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ANOTHER PARTNERSHIP IN THE NEW DEAL

FROM NOW ON THE SUCCESS of the recovery program is going to depend more and more on industrial management. Governmental guidance and support were needed at the start because every industry was sorely affected by external forces over which the individual plant manager had little or no control. But with the completion of the code and industry agreements, the Government slips into the background. The external job of industry planning gives way to the vastly more important internal job of translating the code provisions into practical, working procedures.

Even in chemical industry a surprising number of new problems are going to center around employer-employee relations. Whether we like it or not, Section 7a of N.I.R.A. is labor's bill of rights under the New Deal. Rather than continue to argue about interpretations and exceptions, progressive management is going to get back on the job, re-examine its old personnel policies, and muster full cooperation in carrying new ideas into effect.

One of the means toward this cooperation is the works council form of employee representation. Unfortunately, through poor leadership or lack of supervision during the past few years, many of these groups have been disbanded or have been allowed to become moribund. Now they are badly needed and should be re-organized—not as company unions or as a means of getting around the provisions of the recovery act, but rather in the interest of promoting true partnership—of giving the worker a voice in the affairs of his industry—and thus enlisting the cooperation which through outside meddling he is often disinclined to give.

Employee training has also been allowed to lag during the depression. It seemed like a non-productive expense when there were no jobs for which men should be trained. Now, by increasing the number of shifts because of shorter hours, there is already a need in some plants for additional supervisors. In the past, the plant manager turned to the company's school as the surest way to pick the man from the ranks who knew the most about the job ahead. It is well to remember that employee training is worthwhile, not merely as an aid to production but as a means of increasing the man's understanding of a company's problems and policies.

Selection of new employees is another technique that needs revitalizing or it will soon become one of the lost arts. During the past three years many younger men have been held down to jobs that they thought were merely stepping stones to something better in the plant organization. Shortly there will come the time when these long-awaited opportunities are going to develop. Should they be filled from the ranks or from the outside with older men available for the same money? If the beginners' jobs are vacated, should they go to a new crop of youngsters or to more experienced men from among the unemployed? Re-employment is necessary and desirable but it is our feeling that it should not be made at the expense of those who have served overtime on the lower rungs of the ladder.

After all these are only a few of the *social* implications involved in our great *economic* experiment. But the success of one depends on the other. What economic progress can be achieved in the emergency will be lost in the long pull unless there is a profitable partnership of employer and employee. To attain this fairly and promptly, will be the real test of management.

EDITORIALS

Congratulations To the Winner!

BY VOTE of a distinguished committee of leaders in the industry and profession, the first Award for Chemical Engineering Achievement is to be made to the Carbide and Carbon Chemicals Corporation at the time of the forthcoming Chemical Exposition. Public recognition is thus to be given to the company that in the opinion of the Committee on Award has contributed most since January, 1930, to the advance of chemical industry and of the chemical engineering profession. It will be our privilege next month to present a comprehensive discussion of the unique accomplishment of the Carbide organization in establishing a synthetic aliphatic chemical industry in the United States, which in but three years has risen to a position of world leadership. The record is one of which all chemical engineers may well be proud.

Reports of Its Death Are Greatly Exaggerated

LIKE MARK TWAIN, the NRA seems to be having a little trouble with people who persist in circulating rumors of its death. Perhaps this is simply a sort of wishful thinking that has thoughtlessly been taken for fact; or perhaps it is deliberate propaganda designed for altruistic or other reasons to put an early end to our partnership experiment. But whatever it is, it is manifestly inaccurate and unfair, and a brand of talk with which engineers, of all people, should not identify themselves.

It is true, of course, that planned recovery has not in four months been able to undo the effects of nearly four years of depression. It is true that the PRA, having quietly served its real purposes, is now being allowed to die with an appearance of failure. It is true that living costs have risen faster than income, that re-employment has not met the over-optimistic bogey set for it, and that racketeering labor agitators have been capitalizing on the incipience of recovery. It is true that respectable labor organizations have been loath to cooperate, that the President has failed to come out flat-footedly against direct monetary inflation. . . . But look at the other side of the ledger. It is equally true that an excellent start toward recovery has been made in the consumers' goods industries while, somewhat belatedly, NRA has turned its energies toward the rehabilitation of capital goods. Industry now has what it has long cried for, a relaxation of the outmoded provisions of the anti-trust laws. And best of all, for our future good, we have moved a little closer to an understanding of our economic system and the way it works.

No engineer needs to be reminded of the value of experiment. No engineer in his right mind will discard an experiment before it has been disproved nor hold back from experiment for fear of failure. No engineer, recalling the 13 years that it took to establish the failure of prohibition, will believe that a scant four months with a much more far-reaching experiment can be taken to prove its success or failure. No one can deny the existence of the abuses against which the NIRA is so squarely aimed, and few believe that they cannot be at least partially corrected. Our first attempt may not succeed, nor the second, nor the third. But the main thing is that we shall be trying. NRA is *not* dead; it isn't even weakening. Not only are the reports of its death greatly exaggerated: it has just begun to fight.

Trucking Chemicals Deserves New Consideration

ACCIDENTS incident to the trucking of chemicals of flammable or explosive nature have occurred recently. Two or three such spectacular affairs within a short period in August and September have threatened to place the whole chemical industry on the defensive. Every interested party should give early attention to this matter.

The chemical industry has an enviable reputation of safety in the railway movement of dangerous materials. Cooperation of the industry with railway traffic specialists under the administrative supervision of the Interstate Commerce Commission has given a set of containers and transportation practices which practically eliminate from this activity the difficulties which would be inherent were careless practices tolerated or improper containers used. Like thought must be given to trucking.

The public on the highways is entitled to consideration just as much as the users of the railroad for passenger or freight service. Slovenly packaging and careless handling will inevitably be eliminated. The industry should lead in this effort and not sit back and wait until needlessly burdensome restrictions are imposed by official edict.

A Welcome Change Of Conflicting Dates

JUST AS WE go to press word comes from the Council of the American Institute of Chemical Engineers that the dates for the annual meeting in Roanoke, Va., have been changed to Dec. 12, 13, and 14. Thus is avoided an unfortunate conflict with another important chemical engineering activity, the Fourteenth National Exposition of the Chemical Industries, which will be held in the Grand Central Palace in New York during the week of Dec. 4. To have combined the two in a single week would have taxed the ingenuity of many chemical engineers as well as the train schedules of several eastern railroads. To hold them in following weeks, however, gives ample opportunity to spend sufficient time with each to get the full benefit of the advantages offered.

CHEMICAL CODES DEMAND INDUSTRY'S COOPERATION

• • • Unanimous support for chemical and fertilizer codes appeared, until lately, to be forthcoming. Recent developments show determined opposition on the part of certain companies, particularly to the fertilizer code. Most of the opposition seems to center in subsidiaries of Allied Chemical and Dye Corp.

• • • It is most unfortunate that such an outstanding member of the industry should at this late date find it necessary to raise obstacles to the official approval of the Chemical Alliance code and the code formulated under National Fertilizer Association. However meritorious the objections may be, it is much too late to offer them. They should have been presented weeks ago.

• • • It is the law of the land that codes shall be formulated. It is seemingly the general judgment of business that codes are desirable under present circumstances. Cooperation is the order of the day. Cooperation in the chemical industry furthering its code, and general agreement on the fertilizer code, should be had—and soon.

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CHEMICAL ALLIANCE'S code is still, at the date of writing, not formally approved. During August it received general acceptance, seemingly almost unanimous support. In like manner during September the fertilizer code, under auspices of National Fertilizer Association, was formulated and accepted. Now serious obstacles appear to lie in the way of both.

National Fertilizer Association is outspoken in its statement to member companies and non-member concerns in the industry that the opposition to its code originates almost exclusively with the Barrett Company. This prominent subsidiary of Allied Chemical and Dye Corp. is the major marketer of inorganic fertilizer nitrogen sold other than through fertilizer company channels. It is understood that this company declined to participate in the preparation of the code. Although its part in the industry represents only approximately one per cent of the total tonnage sales of fertilizer, the opposition raised has been sufficient to delay final action at N.R.A. for several weeks.

It appears that an effort was made to create the appearance of controversy between chemical companies and fertilizer companies before General Williams, deputy administrator of N.R.A. Opposition seemed to come from a variety of potash and nitrogen manufacturing and marketing groups. At one stage these groups appeared to include domestic potash producers, potash importers, byproduct nitrogen manufacturers, synthetic nitrogen products makers, and related marketing groups.

Confronted by this hostile element, National Fertilizer Association immediately made inquiry as to the occasion for the opposition. Much of it collapsed when the facts were made clear. At present only part of the synthetic nitrogen companies of the country continue their outspoken attack on the fertilizer code.

Allied subsidiaries have opposed many codes, apparently as a general matter of corporation policy. The opposition to the fertilizer code is based on a participation in the marketing of byproduct ammonium sulphate through the Barrett Co. and the manufacture by Atmospheric Nitrogen Corp. of synthetic products at Hopewell, Va., also marketed by Barrett. Some of the codes opposed are for commodities in which the corporation appears to have much less, or even negligible, interest.

As formulated the fertilizer code would require marketers of chemical nitrogen to observe this code when selling for fertilizer usage either to consumers or to dealers. This means compliance with the open-price agreements there provided for. This requirement amply explains the opposition by Allied subsidiaries to acceptance.

The magnitude of various industries involved in the fertilizer business has been summarized by National Fertilizer Association as follows:

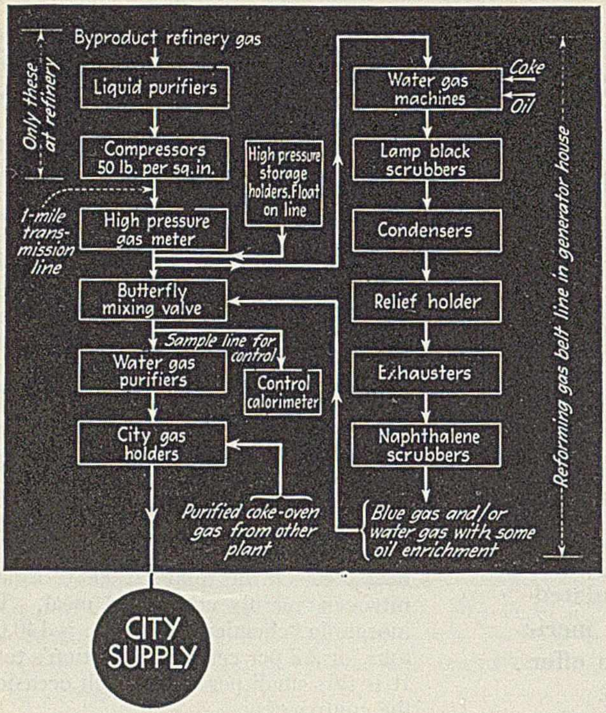
	Short Tons
Tonnage of mixed fertilizer marketed by fertilizer companies	4,600,000
Fertilizer materials sold by mixed fertilizer makers	1,378,000
Fertilizer materials sold by others	357,000
Total	6,335,000

In the last named group, 5.6 per cent of the total, are 1,000 tons of potash, 24,000 tons of phosphate rock, and nitrogen used separately, principally for top and side dressing. Of this total 192,000 is organic nitrogen, mainly cottonseed meal. The inorganic "chemical" nitrogen is 140,000 tons, or 2.2 per cent of the nation's total. It is this small per cent which occasions the controversy.

The chemical code has been delayed significantly for other reasons. As presented at the hearing, it contained the merit clauses to which organized labor has objected. Until this matter has been decided by the Alliance board and a new draft formulated on the basis of the hearings, General Williams' office would not normally take action. Further proceedings are, however, expected shortly, may even take place between this writing and publication date. It is unlikely, however, that the merit clauses will be retained as General Johnson has emphatically announced that the automobile code included both the first and the last appearance of such provisions.

Delay in obtaining industry agreement on the basic chemical code is not being permitted to interfere with the plans for the special supplementary codes for each of the twenty odd subdivisions of chemical industry. A draft of what such a supplementary code might contain was mailed from General Williams' office on Sept. 22 and 23 to more than two dozen trade associations in the chemical field. In this outline the separate groups were urged, in the interest of simplicity and uniformity, to omit any provisions already covered by the Chemical Alliance code for it is assumed that their members have already approved or intend to approve the general code.

General Williams, in a recent interview with *Chem. & Met.*, indicated that he wishes to interfere as little as possible in this work on the supplementary codes. Although open hearings must be held under the law, this work is essentially that of "self-government of industry." In short, he would like to see the whole industry recognize this opportunity to work out its own destiny under the codes.



Use of refinery gas at Greenpoint works

By R. S. McBRIDE

Editorial Representative, Chem. & Met.

Petroleum Refinery Gas for City Supply

USE OF BYPRODUCT GAS from a petroleum refinery as a regular part of city supply mixture has been accomplished under advantageous conditions in Brooklyn. The results afford new petroleum byproduct income, and present an advantage in effective city gas supply. Thus the parties of interest are beneficially affected by this development of the Brooklyn Union Gas Co., utilizing up to 4,000,000 cu.ft. a day of the gas from the Brooklyn refinery of Standard Oil Co. of New York.

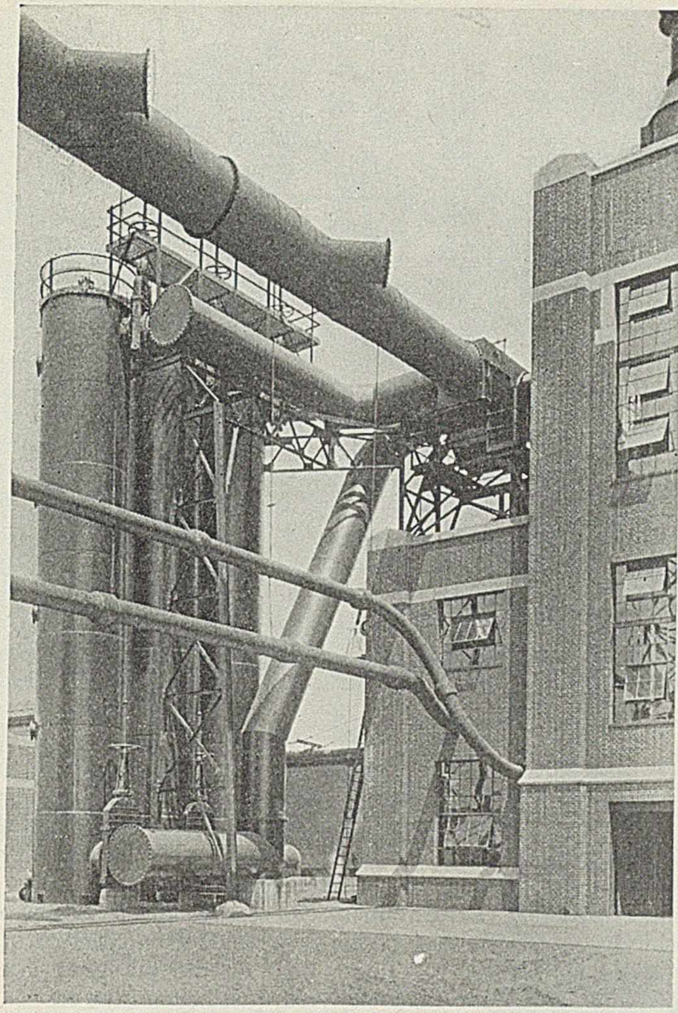
The refinery gas used in this development is pumped about a mile at approximately 50 lb. pressure, from the refinery to the gas works. There it is received through high-pressure Connersville positive-displacement rotary meters, and either utilized directly or stored in two high-pressure bullet holders which float on the line.

Most of the hydrogen sulphide in the gas as received from the refinery has been removed by the liquid purification unit at the oil plant; the remainder is less than would result from gas-oil enrichment for which the refinery gas has been substituted. The heating value varies materially, averaging between 1,750 and 1,800 B.t.u. per cu.ft.; specific gravity is approximately unity. The quantity received, depending on the rate of operation at the refinery, is commonly about 4,000,000 cu.ft. per day. The quantity delivered is always calculated in terms of total heat received and the price is calculated per therm (100,000 B.t.u.). A normal refinery operation supply amounts to 60,000 to 80,000 therms per 24 hr.

The method of use depends upon the quantity available: (1) All may be used merely for cold carburetting of blue water gas. So used 1 M of refinery gas enriches about 6 M of blue gas to the desired heating value. (2) If the supply of cold-carburetting gas is not sufficient to enrich all of the requisite water gas to the necessary heating value some lightly carburetted water gas is produced. The quantity of oil employed to go with the refinery gas makes up the total enricher requirement. (3) When more than sufficient for cold carburetting, some refinery gas is re-formed by the process described below. To the extent the refinery gas is used in this manner, it serves as a substitute, not only for enriching oil, but also in part for the solid fuel used in the water-gas generator.

The object of the gas company is obviously to maintain the lowest over-all cost for the finished gas. This requires a very close watch of the variable factors involved, all of which are modified by the available supply of refinery gas. Formerly the sendout from the Greenpoint works consisted simply of coke oven gas and carburetted water gas. This reached the bulk of the areas supplied by the company, but was augmented by additional water gas from the other works of the company as demand required. Incidentally the use of refinery gas has significantly increased the gas-making capacity of this works, thus reducing to some extent the quantity which must be made at the other works. A few examples of the operating practice will illustrate the importance of these changes.

During certain seasons the Greenpoint works sends out about 50,000,000 cu.ft. of gas per day, containing ap-



Hot scrubbers for removing lamp black after water-gas machines

proximately equal quantities of oven gas and water gas. Under those circumstances, the 25,000,000 cu.ft. of water gas is just about the sufficient volume to absorb all of the refinery gas commonly available by cold enrichment alone.

