi-official estimate showed that by December 1943 the demand for 100-octane would be of the same general order of magnitude as the production that industry had already set out to make. Even this estimate was based on a then-obsolete plane program.

Even in September 1942, the situation was still such that no new official long range figures were available for 1944, and the Office of the Petroleum Coordinator had to make its own unofficial estimate based on information from the Aeronautical Board. This estimate indicated a requirement in 1944 almost double that estimated earlier in the year. Between February and April of this year the indicated requirements rose again sharply. The end is not yet in sight.

The petroleum industry produced during April 1943 more fuel every day than official requirements figures of last July indicated would be necessary. In July of this year it is expected to produce more fuel than the best estimates of a year ago had believed would be necessary by next winter.

However, it takes a year or more to build such plants and the decisions reached now to install new 100-octane facilities cannot have any practical effect until about a year from now. The decisions of a year ago are preventing us from now producing what we could have produced in plants which were properly engineered and which are being properly constructed, but which are coming into production slowly, month by month, rather than with great rapidity, because of failure to provide construction materials to finish them.

Construction materials required for these plants are highly specialized and it is not the absence of cement and lumber which has retarded them. In fact, it is not even the absence of steel plate. The difficulty has been that the apparatus used is extremely intricate, takes a long time to engineer and even today can be built in only a few shops. Those same shops are heavily employed in the Navy program, the Maritime program and the rubber program, as well as the aviation gasoline program. Until the first of this year, some of the few shops that are capable of fabricating special vessels, catalyst cases, heat exchangers, instruments and the like were not able to operate at full capacity because they had been cut down to the use of only a certain percent of the materials they were capable of handling.

Failure to receive parts for the new plants constituted a very serious setback and, roughly, only a minor portion of the new facilities planned to be in operation by the first of January 1943 were completed. Nevertheless, real production in January was in excess of the target that had been set for only eight months before. The 100-octane gasoline which could not be produced in unfinished new facilities was produced anyway and, in addition, the quality of the product turned over to the armed forces was greatly improved!

This increase in production facilities despite the lack of new capacity was attained by forcing every unit to produce at rates formerly deemed impossible. Judicious use of small amounts of critical construction materials permitted the removal of "bottlenecks" in the plants. Specifications were changed. New ingredients were invented. Some fifty refineries lacking any 100-octane equipment were pressed into service to produce special ingredients. All the refineries were run as one in the sense that ingredients available in all parts of the country were blended in such a way as to gain a maximum number of daily barrels. It is partly by such expedients that the productive goal which had been set only last September is expected to be exceeded in July of this year.

However, some new facilities have been completed, although not as fast as desired. In December 1941, there were operating in the United States and Aruba 23 separate major units rated as 100-octane aviation gasoline facilities. These were substantially complete manufacturing units as distinguished from the approximately 50 peacetime refining units which were called into service later to produce special ingredients.

By July 1942, only one additional such main plant had gone into operation but by December 1942, the total number had increased to 32. By April 25, 1943, this number had risen to 42 and had it not been for the conflict with other programs the number of main units in operation today would be in the general neighborhood of 50. The number is expected to reach 60 before the end of the summer.

DIFFICULTIES IN CONSTRUCTION

Some of the difficulties the industry had to undergo in construction of these new facilities are outlined below:

(1) Steel plate for the new plants was not received until March 1942, and even then it was delivered in a haphazard manner without regard to the needs or relative urgencies of the separate projects;

(2) Although the War Production Board allocated steel plate in May 1942, it did not allocate the other materials at that time because current theories of the board revolved around priorities rather than scheduling:

Companies Manufacturing 100-Octane Gasoline in 1942[1]

Continental Oil Company
Gulf Refining Company
Humble Oil and Refining Company
Magnolia Refining Company
Phillips Petroleum Company
Richfield Oil Company
Shell Eastern Petroleum Company
Shell Union Oil Company
Sinclair Refining Company
Standard Oil Company of California
Standard Oil Company (N. J.)
Standard Oil Company (Indiana)
Standard Oil Company of Louisiana
Standard Oil Company (Ohio)
The Texas Company
Union Oil Company of California

[1] Courtesy Standard Oil Co. (N.J.)

(3) In the summer of 1942, the authorities actually voted the aircraft production program and certain other military programs as of higher urgency than the program to produce fuel for combat planes;

(4) In the early fall of 1942, there was a period of more than a month in which all rubber projects were rated higher than all 100-octane projects;

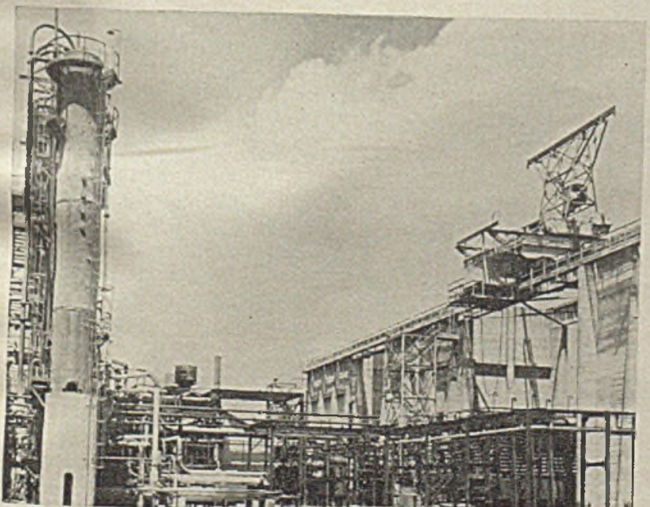
(5) In December 1942, mandatory scheduling of parts for certain plants was finally attained, but the directive which was then issued had to be shared with the rubber program;

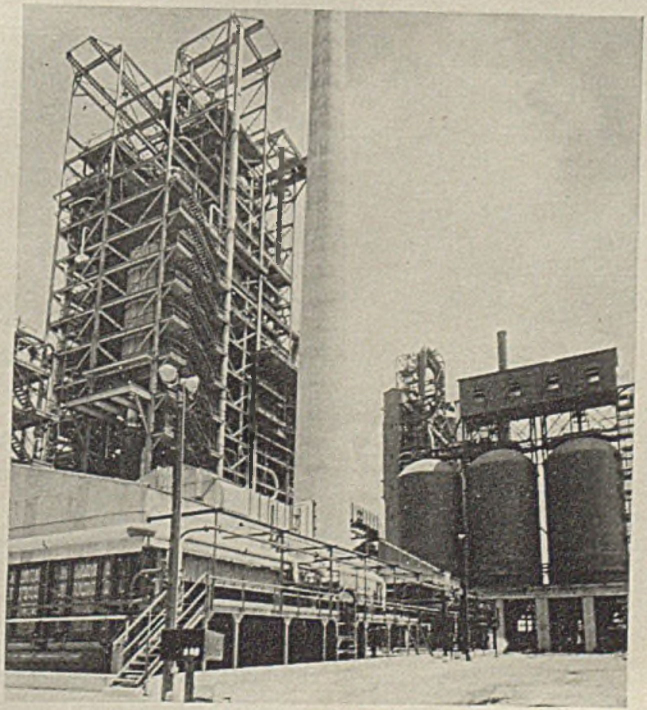
(6) The 100-octane program was denied a similar mandatory directive covering the plants scheduled to be finished in the second quarter of this year, and in addition to failing to receive such help, it suffered a positive hindrance in that the rubber program did receive such a directive.

It was originally estimated by the Office of Petroleum Coordinator for War that this directive to the rubber program and the lack of such a direct-

Right—Fluid "cat" cracker of Standard Oil Co. of Louisiana at its Baton Rouge refinery

Below—Prior to Pearl Harbor this was the largest plant in the world making 100-octane aviation gasoline. It now hydrogenates selective polymer made by 45 other refiners





ive to the 100-octane gasoline program would set back the completion date on some 100,000 daily bbl. of production from plants under construction by some 30 to 90 days. This indicated a probable loss of 9,000,000 bbl. of combat fuel for all time.

Actually, however, results have not been so serious since the directive upon which it was actually based was not as drastic as anticipated. Several other bottlenecks were also broken by joint efforts of engineers. It is now estimated that the preference directive given the rubber program has resulted in the loss of 4,413,600 bbl. of 100-octane aviation gasoline. This is from the rubber directive alone and has no relation to losses suffered as a result of other programs, such as Maritime and Navy.

In conclusion, it is pointed out that it could not be possible to produce today what is coming from the refineries if the industry had to depend upon critical materials from which new plants could be built. Despite results that are extraordinary indeed, this country is not making as much 100-octane gasoline as it needs: we cannot be satisfied until we are making *more than enough*. However, thanks to the miracles that have been performed by American engineers and chemists, in the petroleum administration and in the industry, the army is going to get the amount of 100-octane gasoline that it requested.

STANDARD OF LOUISIANA

Probably one of the largest plants in this country producing 100-octane aviation gasoline and raw materials for synthetic rubber is the Baton Rouge plant of the Standard Oil Co. of Louisiana.

The hydrogenation plant at this refinery was first put into operation in 1931 to make lubricating oil. Until the entrance of the United States into the war, it is believed that this plant was the largest in the world for manufacture of 100-octane gasoline. The plant is still in operation but its processes have been altered in line with war needs. It is now operating on hydrogenation of di-isobutylene (codimer), which is shipped from other plants. The rest of the hydro capacity is being used for producing high-octane aviation base stocks.

The catalytic cracker at Baton Rouge, put in operation in June, 1942, was the first fluid catalytic cracking unit in the world. Two other units, now under construction, are expected to go into operation in June and in July. These two new units, designed primarily for aviation gasoline and making gaseous and liquid fractions, are of radical and streamlined new design.

In addition, the "cat" crackers produce a great deal more butylene than is obtained from ordinary thermal cracking. This butylene can be alkylated to make blending agents for high-octane fuel or can be dehydrogenated to make butadiene for Buna rubber. They also yield toluene for explosives. Around 33 fluid catalyst units are now in operation or under construction, and these units form the backbone of the aviation gasoline and petroleum rubber programs.

ALKYLATION UNITS

In addition, there are three alkylation units in operation using the butane cut from both "cat" crackers and regular refinery operations. One of the petroleum gases is isobutane; the other may be butylene, amylene or other olefins which are produced in large quantities by fluid crackers. Butylene is also used to make butadiene. The blending agent produced by alkylation is not the same as the synthetic isooctane produced by hydrogenation but has almost as high an octane number. There are several alkylation plants at Baton Rouge in operation for a number of years, all financed by the company.

Also in Baton Rouge is the "refinery conversion" unit which comprises a modification of previously existing thermal cracking equipment. These crack light gas oil at high temperatures to produce a substantial volume of butadiene in the gas stream. In addition to furnishing considerable butadiene for the synthetic rubber program, they are producing substantial quantities of raw material for aviation gasoline.

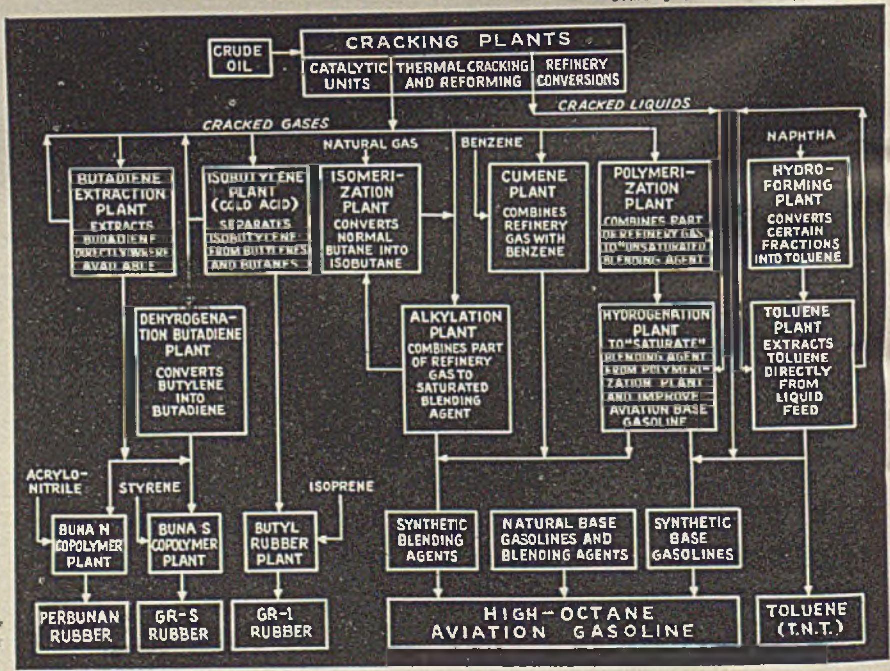
The Standard Oil Co. of Louisiana has invested $38,000,000 in aviation gasoline facilities, none of which is government owned. Exact figures on aviation gasoline may not be revealed at this time, but in comparison to prewar motor gasoline production it would appear that the yield of aviation gasoline is about 20 percent of the crude. Baton Rouge is also operating plants for the production of special blending agents which are even superior to isooctane. The nature of these cannot be disclosed for reasons of national security.

Also of interest is the fact that ethylene is made from certain of the refinery gas streams at Baton Rouge and is an important raw material in the manufacture of tetraethyl lead at the adjacent plant of Ethyl Gasoline Corp. Here a substantial percentage of the country's requirements of tetraethyl lead for use in aviation gasoline is produced.

Other plants located at Baton Rouge include two thermal type butadiene plants, butene dehydrogenation units for butadiene, a Perbunan (Buna N) synthetic rubber plant and a plant for producing Butyl synthetic rubber. These units will be described in a later article which will appear in *Chem. & Met.*

This simplified flow sheet shows the derivation of the three most important war products from cracking plants of the petroleum industry: high-octane aviation gasoline, synthetic rubbers and toluene for T. N. T.

Courtesy Standard Oil of Louisiana

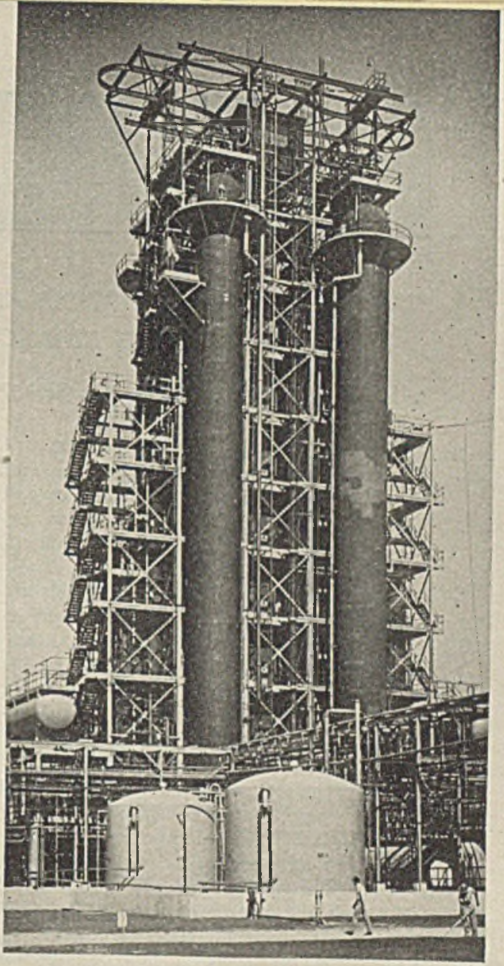


Texas City Styrene Plant Gets Underway

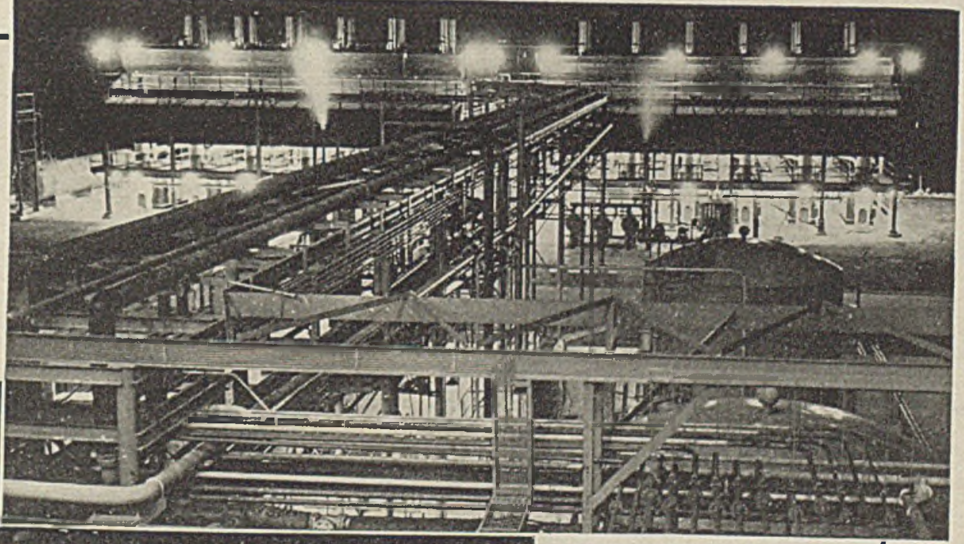
ON November 19, 1941 the Rubber Reserve Co. signed a contract with the Monsanto Chemical Co. to design, build and operate a small plant to produce 3000 tons per year of styrene as part of the synthetic rubber program. In rapid succession the design was changed to increase capacity to 6400 tons, then to 10,000 tons, and in January, 1942, it was revised upward to 20,000 tons. *In April it was again doubled and finally in September, 1942, the annual capacity was projected to 50,000 tons.

Basic construction was begun on March 17, 1942, and in seven days less than one year, the huge plant was put into successful operation by Monsanto engineers. Those who had most to do with this project include J. B. Rutter, director of the general engineering department, F. B. Langreck, chief chemical engineer, E. H. Buford, chief design engineer, C. J. Colley, chief power engineer, Ralph W. Booker, chief construction engineer, and Roy W. Sudhoff, assistant director of Monsanto's Central Research Laboratories. A. B. Boyer, former design engineer at the Illinois plant, was called back from retirement for a second time in order to help speed the Texas City program.

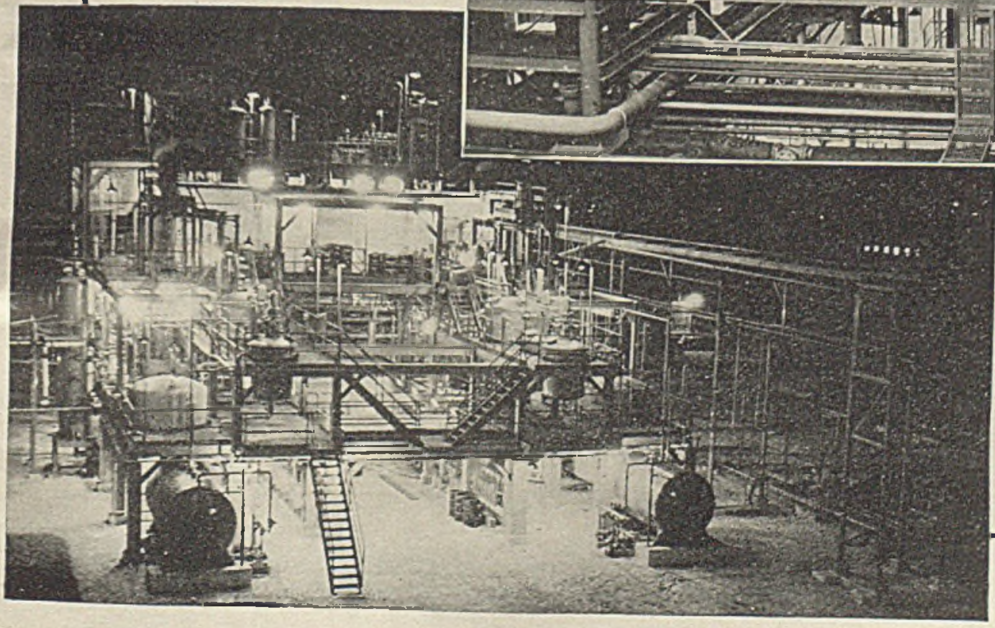
Production of styrene at Texas City is based on propane gas from nearby petroleum refineries and benzol from byproduct coke ovens. The former is cracked to ethylene, then combined with benzene by catalytic alkylation to form ethyl benzene, which is dehydrogenated to produce styrene. In designing and operating the plant, Monsanto has been able to draw not only on its own technical resources but on the technical committee of the Rubber Reserve Co. which provided a free interchange of information with every other company in the field.



Reaching into the sky 20 stories above ground is this distillation column for the recovery and final purification of styrene



Below — Monsanto's plant at Texas City where benzene is alkylated with ethylene produced by cracking propane. Note open-type construction and good illumination



Above—Ethyl benzene is dehydrogenated to yield styrene. This $17,000,000 plant went into production in seven days less than a year from the time basic construction was started

PLANT NOTEBOOK

NEW CHART SIMPLIFIES THE STUDY OF CRUSHING AND SCREENING PROBLEMS

RALPH GIBBS *Consulting Engineer, York, Pa.*

Frequently, in studying closed-circuit crushing and screening problems or operations, many computations are required in making an analysis of the arrangement and sizes of the equipment to be used.

In order to simplify the analysis of such problems, the author has arranged the convenient family of curves shown in Fig. 1.

The fundamental relations used in the development of this simplified group of curves are based on the approximate crushing laws for relatively reciprocating types of crushers, such as the cone, gyratory and jaw, and combining these results with the simple mathematical relations of screening.

The family of lines relating Scales (*A*) and (*B*) are those associated practically with particle sizes produced by crushing. This relation is common for those associated with crushing problems and it shows that 85 percent of the particles produced have a size smaller than that of the crusher opening. It is realized that this is not absolutely accurate for all cases; but for all practical purposes results obtained thereby are highly satisfactory.

Fig. 2 shows a diagrammatic sketch of a simple closed circuit screening and crushing problem as an example.

Example 1—Assume the following conditions exist:

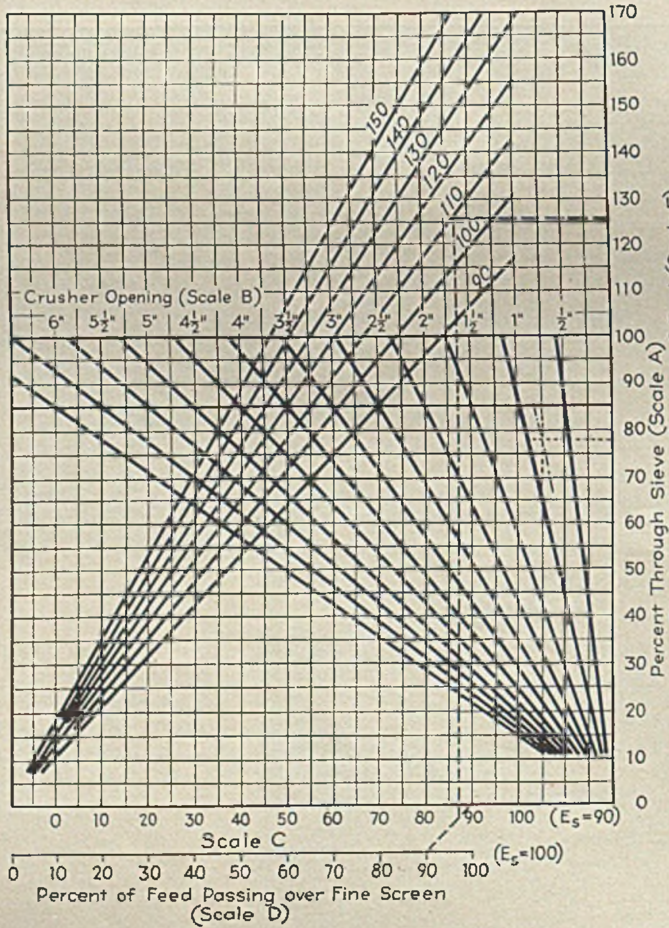
(*a*) The screen has ½-in. openings and is 90 percent efficient in removing this size.

(*b*) 50 tons per hour of minus ½-in. material is wanted.

(*c*) Feed to the screen is 80 percent plus ½-in. in size.

(*d*) The oversize from the screen passes through a crusher set at ½ in.

Fig. 1—Combination crushing-law and screening chart for facilitating the solution of crushing and screening problems



The following terms are used: L_c is the crusher or circulating load, in tons per hour; Q is the incoming feed, in tons per hour; q is the outgoing minus ½-in. material, in tons per hour; A is the percentage of plus screen size in the feed Q; E_s is the percentage screen efficiency; and P_c is the percentage of the crusher product that will pass through a ½-in. sieve.

In this and similar systems equilibrium will be attained when $q = Q$, and to have this condition, the circulating load must be of such magnitude and carrying sufficient "through-screen" particles as to make up the difference between that quantity supplied by the original feed Q and the equilibrium quantity q.

The relations can be shown as follows:

$$L_c = \frac{Q - (1.00 - A)\,QE_s}{E_s\,P_c}$$

$$= \frac{Q\,(1.000 - (1.00 - A)E_s)}{E_s\,P_c}$$

In the example this calculates out as follows:

$$L_c = \frac{50\,(1.000 - (1.00 - 0.80)\,0.90)}{0.90 \times 0.85}$$

$= 53.6$ tons per hour.

The total screen load is $50 + 53.6$ or 103.6 tons per hour and the circulating load in percent of the feed rate is about 107.3.

Referring to Fig. 1, the dashed lines show the solution to the following problem:

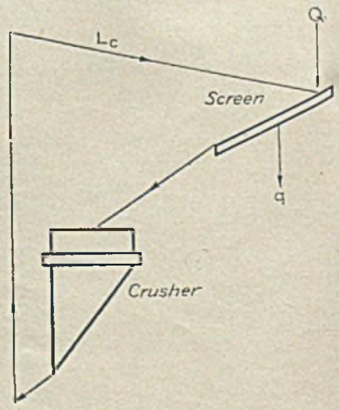
Example 2—The feed has 90 per cent of its pieces larger than ¾ in., which is the desired maximum size. The desired quantity is 100 tons per hour. The crusher is set at 0.825 in. and the screen is 93 per cent efficient.

The computation is made as follows:

$$L_c = \frac{100\,(1.000 - (1.00 - 0.90)\,0.93)}{0.93 \times 0.777}$$

$$= \frac{90.7}{0.723} = 125.5 \text{ tons per hour.}$$

Fig. 2—Simple closed-circuit crushing and screening problem



$P_c = 0.777$ is determined from the crushing law chart as shown by the dotted lines.

In using the proposed curves it is necessary only to locate the vertical dashed line according to the screen efficiency and the plus $\frac{3}{4}$-in. material in the feed. This line is extended upward until it intersects the proper curve of crusher opening in percentage of fine screen opening or in this case, $0.825 \times 100 \div 0.75 = 110$ per cent.

In most actual screening operations, the problem appears to be more complicated than the simple examples used here. Nevertheless, no matter how involved the screening and crushing arrangement may be, the chart can be used just so long as the process is of the closed circuit variety.

Measurement of Wet-Bulb Temperatures Below Freezing

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Carrier Corp., Syracuse, N. Y.

In a recent series of tests on some low-temperature air conditioning—around 10 deg. F.—it was necessary to determine the air-side capacity of a cold diffuser rather carefully. This involved measuring wet-bulb temperatures within about a tenth of a degree F. It was impossible, because of space limitations, to install and read glass thermometers. A system of wetted thermocouples was used. Furthermore, the heat of body and breath might affect the readings of thermometers, while the thermocouples could be used without exposure to body heat. Also, the opening of doors necessary to get in and out of the room to read thermometers frequently would upset room conditions during the test.

The thermocouples were made up into a grid consisting of several iron-constantan couples in parallel, each of the same size and length wire, balanced to prevent cross currents. All the iron wires were connected together and to an iron wire lead; all of the constantan wires were connected together and to a constantan lead. The iron wires were enameled to prevent rusting. The grids consisted of thermocouples held by a wire frame, the couples being placed 2, 3, or 4 in. apart to form a square in the plane of the frame. The grids were made to fit the cross sections of the air streams, and were placed wherever readings were desired, for example, above and below the coils.

Both dry- and wet-bulb readings were taken. The wet-bulb grids had the couple junctions covered with a small wick, which was wetted and allowed to freeze. The wick used was the same that is used on mercury thermometers, a cotton tubing material similar to the material used for shoelaces, washed with soap to remove all sizing so that it would wet. The material is made by the Diamond Braiding Mills, Chicago Heights, Ill., and is designated as No. 8000 white mercerized braid. It was found necessary to sew the wick in a longitudinal seam in order to have it fit snugly on the thermocouple.

The thermocouples were calibrated against a mercury-in-glass thermometer before using. The e.m.f. developed by the thermocouples was measured by means of a slidewire potentiometer, using a sensitive mirror galvanometer. The slidewire itself was mounted on a meter stick and the resistances of the system were adjusted so that 1 cm. movement of the slide along the wire represented 1 deg. F., and so that the reading in centimeters gave the temperature in degrees—thus, the 10 cm. position indicated 10 deg. F. An ice and water mixture in a vacuum flask was used as the reference junction. During operation the system was calibrated continually by checking a thermocouple in the cold room against a mercury thermometer hung next to it, both in an open vacuum flask, to prevent any radiation effect.

Since the potentiometer was located outside the room, readings could be taken in comfort and room conditions were not upset by opening doors. It was only necessary to enter the room to read the calibration thermometer and to wet the wet-bulb wicks. The latter would stay wet (frozen) for from 15 minutes to half an hour, or longer, depending upon the amount of ice deposited. However, for conditions where temperatures are changing, it is wise to prevent too much ice from forming on the wick, as the thermal inertia which would result might affect the readings.

Fig. 1 is a schematic diagram of the slidewire potentiometer used. The slidewire itself was a piece of 22 ga. (0.025-in.) Nichrome wire, mounted on a meter stick. For convenience in reading, the meter stick was cut in two at the 32 cm. mark, and the lower half then fastened at the opposite end, so the stick would read from 32 to 132 cm. Another scale, from 32 to —68, was lettered on the side of the stick, to be used for temperatures below 32 deg. F. Since the reference junction was always at 32 deg. F., temperatures above 32 at the couple being tested would produce currents in opposite direction from temperatures below 32, so a double-pole, double-throw switch was used to reverse the polarity when necessary. A double-pole gang switch was used so that several thermocouples could be measured without having to connect any wires during the test.

To calibrate the system, the slide was set at the point corresponding to the known temperature of the calibration couple. Then, with the gang switch set on the calibration couple, the variable resistor was adjusted until the galvanometer indicated no current flowing. For example, if the calibration couple were in a temperature of 0 deg. F., the slide was set at 0 and the resistor adjusted until the galvanometer showed no deflection. Then the e.m.f. represented by the drop along the slidewire from 32 to 0 just balanced the e.m.f. developed by the couple. Assuming the e.m.f. is directly proportional to temperature—and this is very nearly correct within the range involved—the slidewire will then read temperatures directly. It is wise, however, to have the calibration couple at approximately the same temperature as the temperature to be measured.

Fig. 1—Diagram of potentiometer for determining temperature of wet- and dry-bulb thermocouples above or below freezing

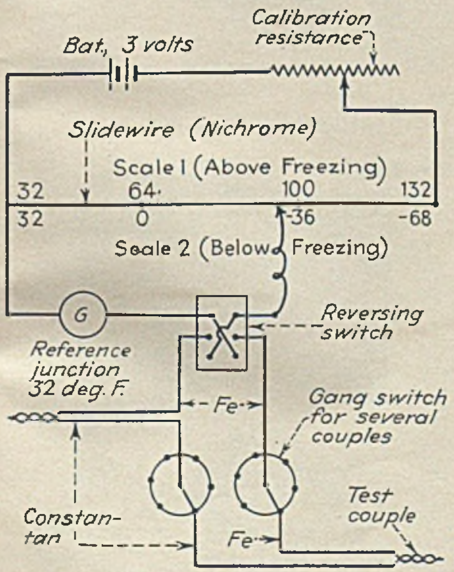
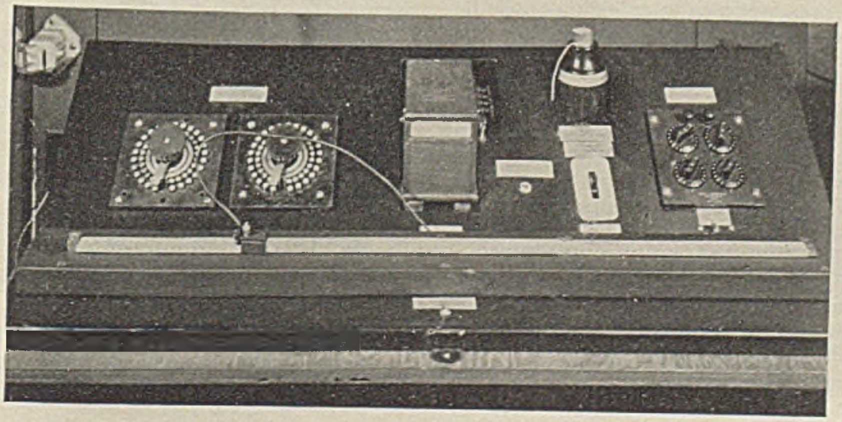


Fig. 2—View of potentiometer and associated apparatus, showing slidewire, temperature scales, galvanometer, gang switches and other elements



PROCESS EQUIPMENT NEWS

Electric Filter Closer

AUTOMATIC opening and closing of one or several filter presses is possible with a new motor-operated hydraulic pumping unit for filter press operation which has been announced by T. Shriver & Co., 810 Hamilton St., Harrison, N. J. The new unit provides for much quicker closing than other types of hydraulic devices for filter presses, according to the manufacturer. Push-button control can be provided at each filter press, or a single control can be used for operating several filter presses. Closing and tightening are accomplished in about one minute. No hand labor for tightening is required, thus reducing the overall time for preparing the filter press for work. A special arrangement on the follower of the filter press permits pushing plates and frames back against the head. A simple weight drawback can be employed, or hydraulic drawback of the ram can be furnished, if desired. The system is applicable to existing filter presses. It consists of a rotary hydraulic pump with suction control, a low pressure rotary pump for automatically increasing capacity at low working pressures, a motor, oil reservoir and the necessary connections and valves between the reservoir and the pump. The entire unit occupies a space only 40x14x39 in. high.

New Proportioning Pumps

TWO NEW TYPES of proportioning pumps have recently been added to the existing line of equipment manufactured by Proportioneers, Inc., Providence, R. I. One is a new series of Midget Adjust-O-Feeders available in both diaphragm and plunger types. The former type is built in capacities from 0 to $7\frac{1}{2}$ g.p.h. for pressures to 100 lb.; the latter type in capacities from 0 to 10 g.p.h. for pressures depending on the cylinder material used. Pumps equipped with plastic cylinders are capable of discharge pressures from zero to 150 lb., while with stainless steel or iron cylinders, the pressures may be as high as 1,000 lb. These pumps feature a straight-through shaft which permits coupling as many as eight units to a single motor. The unit employs a fully-inclosed supporting frame which protects moving parts from dust and dirt and eliminates the necessity of guards. Plunger types are equipped with this company's liquid-sealed stuffing gland.

This company has also developed a new large-size proportioning pump for handling regular and off-grade latex, as well as other viscous liquids. A special double stuffing gland contains metallic stripper rings for keeping the material handled out of the packing. Large, easily removable inspection ports are provided for ready inspection of the $3\frac{1}{2}$-in. diameter ball check valves, without the use of special tools. Liquid sealing is provided for the displacement plunger and stuffing gland, and provision can be made for water washing of the plunger as it moves through the stuffing box. This pump is available in both single and duplex construction, in sizes up to and including 30 g.p.m. at 40 r.p.m.

Electronic Variable Drive

A RECENT development of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is an adjustable-speed electronic motor drive which provides a 20 to 1 speed range and features automatic acceleration and deceleration. The flexibility of a direct-current motor drive, with an alternating-current supply, is obtained, since the incoming a.c. power is converted by grid-controlled rectifier tubes and supplied to the armature and field of a d.c. motor. The new drive gives an infinite number of speeds within the available range, provides constant torque at all speeds up to the base speed, and constant horsepower above the base speed.

The new electronic drive, known as the Mot-O-Trol, has been designed to fill the desired requirements of an a.c. adjustable-speed motor. The basic idea is not new, since the manufacturer has furnished such drives on special applications for several years. However, recent refinements have been developed which are said to make the new electronic system comparable to or better than other existing solutions to the variable speed problem.

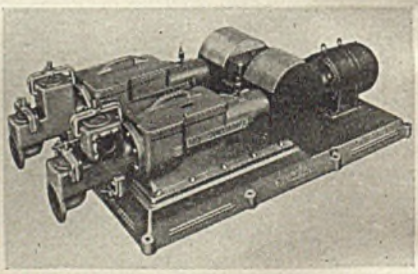
The system consists of a single- or poly-phase grid-controlled thyratron tube rectifier, which takes power from an a.c. line and delivers it as rectified direct current to a regular shunt-wound d.c. motor. The d.c. voltage may be varied from zero to the motor rated voltage (or above) for d.c. armature control. Smaller thyratron tubes are used to provide rectified d.c. field current for the motor. The field voltage is held constant throughout the range of armature voltage, and then is reduced to provide greater speed range by field weakening above the base speed of the motor. The equipment necessary includes a power transformer, electronic control, control station and d.c. motor. A dynamic braking resistor is provided for quick stopping of the motor.

Among the suggested applications for the new drive are the driving of conveyors and feeders in cement and chemical industries, lathes in the ceramic industry, and glass drawing machinery. Rubber tubing machinery and many sorts of paper industry machinery are also suggested applications.

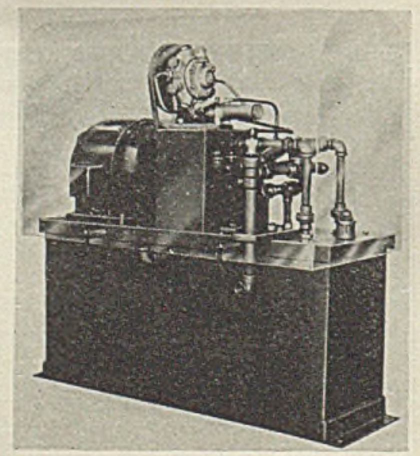
A.C. Welding Electrode

HIGHLY SPECIALIZED welding technique is not required in the making of overhead and vertical welds with the new all-position alternating-current electrode for electric arc welding which has been developed by the Metal & Thermit Corp., 120 Broadway, New York, N. Y., under the name of Murex Type A. The new electrode is available in sizes from $\frac{3}{32}$ to $\frac{3}{16}$ in. and offers

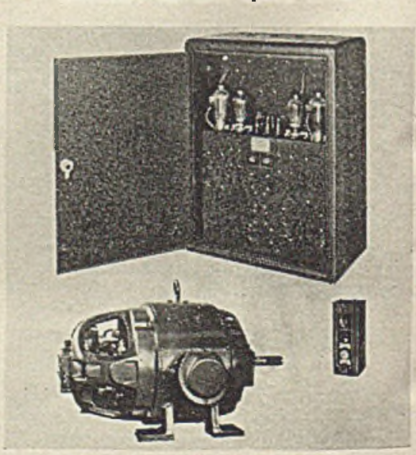
New latex proportioning pump

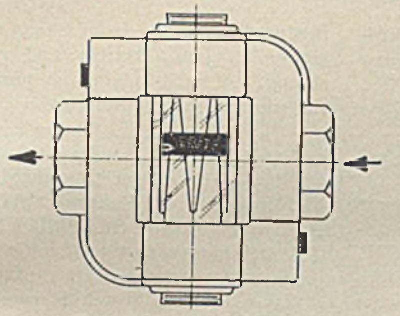


Electric-hydraulic filter closer

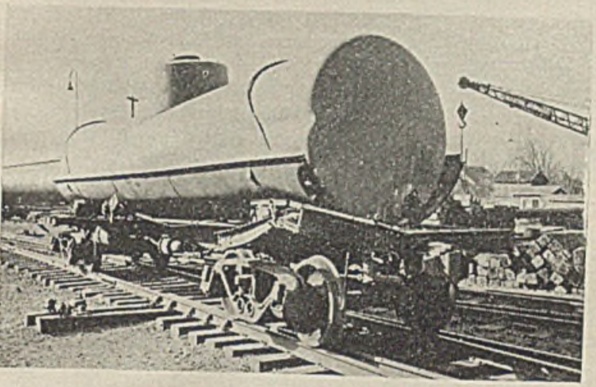


Electronic variable speed drive





New flow rate indicator



Welded Tank Car Survives Crash

As proof of the ability of all-welded tank cars to withstand railroad accidents, American Car & Foundry Co., builders of the car, point to the record of the car shown here. This 8,000 gal., class ICC-103-W single-compartment welded tank car was severely crushed in a railroad collision which sent the car hurtling down an embankment. When the car rolled over, the dome was caved in and the main head badly deformed. Retesting of the tank before repairs revealed not the slightest leak in any welded seam. The testing, which was carried out before the car was photographed, straightened it out somewhat, but the view gives a good idea of the damage. The tank was originally fusion welded by the Unionmelt process.