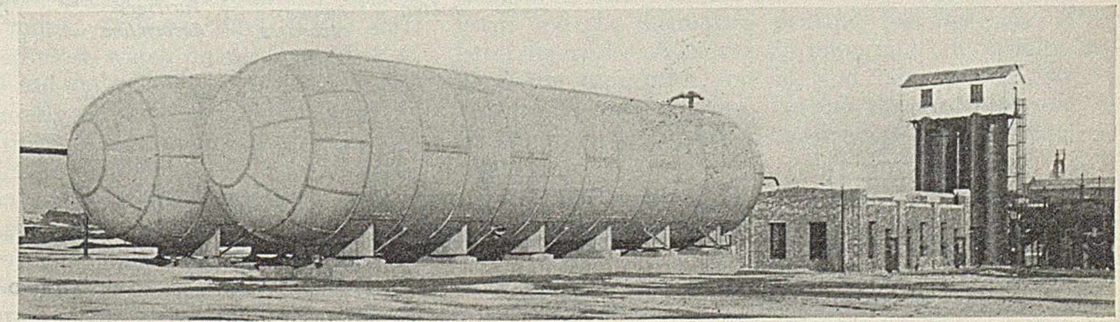
In the summer low-load season, a smaller total demand is placed on this works and some reduction in output is accomplished. Refinery gas is then used more extensively for re-forming. For this purpose this gas is passed through the water-gas generator with the steam, both on the down-runs and on the up-runs. The rich hydrocarbons of the refinery gas are cracked, forming lighter hydrocarbons. Free carbon is deposited in the fuel bed and this becomes a part of the solid fuel to be used both during the blast and during the gas-making periods. In effect, therefore, under these conditions some of the refinery gas becomes not only a substitute for enriching oil, but also a substitute for the coke used as a solid fuel.

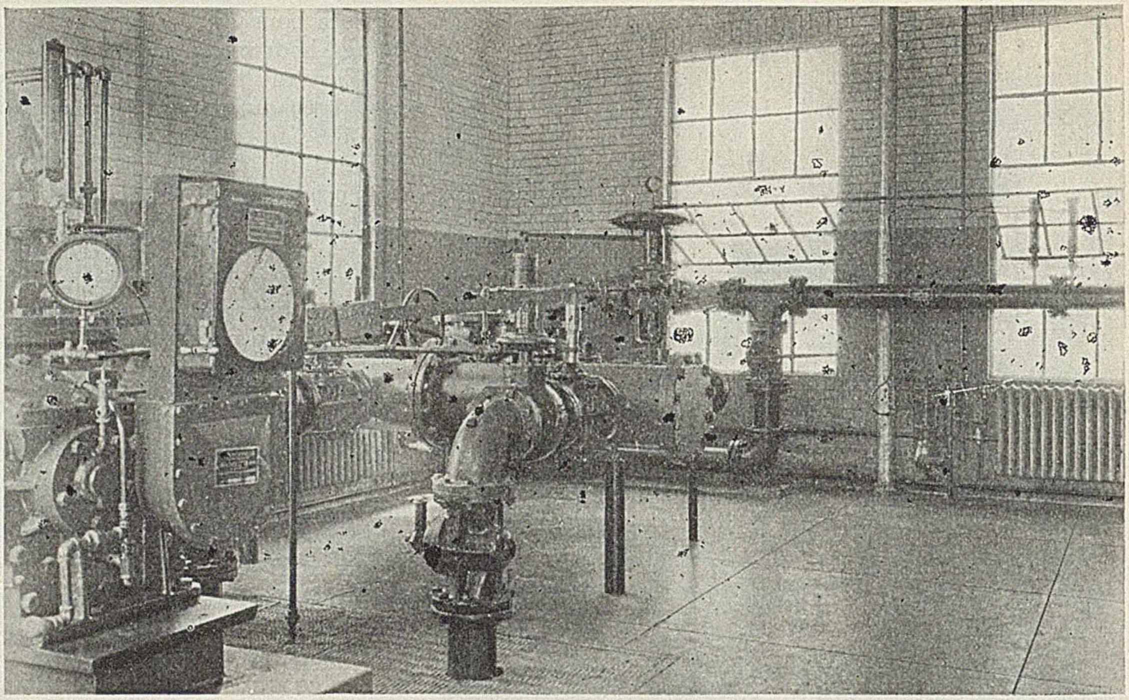
During cold weather the full working capacity of the Greenpoint works is utilized. The demand then greatly exceeds the possible supply without use of both the refinery gas and some oil for the normal type of water gas carburetting. When this condition prevails, it is possible either to add oil to all the machines or, better, to run some machines for blue-gas generation and others with substantial quantities of oil per M cu.ft. made. All the gas from the generators is then mixed and brought up to the requisite heating value by cold enrichment with the refinery gas. Under such circumstances other works of the company make up the requisite total city supply beyond that which can be made at Greenpoint.

Uniformity in heating value and in specific gravity of the gas at the customers' premises is essential for good service. This therefore necessitates not only close control at Greenpoint but such correlation of its output with that of other works as to avoid difficulties in the areas of the city where the two sources of supply both contribute to the consumers' need. Since all the works can readily maintain approximately 537 B.t.u. per cu.ft. at all times, the heating value made necessary by state requirements, the adjustment of the heating value is not complicated. The sendout of other works, containing no coke oven gas, is of higher density than the normal sendout from Greenpoint. Hence to prevent customers' troubles it is necessary at this works to make a water gas of relatively high gravity in order that the gravity of the mixed gas ultimately going into the city mains may not be too low compared with that from the other works of the company. The high gravity gas is easily made by a generous use of the blow-run on one or more machines. The use of the refinery gas also is helpful as the specific gravity obtained is nearly unity, much above that of any of the other constituents in the gas mixture.

Addition of the refinery gas for cold enrichment is automatically controlled by a Cutler-Hammer Calorimix. This device maintains the heating value of the mixture by adjustments from minute to minute on the butterfly valve on the enricher gas, so that the mixture going to the purifiers does not vary more than a few B.t.u. either way from the average which the mixer is set to maintain.

General view showing two high-pressure bullet-type holders, control house, and naphthalene scrubbers





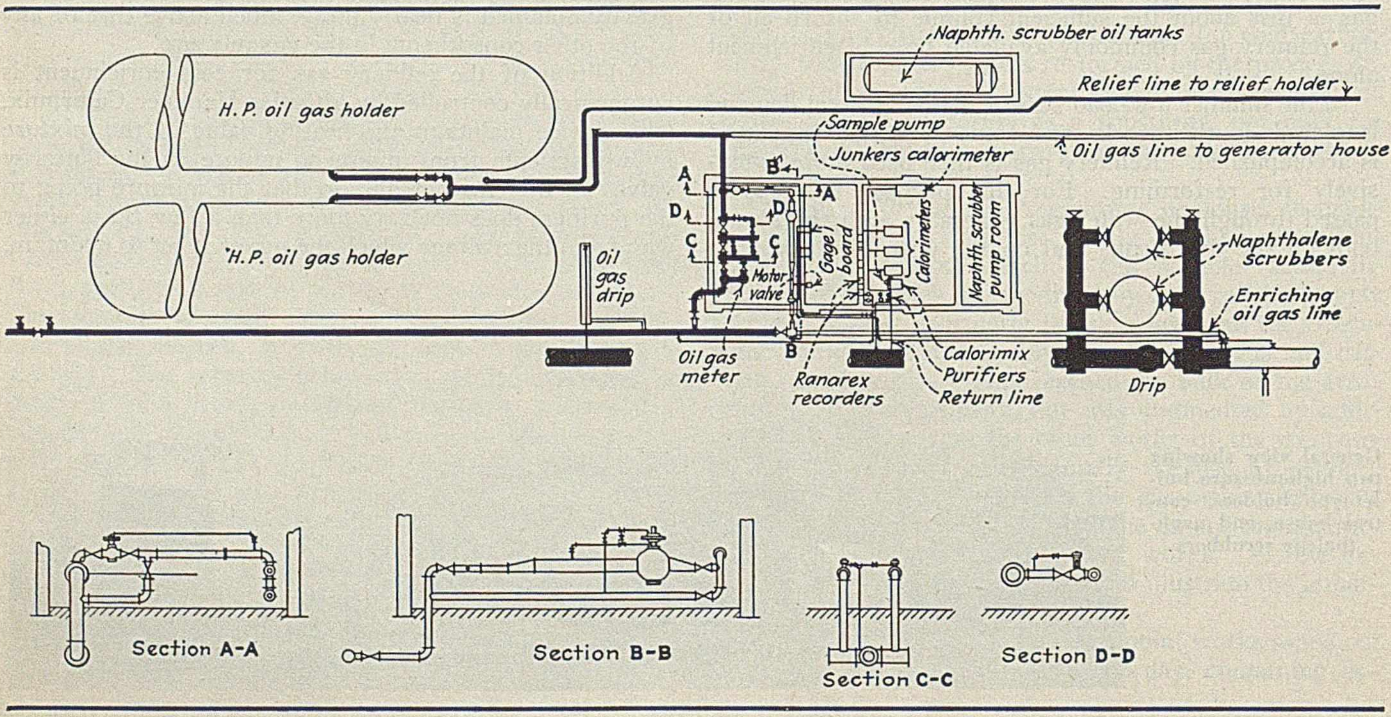
Pressure regulator with high-pressure, Connersville, positive-displacement, rotary meters

Such small variations from the desired average, of course, disappear altogether by the time the gas has entered the big works storage holder and has become mixed with the coke-oven gas preparatory to pumping into the transmission system of the company.

Operating records are made of the specific gravity of the various gases making up the city supply, but no automatic control is necessary. Sufficiently uniform sendout is ensured by the supervision given to this phase of plant operation by the assistant superintendent in charge on any shift. That junior executive also is responsible for supervision and adjustment, according to the prevailing conditions, of the proportions of gas made by cold enrichment, that made by reforming, and also of the quantity of oil, if any, used in carburetting.

The high-pressure refinery gas storage consists of two high-pressure bullet-type holders, each of 45,000 cu.ft. free space capacity. These float on the pumping line through which the gas is received, just beyond the station meter. Normally they operate at about 30 lb. gage pressure, thus holding in reserve about 180,000 cu.ft. or a little over one hour's receipts of refinery gas.

Arrangement of instruments and piping at the control house

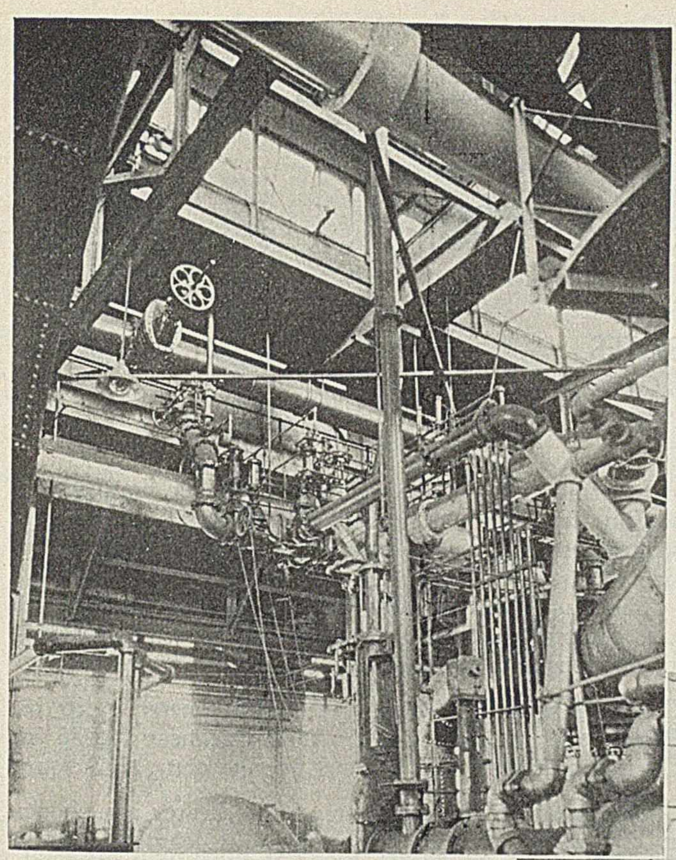


operation will be maintained with a view to maximum generator efficiency.

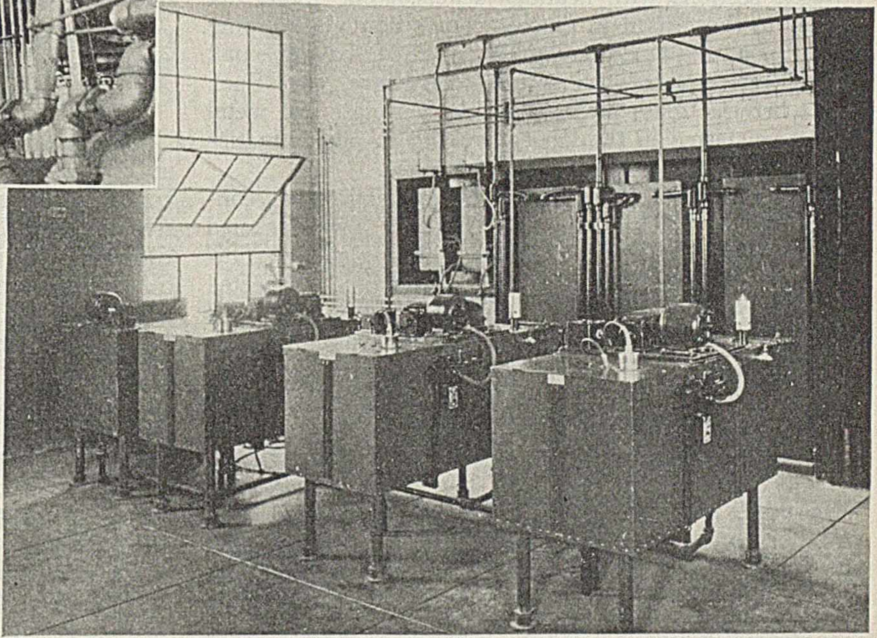
The coke oven operation is not affected by any of this water gas adjustment. It runs at all times on whatever base load is prescribed by the manager, and all adjustments needed from hour to hour are accomplished in the water gas house. Major seasonal changes of demand are, however, significant in determining at any particular time the operating schedule at the coke oven battery. Obviously, however, frequent or rapid changes are not at all feasible.

The advantage which the lowered production cost offers the gas company depends on the ratio between the cost of coke and the cost of refinery gas more than on any other single factor. The cost of coke depends primarily on the prevailing market conditions in Brooklyn and nearby territory where the domestic sizes of coke are sold from the company's own ovens. The price of the purchased refinery gas varies with the prevailing market for fuel oil. It is a nice problem of engineering management at all times promptly to adapt the works procedure to maintain a minimum over-all works cost of gas. The adjustments must take account of the variations in the supply of refinery gas which can be had, the changes in both absolute and relative value of the fuels used, and the fluctuating demand for city gas. This latter figure is, of course, an important one, wholly beyond the company's control, and large enough to be very troublesome at times. In fact the peak winter day's sendout is often 2½ times the average summer requirement.

From the standpoint of the petroleum refinery, this outlet for byproduct gas is equally advantageous. When used in the refinery, the gas serves merely as a boiler fuel or in any equivalent heating operation where a very low-grade heavy oil or still residues will do just as good work.



Connections for sending oil refinery gas to water-gas machines for re-forming



Calorimeters for automatic control of heating value of gas mixture

Since the quantities pumped from the refinery depend strictly on the wishes of the refinery and the conditions of operation there, it is often necessary for the gas works, on very short notice, to take distinctly larger or smaller quantities. Under ordinary conditions they take all the refinery will send—and, except in the summer season, wish they could get more. It is the duty of the shift superintendent to keep close watch on the quantities of this enricher gas on hand and adapt his generator house practice to the constantly fluctuating conditions of its supply. The work there is so organized that in less than 30 min. any machine may go on or off re-forming, or on or off oil carburetting, without significant loss in efficiency. The change-over is practically instantaneous except for the need of building up higher temperatures or lowering the temperatures in a set so that at all times the conditions most appropriate to the particular type of

Heat Transfer in an Industrial Glass Heat Exchanger

By H. C. BATES
Corning Glass Works, Corning, N. Y.

RECENT experiments conducted in the laboratories of the Corning Glass Works have shown the heat transfer characteristics of a new jacketed heat exchanger recently constructed of Pyrex brand glass tubing. The exchanger consists of a series of straight glass pipes connected by glass return bends and surrounded on the straight sections with heating jackets. The joints are similar to those used in the company's new glass piping (see *Chem. & Met.*, May, 1932, p. 288), having small conical upset ends with suitable hardware, etc. Such joints between glass piping and between glass and metal have been tested in the laboratory and in plant practice and have given very satisfactory results.

For long-time test purposes, the exchanger was connected in the circuit shown in Fig. 1. Two jacketed heaters were assembled in series with a glass overflow tank and eight lengths of glass cooling pipe connected with upset-end return bends. Two telescoping slip joints provided for expansion. The equipment was under test some 12 months, 24 hours a day and 7 days a week, operating under about 25 lb. steam pressure, heating and cooling a brine solution. The only attention required was to replenish the water lost by vaporization through the open neck of the carboy. Had higher steam pressures been used, more heat would have been supplied than could be removed and this would eventually have brought the liquid to a boil and emptied the system. For this reason, only 25 lb. steam pressure was used. However, in the heat transfer tests, up to 100 lb. pressure was used successfully. Installations involving larger numbers of sections have also been made and it has been demonstrated that no difficulty is encountered in making plant-size outfits.

The single heater section used in the test consisted of a length of Pyrex brand glass tubing for which the following constants were established:

Overall length	96 in.	Inside diameter	1.10 in.
Effective length	87.5 in.	Wall thickness	0.075 in.
Outside diameter	1.25 in.	Effective area	323 sq.in.

The details of construction of this heater are shown in Fig. 2. In practice any number of lengths may be connected by the use of glass return bends held to the straight lengths by regular upset ends and clamps. Flexible couplings to and from the jacket make it possible to assemble the units without difficulty. The stuffing box and gasket arrangement is important in that it provides a leakproof connection yet slips enough to take care of the differential expansion between the glass and the metal of the jacket. The stuffing boxes each have pipe threads on one end to connect to the metal pipe. The restricted openings at the center are just large enough to pass the upset ends of the glass pipe. The asbestos gaskets shown are slit so as to fit fairly closely to the glass while the one rubber gasket is stretched over the end of the glass and squeezed between the two sets of asbestos gaskets.