Improved industrial thermometer

Volatile liquid pump

typical physical properties of the weld metal such as 52,000 to 61,000 lb. per sq.in. yield point; 62,000 to 71,000 lb. per sq.in. ultimate tensile strength; and 22 to 26 percent elongation in 2 in.

Flow Rate Indicator

Simplicity of construction and low cost are important features of the new Rota-Sight flow rate indicator recently introduced by Fischer & Porter Co., Hatboro, Pa. The new device operates on a principle similar to that of other area meters such as the rotameter but is considerably simplified as compared with meters intended for precise flow rate indication. The function of this device is to show when liquid is passing through a line and, in addition, to give an approximate indication of the flow rate. The device consists of a Pyrex glass tube into which triangular flutes, similar to the V-ports of a valve disk, have been formed. The inner sections of the tube between the flutes are arcs of a circle into which a cylindrical float fits with sufficient clearance to allow it to move without binding. It is said to be possible to see the float readily even when the liquid handled is opaque. The tube is only 3 in. long and is supported within a frame formed from two identical universal fittings, permitting the entering and leaving pipes to be connected to the device in any one of several different ways. Rota-Sights are made in sizes from ½ to 2½ in., for maximum flow rate on water from 4 g.p.m. to 57 g.p.m., the corresponding flow rates on air being 7.5 c.f.m. and 130 c.f.m. If desired, this device may be provided with a magnetic extension which trips an external magnetic switch to operate an alarm circuit for high or low flow rates.

Volatile-Liquid Pump

Designed primarily for aviation refueling systems, a new line of deep-well, turbine-type pumps has been announced by the Deming Co., Salem, Ohio, for industrial uses as well. These pumps are intended primarily for the handling of hydrocarbon liquids, particularly those of volatile character, and are regularly equipped for explosive-atmosphere service, either with explosion-proof vertical motors, or with a right-angle drive for connecting to a driving unit which may be installed in a separate room.

Advantages of the new pump include elimination of priming difficulties, low installation costs, minimum floor space requirements, high efficiency, low operating cost and freedom from lubrication difficulties. Pumps of this type are lubricated only by the liquids being pumped, requiring no other lubricant. They are available in capacities for gasoline and fuel oil up to 1,000 g.p.m., against ordinarily encountered head pressures in refueling systems. Higher capacities can be had at slightly reduced pressure. Impellers are easily adjustable for changes in capacity or to compensate for eventual wear after long service. The pumps are claimed to be self-venting and incapable of becoming vapor-locked. Instant delivery of liquid is said to be assured, regardless of temperature conditions.

Industrial Thermometer

An improved glass industrial thermometer is now being manufactured by American Schaeffer & Budenberg Instrument Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn. The manufacturer claims all major design improvements accumulated in recent years have been incorporated in this model. It is constructed to permit back, side or oblique angle mounting without the use of a ball joint. Scales and tubes are located for greatest readability, while a new method of scale marking is said to improve legibility. A practically corrosion-proof case is employed which is provided with a black suede finish. The scale is black with yellow figures while the tube is of the red-reading mercury type.

Glass Column Packing

Announcement has been made by Owens-Corning Fiberglas Corp., Toledo, Ohio, of the successful use of glass fibers as a packing material for rectifying columns used in the production of 190-proof ethyl alcohol by the beverage distilling industry. Glass fibers, according to the manufacturer, may be used as an alternate for both bubble plates and various rigid types of tower packing. The result of the use of this material is claimed to be an increase in capacity owing to the increase in exposed surface area presented by these fibers, as compared with that of either bubble plates or rigid packing.

One method of use of glass fibers is to place them in large expanded-metal baskets which fit, one over the other, into the inside of the column. When used at their normal density of 3.5 lb. per cu.ft., the fibers present 135 sq.ft. of exposed surface per cubic foot, compared with an exposed surface area of 56 sq.ft. per cu.ft. when raschig rings are used. Rectifying columns are now being built with the shell constructed of such materials as clay tile, cypress staves and steel plate salvaged from discarded tanks.

Rubber-Saving Drive

Possibility of saving as much as 250,000 lb. of crude rubber during 1943 through a slight change in the design of multiple V-belt drives is suggested by Walter Geist, president of Allis-Chalmers Mfg. Co., Milwaukee, Wis. The program suggested by Mr. Geist calls for wartime drives using shorter center distances and larger sheaves on all new applications made this year. It is pointed out that engineering of individual V-belt drives in the past has been governed largely by such considerations as convenience, habit and machine design. In order to save considerable amounts of rubber, however, it is only necessary to employ higher belt speeds, thus permitting a smaller number of belts to be used to transmit the same horsepower. This can be accomplished by using larger diameter sheaves which of course can be chosen to give the same ratio between driving and driven sheaves, but have the higher peripheral speed required to increase the belt speed as desired. An incidental point is that the larger diameter sheave is not necessarily heavier or more expensive since it has fewer grooves. In fact, in some cases it will be lighter and less expensive. The new system must, of course, be applied with judgment, employing belt speeds not over 5,000 feet per minute so as to avoid slippage due to centrifugal force. Properly engineered, such drives are claimed to be an improvement and not simply a wartime expedient.

Shovel Scoop Truck

Typical of the new devices being developed by Towmotor Corp., Cleveland, Ohio, for attachment to standard lift trucks is the new shovel-type scoop shown in an accompanying illustration. This can be exchanged with standard parts to permit picking up, carrying and dumping all types of loose bulk material. The new scoop is available in capacities from 8 to 25 cu.ft. and can be used for handling bulk chemicals, ores, glass scrap and similar materials. The scoop is manually controlled to pick up or dump material at any point within the lift range.

Plastic-Covered Rolls

An accompanying illustration shows a new type of plastic-covered roll of "Shaf-Tite" construction, recently developed by Rodney Hunt Machine Co., Orange, Mass. The roll illustrated is about 5½ in. in diameter. It is of metal, the surfaces of the roll body being covered with a plastic which provides a hard, smooth, glass-like surface which is said to be unaffected by most acids and alkalies. It is offered for use where exposed iron and steel are objectionable and where a hard, smooth surface is desirable.

Seamless Plastic Tubing

Seamless plastic tubing in all diameters up to 2 in. O.D. is now available from Extruded Plastics, Inc., Norwalk, Conn., extruded from Tennessee Eastman cellulose acetate butyrate. The new material is known as Tulox TT. Shortly the manufacturer expects to extend the range to 2½ in. O.D. to meet all requirements for war production. The material is available from stocks at the warehouses of concerns such as the Crane Co., Chicago, and Julius Blum & Co., New York.

Equipment Briefs

Adding to its line of safety equipment for industry, Davis Emergency Equipment Co., 45 Halleck St., Newark, N. Y., has introduced a new safety extension light which is claimed to prevent the possibility of electric shock to the user, even when the guard is removed. The guard is of heavy fiber and is so designed as to serve as the on-and-off switch. When it is unscrewed the current is automatically cut off. All parts of the device except the actual contacts are made of non-conducting materials. Bulbs may be replaced without tools.

For the waterproofing of brick, cement and concrete, even where hydrostatic pressure is present, Modern Waterproofing Paint Co., 1270 Sixth Ave., New York, N. Y., is now offering a new mineral paint, Aquella, which is said to be suitable for all unpainted interior surfaces of these materials. Two coats applied to a wet wall are said to bond to the wall material and not to flake, peel or blister. This treatment will, according to the manufacturer, render the wall impermeable against capillarization and seepage of water.

An improvement in removable liners for rotary pumps is incorporated in a new pump recently introduced by Blackmer Pump Co., Grand Rapids, Mich. The pump employs the same swinging vane principle found in all pumps of this concern's line, but the liner design is such that its replacement does not require disturbing either the piping or the drive. It is claimed that a pump can usually be relined and back on the line within half an hour. Capacities range from 20 to 750 g.p.m., with pressures up to 300 lb. per sq. in.

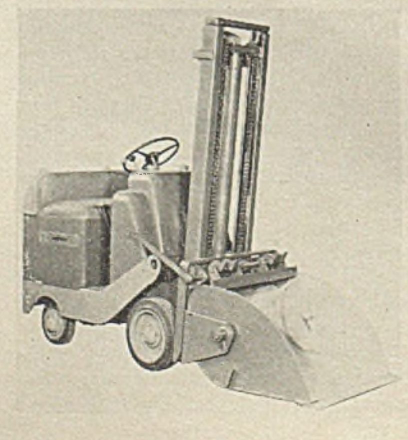
The new safety siphon for emptying carboys, developed by T. P. Callahan and recently introduced by Alden Speare's Sons Co. (*Chem. & Met.*, Jan. 1943, page 109), is now available from Central Scientific Co., Chicago, Ill. Being made entirely from Saran, the new siphon is both flexible and extremely strong. A built-in vacuum pump starts the siphon in complete safety.

Another recent metal-saving plastic application has been announced by Penn Metal Corp. of Pennsylvania, Oregon Ave. and Swanson St., Philadelphia, Pa. This company's new product is a plastic card holder produced from transparent cellulose acetate which is easily affixed to lockers, shelving, doors, etc., for the insertion of a card bearing identifying information. A card size of 3⅛ x 1 in. can be accommodated.

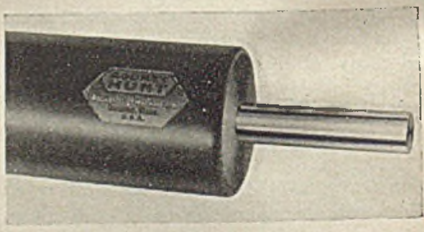
Max Mosher, 130 West 42d St., New York, N. Y., has announced development of an automatic feeder control for pulverizing magnesium, which has been installed in a magnesium plant to speed production and safeguard personnel. The control regulates the rate of feed of magnesium shavings to a grinder where the shavings are converted into fine powder. The feeder is housed in a separate building alongside the one where the grinder is located, for reasons of safety. Chips are carried from the feeder through a pipe by air suction. If the rate of feed is too great, the grinder becomes clogged, resulting in the possibility of a burn-out of the grinder motor, but also in a possible explosion due to overheating. With the new control, the operator merely dumps magnesium shavings into the hopper at intervals, the controller maintaining the maximum safe rate of feed at all times.

Correction—Through an inadvertence the name of the manufacturer of one of the items described in our New Equipment section for May, 1943, was omitted. The omission occurred in an article on page 151, describing the new eye-protective glass, known as Didymium-Noviweld, which is manufactured by the American Optical Co., Southbridge, Mass. The new glass is intended for use in goggles for protecting the eyes of gas welders.

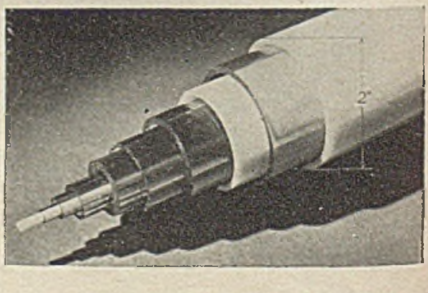
New scoop for lift trucks



Plastic-covered roll



Cellulose acetate butyrate tubing



Production of Buna-S Synthetic Rubber

A Chem & Met FLOW SHEET

THE BUNA S RUBBER PLANT of the Defense Plant Corp., at Institute, W. Va., operated by Carbide and Carbon Chemicals Corp. and United States Rubber Co., has a rated capacity of 90,000 long tons a year. The chemicals section is composed of four units for the production of butadiene and two for styrene. The copolymer plant is made up of three units.

Alcohol from storage tanks passes through a series of converters where heat and the action of catalysts convert a portion of it to butadiene. Unreacted alcohol and intermediate products are removed for recycling through the converters in a recovery system consisting of distillation towers and scrubbers. The butadiene is purified by distilling and washing until it is over the 98.5 percent purity specified by the Rubber Reserve Corp. It is stored in pressure tanks. The raw materials required for styrene production are benzol and ethylene. They are passed over a catalyst in an alkylator to form ethylbenzene. The latter is removed from unreacted benzol and byproducts in a series of fractionating columns and held in intermediate storage tanks. This ethylbenzene is fed to a second set of reactors where two hydrogen atoms are removed to form styrene. The latter is purified by distillation and stored.

The copolymer plant is essentially a standard plant built to plans developed by a committee of engineers from four rubber companies. Such ingredients as soap, catalyst, salt, acid, and caustic, are delivered to the plant by rail. The butadiene and styrene are delivered by pipeline from the adjacent plant. The process consists of mixing three parts of butadiene and one part of styrene with seven parts of soap solution to form an emulsion. Polymerization takes place in a glass-lined vessel. When it reaches the proper stage, the batch is forced by its own pressure to a blow-down tank where the reaction is arrested. The latex is then passed through flash tanks to remove unreacted butadiene and then through strippers to remove styrene. It is pumped to a large blending tank where several batches are mixed so as to attain uniformity. Latex passes into the creaming tank where brine is added; next into a coagulation tank and then into a soap conversion tank where acid is added and the soap in the rubber changed to fatty acid. The dilute chemical solution is separated on a rotary filter and the crumbs of rubber are washed. A belt conveyor takes them to the disintegrator from which they pass into the dryer. After three passes through the tunnel dryer, the crumbs are compressed into 75-lb. blocks and shipped. (For additional details see article on pp. 98-102.)

CHEMICAL & METALLURGICAL ENGINEERING

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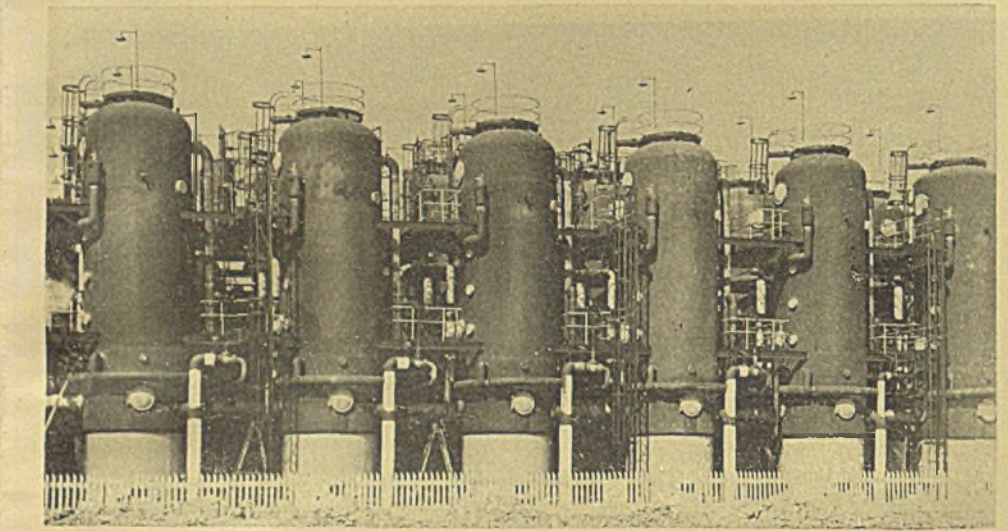
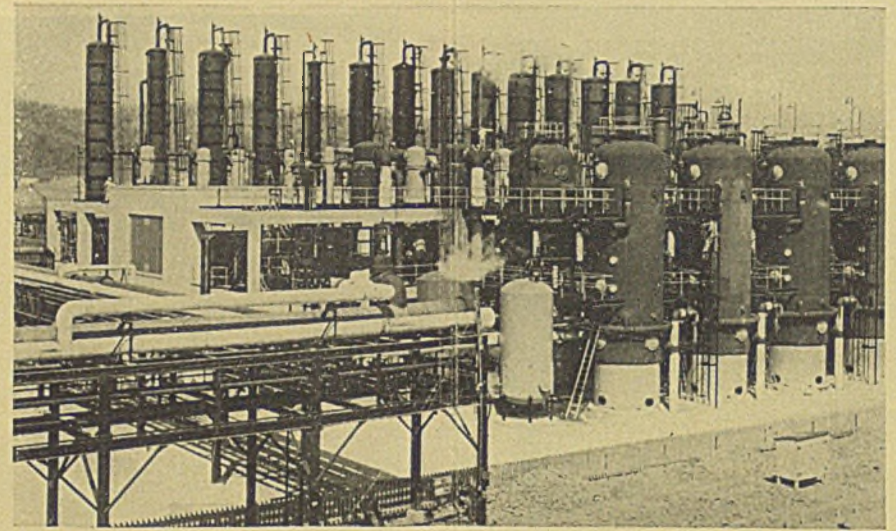
PAGES 140 to 143

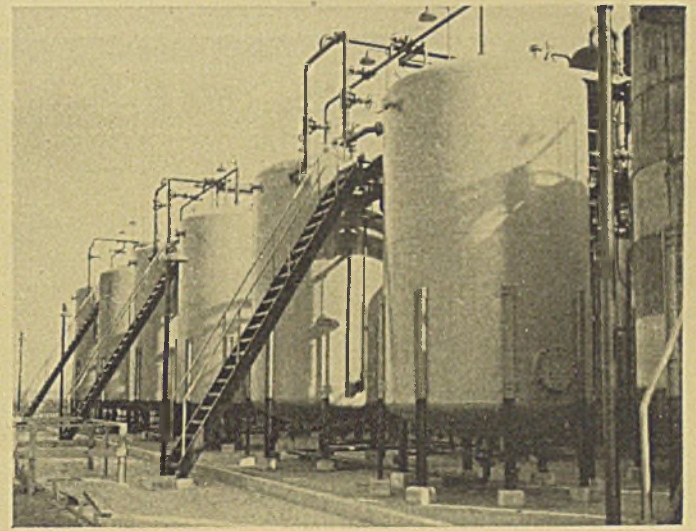
1 Alcohol is shipped to the butadiene plant by tank cars or by barge and is stored in tanks



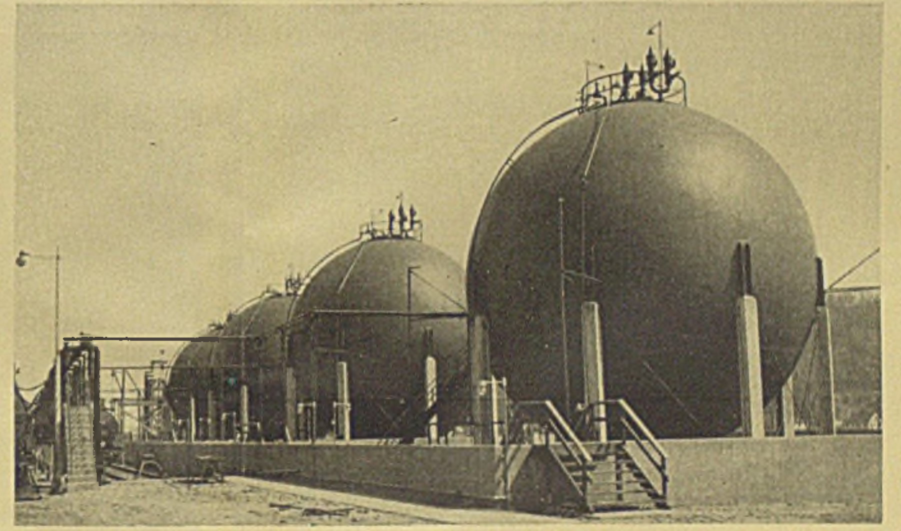
2 Alcohol passes through converters where by heat and action of catalysis a portion is converted to butadiene. Unreacted alcohol and intermediate products are removed



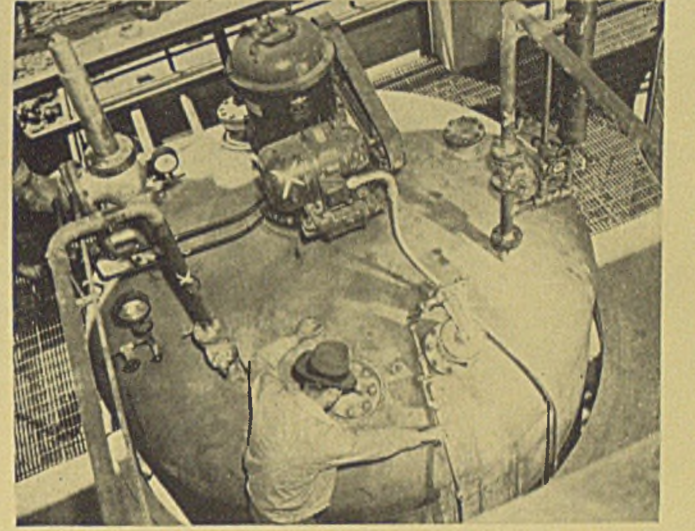
3 Butadiene is purified by distilling and washing until it is over the 98.5 percent purity specified by the Rubber Reserve Co. It is stored in pressure tanks



4 These tanks are used to store temporarily some of the intermediate products from the converters

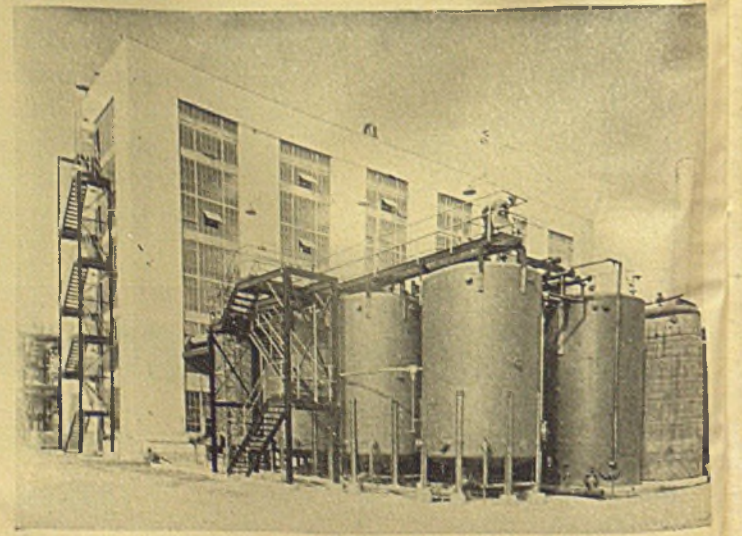


5 Purified butadiene is stored in pressure tanks and is delivered to the copolymer plant by pipeline. It is metered as it passes from chemicals to copolymer plant

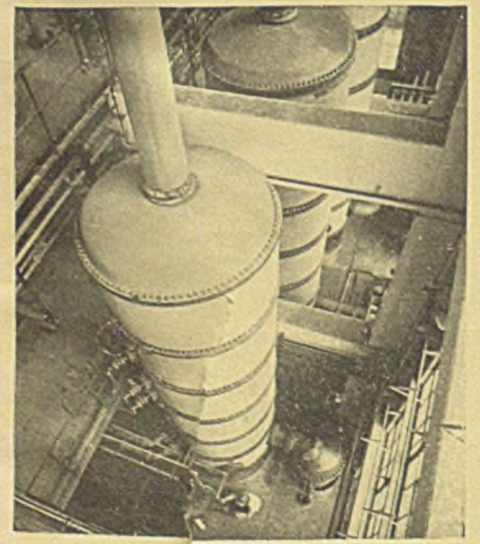


8 Butadiene and styrene are reacted with a catalyst in glass-lined pressure vessels to form the latex

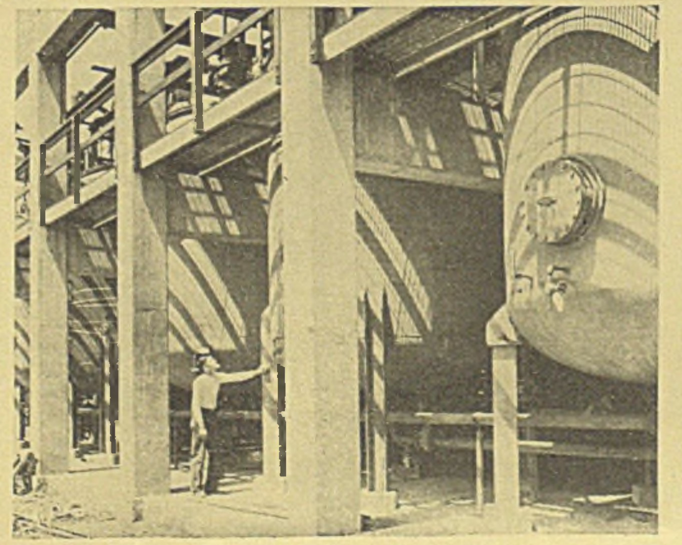
6 Benzol and ethylene are passed over a catalyst in an alkylator to form ethylbenzene which is removed from unreacted benzol



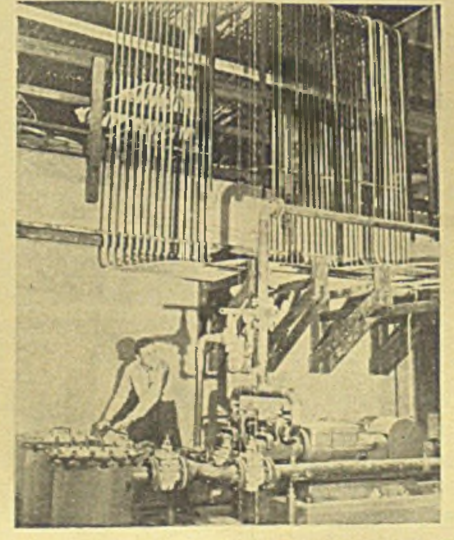
7 Styrene is purified by distillation and stored until delivered to copolymer plant



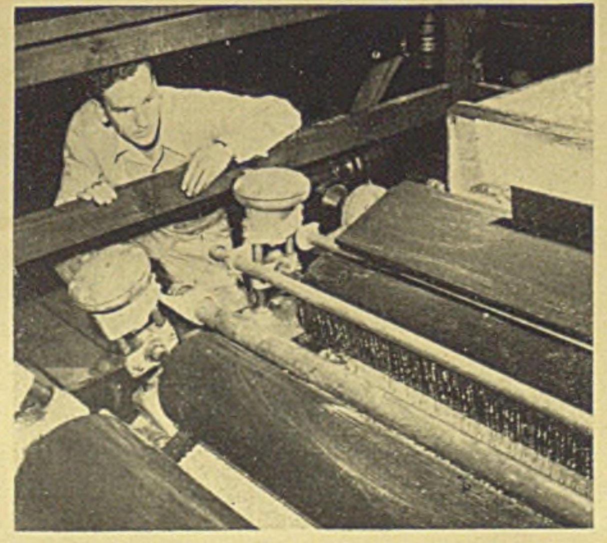
9 The polymerized batch is transferred to blow-down tanks in which the reaction is arrested



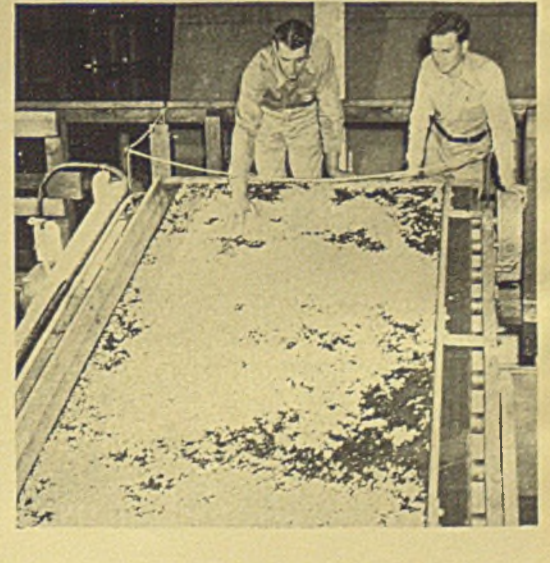
10 Many batches of latex are blended in 30,000 gal. concrete tanks



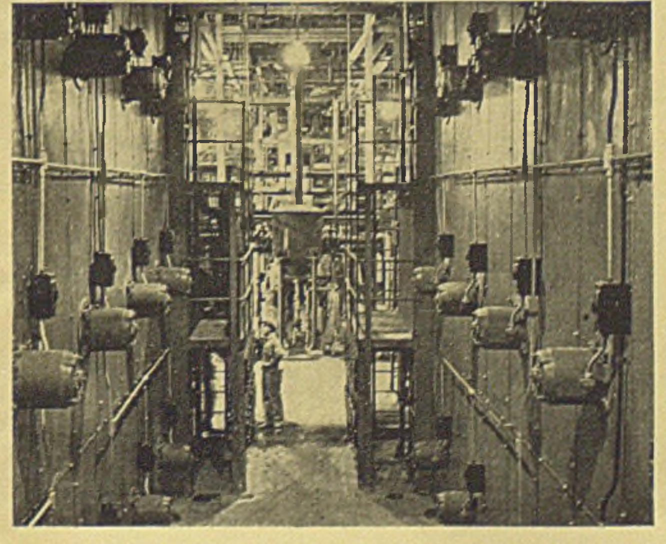
11 On a rotary filter dilute chemicals are separated and rubber washed with fresh water



12 Washed crumbs of rubber, in the form of a blanket, are conveyed on a belt to the disintegrator and dryer



13 Rubber is dried by three passes through a tunnel dryer. It leaves the dryer on a screw conveyor



14 Buna S synthetic rubber is pressed into a 75 lb. loaf. The plant will produce 9,000 loaves per day

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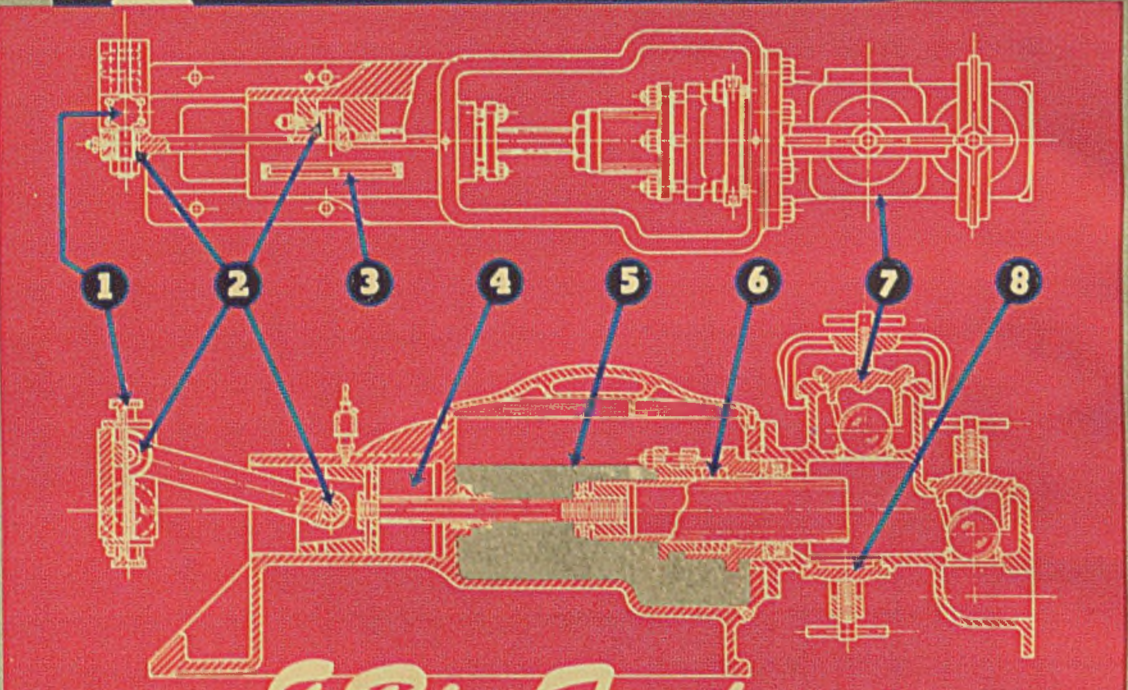

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1. **MICROMETER** stroke adjustment for exact displacement regulation.
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3. **STROKE INDICATOR** scale mounted on cross-head frame shows actual plunger displacement.
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5. **FLUID SEALED** plunger and stuffing gland prevents destruction of frame and working parts by corrosive liquids and of packing by eliminating build-up on plunger from liquids carrying suspended solids.
6. **STUFFING GLANDS** with lantern rings, liquid seals and "wash" connections,—as well as "stripper" rings when required.
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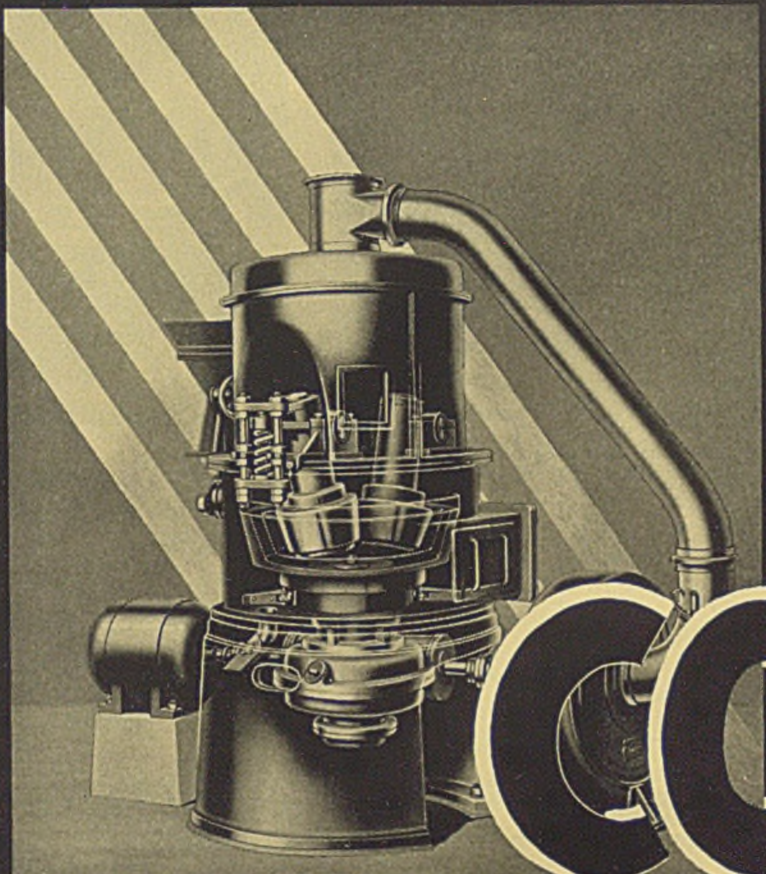
CRANE VALVES



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Chemical Engineering NEWS

NEW MAGNESIUM PLANT IN OPERATION ON WEST COAST

The first of the units of the new government-owned magnesium plant at Spokane, Washington, went into operation on May 25. The plant is being built and operated by the Electro Metallurgical Co., a subsidiary of the Union Carbide and Carbon Corp., for the Defense Plant Corp.

Completed 11 months from the time construction work was started, the new plant is the first and largest completely integrated mill for the production of magnesium from dolomite by a thermal reduction method. Capacity of the plant, when in full operation by the end of this year, will be approximately four times the entire annual pre-war production of the entire United States.

The metallic magnesium to be produced in the Spokane plant will draw on raw materials found in the region. The method for the production, and the furnaces and equipment were designed by the Electro Metallurgical Co. In this process, calcined dolomite is smelted with ferrosilicon in large electric furnaces. Dolomite is abundant in the Spokane region, while the large amount of electric power required is obtained from the Grand Coulee Dam hydro-electric development.

ABBOTT LABORATORIES MAKES FELLOWSHIP GRANTS

Abbott Laboratories has announced that its plan of post-graduate fellowships for research in organic chemistry and in biochemistry will be continued for the academic year 1943-44. These fellowships are to aid capable graduate students in continuing their studies. There are no restrictions as to the professor under whom the work is to be done or the subject to be undertaken. The stipend is $750 per year. For the coming year the fellowships are available to both men and women.

The universities to whom these fellowships have been awarded for the coming year are, in organic chemistry, California, Illinois, Michigan, Minnesota, Purdue, Rochester, and Stanford; in biochemistry, Duke and Iowa State College.

COLLYER DISCUSSES POSTWAR POSITION OF RUBBER

Addressing the New York State Chamber of Commerce on June 3, John L. Collyer, president of the B. F. Goodrich Co., recommended that the nation's synthetic rubber facilities be kept intact after the war and in operation at least on a limited basis. He said world consumption of rubber, crude and synthetic might reach a total of 2,000,000 tons a year after the war, or almost twice as much as ever consumed even in the biggest years up to now. He said the progress already made in synthetic production had run ahead of expectations both as to indicated capacities of given plants and in the adaption of the material to necessary uses. A clue to the progress being made, as reflected in price, he said, was seen in the fact that while his estimate three years ago before a Senate committee that synthetic rubber could be produced on a large scale in this country for as low as 25c a lb. had been received with skepticism the office of Rubber Director Jeffers was reported as mentioning 16c as a probable price but it will take a lower cost than that to eliminate natural rubber on economic grounds.

SOLID MOLASSES PLANNED TO AID IN TRANSPORT

Molasses can be dehydrated and packaged in paper bags so that it may be moved in ordinary ship space from Cuba and Puerto Rico to the United States. This development, credited to the scientists and engineers of Board of Economic Warfare, may aid greatly in getting this important raw material to industrial alcohol plants of the Eastern Seaboard. Between 350 and 400 million gallons of molasses are available in nearby islands where facilities for evaporation to dryness are believed available in the present sugar mills, with very slight modifications and additions of equipment. Development work is in process under the public service patents which have been applied for. Any interested sugar producers or alcohol makers will be assisted in development work if desired. No estimates of cost are made by officials.

CHEMICAL SUBSTITUTES URGED FOR SCARCE ITEMS

WPB is aggressively working on alternate chemical supplies where otherwise increased production capacity would be necessary to meet essential industry needs. Great encouragement is being given, for example, to the development of apple honey, a sirup made from apple juice, as a substitute for glycerine in tobacco products. But at the same time other government officials warn that miscellaneous substitutions are to be watched carefully, especially in foods and drugs. Use of various glycols instead of glycerine in such commodities is particularly condemned.

The antifreeze problem also is causing active planning because butyl alcohol will not be available as a denaturant for much of the alcohol assigned to this service for next winter. About half of the 42.5 million gallons of alcohol so used will have to be denatured with other chemicals. Incidentally, methyl isobutyl ketone has to be allocated by WPB because of these scarcities.

GOLDENROD PLANTED AS PART OF RUBBER PROGRAM

Experimental plantings of four selected strains of goldenrod totaling 650 acres have been completed this spring by the USDA as part of the 1943 emergency rubber program. As authorized by Rubber Director William M. Jeffers, the Forest Service has planted selected strains of goldenrod on about 550 acres in the vicinity of Waynesboro, Georgia. Small experimental plots of two to ten acres were planted by the Bureau of Plant Industry, Soils, and Agricultural Engineering in South Carolina, Alabama, Mississippi, Louisiana, Texas, and California. Threefold purpose of the planting program is to determine the best locations, soil types, and methods for growing rubber-producing goldenrod; to obtain more complete information on possible yields; and to harvest a supply of goldenrod for testing extraction methods, and the properties and uses of the rubber product.

ARGENTINA AND CHILE ENTER INTO TRADE AGREEMENT

According to advices received by the Department of Commerce, Argentina and Chile have entered into a ten-year agreement whereby Argentina will purchase only natural sodium nitrate; will prohibit importations of substitutes; and will not construct a synthetic nitric acid plant. In return, Chile has agreed to maintain a supply of 10,000 tons of sodium nitrate in Argentina and to sell a maximum of 25 metric tons of iodine to the Argentine government for official industrial use. Provision is made for automatic renewal of the agreement after ten years.

FERTILIZER ASSOCIATION WILL MEET AT HOT SPRINGS

National Fertilizer Association will hold its annual convention June 21-23 at The Homestead, Hot Springs, Virginia. Government officials have been invited to participate so that the bulk of the program will be a war conference. Contrary to the usual custom the Association will not have an elaborate series of social functions nor the usual golf tournament.

PLACEMENT OF CHEMICAL ENGINEERS

Chemical engineers and men and women with technical training are assured of all-round placement service when they register with local U. S. Employment Service offices, according to a statement of Paul V. McNutt, chairman of the War Manpower Commission. A cooperative procedure between the National Roster of Scientific and Specialized Personnel, of the WMC Bureau of Placement and all local offices of the Employment Service, has been placed in operation. The names of registrants, together with information regarding each applicant's availability, are now immediately sent to the National Roster if they cannot be placed locally.

ADVISORY COMMITTEE SET UP TO AID WAR INDUSTRIES

Early in 1942 a number of scientists in Minnesota felt they could make a greater contribution to the war effort if they were able to help solve scientific and technical problems that industries uncovered as they converted to war production. Discussions with government officials brought the suggestion from Dr. Donald Keyes that state organizations be established to handle in an advisory capacity the technical problems arising from the transition of industry to war work. As a result, Governor Stassen in cooperation with the Minnesota Resources Commission, set up a scientific advisory committee to Minnesota war industries. L. H. Reyerson, Professor of Chemistry and Director of the Northwest Research Institute, University of Minnesota was made chairman of the committee. Other members are T. L. Joseph, Professor of Metallurgy and Head of the Department of Metallurgy; I. M. Kolthoff, Professor of Analytical Chemistry and Chief of the Division; Louallen F. Miller, Professor of Physics; Ralph E. Montonna Professor of Chemical Engineering and Associate Director, Northwest Research Institute; Frank B. Rowley, Professor of Mechanical Engineering and Director of the Engineering Experiment Station; and M. B. Visscher, Professor of Physiology.

An advisory committee on chemical matters likewise has been appointed for the Detroit area of Michigan by Dr. Harvey N. Davis, Director of the Office of Production, Research and Development of WPB. Dr. Alfred H. White, Professor of Chemical Engineering, University of Michigan, is chairman of the committee and other members are: Dr. George Calingaert, Director of Chemical Research, Ethyl Corp.; Dr. Arthur H. Carr, Dean of the College of Engineering of Wayne University; Dr. Clyde C. DeWitt, Chairman of the Department of Chemical Engineering, Michigan State College; Ralph D. Hummel, Assistant Manager, Chemical Department, Parke, Davis and Co.; Dr. Harvey Merker, Superintendent of Manufacturing, Parke, Davis and Co.; Mark E. Putnam, Vice-President, Director, and Production Manager, Dow Chemical Co.; and Major W. P. Putnam, President, Detroit Testing Laboratory.

Employees of the Tennessee Valley Authority's Nitrate Plant No. 2 have received the Army-Navy "E" award for, according to Under Secretary of War Robert P. Patterson, "high achievement in the production of war material and for accomplishing more than seemed reasonable or possible a year ago." Colonel J. P. Harris of the Picatinny Arsenal presented the award and Arthur M. Miller, director of the Department of Chemical Engineering of the TVA, accepted it on behalf of the employees

E Awards

FOR PRODUCTION EXCELLENCE

Among the companies which, in the past month, have been awarded the honorary Navy "E" and joint Army and Navy "E" burgee for exceeding all production expectations in view of the facilities at their command, are included the chemical and explosives plants, the chemical process industries and the chemical engineering equipment concerns listed below. Other process and equipment plants will be mentioned in these columns as the awards are presented to the individual plants.

Alloy Steel Products Co., Linden, N. J.
American Art Metals Co., Inc., Atlanta, Ga.
American Brass Co., Kenosha Brass Co., Kenosha, Wis.
American Cyanamid & Chemical Corp., Selden Division, Bridgeville, Pa.
American Locomotive Co., Latrobe, Pa.
Badger Meter Mfg. Co., Milwaukee.
Bard-Barker Co., Danbury, Conn.
Bermite Powder Co., Saugus, Calif.
Borg-Warner Corp., Rockford Drilling Machine Division, Plants No. 1, 2, and 3, Rockford, Ill.
Brass Foundry Co., Peoria, Ill.
Bridgeport Brass Co., Ordnance Plant, Indianapolis.
Brown Steel Tank Co., Minneapolis.
Buffalo Arms Corp., Buffalo.
Chicago Bridge and Iron Co., Ship Building Division, Seneca, Ill.
Cleveland Tractor Co., Cleveland.
Arthur A. Crafts Co., Boston.
Cudahy Packing Co., Omaha, Nebr.
Curtiss-Wright Corp., Propeller Division, Beaver, Pa.
Defiance Automatic Screw Co., Defiance, Ohio.
DeLong Hook and Eye Co., Philadelphia.
E. I. du Pont de Nemours & Co., Electrochemical Division, Perth Amboy, N. J. and Belin Plant, Moosic, Pa.
Erie Foundry Co., Erie, Pa.
Evansville Ordnance Plant, Chrysler and Sunbeam Divisions, Evansville, Ind.
Federal Cartridge Corp., Twin City Ordnance Plant, Minneapolis.
General Motors Corp., Fisher Body Division, Aircraft Unit, Plant No. 21 and Fleetwood Unit, and Research Laboratories, Detroit.
B. F. Goodrich Co., Clarksville, Tenn.
Gustin-Bacon Mfg. Co., Insulation Board Plant, Kansas City, Kans., and Rolagrip Pipe Coupling Division, Kansas City, Mo.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Improved Paper Machinery Corp., Nashua, N. H.
International Industries, Inc., Plant No. 2, Ann Arbor, Mich.
Jones & Laughlin Steel Corp., Pittsburgh.
Lawrence Leather Co., Shearling Tannery, Winchester, N. H.
Link-Belt Co., Ewart Works, Indianapolis.
Link-Belt Ordnance Co., Chicago.
Mall Tool Co., Chicago.
Mason Can Co., East Providence, R. I.
Maxim Silencer Co., Hartford, Conn.
Metal Specialty Co., Cincinnati.
Minneapolis-Moline Power Implement Co., Como Ordnance Plant, Minneapolis.
Nashawena Mills, New Bedford, Mass.
National Enamel & Stamping Co., Granite City, Ill.
D. W. Onan & Sons, Arrowhead, Madison, Royalston, and University Plants, all in Minneapolis.
Parkersburg Rig and Reel Co., O. C. S. Division, Coffeyville, Kan.
The Protectoseal Co., Chicago.
Philadelphia Gear Works, Inc., Philadelphia.
Quaker Oats Co., Cedar Rapids, Ia.
R. C. A. Laboratories, Princeton, N. J.
Resinous Products and Chemical Co., Bridesburg, Philadelphia.
Revere Copper & Brass, Inc., Baltimore.
John Royle & Sons, Paterson, N. J.
Skilsaw, Inc., Chicago.
Savannah Machine & Foundry Co., Savannah.
E. H. Scott Laboratories, Inc., Chicago.
J. P. Seeburg Corp., Plants No. 1, 2, and 3, Chicago.
Stamford Rolling Mills, Springdale, Conn.
St. Charles Mfg. Co., St. Charles, Ill.
Thomson Machine Co., Belleville, N. J.
Thomson Co., Thomson, Ga.
Tappan Stove Co., Mansfield, Ohio.
United States Metals Refining Co., Carteret, N. J.
United States Rubber Co., Shelbyville, Tenn., and Eau Claire Ordnance Works, Eau Claire, Wis.
Vaughan Novelty Mfg. Co., Inc., Chicago.
Wald Mfg. Co., Inc., Maysville, Ky.
F. W. Wakefield Brass Co., Vermilion, Ohio.
Wayne Pump Co., Fort Wayne, Ind.
Wilson & Co., Inc., Chicago.
Worcester Moulded Plastics Co., Worcester, Mass.

WASHINGTON NEWS

Rows between government agencies are to be settled by an old arbiter with a new title, James F. Byrnes, now Director of War Mobilization. Moving rapidly to beat Congress to the Punch, President Roosevelt established his super agency Office of War Mobilization. Next to the President. Byrnes becomes the most powerful figure in Washington. He is on a par with the chiefs of staff and can also issue directives to them. Donald Nelson, WPB Chairman, is in third place and many think that he has abdicated that spot in favor of Charles Wilson, WPB Executive Vice Chairman, who has been both calling the signals and carrying the ball in recent months.

Congressional action to form an Office of War Mobilization was started last session, the idea being an overall top agency similar to the one established by the Executive Order of May 27, 1943. At the request of the Administration the idea was allowed to languish in committee. In the meantime, Donald Nelson moved to forestall Congress by requesting the President to appoint three new members to the War Production Board (*Chem. & Met.*, May, 1943, p. 165). The enlarged War Production Board provided a common meeting ground for all government agencies engaged in the production of raw materials and their fabrication for war and for essential civilian supply. Subsequent events have shown that Mr. Nelson was unsuccessful in his effort to prevent another layer of Bureaucracy from being interposed between his office and the White House.

The only comparable grant of presidential power to that given Justice Byrnes occurred in January, 1942, when the War Production Board was established under the direction of Donald Nelson. Some powers granted to the WPB Chairman were never exercised and others were delegated to the various "Czars." The latest Presidential action again places power over production and procurement in the hands of one man.

President Roosevelt stated at the time OWM was created, "We are entering a phase of the war effort when we must streamline our activities, avoid duplication and overlapping, eliminate interdepartmental friction, make decisions with dispatch, and keep both our military machine and our essential civilian economy running in team and at high speed."

The executive order establishing the Office of War Mobilization also established a War Mobilization Committee consisting of the Director, Secretary of War, Secretary of Navy, chairman of the Munitions Assignment Board, chairman of the War Production Board, and the Director of Economic Stabilization. Power to act is vested in the Director of War Mobilization. Paragraph III of the Executive Order, giving the functions of the office, reads, "It shall be the function of the Office of War Mobilization, acting in consultation with the committee and subject to the direction and control of the President.

"(a) To develop unified programs and to establish policies for the maximum use of the Nation's natural and industrial resources for military and civilian needs, for the effective use of the national manpower not in the armed forces, for the maintenance and stabilization of the civilian economy, and for the adjustment of such economy to war needs and conditions.

"(b) To unify the activities of Federal agencies and departments engaged in or concerned with production, procurement, distribution or transportation of military or civilian supplies, materials, and products and to resolve and determine controversies between such agencies or departments, except those to be resolved by the director of economic stabilization under Section 3, Title IV, of Executive Order 950; and

"(c) To issue such directives on policy or operations to the Federal agencies and departments as may be necessary to carry out the programs developed, the policies established, and the decisions made under this order. It shall be the duty of all such agencies and departments to execute these directives and to make to the Office of War Mobilization such progress reports as may be required."

No action has been taken up to the first week in June to indicate how Director Byrnes intended to operate in his new office. In Washington, it was believed that the actual change in functions would be slight, since settlement of inter-agency disputes had been engaging more and more of Mr. Byrnes' time.

Immediately following the new assignment for Mr. Byrnes, there was much speculation as to whether the President's latest move would forestall the desire of Congress to set up a new civilian supply agency. It was felt that in the event that Congress went ahead with its ideas it would cause the Administration no embarrassment. OWM is a tent that covers the main acts and the side shows as well. An autonomous civilian supply agency would fit in with the rest, directly under control of Mr. Byrnes.

Director of Economic Stabilization, Fred M. Vinson, continues to resolve differences of opinion between OPA and the War Labor Board and OPA and the War Food Administration having to do with the Price Control Act and ceilings on agricultural commodities.

War Production Peak

Peak of war production is to be reached in the fourth quarter of this year. The general production curve will continue to rise until some time in the fall when it is expected to level off for the duration. From now on one of the major problems will be to expand production of raw materials to meet the additional requirements of the mills and factories making military items.

Top ranking WPB officials are worried over the public reaction to cut-backs in tank and munition programs and to such announcements as that machine tool production is due to be curtailed. It is feared a general feeling that "we are over the hump" will have an adverse effect on the quantity of goods turned out.

In the case of the machine tool industry, the further announcement that the facilities released would be converted to production of military equipment of some kind has not been appreciated. Proof of fuzzy thinking has been the reclassification of tool makers to A-1 draft status by some draft boards. Induction of hundreds of these highly skilled artisans into the armed services has resulted in the face of industry's crying need for skilled mechanics to help put over the last big production drive that faces the nation. The induction of tool makers is second only to the situation in some localities where miners have been urged to go on to farms or face induction in spite of shortages of metals and minerals that now exist.

This is a partial explanation of the concern with which WPB Chairman Donald Nelson and his immediate advisors view the current situation. They have spent much time recently explaining that greater quantities of raw materials are going to be needed in spite of the cut-backs in certain programs. While some programs are being curtailed others will continue to expand. Tank production reached its peak last December and since then has been trimmed to meet actual day-to-day military requirements. Bombers will be built in increasing numbers until the peak is reached some time in 1944. Other adjustments in production schedules are being made to correct the errors in judgment made last year.

Except in emergencies now unforeseen there will be little future construction of new plant facilities. The building program is rapidly coming to a close but plants already scheduled for manufacturing high octane gasoline, synthetic rubber and new types of explosives will be under construction for some months to come—possibly well into 1944. Materials that have been going into factory buildings will be diverted into production channels from which they will emerge as ships, tanks, guns, planes, etc.

Washington officials know that the supply of materials and critical common components will scarcely meet actual requirements until sometime after the production peak has been reached. To insure the proper distribution of the scanty supplies there is to be further scheduling not only of raw materials but also of critical components and facilities.

Control of Materials

With CMP just about through its trial run and scheduled to become mandatory July 1, WPB has come up with two new devices, both of which represent further steps in the evolution of materials control. The more formal of these is the Component Scheduling Plan, which will see to it that the supply of critical common components is geared precisely to the supply of scheduled end products. Considerably less formal, and currently less complete, is a preference rating system for facilities.

The Component Scheduling Plan exists in fact, although as yet it has no directive in the sense that the Controlled Materials Plan has. Orders placed after June 1 for the components affected by the plan must go through the WPB industry divisions which handle such components. It will be the duty of these industry divisions to see that the component production schedules end products. A favorite explanation of CMP was based on the futility of allocating steel for fifty tanks unless rubber and steel for 100 tracks also was allocated. Applying this reasoning to CSP, it becomes immediately obvious that production of 50 internal combustion engines, which are controlled components, is merely a waste of time unless, at the proper point in their production, the manufacturer gets 50 crankshafts, which are sub-components.

The facilities preference rating scheme has hardly taken recognizeable shape thus far, publicly at least. It has been announced merely that a system of preference ratings for use of facilities has been authorized, and that "appropriate administrative orders and directives" will be issued. For the present at least, these "equipment priorities" will be confined to contracts calling for fabrication or processing rather than for delivery to an ultimate consumer, to contracts calling for use of equipment in essential construction not involving delivery of materials, and to contracts for use of facilities for repair and maintenance of plant or equipment of essential producers.

Manpower Regulations

Running true to form the War Manpower Commission has established the machinery by which the 48-hour week order and the employment stabilization plan can be completely emasculated. WMC Regulation No. 5 establishes the method by which appeals from any of the manpower regulations may be made by both employees and employers.

The new regulation prescribes who may appeal, actions from which workers may appeal, actions from which employers may appeal, notification of the right to appeal and officers and committees to whom appeals are originally taken. After decisions on the original appeals, further appeals to the Regional Management-Labor Manpower Committees and to the Chairman are possible.

The regulation provides that appeal of an employer from a decision granting one of his workers a statement of availability in no way stays the effect of the decision so far as the worker is concerned, but the officer to whom the appeal is taken may direct that subsequent cases involving other workers of an employer and raising identical issues may be suspended pending final settlement of the issue. There is a similar provision protecting employers who are satisfied with certain decisions from which workers may appeal. In all other cases the taking of an appeal stays the action appealed from, unless the chairman of the Committee to whom the appeal is taken specifically directs otherwise.

Inventory Restrictions

Inventory restrictions imposed by CMP Regulation No. 2 are not as drastic as has been interpreted by some members of the chemical industry. No company should take a chance of halting production by failure to keep on hand repairs to meet unpredictable demands. The official interpretation on this very point in "Questions and Answers Regarding Operation Under the Controlled Materials Plan" explains that it is possible to maintain an adequate inventory and remain within the intent and meaning of Regulation No. 2. The official answer reads:

"With regard to material needed for uses which are authorized but which are not specifically predictable, CMP Regulation No. 2 permits a company to have on hand at any time the amount of each item which it estimates it must have in order to meet the demands which it reasonably anticipates arising during the next 60 days. In computing the amount which it is considered necessary to have on hand, the estimates should be based on past experience of use, the possibility of obtaining material from warehouses, and upon the length of time required to obtain delivery from producers under CMP. Acceptance of delivery of controlled materials must be in such quantities that the limitations described above will not be exceeded.

"This standard need only be applied when the amount which the company wishes to receive is greater than the allowable minimum shown on Schedule A of the Regulation."

Just as the inventory restrictions have caused some producers trouble the question whether pipes, tubes, channels, rails, and similar mill products are fabricated items is causing trouble for other producers. These shapes fall into the group listed in Schedule 1 of CMP Regulation No. 1 which are classed as controlled materials.

Producers who have received a general authorization under P-89 do not have to write to Washington for specific permission to apply ratings and allotment symbols to their purchase orders for mill items classed as controlled materials. The only restriction is that the total purchased in the allotment period must not exceed the authorized quota.

There also seems to be some confusion among producers on the procedure to follow to secure fabricated repair items costing more than $500. Producers operating under P-89 must file a specific application as outlined in Paragraph E of the order for permission to apply their rating and allotment symbol to the purchase orders for any fabricated item costing more than $500 per unit.

In cases where the manufacturer is operating under CMP Regulation No. 5, fabricated items costing more than $500 may not be purchased. An official interpretation issued last March was still good for the amendment of Regulation No. 5 which came out May 14. The question and answer read as follows:

"CMP Regulation No. 5 states that 'repair' means the restoration of a facility to sound working condition when it has been rendered unsafe or unfit for service by wear and tear, damage, failure of parts or the like. May I obtain a new boiler costing $2,000 under the procedures provided in the regulation to replace a boiler which has been damaged beyond repair?

"Answer—No. A boiler which is damaged beyond repair and which costs in excess of $500 to replace cannot be obtained under the provisions of this regulation. However, your attention is called to paragraph (b)(3) of the regulation which permits minor items of productive capital equipment, minor capital additions or replacements not exceeding $500 to be included as maintenance, repair and operating supplies."

The Corn Supply

There will be no corn for whiskey, industrial alcohol, or corn products' manufacturers until the new crop is harvested. The tight situation was emphasized in mid-May when zein, the alcohol soluble protein derived from corn was placed under allocation control. While there is a vast quantity of corn in the country, the supplies are on the farms and will stay there until there is a drastic change in government policy.

The situation might be explained by saying that a government priority for hogs has been established. It is a priority of position since both corn and hogs are on the farms. The corn-hog ratio aided by the ceiling on cash corn, has made it more profitable for the farmer to feed his corn than to sell it.

The wet millers had their product frozen at the March, 1942, price level by the General Maximum Price Regulation. At that time the price of corn was about 80 or 82 cents per bushel. They cannot buy corn at the present ceiling and break even let alone make a profit.

Top government officials have been reluctant to meet the problem head on. To date action has been slow. Release of some CCC corn and application of inventory regulations has helped soften hog prices. Rationing of pork products to consumers may further weaken hog prices which will help to change the direction of flow of surplus corn from the feed lot to industry.

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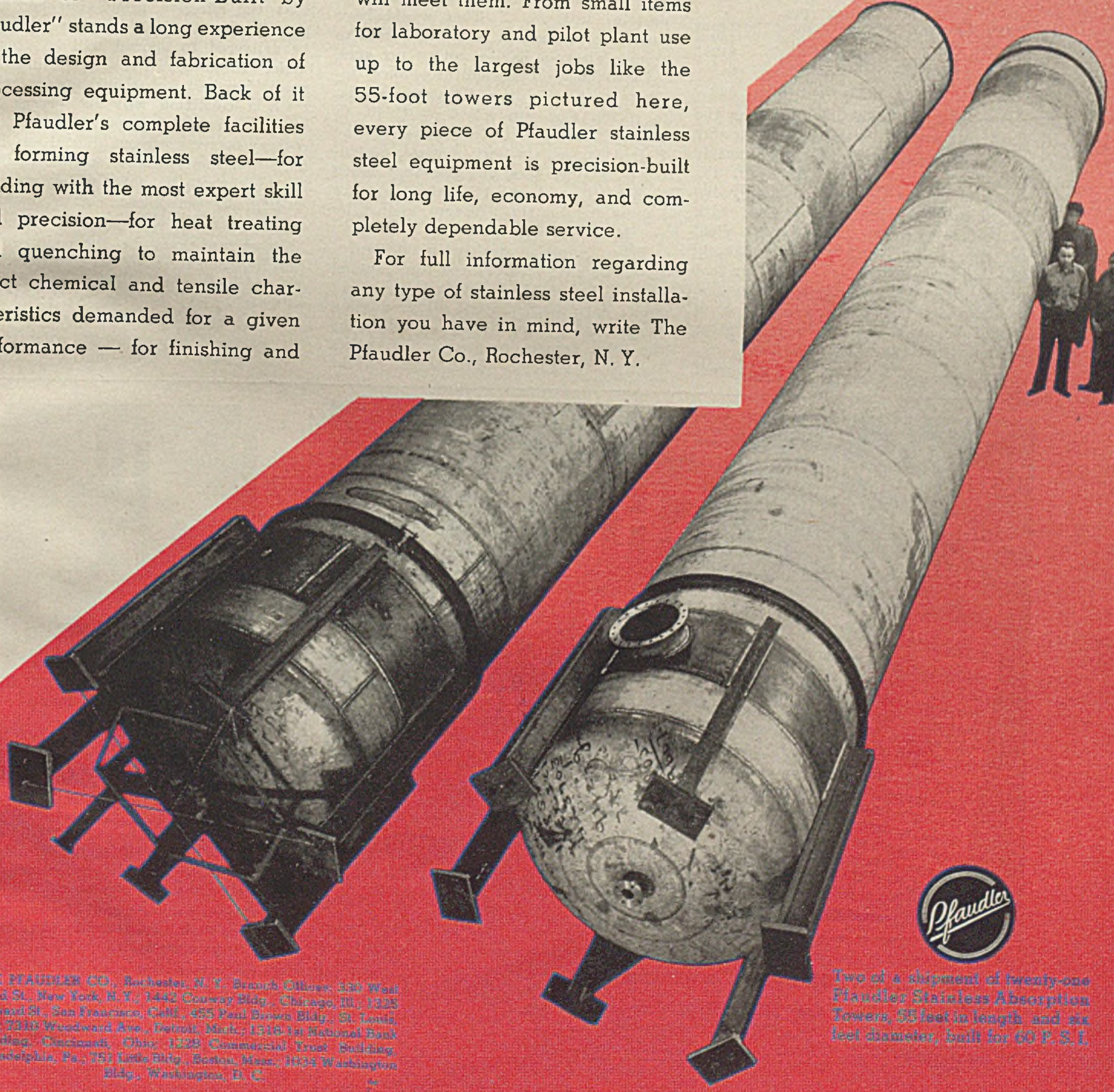

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READERS' VIEWS AND COMMENTS

COTTON AS FOOD

To the Editor of Chem. & Met.

Sir:—My attention has been called to an erroneous statement in an editorial entitled "Cotton As a Food," Chemical and Metallurgical Engineering, April, 1943, page 96. It is claimed that "An acre of cotton provides more edible oil and edible protein than an acre of any of the competitive crops such as soybeans and peanuts." This is a gross misstatement. Accepted average figures for the United States are given in Fats and Oils Situation, FOS-73, March 1943, as follows:

Yields per acre	Cotton-seed	Pea-nuts	Soybeans
Oil, lb.	72	216	169
Meal, lb.	206	323	912
Protein (41%), lb.	85	132	374
Oil and Protein, lb.	157	348	543

The editorial bases its figures on the incorrect assumption of a bale-per-acre yield. Average yields are more nearly one-half bale per acre. Moreover, the editorial claims that approximately 400 lb. of edible protein are obtained with every bale of cotton. Actually, the yield per bale of lint cotton is approximately 400 lb. of meal which is only 41 per cent protein. Thus, the oil figure in question is approximately twice as high as it should be and the protein yield given is almost five times the actual.

C. T. Langford

Editor's Note—It is quite evident that we tried to do too much in a short space and consequently gave an erroneous impression in the two particulars which Dr. Langford noted. Perhaps the most serious distortion comes from the fact that the protein meal from cottonseed was referred to as though it were all protein.

It is not surprising that Dr. Langford should take exception to the phrasing in the first sentence of our second paragraph. Therein should have been pointed out that "an acre of cotton *can* provide, *according to enthusiastic partisans*, more edible oil and edible protein meal. . . ." That would have been true. To be fair one would have to assume also one bale of cotton per acre.

Department of Agriculture figures indicate that the ratio of lint production to cotton seed production is 35 lb. to 65 lb. for typical conditions in the United States. On such a ratio, assuming a bale per acre, one gets very much higher oil and meal totals than are represented by the averages quoted by Dr. Langford.

There is a discrepancy in oil figures which we have received and those quoted by Dr. Langford. Probably his figures relate only to the actual oil production in practice during the 30's divided by the total acreage planted or harvested. It seems as though the total oil in the seed produced per acre is much higher than he indicates. The figures which we have are nearly double his.

It may be assumed that the cotton advocates are not unduly distorting their arguments if they are discussing an increase in cotton acreage for some of the better areas where there is neither the machinery nor experience for greater production of soybeans and peanuts. Actually we know that a very large percentage of last year's crop of these two important crops was never harvested. We may expect a similar unfortunate result this year, despite strenuous efforts of the Department. For this reason we are a little disposed to let the cotton extremists have a bit of superlative in their claims. It does seem that the effective production per acre contributing to food supplies that can be delivered to market will be greater under these conditions, governing for many hundreds of thousands of acres. Such a condition will not persist for many years after experience and machinery corrects present difficulties. But, as a wartime measure, we are inclined to think that the point which we were willing to let these cotton boosters make editorially is a sound one.

It seems that the most important consideration for chemical engineers, and one which made us interested in this editorial idea, is that we must improve materially the technique of processing these oil seed crops in order to increase yields of food-quality products.

INTERPRETING WASHINGTON

EDITOR'S NOTE: *Copies of the orders, rules and regulations covered in this installment may be obtained by writing to the appropriate federal agency, citing the order number or release date.*

INDUSTRIAL INSTRUMENTS

Limitation Order L-272 was amended on May 29 to provide for simplification of indicating dial pressure gauges and various types of regulators.

The pressure gauges are covered by Schedule IV which regulates the sizes and ranges in which gauges may be manufactured. Special features are eliminated and a standard connection is designated for larger sizes.

Schedule V specifies sizes and pressure classes for steel, iron or bronze body regulators, also materials for inner valves and seat rings. Exceptions are allowed for the armed services.

L-272 applies only to new purchase orders. Where Schedule V conflicts with Order L-134, which curtails the use of chromium and nickel in industrial instruments, the less restrictive Order governs.

STEEL PIPE FITTINGS

Limitation Order L-278, issued May 8 by WPB, reduces the number of types of steel pipe fittings which may be made from 40,000 to less than 4,000. Iron and brass pipe fittings were previously simplified by Order L-288. Changes in specifications of materials and of pressure classes correspond closely with those of Order L-252 covering valves and valve parts. The chief reductions are in the number of sizes permitted for "reducing fittings," used to join pipes of different diameters.

Certain types are exempt such as those for use on airplanes and ships, conductors of corrosive liquids or gases, those specially designed for combat use, those used to replace special type fittings, and others which are enumerated in a list of special types. The types permitted comprise about 98 percent of all produced.

REFRIGERATION AND AIR CONDITIONING

General Limitation Order L-38 was amended on May 28 by WPB to bring it in line with the minimum preference ratings for repair and maintenance parts established by CMP Regulation No. 5 as amended May 14. Purchase orders for maintenance and repair parts for industrial and commercial refrigerating and air conditioning equipment must bear preference ratings of AA-5 or higher under the new amendment.

POWER AND CONVEYING EQUIPMENT

General Limitation Order L-193 as amended on May 10 by WPB, provides that purchase orders for conveying machinery and mechanical power transmission equipment are restricted to those rated AA-5 or higher under the terms of the Order. The definition of conveying machinery was clarified by naming portable conveyors, now covered by Limitation Order L-287, as one of the items exempted. Slope conveyors used in mining are also exempted. Monthly production and delivery schedules are no longer required since scheduling is now covered by General Scheduling Order M-293.

FORM PD-1A APPLICATIONS

In line with its policy of decentralization, the WPB has raised the dollar limit of PD-1A applications processed in the field from $100 to $500. Applications involving not more than $500 worth of material on which priority assistance is requested, are now processed in either the District or Regional offices according to the direction of the respective regional directors, except where specifically otherwise directed by the Director of the Distribution Bureau. This change means that approximately 80 percent of all PD-1A applications will be handled entirely by the field offices.

CALCIUM METAL

Conservation Order M-303 was amended on May 25 by WPB to permit industrial users who require small quantities to accept and use three pounds of calcium metal in the form of carrots, or two pounds of calcium metal in any other form per month without specific authority of the WPB.

TANTALUM, MOLYBDENUM, TUNGSTEN

Future requests for tantalum, molybdenum, and tungsten should be made in terms of kilograms instead of pounds avoirdupois, the Steel Division announced on May 25. The date for filing Forms PD-487 and PD-488 for allocation of tantalum has been changed from the 20th to the 7th of the month preceding the month for which application is made.

SOLUBLE NITROCELLULOSE

General Preference Order M-196 which governs the delivery and use of soluble nitrocellulose, was revoked by WPB on May 14. At present, supplies are adequate to meet the need for this material which is used for such products as lacquer, coated textiles, photographic film and plastics both for military and civilian items.

CHLORINATED SOLVENTS

General Preference Order M-41 was amended on May 20 by WPB to permit greater quantities of chlorinated hydrocarbon solvents for civilian uses. The Order provides that with a preference rating of B-2 a consumer may receive in any one month not more than his average monthly consumption during the base period of the year ending September 5, 1941. In the case of carbon tetrachloride, a consumer may receive delivery in any month of up to 150 percent of his average monthly consumption during the base period. These allotments for civilian uses may, of course, be obtained only after all military requirements have been fulfilled.

MICRO-CRYSTALLINE WAX

Allocation Order M-195 issued by WPB on May 19 and effective July 1 provides that no supplier of micro-crystalline wax and its blends may use or deliver wax except as specifically authorized by WPB. The usual allocation Forms PD-600 and PD-601 should be used by suppliers and consumers.

PAPER AND PAPER BOARD

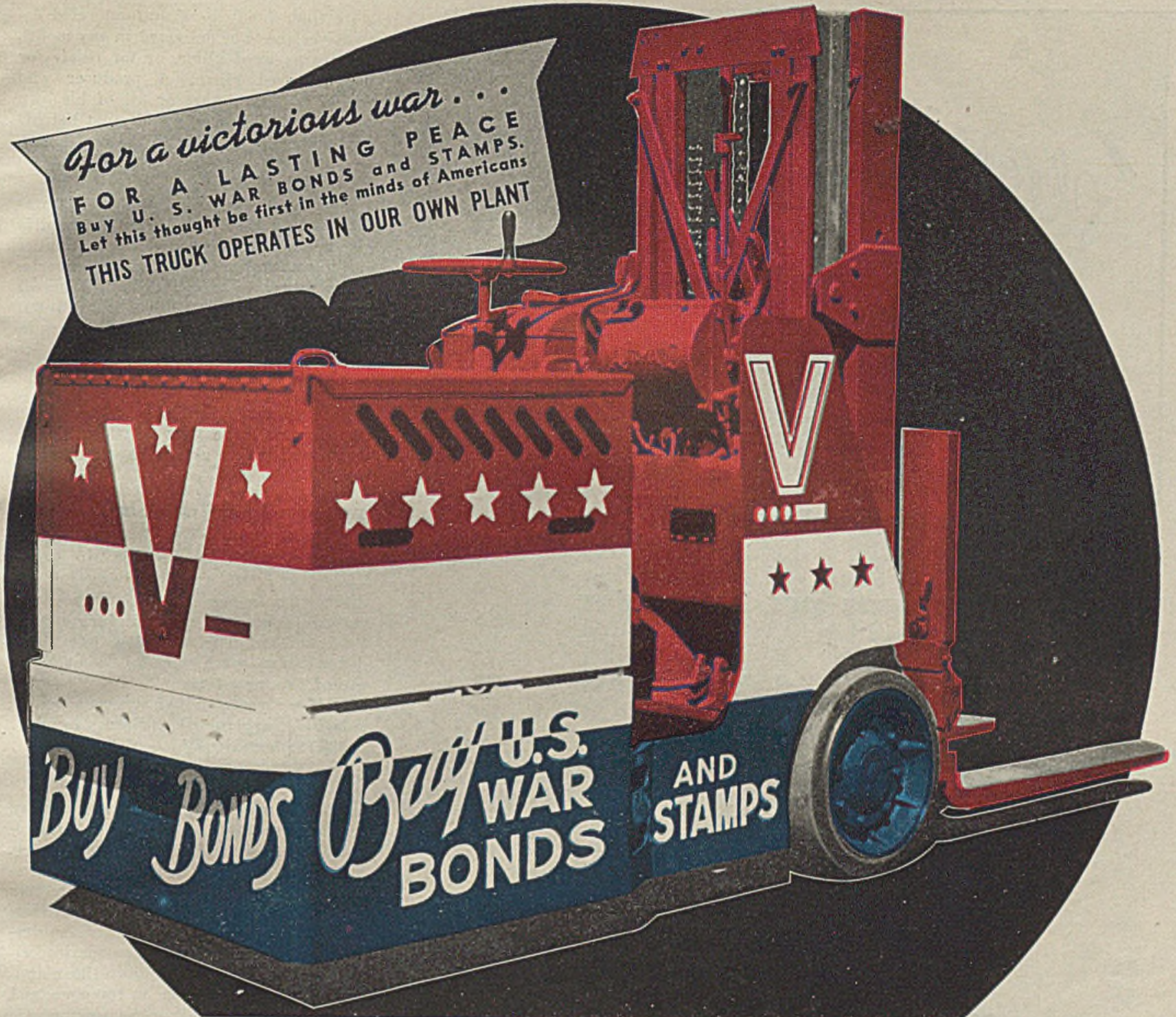
General Conservation Order M-241 was amended on May 15 by WPB to clarify and define certain points and to provide a clear and equitable basis for the classification of paper products for the industry. Formerly, three unrelated codes were used, but under the amendment a standard classification code is now set up by the Bureau of the Census which is covered by WPB Form 514, dated February 24, 1943. The change to census code numbers will simplify the calculations of paper quotas in the mills and aid in carrying out the production limitation of paper by broad grade classifications. All limitations remain as previously outlined in the Order last amended on March 12, 1943.

ETHYL CELLULOSE

General Preference Order M-175 was amended on May 6 prohibiting the use of ethyl cellulose except on specific authorization by WPB. The general 50-lb. exemption for small purchase orders has been replaced with a 10-lb. exemption and in the case of acceptance or use for experimental purposes, an exemption of 50-lb. The amended Order also provides that ethyl cellulose allocated for inventory may not be used except as specifically authorized or directed in writing by WPB. The standard chemical allocation Forms PD-600 and PD-601 should be used by applicants for authorization to deliver, accept delivery or use ethyl cellulose.

SULFAMIC ACID

General Preference Order M-242 was amended by WPB on May 7 to provide for the use of Form PD-602 in place of the regular Forms PD-600 and PD-601, formerly used. Paper work is eliminated by providing that a producer or primary distributor need not list on Form PD-602 the name of any customer to whom not



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more than 2,500 lb. of sulfamic acid derivatives are to be delivered in any month for use as weed killer, or for resale for use as weed killer. A producer who wishes to use a part or all of his own production of sulfamic acid must list his own name as customer on the new forms.

ISOPROPYL ALCOHOL

General Preference Order M-168 was amended on May 18 by WPB to simplify the paper work required of a supplier seeking authorization to make deliveries of, or to use, isopropyl alcohol. Whereas previously Forms PD-600 and PD-601 were required, Form PD-602 may now be used. Requests for quantities up to 3,500 gallons in any one month must be lumped by the supplier on Form PD-602 under specified end uses, and requests for more than 3,500 gallons in any one month must be listed individually.

SYNTHETIC RUBBER INGREDIENTS

WPB on May 8 specified the use of Form PD-602 in place of the two Forms PD-600 and 601 when applying for authorization to use or deliver three basic materials used in manufacturing synthetic rubber. The following three Allocation Orders were amended to cover the use of this new form:

M-170, styrene (vinyl benzene).
M-153, acrylonitrile (vinyl cyanide).
M-178, butadiene.

ROTENONE INSECTICIDE

WPB Directive No. 15, issued on May 8, transfers to the War Food Administrator control over the uses and distribution of rotenone insecticide for agricultural purposes. The amended directive reserves to the WPB the right to determine the amount of government requirements for rotenone and rotenone insecticide, to regulate or prohibit the manufacture or importation of rotenone and to regulate or prohibit the use or sale of rotenone insecticide for non-agricultural purposes.

WOOD PULP

The "withholding clause" of General Preference Order M-93 was invoked on May 4 by WPB through issuance of Supplementary General Preference Order M-93-a. All producers of wood pulp must withhold 20 percent of their production of all types of wood pulp during the month of June and each month thereafter, and must make delivery of such withheld tonnage only as ordered by WPB. While the wood pulp shortage has reached the point where it is deemed necessary to invoke the withholding clause of the Order, the power to allocate such tonnage will be used only to safeguard important war production, and it is very likely that, in many cases, all or most of the withheld wood pulp will be allocated back to the producer.

DYESTUFFS

Order M-103 was amended on May 25 permitting commercial dyers to get all the dyestuffs and organic pigments which are required for dyeing used apparel and used house furnishings without adhering to quota restrictions. The amended Order also contains an exemption for food, drug and cosmetic colors. Another exemption permits unrestricted sales and deliveries of any dyestuffs and organic pigments to any person for medicinal, therapeutic and diagnostic uses and for chemical indicators and bacteriological stains. These unrestricted sales and deliveries must be in packages of eight ounces or less.

LEAD

General Preference Order M-38, which controls the use of lead, was amended on May 26 to facilitate the use of lead in place of scarce materials. As it stands now, the Order places practically no restrictions on the use of lead except for purposes considered purely non-essential. Restrictions on roofing and weight of flashing and waterproofing are removed. The former restriction on the use of lead for many purposes to a quantity not exceeding 90 percent of the amount used in a base period has been removed, making it possible to use lead without special approval for items not previously made of lead.

ALKANOLAMINES

Allocation Order M-275 was amended on May 25 by WPB placing diethylethanolamine under allocation and removing triethanolamine. Alkanolamines are now defined as "monoethanolamine, diethanolamine and diethylethalomine." Orders for five gal. or less of diethylethalomine per month will be permitted without WPB authorization after July 11.

PHOSPHATE PLASTICIZERS

Allocation Order M-183 was amended on May 24 to include control over diphenyl mono-phosphate and di-monophenyl phosphate. Allocations may be requested by filing standard Forms PD-600 and PD-601 with the Chemicals Division of WPB.