Pyrex brand glass tubing has previously been used in various designs of heat exchanger, but the present assem-

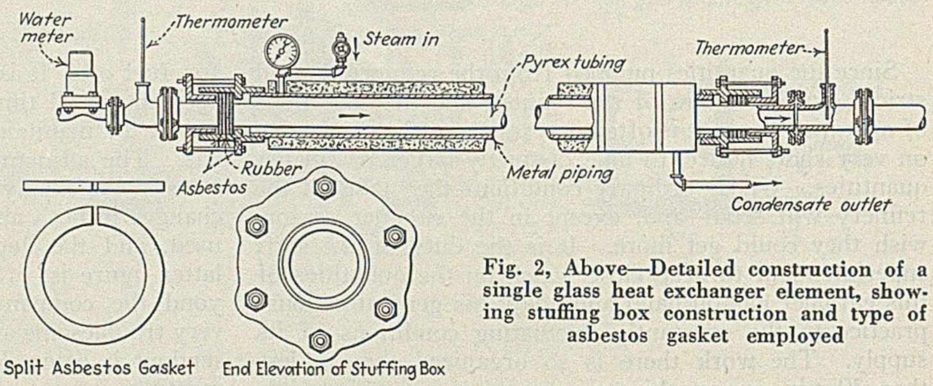


Fig. 2, Above—Detailed construction of a single glass heat exchanger element, showing stuffing box construction and type of asbestos gasket employed

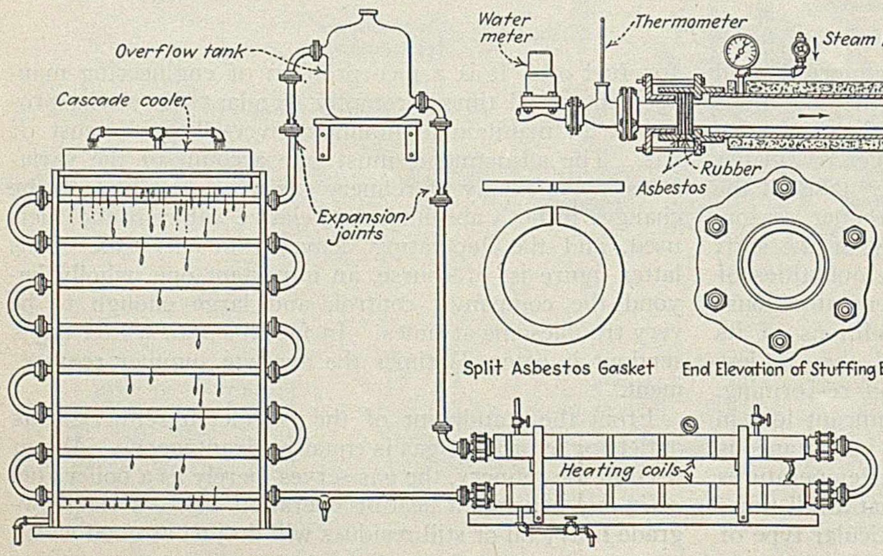


Fig. 1, Left—Layout of heater and cooler for testing all-glass, jacketed heat exchanger

Averaged Data for Heat Transfer Coefficient Between Steam and Water Through 1-In. I.D. Pyrex Brand Glass Tube, 0.075 In. Wall Thickness

Steam Pressure Lb. per Sq. In.	Temperatures, Deg. F Steam	Water In	Water Out	Water Rise	M.T.D.	Water Flow Lb. per Hour	Water Flow Ft. per Second	Heat Transfer B.t.u. per Hour	Heat Transfer K, B.t.u. per Sq. Ft. per Hr. per Deg. F
18.0	255.0	52.7	95.1	42.4	181	996	0.67	42,200	104
18.0	255.0	52.4	82.2	29.8	188	1544	1.03	46,000	109
18.0	255.0	52.4	74.1	21.7	192	2241	1.50	49,000	114
18.7	256.0	51.5	69.5	18.0	195	3196	2.14	58,000	133
17.6	254.0	51.9	67.5	15.6	194	3735	2.50	58,000	133
17.0	254.0	51.6	66.0	14.4	195	4233	2.83	61,000	139
18.0	255.0	51.6	65.3	13.7	197	4382	2.93	60,000	136
16.6	242.0	51.9	64.7	12.8	184	4631	3.10	59,000	143
41.0	288.0	53.7	112.0	58.3	205	747	0.50	43,500	95
40.7	287.5	52.4	102.5	50.1	211	963	0.64	48,200	102
40.0	286.5	53.2	98.0	44.8	211	1096	0.73	49,100	104
37.6	283.8	52.2	83.1	30.9	216	1809	1.21	55,900	115
36.6	282.6	51.5	77.5	26.0	218	2320	1.54	60,200	123
39.7	286.3	52.4	70.5	18.1	225	3635	2.43	65,800	131
39.0	285.6	52.4	68.3	15.9	225	4330	2.90	68,800	136
61.6	308.8	53.2	117.0	63.8	224	847	0.57	54,000	108
59.3	306.7	52.5	97.5	45.0	232	1295	0.87	58,300	112
61.5	308.7	52.4	86.1	33.7	239	1942	1.30	65,400	122
60.0	307.3	52.6	83.7	31.1	239	2092	1.40	65,100	121
61.5	308.7	52.4	79.5	27.1	243	2440	1.63	66,100	122
60.0	307.3	52.4	77.6	25.2	242	2739	1.83	69,000	127
60.3	307.6	52.4	75.2	22.8	244	2988	2.00	68,100	125
59.7	307.0	52.4	74.0	21.6	244	3287	2.20	71,000	130
60.0	307.3	52.4	72.5	20.1	245	3735	2.50	75,100	137
60.3	307.6	52.4	71.5	19.1	246	3785	2.54	72,300	131
60.0	307.3	52.4	69.7	17.3	246	4283	2.87	74,100	134
100.0	338.0	52.7	115.4	62.7	256	1038	0.70	65,100	113
102.5	339.6	52.4	98.0	45.6	264	1502	1.00	68,500	116
102.0	339.0	52.1	87.0	34.9	269	2091	1.40	73,000	121
103.0	339.9	51.9	76.0	24.1	276	3187	2.13	76,800	124
102.6	339.7	51.9	70.8	18.9	278	4432	2.97	83,800	134
100.0	338.0	51.9	70.5	18.6	277	4432	2.97	82,400	133

bly differs in that an individual jacket is used for each pipe, the fluid being treated is circulated entirely in glass, and its treatment may be either under high or reduced pressure. Similarly, the heating or cooling media may be either under high or low pressure. In previous heat transfer measurements, using glass tubing and steam as the heating medium, only low pressures were employed.

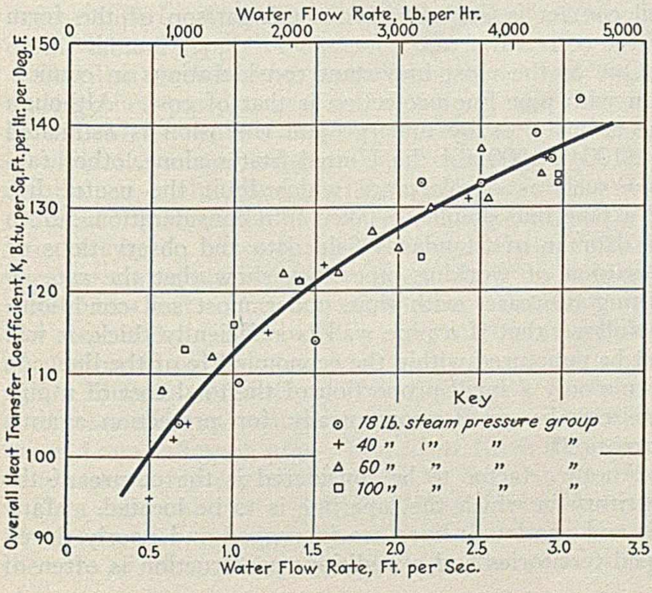
Heat transfer measurements were carried out by measuring the rise in temperature of the water passed through the tube at various steam pressures and water rates. Water rates were measured by use of a calibrated meter and the temperatures by thermometers, whose bulbs were placed in the line of flow. Steam temperatures were determined from the pressure by use of the steam tables.

The results are summarized in the accompanying tabulation. At each flow rate and steam pressure, several readings were taken and averaged. The average values are those reported which accounts for the number of significant figures shown for the several values, representing greater accuracy than was justified from a single observation. For most ready use, the curve plotted in Fig. 3 records the values given in the 7th, 8th and 10th columns.

As would be expected, heat transfer increases with both increasing mean temperature difference and increasing water flow rate. However, the scattering of the points for different steam pressures shows that the overall coefficient does not vary with changing steam pressure, but only with flow rate. Hence there are evidently no conditions operating to change the film resistance on the steam side of the heat transfer surface. It should be noted that all rates of flow were such as to give turbulence.

So far as the extension of these data to other conditions is concerned, it is necessary to consider the factors which would affect such heat transfer. In using a liquid other than water, the new film coefficient will depend on the thermal conductivity, specific heat, viscosity, density and velocity of flow. The curve of Fig. 3 shows how the overall coefficient, *K*, varies when the liquid is water and its velocity in the glass tube is varied. The table gives heat transfer values which, modified for other films, provide a guide in regard to the glass surface requirements for a given problem. To accomplish the necessary modification, the reader should refer to such discussions of principles as Badger's "Heat Transfer and Evaporation," Chapter 5, or Walker, Lewis and McAdams' "Principles of Chemical Engineering," Chapter 4. For a discussion of the effect of glass thickness, which varies with the tube diameter, see Littleton and Bates, *Chem. & Met.*, June, 1932, pp. 315-18.

Fig. 3—Variation of overall heat transfer coefficient, *K*, with flow rate. (Transfer from steam to water through a 1-in. I. D. Pyrex Brand glass tube of 0.075 in. wall thickness)



Protecting Underground Pipe Lines Against Soil Action

By K. H. LOGAN

U. S. Bureau of Standards, Washington, D. C.

For eleven years the Bureau of Standards has conducted an investigation of the relation of soils to corrosion and now it appears possible to draw some tentative conclusions as to the nature and mechanism of underground corrosion

THE PROPER DESIGN of a system to protect underground pipes from corrosion must be based upon a knowledge of the fundamental nature of the phenomena involved. Up to the present time, the reports of the investigation of the relation of soils to corrosion, undertaken in 1922 by the U.S. Bureau of Standards have been confined almost entirely to the presentation of experimental results. This has been done because it was felt that conclusions regarding the fundamental factors which cause corrosion and influence its rate of progress should not be undertaken until adequate data were at hand. It now appears to be possible to draw at least some tentative conclusions as to the nature and mechanism of underground corrosion.

Corrosion is probably always an electrochemical phenomenon, the relative influence of the various factors affecting its rate of progress depending upon the conditions under which it takes place. A metal which resists corrosion well when exposed to the atmosphere, for instance, may not perform so well under water and its performance underground may be still different. The data on underground corrosion indicate quite definitely, however, that all of the commonly used ferrous pipe materials corrode at nearly the same rate under the same soil conditions. On the other hand, both the rate of corrosion and the form and distribution of the corroded areas differ widely for different soils and appear to be characteristic of the soil.

It seems quite probable that the potential differences which cause most of the corrosion underground are the result of variations in oxygen supply at different points on the surface of the buried metal. The chemical characteristics of soils seem to have a direct affect on their corrosiveness and on their physical characteristics. These in turn affect the ability of the soil to admit oxygen and hold moisture and determine the changes in the soil as it dries or absorbs moisture. Shepard at the Bureau of Standards placed open-end insulating cylinders filled with earth on a steel sheet and observed the difference of potential between the two cylinders containing the same soil as one was allowed to dry out while the other was maintained wet; he found potential differences as high as 0.9 v. with one soil and 0.5 v. or more with several others.

The soluble salts present influence the behavior of soils as they dry out and thus affect the rate of corrosion. They also influence the conductivity which determines the amount of current that can flow under the potential differences due to differences in oxygen supply or other causes. The conductivity, therefore, may be taken as a rough indication of the corrosiveness of a given soil, at least for soils high in soluble salts.

A secondary factor which influences the rate of underground corrosion is the area of the anodic and cathodic surfaces. This is a function of the physical characteristics of the soil. The effect of variations in soil contact is evident from a comparison of the form of the corroded areas.

One of the most important considerations in connection with pipe line protection is that of cost. Although the annual loss by underground corrosion is estimated at $100,000,000 for the United States alone, other factors such as obsolescence which limit the useful life of a pipe line should be taken into consideration. Both the Bureau of Standards field data and observations of corrosion of working pipe lines show that the rate of pitting decreases with time under most soil conditions. It follows that if a pipe wall is sufficiently thick, it will not be punctured within the economic life of the line. As a rule only a small proportion of the total cost of a pipe line can be spent economically for protection against corrosion.

Another factor to be considered is the nature of the territory in which the pipe line is to be located. Many oil and gas trunk lines are in rugged and poorly developed territories and expeditious construction is often of

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Based upon article presented before Electrochemical Society, Chicago, Ill., Sept. 11.

Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

great importance. Careful handling of the pipe and coating materials is very difficult under such conditions and the protection has frequently to be applied under unfavorable weather conditions. It is highly important under such circumstances to choose a pipe covering which can be easily applied on the job, or one which is not easily injured during shipment by truck over rough roads or by rough handling when the pipe lengths are joined and placed in the trench.

As differences in local conditions along the pipe surface appears to be the primary cause of corrosion, it seems probable that a coating which serves only to maintain uniform conditions with respect to the pipe surface might be satisfactory. Thus the coating might absorb moisture and permit the diffusion of oxygen, provided the absorption or diffusion were uniform. But the rate at which either oxygen or moisture penetrates a coating depends upon the supply just outside the coating. For this reason the specified uniform condition is likely to be obtained only where the soil is constantly wet. Nevertheless, it seems probable that a uniform, continuous coating would reduce the potentials which cause corrosion and thus decrease the number of deep, isolated pits. Obviously, without a continuous coating, uniform conditions at the pipe surface cannot be maintained.

Maintaining Pipe Cathodic Prevents Corrosion

If, in addition to reducing potentials, the galvanic currents can be further reduced by increasing the resistance of the path over which they flow, a further reduction of corrosion may be effected. Bituminous coatings furnish this increased resistance to a very considerable degree.

A quite different method of preventing corrosion is to maintain the pipe cathodic with respect to the adjacent ground. This may be accomplished in several ways.

All of the principles mentioned above have been applied to a greater or less extent in the construction of protective coatings.

One way to reduce corrosion is to use a metal, the natural corrosion products of which inhibit further attack. Outstanding examples of such metals are copper-bearing steel which resists atmospheric corrosion and the so-called stainless steels which also resist some other forms of corrosion. Copper-bearing steel, however, does not appear superior when buried in soil, perhaps on account of the limited supply of oxygen.

Stainless steel has not been seriously considered for underground pipes, except under unusual conditions, on account of its relatively high cost. Its behavior in soils in which the oxygen supply is limited has not been fully determined. The Bureau of Standards is now testing different iron-chromium alloys in a wide variety of soils. One test by an oil company involving an alloy with 18 per cent chromium and 8 per cent nickel gave favorable results in a soil containing sulphates in which commercial steel and an alloy with 5 per cent chromium both showed rapid corrosion.

The Bureau of Standards has removed a number of specimens of iron containing above 26 per cent chromium from different soils. For all of these the rate of penetration of the metal exposed to the soil was low.

Data collected by the Bureau of Standards, on depths of pits for different periods, indicate that in most soils the rate of pitting is greatest for the first year or two after the pipe is buried. This can be partly accounted for by the loose condition of the earth in the trench during the early period, a condition favorable to the downward movement of oxygen and water. In a large proportion of the soils under observation the curve for the penetration-time continues downward throughout the test. This may be accounted for by a film of corrosion products on the pipe surface, or in the adjacent soil, which tends to retard further corrosion.

Self Protecting Properties of Pipe Line

In a number of localities where the soils are of limestone origin, a whitish deposit, probably calcium carbonate, has been observed on the pipes; where this deposit was observed the corrosion was negligible. This phenomenon might possibly be utilized to a greater extent by proper treatment of the soil. Increasing the self-protecting properties of a pipe line appears to be a field for profitable research.

Specimens buried by the Bureau of Standards include coatings of lead, zinc, and aluminum. Unfortunately, the number of specimens of the last-named coating is very small. The relative merits of zinc and lead differ in different soils, but, on the average, the galvanized pipe appears to be superior to the lead coated pipe. At the end of eight years the galvanized specimens in most soils retained a large percentage of the original 2-oz. coating of zinc, although many of the specimens showed rust spots or pitting. The progress of the test is not yet sufficient to indicate the effect of the base metal, the relative merits of the pure zinc and the zinc-iron alloy layer, or the extent of the cathodic protection afforded by the zinc. The effectiveness of the coating depends on soil conditions. In neutral and nearly neutral soils a 2-oz. coating should not show signs of failing for at least eight years, and the protection afforded would probably extend over a considerably longer period. In highly acid or alkali soils definite pitting of the base metal may be expected to begin within six years. Whether the zinc affords any cathodic protection after pitting begins and thereby decreases the normal rate of penetration cannot be determined from the data now available.

Zinc Coatings Appear Better Than Lead

On the average, the lead-coated specimens showed considerably higher rates of loss of weight and of penetration than the galvanized specimens in the same soils. Although lead applied by a different process may possibly afford greater protection, the fact that specimens of sheet lead show appreciable losses of weight, and in some cases considerable pitting, makes it doubtful if lead is more satisfactory than zinc as a protection for buried metal.

Comparison of the rates of corrosion of the two kinds of metal-coated specimens with those of uncoated specimens shows that both coatings reduced the corrosion during the period of the test, but did not protect the bare metal completely under many soil conditions.

A test of a few specimens of wet and dry calorized pipe gives rates of loss of weight and of penetration of the same order of magnitude as found for lead-coated pipe.

Of the two types of inorganic non-metallic coatings now seriously advocated for pipe line protection, only cement mortar has had extensive use and this use has been confined to applications so thick that the coating is rather expensive. Well made and properly applied cement mortar has proved effective. Within the last two years a coating has been developed which requires much less material and is more easily and economically applied.

Vitreous Enamel for Protection

Recently a vitreous enamel has been offered for pipe line protection. The material seems to have possibilities, but only exposure to a variety of soil conditions will tell definitely the extent of the protection such a coating can afford. In addition to withstanding soil action the coating must resist considerable rough handling and be reasonable in cost.

The most extensively used pipe coatings have bituminous bases. Originally they took the form of cutbacks or paints. These proved ineffective under severe soil conditions and were followed by hot applications of coal tar or asphalt, in some cases modified by the addition of other materials, such as lime, clay, and volcanic ash. These in turn were found to be inadequate in territories where the soil contained stones or formed hard clods. To overcome the effects of so-called soil stress, it is now common to reinforce bituminous materials with felt or woven fabric. The reinforcement reduces the number of punctures of the coating due to rough handling and clod pressure. In many cases it also results in the use of a greater amount of bitumen and consequently in a more nearly moisture-proof coating. Successive measurements of the electrical resistance of protective coatings applied to short lengths of pipe indicate that most bitumen-base coatings absorb enough moisture to reduce their resistance materially. This absorption of moisture appears largely to take place through pinholes and pores which may or may not be bridged over by a film of bitumen. The asphalt base coatings seem to absorb a certain amount of moisture through still more minute pores; when such coatings have been exposed to wet soils for considerable periods, a thin film of rust is often found beneath the coating. Whether or not this film increases with time and whether it affects the value of the coating has not been very fully determined at this time.

It appears that, other things being equal, coatings with coal tar base are, as a class, more nearly moisture-proof than those with petroleum asphalt base; on the other hand, the asphalts have some characteristics which tend to make them superior to coal tar for pipe coating. The protective value of bituminous coatings seems to lie in their ability to maintain uniform oxygen and moisture distribution at the pipe surface, thus minimizing the number and potentials of the concentration cells. The relatively high resistivity of a coating even when it has absorbed moisture, reduces materially the galvanic currents, as the resistance of the paths of these currents lies largely in the region immediately adjacent to the pipe surface. An essential feature of a pipe coating is continuity. The bitumens are essentially fluids, yielding even to low pressure if applied for long periods, and offering little resistance to the rough handling to which pipes are subjected during the construction of a line. Consequently, it is difficult to maintain continuity in bituminous coatings.

Lack of resistance to applied forces is not the only weakness of bituminous coatings. Until recently, most coatings were applied to all but small-dimensioned pipe in the field and the facilities for the work were necessarily rather crude. Under field conditions it is almost impossible to secure perfectly clean and moisture-free pipe, to maintain the melted bitumen at the optimum temperature, or to apply a continuous and uniformly thick coating. This frequently results in an imperfectly protected pipe.

As most of the corrosion loss of a bitumen-coated pipe is at points where the coating is defective, and as the area of the defective spots is small compared with the area of the line, it may prove more economical to apply supplementary protective measures to the defects than to produce a perfect coating. One way of stopping corrosion at defective points on a coated line is to maintain the line cathodic to the adjacent ground. This involves a continuous expense for electrical energy.

Cathodic Protection for Bare Pipe

It might appear that cathodic protection of a bare pipe would offer a satisfactory solution to the corrosion problem. Cathodic protection for pipe lines was proposed by scientists of the Bureau of Mines (Clement, J. K., and Walker, L. V., An electrolytic method of preventing corrosion of iron and steel, Bureau of Mines, TP 15) years ago and has been used to a very limited extent, both in the laboratory and in the field. The resistance between the pipe and remote ground varies greatly from point to point along the pipe surface, on account of variations in contact pressure, moisture, and soil characteristics. These variations have made it economically impractical to maintain all points on a bare pipe surface cathodic to the ground.

One of the reasons for the rather slow development of satisfactory pipe line protection has been the lack of satisfactory methods for determining the performance or condition of coatings. The need for methods of testings coatings has been partially supplied by recent developments.

Detection of Flaws

As a large part of the coating failures is the result of poor application, a test applicable to coatings prior to the laying of the protected pipe is needed. An apparatus to accomplish this has been developed by Clarvoe (Clarvoe, G. W., The detection of flaws in pipe line protective coatings before burial. To be published probably in *Pipe Line News*).

A large part of the annual hundred million dollars loss caused by the corrosion of pipe lines can be prevented by the proper application of suitable protection confined to those sections of lines that traverse corrosive soils. The present trends in pipe line protection are the development of effective methods for determining where protection is needed, the construction of bituminous coatings to resist soil stress, and the design of apparatus for the detecting of flaws and failures in coatings.

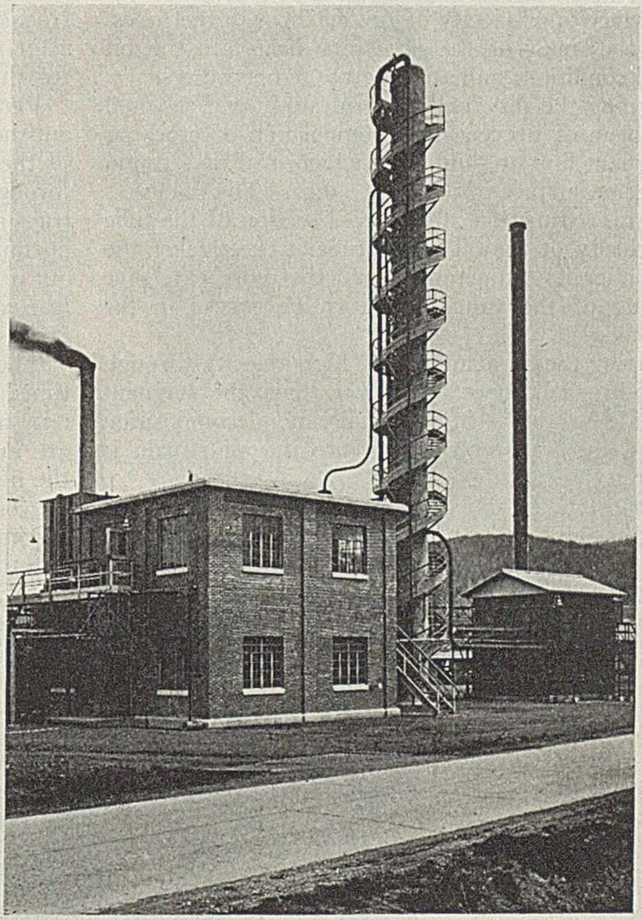
New Distillation Unit Increases Yield of LUBRICATING OILS

By PAUL TRUESDELL
Universal Oil Products Co., Chicago, Ill.

INCREASING SEVERITY in the conditions under which lubricating oil must perform its duties in the cylinders of new high-speed motor cars has had a stimulating effect upon the developments during the past months, to make use of solvents as refining agents for motor lubricants.

Various solvent processes have been devised and put into operation which have received a good deal of publicity in the technical press and in trade journals. Among the solvents used in processes which have been developed to commercial status are dichlorethyl ether, phenol, and nitrobenzene. Sulphur dioxide has been used more or less as a solvent in the manufacture of lubricating oil for a long time.

While this development in the use of solvents has been going on, at least one company has been studying more closely than ever before the physical and chemical laws which govern heat-transfer, distillation and fractionation. The results of these studies are embodied in a distillation unit recently completed at the plant of the Bradford Oil Refining Co.



Primary distillation unit of Bradford Refining Company

By the better understanding and application of thermodynamic laws to the distillation and fractionation of Pennsylvania crude, it has been possible to make products with characteristics which are not usually found in products made from Pennsylvania or any other crude. These products command a substantial premium above the market.

The unit was designed with the object in view of manufacturing products which meet two particular specifications that are most important in the lubrication of the modern engine. These are: (1) very low carbon content, and (2) very high flash point. The products from this unit meet these requirements. On the steam-refined stock the Conradson carbon test averages about 2.4 per cent and on the finished bright stock 1.35 to 1.40 per cent; the flash point, taken by the Pensky-Martens closed cup, averages 545 deg. F., which is unusually high. This low carbon content and high flash point are the properties which give the products their superior market value.

The unit consists primarily of a pipe still and a flash-fractionating tower, with the necessary condensers, pumps, and other auxiliaries. It was built by Leader Industries, Inc., and was designed by Dr. E. H. Leslie, head of Leader's technical staff. The distinctive quality of the products and the high yield are attributed chiefly to three main factors.

1. Special new design of the pipe still.
2. Special new design of the combination flash and fractionating column and its trays, bubble caps, and stripping section.
3. Carefully controlled use of steam in the tower.

The pipe still is designed to take full advantage of the latest knowledge of the laws of thermodynamics governing transmission of heat through the walls of steel tubes into a flowing stream of oil. Compared with standard practice in pipe-still design the tubes are small; they are so arranged that they receive the full effect of the direct radiation from the gases of combustion as well as from the incandescent walls and floor of the furnace.

Design of Pipe Still

Careful calculations have been made of the areas of heating surface and velocity of the oil through the tubes, to permit the input of the necessary heat into the oil under mild conditions and at moderate temperatures.

In designing the pipe still, careful study was devoted to the problem of preventing decomposition or cracking of the stagnant film or skin of oil which is always found on the interior surface of a furnace tube. The thickness of this film is a function of the cross section of the tube and the velocity of the oil in the tube. The thicker the film the higher its temperature, and the more extensive the cracking of the valuable lubricating stocks in the crude.

By pumping the oil at unusually high velocity through the relatively small tubes in the new unit, the stagnant film is made so thin that practically no decomposition occurs, and the transfer of heat into the oil stream is speeded up.

Above the topmost bubble tray is a layer of vitreous tile, which has an important effect in the operation of the unit. In the bottom of the tower is the flash chamber with the stripping section.

As shown in accompanying illustrations the bubble tower is completely encircled, from top to bottom, by a spiral steel stairway. This arrangement, which does not add substantially to the cost of the installation, makes it very easy to work on any part of the tower; it also gives easy access to all of the bubble trays, the stripping section, and any other part of the tower.

Fifteen hundred barrels of crude a day is now being handled by the unit. The hot oil and vapor are discharged from the pipe still at about 670 deg. F., into the flash chamber where it flashes to about a 20 per cent bottom. The unvaporized portion of the oil remains in the bottom of the flash chamber as steam refined stock, while the vapors pass upward through the bubble trays. By spraying reflux material into the top the tower is trimmed to the desired temperature.

With the present arrangement one overhead and five side streams and the bottoms are taken off the tower. These are:

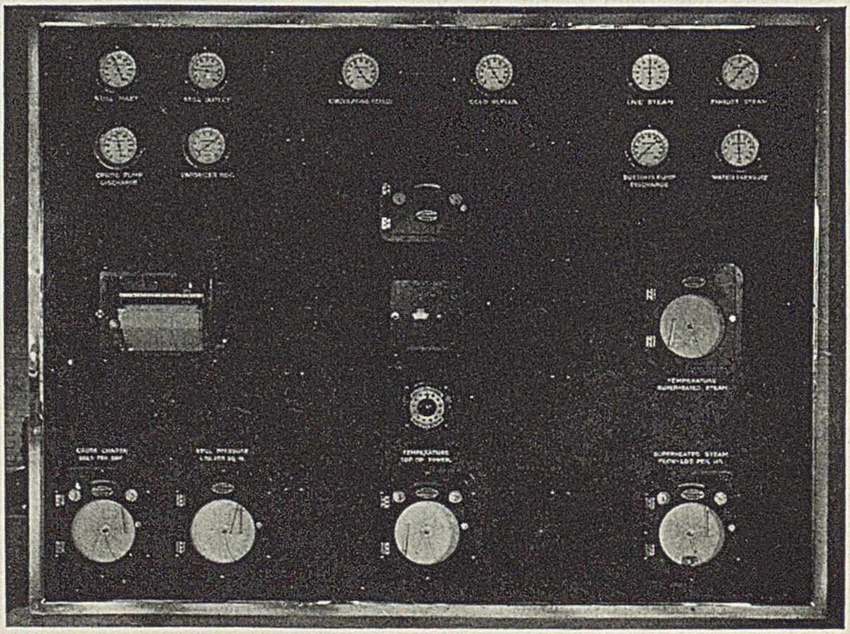
1. Gasoline of about 300 end point.
2. Naphtha of 300-400 deg. F. boiling range.
3. Kerosene.
4. Fuel oil.
5. Light wax distillate.
6. Heavy wax distillate.
7. Steam refined stock.

The stripper in the base of flash chamber consists of seven specially designed bubble trays. Open steam is introduced into the base of the tower. This steam is continuously boiling off the lighter fractions in the heavier ends of the oil as they percolate down through the bubble trays, and the vapors are continuously carried up through the tower. Thus, a constant stripping of the stock is going on.

This exceedingly efficient stripping out of the lighter fractions, together with the avoidance of cracking and after-formation of low-boiling material, is responsible for the unusually high flash point of the cylinder stock.

Very sharp separation of products is obtained throughout the tower. This is accomplished largely by the design of the bubble trays and caps. The openings in the caps through which the vapors escape into the liquid on the trays are long, narrow orifices. The constriction of these openings imparts velocity to the vapors, which come out of the slots with such force that they whip the liquid into a foam, thereby effecting very intimate and thorough contact between vapors and liquid.

The tower is so designed and the flow of oil is so timed that oil and vapors are held in the system for only about 15 min. In some other units oil and vapors are in process as long as two to three hours. Thus, in the new unit, cracking of the products is almost entirely prevented, because the time factor is too short to permit decomposition reactions even though the cracking temperature may be reached.



Centralized controls for distillation unit

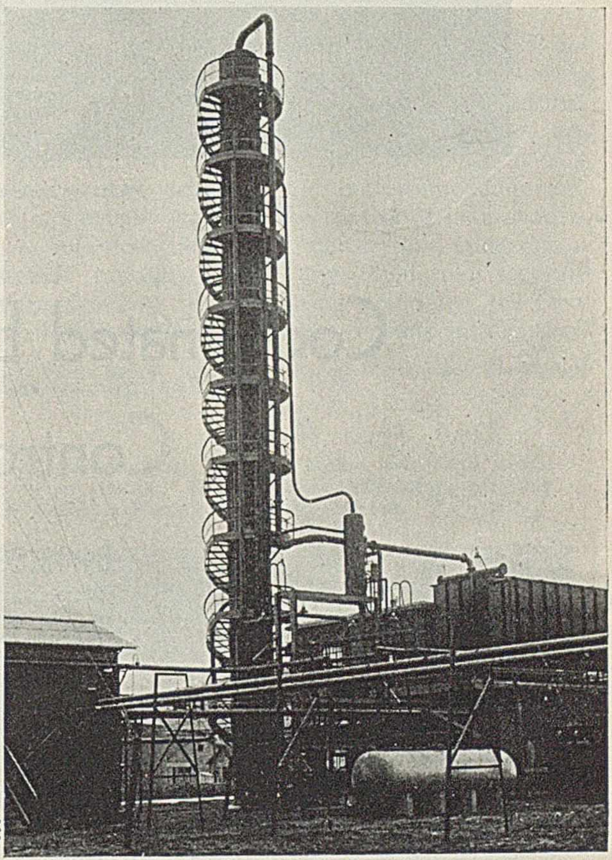
Another feature of this unit is the "salt drum" for the removal of salt water from the crude. While salt drums are used to a considerable extent in the Mid-Continent and other fields, they have not generally been considered necessary in the refining of Pennsylvania oils. However, in this particular unit it has proved its value by preventing corrosion in the fractionating system and by reducing the carbon residue of the stock.

Crude on the way to the pipe still is pumped into the salt drum, which is simply a horizontal tank built to stand high pressure. The oil is heated in the drum to about 215 deg. F. under 220 lb. pressure. Salt water and silt drop to the bottom and are drawn off, while the cleansed crude proceeds through the system.

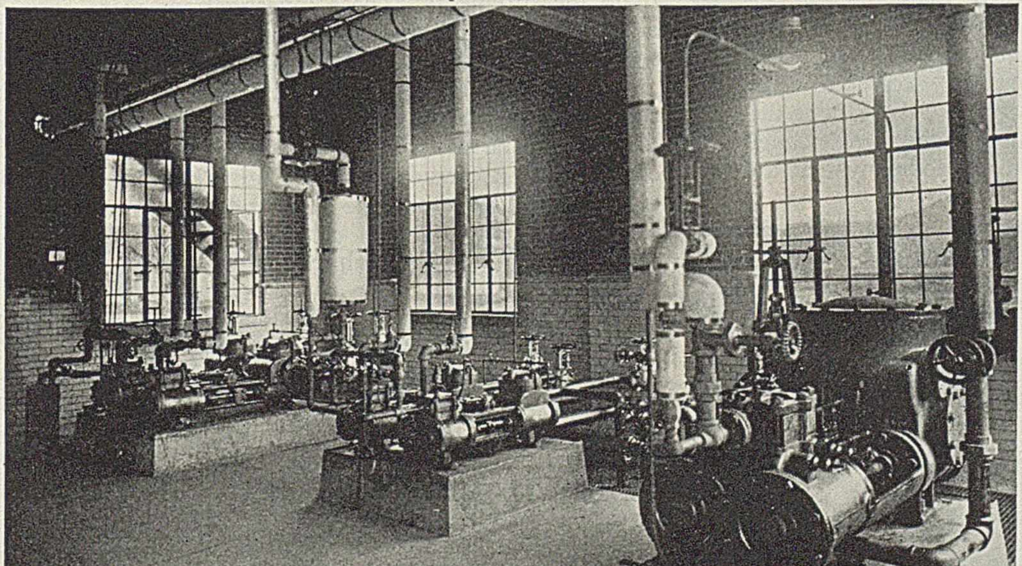
The extremely low carbon residue of the finished steam-refined and bright stocks is attributed to the removal of the salt water from the crude and the prevention of cracking. It has been found that without this treatment the salt water does not only tend to deposit carbon-forming constituents in the cylinder stock, but it also seems to catalyze the formation of carbon in the Conradson test.

Gasoline comes from the tower as a finished product, requiring no further treatment, while the naphtha and kerosene are acid-treated. The fuel oil is a premium fuel for domestic or special industrial purposes because the efficient fractionation has stripped it of the heavier ends and sticky constituents which tend to clog burner tips and plug minute orifices. The steam refined stock is diluted, chilled, centrifuged, and distilled to remove the naphtha, all in the conventional manner, and then contact filtered for color.