BUTYL ALCOHOL

General Preferenee Order M-159 which controls all grades of butyl alcohol was amended on May 26 to include control over the acetic esters of butyl alcohol. These are the normal butyl acetate, secondary butyl acetate and isobutyl acetate. The usual Forms PD-600 and PD-601 must be used to obtain an allocation, a separate set of forms being used for each grade of butyl alcohol requested.

METHYL ISOBUTYL KETONE

General Preference Order M-322 issued on May 25 by WPB placed hexone, or methyl isobutyl ketone, under allocation. Its chief uses are as an alcohol denaturant and a substitute for butyl alcohol. Up to fifty gallons per month may be obtained without specific authorization. For larger quantities the purchaser must file with his supplier a statement of the amount desired together with the proposed end uses. The supplier must then file Form PD-602 covering his proposed deliveries.

THERMOPLASTICS

General Preference Order M-154 was amended on May 25 removing the prohibition covering the use of thermoplastics in the manufacture of "sun goggles, except for use with corrective lenses". Control will be exerted by amendment to Limitation Order L-238, covering sun glasses.

FIBRE SHIPPING DRUMS

Conservation Order M-313 issued by WPB on May 21 provides for the allocation of shipments of cylindrical fibre shipping drums by manufacturers, as of June 16. The Order applies to the types known as "drums" and "pails". They are made with a body of paperboard and ends of paperboard, steel (28 gauge or heavier), wood, or any combination of such materials. Drums or pails of one-gallon capacity, and fibre containers known as "cans" and "tubes", are excluded from the Order.

Notwithstanding any preference rating already received, no manufacturer may ship fibre drums after June 16 to any purchaser except as specifically authorized by WPB on Form PD-881. Suppliers must file this form monthly, listing each customer's proposed use and desired delivery date for drums. No person may order any type of fibre drum for delivery on any date if receipt of the drums would increase his estimated inventory of that type drum to more than 60 day's requirements.

MAXIMUM PRICE REGULATIONS

MPR-37, Amendment No. 4, issued by OPA on May 7, revised the ceiling prices for fermentation butyl alcohol. Wheat constitutes the chief butyl alcohol source in states other than the Indiana-Illinois area and is at the present time being supplied at a uniform delivered price, but on July 1 this price will be raised to nine cents under the maximum price for corn. This amendment, accordingly, provides for increased prices for butyl alcohol produced outside Indiana and Illinois. The existing base ceiling will be maintained in Indiana and Illinois.

MPR-180, issued May 8 by OPA, placed under one specific price regulation all dry, flushed and pulp color pigments. The price levels which have been set reflect price ceilings as of October, 1941. For the purpose of the regulation, organic and inorganic color pigments have been grouped together. Type listings have been divided into shades; blues and violets, greens, yellows and oranges, reds and maroons. White, mineral earth, synthetic iron oxide and carbonaceous black pigments will remain under the control of the General Maximum Price Regulation. Formulas are provided for pricing new color pigments, or color pigments not specifically listed in the Regulation.

MPR-386 (agricultural mining materials), effective May 15, establishes a variety of optional methods for determining f.o.b. plant prices for liming materials in bulk when used as an aid to the growth of crops in plants. When liming materials are sold in bags, 25 cents per ton, plus the cost of the bag, may be added to the bulk price.

MPR No. 354, amended on May 11 by OPA, permits distributors who make retail sales of copper sulphate as an agricultural insecticide or fungicide to use the maximum prices provided for retail dealers in MPR No. 144. For quantities of 300 lb. or more, however, the distributor must use the wholesale ceilings established by Regulation No. 354.

REVISED PRICE SCHEDULES

RPS-38 was amended by OPA on May 11 to conform more exactly to conditions as they actually are in the glycerine industry, and was redesignated Maximum Price Regulation No. 38. A converter is defined as a person who buys refined glycerine in quantities of 2,200 lb. or more per month in drums or tank cars and who repackages it without further processing for resale. Other definitions such as "carloads," "case," "importer," are also clarified in this amendment. The maximum prices established in the previous schedule are not changed by this amendment.

RPS-60, Amendment No. 7, issued by OPA on May 7, extended the same pricing provisions in connection with purchases, sales and transportation of direct-consumption sugar which previously covered the Defense Supplies Corp. The amendment also provides that any other government agency which may, in the future, be authorized to perform such functions shall be in the same category.

RPS-87, Amendment No. 5, issued by OPA on May 6, states that the maximum price for hard rubber scrap shall be determined in accordance with the provisions of the General Maximum Price Regulation and not under RPS-87. Under Schedule 87 hard rubber scrap would be entitled to a maximum price of $15 per ton, whereas prices of such scrap ordinarily range, in accordance with its grade, from $5 to several hundred dollars per ton.

RPS-88, Amendment No. 95, issued May 7 by OPA, removes from the General Maximum Price Regulation and places under Schedule 88 industrial napthas, solvents, mineral oil polymers, and petroleum sulphonates. However, sellers still have the option of retaining maximum prices already established under the General Maximum Price Regulation, or using an alternative method in Schedule No. 88.

Revised Supplementary Regulation No. 1 to GMPR was amended on May 31 to exempt from price control those commodities which are insignificant in the cost-of-living, or which impose administrative burdens out of proportion to the role of the item in the national economy. Specifically exempted are manufacturers' sales of chemicals, which they did not sell up to March, 1942, until total sales for the chemical amount to $1,000. Sales of chemicals in the experimental stage of production are also exempted from the GMPR provided that OPA approves the manufacturer's report describing the chemical.

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MPING DOLLAR

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MAKE THE MOST OF PLANT SPACE
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The Same Pomona Handles Different Jobs! Because Pomonas are unusually adaptable, the same Pomona bought for pumping process solutions from a sump or vat, for example, can be easily converted to deep well primary water supply work by simply adding column pipe and shafting . . . or can be converted to line or booster pumping . . . or can even be mounted on a portable frame and used for shaft dewatering or other similar work.

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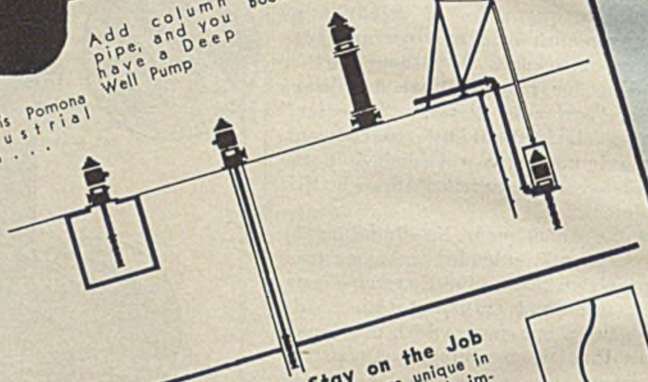

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Pomona Flow Pattern

IN ADDITION. Pomona Pumps cut replacements because they are self-lubricated by the fluid being pumped, eliminating risk of neglecting lubrication and damaging pump. They have no wear rings to renew or replace. And the bulbous-end vane shape, besides increasing efficiencies above the 90% mark on many sizes within the range, provides additional strength and longer wearing life to pump bowls, further reducing replacement costs!

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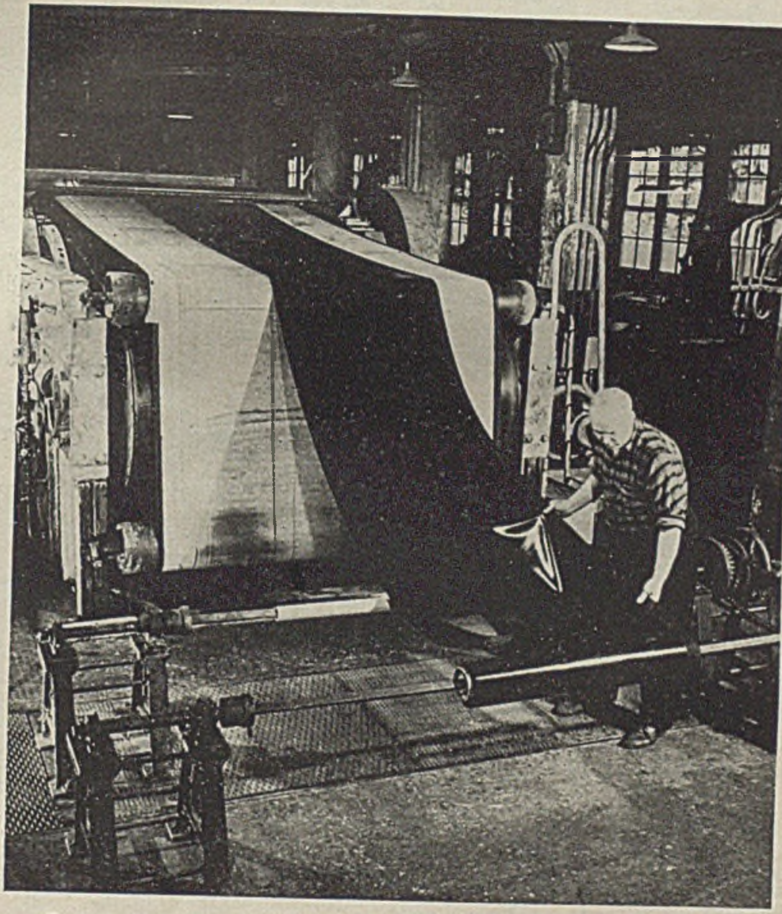
NEW PRODUCTS AND MATERIALS

CONTENTS



Tank lining leaves curing press. Rough edge is for adhesion of lap
Successful adaptation of the use of concrete tanks for storage of gasoline resulted from development of synthetic linings. Among these is a thin sheet of synthetic rubber, Thiokol FA. This type of lining protects the gasoline from a drop in octane rating and prevents loss of fuel by seepage through porosity in the concrete walls

TEXTILE FINISH

This finish eliminates the objectionable properties and hazards of solvent type agents. It is an aqueous emulsion and can be applied by padding and drying with moderate heat treatment. Although developed by Dupont especially for the Army, such peacetime applications as the treatment of tobacco cloth are indicated when the material is available for civilian uses. The new product is officially called Camouflage Sand No. 3 Finish and Camouflage Olive No. 9 Finish.

COTTON ROPE PRESERVATIVE

With imports of manila fiber for rope cut off by the war, and the government preempting what supply there is, professional and amateur fisherman, yachtsmen and others hesitate to turn to cotton rope. While it has adequate and even superior strength for many purposes, it is inherently soft; organisms in sea water and in some so-called fresh water cause it to deteriorate rapidly.

I. F. Laucks, Inc., 911 Western Ave., Seattle, is bringing out a new formulation, Fungiseal Ready-to-Use Rope Preservative. It is a clear liquid into which the rope is dipped, then dried. Its purpose is not only to protect the cotton fibers against water-borne organisms, but also to stiffen them for added firmness and wear resistance.

CHEMURGIC RUBBER

A new type chemurgic rubber called Witcogum has been developed from vegetable oils by Wishnick-Tumpeer, Inc., New York, N. Y. It is already being used by rubber-goods manufacturers for many essential applications. This rubberlike material, which is comparable to rubber in many of its properties, requires neither critical materials nor critical equipment for its manufacture. Standard rubber mills and mixers do its milling and mixing. Calendering, extrusion and vulcanizing are similar to that of crude and reclaimed rubber. Witcogum contains an accelerator of the granidine type and sufficient sulphur to give a cure in 30 min. at 40 lb. steam pressure (287 deg. F.). Furthermore, all the necessary vulcanizing ingredients are already in Witcogum, though it may be loaded and softened as requirements demand.

It may be used independently or as an extender blended with natural rubber, reclaim or synthetic rubber. Blends with reclaim show promise in extending it. Furthermore, a small amount of reclaim added to a Witcogum compound improves molding and facilitates its removal from the molds. Softeners may be added to increase tack, improve processing and molding and give a more homogeneous product. The proper compounding of Witcogum with such pigments as carbon black or clay or a combination of both will result in higher tensile strength. Tests have proven that tensile as high as 450 lb. per sq. in. elongation as high as 150 percent, shore hardness of 60-65 and tear of 45-50 lb. per in. can be obtained through proper compounding.

Water, alcohol and lubricating oils have no apparent effect on it, nor do antioxidants upon accelerated aging tests. Generally speaking, its reactions to solvents and chemicals are similar to that of rubber.

SELF-POLISHING FLOOR WAX

A self-polishing type of floor wax both slip-retardant and water-resistant is being introduced by the Finishes Division of E. I. Du Pont de Nemours & Co., Wilmington, Del. Designed as a durable, protective glossy coating for linoleum, asphalt tile, rubber, finished and unfinished wooden floors in homes, offices and institutions, Du Pont Self-Polishing Wax has been extensively tested.

A high percentage of natural carnauba wax combined with a special emulsifying agent contributes qualities of unusual wearability and resistance to water. The new product is easily spread with applicator, mop or cloth. No rubbing is required and the laboratory-balanced film dries in twenty minutes. The slip-retardant feature has definite value as a safety measure. A high degree of resistance to water reduces the frequency of re-waxing.

PLASTICIZER

TP-90, a new plasticizer for low temperature flexibility has been developed by Thiokol Corporation. This liquid plasticizer works equally well with Thiokol, Buna and other oil-resisting synthetic rubbers.

A second plasticizer, Galex, is a stabilized natural resin in solid form. It is particularly compatible with Buna S. This resin imparts many exceptional properties, particularly greatly improved resistance to flex-cracking.

ELASTIC ALLOYS

Elastic alloys, made from several different types of synthetic rubber blended together to form a material with different properties than any of its components, may well prove to be our rubber of the future according to Dr. S. M. Martin and A. E. Laurence of the Thiokol Corporation.

Reporting to the American Chemical Society on a recently completed study of the properties of the blends of "Thiokol" FA with Neoprene GN, Hycar OR, and Perbunan 26, the Thiokol Chemists found that it was not possible to predict the properties of the blends from the properties and proportions of the synthetics blended. This is illustrated by the fact that such properties as tensile strength, diffusion resistance, low temperature flexibility, and compression set of the elastic alloys do not change as a linear function of the composition of the blend.

Data of a fundamental nature have been acquired on representative stocks for each of the synthetic rubbers tested to establish trends of various properties of the blends. Even though any specific characteristic could be varied within certain limits by formulation changes, the data present useful basic information on the general characteristics of blends to synthetic rubber technologists.

The elastic alloys offer several advantages to the manufacturer of synthetic rubber products. In the first place, they provide a means of formulating stocks with better processing characteristics. Secondly, they open the way for new combinations of physical and chemical properties in finished articles, and finally provide a means of extending any particular synthetic rubber whose supply might be momentarily short.

INORGANIC BASE FINISH

A new type of finish founded upon an inorganic base is known as Silco, and is made by Mitchell-Bradford Chemical Co., Stratford, Conn. Silco adheres tenaciously to steel, brass and chrome plate, is unaffected by a wide range of solvents, and resists mild alkalis and acids. It is applied by preparing the work free of oil, grease, etc. spraying either manually or automatically. It is dried in oven at 210 deg. F. for 5 min. and baked at 350 deg. F. for 45 min. It is said to be remarkably resistant to abrasion, heat and corrosion. When coated on ferrous metals it has withstood 200 hr. or more in salt spray without breakdown. It is available at the present time in navy-warm drab, army-olive drab, and black. Other colors will be furnished after the war. No priorities are necessary to obtain this material. It withstands heat up to 1,000 deg. F. When properly applied it will not rub off, and is perhaps more rustproof than any other finish that could be applied to such work. It requires only one coat and is, therefore, economical coverage for a number of large fabrications.

THERMOPLASTIC RESINS

New thermoplastic resins with unusual high softening temperatures, low dielectric loss and excellent water resistance, have been announced by General Aniline & Film Corp., New York, N. Y. Properties of Polectron products make them useful in dielectric material for replacement of mica in radio condensers, etc. In tests of Polectron products by standard methods, the following data have been obtained:

Heat distortion temperature.	140–160 deg. C.
Power factor	
One kilocycle to one megacycle at 25 deg .C.	0.10% or less
At one kilocycle from 25 deg. C. to 100 deg. C. .	0.10% or less
Specific resistivity at 400 volts.	More than 10^{16} ohm cm.
Dielectric Constant (one kilocycle to one megacycle).	3.0
Dielectric strength.	More than 1,000 v. per mil.

TOUGH POLYSTYRENE RESIN

The most logical method of producing a tough polystyrene was to copolymerize styrene with some resin which would give to the finished material this desirable characteristic of toughness. However, it was soon ascertained that the resins which would so affect the styrene impaired its electrical characteristics. An alternative method was suggested by reference to the known fact that orientation of large polymers produced increased strength in the direction of orientation. If these orientations could be produced in two directions, a tough flexible sheet would result.

The Plax Corp. developed the first semi-large scale machine to produce this type of flexible sheet. Later, a new large-scale unit was designed, built, and put in production. The electrical characteristics of this new sheet were those of an excellent grade of polystyrene as listed below. From the point of view of physical characteristics, ultimate toughness has not been obtained in the present flexible sheet.

This new polystyrene sheet material, having such excellent dielectric properties, and acid resistance as well, can be employed for such applications as condenser manufacture, cable wrapping, or thin washers, or windows for electrical purposes. The sheets may also be used to replace hard rubber or mica in some applications. The material is produced in ribbons or sheets in various thicknesses of from 1 or 2 mils up to 20 mils.

ORGANIC ALKYL PEROXIDE

Commercial *t*-butyl hydroperoxide, a new organic alkyl peroxide whose stability and high active oxygen content offer extremely interesting possibilities, is available from Union Bay State Co., Cambridge, Mass. Commercial *t*-butyl hydroperoxide is standardized at a concentration of 50-60 percent (10± percent available oxygen)—and appears to be ideally adapted for use as a catalytic agent in one or two phase polymerizations, as an oxidation agent for laboratory purposes, as a drying accelerator in oils, paints, varnishes, etc., as a combustion accelerator for heavy fuel oils used in diesel engines, as a bleaching agent for cotton, wool and other fabrics, and for numerous other uses.

LEATHER SUBSTITUTES

It is claimed that the new material known as Cottonleather Fabric makes an excellent bottom for shoes of certain types. It consists of cotton fabric of from 2 to 6 plies in thickness which is impregnated with a thermosetting organic binder, cured, calendared and surface ground to resemble leather in color. It is semi-flexible, water repellent and resists oil and heat. The manufacturers, the Southern Friction Materials Co., Charlotte, N. C., report that it has proven highly successful in all types of shoe production. It is available in 4½, 6¼, 8½ and 10 iron weights. The widest width is 6 in., reports the *Chemurgic Digest*, April 15, 1943.

PENICILLIN

Penicillin, the latest of the "wonder drugs" to attain popular notice, is as yet more of a problem than a solution. It is apparent now that this material is particularly useful against many infections previously resistant to treatment and appears to be non-toxic, according to the *Industrial Bulletin* of Arthur D. Little, Inc., April, 1943. The problem lies in producing the penicillin and preventing its deterioration. There are recent indications that both of these may be solved in the not too distant future. Although penicillin is effective in extremely high dilution in preventing the development of many disease-producing organisms, it produces no injurious effect on other living cells. Penicillin shares with the sulphonamide drugs an advantage over such commonly used antiseptics as iodine, silver nitrate and bichloride of mercury in that when applied locally it is not fixed at the surface of the wound and may penetrate to the actual sites of bacterial multiplication. It may also be injected in the blood stream or beneath the skin, as well as used locally on wounds, without injuring the normal processes of the body or preventing the growth of new cells, which is necessary in the repair of wounds and burns. The sulphonamide drugs are inhibited in their action by the presence of pus which is formed by staphylococci, but penicillin is apparently unaffected by pus or any body fluid.

LIQUID WAX FINISH

Operators of fleets of trucks, buses or cars will be interested in Transportation Maintenance Wax, a liquid wax finish manufactured by S. C. Johnson & Son, Inc., Racine, Wis. It is said to protect the finish of automobiles and trucks. It is applied with a compressed-air spray gun, drying to a gloss without rubbing.

SHOE SOLE MATERIAL

New synthetic shoe soles promise to give 50 percent more mileage than grade A sole leather. The shoe sole will be made of tightly woven cotton and impregnated with synthetic resin by Bigelow-Sanford Carpet Co., Inc., New York, as soon as WPB approves. Jule F. Marshall, vice-president of American Felt Co., Glenville, Conn., has invented, tested, and applied for patents on the new "ventile" wool felt insole for shoes to be used in subzero regions. Its foot-warming construction of two layers of perforated felt will be licensed to manufacturers.

FLOOR COMPOUNDS

The fear of slipping on floors can be eliminated, it is said, by the use of AleXitE, the new floor compound formulated by the AleXitE Engineering Co., Colorado Springs, Colo. This material absorbs grease and oil, and at the same time it reduces the danger of skidding on oily floors. It is dielectric, fireproof, light, dry, odorless, clean, and can be swept up and reused many times. When thoroughly soaked with oil it then becomes a dustless sweeping compound. Because of lightness, it covers more space.

TEMPERATURE RESISTANT PLASTICS

Plastic articles which will withstand much higher temperatures than those made from any commercial thermoplastic powder may be made from a new formulation of Lucite molding powder, according to the announcement of Dr. G. M. Kuettel of the Plastics Department, E. I. du Pont de Nemours & Co., Wilmington, Del. This special formulation, called high heat-resistant Lucite, a methyl methacrylate resin molding powder, is a war development. It will be available for numerous peacetime uses. Many articles molded from this new powder will not soften appreciably or distort when exposed to a temperature of 212 deg. F. The new formulation was developed for use in existing compression, injection and extrusion equipment. It is available in granular form for compression molding, and has all the temperature characteristics of the injection or extrusion powder.

CLEANING COMPOUNDS

Cleaning compounds for use in laundries, which it is claimed shorten the wash formula, have been developed by Turco Products, Inc., Los Angeles, Calif. By quickly loosening the soil, a high percentage of it can be rinsed off, making little soap necessary for the finishing rub.

PHOSPHATES

Here are five new phosphates with interesting possibilities as yet unexplored. Four seem to have definite utility in glass, chinaware, porcelains and enamels. One is an excellent source of calcium and phosphorus for mineral enrichment of foods.

While only one of these phosphates is available as yet in commercial quantities the others could be placed in quantity production if sufficient demand develops. For experimental samples, write to: Monsanto Chemical Co., Phosphate Division, St. Louis, Mo.

Aluminum Metaphosphate, $Al(PO_3)_3$

Molecular weight: 263.91
Appearance: white crystalline powder
Melting point: above 1,700 deg. C.
Solubility: insoluble in water, practically insoluble in acids

It might be used as a constituent of glasses, chinaware and porcelains.

Barium Metaphosphate, BaP_2O_6

Molecular weight: 295.40
Appearance: white crystalline powder
Melting point: red heat (about 850 deg. C).
Solubility: insoluble in water

The manufacturer suggests two uses for this phosphate; as an opacifying agent in glazes and as a constituent in special types of glass.

Calcium Magnesium Pyrophosphate, $Ca_2Mg_2(P_2O_7)_2$

Molecular weight: 476.88
Appearance: grey powder
Solubility; insoluble in water, soluble in acids
Grade: Technical

In the ceramic industry calcium magnesium pyrophosphate can be used as a constituent of porcelains and enamels.

Calcium Pyrophosphate, $Ca_2P_2O_7$

Molecular weight: 254.20
Appearance: white, non-gritty powder
Odor: none
Taste: none
Melting point: 1,230 deg. C.
Density: 36 to 37 lb. per cu. ft.
Solubility: insoluble in water, soluble in acids

Calcium pyrophosphate can be used as a source of calcium and phosphorus in mineral enrichment of foods.

Magnesium Pyrophosphate, $Mg_2P_2O_7$

Molecular weight: 222.68
Appearance: white crystalline powder
Melting point: 1,383 deg. C.
Solubility, insoluble in water, soluble in acids

Like calcium magnesium pyrophosphate, it may be used as a constituent of porcelains and enamels.

GERM KILLING AGENT

A disinfectant which is said to be 15 times more powerful than phenol as a germ killing agent has been developed by Rampel Chemical Co., New York,

N. Y. The new development is known as Perm-Astic-Ramplex. Moreover, the product curbs germ growth with high effectiveness under a wide variety of conditions. It has no odor, no taste, no color. It is non-toxic in the concentration in which it is made available for use in various applications. Tests, according to *Modern Industry*, May 15, 1943, show these properties: germ killing or germ growth inhibiting action equally effective when the substance is in a dry or liquid state, ability to destroy and inhibit growth of bacteria as well as fungi, no deleterious effect on materials treated with it, a high degree of permanence, solubility in water and a variety of other solvents such as ethyl alcohol, glycerine and benzine.

COAGULATION AIDS IN WATER PURIFICATION

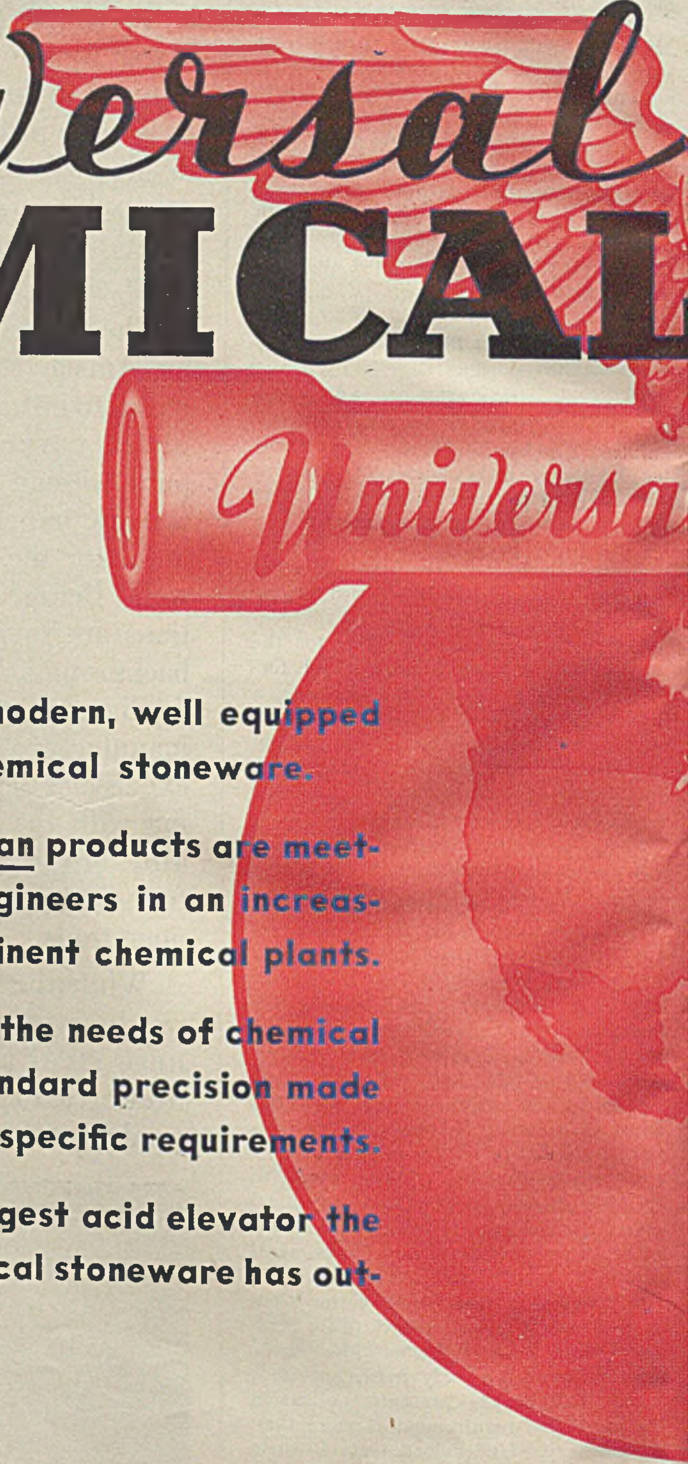
A process patent (U.S. No. 2,310,009), for water purification by a special coagulation aid has been granted to Chester L. Baker and Charles H. Dedrick and assigned to the Philadelphia Quartz Co., Philadelphia, Pa. The patent covers a method for preparing a special solution of sodium silicate and a metal salt, which mixture is introduced to raw water prior to the addition of the coagulant. This coagulation aid is for the purpose of inducing a more rapid formation of larger floc, thus removing a higher percentage of the suspended impurities. The silicate-metal salt method has already been used in several water purification plants.

CERAMIC PLASTIC DEVELOPED FOR RADIO TUBE BASES

Faced with the possible shortage of material formerly used in manufacturing bases for high frequency radio tubes for military communication equipment, Heintz & Kaufman, Ltd., South San Francisco, Calif., recently adopted a new material, Prestite, developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Made of raw materials found in quantity in this country, this new porcelain is not restricted on priority materials lists. Bases made of Prestite possess satisfactory mechanical and electrical strengths and meet all performance specifications. Tests show that this material has a high dielectric strength and a loss factor better than Navy Grade F requirements. This ceramic has a slightly higher loss factor than material formerly used, but it is found that in the present application the insulation requirement is more than is necessary. Under load tests Prestite bases withstand more voltage than their ratings show. Prestite combines the electrical and mechanical strength of wet process porcelain with the molding qualities of dry process porcelain. It is formed under heavy hydraulic pressure that imparts a dense grain structure, enabling it to stand more electrical, mechanical and chemical abuse than the average ceramic. It is used in many products where intricate shapes must meet high insulation requirements.

PRECISION

"Universal
CHEMICAL



Universal American in its new, modern, well equipped plant is producing precision chemical stoneware.

More and more **Universal American** products are meeting the approval of chemical engineers in an increasing number of the Nation's prominent chemical plants.

Universal American understands the needs of chemical manufacturers and furnishes standard precision made stoneware or plans products for specific requirements.

From the smallest pipe to the largest acid elevator the **Universal American** line of chemical stoneware has outstanding qualities.

Universal American

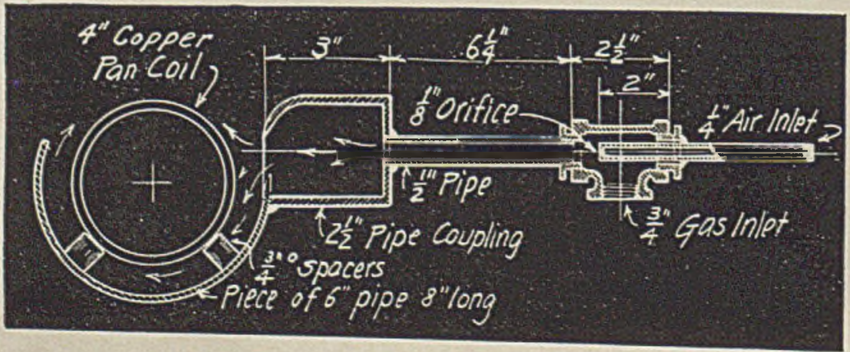
FROM THE LOG OF EXPERIENCE

Dan Gutleben, Engineer

LIBERAL USE OF lubricating oil in steam pump and engine cylinders whose exhaust is used for process, often results in coating the heating surfaces of equipment using the exhaust steam. This naturally reduces the effectiveness of the heat transfer. An insulating coat of oil and carbon is built up on the inside of the sugar pan coils that refuses to respond to any solvent we have tried. Soda, sulphuric and hydrochloric acid, kerosene, gasoline and alcohol can soften the film so that it can be brushed off, but the surfaces are not accessible for brushing. Recognizing that a solvent is required which completely removes the coating, resourceful Rudolph decided to try fire which is an effective solvent for carbon. He therefore inserted a wire-bound twin hose through one of the 4-in. dia. by 75 ft. long coils and fitted the hose with a gas burner at the end. The flame heated the coil as he drew the hose back, but something happened to the gas supply and the resulting explosion sent a helper to the hospital. He then made a torch with a semi-circular hood as shown, and with this, the outside of the coil was brought to a red heat. Throughout the operation a ventilating blower attached to one of the manholes of the can provided comfortable working conditions within. If the gaskets in the coil joints became leaky through this operation they were replaced with new ones. One advantageous result of the heating was the annealing of the copper. With the burner shown it required about 30 hours for three men to complete the job of burning 1300 ft. of coil in a 14-ft. pan, and the effect of the cleaned surface was a reduction of nearly a quarter of the boiling cycle.

When the coil pans were replaced by calandrias in '33, fire was no longer applicable. Then the chemists applied their wits and stumbled onto the idea of using two solutions successively. The first treatment made the film pervious, and the second was then able to penetrate and attack the copper oxide covering of the tubes. When this was dissolved the insulating film fell off. This was a heroic remedy, like the Nebraska farmer's turpentine for a horse afflicted with colic. Some further research and trial and error developed solvents that accomplish the desired result without chilling the marrow of the maintenance engineer's bones when he contemplated the effect of the hydrochloric acid on the metal. Now this is comfortably accomplished as described in John Dittmar's exposition in *Chem. & Met.* for February, 1943, page 137.

After the cleaning, the production cycles for fine granulated sugar were reduced from eighty minutes to sixty minutes. The long cycles of special sugar in one pan were reduced from five hours to four hours. Sugar boiler Jake, desiring to make conversation when Boss W. H. came around, remarked that this should have been done a long time ago. Impatiently, W. H. came back, "Dash-dash it, how in the world could we, when we learned how only last week!"



THE CHRONICLER FELL HEIR to the job of consulting engineer to the Alameda Sugar Co.'s Alvarado factory after J. C. H. Stutt's death in 1917. Stutt was the builder of the Union Sugar House at Betteravia (1897) and the famous San Francisco cable railways which even now, after more than 50 years of service, are still unsurpassed as a means of negotiating the precipitous hills. Good Old Burr had retired, and the new manager of Alvarado was J. McCoy Williams, who took pride in the euphony of his name. He had been trained at Oxnard and had been associated in the building of the Hamilton City factory in 1906. The first job at Alvarado was a new carbonator and sundry plant improvements estimated at $100,000, which was characteristically cut down by the directors to $80,000. Under the connivance of Charley Fleener, Bill Loranger and Ray Stewart of J. McCoy's staff, the job was accomplished within the allowance.

As an aid in stretching the appropriation, the boys dug into the 1887 "graveyard" and unearthed valves and fittings which were sent to the shop for overhaul. The parts possessed a certain antediluvian appearance, having been on the scrap pile since the boiler explosion thirty years earlier, but were made serviceable in the shop nevertheless. There was at hand a brass melting pot and plenty of brass scrap. Bill also mined from the 1887 ruins a pile of asbestos which he puddled into paste, cast into molds for pipe covering and slabs and then dried in the sun. This was the self-same asbestos that fell under the criticism of a German visitor in 1885 when he complained that more compactness in the design of the steam plan would have reduced the length of the steam line and thereby avoided the necessity of asbestos.

Materials were comparatively more difficult to acquire because of the scrutiny of the purchasing agent. However, the control of the workmen was a field adjunct and there were at hand a certain number of perennials who were there "anyway." Furthermore, bookkeeping could not be allowed to stand in the way of an important objective, and so a crew was occasionally abstracted from the farm and transferred to the construction work.

The ranch carried the burden, and flexible old nature entered into the conspiracy by withholding the penalty for temporary neglect of the fields. At the end of the year the directors had a surprise when the factory returns showed how a little kindness caused the old works to respond. Incidentally, the carbonators and the evaporator condenser installed under this program were the only parts reused twenty years later when rebuilding the works.

GREAT DISTRESS EXPLODED over the telephone from the pan floor when Charlie (the "Soop") discovered the thermometer on the steam line. For four years this instrument had been proclaiming the presence of superheat to the amount of 100 deg. in the 35-lb. steam to the pan. "How in the world do you expect me to boil sugar with superheated steam? It can't be done!" Notwithstanding, a million tons of c.p. sugar had been crystallized with this steam since the coils were replaced with calandrias, but the operators did not recognize the superheat until a visiting expert chanced to spy the thermometer. However, this situation had been anticipated by the installation of a little Westco turbine pump arranged to draw condensate from the bottom of the calandria and spray it into the steam pipe just above the inlet. Charlie was shown the starter button and requested to push it and see what happened. Directly he called back to report that the temperature dropped to the saturation point,

but the steam-flow meter showed no change and there was no increase in the speed of evaporation. In a few days the excitement subsided and contentment returned. Sugar boiling went on as usual, and so did the superheat. The little Westco pump was removed.

Before the last of the coil pans was dismantled in '34, it was tried out with superheated steam just to check up on the assertion of the experts. And, sure enough, they were right. The coils 4 in. in dia. by 75 ft. long behaved as if fed with hot air. The sugar liquor acted like a blanket of hot oil with little ebulition. Cooling air releases a quarter of a B.t.u. for every degree drop in temperature.

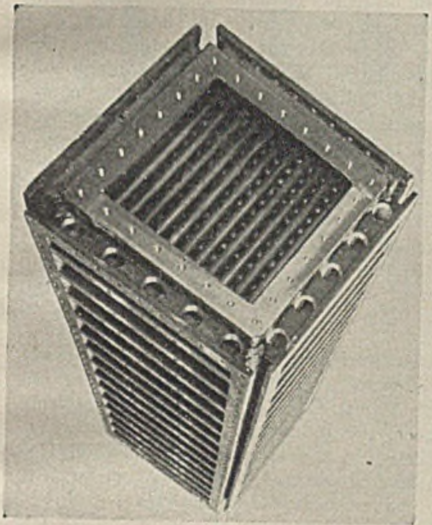
When a pound of steam at 35-lb. pressure and saturated temperature of 281 deg. drops a fraction of a degree it condenses and gives up 900 B.t.u. Our 35-lb. steam at its superheat temperature of 381 deg. gives up 51 B.t.u. in dropping 100 deg., and thereafter condenses and releases 900 B.t.u. per pound of steam for a drop of a single degree in temperature. Superheat is a useful vehicle for the economical transport of steam in pipes or through engines, but not for evaporation. However, the calandrias, having an area of 4,000 sq.ft. of vertical tubes against 1300 sq.ft. of air-locked coils, doubtless condense some steam instantly upon entrance and thereby provide moisture for the continuous desuperheating.

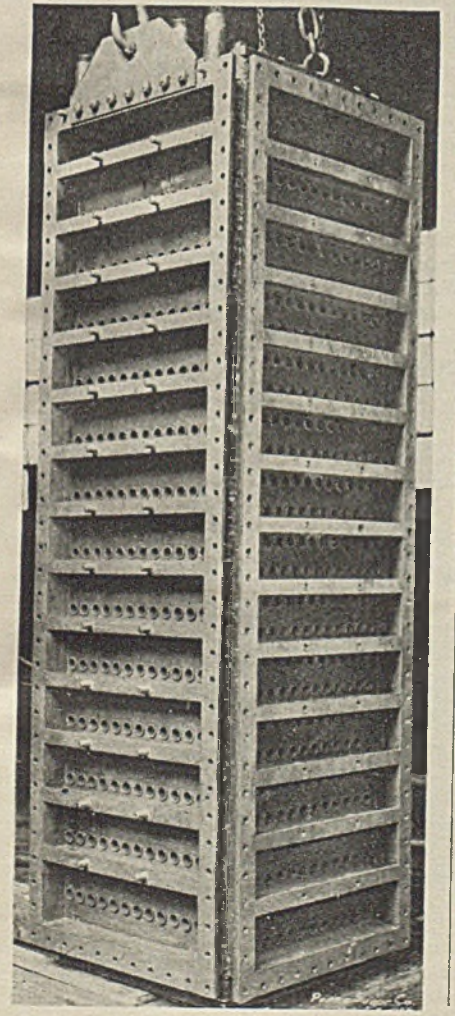
THE HEAT EXCHANGER illustrated was first built of steel and used for cooling CO_2 gas as well as compressed air. The cooling water passes through the easily-cleaned tubes while the gas meanders counter-current through the shell.