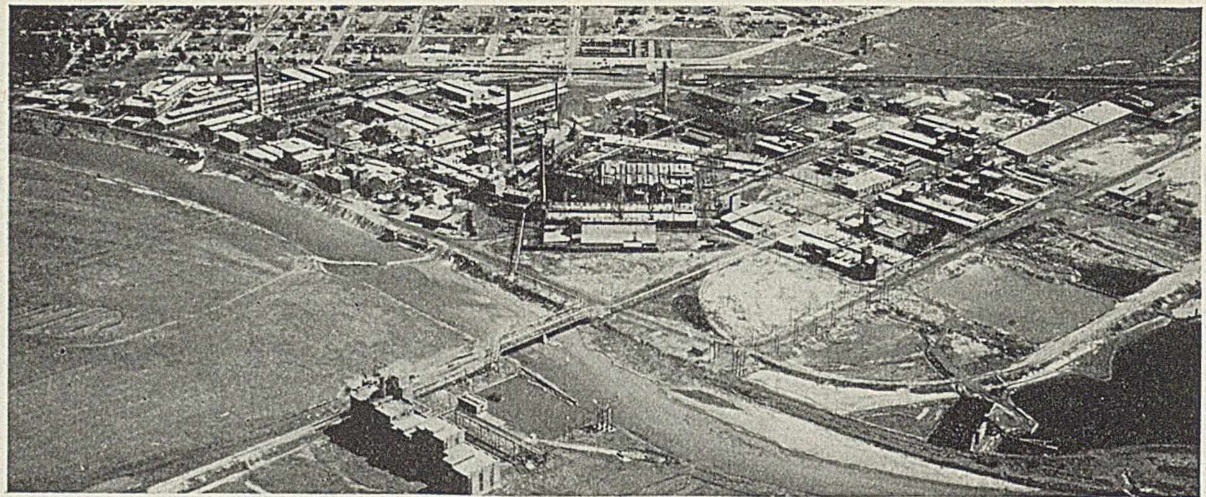
At present the wax distillate is sold to other refiners for finishing into viscous and non-viscous neutrals. It commands a substantial premium above the market price on account of the crystalline character of the wax and the consequent easy pressibility of the distillate, and also because of the large yield of high quality neutral. The yields obtained in this unit, and the characteristics of the products, check to a nicety those obtained in the most careful laboratory tests. In other words, the unit is recovering all the valuable constituents of the crude. The unit possesses great flexibility and may be used, without any change in the apparatus itself, to meet rapidly changing market conditions. Operating conditions, such as temperature, reflux rate, time factor, and steam input can be varied over a wide range.



Corner of pump house at refinery



Bubble tower with special steel stairway for facilitating repairs on all parts of the unit



Plant of Dow Chemical Co., Midland, Mich.

Coordinated Effort Solves Dow's Control Problems

By THEODORE R. OLIVE
Associate Editor, Chem. & Met.

ASK ANY Dow Chemical man what his company's outstanding depression achievement was and he will probably tell you, as one of them told me when I recently visited Midland: "It wasn't a chemical process or a chemical engineering discovery, although there were several of those. Rather, it was the continued development and coordination of a versatile and capable organization, which not only was maintained during the depression, but was actually increased." Others may say, with the writer, that this is but a manifestation of Dow custom, and that the real, current accomplishment has been in measurement and control; but there, none the less, in a few words you have the tradition of cooperative achievement and the pride in the company that are the essence of the Dow spirit.

And there is another phase of this spirit, largely the result of the remoteness of the plant from markets and sources of fuel and equipment. This is a consciousness of self-sufficiency, and a will to create what is needed without dependence on others. It is this factor that is responsible for Dow's machine shop, enormous for a chemical plant; and responsible for the fact that Dow engineers are never completely satisfied with their plant equipment and processes, but always on the search for something better. This was parent to the philosophy you find throughout the plant. Not: "How much will a certain development cost?" but "How long will it take?"

It was one of these dissatisfactions with the best that was currently available that led, directly or indirectly, to four out of six of the company's chemical and engineering achievements of the depression period. The dissatisfaction was with the methods then known for rapid and extremely accurate analysis of chemical solutions; and the result, the development under John J. Grebe of new and very efficient electrometric analyzers depending upon oxidation potentials, metallic pH electrodes and conductivity measurements. These investigations were carried on independent of anything being done outside, much of which they anticipated.

Today the company employs more than a hundred of these electrometric analyzers. The greatest number are used in routine analysis, but many are employed with recorders and a considerable number with complete controllers of a type later to be discussed.

What the Achievements Were

Two of the company's depression achievements cannot be traced to electrometric analysis. These were the development of fabricating methods for magnesium Dowmetal alloys, together with markets for the product; and the widespread use in its own plant, and sale of, the Dowtherm heat transfer fluids.

Two more of the achievements depend on electrometric control from start to finish. One is Dr. C. W. Jones' process for the recovery of iodine from natural waters and oil well brines, which made the United States iodine-independent and resulted in the formation of

Dow's subsidiary, the Jones Chemical Co., at Long Beach, Calif. The other is the sea-water bromine project at Kure Beach near Wilmington, N. C. The plant now under construction is to be operated by the Ethyl Dow Chemical Co., owned jointly by the Dow Chemical Co. and by the Ethyl Gasoline Corp. Dow developed the process and is building the plant for the new corporation. Here, with a raw material carrying only about as much bromine as is present in the sewer waste at Midland, was a real problem for automatic electrometric control. Nothing could be done, it was found, without the control. It is probable that, without it, nothing ever could have been done.

First Aid for Oil Wells

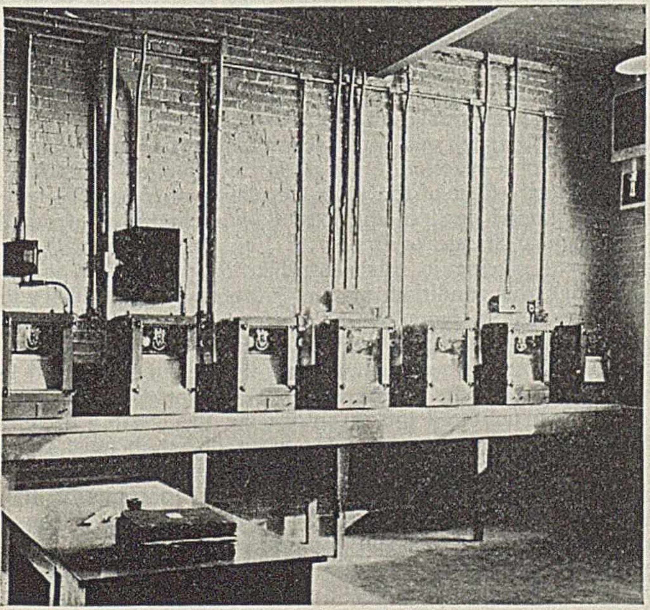
In the last two achievements, electrometric analysis played in the one case an indirect, and in the other a frequent and necessary part. As a result of the electrometric study of impurities in waste brine at Midland, and of a similar study of the action of inhibited HCl on metals, a most unexpected series of happenings occurred. The first was a successful attempt to rejuvenate some of the company's exhausted brine wells by means of inhibited HCl, which left the casings untouched, but attacked the calcareous binder in the sandstone formation. When these results came to the attention of engineers of the Pure Oil Co., the latter sought to try the method with oil wells. Further experiments again showed success, and a technique was evolved which included "blanketing" the well bottom to prevent the acid from striking down; methods for dissolving paraffin and other plugging materials; and methods for speeding the rejuvenation by applying pressure to the acid. Dowell Inc., the service subsidiary which handles these processes, is covering the country's oilfields with its special trains and tank trucks. A record of over 1,500 wells treated, most of them with astonishing results, attests to the vigor of this child which electrometric analysis begot.

Then, lastly, there is the automatic control achievement, not entirely one of the depression, for its roots go deeper than that, but nevertheless completed and an outstanding success since 1929. Mr. Grebe and his associates have described its principles very completely in a recent paper,* and it is by drawing heavily on this source, and on conversations with Mr. Grebe, that the present author has sought below to set forth his own, simplified version of this fundamental development. Although many commercial controllers do some of the things the Dow control accomplishes, and one (since 1930) has done most of them, the Dow analysis of the problem has put control science in such shape that the advances of the next few years should easily eclipse all those that are past.

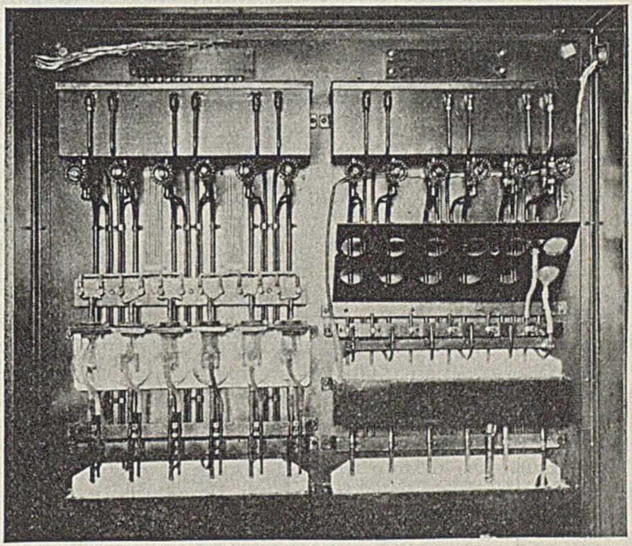
Primary to the automatic control problem was the development of the methods, already cited, for electrometric analysis; for it was to control processes so analyzed that the automatic equipment was evolved. That does not mean, however, that the new methods were useful only with electrometric detecting and indicating equipment, for they are equally suited to the control of temperature, pressure, fluid flow, liquid level, density and other chemical process variables. With any rapid and accurate means for detecting and measuring a variable, the Dow equipment will translate the measurements into control.

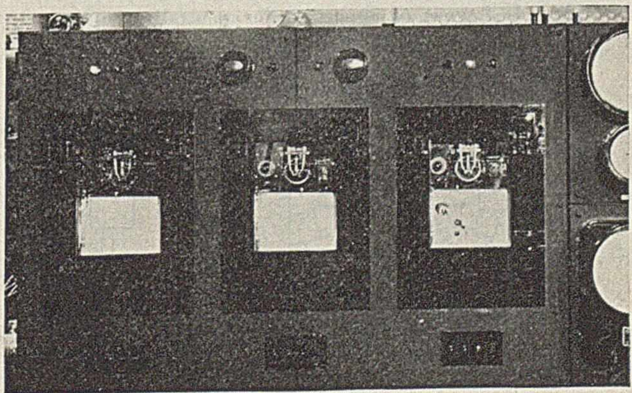
*John J. Grebe, Ray H. Boundy and Robert W. Cermak, "The Control of Chemical Processes." A.I.Ch.E., June, 1933.

Bromine sewer loss recorders and temperature, pH and oxidation controllers



Above: Conductivity cells for boiler water and steam carry-over; Below: Boiler water purification, pH and softening control instruments





Before we come to the control proper, there is a good deal of fundamental reasoning to be followed:

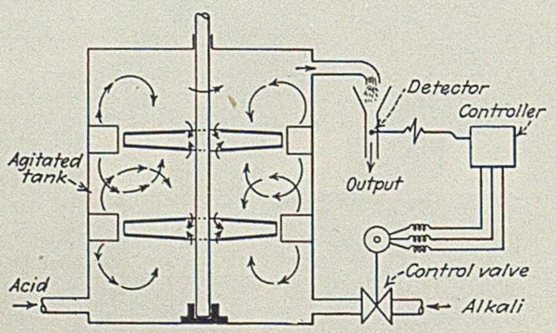
First, a definition or two: the Dow principles are intended primarily for the control of continuous processes, as distinguished from the much simpler batch processes. Any controller that will hold the correct conditions in the former can easily maintain the latter. In any continuous process there is some instantaneous *demand* which may vary widely from minute to minute. In order to maintain the optimum conditions in the process, this demand must be matched accurately, and as quickly as possible after any change, by a change in the *supply*. Measuring the demand, then, and following with the regulated supply is the function of the controller.

At the start of the Dow investigation an analysis of existing controller types was made to see in what manner these instruments matched supply to demand. There were, it appeared, two fundamental types: (1) Controllers, generally called floating or throttling, which attempted at all times to equalize supply and demand; and (2) other instruments, usually known as "on and off," which controlled all or a part of the supply between maximum and minimum rate limits so that the average of the supply, but not its instantaneous values, would equal the demand. The first type was again divided into two: one capable of reaching a supply rate exactly equal to the demand under all conditions; and the other suffering from an inherent "drooping characteristic" which, for every demand rate except one, would arrive at an equilibrium below or above (for higher or lower demand) the desired equilibrium or control point. For many purposes this shift was too small to be of consequence, but it was none the less a bar to perfect action with this type of controller.

The "on and off" controller, it was found, possessed this drooping characteristic to a much smaller degree—usually negligible—but with increasing deviation from some single demand rate for which the instrument was set, the fluctuations in the controlled conditions increased widely in magnitude. While the average result would remain very nearly at the set point, the instantaneous values, except in systems with large inventories and low lag, were usually too diverse for delicate control. Hence this controller too, for most of the Dow processes, was found to be below the necessary standard of accuracy and attention was turned toward the first of the floating controllers, the one which would permit no shift in the control point, no matter how the demand might vary.

In the development of a controller of this sort, the first step was to analyze the "lags" met in continuous processing, for it is the lag in the controller's "knowledge" of what is happening to the demand that causes most of the difficulty. If the lag is sufficiently small, there is almost no problem, for the supply can follow every demand change without hesitation. However, despite the best efforts of equipment designers, it is rare that the lag can be brought to negligible proportions and it is rare that the controller can "know" of a change until some fairly considerable time after it has happened.

Fig. 1—Layout of apparatus for neutralization control problem



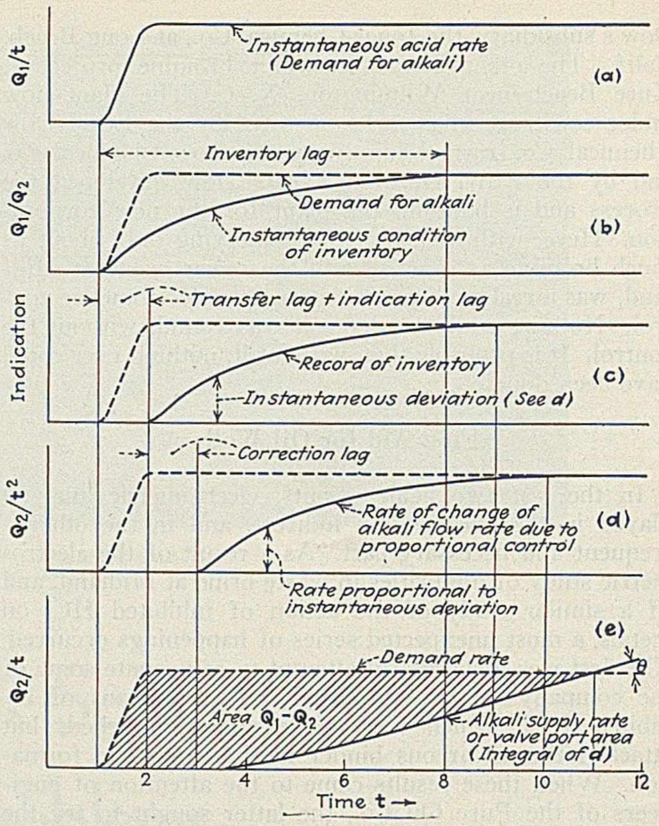


Fig. 2—Curves showing the rate of action and result of a proportional controller

For purposes of illustration, assume a continuous neutralization in which an acid is fed continuously into an agitated tank (Fig. 1) and there neutralized by a controlled flow of alkali. The "independent variable" is the number of acid units that enter per unit of time—*i.e.*, the rate of acid flow and its concentration—and the "dependent variable," the number of alkali units required to effect neutralization. The lags include the following:

1. *Capacity or Inventory Lag*—This represents the time required for a new demand to become established. In every control problem there is some capacity or inertia which cannot be entirely eliminated. Capacity is inherent, of course, in batch processes; in continuous processes, more or less of it is necessary for various practical reasons. For example, since controllers cannot follow changes instantly it is usually necessary to have a storage capacity in which to average the inaccuracies in supply brought about by demand variations. Capacity is often required to give time for the completion of a reaction, or to permit completion of mixing. The practical effect of the inventory lag is to delay the controller's "knowledge" of the extent of a change in demand when such a change occurs as in Fig. 2*a*. Even with instantaneous mixing in this neutralization problem, it is obvious that the condition of the inventory (Fig. 2*b*) will change gradually from the old, balanced state to the new unbalanced state and that the time required to reach the state determined by the new demand will be the time required to displace the contents of the tank. Where wide flow variations are encountered the inventory lag itself will vary and special control means must often be used, but in most problems it is sufficient to assume that this lag remains constant for all variations in demand. It is on this assumption that "rate" or "anticipating" controllers are based.

2. *Transfer Lag*—In addition to the time required to establish the new demand condition, the detecting element will often require an appreciable time to measure the condition.

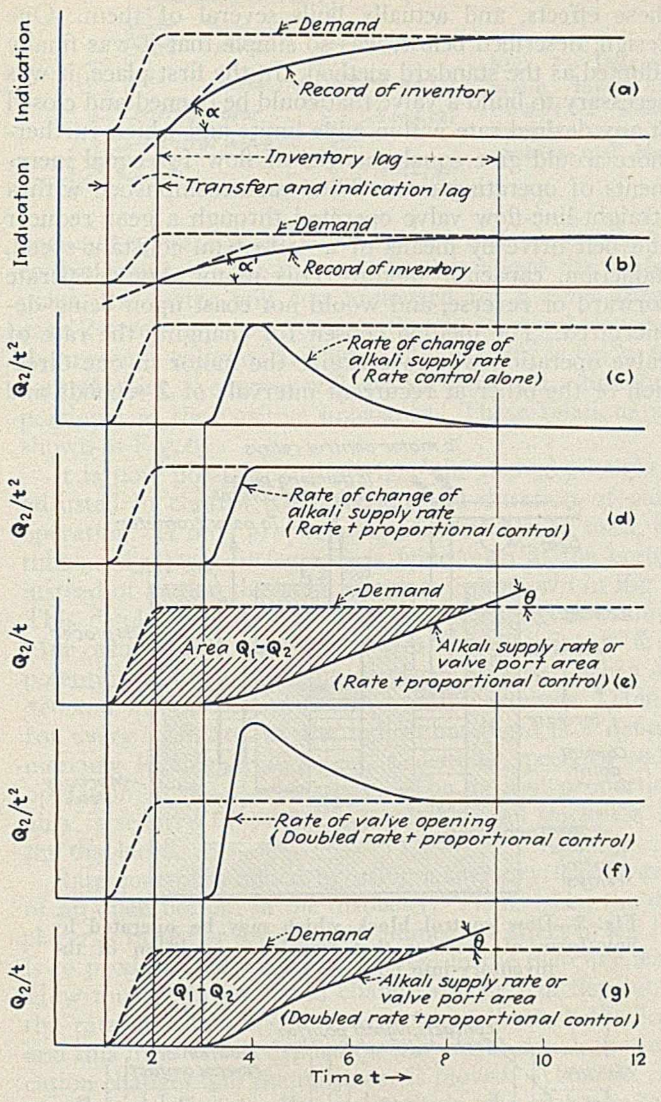


Fig. 3—Rate of action and effect of combined rate and proportional controllers

Part of this time may be in bringing the material to the detector (as in imperfect mixing or where the detector is separated from the tank by a sample line) or part in the inertia of the detector itself (as in the heat capacity of a thermometer bulb and its protective casing). This last may also be considered as part of the capacity lag.

3. *Indication Lag*—Even when the detecting element has responded to the new condition, an appreciable time is usually required for the instrument to deflect to the new position.

4. *Correction Lag*—Further time is needed to convert the measurement into a change in the rate of supply.

These four principal lags appear in every problem. One or more of them may be too small to cause trouble, but their possible effect must always be taken into consideration. Obviously each one should be made as small as possible.

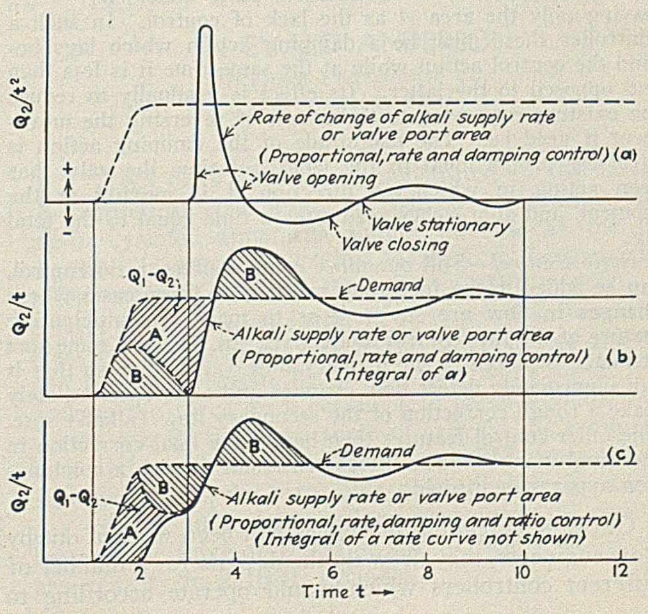
Now that we understand the lags involved, we can analyze the four control principles which can be used to circumvent them. For the sake of having a name by which each of these can be known, they will be referred to as (1) proportional control; (2) rate control; (3) damping control; and (4) ratio control.

Proportional Control—The first requirement of a controller is that it shall have a definite and invariable control point that cannot shift with each change in demand. When it has become stabilized, the controller must, under all circumstances, pass a supply equal to the new demand. Such a definite control point will be attained if the instrument is able to change the rate of flow through the valve or other device controlling the supply at a rate which is proportional to the instantaneous deviation. Without lag it is obvious that such a controller would follow the demand exactly and instantly. For many purposes, such a control is entirely satisfactory, although any considerable lag will cause it to "hunt" (oscillate either side of the control point) unduly. Fig. 2 shows the effect of this "proportional" control. Here Q_1 represents the demand rate and Q_2 the supply rate, for example, in gallons per minute. In curve (*a*) there is a sudden increase in demand. Over a period of time equal to the inventory lag this alters the inventory as in (*b*). After a lag equal to the sum of the transfer and indication lags, the beginning of this change is noted by the instrument as in (*c*). The control valve then operates at a rate proportional to the changing conditions as in (*d*), but after still another lag, the "correction lag." The operation of the valve is such that its rate of opening (increase in port area) is proportional at each instance to the deviation noted at the corresponding instant by the detecting mechanism. The result of this action is portrayed in curve (*e*), which is a plot of the port area (or alkali supply rate) at any instant. Mathematically, this is a rate-of-supply curve obtained by integrating curve (*d*), which is a rate-of-change-of-a-rate-of-supply curve. The shaded area, $Q_1 - Q_2$, is the area of lack of control. Mathematically, it represents the difference between the definite integrals of the rate of demand and rate of supply curves between $t = 1$ and $t = 11$. It is therefore, the quantity by which Q_2 fails to equal Q_1 during this interval.

One further factor of importance appears from curve (*e*). This is the rate (θ) at which the supply is increasing at the instant when it equals the demand. The larger the angle of θ, the greater will be the hunting tendency of the controller, since the more it will overshoot before the trend can be reversed by the effect of the accelerated alkali flow rate. It will be noted, of course, that the curves will not be exactly as shown since the effect of the changed alkali flow rate will begin to make itself felt at the control valve at about $t = 5$.

Rate Control — Another sort of control can now be analyzed which, added to the proportional control, will "short-circuit" the inventory lag, and materially reduce the area of lack of control without increasing the tendency of the controller to hunt. First, however, we shall consider it separately. It was mentioned above that in most cases the

Fig. 4—Effect of adding damping control (and in c, ratio control also) to the type of controller of Fig. 3f



transfer lag can be assumed to remain constant. The effect of this will be seen from a consideration of Figs. 3*a* and *b*, where it is apparent that the slope (rate of change) of the inventory record at the beginning of the change is an indication of the point to which the inventory will go at $t = 9$. Hence the change can be anticipated long before it has been established. It is only necessary to operate the control valve at a rate proportional to the rate of change of the indication (α or α'); in other words, to open the valve rapidly when the deviation is increasing rapidly (α), or to open it more slowly when the rate of deviation is slower (α'). If a rate-operated controller of this type were operated alone the effect would be as in Fig. 3*c*. Very rapid opening of the valve would result but without the addition of proportional control, the final opening of the valve would not bear any necessary relation to the new value of the demand. Consequently, a superposition of the two controls is needed, giving a rate of valve opening as in curve (*d*), which is the result of adding together the two rates shown in Fig. 2*d* and Fig. 3*c*. If we integrate the effect of the combined controls, *i.e.*, of a controller which changes its valve port area at a rate proportional to both the *deviation* and the *rate of deviation*, the resulting control appears as in Fig. 3*e*, in which the area of lack of control, $Q_1 - Q_2$, has been much reduced without increasing angle θ, the hunting tendency.

Combining a proportional and rate controller, then, eliminates the effect of the inventory lag and decreases the area of lack of control. $Q_1 - Q_2$ can be still further reduced by increasing the effect of the rate controller relative to the proportional control, as in Fig. 3*f* where the rate of valve opening is greater than that indicated by the new demand. This magnified sensitivity of the rate control may be as much as 10 to 1. The resultant curve shows $Q_1 - Q_2$ still further reduced, without any increase in the hunting tendency, θ. However, some tendency to hunt still exists and the addition of a third control effect to damp out the oscillations is often desirable.

Damping Control—What is needed, obviously, is a controller which will operate at a very high rate at the start, so as to offset the supply deficiency as far as possible, but which will then, automatically and without waiting for any indication of the result of the increased supply, cut down the valve opening to a point nearly equal to the new demand. Such a controller could not counteract all of the deficiency, $Q_1 - Q_2$, since some of the inventory would have passed from the mixing tank, but it should be able to supply an extra slug of alkali, thus bringing the remaining inventory to the right value, and immediately reduce the caustic rate to the new demand. The rate of action of such a control is as in Fig. 4*a* and the integrated effect as in (*b*) where the "overshot" area, *B*, in considerable parts offsets $Q_1 - Q_2$, leaving only the area *A* as the lack of control. In such a controller there must be a damping action which lags behind the control action while at the same time it is less than and opposed to the latter. Its effect is gradually to reduce the existing rate, even to the extent of reversing the movement if need be. The magnitude of the damping action is inversely proportional to the length of time the valve has been acting in whichever direction it is moving at the moment, and approaches zero after a time equal to the total lag.

Ratio Control—Still one more control effect, ratio control, can be added to the foregoing methods in those cases where changes in flow are so great as to make the anticipating feature of the rate control ineffective. In this case some sort of meter is placed in the primary flow (acid) line so that it can immediately detect flow changes and almost immediately make a rough correction of the secondary flow (alkali) rate. The other control features then handle the final correction in the usual manner. The integrated result of such a combination appears in Fig. 4*c*.

Once the foregoing principles had been worked out by Dow engineers, they drew up the designs for a number of different controllers which would operate according to these effects, and actually built several of them. One design, described below, was so simple that it was finally adopted as the standard method. In the first place, it was necessary to build a valve that could be opened and closed at any desired rate within wide limits and which furthermore would give equal changes of flow for equal increments of operating time. This was accomplished with a straight-line-flow valve operated through a gear reducer and belt drive by means of a 450-r.p.m. constant-speed, induction, capacitor motor. This motor would operate forward or reverse, and would not coast upon being de-energized. The method chosen for changing the rate of valve operation was to energize the motor in one direction or the other at recurrent intervals of 2 seconds and

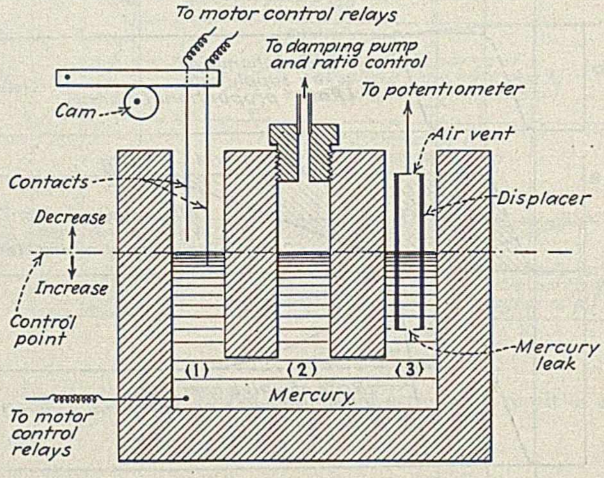


Fig. 5—Dow control block which may be operated by any form of detector that translates condition of the inventory into position of the mechanism

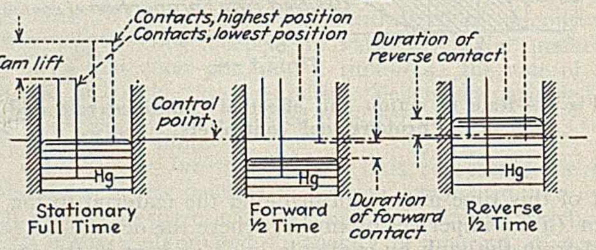


Fig. 6—Illustrating the effect of mercury height on the duration and direction of valve operation

to maintain the contact during each interval for a period proportional to the desired rate of operation.

The contact device which translated the indications of the instrument into control impulses of suitable length and direction was a non-conducting W tube containing mercury (Fig. 5). By adjustment of the mercury level in leg (1) the valve could be made to remain stationary or to run forward or backward at any rate from zero to full time. This was accomplished as follows: Note the two contact points in leg (1). Their difference in length is very slightly less than their vertical travel due to the rotation of the cam. The cam cycle is 2 seconds, which determines the contact intervals referred to above. Now, these contacts are so connected with a pair of relays, one of which operates the motor forward, and the other reverse, that when both contacts are out of the mercury, the motor runs ahead. When both contacts are in the mercury, the motor runs in reverse. When the long contact is in and the short contact out of the mercury the motor

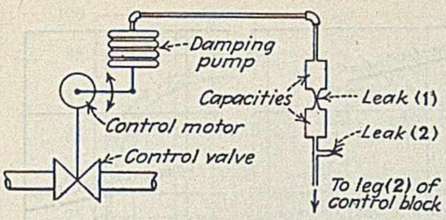


Fig. 7 — Diagrammatic layout of control motor, damping pump, capacities and leaks

does not operate at all, a condition which obtains at the control point. If the mercury level is above the control point, the motor will run backward for a time during each 2 seconds proportional to the negative unbalance of the mercury column; and when the mercury is below the control point, the motor will run forward, for a time proportional to the positive unbalance. These relations are shown in Fig. 6.

It is now possible to show how the mercury height is adjusted to control the direction and duration of valve operation. If only proportional control is to be used, the tubular displacer in leg (3) is wide open at the bottom instead of having the small mercury leak shown in Fig. 5. This displacer is connected to the indicating mechanism (for which Dow preferably uses a null point L & N potentiometer) so that the displacer is raised when the demand increases, and lowered as it decreases. Hence, for every deviation of the indication, there is a definite mercury level and, in effect, a definite speed of valve operation, forward or reverse. The desired proportionality is secured by selecting a suitable wall thickness for the displacer.

Rate control is added by using a mercury leak instead of an open bottom in the displacer. Then, when the displacer is raised or lowered, the immediate effect in leg (1) is to produce a much larger change in the mercury level. How much this increased change will be will depend on the rate at which the mercury passes through the leak, and this in turn will depend on the rate at which the indication changes and the displacer is moved. After the displacer has stopped at a new position, the mercury level will gradually equalize, inside and outside the tube, and the resultant level in leg (1) will be the same as that due to the proportional control alone.

For still greater lag than can be handled by the preceding methods, damping control is necessary. This is accomplished by connecting an air pump (piston or bellows) as in Fig. 7 to the middle leg of the control block and operating it from the stem of the control valve or from something that has a proportional movement, such as a Selsyn motor. The bellows is so operated that the air pressure or vacuum produced by its movement opposes the tendency of the rate and proportional controls. For example, when the demand is increasing and the mercury level in leg (1) is below the control point, the damping pump produces a pressure in leg (2) which will tend to raise the mercury in leg (1) and thus decrease the rate of valve opening. In order that the damping effect may lag behind the movements of the valve, two capacities with an adjustable leak between them (leak 1) are introduced into the line connecting the pump to leg (2) of the control block. A second leak (leak 2) is provided to neutralize the effect of the damping control after a period of time equal to about twice the time lag.

When ratio control is to be added, the method may be very similar to that of the damping control, or it may make use of a venturi through which the primary material is passed and into the throat of which the secondary material is fed. A greater primary flow, provided the venturi is correctly proportioned, will automatically increase the rate of secondary flow in the proper ratio. By the other method, the flow meter in the primary liquid line operates a pump to create a vacuum with increasing flow or a pressure with decreasing flow in leg (2) of the control block. The change in level that results in leg (1) thus causes the control to operate to correct the supply roughly before the indication has had time to change. The pressure or vacuum is relieved through leak (2) after a time, as in the case of the damping control.

These control effects then are used by Dow whenever automatic control is needed. Where slow changes only take place in a low-lag system, the proportional control alone would usually be satisfactory, but it is never used alone since the addition of the mercury leak in the displacer involves no increased expense or complexity. Many applications with small lags could be handled with a combination of proportional and rate control, but it has been found more economical to add also the third effect, damping control, to each installation.

Thus, in every case, as soon as a change is detected, the valve quickly moves to anticipate the new condition. Before the effect of the change can be detected, the valve rate is decreased and its movement usually reversed to bring it near to the opening required by the new conditions. As this is accomplished practically without hunting, and with an invariable equilibrium or control point, this instrument has solved numerous difficult problems, many of which were impossible with other means. Today the company looks forward to the eventual feasibility of using the new commercial instruments now being developed, but in doing so, it will not lose sight of the outstanding contributions that Dow engineers have made to this evolution.

Effect of Tube Diameter in Cyclonic Dust Collectors

By EVALD ANDERSON
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IT HAS OFTEN been demonstrated on the basis of theoretical considerations that the separating effect in cyclonic apparatus should increase as the tube diameter is decreased. Thus, Marcel A. Lissman, in a recent article (*Chem. & Met.,* Oct., 1930, p. 630), calculates the separation factor in cyclones of various diameters for an initial velocity in the outer vortex of 60 ft. per second, wherein he shows that while in a 10-ft. cyclone the force on a certain size particle in the outer vortex was 22 times the force of gravity, the same force in a cyclone, 4 in. in diameter, was 672 times gravity. In other words, the force on a given particle for a given gas velocity in a 4-in. cyclone was about 30 times as large as the force on the same size particle with the same gas velocity in a 10-ft. cyclone.

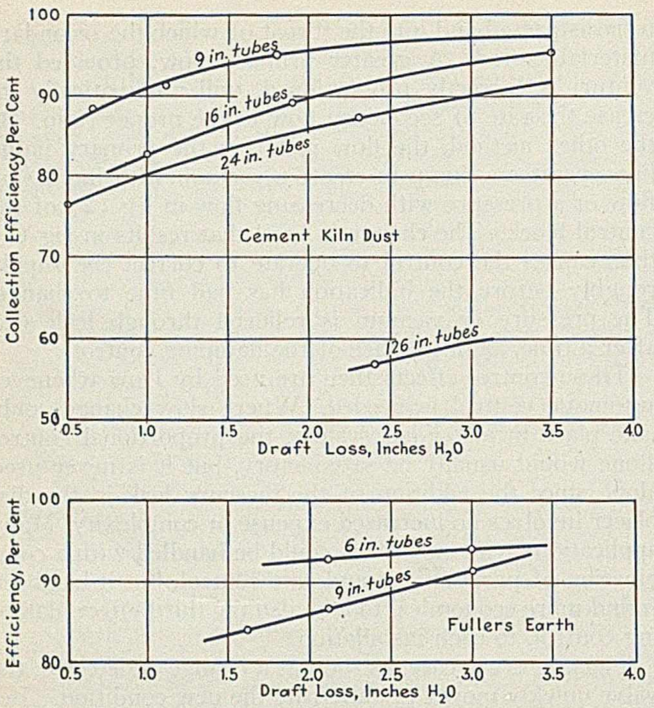

Fig. 1—Collection efficiencies of cyclonic collectors with various sized tubes on cement dust and fullers earth

Within the past year, while continuing the experimental work in connection with the further development of Multiclones, we have accumulated considerable actual experimental data bearing on this subject. Efficiency tests have been made on cyclones and Multiclones with various tube diameters, operating on different types of gases. The curves of Fig. 1 show some of the results obtained in such tests. The first set of curves represents tests made with Multiclones with 9-in., 16-in. and 24-in. diameter tubes on cement kiln gases, operating with varying pressure drops or draft losses; and also shows a single test on a 126-in. cyclone operating on the same type of gases. The second set of curves shows the results of tests with 6-in. and 9-in. Multiclones on gases containing fullers earth.

It is evident from these data that the theoretical conclusions are fully justified. A study of the cement kiln dust curves, for example, at a draft loss of 2.5 in. gives the following efficiencies:

Diameter, Inches	Per cent Efficiency
9	96.7
16	92.5
24	88.2
126	57.5

It is interesting to note that if one coordinates the above efficiencies with the diameter of the separating tubes, the first three points, which represent the smaller sizes, all lie close to a straight line drawn through the point representing zero diameter and 100 per cent efficiency. There can naturally be no general relationship of that kind with collection efficiencies in cyclonic apparatus, since this type of collection apparatus is essentially a classifier tending to collect all the particles above a certain size and reject all below that size. Increased collection efficiency, therefore, here means collection of finer particles, and a given collection efficiency merely means that this proportion of the total suspended solids was above a given particle size.