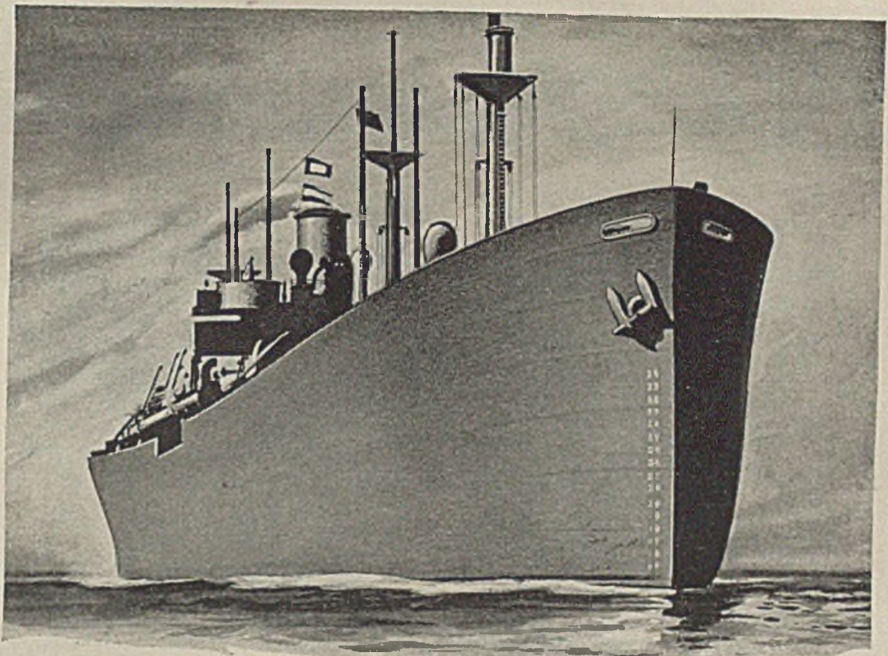
The same device was thought to have special merit as a heat exchanger for molasses, as this cantankerous material can convulse with little head loss through the tortuous path outside the tubes while the hot waste water from the condensers passes through the tubes. Four of them, therefore, were built of bronze, each consisting of four cast sides welded together at the corners. The first one heated the molasses "patiently" without caramelizing, using waste water from the condenser. The second raised the molasses to the pasteurizing temperature, using condensate en route from the traps to the hot well.

The operation proceeded satisfactorily for a period as the molasses was washed out at the end of every cycle. However, on one occasion, by operating forgetfulness, the hot condensate at about 240 deg. was allowed to continue to circulate through the tubes while the molasses flow through the shell was shut off. The result was a heavy deposit composed of lime salts and carbon that responded not a whit to any liquid solvent that was tried out. But the deposit was found to be soluble in fire and left a fluffy ash which lost its ambition to stick.

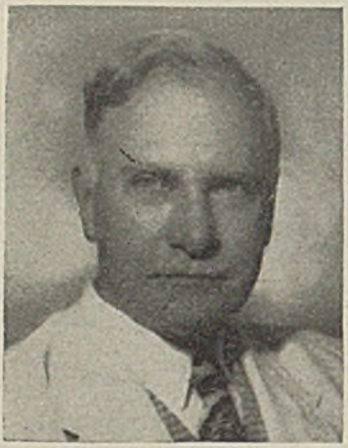
Operator Stetson thereupon circulated warm water vigorously through the copper tubes and ignited the deposit on the outside by the aid of a little excelsior and a current of air, the air being regulated from a hose to suit the maximum rate of carbon dissolution that was considered not too dangerous! The smoldering continued for a period of four days, accompanied by the evolution of a vile odor that penetrated up through the distillery. When all of the carbon had been dissolved the tubes were as clean as an Ethiopian's heel, and the original heat transfer coefficient of about 140 B.t.u. per hr. per sq.ft. per degree of average temperature difference was restored.







PERSONALITIES



Allied News

C. E. Fritsche

A. G. Olsen

✦ C. E. FRITSCHE, vice president of Reichhold Chemicals, Inc., is in charge of operations at the company's Tuscaloosa, Ala., plant. It is expected that the plant will be completed soon.

✦ HENRY F. SCHIPPEL, of The B. F. Goodrich Co., Akron, Ohio, has returned to the United States after nearly a year in Africa where he was project engineer in charge of rubber products at two large American repair and maintenance bases.

✦ E. D. YOUMANS has been elected to the position of vice president and technical director of The Okonite Co., and the Okonite-Callender Cabe Co., Inc.

✦ JOHN W. HADDOCK has been elected president of Farrel-Birmingham Co. of Ansonia, Conn. and Buffalo, N. Y. Mr. Haddock was formerly vice president of the Sullivan Machinery Co., Claremont, N. H. and Michigan City, Ind.

✦ E. W. POTTER has been elected president and general manager of Mid-West Refineries, Inc., Grand Rapids, Mich. Mr. Potter came with Mid-West in March 1940 as executive vice president. He was formerly connected with Universal Oil Products Co. and Cosden Petroleum Corp. V. M. SKINNER was elected vice president and sales manager. He is a native of Michigan and has been associated with Mid-West Refineries, Inc., since 1934.

✦ LEWIS W. WATERS, formerly vice president in charge of research and development for General Foods Corp., has been appointed to the newly created post of vice president in charge of scientific relations.

✦ JOHN M. SHIMER has been appointed to the post of research engineer with the Cooper-Bessemer Corp., Mt. Vernon, Ohio. He will be located with the company's Dallas, Tex., office.

✦ A. G. OLSEN has been appointed assistant manager of General Foods Central Laboratories at Hoboken, N. J. He will continue as director of the food technology section of the Laboratories.

✦ DONALD H. POWERS has joined the staff of Merrimac Division of Monsanto Chemical Co. as specialist on applications of the company's chemicals in the textile industry. Although his headquarters will be in Everett, Mass., Dr. Powers will serve as a consultant for all Monsnato divisions on textile applications.

✦ GEORGE W. DEBELL has opened his own offices at Stamford, Conn., where as a consulting engineer he will specialize in all types of plastics engineering. He leaves the Thomas Mason Co., where he has been employed for the past two years as chief engineer in charge of product design.

✦ R. E. BENSON, formerly with National Aniline Division of Allied Chemical & Dye Corp., has joined the Benson Process Engineering Co., Eden, N. Y., to serve as technical director of the consulting and development laboratories and as coordinator for the associate members of the company.

✦ DAVID DICKINSON, formerly with the Maytag Co., has joined the Benson Process Engineering Co., Eden, N. Y., in the capacity of physicist and engineer.

✦ A. E. BEDELL has been appointed chief engineer of Graver Tank & Mfg. Co., Inc., in charge of engineering and development covering all divisions of the company. He was formerly associated with Max B. Miller & Co. His headquarters will be at the general offices of the company, East Chicago, Ind.

✦ CHARLES F. ROHLEDER has been appointed factory superintendent of Maas & Waldstein Co., Newark, N. J. Mr. Rohleder, who has held the position of chief chemist of Maas & Waldstein since 1937, was graduated from Cooper Union in 1926 with the degree of B.S. in chemistry.

✦ LAWRENCE W. WALLACE, vice president of the Trundle Engineering Co., Cleveland, was given an honorary degree of doctor of engineering by the Agricultural & Mechanical College of Texas, College Station, Tex., at the commencement exercises held there recently. The honorary degree conferred in recognition of Mr. Wallace's outstanding contribution to engineering science and to the cause of engineering education is the second which he has received. He was given the honorary degree of doctor of engineering by Purdue University in 1932.

✦ GRANT B. SHIPLEY has been appointed chairman of the board of directors of the Elliott Co. He has had a long and successful industrial experience, having started in the shop as a mechanic. He organized several enterprises of which he was president and chairman.

✦ MAURICE L. TAINTER, professor of pharmacology at Stanford University and at the College of Physicians and Surgeons, San Francisco, has been named research director of Winthrop Chemical Co. Dr. Tainter will make his headquarters at the company's plant and laboratory at Rensselaer, N. Y.

✦ JOHN C. STRANGE has resigned as chief of the War Products Development Section, Pulp and Paper Division, W.P.B. Mr. Strange, who set up the War Products Development Section and has acted as its chief ever since will be succeeded by R. J. ZAUMEYER, of Neenah, Wis. Mr. Strange will return to his duties as secretary of the Institute of Paper Chemistry, at Appleton, Wis. but will continue to serve as a consultant to the section of the development of some of the forty special paper projects designed to meet war requirements.

✦ FRANK K. SCHOENFELD has been named technical superintendent of the chemical division of The B. F. Goodrich Co. Dr. Schoenfeld goes to his new post after many years of specializing in the development and application of Koroseal. He has been for several years in charge of the Koroseal research and development laboratories. In his new post he succeeds DR. ROBERT V. YOHE, recently named manager of the Kentucky synthetic rubber plant operated by the company for the government.

✦ JUDSON C. TRAVIS, formerly assistant to the president of Handy & Harman and recently elected to the board of directors to replace H. H. DELOSS, de-

COMMERCIAL SOLVENTS CORPORATION
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ceased, was elected vice president in charge of sales.

✦ JULIAN W. NASH, chemical engineer, has been appointed to the research staff of Battelle Memorial Institute, Columbus, Ohio, and assigned to its division of non-ferrous metallurgy. Mr. Nash, a graduate of West Virginia University, was formerly associated with the Alexite Engineering Co., Colorado Springs, Colo., and prior to that held chemical engineering positions with the U. S. Department of Agriculture and the E. I. du Pont de Nemours & Co. Among the other recent additions to the staff of Battelle Memorial Institute is LOUIS C. BEALE, a recent graduate in chemical engineering from Ohio State University, who has been appointed to the research staff of Battelle. A new appointee to the electrochemical research division of Battelle is HAROLD F. HAASE, chemical engineer, a graduate of the University of Wisconsin and the Massachusetts Institute of Technology, and Marquette University. In the division of chemical research at Battelle is BASIL H. MINNICH, a chemical engineering graduate of Ohio State University. Mr. Minnich has held positions with Standard Oil Co. of Ohio and the Ashland Oil and Refining Co., Ashland, Ky.

✦ J. V. N. DORR received an honorary degree of Doctor of Science from Columbia University on June first.

✦ GUSTAV EGLOFF, director of research of Universal Oil Products Co., was the 1943 recipient of the Columbia University Medal of Merit which is awarded annually to an outstanding scientific or technological leader in industry.

✦ JULIAN S. GRAVELY, an executive of the Western Cartridge Co. until he resigned recently, is now president of the Beryllium Corp. and the Beryllium Corp. of Pennsylvania. Mr. Gravely has his headquarters at Reading, Pa., where the manufacturing plants are located.

✦ H. W. NORTH has joined the Aircraft Division of Odin Stove Mfg. Co. as consulting engineer. He was formerly with the Austin Co.

✦ ROBERT D. THOMPSON has been appointed manager of a new glass products engineering division of The Taylor Instrument Cos. Dr. Thompson has been engaged in research work on glass products with Taylor following a year as a research fellow in the Heat and Power Division of the National Bureau of Standards.

OBITUARIES

✦ FREDERICK KERSHAW, President of Proctor & Schwartz, Inc., died at his home last month after an illness of several weeks. He was 58 years old and had been associated with Proctor & Schwartz since 1898.

✦ HAMILTON P. CADY, professor at the University of Kansas and pioneer in the development of helium resources, died May 26. His age was 68.

✦ FRANCIS J. McDONOUGH died May 31 at his home in Brooklyn. He was 54 years old. For 18 years he was President of New York Quinine and Chemical Works, and for many years he was active in the affairs of the drug and chemical industry.

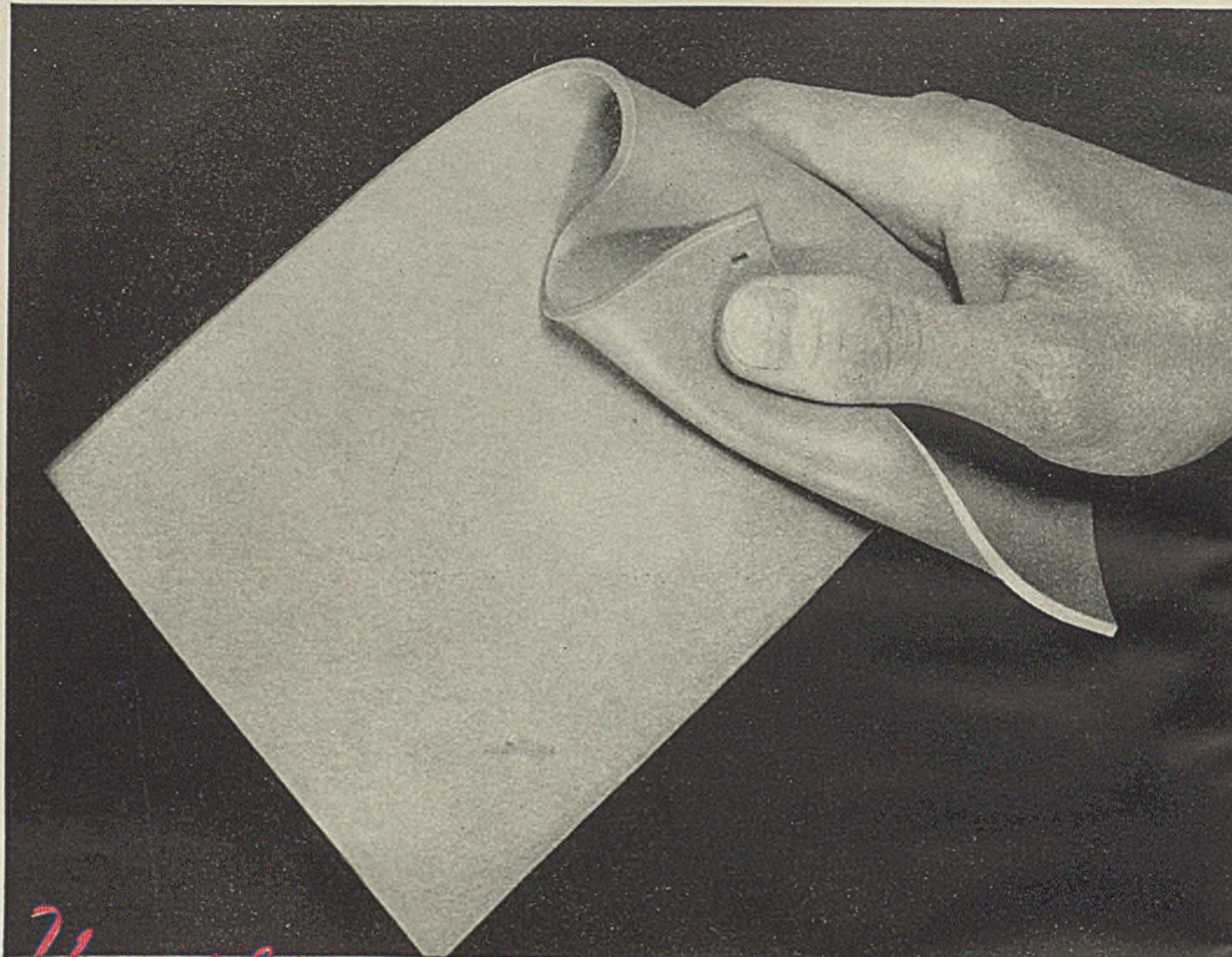
✦ JOSEPH W. HAYS, founder of what is now The Hays Corp., died at the family home in Grinnell, Iowa, on April 22 at the age of 75.

✦ ALBERT L. AUSTIN, sales engineer of Robins Conveyors Inc., Passaic, N. J., passed away on May 2 after a protracted illness. Mr. Austin joined the mead-Morrison Mfg. Co., as draftsman in the late summer of 1915. When Robins took over the coal and ore handling products of Mead-Morrison in 1934, Mr. Austin became a Robins sales engineer.

✦ ROBERT M. CASTLES of Short Hills, N. J. died April 22 in Wagner Hospital from injuries sustained in an explosion in the Rohm & Haas plant at Bristol, Pa. He was employed as a chemical engineer. He was graduated Feb. 1 from Massachusetts Institute of Technology.

Edwin M. Baker

✦ EDWIN M. BAKER, professor of chemical engineering, at the University of Michigan, Ann Arbor, and a chemical engineering consultant, died in New York May 26. He had suffered a heart attack a week previously from which he did not recover. Mr. Baker was born in 1893 and was graduated from Penn. State College in 1916 with a Bachelor of Science degree in electrochemical engineering. He joined Hooker Electrochemical Co., at Niagara Falls and remained with that organization until September, 1918. At that time he joined the University of Michigan as an instructor in the department of chemical engineering. He became assistant professor in 1920 and later associate professor. He has been full professor since 1933. As a co-author with W. L. Badger, he will be remembered for the authorship of "Inorganic Technology." For many years he has been one of the countries outstanding electrochemists and served as president of the Electrochemical Society in 1942-43.



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TYGON Tape is used as a protective wrapping for plating hooks, racks, bus bar — for insulation and corrosion-resistance.

TYGON Paint protects piping, structural steel and equipment against corrosive fumes, vapors, or occasional spillage.

TYGON Tempro-tec provides an easily removed temporary protection for highly polished surfaces, or may be used as a temporary masking agent.

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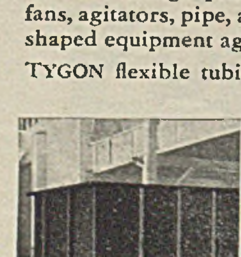
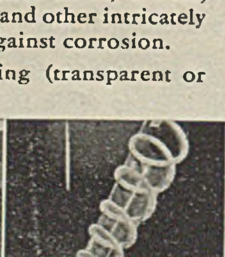
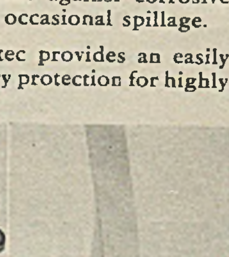






MEETINGS AND CONVENTIONS

DU PONT URGES POSTWAR PLANNING

ADDRESSING the Manufacturing Chemists' Association at its annual meeting in New York June 3, Lammot Du Pont, chairman of the board of E. I. Du Pont de Nemours & Co., said that practical postwar planning with "one doing the planning of one's self—the individual for the individual, the small company for the small company, and the corporation for the corporation"—should bring about the highest peacetime employment in the nation's history.

Mr. Du Pont revealed that his own company's postwar planning group had made a survey which "indicates that the new projects which Du Pont will be ready to launch when the war is over, together with increased outlets for existing products, are expected to give rise to an all-time high in peacetime employment by the company." Although the United States will have the greatest productive capacity in its history when peace comes, the task of swinging this capacity from the channels of war to those of peace will be fully as titanic as was the conversion of a peaceful nation into the "arsenal of democracy."

All these assumptions, Mr. Du Pont pointed out, were based upon certain fundamentals being respected, for instance, (1) sound money based preferably on the gold standard, (2) taxes at such a level as to give industry the incentive to expand and pioneer, and (3) that government will abstain from competition with business.

Officers reelected by the Manufacturing Chemists' Association were as follows: H. L. Derby, president; Lammot Du Pont, chairman of the executive committee; J. W. McLaughlin, vice president; and W. M. Watson, secretary. New members added to the executive committee include W. S. Landes, vice president of Celanese Company of America; H. M. Hooker, president of Hooker Electro Chemical Co., and S. Sharples, pres., Sharples Chemical Co.

A.I.Ch.E. PASSES RESOLUTION ON DRAFTING OF CHEMICAL ENGINEERS

AT ITS semi-annual meeting in New York during May, members of the American Institute of Chemical Engineers discussed deferment of essential technical personnel in war industries. The report of the Technical Manpower Committee, under the chairmanship of S. D. Kirkpatrick, led to the passage of the following resolution:

"The members of the American Institute of Chemical Engineers present at the Institute's 35th semi-annual meeting in New York City, May 10, 1943, by unanimous vote, express their belief that many of the existing difficulties incident to the determination of the desirability of deferring chemical engineers and chemists engaged in essential chemical and related industries would be overcome by appointment of an advisory committee to the War Manpower Commission, which would achieve the objectives of the advisory committee on the deferment of physicists set up under W.M.C. Local Board Release No. 159; and concur in the request recently made by the Board of Directors of the American Chemical Society, that a separate advisory committee, restricted in its recommendations to chemical engineers and chemists, be appointed."

SOCIETY OF PLASTICS INDUSTRY ELECTS NEW OFFICERS

AT ITS annual meeting in Chicago on May 13-14, the Society of Plastics Industry elected the following officers to serve during the coming year: chairman, Ronald Kinnear; president, George Scribner; vice-president, Howard Bunn, and secretary-treasurer, H. H. Wanders. Newly elected directors included Horton Spitzer, William Joslyn, James Neal, W. M. Phillips, J. D. McDonald, O. W. Marsh, M. G. Milliken, F. A. Morlock, Carl Hitchcock, W. J. McCortney, and A. E. Byrne.

INDUSTRIAL RESEARCH INSTITUTE HOLDS ANNUAL MEETING

THE INDUSTRIAL Research Institute completed five years of activity with its recent annual meeting in New York on May 21-22. Seventy industrial executives and research directors, representing member companies and their guests, attended the meeting and participated in informal conferences. Organization of research in Great Britain and the United States, its support of the war effort and probable postwar trends, was discussed. Dr. G. S. Whitby, recently of the department of scientific and industrial research, Teddington, England, presented the British picture and Dr. Robert W. King, American Telephone & Telegraph Co., discussed the situation in this country. Further sessions were devoted to discussions of new research tools in the field of chemistry, industrial research management problems and rating of research personnel.

William R. Hainsworth, vice president, Servel, Inc., New York, was elected chairman of the Institute's Executive Committee for the coming year, and Harold K. Work, manager of research and development division, General Metallurgical Department, Jones & Laughlin Steel Corp., Pittsburgh, was elected vice chairman. Three new members of the committee were also elected for three-year terms. These were A. Griffin Ashcroft, Ralph T. K. Cornwell, and John M. McIlvain.

CHEMICAL SHOW TO BE HELD IN MADISON SQUARE GARDEN

DATE FOR the 19th Exposition of Chemical Industries has been definitely set for the week of December 6-11, 1943, according to C. M. Roth, manager of the exposition. However, this year Madison Square Garden will be the scene of the event instead of Grand Central Palace, since the U. S. Army has commandeered the exposition floors of the Palace. All exhibition space at Madison Square Garden will be on one floor. The actual amount of space available will be approximately 50 percent that of the 1941 exposition, and booth sizes will vary. A diagram of the floor plans is now being prepared by the International Exposition Co., 480 Lexington Ave., New York, N. Y.

CONRAD ELVEHJEM RECEIVES WILLARD GIBBS MEDAL

THE 32ND Willard Gibbs medal has been presented by the Chicago section of the American Chemical Society to Conrad A. Elvehjem, professor in agricultural chemistry at the University of Wisconsin. The presentation was at the May 20 meeting of the section.

The recipient was cited for his work on vitamins and nutrition, and especially for his research in the field of the B vitamins. C. Glen King, scientific director, Nutrition Foundation, Inc., spoke of the medalist and his achievements, while Per K. Frolich, president of the American Chemical Society, presented the medal. Dr. Elvehjem then spoke on "Nutritional Significance of the Newer Members of the B-Complex."

DOW RECEIVES CHANDLER MEDAL FROM COLUMBIA UNIVERSITY

WILLARD HENRY DOW, head of the Dow Chemical Co., Midland, Mich., has been chosen by Columbia University as recipient of the Chandler medal for this year. The medal was presented to Dr. Dow at Columbia University, May 20, at which time he delivered an address on "Rediscover the Rainbow."

Dr. Dow was chosen for his dynamic and successful leadership in the American chemical industry. In addition to his accomplishment in expanding a chemical industry from Michigan salt brines, his daring enterprise in the extraction of bromine and of magnesium from sea water as well as the production of synthetic plastics and synthetic rubber have all attracted world-wide attention.

CANADIAN CERAMIC INDUSTRY APPOINTS ADVISORY BODY

A CERAMIC ADVISORY COMMITTEE has been formed by the Canadian ceramic industry to assist in an advisory capacity to the Conservation Committee of the Department of Munitions and Supply, Ottawa, and to study possibilities of extending the line of ceramic products so as to conserve metals and other critical materials or to replace commodities of which there is a shortage. The Advisory Committee is under the chairmanship of Howells Frechette, chief of the Industrial Minerals Division, Bureau of Mines, Ottawa.

ELECTROCHEMICAL SOCIETY TO HOLD CONVENTION DURING OCTOBER

THE NEXT convention of the Electrochemical Society will be at the Hotel Pennsylvania, New York, Oct. 13–16, 1943. Lincoln T. Work, director of research, Metal & Thermit Corp., heads the New York local committee. Among the special items on the program will be the Joseph W. Richards' memorial lecture by B. D. Saklatwalla.

There will be one session on "Electro-Organic Chemistry" and two sessions on "Electrodeposition." James A. Lee, managing editor, *Chem. & Met. Eng.*, reports twelve manuscripts promised on the subject of "Electroplating Strip Steel." In the electro-organic field, H. Germain Creighton urges members and guests to submit manuscripts on electrolytic oxidation and electrolytic reduction of organic compounds and in particular on organic reactions in the electric discharge tube.

TEXTILE CHEMISTS CANCEL ANNUAL MEETING

IN COMPLIANCE with the restrictions on traveling imposed by the Office of Defense Transportation, the Council of the American Association of Textile Chemists and Colorists has again voted to abandon plans for an annual meeting this year. Nevertheless, demand for continuation of the intersectional technical contest has been so persistent that this event will be held. Papers contributed by sections of the Association will be submitted at a fall meeting of the New York Section, the date of which will be announced later.

CORROSION COMMITTEE ISSUES DIRECTORY

THE AMERICAN Coordinating Committee on Corrosion is revising its confidential directory of technologists actively engaged in studies on corrosion and its prevention. The committee comprises delegates from 15 major technical societies together with representatives from the principal research institutes and the National Bureau of Standards. Its directory currently lists some 450 investigators in a diversity of corrosion-preventive fields, selected on the basis of questionnaires. The committee now requests all persons engaged in corrosion researches who have not been contacted to write to the secretary, Dr. G. H. Young, 4400 Fifth Ave., Pittsburgh, Pa., for further details and application form.

GIBSON ISLAND CONFERENCES UNDER WAY

THE SIXTH summer research conferences on chemistry and allied fields under the auspices of the American Association for the Advancement of Science are now under way, lasting from June 14 through August 16. Conferences scheduled include those on "Frontiers in Petroleum Industry," under the chairmanship of R. E. Burk; "Catalysis," under Hugh S. Taylor; "Organic High Molecular Weight Compounds," under H. Mark; "Strategic Materials," under Robert Calvert; "Vitamins," under R. Adams Dutcher; "Corrosion" under R. B. Mears and "Instrumentation" under John J. Grebe.

Requests for attendance or other additional information should be addressed to the director of the conferences, Neil E. Gordon, chemistry department, Wayne University, Detroit, Mich.

CONSULTING CHEMISTS AND CHEMICAL ENGINEERS DISCUSS KILGORE BILL

RELATIVE merits of Kilgore Bill S. 702 were discussed by members of the Association of Consulting Chemists and Chemical Engineers, Inc. at the April meeting of this organization in New York.

Certain features of the bill were defended by A. P. Sachs, vice president of the Association of Consulting Chemists and Chemical Engineers, and by B. L. Oser, Food Research Laboratories, Inc. Opposition was voiced by Preston S. Millar, president, Electrical Testing Laboratories, Inc., C. O. Brown, consultant, and Nicholas M. Molnar, Molnar Laboratories.

SELECTIONS FROM CONVENTION PAPERS

CONTAMINATION BY SUCCESSIVE FLOW IN PIPE LINES

IN THE transportation of different fluids in pipe lines, it is customary to pump one product immediately after the other. This leads to contamination of a portion of the material delivered from the far end of the pipe line. Experimental work has been done in the laboratory under conditions where the contaminated portion may be determined with much greater precision than is possible in commercial lines. Fluids used consisted of water and salt solution of almost identical physical properties covering viscosities from about 0.8 to 1.5 centipoises, Reynolds numbers from less than 200 to 19,800 and length-diameter ratios from less than 200 to over 10,000.

In the laminar flow region the contaminated portion was found to be independent of Reynolds number, as is indicated by a theoretical analysis. In turbulent flow the contaminated portion may be computed by the following equation:

$$\log_{10} (\textit{contaminated portion}) = \log_{10} (\textit{pipe vol.}) - 0.4 \log_{10} \frac{L}{D} + c$$

where *c* is a function of Reynolds number and range in instantaneous composition defining contaminated portion.

The above equation can be applied to commercial pipe line data covering the transportation of oil products, using the average Reynolds number of the two products in the above equation. The commercial data cover viscosities varying from 0.51 to 7.4 centistokes, corresponding to Reynolds numbers from 27,000 to 610,000 (average Reynolds numbers from about 55,000 to 537,000) and length-diameter ratios from 437,000 to 1,765,000.

Frank C. Fowler, Phillips Petroleum Co., Bartlesville, Okla., and G. G. Brown, University of Michigan, Ann Arbor, Mich. before the American Institute of Chemical Engineers, New York, N. Y., May 10–11, 1943.

GLUTAMIC ACID CONTENT OF STEFFEN'S WASTE FROM BEET SUGAR PRODUCTION

Glutamic acid or sodium glutamate, much in demand as a condiment, can be made from Steffen's waste. Variations in the glutamic acid content of Steffen's waste from various parts of the country having been noted, attempts were made to determine the variations and, if possible, to explain them.

On a comparative basis using wastes concentrated to a specific gravity of 1.4, 500 grams of the concentrated waste yielded the following amounts in grams: Tracy, Calif., 30.75; Mason City, Iowa, 30.7; St. Louis, Mich., 28.95; Freemont, Ohio, 27.05; Grand Island, Nebr., 21.92; Spanish Fork, Utah, 18.4; Loveland, Colo,. 17.57. Smaller amounts were obtained from Swink, Colo., 10.65; Fort Morgan, Colo., 10.9; Ovid, Colo., 9.55; Worland, Wyo. 6.05.

While no glutamic acid or very little was obtained from samples from Colorado prior to 1938, either because of a more accurate method or because of a variation in seasonal conditions, considerable glutamic acid was obtained from the present Colorado samples. The highest yields of glutamic acid were obtained from samples procured from factories located in the midwestern states and in California.

Wastes from Iowa, Michigan, Ohio, and California should be chosen as a commercial source of glutamic acid.

David W. O'Day and Edward Bartow, The State University of Iowa, Iowa City, Iowa, before the 105th annual meeting of the American Chemical Society, Detroit, Mich., April 12–16, 1943.

ISOTHERMAL AND ADIABATIC FLOW OF COMPRESSIBLE FLUIDS

In pipe lines handling compressible fluids at high pressure drops, the flow conditions are usually intermediate between isothermal and adiabatic, depending on the flow rate, the degree of pipe insulation, and the length of pipe. A graphical presentation has been prepared to give a direct quantitative comparison of the effect of adiabatic and isothermal flow conditions on mass discharge rates through such pipe lines.

It is shown that the mass discharge rate through a given pipe line at a specified pressure drop for adiabatic flow conditions is, in general, greater than for isothermal flow conditions but will never be more than 20 percent greater and will be practically the same as for isothermal flow conditions for pipes more than 1,000 pipe diameters long. The adiabatic flow equations will reduce, as is necessary, to the corresponding isothermal flow equations if the value of k (ratio of specific heats), appearing in the adiabatic flow equations, is set equal to unity. Design charts have been drawn up for various values of k, and comparisons of the theoretical curves with available literature data show excellent agreement.

C. E. Lapple, E. I. du Pont de Nemours & Co., Wilmington, Del. before the 35th semi-annual meeting of the American Institute of Chemical Engineers, New York, N. Y., May 10–11, 1943.

CHEMICAL PROCESS INDUSTRIES AFTER THE WAR

Whether the war drags on for several years or comes to a fairly early conclusion, careful thought must now be given to the question of post-war trends and possibilities. If the war should be protracted, tentative conclusions regarding future developments will obviously have to be resurveyed at intervals. But in order not to be caught unaware if a sudden ending of the conflict should come, it is advisable to make now some preliminary investigations at least along broad lines. Management must continually carry on long-range planning.

Electrochemical Industries—These industries have been enormously stimulated by the war program and by the construction of Bonneville, Boulder, Grande Coulee and the dams near Muscle Shoals. If the Federal Power Commission has its way the present generating capacity of the country of 50,000,000 kw. will soon be pushed up to 62,000,000 kw.

Much of this power will be used by our aluminum industry, which is planned to have an ultimate capacity of 3,000,000 lb. or almost ten times the 1939 figure. Magnesium production at the close of 1942 was at the rate of 260 million pounds. Ultimate capacity is now planned at 600 million pounds, or almost 100 times the 1937 output. Almost anything that flies, runs, moves, or is otherwise mobile or motive will offer a potential market for these light metals and their alloys. But they will have increasing competition from plastics and from high strength, low-alloyed steels.

In 1939 this country produced 485,000 tons of chlorine, and last year's output is believed to have been over 1,000,000 tons. Additional capacity which has since been completed will raise the figure in 1943 to 1,200,000 tons. One of the largest users of chlorine is the organic solvents industry. In 1942, some 200,000 tons of chlorine were used for production of trichloroethylene, carbon tetrachloride, tetrachloracetylene, ethylene dichloride, and other chlorinated hydrocarbons.

Another interesting electrochemical development is the improved plating process for strip steel for fabrication at speeds 100 times faster than those in the past.

Use of Aluminum by Industry

	Nov. 1939	May 1942	Estimate After World War II
Transportation ..	29%	63%	34%
Cooking utensils.	14	1	10
Electrical conductors	10	0	8
Machinery and electrical appliances	15	6	12
Building construction	8	3	9
Chemical	5	5	5
F[illegible]ry and metal working.	4	19	9
Ferrous and nonferrous metallurgy	5	2	4
F[illegible] and beverages	6	0	5
General miscellaneous	4	1	4

Heavy Chemicals—Commodities like ammonia and nitric acid as well as phenol have been greatly stimulated by war demands and will recede unless important new uses not now in sight are developed for postwar exploitation. Sulphuric acid, soda ash and caustic soda have expanded plant capacities of 12 to 15 percent over 1941.

Nitric acid may well be in for a nose dive unless the present slow trend toward more concentrated fertilizers opens up a more promising outlet for ammonium nitrate and ammnoium phosphate. Organic nitrated materials, such as the nitroparaffins, have interesting possibilities but do not yet loom large as acid consumers.

Synthetic Organic Chemicals—This industry undoubtedly will emerge from the war period with greatly expanded capacity, improved raw materials and processes, and hungry for new and larger markets. The war has definitely proved that the industry can "tailor-make" its products to fit practically any specification of properties and performance. Organic chemical engineering is the engineering of the future.

Last year this industry set an all-time peak in production and is expected to gain another 25 or 30 percent in 1943. Coal-tar crudes and intermediates, especially those destined for plastics, rose sharply. Synthetic medicinals showed an outstanding development that seems certain to continue to gain momentum.

The solvents industry will undoubtedly encounter many postwar problems. With ethyl alcohol production up five times the largest output in normal times, with more isopropyl than we formerly had of ethyl, with methanol up 50 percent and toluol and benzol production skyrocketing, it is certain that the industry will have to look for new fields to cultivate. Fortunately, synthetic rubber, resins and plastics are going to need much larger volumes of solvents than ever before. Fortunately, too, in the case of ethanol is the fact that fully half of its production is coming from the whisky distillers, who presumably will revert to their own business after the war.

Plastics and Resins—Plastics will undoubtedly be put on the market at lower prices after the war. The backbone of this industry in prewar days was the larger number of applications calling for comparatively small quantities. The war, however, has shown that large volumes of materials will completely overshadow the small outlets. Already the industry is talking in tons, and last year production exceeded 200,000 tons. This is insignificant when compared with 100,000,000 tons of steel, but when it is put alongside of 300,000 tons of magnesium, 75,000 tons of tin or 600,000 tons of zinc, and when it is realized that plastics are lighter than all metals except aluminum and magnesium, we get a better basis for talking about the "Plastics Age."

James A. Lee, managing editor, *Chemical & Metallurgical Engineering*, before the Chicago Section of the Electrochemical Society, Chicago, Ill., March, 1943.

HYDROGENATION AND LIQUEFACTION OF COAL

MEASUREMENTS were made of rates of hydrogen utilization; of oxygen, nitrogen, and sulphur removal; and of coal liquefaction at temperatures in the range of 310-430 deg. C. at about 180 atmospheres pressure of hydrogen in presence and absence of a catalyst. These tests were made in 1200-cc. rotating autoclaves using Pittsburgh bed coal in all cases except when the effect of rank was being studied.

Chief function of the catalyst is to increase the rate of regeneration of a hydrogen carrier which is a hydroaromatic compound such as tetrahydronaphthalene. Reactions of the hydrogen carrier with oxygen and unsaturated groups in the coal are largely noncatalytic. Effects of the catalyst on rate of oxygen elimination and liquefaction are similar.

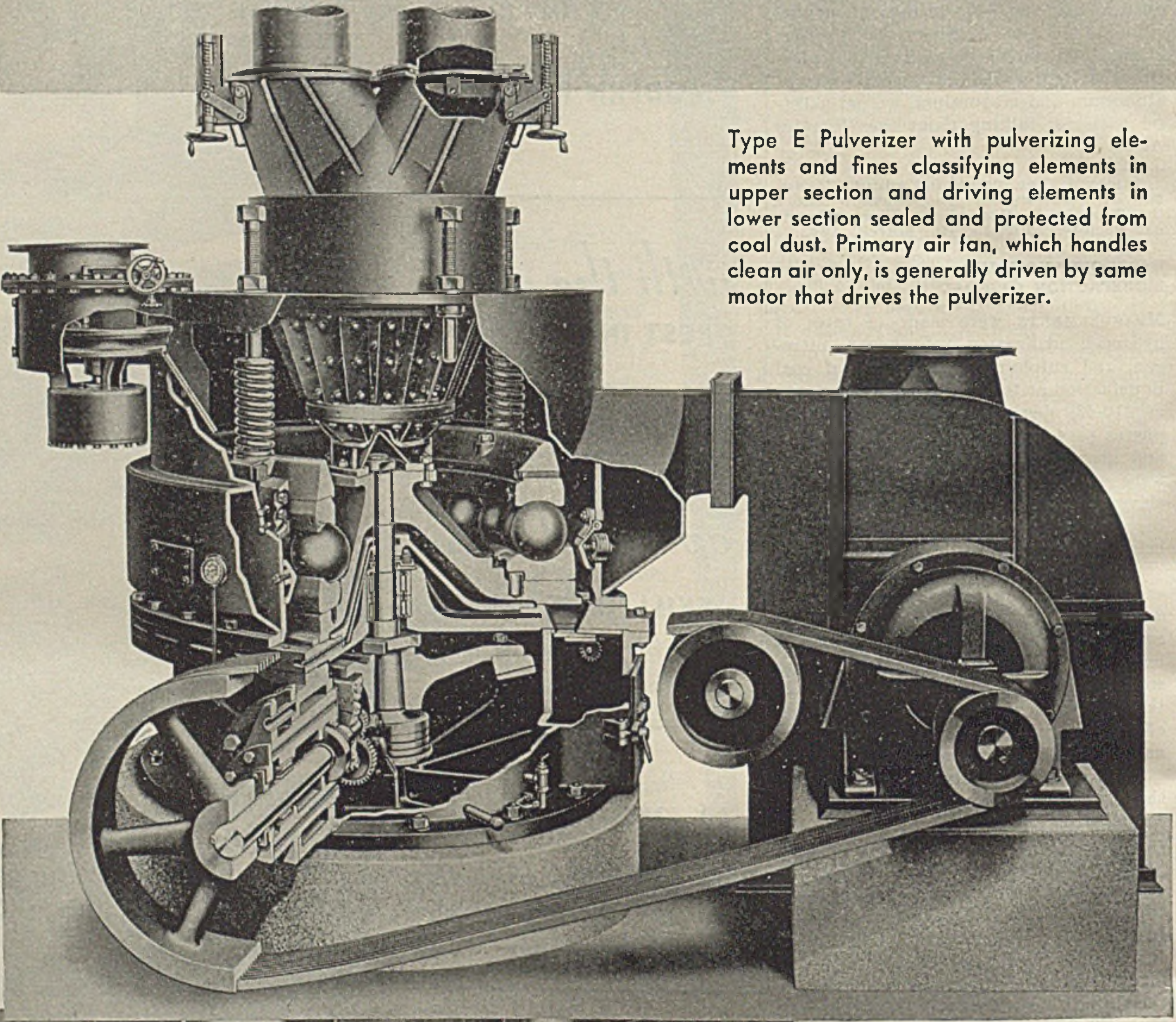
Rates of hydrocarbon gas formation show similar variations in temperature coefficients. The latter indicate that the rate-determining step changes with temperature. Below 300 deg. C. it is apparently a chemical reaction between a hydrogen carrier and unsaturated groups in the coal; between 310-355 deg. C. diffusion of hydrogen through liquid films on the surface of the coal and catalyst is the slowest step. Between 355-370 deg. C. the diffusion rate surpasses that of primary thermal decomposition of the coal substance and the latter becomes the rate-controlling process.