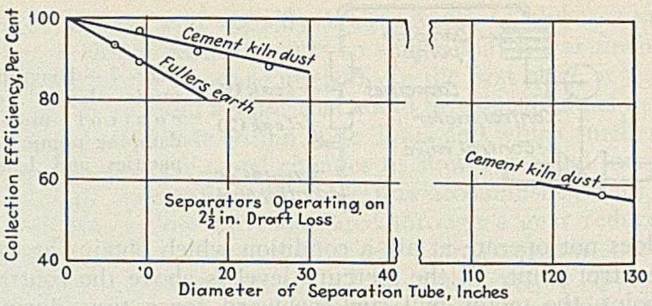

Fig. 2—Correlation of tube diameters and separating efficiencies, showing straight-line relationships

Consequently, in cases where the suspended material is a mixture of two largely different size particles as, for example, coarse dust and true fume, centrifugal apparatus of the correct diameter will collect practically 100 per cent of the dust, and moderate decrease in size will then not change the collection efficiency appreciably.

In many practical installations, however, the particle size distribution is often fairly uniform from dust particles 100 microns or more in diameter to fume-like particles less than 5 microns, and here the above-mentioned coordination may be applicable.

The three curves of Fig. 2 have been constructed in that manner in that straight lines have been drawn from the 100 per cent efficiency-zero diameter point through the series of points representing the efficiencies at 2.5 inches draft loss for the different size tubes. Except for the point representing the data with the large cyclone on cement kiln gases, these points do lie in the neighborhood of such straight lines.

The approximate relation may, therefore, often serve to give a rough idea of how changes in the diameter of centrifugal separating tubes may affect the separating efficiencies.

Comparison of Methanol and Other Anti-Freeze Agents

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MARKETING of methanol for anti-freeze has been handicapped materially by lack of knowledge, and also somewhat by the unsavory reputation of this chemical, most of which seems wholly unwarranted by the facts. For example, popular belief as to the toxicity of methanol greatly exaggerates this feature, and often leads to difficulties in selling that are not at all justified. On the other hand, some manufacturers of methanol from wood distillation have in the past marketed such a low grade product as to deserve criticism.

Because of the difficulty experienced with improperly

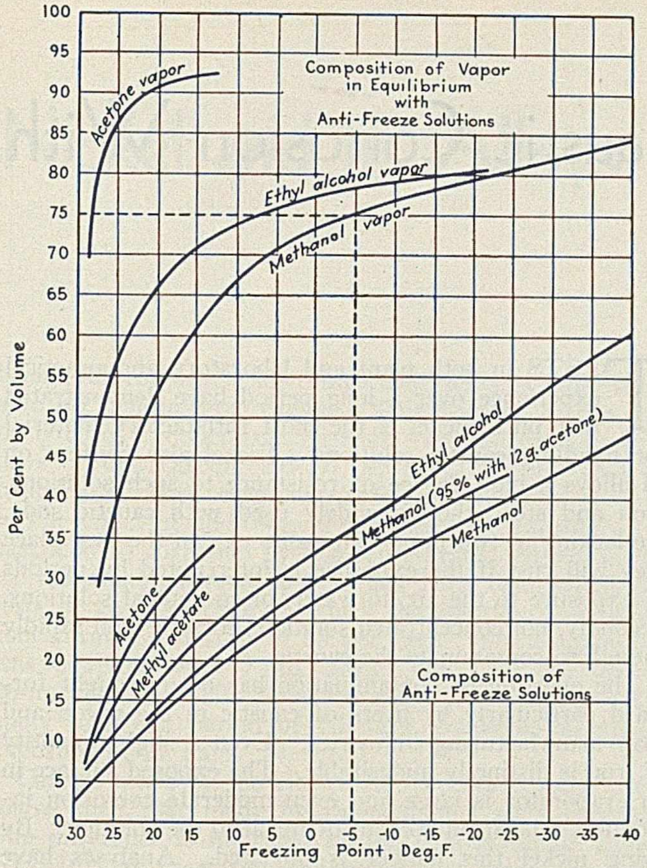
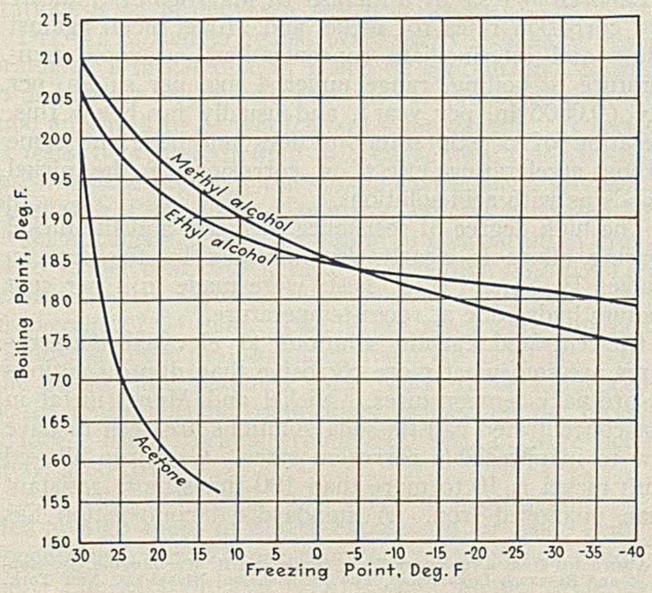


Fig. 1—Composition of anti-freeze solutions and vapor composition in equilibrium with such solutions versus freezing points

refined methanol sold as an anti-freeze, a group of the technical men in the hardwood distillation industry has worked out proposed new specifications. Under the auspices of the Wood Chemical Institute, Inc., the accompanying specifications have been proposed; and it is anticipated that they will generally be followed by those marketing this product for anti-freeze purposes.

Fig. 2—Boiling point of anti-freeze solutions versus freezing points



Proposed Specification for Methanol

Anti-freeze stock before adding diluting water or safeguards (color, etc.)

1. Tralles: Not less than 97 per cent
2. Color: Water white
3. Miscibility: Miscible with water in all proportions without turbidity
4. Acetone: Not more than 2 per cent by volume in the 97 per cent grade
5. Esters: Not more than 0.5 per cent calculated as methyl acetate
6. Allyl: Not less than 80 c.c. as determined by bromine absorption
7. Analysis to be according to methods prescribed by the Bureau of Industrial Alcohol for denaturing-grade methanol.

The value of methanol as an anti-freeze, of course, depends upon lowering of the freezing point of water in the motor cooling system. The permanence of the protection accorded depends on the slowness of evaporation of the methanol during operation of the machine. The accompanying charts bring out the important relationship of methanol to ethyl alcohol, and to acetone, the common impurity in wood methanol. The effect of methyl acetate is also indicated.

Properties of Anti-Freeze Solutions

At the top of the chart of Fig. 1 is shown the composition of the vapor in equilibrium with solutions of different freezing points. Obviously, the greater this vapor concentration the greater is the tendency to evaporate. The lower curves of this chart show the composition of anti-freeze mixtures required to provide a given lowering of the freezing point. A methanol solution for a —5 deg. freezing point, for example, will contain 30 per cent methanol, while the vapor in equilibrium with this solution at the boiling point will contain 75 per cent methanol. The three curves of Fig. 2 show the boiling points of the various anti-freeze mixtures.

It will be noted that for all concentrations up to that giving about —25 deg. F. as a freezing point, the vapor concentration of methanol is less than that of ethyl alcohol for a given amount of protection. However, with concentrations below that affording —5 deg. F. freezing point, the actual boiling point of the methyl alcohol is higher. At greater concentrations the ethyl alcohol has the higher boiling point.

These data have been prepared by the author from the best available sources in the technical literature. They offer a basis for proper instructions to be followed in making up anti-freeze mixtures with methanol. The data are, of course, equally applicable to other chemical-engineering operations using aqueous solutions of the three chemicals.

Checking Caustic Corrosion With

Table I—Corrosion Tests on Various Metals In 4 Per Cent Sodium Hydroxide

	Corrosion Rate—Mdd*				
	Quiet Immersion	Air-Agitated Solution	Continuous Alternate Immersion	Intermittent Alternate Immersion	Spray Test
Nickel	.3	.3	3.1	3.7	.3
Monel metal	1.0	1.3	.4	.9	<.1
Copper-nickel (54-45)	.5	.6	.4	.4	<.1
Copper-nickel (70-29, 1% tin)	.2	.3	.9	.5	<.1
Copper	13.6	20.5	29.2	14.3	2.0
Admiralty brass	12.0	33.5	54	24	1.2
Zinc	90	175	1,850	450	2.8
Lead	75	370	5,500	2,200	9.5
Aluminum	26,000	26,000	7,900	1,300	13

*"Mdd" signifies milligrams per square decimeter per day. In the case of nickel 1 mdd corresponds to 0.00016 in. penetration per year of continuous exposure, 100 mdd corresponds to 0.016 in. per year penetration. Conversion of mdd to inch per year is as follows, d representing the density of the metal:

$$Mdd \times \frac{0.001437}{d} = \text{inch per year}$$

Table II—Effect of Nickel Content Upon Corrosion Rate Of Cast Iron in Hot Caustic Soda

Nickel Content—per Cent	Corrosion Rate—Mdd
0	366
0	458
0	429
3.5	235
5	247
15	152
20	17
20*	31
30	2

*Specimen carried 2 per cent chromium.

Table III—Comparison of Corrosion in Electrolytic And Ammonia Soda Caustic

Analysis					Corrosion Rate—Mdd	
Nickel	Chromium	Copper	Silicon	Total Carbon	Electrolytic Caustic	Ammonia Soda Caustic
28.60	1.71	....	1.30	2.87	90	0
28.37	....	....	1.50	2.72	94	0.5
14.26	2.39	6.08	1.62	3.15	112	...
19.40	....	....	1.42	3.15	123	1.0
19.02	2.90	....	1.22	3.18	145	0
20.53	....	....	1.25	2.91	161	1.0
Pure nickel					24	...

Table IV—Corrosion of Cast Iron in Hot Caustic Potash

Cast Iron		
Silicon Content	Nickel Content	Corrosion Rate—Mdd
3.19	....	2,400
0.67	....	1,000
....	1.05	800
....	3.17	400
....	5.70	155

Table V—Laboratory Tests With Various Metals Exposed To High Caustic Concentrations

Metal	Corrosion Rate Mdd
Silver	39
Nickel	320-440*
Nickel-chromium (80-20)	550
Cast iron, 30% nickel	680
Cast iron, 20% nickel	760
Monel metal	1,600
Cast iron	6,660
Stainless steel (18-8)	9,890
Stainless steel (18.5% chromium)	15,050

*Five specimens of nickel, each from a different melt, were tested.

Tests in both plant and laboratory and practical experience over a long period have demonstrated that pure nickel is the most satisfactory material for handling caustic solutions. Nickel also confers on its alloys a high degree of resistance to such solutions. Iron and steel, though widely used with caustic soda, are lacking in two important respects. In the first place they will rust if the exposure is interrupted by periods of exposure to the air, to water, or to neutral solutions. Secondly, hot concentrated solutions corrode iron rapidly enough to contaminate the caustic.

The question of contamination has been brought forward particularly by users of caustic in the rayon and soap manufacturing industries. Even a slight quantity of iron is distinctly undesirable. The exposed surface in an evaporator is large and even moderate corrosion introduces a harmful content of metal to the solution. By using nickel this danger is obviated. Analyses have shown that 50 per cent caustic soda, concentrated in evaporators fully equipped with nickel tubes and tube sheets, usually runs under 0.00002 per cent nickel. The largest quantity found in any sample of finished 50 per cent caustic soda has been 0.00008 per cent. Development of nickel-clad steel has made possible the construction of evaporators having all exposed surfaces of pure nickel.

The corrosion resistance of nickel, nickel alloys, and other metals to caustic soda solutions up to 75 per cent strength has been studied by various means. Some tests have been made by exposing samples within equipment in actual operation, while other tests have been of strictly laboratory character.

Laboratory tests by a number of investigators indicate that corrosion rates for nickel and Monel metal against dilute and intermediate concentrations, at room temperature to boiling, range under 4 mg. per sq.dm. per day (0.0006 in. per year), and usually far below this. Aeration of caustic solutions does not have the same strong accelerating effect on corrosion of the nickel metals as with acid solutions.

The high degree of resistance of nickel and the nickel bearing alloys is clearly demonstrated by the data in Tables I[1], X, and XI. Tests were made in 4 per cent sodium hydroxide at room temperature.

Concentrated caustic solutions at elevated temperatures are somewhat more corrosive than dilute solutions at ordinary temperatures. Nickel and Monel metal in hot concentrated caustic soda solutions are seen to have low to inappreciable corrosion rates. Cast iron alloyed with nickel is 10 to more than 100 times more resistant than unalloyed iron. A standardized composition has

Abstracted from a report by H. E. Searle and R. Worthington, Development and Research Department, The International Nickel Co., New York.

Nickel and Its Alloys

been evolved, which, all things considered is most suitable for concentrated caustic. This material carries the designation "copper-free Ni-resist" and analyzes as follows: Total carbon, 2.6-3.0 per cent; silicon, 0.8-1.4; nickel, 18.0-22.0; chromium, 2.0-4.0 per cent.

The effect of additions of nickel on the resistance of cast iron to corrosion by hot concentrated caustic made by the ammonia-soda process has been determined by tests in an evaporator in which the solution was being concentrated from 50 to 65 per cent. The evaporator was supplied with 75-lb. steam and operated under 26-in. vacuum. The corrosion rates given in Table II apply to a test period of 54 days, following previous exposure of 27 days.

Caustic made by the electrolytic process is more corrosive than that made by the ammonia soda process. The difference is indicated by the data given in Table III. In both cases the specimens were exposed within actual plant evaporators. In the case of electrolytic caustic, the liquor was being concentrated from 37 to 50 per cent, at 248 deg. F. (out temperature) and 16-in. vacuum. The exposure period was 51 days. In the tests on ammonia soda caustic the duration was 92 days, the final concentration 50 per cent.

Cast irons exposed 15½ hours in a concentrating caustic potash solution having originally a concentration of 25 per cent at 446 deg. F. were corroded at rates as given in Table IV[2].

Recently considerable attention has been given to the feasibility of producing anhydrous caustic in vacuum evaporators heated with diphenyl or mercury. The behavior of nickel in exposure to these very high concentrations is suggested by a few test results.

Dr. W. L. Badger[3] constructed an experimental evaporator of a nickel tube in which he concentrated caustic to as high as 98 per cent NaOH. He reported that the tube appeared to be unaffected by the caustic. A series of tests, over periods of 3 to 8 days, were made by the research laboratory of the Columbia Chemical Division, Pittsburgh Plate Glass Company, on the corrosion of nickel in caustic solutions ranging in concentration from 74 to 98 per cent caustic near their boiling points. The results showed corrosion rates from 0 to 194 mdd, with an average of 34 mdd. The higher rates were obtained within the concentration range from 80 to 90 per cent. The actual rates obtained were found to be influenced by the nature of the oxide films formed on the nickel surface. Films formed around 800 deg. F. were definitely protective.

Some laboratory tests have been made using rods rotated at high speed in a bath exposed to air while being concentrated from 75 per cent to the anhydrous condition. The aeration and high velocity factors were in excess of what might be expected in practice; this probably accentuated the corrosion.

Of the cast iron compositions, the "copper-free Ni-resist" is recommended for very high caustic concentrations.

Tests have been made on nickel specimens submerged in molten technical caustic at about 810 deg. F., with the results given below. The specimens in the one week test were previously exposed for 24 hr. The degree of protection of the corrosion product film is indicated by the difference in corrosion rates (Table VI) between the 24 hr. and the one week tests.

Tests have been reported[4] comparing the resistance of nickel, iron, and copper to fused caustic soda both with and without an addition of 5 per cent sodium peroxide. In each case 5 grams of the substance was fused for

Table VI—Tests on Nickel Submerged in Molten Caustic

Duration	Number of Specimens	Average Corrosion Rate Mdd
24 hours	4	333
7 days	8	31

Table VII—Influence of Peroxide on the Corrosive Action of Caustic Soda

	Temperature °C.	Metal Pickup, Grams Nickel	Iron	Copper
Caustic soda	350	....	.4	strongly attacked
	360	.01-.02	....	
	400	trace-.02	.426	
	450	.01-.02	.2-.3	
	500	.005-.015	.2-.3	
	550	....	.4-.48	
	600	....	.13-.3	
Caustic soda with 5% sodium peroxide	350	.0024	.024	trace
	400	.0135	.025	.013
	450	.0131	.11	.08

Table VIII—Resistance of Nickel-Cast Iron to Fused Caustic

Analysis: Total Carbon	Silicon	Nickel	Corrosion Rate Mdd
3.48	2.02	....	5,979
3.45	1.86	1.34	2,591
3.45	2.07	3.54	2,118
2.99	1.93	15.12	299

Table IX—Effect of Water Content Upon the Corrosiveness Of Fused Caustic

Analysis: Total Carbon	Silicon	Nickel	Corrosion Rate—Mdd: 4-Hr. Test	24-Hr. Test
3.48	2.02	.....	822	620
3.35	.58	.....	866	729
3.30	.57	2.91	707	619
2.73	.60	16.66	283	101

Table X—Corrosion Tests With Exposures for 380-384 Hr. at 179 Deg. F., Concentrating Caustic Soda From 30 to 50 Per Cent

	Corrosion Rate Mdd
Pure nickel	0.6
Monel metal	1.2
Copper-nickel-zinc (75-20-5)	3.1
Copper	14
Steel	20
Cast iron	35
Stainless steel (14% chromium)	180
Stainless steel (18-8)	1,700

Table XI—Laboratory Tests With Exposures for 4½-5½ Hr. of 185-196 Deg. F., Concentrating Caustic Soda From 32 to 50 Per Cent

	Corrosion rate—Mdd: Maximum	Minimum	Average
Monel metal	3.5	0.0	1.2
Nickel	9.3	6.3	8.3
Copper-nickel-zinc (75-20-5)	24	14	14
Steel	3,700	3,200	3,500

4 hr. in a laboratory crucible of the given metal, and the fusion analyzed for metal pickup.