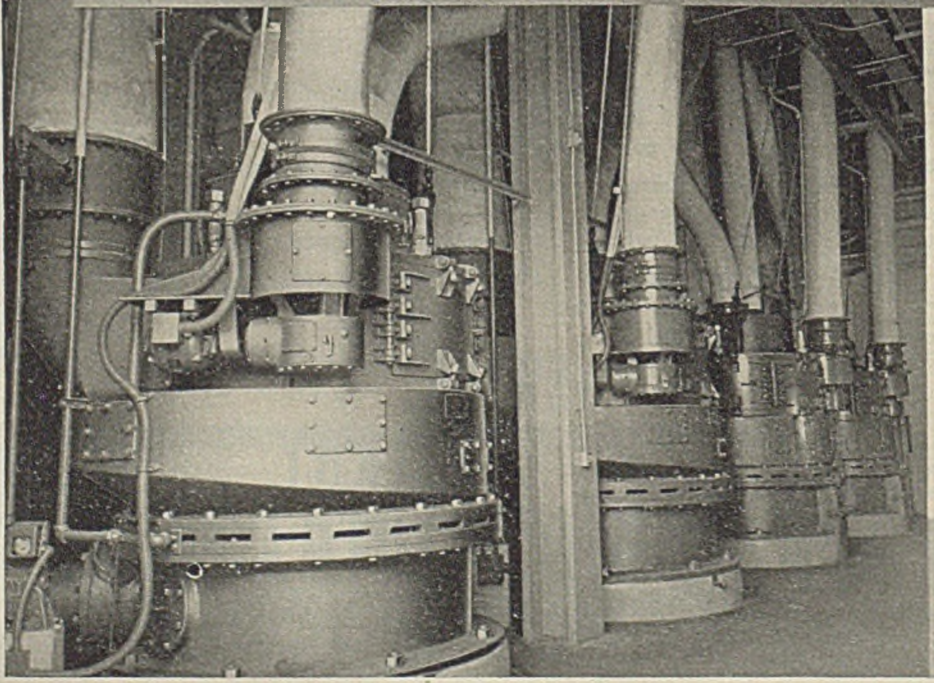
Above 385 deg. C. the rate of primary decomposition of coal surpasses that of secondary decomposition which is probably a reaction between oxygen-containing groups of the primary decomposition products and a reactive hydroaromatic such as tetrahydronaphthalene.

H. H. Storch, C. H. Fisher, C. O. Hawk, and A. Eisner, U. S. Bureau of Mines, before the Division of Gas & Fuel Chemistry of the American Chemical Society, Detroit, Mich., April 12-16, 1943.

• • •

When the chemical engineer has worked with workmen, and has been selling with salesmen, and discussing finances with financial men and research plans with technical groups, he begins to acquire the necessary habits of thought and an insight into the various types of minds with which he must deal, if he is to function in an administrative capacity.





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Respond readily to load changes—output controlled at one point, the primary air damper, and are adoptable to fully automatic control.

Maintain fineness and capacity throughout life of grinding elements.

Handle coal of a wide variety and, due to drying in the mill, can handle coal with as much surface moisture as it will carry.

These and other features of the Type E Pulverizer are given in more detail in Bulletin G-30-A. Copies obtainable on request.

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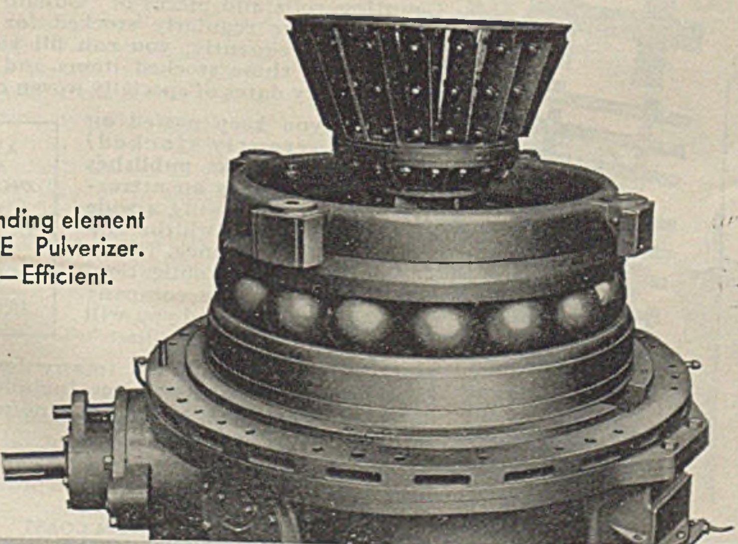
The Army-Navy "E" and Maritime Commission Award flags are floated proudly at the plant that builds Type E Pulverizers.



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G-244 T

NEWS FROM ABROAD

FUEL ECONOMY AND IMPORT DIFFICULTIES INCREASE BRITISH INTEREST IN SUBSTITUTION PROBLEMS

Special Correspondence

Only now that the government-sponsored fuel economy campaign is in full swing, does it become clear how close are the connections between fuel industry and chemical trades. The government fuel economy program is remarkable for the diversity of methods applied to that end, and chemical manufacturers cooperate with the fuel industry not only as important consumers of coal and coke, but also as suppliers of substitute fuels and as producers of substances which can help to reduce the consumption of coal required for the development of a certain amount of heat. Among substitute fuels a creosote-pitch mixture supplied in substantial quantities by coal-tar distillers is used on quite an important scale in place of imported fuel oils.

The Ministry of Fuel and Power has arranged for the conversion of oil-burning furnace and boiler plant to the burning of this creosote-pitch mixture, and experience so far has been satisfactory, so much so that it seems likely that any surplus which may arise during normal operations after the war will be disposed of in this way, even though imported fuel oils may again become available on a larger scale. Another new fuel which is likely to increase in importance are coal briquettes. There are now 25 coal briquetting machines in action, and by next autumn hundreds of thousands of tons of briquetted coal will be available. Considerable use of briquetting has been made in Continental Europe, especially for lignite, but in the British Isles this is a new development of special importance for the disposal of inferior grades and sizes of coals.

The fuel economy problem in the chemical trades has been tackled through the industrial organizations. These have invited their members to meetings at which opportunities are provided for the exchange of experience and for expert advice on fuel saving practice. In the plastics industry, to quote an important example, a questionnaire asking for statistics concerning average consumption of gas, electricity, coal, and coke was sent to manufacturers, and the results obtained in this way were circularized in a memorandum to individual firms in which attention was drawn in particular to those points which had been found to be most important from the point of fuel economy. The expert committee in charge came to the conclusion that while the problems attaching to heat and power generation are those confronting all industries, those of utilization deserve to be approached from the special angle of the plastics industry. Reduction of moisture losses by efficient covering on all piping and steam flanges; installation of steam separators at suitable points, with strainers, check valves, and traps; checking-up on leaking joints; lagging of flanges; correct choice of steam traps in accordance with the conditions under which they work—these are some of the points selected for special mention.

Industries which are using very high furnace temperatures—iron and steel, glass, pottery, refractories, cement and lime producers—have also entered upon an exchange of practical knowledge. Some of these industries are able to calculate exactly the quantity of fuel necessary under ideal conditions, which is a great help in assessing economy possibilities. In the cement industry efforts have been made to use a dry mixing process, such as is used in the United States, for drying out the slurry, but so far this has been unsuccessful.

Much attention has been paid to avoiding excessive use of fuel by improving insulation and eliminating waste heat, but these efforts cannot be expected to yield great results in existing plants unless considerable reconstruction work is carried out. There is, however, the possibility of making better use of waste heat and waste gases. The British Refractories Research Association has been working on special refractories for certain boilers and furnaces. At power stations coal has been saved by making increased use of water chlorination, with a view to the prevention of gradual deposition of algae on condenser tubes. Were chlorination plant installed everywhere, an annual saving of something like 600,000 tons of coal annually would be the result, according to one claim.

Rayon Federation

Co-operation between individual firms and exchange of knowledge gained in practical operations is a feature in other fields of British industrial activity. A British Rayon Federation has been formed to include the Rayon Producers' Committee, Rayon Weaving Association, Rayon Warp Knitters, Rayon Staple Spinners' Association, and many other trade organizatinos. A Rayon Council had been set up earlier to assist the Rayon Controller, but lately it was felt that a more closely-knit organization was required to help in the practical execution of tasks devolving on the industry. At the same time the link existing between silk and rayon producers in the form of the Rayon and Silk Association has been severed. Another new organization is the British Shellac Bleachers' Association whose aim it is to improve, by united effort, the quality and output of British bleached lac, with the ultimate object of participating, after the war in the European export trade (which in the past was in foreign hands) of securing the best possible raw materials from India, and of building up a sound trade based on an agreed policy of buying and selling.

The annual report of the Imperial Institute for 1942 again shows the wide variety of investigations entrusted to this organization and draws attention to the stimulus which new products and new sources of supplies in the colonial territories have received owing to the war. Agar was received from New Zealand and, except in appearance, compared very favorably with the established commercial grades. New Zealand seaweed was investigated and is believed to be of value in place of Irish moss for certain purposes. Po-yok oil extracted from po-yok fruit received from Sierra Leone was found to be generally superior to linseed oil, though inferior to tung oil. Of special interest is an investigation concerning essential oils from the Congo which was carried out for the Comité Special du Katanga. Geranium oil from that source was rather inferior in odor to Algerian and Réunion oils but would compete favorably with Kenya geranium oil. Basil oil was found to have the normal characteristics, although it was inferior to the French oil. Eucalyptus citridora could not in normal circumstances compete with Java citronella oil, even though it commands a lower price. The fourth sample, of unstated botanical origin, was considered to be promising as a flavoring agent and for use in the soap and cosmetic industries. Another investigation was concerned with citronella and lemon-grass oil from the West Indies. These would meet with a ready market in England now, but compared with the Java type citronella oil its post-war prospects appeared less satisfactory. A substitute for gum damar to be incorporated in a special type of paint was found in certain shellac compounds, and a plastic material may also fulfill the requirements.

It is characteristic of the Imperial Institute's work in wartime that many of these investigations had the purpose of helping to establish new sources of production for commodities which used to come from producing countries no longer available to British consumers. Yet the Imperial Institute's work has always been concerned with the dissemination of knowledge about materials produced in some countries to potential producers in others, and in this work there has been no interruption. The production of pyrethrum in India was attempted first in 1937. Since then it has been established that its cultivation was possible in some parts of the country, and if grown above an altitude of approximately 4000 feet the Indian plant seemed quite capable of competing with that grown in Japan or Kenya.

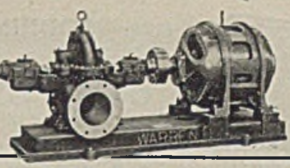
Another development of general interest is the plan to produce in the East African territories at least a portion of the local quinine requirements. Tanganyika produces cinchona bark which will be made into totaquina in a factory recently opened at Dar-es-Salam.

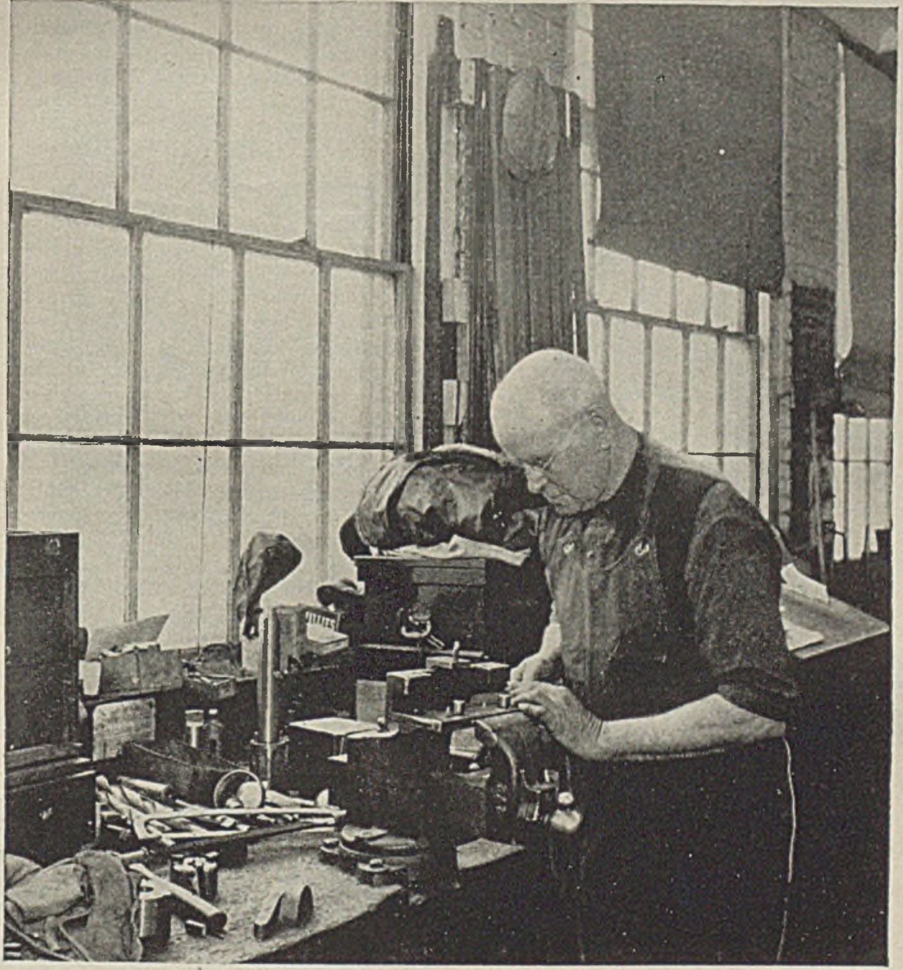
Quinine Substitutes

In the meantime British hospital authorities have been informed by the Minister of Health that synthetic substitutes for quinine are available from several British manufacturers. The products in question are mepacrine hydrochloride B.P., mepacrine Methanesulphonate B.P., and pamaquin B.P. A new sulphonamide derivative is being produced by a British firm. The compound is 2-para-succinylaminobenzenesulphonamido-thiazole. It is stated to exert a potent anti-bacterial effect within the intestinal tract.

To what extent government agencies are forced into undertaking new tasks is shown by a report from Turkey that the United Kingdom Commercial Corp. has begun there to manufacture soap from its local stocks of olive oil. The United Kingdom Commercial Corp., plays an important part in the practical implementation of the Anglo-Turkish commodity transactions. The caustic soda required is reported to be supplied by the United States, and it is hoped that the increase in Turkish soap production will result in a general reduction of producing costs. An initial consignment of 1,500 tons of soap has been arranged for Russia, and some hundreds of tons are to be distributed by the International Red Cross in Greece.

The supply of the British colonies with medicinal products is to be undertaken centrally through the medium of the Crown Agents. This is another new development capable of considerable extension after the war and has therefore aroused some concern in the trades concerned. The National General Export Merchants' Group has protested to the Colonial Office and Board of Trade against the introduction of a scheme for the bulk purchase of essential medical supplies. No objection is raised to the purchase in bulk of supplies that may have to be made from the United States or to the decision to estimate the requirements of the Colonies, but so far as supplies from Great Britain are concerned the traders represented see no advantage to be gained from the new system. The principl involved in these government transactions is of considerable importance, and since the question of export policy after the war has lately received some attention, all actions of government agencies are subjected to close scrutiny. Nevertheless, it seems certain in present circumstances that direct government participation in trading with Colonies and other overseas countries will, if anything, increase but certainly not decline in importance.





SODIUM CELLULOSE GLYCOLATE FINDS WIDE APPLICATION AS A SUBSTITUTE MATERIAL IN THE REICH

In a recent issue of Foreign Commerce Weekly, Virginia Kinnard of the Division of Industrial Economy, has an article which states that sodium cellulose glycolate, a gelatin substitute developed in the last war is now finding wide application in the Reich. It is being used in place of scarce, ordinarily imported materials such as gum arabic, agar-agar, carageheen or Irish moss, gum tragacanth, cherry gum, carob gum, and gluten.

The article states that cellulose chemistry research, especially in connection with cellulose for producing fibers, wood sugar, and plywood plastics, has helped to provide a basis for the improved sodium cellulose glycolate now being used to supplant natural products in the manufacture of adhesives, textiles finishing and sizing agents, thickeners, and emulsifiers, even including those employed in the photographic field.

In addition to these industrial applications the recent discovery of the physiological inertness of sodium cellulose glycolate opens up new fields for its use, particularly as a stabilizer in the foodstuffs industry. Through slight variations in the complex molecular structure of this cellulose ether, which is now better understood than it was a decade ago, more than 40 different preparations are now said to be manufactured by six German concerns. Commercial-scale production of them, however, began only around the outbreak of the present war.

The formerly imported natural substances, obtained from seaweed or gummy exudations of certain plants and trees, although not used in large amounts, are indispensable in many specialized manufacturing processes. Generally, their value lies in their mucilaginous nature, and their ability to gelatinize even when considerably diluted.

Probably the best-known product in the group is agar-agar, long associated with the Orient, where it is extracted from marine algae or seaweeds, found along the coasts of China and Japan. After boiling the weed, the resulting solution is strained, cooled, cut into blocks, and then pressed into bundles of strips. The finished product is a white, powdery substance. Germany imported 75 tons of agar-agar from Japan in 1938. Little information is available as to whether the new test-tube product is a completely satisfactory substitute for agar-agar in its important uses, as a medium for cultivating bacteria, as a medicinal substance, or as a base and stabilizer. By far the outstanding industrial use of agar-agar is in the form of a base where it is used in the manufacture of about 200 commodities.

Irish moss or caragheen, made of kelp

taken from the coasts of Ireland and North America, is used as a demulcent for soothing and protecting inflamed tissues, and as a clarifying agent in brewing. In addition to considerable quantities of Irish moss, Germany imported about 1,500 metric tons of gum arabic, mostly from the Anglo-Egyptian Sudan, and 1,400 tons of gum tragacanth in 1938, the last year for which statistics are available; some gum tragasol was also imported.

Gum arabic, a fine white powder, is obtained by drying the gummy exudation of the acacia verek. The average yearly crop per tree is from 1 to 2 pounds. Gum arabic has many uses, although perhaps its greatest application is in the confectionery trade—it is used to give soothness and elasticity to candies and icings. In medicine the best-quality gum is employed as a softener or soothing agent, and as an emulsifier. It is also used in sizing, stiffening, and finishing textiles, for calico printing, and in clearing liqueurs. Any number of manufactured items—from shoe polish to matches—also make use of this highly serviceable chemical agent.

Gum tragacanth is the gum of a tree growing in Asia Minor. Its collection and preparation are similar to that of gum arabic, and it has many of the same uses.

Tragasol or carob gum is used in finishing textiles, for tanning, and in the manufacture of face creams and mucilage. With sources of supply for these natural products cut off, Germany began a widespread search for substitutes used in various industries in this war as well as the last one.

Toward the end of World War I when Germany was similarly cut off, a sodium cellulose glycolate, soluble in cold water, was produced through the action of monachloracetic acid on alkali cellulose in alcohol solution, by the Deutsche Celluloid Fabrik, Eilenburg, near Leipzig (German patent No. 332,203). This old firm, now a subsidiary of I. G. Farbenindustrie, is one of the larger producers of raw celluloid for film and nitrocellulose for explosives, and in making sodium cellulose glycolate drew on its long experience with cellulose materials.

In 1924 an improved process was developed by J. K. Chowdhury (described in "Biochemische Zeitschrift" 1924, vol. 148, p. 85), avoiding the use of alcoholic solutions. Production on a commercial scale was delayed, however, by the small margin of profit and by technical difficulties. One of these is that the size of the apparatus required is large in relation to the output of the product (about 50 kilograms per cubic meter) and the process must be carried out in special alloy steel equipment.

Details of the process developed by F. Hoeppler in 1938 and applied on a large scale in the plant of the Gebrueder Haake in Medingen-Dresden, a center of German cosmetic production, are not available, since only parts of the process have been patented and others remain trade secrets. However, it is known that the process is basically similar to that developed by Chowdhury in 1924.

In the earlier laboratory method, about 1,100 grams of 40 percent caustic soda solution are allowed to act on 100 grams of ground-up cellulose for 3 hours at ordinary temperatures. Then 400 grams of monochloracetic acid are added, and the mixture is allowed to stand for 24 hours. The clear viscose solution is then precipitated with 2,000 cubic centimeters of alcohol and extracted for 16 hours with 80 percent alcohol in a Soxhlet apparatus with reflux condenser. Further purification yields about 140 grams of sodium cellulose glycolate with a constant sodium content of about 6.3 percent. The resulting product is a water soluble ether, although it has sometimes erroneously been called a cellulose ester.

For comparative purposes the 40 variations of sodium cellulose glycolate are tested in a Hoeppler viscosimeter, with viscosity of a 2 percent solution at 20° C. in centipoise (the viscosity of water at 20° C. is taken as 1.00) being considered as a standard. Tests of various sodium-glycolate products on the market show viscosities ranging from 10 to 1,000 units centipoise. The viscosities of the non-homogeneous, colloidal solutions depend very largely on the state of degradation of the cellulose used in their preparation.

Whatever commercial value the new series of products has is based on the high viscosity of the solutions and on their power to gelatinize when diluted. Low-viscosity preparations are being used as textile dressing and finishing agents, while the medium- and high-viscosity products are used in making sizing, wallpaper paste, thickening agents, and employed in the preparation of emulsions.

STOCKS OF PALM OIL HELD AT LIBERIAN PORTS

Because of shipping shortages, resulting from war conditions, Liberia has been cut off from the markets for palm oil, normally one of the country's chief crops. In 1941 only a sample shipment of 55 gallons was exported, and in 1942 no palm oil whatever was shipped out. It is reported that 66,850 imperial gallons of palm oil, available for shipment, are stored at the port of Sinoe.

The quality of Liberian palm oil is said to be inferior to that produced in British West African colonies where such commodities are inspected, graded, and controlled. The free fatty-acid content of Liberian palm oil is reported to run from 40 to 55 percent, whereas oil from Nigeria can be exported with a free fatty-acid content of only 5 percent.

FURFURAL PRODUCTION PLANNED FOR DENMARK

Furfural, an oily, colorless substance used as a substitute for wax and as a component in a printing-roller compound, will be manufactured in Denmark by the strawboard industry. The extraction of furfural will yield also several byproducts. A process has been developed, and it is expected that production will start soon.

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IT WOULD have been easy to make it in three sections and assemble it like a tower. But the customer wanted a tank 9 feet high and 30 inches in diameter, all in one piece, of acid-proof chemical stoneware. And that is what Maurice Knight engineers designed and Knight craftsmen made for him.

From a practical standpoint, we criticize ourselves for advertising Knight-Ware of such size, for it requires utmost care in processing and handling. Also, to get such big pieces in their green state into kilns for firing is a delicate job wrought with difficulties. This tank weighed close to a ton.

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CHEMICAL EQUIPMENT

ABSTRACTS FROM FOREIGN LITERATURE

FILM ON ALUMINUM ALLOYS

ANODIC oxidation is one of the important methods for providing a protective surface to airplane parts made of aluminum alloys. Parts subjected to anodic treatment by the sulphuric acid method followed by treatment with a solution of potassium bichromate have served for more than a year without any further protection and without showing any signs of corrosion. Moreover, this anodic film makes an excellent base for application of lacquers and paints, whereas untreated aluminum has very poor adhesive qualities for that purpose.

Electrolytes used in the anodic oxidation of such aluminum alloys must have a mildly corrosive effect on the oxide film being formed, otherwise the first passive film formed will be so dense that it will prevent the anodic process from proceeding. If they are too corrosive they will destroy the film as rapidly as it is formed. Satisfactory electrolytes are oxalic acid, sulphuric acid, sulphates, alum and permanganates.

The process can be followed by watching the change in weight of the article being treated. Under the experimental conditions in this case the rate of chemical solution of the Al_2O_3 was 0.0023 g. of aluminum per minute from 1 sq.in. which would mean a loss of 4.6 g. of aluminum per sq.m. during a 20-minute operation. This figure corresponds closely to that for large-scale operation, which is 5 g. per sq.m.

Rate of growth of the film decreases considerably with increased thickness of the film. In anodic oxidation with sulphuric acid it was found that as the film grows thicker, an increasingly greater part of the current is expended on evolution of oxygen at the anode. Thickness of the oxide film can be determined on the basis of the amount of electricity utilized.

Digest from "Mechanism of Anodic Oxidation of Aluminum in Sulphuric acid", by G. V. Akimov, N. L. Tomashov, and M. N. Tiukina, *Zhurnal Obshchci Khimii* XII, No. 9–10, 433-448, 1942. (Published in Russia.)

INHIBITORS IN PETROLEUM PRODUCTS

AN UNIQUE method has been developed by the Standard Oil Co. of Brazil for the determination of inhibitors in petroleum products, based on the saponification reaction.

Actual determination is carried out as follows: 20 g. of the inhibited oil are placed in a 250 cc. Erlenmeyer flask, then 20 cc. of petroleum ether and 20 cc. of 0.5N alcoholic solution of KOH are added. Another flask is provided with a control solution of 20 cc. of petroleum ether and 20 cc. of 0.5N alcoholic KOH. Both the sample and the control test are refluxed 3 hr. and then permitted to cool,

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This structurally strong board is processed from mineral wool and suitable binders. It is an effective barrier to heat, has good moisture resistance, and is free from objectionable odors. Armstrong's Mineral Wool Board is self-supporting, will not settle, sag, or warp. It is especially recommended where original cost is a factor.

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after which 20 cc. of neutralized alcohol are added and the solution titrated with 0.5N HCl solution, using phenolphthalein as indicator.

If N is cc. of 0.5N HCl used in neutralization of the control, n the cc. of 0.5N HCl used in neutralization of the sample, I^s the index of saponification of the inhibitor, and m the weight of sample, then

$$\text{percent inhibitor} = \frac{(N - n)\ 28 \times 100}{m \times I^s}$$

Digest from "Determination of Inhibitors in Petroleum Products," by C. E. Nabuco de Araujo Junior and Leopoldo A. Miguez de Mello, *Anais da Associacao Quimica do Brasil* 1, No. 1, 16-18, 1942. (Published in Brazil.)

COLUMBIUM IN NITRIDING STEEL

Presence of the element columbium in carbon steels causes a considerable increase in the surface hardness of the steel during nitriding and also increases the thickness of the nitrided layer, thus accelerating the process. Only the active or free columbium has this effect, since that portion of the element present as the carbide does not take part in the nitriding process. The quantity of active columbium which does take part in the reaction depends primarily upon the solubility of this metal in iron in the solid form in the presence of other components. An excess of the element is of no benefit.

An attached table gives the Vickers hardness (P=20 kg.) of two nitrided steels: (A) which contains 1 percent aluminum and some columbium and (B) which contains only the 1 percent aluminum and no columbium.

Digest from "Effect of Niobium in Nitriding Steel", by N. M. Voronov, *Zhurnal Prikladnoi Khimii* XV, No. 1-2, 47-50, 1942. (Published in Russia.)

Hardening Effect of Columbium in Nitrided Steels

(Duration of Process, 5 hr.)

Steel Specimen	Process Temperature	Hardness Before Nitriding (Annealed)	Hardness After Nitriding	Percent Increase in Hardness
A	500°	96	250	260
B	500°	78	129	165
A	600°	88	580	660
B	600°	82	312	380
A	650°	90	549	610
B	650°	85	359	422

PETROLEUM PRODUCTION IN MEXICO

Total production of crude petroleum in Mexico from 1901 (when operations first began in that country) through 1941 amounted to some 2,034,103,000 bbl. During the latter part of 1941 there was a considerable increase of activity in oil well drilling in Mexican fields. A total of 22 wells was drilled during that year, 12 of which were productive. These had an initial total capacity of some 29,600 bbl. of crude oil daily.

Some 42,603,300 bbl. of various petroleum products were produced during 1941, 45.0 percent of which was fuel oil, 22.4 percent crude gasoline, 10.1 percent refined gasoline, and 9.7 percent gas oil.

Present outlook for Mexico's petroleum

industry is favorable since the North American market is good under present war conditions. To encourage further activity, the United States is to provide the necessary equipment and machinery for expansion in the Mexican fields.

Digest from "Petroleum Activities in Mexico until December 31, 1941", *Boletin de Minas y Petroleo* XIII, No. 4, 119–121, 1942. (Published in Mexico.)

VINYL PHENYL ETHER

Vinyl phenyl ether has been successfully synthesized on a small scale in the following manner: 300 g. of phenol were placed in an autoclave in the presence of 5-20 percent catalyst, which was caustic potash in this case. Acetylene was added from a cylinder at an initial pressure of from 10 to 18 atm. and the process was carried out at a temperature of about 180 deg. C.

When dry phenol was used in the synthesis, the end product was a vitreous, resinous mass. This was undoubtedly the result of side reactions as well as of the tendency of vinyl phenyl ether to thermopolymerize. Several experiments were conducted in which small quantities of water (from 10 to 15 percent) were added to the phenol in the autoclave. The resulting vinyl phenyl ether could be separated out in the pure form with a yield of about 60-80 percent.

Metal chlorides were found in the experiments to be effective catalysts for the polymerization of vinyl phenyl ether. The resulting polymers were colorless, transparent materials.

Digest from "Synthesis and Properties of Aryl-Vinyl Ethers", by M. F. Shostakovski and M. S. Burmistrova, *Zhurnal Prikladnoi Khimii* XV, No. 4, 260–266, 1942. (Published in Russia.)

IRON AND STEEL IN BRAZIL

Brazil's consumption of iron ore for the domestic production of cast iron and steel has increased considerably since 1931. The national production of cast iron in 1941 was seven times as great as that of 1931, and the production of steel was six times as great. Imports of these materials in 1941 were three times as great and the consumption four times as great as compared with 1931.

An accompanying table shows the growth in the Brazilian consumption of cast iron and steel (raw material) in thousands of tons.

Digest from "Cast Iron. Iron and Steel. Analysis of the National Consumption of Raw Material in the Period 1931–41," *Boletim do Conselho Federal de Comercio Exterior* V, No. 31, 1–2, 1942. (Published in Brazil.)

Brazilian Iron and Steel Industry
(Thousands of Tons)

Year	Cast Iron Production	Iron and Steel Exports	Iron and Steel Imports	Iron and Steel Consumption
1931....	28	..	26	54
1932....	29	..	30	59
1933....	47	..	60	107
1934....	59	..	74	133
1935....	64	..	99	163
1936....	78	..	106	185
1937....	98	..	132	230
1938....	122	2	93	213
1939....	160	23	91	227
1940....	186	31	96	251
1941....	209	55	74	227


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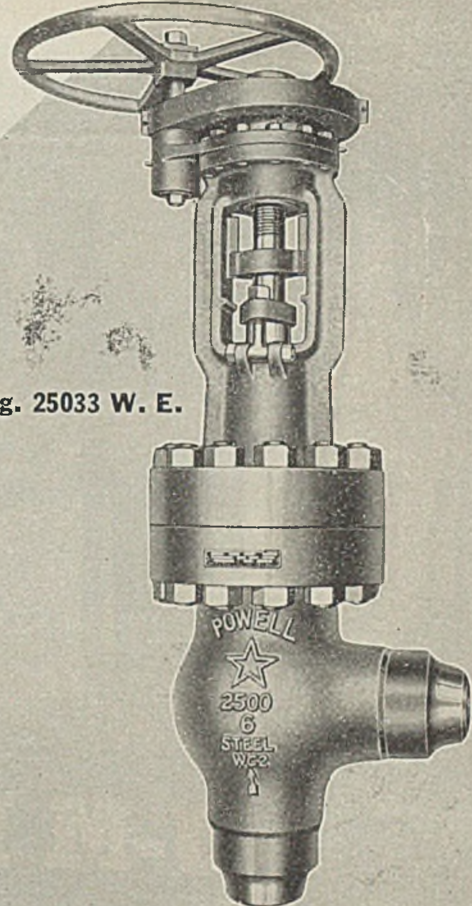

Fig. 25033 W. E.

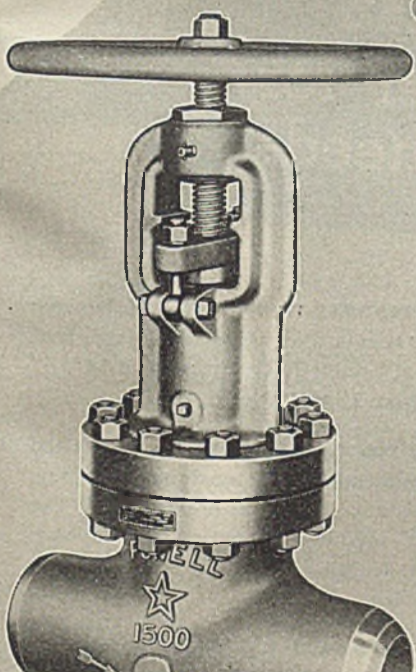

Fig. 1331 W. E.

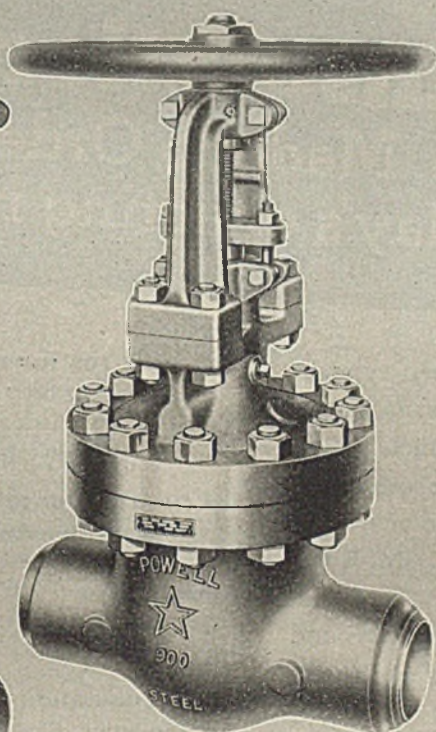

Fig. 9003 W. E.

Fig. 25033 W. E.—Class 2500 pound Cast Steel Angle Valve with welding ends, outside screw rising stem, bolted flanged yoke and spur gears. Can be equipped with bevel gears and motor operator. Regularly furnished with semi-cone seat and disc but for special throttling service can be furnished with piston-guided disc. (Fig. 25028 W. E.)

Fig. 1331 W. E.—Class 1500 pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke. Sizes 3" and larger are regularly furnished with Anti-friction bearing yoke and spur gears.

Fig. 9003 W. E.—Class 900 pound Cast Steel Gate Valve with welding ends, outside screw rising stem and bolted flanged yoke. Seat and disc are hard faced with Stellite.

VALVES

CHEMICAL ENGINEER'S BOOKSHELF

AMERICAN POTASH

POTASH IN NORTH AMERICA. By *J. W. Turrentine*. Published by Reinhold Publishing Corp., New York, N. Y. 186 pages. Price $3.50.

In 1926 there appeared the book "Potash: A Review, Estimate and Forecast" by the above author. The primary purpose of the present volume is to review the developments, both economic and technological, that have taken place in the domestic potash industry since those dark days of the middle twenties, when only a handful of government and industry optimists, including the author, prevented this country from settling back into comfortable and complete dependence upon German imports for potash supplies. No one is better fitted to chronicle the remarkable developments of the American potash industry than Turrentine, who is now president of the American Potash Institute and for many years was in charge of Potash Investigations of the U. S. Department of Agriculture.

First, the author devotes considerable space to outlining potash developments during the past 16 years, both domestic and foreign. Major legislative and cartel actions relating to this chemical raw material are included in this section. Next some 55 pages deal with the uses of potash in American agriculture and industry. This section includes considerable statistical data, with figures on imports and exports in table and chart forms. The final chapter of 75 pages deals with the technology of potash production in this country, including that at Searles Lake, the great Permian Basin deposits, and the recently exploited Salduro Marsh brines. Most of the material in this technology section is quoted directly from recent articles which have appeared in the technical literature.

Turrentine has turned out an excellent summary of the developments of the domestic potash situation since 1926, and this volume will undoubtedly be welcomed by all persons interested in this great and independent American industry.

COAL AND COKE

COKE FORMATION PROCESS AND THE PHYSICO-CHEMICAL PROPERTIES OF COALS. By *W. Swietoslawski*. Published by Polish Institute of Arts and Sciences in America, New York, N. Y. 145 pages. Price $3.50.

Reviewed by *F. C. Nachod*

It is gratifying to note that wars also bring about good developments. Dr. Swietoslawski, formerly of the Institute of Technology of Warsaw, published this book originally in Polish. As an exile from his native Poland, he came to this country and subsequently his work was published in English, thus making available to the Anglo-Saxon audience a large amount of data and experiments which otherwise would probably not have been accessible.

The present booklet does not pretend to be a comprehensive treatise on the subject. The author is aware that an American Chemical Society monograph is in preparation which will cover the subject and the pertaining literature completely. The scope of the book may be understood by an examination of the chapter headings:

Coals as in homogeneous systems, Adsorption and Sorption Phenomena in Coals, Development of Surface by Activation Processes, Ignition Temperature of Solid Fuels, Plasticity of Bituminous Coals, Plasticity Phenomena and Binding Capacity of Coals, Agglutination Capacity of Coals, Swelling Phenomena in Coking Coals, Binary Mixture Method, Permeability of the Plastic Zone, Heat of Carbonization of Coals, Total Amount of Gases and Vapors developed during Carbonization, Physico-Chemical Analyses of the Coke Formation Process, Coke Formation Process in Mixtures of Non-Coking Coals and Pitch, Optimal Conditions for the Coke Formation Process.

The booklet is recommended to the chemist and the chemical engineer working in this field.

GAS PROCEEDINGS

PROCEEDINGS OF THE AMERICAN GAS ASSOCIATION, 1942. Published by American Gas Association, New York, N. Y. 441 pages. Price $3 to members, $7 to non members.

This is the usual printing of all the technical articles and committee proceedings for meetings during the calendar year 1942. It represents a must item in any library which pretends to keep in touch with either natural gas or manufactured gas literature.

SMALL PARTICLES

MICROMERITICS. By *J. M. Dallavalle*. Published by Pitman Publishing Corp. New York, N. Y. 428 pages. Price $8.50.

Reviewed by *Lincoln T. Work*

This title, derived from the Greek from "small" and "part" is used to cover the technology of fine particles. The author has introduced the work by discussing the order of magnitude of particle size measurement which this covers, namely, the range from 10^{-1} to 10^{6} microns, discussing the application to soil physics; mineral physics; chemical engineering; geology—ground water and petroleum; hydrology—silting of streams; and other applications. He considers extensively the dynamics of small particles and their shape and size distribution. Under "Methods of Particle Size Measurement" he includes the direct methods of sieve and microscopic measurement and those indirect methods which are based on settling characteristics of the particles. He discusses the theory of sieving and grading of materials with an up-to-date discussion of calibration of sieves. He deals at some length with the arrangement of particles in space, from the packing of spheres to the handling of heterogeneous systems and the flow through beds of packed solids.

Electrical and optical properties, sonic flocculation, thermo-dynamics, including adsorption and chemical properties are also presented. Three chapters are devoted to the flow of fluids through packing, infiltration and particle-moisture relationships, and capillarity. Another chapter dicusses the determination of particle surface, utilizing statistical and experimental methods, and permeability, adsorption and optical methods. Two chapters are devoted to muds and slurries and the transport of particles. Chapters on grinding, air separation, and atmospheric and industrial dust complete the treatment. The author appends an extensive selected bibliography covering early work to the present time.

General treatment of the subject is comprehensive, the material is covered mathematically and many different approaches to the several phases of this subject are reviewed. The author has undertaken some critical commentary but in many cases the work reviewed is not integrated. As a text or reference work in the field, this book gives a good statement of the fundamental principles and practical operation of a wide variety of subjects in which this range of particle size is important. It should be useful as a text for the student and as a handbook for the specialist in this field.

EXPOSITION OF FUNDAMENTALS

AIR CONDITIONING ANALYSIS. By *William Goodman*. Published by The Macmillan Co., New York, N. Y. 455 pages, plus seven psychrometric charts. Price $6.

Reviewed by *T. R. Olive*

Since the appearance in 1938 of Mr. Goodman's earlier book, the Trane Air Conditioning Manual, published by the Trane Co., several excellent books have appeared on air conditioning, but in the reviewer's opinion, the Trane Manual in some ways is still the best work on the subject. The author's new book is a better exposition of the fundamentals, although there could be little complaint on this score with the earlier book, for Mr. Goodman is and was one of the most effective teachers in the entire air conditioning field. He continues to lean heavily on the graphical approach to air conditioning analysis and has now developed what is evidently a more perfect psychrometric chart than the one he used formerly. This has been accomplished, however, with what seems to the reviewer a sacrifice in the convenience of the chart. Possibly more extensive experience with the new chart, a modified Mollier diagram similar to that advocated a number of years ago by Weisselberg, would prove that this is not the case.

A tremendous number of illustrative examples in the new book will assure the reader's thorough understanding of the subject, both mathematical and graphical. In addition, the new volume contains the most complete collection of air conditioning tables to be found anywhere, occupying about half the book and covering all atmospheric pressures from 22 to 32 in. Hg, as well as normal barometric tables in 0.1 deg. F. intervals. The book is novel in devoting little space to the descriptive details of air conditioning equipment.

RECENT BOOKS and PAMPHLETS

The Foreman, the Key Man in Your Plant. Issued by the National Association of Manufacturers, 14 West 49th St., New York, N. Y. 16 pages. Gratis. Principles and practice recommended in the manual are presented in two sections: (1) A sound program for the training and education of foremen; (2) sound principles of management, supervisory relations. Issued so that company practices may be checked against sound policies of American industry.

Manual of Industrial Hygiene and Medical Service in War Industries. Edited by *W. M. Gasaser.* Published by W. V. Saunders Co., West Washington Square, Philadelphia, Pa. 508 pages. $3. Written to meet changed health conditions in industries converted to war purposes and planned specifically for the general medical profession, and others engaged in industrial service. Provides guidance in dealing with industrial health hazards.

A Contribution to the Manpower Problem. By *Albert Ramond.* Published by The Bedaux Co., New York, N. Y. 15 pages. A recently-delivered address which elaborates the view that properly established incentive wage payment is one of the most effective solutions to our present manpower problem.

Tenth Annual Report. Published by Engineers' Council for Professional Development, New York, N. Y. 47 pages. Price 25 cents. Reference material on what engineers are doing in selecting and training new personnel for the profession and in elevating the status of engineers.

Nitriding Furnaces. By *D. Landau.* Published by the Nitralloy Corp., New York, N. Y. 99 pages. In four parts: nitriding and nitriding furnaces, ammonia and its handling, determination of furnace size for nitriding, and instrumentation.

A.S.T.M. Standards on Copper and Copper Alloys. Published by American Society for Testing Materials, Philadelphia, Pa. 376 pages. Price $2.25. Provides specifications widely used throughout industry and by the Government in connection with the war effort. Important features in the new publication are the emergency alternate specifications to aid in expediting procurement.

Battle Stations for All. Published by Office of War Information, Washington, D. C. 128 pages. Handbook on the fight to control living costs and prevent inflation.

The Carbon Reinforcement of Buna S (GR-S). Published by Columbian Carbon Co., New York, N. Y. 152 pages. Researches on the reinforcement of Buna S rubber with colloidal carbon.

Review of Iron and Steel Literature for 1942. By *E. H. McClelland.* Published by

A fast, simple, accurate method for analyzing hydrocarbon mixtures!

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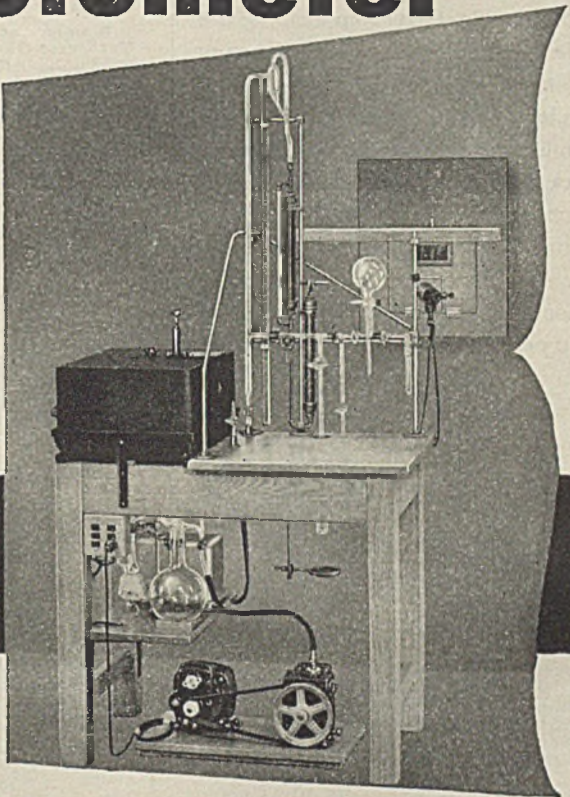
THE Beckman Infrared Spectrophotometer is the most advanced development in hydrocarbon gas analysis and control—vitally important operations in today's war-paced synthetic rubber and aviation gasoline programs. This instrument was developed in one of the nation's leading petroleum laboratories and has been perfected and thoroughly proved through more than *two years'* use in actual refinery control. *It is not experimental!*



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This instrument has already been adopted as standard by the leading oil companies and current production is completely allocated to vital war plants by special order of the W.P.B. Increased output will soon make additional instruments available, however, and early inquiry is suggested.

BECKMAN **INSTRUMENTS CONTROL MODERN INDUSTRIES**

Carnegie Library of Pittsburgh, Pittsburgh, Pa. 25 pages. A classified list.

More Manpower Through Reduction of Absences. Published by Industrial Hygiene Foundation, Pittsburgh, Pa. 63 pages. Six amplified discussions of the different phases of absenteeism presented at the Foundation's last annual meeting.

Road Tests of Automobiles Using Alcohol-Gasoline Fuels. By *R. G. Paustian.* Bulletin 158, Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa. 56 pages. Results of a series of road and laboratory tests designed to measure mileage and performance characteristics of alcohol-gasoline blends.

Women at Work in Wartime. By *Katherine Glover.* Pamphlet 77, published by Public Affairs Committee, New York, N. Y. 31 pages. Price 10 cents. Problems of recruiting women for war jobs.

Literature on the Extraction of Alumina from Clay with Short Discussions. By *R. J. Woody.* Bulletin E-1, Mining Experiment Station, State College of Washington, Pullman, Wash. 31 pages. Price 25 cents. Contains 544 references.

Ninth Biennial Report of the State Water Commission. Public Document No. 78, published by the State of Connecticut, Hartford, Conn. 77 pages. Sewage, industrial wastes, flood control, stream gaging, etc. Also contains a research report on treatment of metallurgical wastes.

Lye Peeling. By *C. F. Wolters, Jr., H. G. Elledge* and *R. D. Kerwin.* Published by Diamond Alkali Co., Pittsburgh, Pa. 34 pages. Illustrated booklet on lye peeling of potatoes for dehydration.

A Preliminary Report on Cobalt Deposits in the Blackbird District, Lemhi County, Idaho. By *Alfred L. Anderson.* Pamphlet 61, published by University of Idaho, Moscow, Idaho. 34 pages. Price 50 cents. A preliminary report making available the data obtained during a reconnaisance study of the deposits carried on between July 7 and July 14, 1942.

Influence Charts for Computation of Stresses in Elastic Foundations. By *M. M. Newmark.* Bulletin Series No. 338, published by the University of Illinois, Urbana, Ill. 25 pages. Price 35 cents. Describes graphical procedure for computing stresses in the interior of an elastic, homogeneous, isotropic solids bounded by a plane surface and loaded by distributed vertical loads at the surface.

GOVERNMENT PUBLICATIONS

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

First Aid in the Prevention and Treatment of Chemical Casualties. Office of Civilian Defense, OCD 2202-1. Price 10 cents.

Markets After the War. An Approach to Their Analysis. By S. Morris Livingston. Bureau of Foreign and Domestic Commerce, unnumbered document. Mimeographed.

Official Publications of Present-Day Germany. Government, Corporate Organizations and National Socialist Party, With an Outline of the Governmental Structure of Germany. By Otto Neuburger. Library of Congress, unnumbered document. Price 20 cents.

Producers' Sales of Natural Sodium Sulfates and Carbonates Increased in 1942. Bureau of Mines. Mineral Market Report, MMS No. 1046. Mimeographed.

Manual for Inspection of Damaged Shipments. Prepared by Container Coordinating Committee with cooperation of Army, Navy, and others. March, 1943. Order from War Department.

Some Standard Thermal Dehydration Curves of Minerals, by P. G. Nutting. U. S. Geological Survey Professional Paper 197-E. Price 5 cents.

Monazite Sand, by L. G. Houk. Bureau of Mines, Information Circular I. C. 7233. Mimeographed.

Marketing Kyanite and Allied Minerals, by Nan C. Jensen. Bureau of Mines, Information Circular, I. C. 7234. Mimeographed.

Determination of the Oxides of Nitrogen by the Phenoldisulfonic Acid Method, by R. L. Beatty, and others. Bureau of Mines, Report of Investigations R. I. 3687. Mimeographed.

The Asbestos Industry in 1942. Bureau of Mines. Mineral Market Report, MMS. No. 1047. Mimeographed.

Aluminum Salts and Alumina in 1942. Bureau of Mines. Mineral Market Report, MMS. No. 1048. Mimeographed.

Boron-Mineral Production in the United States Declined in 1942. Bureau of Mines, Mineral Market Report, MMS. No. 1051. Mimeographed.

Potash Industry of the United States in 1942. Bureau of Mines, Mineral Market Report, MMS. No. 1052. Mimeographed.

Production of Coke and Byproducts from Coal Gas Retorts in 1942. Bureau of Mines, Mineral Market Report, MMS. No. 1057. Mimeographed.

Carbon Black Sales Decline 30 Percent in 1942. Bureau of Mines, Mineral Market Report, MMS. No. 1058. Mimeographed.

Mine Production of Copper in the United States, 1942. Preliminary Annual Figures. Bureau of Mines, Mineral Market Report, MMS. No. 1059. Mimeographed.

Mine Production of Lead and Zinc in the United States, 1942. Preliminary Annual Figures. Bureau of Mines, Mineral Market Reports MMS. No. 1060. Mimeographed.

Hard and Soft Kaolins of Georgia. By T. A. Klinefelter, and others. Bureau of Mines, Report of Investigations, R. I. 3682. Mimeographed.

The Burning Rate of Natural Graphite, by Glen Dale Coe. Bureau of Mines, Report of Investigations, R. I. 3692. Mimeographed.

Some Refractory Properties of Washington Chromite. By Hewitt Wilson and others. Bureau of Mines, Report of Investigations, R. I. 3694. Mimeographed.

List of Respiratory Protective Devices Approved by the Bureau of Mines. By H. H. Schrenk. Bureau of Mines, Information Circular, I. C. 7237. Mimeographed.

Olivine. By G. Richards Gwinn. Bureau of Mines. Information Circular, I. C. 7239. Mimeographed.

Coke-Oven Accidents in the United States. By W. W. Adams and V. E. Wrenn. Bureau of Mines, Technical Paper 651. Price 10 cents.

Mineral Wool; Loose, Granulated, or Felted Form, in Low-Temperature Installations. Bureau of Standards, Commercial Standard CS105-43. Price 5 cents.

Union Agreement Provisions. Bureau of Labor Statistics. Bulletin No. 686. Price 35 cents.

Census of Business, 1939. Volume 2. 16th Census of United States, 1940. Bureau of the Census. Wholesale trade. Price $2.75. Clothbound.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog on the following items: Insulation, laminated-asbestos, HH-I-561, price 5 cents. Leather, hydraulic-packing, vegetable-tanned, KK-L-181a, price 5 cents. Tableware, plastic, L-T-48, price 5 cents. Paint, oil, interior, one-coat-flat, heavy-bodied (for thinning), light tints and white (combined sealer, primer, and finish), TT-P-47, price 5 cents. Soap, low-titer (for low-temperature washing), P-S-600, price 5 cents. Acid, hydrochloric (muriatic), technical-grade, O-A-86, price 5 cents.

Federal Specifications Index. Revised to February 1, 1943. Procurement Division, Treasury Department, Federal Standard Stock Catalog. List of specifications which the government uses in its purchasing. Purchase from Superintendent of Documents. Price 15 cents.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Protective Coatings. Protective Coatings, Inc., P. O. Box 56, Strathmoor Station, Detroit, Mich.—26-page folder dealing with the "Tocol" line of corrosion protective materials put out by this concern. Contains technical information on applications and advantages of "Synthetex", "Silco", and "Alkacite".

Chlorinated Paraffin. Hercules Powder Co., Wilmington, Del.—Form 50014-A—8-page folder dealing with this concern's chlorinated paraffin, first produced to pinch-hit for Parlon in fireproofing formulations. Lists physical and chemical properties, compatability, use as a non-flammable plasticizer and suggests other industrial uses.

Safety Equipment. Mine Safety Appliances Co., Pittsburgh, Pa.—Bulletin 433—32-page booklet entitled "How to Make Your Safety Equipment Last Longer." Discusses and illustrates timely hints on conservation of various safety equipment, such as protective hats, respirators, goggles, safety clothing and first-aid kits. Well organized and full of helpful information.

Apprentice Training. The B. F. Goodrich Co., Akron, Ohio—26-page catalog dealing with the apprentice training program of this company. Deals with such subjects as selection of apprentices, administration of program, length of apprenticeship, shopwork schedules, classroom curriculum, wages, vacations, etc.

Spring Design. Midwest Spring Mfg. Co., 4632 So. Western Ave., Chicago, Ill.—39-page form entitled "Spring Design and Engineering." Discusses basic factors in spring design, compression springs and other forms, wire forms, etc. Contains a table of deflection formulas for helical springs, as well as tables of data on wire. Contains extensive engineering data.

Heat Treatment. Metallizing Company of America, 1330 West Congress St., Chicago, Ill.—4-page form which describes this concern's new electric bonder for preparing hardened metal surfaces for metallizing. Gives operating features, advantages, method of operation and other data. Illustrated.

Pipe Alignment. American District Steam Co., North Tonawanda, N. Y.—Bulletin 3570D—6-page folder covering this concern's improved pipe alignment guide. Includes data on dimension set-ups, list prices and weights, and recommended spacing for the various types of pipe supports, saddle plates, etc.

Water Treatment. Cochrane Corporation, 17th and Allegheny Ave., Philadelphia, Pa.—4-page reprint on "Operation of Hot Process Softener at 50-lb. Gage Improves Performance and Saves Chemicals." Illustrated by diagrammatic drawings and photographic reproductions.

Vibration Fatigue. All American Tool & Mfg. Co., 1014 Fullerton Ave., Chicago, Ill.—8-page notebook dealing with this concern's line of vibration fatigue testing machines. Discusses principles of vibration fatigue testing, includes a nomograph for vibrating systems and illustrates, discusses and gives specifications for each of the various models of machines.

Insulation. The Sterling Varnish Co., 116 Ohio River Boulevard, Haysville, Pa.

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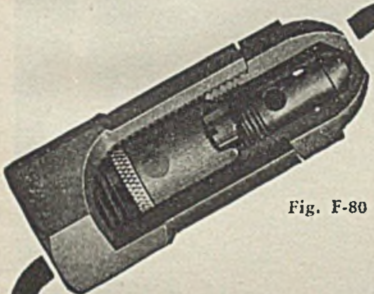

Fig. F-80

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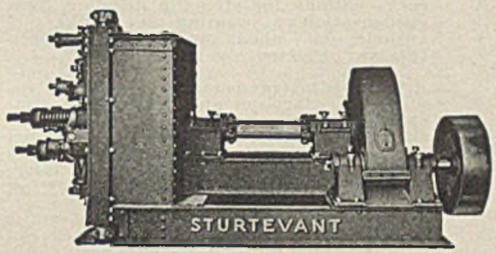

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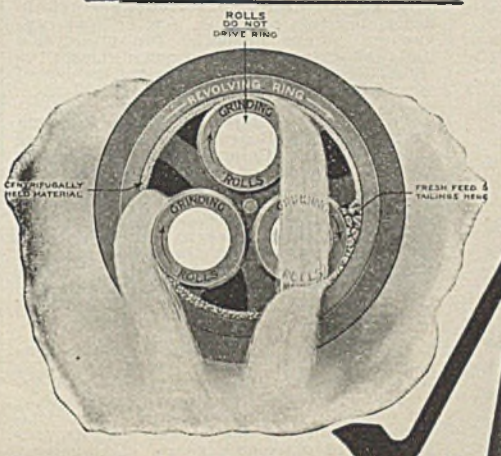
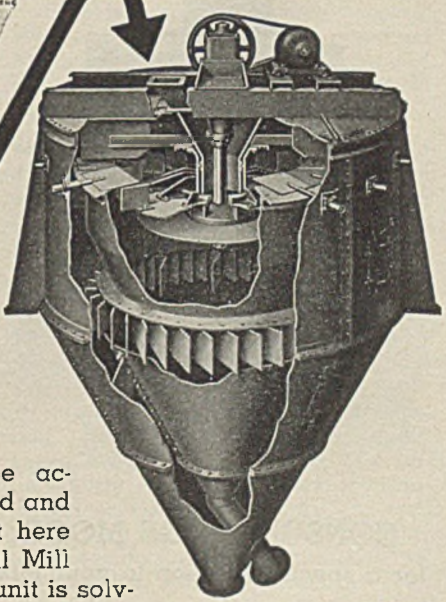


AND AIR SEPARATOR



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—4-page bulletin describing ten insulating mediums called "Thermobonds" put out by this concern for heavy duty motors and transformers, high cycle drill and grinder motors, etc. Describes outstanding features of these insulating varnishes, their application in various industries, and specifications.

Heat Treatment. Ajax Electric Co., Inc., Frankford Ave. at Delaware Ave., Philadelphia, Pa.—Catalog 107A—20-page booklet entitled "Heat Treatment in Ajax-Hultgren Electric Salt Bath Furnaces." Shows installation of the immersed electrode salt bath furnaces for heat treating processes including hardening high speed steel tools, carburizing, solution heat treatment of aluminum alloys, etc. Discusses operating principles, standard sizes, accessories and mechanical and manual types in general use. Extensively illustrated.

Condensation Prevention. J. W. Mortell Co., Kankakee, Ill.—Form B11—6 pages dealing with this concern's line of plastic cork coatings for stopping dripping from condensation or sweating pipe, tanks, etc. Includes data about properties and applications. Extensively illustrated.

Control Instruments. Wheelco Instrument Co., Harrison and Peoria Sts., Chicago, Ill.—Bulletin Z-6200—16-page bulletin which gives current prices and short descriptions of all instruments for measuring and control put out by this concern. Illustrated.

Vacuum Pumps. American Automatic Typewriter Co., 614 No. Carpenter St., Chicago, Ill.—Bulletin 10—4-page bulletin describing this concern's new bellows-type vacuum pumps designed for production and laboratory applications. Describes construction features and gives tables of specifications for each model. Illustrated.

Farm Raw Materials. South Carolina State Planning Board, 100 Calhoun State Office Building, Columbia, S. C.—Bulletin 12—56-page catalog entitled "From Farm to Factory," a special study on processing and utilization of the state's farm products. Includes extensive data on various methods of food preservation, crops now under cultivation, new crops such as tung trees and tung oil, castor beans, perilla, etc., and summary of farm data by counties. Includes detailed statistical information.

Liquid Gas. American Liquid Gas Corp., 1109 So. Santa Fe Ave., Los Angeles, Calif.—20-page illustrated booklet which discusses briefly uses of "Algas" for domestic and industrial purposes. Discusses origin and qualities as well as uses of liquefied petroleum gases. Extensively illustrated by photographic reproductions and diagrammatic sketches.

Steam Traps. The Strong, Carlisle & Hammond Co., 1392 West Third St., Cleveland, Ohio—Catalog 66—23-page catalog dealing with this concern's steam traps and drainage equipment of various types. Each unit is illustrated by photographic reproductions and cross-sectional drawings and is accompanied by a table of dimensions and list prices.

Time Delay Relays. The R. W. Cramer Co., Inc., Centerbrook, Conn.—Bulletin 800—4-page form illustrating and discussing briefly this concern's line of synchronous motor-driven time delay relays. Contains a table of time scales and price lists, together with wiring diagrams and housing dimensions.

Blowers. L. J. Wing Mfg. Co., 154 West 14th St., New York, N. Y.—Bulletin CO5—8-page bulletin on the line of axial flow blowers with built-in volume control put out by this concern. Each unit is illustrated and discussed briefly. Contains numerous installation photographs.

Koroseal Lined Tanks. The B. F. Goodrich Co., Akron, Ohio—Section 9028—4-page section dealing with Koroseal lined tanks, their resistance to corrosion, applications, advantages and limitations. Includes detailed tables of chemical resistance of Koroseal lining and typical installations of tanks already in service. Illustrated.

Pipe Line Filters. American Locomotive Co., Alco Products Division, 30 Church St., New York, N. Y.—Bulletin 1033—8-page booklet describing and illustrating the pipe line filters put out by this concern. Discusses outstanding features and applications. Illustrated by photographic reproductions and cross sectional drawings.

Pumps. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 31B15 —6-page folder describing and illustrating the line of positive displacement gas pumps put out by this concern. Includes a table of depth capacities in the low-pressure, medium-pressure and high-pressure ranges. Illustrated by photographic reproductions and diagrammatic sketches.

Synthetic Rubber. The B. F. Goodrich Co., Akron, Ohio—Section 8000—8-page form dealing with the properties of this concern's Americol D synthetic rubber. Gives extensive data on chemical and physical properties, property-relations of natural and synthetic rubbers, properties of typical Americol D vulcanized compounds and an application guide table.

Synthetic Rubber. The United States Rubber Co., 1230 Sixth Ave., New York, N. Y.—Form 431—40-page booklet giving information on the five commercial types of synthetic rubber. Includes a historical introduction, a chart of comparative properties of the synthetic rubbers and natural rubber, and brief descriptive material on outstanding advantages and uses of the various synthetic rubbers. Includes condensed information on methods of manufacture, polymerization reactions, vulcanization, and a glossary of terms. Well illustrated.

Lathes. South Bend Lathe Works, 425 East Madison St., South Bend, Ind.—Catalog 100-C—48-page catalog describing the entire line of lathes of various types put out by this concern. Each size and type is illustrated and fully described. Specifications are tabulated to facilitate selection. Attachments and accessories are illustrated and described.

Fluid Filters. The Cuno Engineering Corp., Meriden, Conn.—Form 1343—32-page booklet entitled "Quick Facts on Keeping Fluids Clean." Contains factual information on this concern's line of filters and filter installations in eleven major industrial classifications. Contains 46 actual case studies. Contains tables of specifications. Extensively illustrated by photographic reproductions, diagrammatic drawings and cross sectional sketches.

Tubing. Summerill Tubing Co., Bridgeport, Pa.—Bulletin 443—12-page booklet dealing with the line of tubing and tubing material put out by this concern. Includes a guide chart giving detailed information on chemical composition of 25 different metals in regular production, size and ranges available for each, and mechanical and physical properties of interest in design and use of materials.

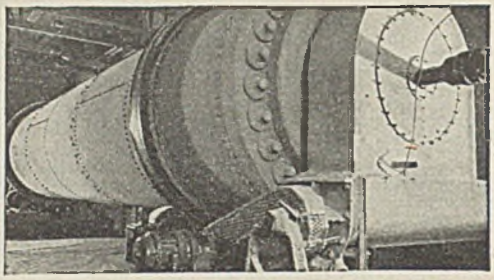
Flashlight Batteries. Ideal Commutator Dresser Co., Sycamore, Ill.—4-page form illustrating and describing briefly this concern's rechargeable flashlight batteries for industrial and utility service. Includes brief description of outstanding features and applications.

Control Instruments. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill.—Bulletin 434—8-page folder illustrating and describing this concern's pneumatic flow transmitter of the differential pressure type for measurement of flow and level. Discusses operating principles, design features, performance, operating adaptability, construction details and specifications. Illustrated by photographic reproductions and cross sectional views.

Pulley Lagging. Victor Balata & Textile Belting Co., 53 Park Place, New York, N. Y.—Circular 13—2-page form illustrating and describing briefly this concern's "Grip-On" safety pulley lagging for straight or crown face pulleys. Describes briefly outstanding principles and applications. Includes a price list.

Graphite Lubricant. Acheson Colloids Corp., Port Huron, Mich.—Bulletin 423—4-page folder illustrating the use of this concern's "dag" colloidal graphite as a high-temperature lubricant. Discusses limitations of liquid or semi-liquid lubricants, and gives case study information on the use of colloidal graphite for various uses. Illustrated.

Vitamins. Vitamins Industrial, 222 N. Bank Drive, Chicago, Ill.—12-page folder dealing with this concern's line of "Vio" complete vitamins for use in industry. Discusses plans of distribution to industrial workers, mineral and vitamin content of the product as related to daily human needs, and applications in various war industries. Discusses potencies, balance, assimilability, stability, and price.



LOUISVILLE CHEMICALS DRYER CUTS COSTS, SPACE, INVESTMENT!

If you use any sort of drying process in your manufacturing operations, *study the little "blue print"* at the right. It gives the essential facts about a Louisville Rotary Dryer installation in which *Engineered Drying* is drastically reducing the cost, space and investment formerly required for drying of a more or less typical heavy chemical. . . .

In addition to saving $13,680 annually in operating costs—and cutting the required space in half—this new Louisville Dryer is also solving a very serious dust problem which was in itself a major item.

FORMER PROCESS
(Steam-jacketed filter presses with hot air introduced under pressure)

Annual Production, tons	18,000
Drying Cost, per ton	$1.30
Space Required, sq. ft.	1,000
Installed Cost	$55,000

LOUISVILLE INSTALLATION
(Louisville Rotary Steam Tube-Dryer)

Annual Production, tons	18,000
Drying Cost, per ton	$0.54
Space Required, sq. ft.	450
Installed Cost	$7,000

Note also that the former batch process is now a rotary, continuous process, and that the new Louisville equipment represents an investment of only $7,000!

For many years a large part of this company's business has come from just such installations, in which we have been able to prove, in advance, the lasting economies of real *Engineered Drying*. Our pilot plants and laboratories are available for tests of your production. *Drop us a line for details. Address:* Louisville Drying Machinery Co., Incorporated, 451 Baxter Avenue, Louisville, Kentucky.

ECONOMICS AND MARKETS

CONSUMPTION OF CHEMICALS PROMISES TO MAKE SLIGHT GAIN IN SECOND QUARTER

The large industrial chemical-consuming industries have varied their manufacturing rates but little in the second quarter of this year but from present indications will show a slight gain over the results of the first quarter. This is due to some improvement at pulp and paper mills, increased operations at oil refineries, continuance of record outputs of glass containers, larger production at steel mills, and moderate gains in rayon supplies. Production of plastics have gained with particular influences affecting the different types. Consumption of chemicals in direct war industries likewise has felt the effects of different influences. Operations at some of the high explosives plants has been slowed because supplies of finished products accumulated more quickly than had been expected, this in part, due to a higher-than-anticipated efficiency at the plants. Production of aluminum has been cut at a plant using sea water as a raw material and has been increased by the opening of a new producing plant on the Pacific Coast. Plants for making synthetic rubber are now coming into operation and will account for a steadily growing disappearance of chemicals.

The *Chem. & Met.* index for consumption of chemicals for April is 174.49 which compares with 171.38 for April last year. The index for March has been revised to 178.96 which tops the 176.38 reported for March 1942. Some industries have felt the shortage in trained manpower and this promises to be more of a factor before the end of the year. Otherwise the outlook for industrial consumption of chemicals appears favorable for a continuance of the current levels unless necessity for plant repairs becomes a factor.

Demand for carbon black has been more active and consumption is expected to increase materially from now on as synthetic rubber requirements gain in volume. Production of black last year fell off only about 3 percent while sales were off about 30 percent, hence stocks accumulated to a near record degree and continued to grow in the first quarter of this year. Last year, the rubber industry consumed, or at least purchased, almost 296,000,000 lb. of carbon black and undoubtedly will call for deliveries at a much higher rate over the last half of this year. Last year production of furnace black was approximately 24 percent of the output. This year demand for furnace type is increasing and production has been arranged to turn out sufficient of this type to take care of all domestic and foreign requirements.

Current data for superphosphate production are not on the same basis as those formerly issued as the monthly reports now include all units, including government-owned, known to have facilities for superphosphate manufacture. Formerly the monthly figures covered about 95 percent of the producing industry and did not include the TVA output. Production, however, has been running ahead of that of last year and must continue on a large scale as about 6,500,000 tons of normal superphosphate will have to be produced during the 1943-1944 year to round out the fertilizer program. This includes 5,000,000 tons for distribution through commercial channels and 1,500,000 tons through the AAA program. To obtain this total, a tentative quota has been set up for each producer. This means that a fairly regular rate of production will be maintained throughout the year with the usual seasonal fluctuations eliminated. Incidentally the quotas established are not intended to put a limit on total, or individual plant, production but rather to fix minimum levels for each plant.

Chem. & Met. Index for Industrial Consumption of Chemicals

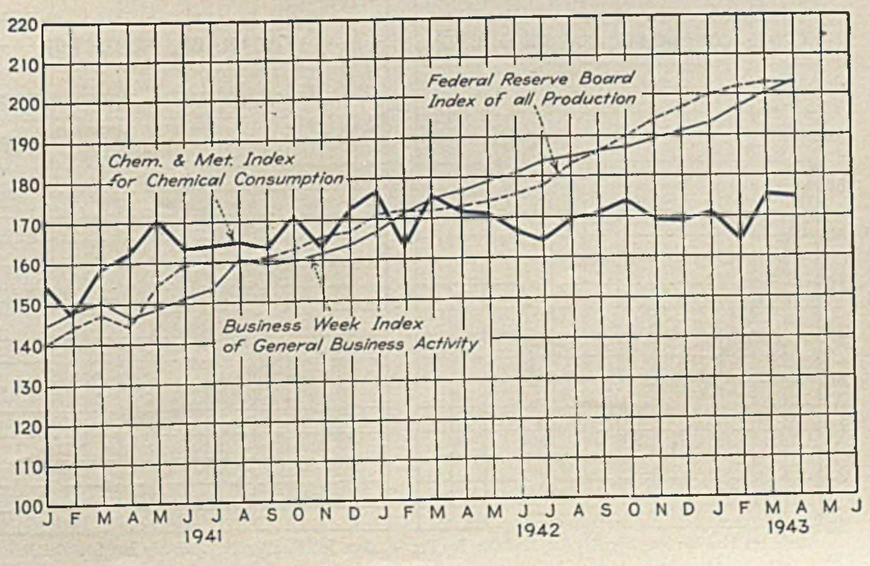
	March revised	April
Fertilizers	40.18	37.10
Pulp and paper	19.89	19.40
Petroleum refining	14.79	14.56
Glass	18.42	18.50
Paint and varnish	15.05	16.53
Iron and steel	13.86	13.42
Rayon	16.28	15.63
Textiles	12.58	11.82
Coal products	9.81	9.65
Leather	4.70	4.65
Industrial explosives	5.74	5.63
Rubber	3.00	3.00
Plastics	4.66	4.60
	178.96	174.49

Glass production continues to create new records as far as consumption of soda ash and other raw materials is concerned even though flat glass is making a very poor showing. Demand for containers has been running above the capacity to produce and it has been necessary to place restrictions on distribution. One of the mid-western container plants was forced to curtail work temporarily last month because of local flood conditions and this served to reduce the output.

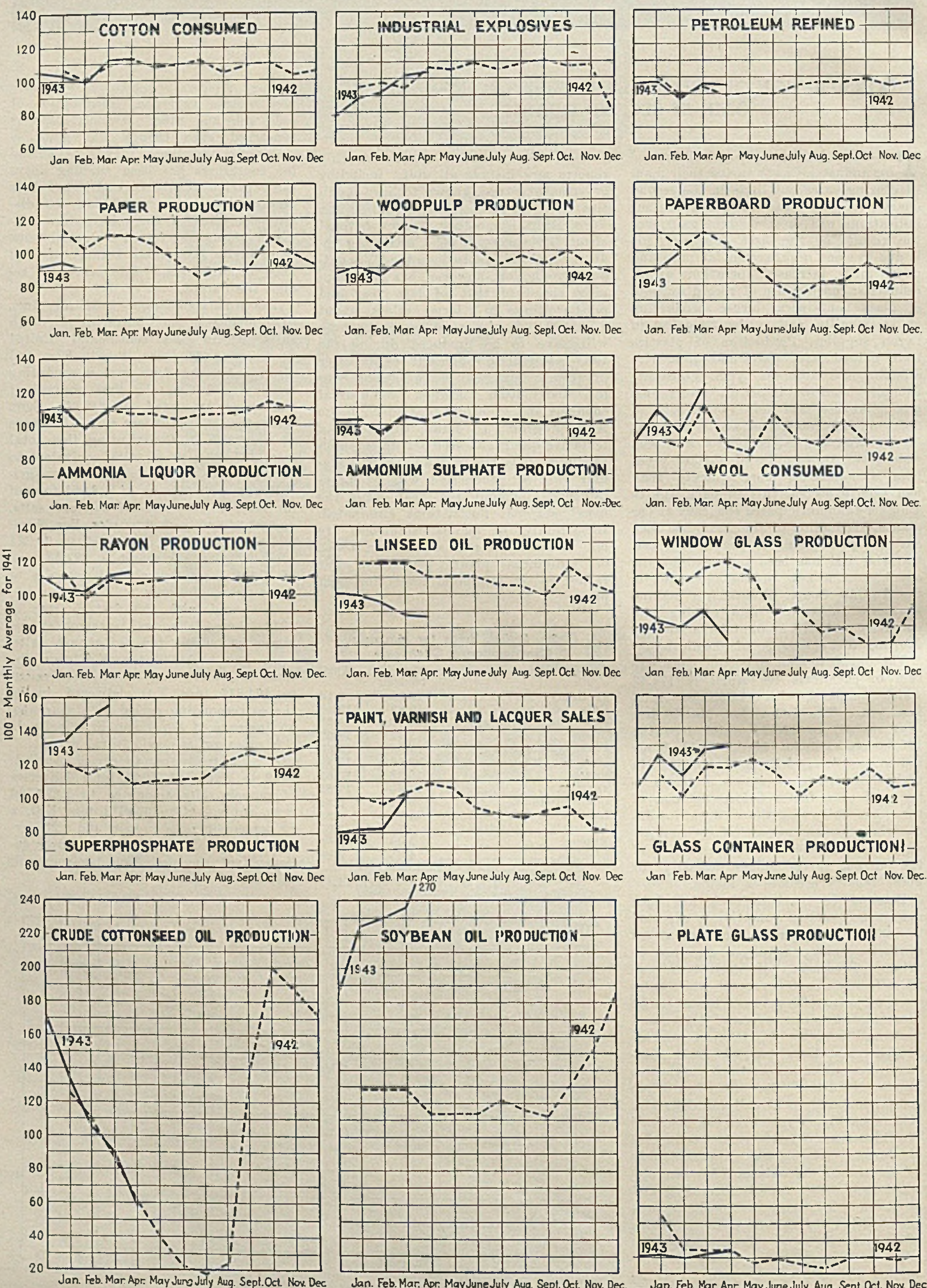
The American Potash Institute, Inc., has announced that deliveries of potash salts within the continental United States, Canada, Cuba, Puerto Rico and Hawaii by the four major producing companies during the first quarter of this year amounted to 346,254 short tons of salts, equivalent to 178,883 tons of actual K_2O. Constituting this total were 317,033 tons of salts, equivalent to 160,830 tons K_2O, designed for agricultural use, made up of 228,051 tons of muriate, 61,137 tons of manure salts, and 27,845 tons of sulphates. For chemical use deliveries amounted to 29,221 tons of salts, equivalent to 18,053 tons of K_2O. These figures include salts of domestic origin only.

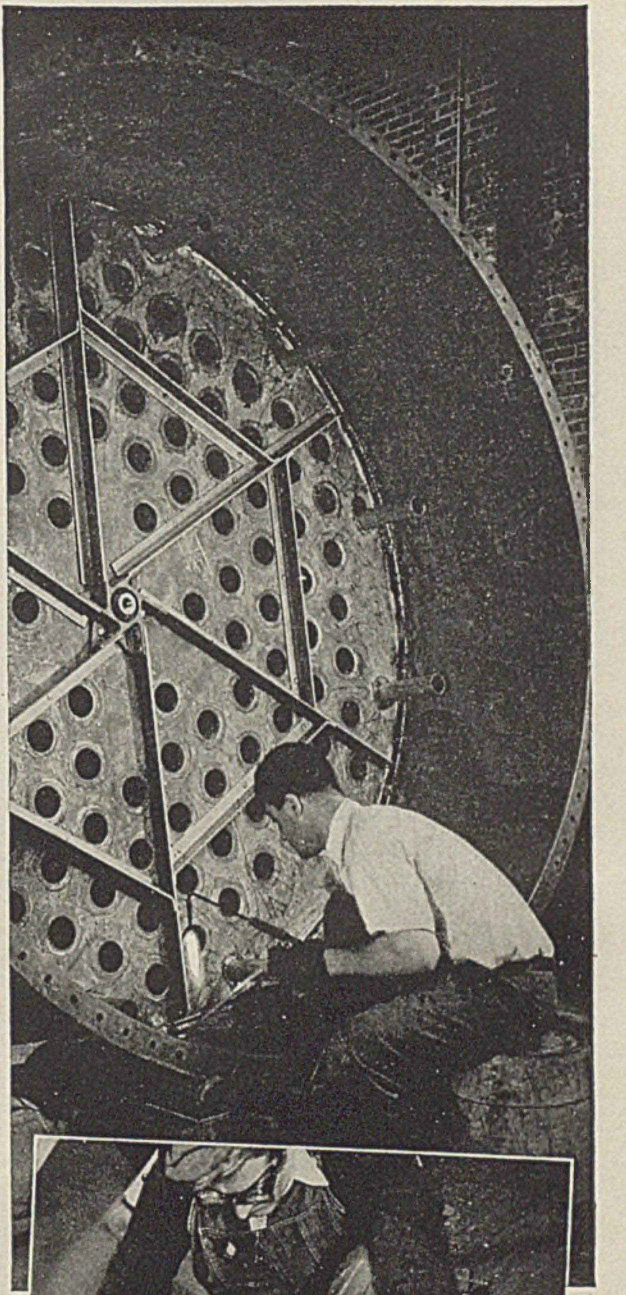
Compared with the first quarter of 1942, these deliveries represent an increase of 26,581 tons of potash salts, equivalent to 14,000 tons K_2O, from the total of 319,673 tons of salts, equivalent to 164,877 tons K_2O, delivered during the corresponding period of a year ago, an increase of 8 percent, principally in the category of agricultural salts.

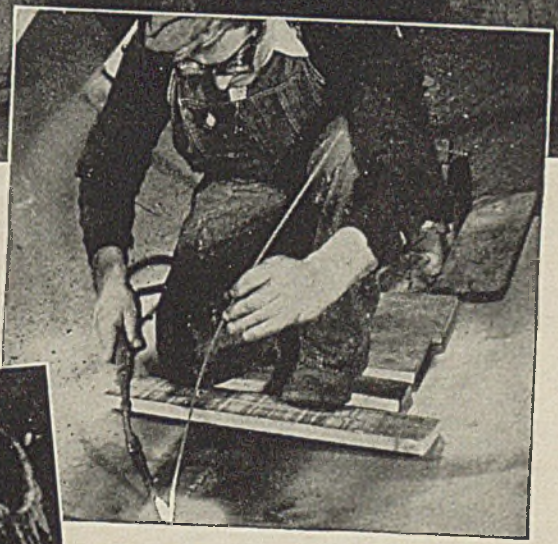
For the twelve-month period, April 1, 1942 to March 31, 1943, total deliveries of potash salts amounted to 1,279,709 tons, equivalent to 674,161 tons K_2O, a 19 percent increase in salts and a 20 percent increase in K_2O equivalent over deliveries of the preceding twelve-month period.



Production and Consumption Trends







CITRIC ACID AND BUTYL ACETATE INCLUDED AMONG CHEMICALS UNDER ALLOCATION

As the greater part of chemical output is sold ahead and moves out against contracts, current trading is not very important. However, there have been some inquiries for export involving good-sized lots but such demand seems to run heavily toward the chemicals which are in limited supply and actual business is restricted by the scarcity of offerings and by other difficulties surrounding export trade. While changes in the military program have made it possible to provide some chemicals in larger quantities for civilian lines, the number of selections which are scarce continues to increase. In the last month citric acid and butyl acetate, including normal and secondary, were placed under allocation. Isobutyl acetate, diphenyl mono phosphate, and dimono phenyl phosphate also were placed under distributional control.

It is pointed out that total productive capacity of refined citric acid in this country is 32,000,000 lb. made up of 7,000,000 lb. from citrus fruits and 25,-000,000 lb. from the fermentation of molasses. Production for this year, however, is estimated at but little over 25,000,000 lb. as only about 1,500,000 lb. is expected to be made from lemons because of the reduction in the lemon crop and increased military demand for lemon juice. With production below capacity levels and demand steadily growing the market for citric acid has been very strong for some months and finally reached a point where the allocation measure was deemed necessary in order to assure equitable distribution of military and essential civilian uses.

The scarcity of butyl acetate is explained by the fact that since the first of the year, demand for butyl alcohol has been increased with the result that smaller amounts were available for conversion into the acetate. Tricresyl and triphenyl phosphates have been under allocation for some time and the adding of the two other phosphate plasticizers was for the purpose of meeting essential requirements.

Casein, likewise, has been of interest because imports from the Argentine have not been large enough to give an adequate supply and it has been evident for some time that some consumers would be forced to do without this material. WPB has announced that the supply for May and June was large enough to fill all military requests but requests for civilian use were cut in some cases to 30 percent of the requested totals.

Although imports of many materials have been irregular and in reduced quantities chrome ore has been reaching this country in relatively large volume and production of chrome salts has been above normal. In particular it is pointed out that domestic production of zinc chromate has reached an astonishing total as compared with any peace-time period and consumption is heavy enough to keep production of an ascending scale.

In the market for alcohol, the chief development consisted in an announcement to the effect that a new process for dehydrating and packaging molasses has been developed by the engineering division of the Board of Economic Warfare. It is further stated that the molasses treated by the new process is suitable, when reconstituted, only for the manufacture of alcohol and not for feedstuffs. In view of the shortage of tankers for transporting molasses from Cuba and other outside points, the new process gives promise of making molasses supplies more available. It is estimated that between 200,000,000 and 220,000,000 gal. of molasses are stored in Cuba, 60,000,000 gal. in the Dominican Republic, 65,000,000 gal. in Puerto Rico, and between 25,000,000 and 30,-000,000 gal. in Haiti. The dehydrated product can be shipped in 40 percent less space than the fluid molasses. Because of the packaging angle, paper bag manufacturers have worked with BEW engineers on this project. To date everything has been carried out on an experimental scale and it will be necessary for interested users of the process to do further experimental work before going into large scale production. It is asserted that the dehydration operation can be done at sugar mills with the simplest of equipment and at small cost.

The easier position of chlorine is shown in the amendment to General Preference Order M-41 whereby larger amounts of chlorinated hydrocarbon solvents are released for civilian uses. The amended order provides that a person requiring these solvents for any use for which a preference rating of B-2 is assigned may receive in any month not more than his average monthly consumption during the base period of the year ending September 30, 1941.

Some improvement has been noted in demand for turpentine and values have turned upward. The market, however, is said to be stronger more because of relatively light offerings than to active buying. The Naval Stores Research Division of the Department of Agriculture has just issued its report on the naval stores industry for the 1942-43 season.

CHEM. & MET.
Weighted Index of CHEMICAL PRICES

Base=100 for 1937

This month	109.01
Last month	108.88
June, 1942	109.30
June, 1941	100.49

While the greater part of chemical output is passing against contracts, high prices are paid for small lots in the spot market both for domestic use and for export. Nitrate of soda prices have been extended to cover June deliveries. Solvents displayed a strong tone in recent trading.

While all data connected with imports and exports have been excluded, the report brings out clearly the downward trend for consumption of turpentine and rosin. Apparent total consumption —including exports for 1942-43 was 427,-954 50-gal. bbl. of turpentine as compared with 602,337 50-gal. bbl. for the preceding season. Consumption of rosin in the same periods were 1,899,145 500-lb. bbl. and 2,575,076 500-lb. bbl. respectively.

Production of turpentine in the 1942-43 season was 559,798 50-gal. bbl. as against 548,796 50-gal. bbl. in the preceding period. These totals included 321,-930 bbl. of gum turpentine and 237,868 bbl. of wood turpentine for 1942-43 and 285,050 bbl. of wood turpentine and 263,746 bbl. of wood turpentine for 1941-42. Production of rosin for the year ended last March, amounted to 2,069,-754 500-lb.-bbl. as compared with 2,-135,593 500-lb. bbl. in the preceding fiscal year. Despite the drop in production stocks of turpentine increased during the year from 156,369 bbl. to 288,-213 bbl. and stocks of rosin grew from 1,434,677 bbl. to 1,605,286 bbl.

Animal, neat's foot, and red oils have been added to the list that the War Food Administration is allocating to provide adequate supplies for meeting military, essential civilian, and lend-lease needs. These oils are highly important as metal working oils and are essential in textile weaving and processing, leather tanning, and in the manufacture of various specialized lubricants. Demand for them has increased with the acceleration of wartime industrial activity, and their shortage is magnified by the shortage of tallow and grease, the raw materials from which they are manufactured. Animal oils are defined to include grease (lard) oil, tallow oil, pig's feet oil as well as any other oil produced from animal fat.

They also are important substitutes for more commonly used sperm, castor and olive oils, and petroleum sulphanates—all of which are critical because of uncertain shipping conditions, and expanded demands.

Two sulphuric acid plants will be established in Bulgaria, say Axis press reports.

Permission for their erection has been given by the Bulgarian Industrial Council to one German and one Italian firm, it is stated.

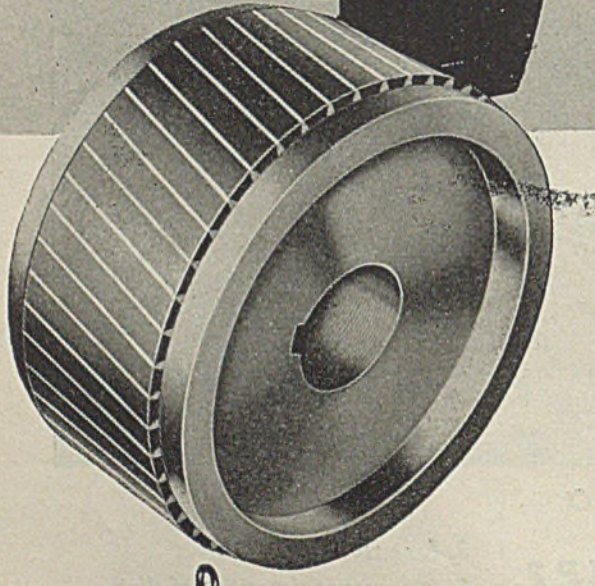
CHEM. & MET.

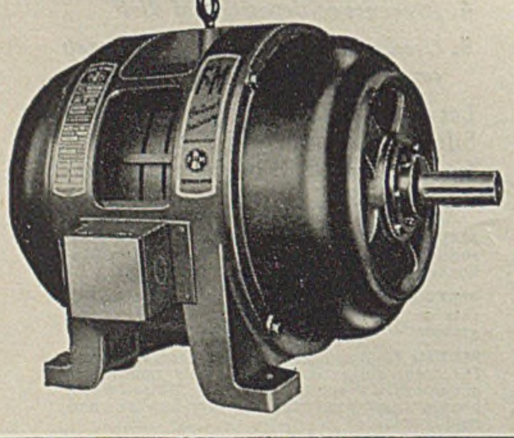
Weighted Index of Prices for OILS & FATS

Base=100 for 1937

This month	145.55
Last month	146.03
June, 1942	143.60
June, 1941	112.00

Most important price development was the establishment of maximum prices for linseed oil. The basic price is fixed at 14.5c a lb. for raw oil, in tanks, delivered in Zone 1 which centers around Minneapolis. The usual differentials apply where oil is delivered in other containers.





REALLY, it's no hardship when you have to buy smaller motors. *You save money.* But remember, when you can't buy 'em big—buy 'em good.

Now that you cannot depend on oversize to take your motors through tough service—you must depend on quality.

That is why you should investigate Fairbanks-Morse Motors with *Copperspun* Rotors.

The winding of the *Copperspun* Rotor is centrifugally cast of COPPER in one piece. It provides electrical and thermal characteristics that give this motor the stamina to stand up under the most severe service without mechanical failure. You can operate a Fairbanks-Morse Motor with *Copperspun* Rotor at its full rated capacity continuously and indefinitely without fear of damage from overloading.

Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill.

Copperspun

FAIRBANKS-MORSE

Motors

DIESEL ENGINES	WATER SYSTEMS
PUMPS	FARM EQUIPMENT
ELECTRICAL MACHINERY	STOKERS
SCALES	AIR CONDITIONERS
MOTORS	RAILROAD EQUIPMENT

CURRENT PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.085–$0.109	$0.085–$0.109	$0.168–$0.173
Acid, acetic, 28%, bbl., cwt	3.38 – 3.63	3.38 – 3.63	3.38 – 3.63
Glacial 99.5%, drums	9.15 – 9.40	9.15 – 9.40	9.15 – 9.40
U. S. P. X 1, 99.5%, dr	10.95 –11.20	10.95 –11.20	10.95 –11.20
Boric, bbl., ton	109.00–113.00	109.00–113.00	109.00–113.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys, lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.10 – 1.15	1.10 – 1.15	1.10 – 1.15
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb.	.073– .075	.073– .075	.073– .075
Muriatic 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –20.00	18.50 –20.00
Oxalic, crystals, bbl., lb	.11½– .13	.11½– .13	.11½– .13
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.71 – .73	.71 – .73	.71 – .73
Tartaric, powd., bbl., lb	.70 –......	.70 –......	.70 –......
Tungstic, bbl., lb	nom	nom	nom ......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.131–......	.131–......	.131–......
Alcohol, Butyl, tanks, lb	.10¾–......	.10¾–......	.158–......
Alcohol, Ethyl, 190 p'f., bbl., gal.	11.94 –......	11.94 –......	8.19 – 8.25
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, dr., gal. wks.	.62 –......	.62 –......	.60 –......
Alum, ammonia, lump, bbl., lb	.03¾– .04	.03¾– .04	.03¾– .04
Potash, lump, bbl., lb	.04½– .04¾	.04½– .04¾	.04 – .04¾
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.85 – 2.10	1.85 – 2.10	1.85 – 2.10
Aqua ammonia, 26°, drums, lb	.02½– .03	.02½– .03	.02½– .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.16 –......
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09¼– .12	.09¼– .12	.09¼– .12
Sulphate, wks., ton	29.20 –......	29.20 –......	29.00 –......
Amylacetate tech., from pentane, tanks, lb	.145–......	.145–......	.145–......
Antimony Oxide, bbl., lb	.15 –......	.15 –......	.15 –......
Arsenic, white, powd., bbl., lb	.04 – .04½	.04 – .04½	.04 – .04½
Red, powd., kegs, lb	nom	nom	nom ......
Barium carbonate, bbl., ton	60.00 –65.00	60.00 –65.00	60.00 –65.00
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.11 – .12	.11 – .12	.10½– .11
Blanc fix, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.25 – 2.35	2.25 – 2.35	2.25 – 2.35
Borax, gran., bags, ton	44.00 –......	44.00 –......	44.00 –......
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –......	3.00 –......	3.00 –......
Arsenate, dr., lb	.07 – .08	.07 – .08	.07 – .08
Carbide drums, lb	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	18.00 –24.00	18.00 –24.00	19.00 –24.50
flake, bags., del., ton.	18.50 –25.00	18.50 –25.00	20.50 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05½–......	.05½	.05½–......
Tetrachloride drums, gal	.73 – .80	.73 – .80	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb.	2.00 –......	2.00 –......	2.00 –......
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b., wks., ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.18 – .20	.18 – .20	.18 – .20
Sulphate, bbl., cwt	5.00 – 5.50	5.00 – 5.50	5.15 – 5.40
Cream of tartar, bbl., lb	.57 –......	.57 –......	.57 –......
Diethylene glycol, dr., lb	.14 – .15½	.14 – .15½	.14 – .15½
Epsom salt, dom., tech., bbl., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Ethyl acetate, drums, lb	.12 –......	.12 –......	.12 –......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06¼	.05½– .06
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, drums, lb	.18 – .19	.18 – .19	.18 – .19
Glaubers salt, bags, cwt	1.05 – 1.10	1.05 – 1.10	1.05 – 1.10
Glycerine, c.p., drums, extra, lb	.18¾–......	.18¾–......	.18¾–......

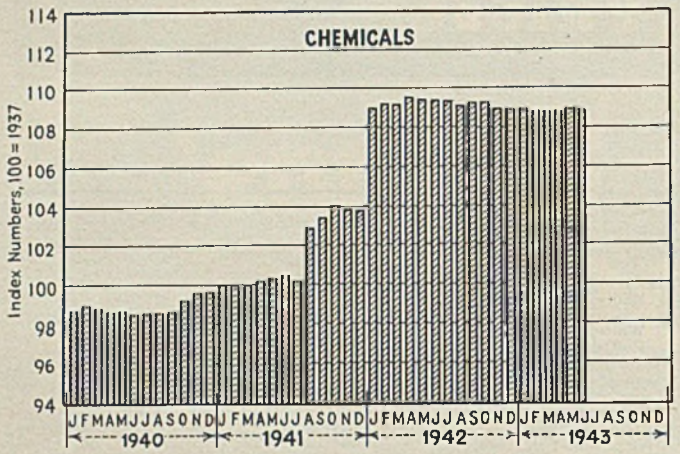
	Current Price	Last Month	Last Year
Lead:			
White, basic carbonate, dry casks, lb	.08¼–......	.08¼–......	.08¼–......
White, basic sulphate, sck., lb	.07½–......	.07½–......	.07½–......
Red, dry, sck., lb	.09½–......	.09½–......	.09½–......
Lead acetate, white crys., bbl., lb.	.12¾– .13	.12¾– .13	.12¾– .13
Lead arsenate, powd., bag, lb	.11 – .12	.11 – .12	.11 – .12
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, powd., csk., lb	.08½–......	.08½–......	.08½–......
Lithopone, bags, lb	.04¼– .04½	.04¼– .04½	.04¼– .04½
Magnesium carb., tech., bags, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½
Methanol, 95%, tanks, gal	.58 –......	.58 –......	.60 –......
97%, tanks, gal	.58 –......	.58 –......	.60 –......
Synthetic, tanks, gal	.28 –......	.28 –......	.28 –......
Nickel salt, double, bbl., lb	.13¼– .13½	.13¼– .13½	.13¼– .13½
Orange mineral, csk., lb	.12½–......	.12½–......	.12½–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09½– .10	.09½– .10	.09½– .10
Carbonate, 80–85%, calc. csk., lb.	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 60% bags, unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.19½– .20
Prussiate, yellow, casks, lb	.17 – .18	.17 – .18	.17 – .18
Sal ammoniac, white, casks, lb	.0515– .06	.0515– .06	.0515– .06
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –......	17.00 –......	17.00 –......
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07¾– .08	.07¾– .08	.07¾– .08
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	16.00 –17.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.08 – .09	.08 – .09	.08 – .09
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.50 – 2.65	2.50 – 2.65	2.50 – 2.65
Nitrate, bulk, cwt	1.35 –......	1.35 –......	1.35 –......
Nitrite, casks, lb	.06¼– .07	.06¼– .07	.06¼– .07
Phosphate, tribasic, bags, lb	2.70 –......	2.70 –......	2.70 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.), wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb.	.03 – .03½	.03 – .03½	.03 – .03½
Sulphite, crys., bbl., lb	.02¼– .02½	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, long ton	16.00 –......	16.00 –......	16.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .08
Flour, bag, cwt	1.90 – 2.40	1.90 – 2.40	1.90 – 2.40
Tin Oxide, bbl., lb	.55 –......	.55 –......	.55 –......
Crystals, bbl., lb	.39½–......	.39½–......	.39½–......
Zinc, chloride, gran., bbl., lb	.05¾– .06	.05¾– .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.1035–......	.1035–......	.10¼–......
Oxide, lead free, bag, lb	.07½–......	.07½–......	.07½–......
5% leaded, bags, lb	.07½–......	.07½–......	.07½–......
Sulphate, bbl., cwt	3.85 – 4.00	3.85 – 4.00	3.40 – 3.50

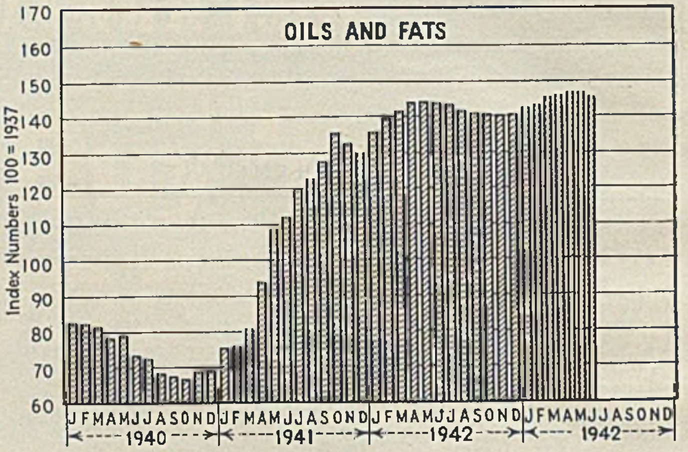
OILS AND FATS

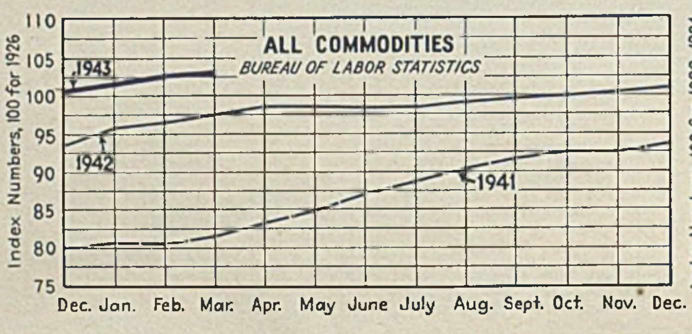
	Current Price	Last Month	Last Year
Castor oil, No. 3 bbl., lb	$0.13¼–$0.14¼	$0.13¼–$0.14¼	$0.13¾–$0.14½
Chinawood oil, bbl., lb	.38 –......	.38 –......	.38 –......
Coconut oil, Ceylon, tank, N. Y., lb	nom	nom	nom ......
Corn oil crude, tanks (f.o.b. mill), lb	.12¾–......	.12¾–......	.12¾–......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12¾–......	.12¾–......	.12⅞–......
Linseed oil, raw car lots, bbl., lb.	.153–......	.156–......	.139–......
Palm, casks, lb	.09 –......	.09 –......	.09 –......
Peanut oil, crude, tanks (mill), lb.	.13 –......	.13 –......	.13 –......
Rapeseed oil, refined, bbl., lb	nom	nom	nom ......
Soya bean, tank, lb	.11¾–......	.11¾–......	.11¾–......
Sulphur (olive foots), bbl., lb	nom	nom	.19¾–......
Cod, Newfoundland, bbl., gal	nom	nom	nom ......
Menhaden, light pressed, bbl., lb.	.117–......	.117–......	.114–......
Crude, tanks (f.o.b. factory) lb.	.088–......	.088–......	.088–......
Grease, yellow, loose, lb	.08¼–......	.08¼–......	.09295......
Oleo stearine, lb	.09½–......	.09½–......	.09½–......
Oleo oil, No. 1	.11½–......	.11½–......	.11½–......
Red oil, distilled, dp.p. bbl., lb	.11¾–......	.11¾–......	.12 –......
Tallow extra, loose, lb	.08¾–......	.08¾–......	.097125....

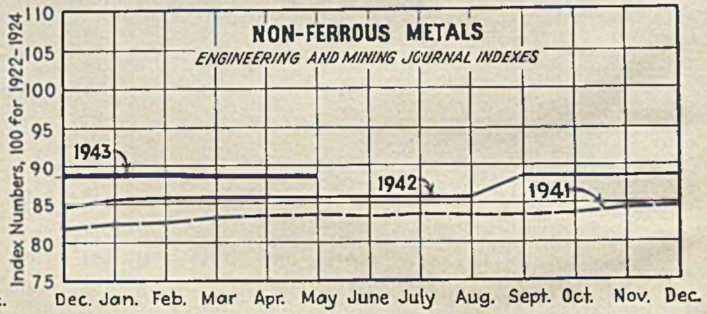
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to June 14

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52– $0.55	$0.52– $0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb.	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb.	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal.	.15 –......	.15 –......	.14 –......
Beta-naphthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb	.11 –......	.11 – .11	.10¾– .11
Cresylic acid, dr., wks., gal	.81 – .83	.81 – .83	.81 – .83
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb	.18 – .19	.18 – .19	.18 – .19
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. f.o.b. wks., lb.	.60 –......	.60 –......	.70 –......
H-acid, bbl., lb.	.45 – .50	.45 – .50	.45 – .50
Naphthalene, flake, bbl., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb.	.10½– .11	.10½– .11	.13 –......
Picric acid, bbl., lb	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs., lb.	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.33 – .40
Solvent naphtha, w.w., tanks, gal.	.27 –......	.27 –......	.27 –......
Tolidine, bbl., lb	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal.	.33 –......	.33 –......	.32 –......
Xylol, com., tanks, gal.	.26 –......	.26 –......	.26 –......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.21 – .23½	.21 – .23½	.17– .20
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335– .30	.0335– .30	.0335– .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb.	.11 – .26	.11 – .26	.11 – .26
Chrome green, bbl., lb.	.21½– .30	.21½– .30	.21½– .30
Carmine, red, tins, lb.	4.60 – 4.75	4.60 – 4.75	4.60 – 4.75
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	3.05 – 3.10	3.05 – 3.10	3.05 – 3.10
Chrome yellow, C.P., bbl., lb.	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b.N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 – .10	.08 – .10	.08 – .10
Gum copal Congo, bags, lb.	.09 – .30	.09 – .30	.09 – .30
Manila, bags, lb.	.09 – .15	.09 – .14	.09 – .15
Demar, Batavia, cases, lb.	.10 – .22	.10 – .20	.10 – .22
Kauri, cases, lb.	.18 – .60	.17 – .60	.18 – .60
Kieselguhr (f.o.b. mines), ton.	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton.	64.00 –......	64.00 –......	64.00 –......
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	nom	nom	nom ......
Rosin, H., 100 lb.	4.09 –......	4.10 –......	3.33 –......
Turpentine, gal.	.73½–......	.70½–......	.67 –......
Shellac, orange, fine, bags, lb.	.39 –......	.39 –......	.43 –......
Bleached, bonedry. bags, lb.	.39 –......	.39 –......	.40 –......
T. N. bags, lb.	.31 –......	.31 –......	.32 –......
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o.b. Ga.), ton.	6.00 – 8.00	6.00 – 8.00	6.00 – 8.00

Industrial Notes

THE H. K. FERGUSON CO., Cleveland, has appointed J. Stuart Sneddon vice-president in charge of sales. Clarence McDonough, who did special work in synthetic rubber and ordnance plant construction, will resume his position as vice-president in charge of construction.

THE PERMANENTE CORP., Oakland, Calif., has changed its name to the Permanente Cement Co.

GENERAL CONTROLS CO., Glendale, Calif., has appointed Claude S. Slocum as its representative in the Rocky Mountain and adjacent territory. He will make his headquarters at 2135 South Adams St., Denver, Col.

HENRY L. CROWLEY & CO., INC., West Orange, N. J., has appointed L. A. Shea district manager for the Chicago territory and named Ralph Hulton field engineer in the Ohio and Michigan territories.

KELLY O'LEARY STEEL WORKS, Chicago, has added Roy E. Smith to its executive staff where he will serve as sales manager.

WISHNICK-TUMPEER, INC., New York, again has Clement A. Damen on its sales staff. Mr. Damen had left the company to work with the Army Medical Corps.

THE CHARLES S. JACOBOWITZ CO., Buffalo, together with its affiliate, the Niagara Filter Corp., has moved to 3080 Main St.

SULLIVAN MACHINERY CO., Michigan City, Ind., has appointed O. J. Neslage general sales manager and J. N. Rolston assistant general sales manager.

AMERICAN PIPE & CONSTRUCTION CO., Los Angeles, is now represented in Canada by Gunite and Waterproofing, Ltd., 1538 Sherbrooke St., W. Montreal.

RODNEY HUNT MACHINE CO., Orange, Mass., has placed Harold H. Belcher in charge of engineering and development work for the textile machinery division.

HERCULES POWDER CO., Wilmington, has appointed Arthur H. Sanford manager of naval stores sales at the Boston office. Hind and Connor, Inc., Boston, will continue as distributors in the New England area.

KESSLER CHEMICAL CO., Philadelphia, has moved its offices to State Road and Cottman Ave.

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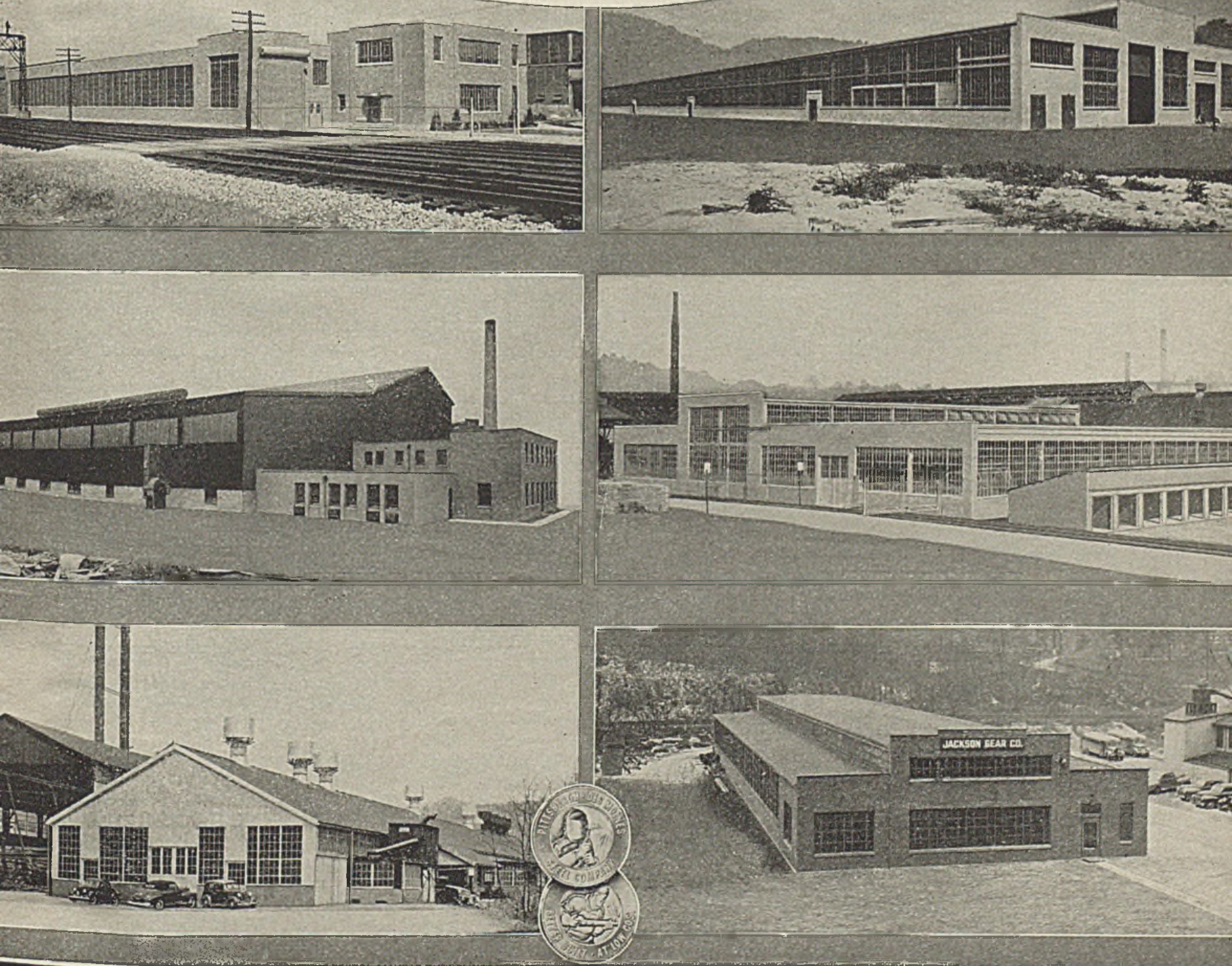

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NEW CONSTRUCTION

	Current Projects		Cumulative 1943	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$175,000	$15,000	$295,000	$350,000
Middle Atlantic	140,000	....	14,070,000	1,900,000
South	4,650,000	1,000,000	6,863,000	6,600,000
Middle West	....	40,000	8,530,000	8,535,000
West of Mississippi	1,690,000	1,405,000	12,300,000	9,470,000
Far West	75,000	50,000,000	1,925,000	57,126,000
Canada	580,000	....	4,824,000	1,127,000
Total	$7,310,000	$52,490,000	$48,807,000	$85,108,000

PROPOSED WORK

Calif., Berkeley—Cutter Laboratories, 4th and Parker Sts., plan to construct additional plant facilities. Project will be financed by Defense Plant Corp., Washington, D. C. Estimated cost $75,000.

Colorado—Bureau of Mines, Department of Interior, Washington, D. C., plans to construct a helium manufacturing plant in the Thatcher area.

Ia., Dike—Farmers Cooperative Elevator, Dike, plans the construction of a soybean processing plant. Estimated cost including equipment $40,000.

Ia., Muscatine—Muscatine Processing Corp., S. C. Stern, Pres., plans the construction of a soybean processing plant. Estimated cost $200,000.

Kansas—Bureau of Mines, Department of Interior, Washington, D. C., plans the construction of a helium manufacturing plant in the area of Cunningham.

Kansas—Bureau of Mines, Department of Interior, Washington, D. C., plans the construction of a helium manufacturing plant in the area of Otis.

Kansas—Midwest Solvents Co., Atchison, plans to construct additional plant facilities. Project will be financed by Defense Plant Corp., Washington, D. C. Estimated cost $300,000.

Kentucky—Reynolds Metals Co., 311 West Broadway, Louisville, plans to construct additional plant facilities. Defense Plant Corp., Washington, D. C., will finance. Estimated cost $250,000.

Montana—Domestic Manganese & Development Co., South Montana St., Butte, plans to construct additional plant facilities. Defense Plant Corp., Washington, D. C., will finance. Estimated cost $250,000.

N. H., Nashua—Nashua Gummed & Coated Paper Co., 44 Franklin St., is having plans prepared by Sidney Hooper Archt., 199 Washington St., Boston, Mass., for the construction of a warehouse. Estimated cost $175,000.

New Jersey—Casob Corp., c/o Irving Varnish Co., 6 Argyle Terrace, Irvington, plans to alter and construct 1 story addition to its plant. Estimated cost $40,000.

N. J., Newark—New Jersey Galvanizing & Tinning Works, foot of Pacific St., are having plans prepared by Victor Strombach, Archt., 1243 Springfield Ave., for the construction of a 1 story, 77x165 ft. manufacturing plant. Estimated cost $100,000.

New Mexico—Bureau of Mines, Department of Interior, Washington, D. C., plans to construct and equip a helium manufacturing plant in the area of Shiprock.

Tex., Beaumont—Southern Acid & Sulphur Co., Beaumont, and 7621 Walisville Rd., Houston, plans to construct an addition to its acid and sulphur plant here. Chemical Construction Co., Houston, Engr. Estimated cost $700,000.

Tex., Columbus—Southern Products & Silica Co., Lilesville, N. C., plans to move two of its large mill units from Lilesville to Columbus and construct tumbling mill to process flint rocks for paint ceramics and other products.

Virginia—E. I. du Pont de Nemours & Co., Inc., du Pont Bldg., Wilmington, Del., plans to enlarge its plants in Henrico and Chesterfield Counties and in New York State. Project will be financed by Defense Plant Corp., Washington, D. C. Estimated cost $4,400,000.

Alberta—Dominion Government, Ottawa, Ont., Can., has taken over the plant of the Abasand Oils, Ltd., McMurray, and plans to reconstruct same. Estimated cost $500,000.

Ont., Windsor—Winthrop Chemical Co., Inc., c/o H. L. Schade, Windsor, plans to construct a plant for the manufacture of medicinal, chemical and pharmaceutical compounds. Estimated cost $40,000.

Ont., Windsor—Wolverine Chemicals, Inc., c/o H. C. Shotwell, Windsor, plans to construct a plant for the manufacture of pharmaceutical, chemical and industrial compounds. Estimated cost $40,000.

CONTRACTS AWARDED

California—Texas Co., 135 East 42nd St., New York, N. Y., and 929 South Bway., Los Angeles, will adapt present refinery to produce 100 octane gasoline. Part of work will be done by own forces; alkylation system and feed preparation by Foster-Wheeler Corp., 715 West Olympic Blvd., Los Angeles. Estimated cost $50,000,000.

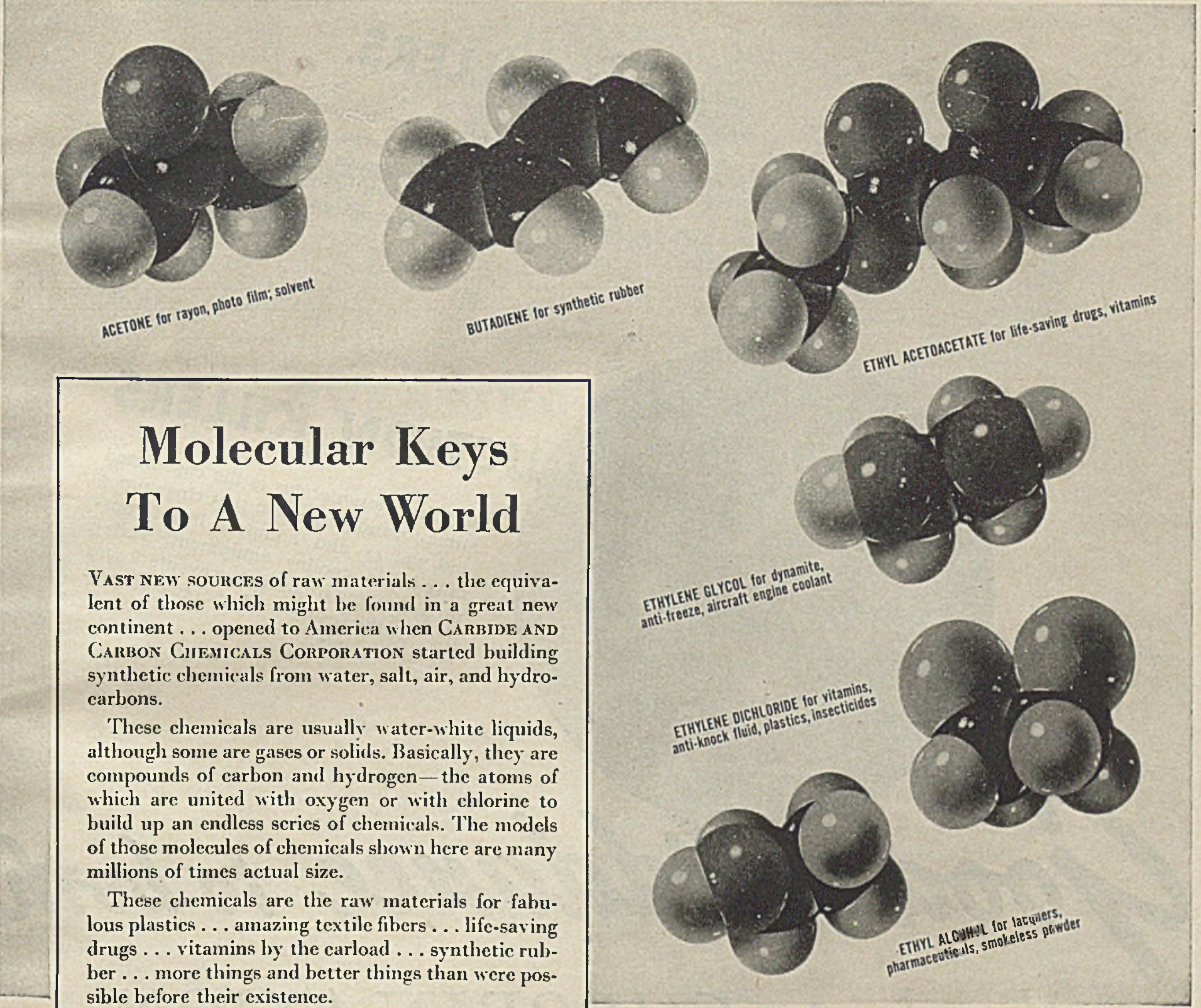
Mass., Southbridge—American Optical Co., 14 Mechanic St., has awarded the contract for the construction of a 4 story, 50x60 ft. factory addition to H. P. Cummings Construction Co., 14 Prospect St., Ware. Estimated cost $45,000.

Tennessee—Tennessee Eastman Kodak Co., Knoxville, and E. I. du Pont de-Nemours & Co., du Pont Bldg., Wilmington, Del., have awarded the contract for the construction of a manufacturing plant in Roane and Anderson Counties, to Stone & Webster Engineering Corp., 90 Broad St., New York, N. Y. Project will be financed by Defense Plant Corp., Washington, D. C.

Texas—Republic Oil Refining Co., Texas City, has awarded the contract for the construction of a refinery to Bace-Marshall Co., 4009 Center St., Houston, Defense Plant Corp., Washington, D. C., will finance project. Estimated cost $180,000.

Tex., Conroe—Columbian Carbon Co., Houston and Rosslyn Rds., Houston, will construct a carbon black plant for synthetic rubber. Work will be done by separate contracts. Present appropriation $1,225,000; total estimated cost $3,000,000.

Wis., New Richmond—Doughboy Mills Chemical Co., New Richmond, will construct a 2 story, 36x36 ft. pilot plant for Plant "K". Work will be done by day labor.



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