Additions of nickel to cast iron have a quite definite beneficial effect on resistance to fused caustic. Tests have been made to bring out this comparison quantitatively. Specimens of cast iron with and without nickel, as given in Table VIII, were suspended in fused, sulphur-free caustic soda at 675 deg. F., about 70 deg. F. above the melting point of the substance. The specimens were in motion throughout the four-hour run.

It has been noticed that the corrosiveness of fused caustic is to some extent dependent on the quantity of water in the caustic. In the tests that gave the results listed in Table VIII, 5-10 per cent water was added to the caustic before the heat was applied, to duplicate humidity conditions where atmospheric moisture is absorbed by the caustic. Other tests were made, without the presence of this moisture, resulting in the lower average rates of Table IX.

The conclusion is obvious that the action on the high nickel iron decreases with time to a greater extent than on the other cast irons.

In fused caustic, as in concentrated caustic solutions, "copper-free Ni-resist" with 18-22 per cent nickel and 2-4 per cent chromium is recommended as the most suitable composition for cast iron.

In the final processing of caustic soda by fusion it is customary to mix in a small quantity of flowers of sulphur for the purpose of improving the color of the caustic and precipitating heavy metals. This tends to offset the advantage of high nickel content and use of nickel in caustic pot irons has therefore been limited to small percentages.

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[1]Fuller, T.S. et al: "Report of Committee B-3 on Corrosion of Non-Ferrous Alloys." Proc. Am. Soc. Testing Mat. 27-I (1927). Rawdon, H. S. and E. C. Groesbeck: "Effect of the Testing Method on the Determination of Corrosion Resistance." Bur. of Standards Techn. Paper No. 367 (1928)

[2]Kotzsche, P. and E. Piwowarsky: "On the Corrosion and Rusting of Unalloyed and Alloyed Cast Iron." Arch. Eisenhüttenwesen 5 (1928).

[3]Badger, W. L., G. C. Monrad and H. W. Diamond: "Evaporation of Caustic Soda to High Concentrations by Means of Diphenyl Vapors." *Ind. Eng. Chem.*, 22 (1930).

[4]Wallace, T. and A. Fleck: "Some Properties of Fused Sodium Hydroxide." *J. Chem. Soc.*, 119 (1921).

Bacteria Destroy Pipe Line In California

By T. D. BECKWITH and P. F. BOVARD

Los Angeles and San Francisco, Calif., respectively

COMMERCIAL PREPARATIONS used for sealing joints in water mains may be susceptible to breakdown under certain conditions, if sulphur is present in their composition. The cause of loss of sulphur is biologic in character. Certain thiobacilli bring about oxidation of sulphur to sulphuric acid, which is converted into a sulphate. This portion of the sequence is synthetic and the organisms responsible are aerobic. In turn, resultant sulphates are broken down by the activity of certain other forms which are anaerobic in habit. Hydrogen sulphide therefore appears and will combine with iron if available to produce the black iron sulphide. These bacterial organisms seemingly are relatively resistant to germicides usually utilized for water treatment in concentrations practiced. Such were the conclusions drawn from the following investigation of a water line in California.

An industrial organization sank a series of wells at a location several miles from its plant for the purpose of obtaining a water supply. Some of the water was stored in a reservoir whose sides were of soil. The water was pumped through a cast iron pipe line, but in spite of the distance with attendant opportunities for heat losses, the water was still distinctly warm when received there. It was chlorinated at a station near the wells. Joints in the line were sealed by means of a commercial preparation containing a large proportion of sulphur. When melted, with care not to overheat, this material produces a joint, well sealed and resistant to failure under relatively low water pressures.

Investigation indicated that sulphur oxidizing bacteria had been transported from a location at or closely adjacent to the source of supply and that they had been carried by the water through the miles of pipe line to the plant. Likewise it was indicated that they were present at intervening points, that is, within the pipe line itself, also that unusual treatment procedures based upon application of chlorine are not potent to eradicate these bacteria.

Another series of experiments proved that the sulphur in this pipe-joint sealing compound is attacked actively by sulphur oxidizing bacteria. Changing the physical condition does not alter its susceptibility to attack.

If one considers carefully the facts, he might well prophesy that the pipe line in question would fail if given a proper period of time necessary for bacterial growth. The passage of time indicated that such a forecast was well justified in as much as several months after the line had been placed in use evidences of line losses commenced to appear. Soil about the joints began to become moist and this moisture was attended by a degree of blackening and by a definite odor of hydrogen sulphide. Pumpage losses increased constantly until they became altogether too large for continued efficient operation. Examination of certain of these leaking joints showed the sealing compound to be porous.

A third experiment demonstrated thiobacterial organisms in the disintegrated joint cement and that the function of the bacteria during their life cycle is to alter sulphur by oxidation processes.

Sulphuric acid produced changed over to sulphates which are unstable. Anaerobes break down these substances. The byproduct of their metabolic activity is hydrogen sulphide and when iron is present as usually it is in nature, this gas combines with that element to form black iron sulphide. *Microspora desulphuricans* is present in nearly all black muds and because of the hydrogen sulphide with which it is always surrounded, it is extremely resistant to the effects of ordinary germicides such as chlorine. Conditions therefore had become favorable to the growth of this microspora which in turn attacked the sulphates. This resulted in evolution of hydrogen sulphide. The appearance of this gas in these instances therefore was distinct evidence of progressive disintegration of the sulphur containing commercial joint sealing compound.

Safety Engineers Discuss Repair of Stainless Equipment

THE TWENTY-SECOND annual convention of the National Safety Council was held in Chicago, Oct. 2-6. At the meetings of the Chemical Section several papers of particular interest to the chemical engineers were given. Among the subjects discussed were: inspection and repair of stainless steel equipment, application of automatic and remote control to chemical operations, and safety in synthetic ammonia plants.

Inspection and repair of stainless steel equipment was the subject of the paper by C. E. Plummer, Robert W. Hunt Co., Chicago. The author stated that selecting the proper materials for construction of stainless steel equipment is one of the most important duties of the engineer.

The chemical composition is of the utmost importance, if the desired properties for a particular service are to be attained. Because the effect of too high or too low a temperature would more than likely prove detrimental to the ultimate efficient and safe use of any equipment, it is essential after the rolling or working of the alloy into the proper shapes, that the heat treatment of such shapes be carefully conducted. The only means to determine whether or not proper heat treatment has been given is for the inspector actually to witness this operation and check both the time and the temperature specified and used.

The fabrication of the raw materials, be it into tanks, pressure vessels, pumps, or soda fountains, is likewise a process susceptible to inspection as a means of guaranteeing safe and satisfactory performance.

If the stainless steel is to be fabricated into tanks or other equipment of similar nature, requiring fittings of parts and their subsequent riveting or welding, then it will be the inspector's duty to check the laying out of the component parts, in order to make sure they fit absolutely, that edges are planed and not bevel-sheared, that rivet holes (if such be necessary) are sub-drilled and reamed, rather than punched.

If the equipment is to be welded, additional precautions are necessary. Corrosion or embrittlement must be guarded against, and in addition, the type of parent metal will be an important factor in the particular method used. If the metallic arc welding method is used, reverse polarity is recommended, the work being the negative and the welding rod the positive. Before welding, the inspector should be sure that the parts to be welded are clean. The selection of the welding rod is important; coated rods are recommended for metallic arc welding, and uncoated for oxy-acetylene welding.

A few of the most common causes of failures of stainless steel equipment are as follows:

- Improper selection of stainless steels;
- Improper inspection during fabrication;
- Failure to heat treat after welding;
- The selection of too thin a gage of material;
- Galvanic action resulting from dissimilar metals in contact in an electrolyte; and
- Mechanical failures.

In the repair of stainless steel equipment careful consideration should be given to the selection of the method of welding, both from the standpoint of corrosion resistance and economy. The proper location of the weld is important. The weld should be so placed that any breathing action or movement of equipment in any way will not place the stresses at the weld, but at the place where the material is less liable to failure. Provided the proper stainless steel is selected for a definite application, and that proper precautions are observed during fabrication, there will be little need for repair of stainless steel equipment.

Commercial scale high pressure operations are less than 15 yr. old in this country, but in this comparatively short time a very adequate technique of design and operation has been developed, E. C. Curtis, assistant general superintendent of the Niagara plant of the Mathieson Alkali Works, told the group. The more than ordinarily hazardous potentialities of these processes have made considerations of safety paramount in the minds of both designing engineers and operating staffs. The search for better materials of construction and methods of operation has been intensive. There is no better evidence of the success of their efforts than the relatively few serious accidents in plants of this character.

Safety in Synthetic Ammonia Plants

Curtis limited his discussion to safety in synthetic ammonia plants because it is in that industry that all his own experience had been gained. His viewpoint is essentially that of the operating man, but he touched on some points of design where such reference was pertinent.

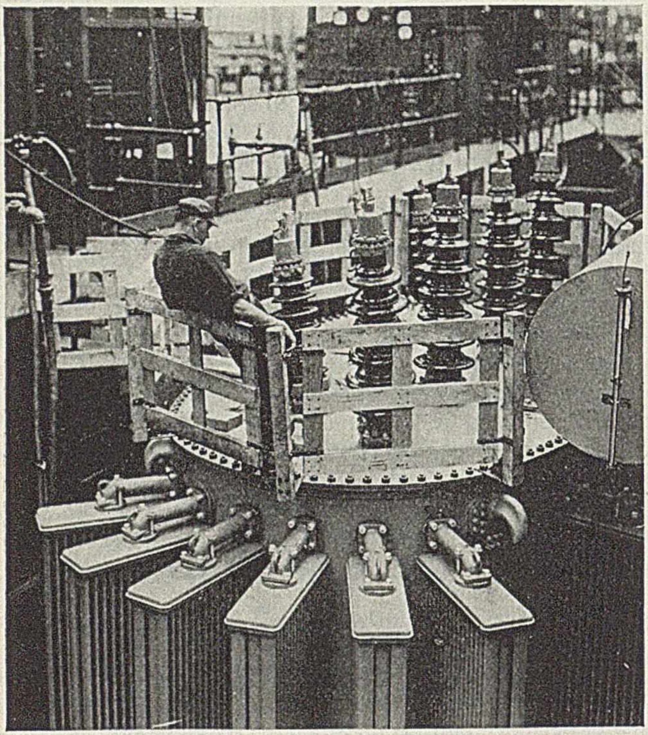
A process utilizing large quantities of hydrogen and nitrogen at pressures ranging from 1,500 to 15,000 lb. and at a temperature from 30 deg. below zero to over 600 deg. C. requires very little engineering imagination to appreciate its hazardous possibilities. And the transportation of hydrogen in low pressure pipe lines and its storage give rise to some special hazards. Hydrogen-air mixtures are explosive between 4 per cent and 75 per cent hydrogen. Wherever a flammable gas is handled there is always a possibility of admixture with air in pipe lines or holders.

The lines and equipment containing hydrogen when worked on require certain precautions before the work starts. It is insufficient to close a valve or insert a blank somewhere in the line; it must be completely disconnected from the source of hydrogen and flushed out with an inert gas.

When discussing relief valves for high pressures which will open at constant pressure and reseat repeatedly without leakage, Curtis stated that a valve developed at the Fixed Nitrogen Research Laboratory and modified slightly had overcome most of the difficulties generally experienced with such valves.

Corrosion of equipment by cooling water gives rise to dangers which are not necessarily peculiar to high-pressure operations but which are rendered more acute by the pressures used. The water of Niagara River is quite corrosive. Compressor intercoolers, for instance, are quite rapidly attacked. Continual cleaning and renewal of tubes is necessary to prevent leaks of flammable hydrogen gas. Danger of igniting the gas is the principal hazard here because leaks due to corrosion do not usually show up as a violent rupture.

MAKE YOUR PLANT



Danger of repair men falling off the top of tall equipment can be prevented by a sectionalized fence

PROBABLY the most spectacular hazard in the chemical industry is the explosion of gases ignited by electric sparks. One such explosion can wreck a plant and kill or maim dozens of men. The production of moving picture films, of Cellophane, of alcohol and of gasoline are typical of industries where motor drives must operate in explosive gas mixtures. The explosion resisting motor was developed to eliminate this hazard. Such a motor must of necessity be enclosed so as to prevent the ignition of a gas mixture outside the case from an explosion inside the case. Three constructions are available—totally enclosed, totally enclosed fan cooled, and totally enclosed pipe ventilated. The first is practical in small and slow speed ratings, but becomes prohibitive in cost in medium sizes and impossible to build in the larger ratings. The last is applicable in a relatively few cases, and then only when the number of units installed is low.

The fan cooled construction is practicable from medium size motors of 2 hp. up to 200 hp. Built in accordance with the specifications of the National Board of Fire Underwriters and approved by them for Class 1 Group D atmospheres, this motor insures adequate protection in all conditions coming under that classification.

In the case of the heat exchanger or dual ventilated construction, by circulating the internal air through ducts in the frame adjacent to ducts for the external air the rotor heat is disposed of without large temperature gradients and with complete elimination of hot spots.

The gases escaping after an explosion within the motor must escape through the bearings or through the ground metal fit of the brackets to the frame. The cooling thus obtained has been proven by actual tests in the Underwriters Laboratory to prevent ignition of the atmosphere outside of the motor.

There are many combinations such as multi-speed drives using a variable ratio set of gears, a pole changer motor or a combination of such a gear motor with multi-speed drive to obtain very slow speeds and several of them from a single unit.

With the hazard eliminated from the motor the next step was to build explosion resisting starters and push-buttons. Where the gases are corrosive or dirty it is necessary to use an oil immersed construction. In the case of one linestarter with the contactor and the contacts of the overload relay under oil, the cover and tank are designed to withstand an explosion in the air space above the oil without igniting a Class I Group D atmosphere outside of the starter.

Probably the second most common hazard is that due to fires originating from the operation of circuit interrupting devices. Since the discovery of the De-ion principle of current interruption Westinghouse has been rapidly developing air circuit breakers to apply to all feeder and power circuits and to eliminate the hazards of the older types of construction.

The Nofuze switch unit is a small De-ion circuit breaker for lighting circuits. There is no temptation to wire around the device when a refill is not handy—being a circuit breaker, one has simply to reclose it to make the circuit operative. If the fault has not cleared there will be no burned fingers—the device is trip free in all positions. Furthermore, accidents are prevented by the short time necessary to restore lighting service. The position of the handle shows which switch has operated. Movement of the handle to the "off" position resets the device then to the "on" position and service is restored in less time than it takes to tell about it.

The ABI De-ion circuit breaker has been developed for industrial feeder circuits. This switch has opened

Presented before the National Safety Council convention, Chicago, Ill. October 2-6, 1933.

SAFER FOR WORKERS

By J. V. ALFRIEND, JR.

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short circuits of 10,000 and 20,000 amp. on 440 volts without setting fire to absorbent cotton with which the case was wrapped for the experiment. The switch is shown in an accompanying illustration.

And the father of them all is the type U De-ion circuit breaker. Different in appearance and construction —the same in principle of arc extinction, these circuit breakers open power faults of 500,000 to 1,000,000 arc kva. in less than 3 cycles after the occurrence of the fault. With no oil to throw during the tremendous electrical stresses involved there is no possibility of setting fire to the station.

The number of electrocutions in chemical plants from operators and laborers coming in contact with live circuits is beyond estimation. This type of hazard falls into two classes: Accidental contact with known live circuits; and contact with supposedly dead circuit.

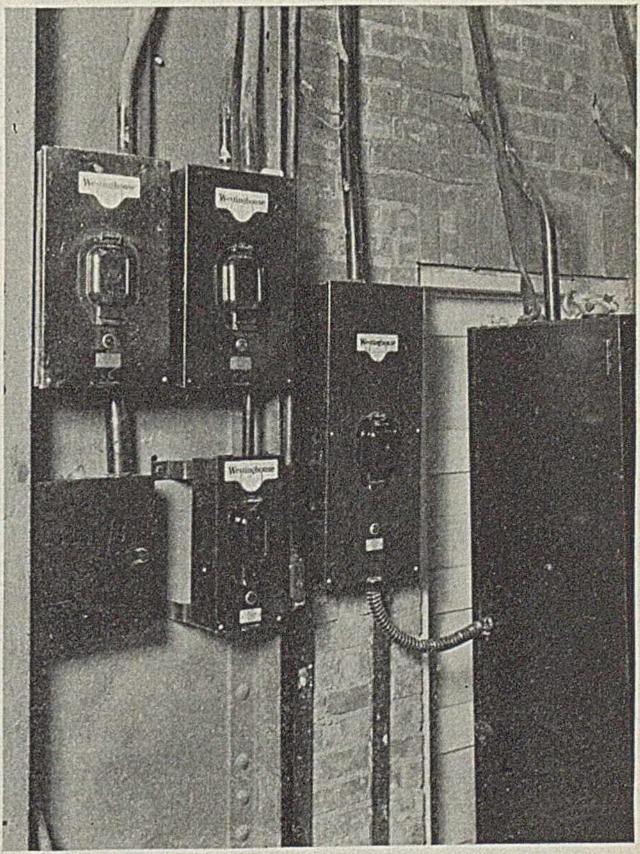
The first form of hazard is entirely eliminated by the use of "dead front" control and switchboards. All power circuits are behind the board—all operating handles are "dead." Not even deliberate suicide is possible from the front of the board.

The supposedly dead circuit may be protected against by one of the forms of metal clad switchgear known as "lift up" or "roll out." In the former the circuit breaker is lowered from engagement with stationary contacts (only possible with the circuit breaker in the open position) and the unit removed from its compartment where it may be worked on with all possible safety. No one can close these disconnecting switches while the operator is working on the breaker for the switches are the terminals of the breaker. The roll out equipment is similar except that as the term implies the movement of the unit to disengage the stationary contacts is horizontal instead of vertical.

The liability of transformer fires resulting from lightning disturbances has recently been reduced to the minimum by the development of the surge proof transformer. This design is capable of withstanding direct strokes of lightning without puncturing the insulation. In this design the insulation of the windings is correlated with the insulation of the terminal bushing or with a special form of lightning arrester in the transformer so that the surge will jump across the terminal bushing to ground or across the arrester before it will puncture the insulation. In order to improve the transformer insulation to this extent creepage paths had practically to be eliminated because strange as it may seem increased creepage distance does not increase the resistance to surge voltage in anything like the ratio encountered in the less steep wave fronts of 60 cycle voltages.

The most fool-proof equipment that the manufacturer can devise can be made death traps by thoughtless or careless installation. Many a control board has been installed on the rotational center-line of the driving or driven equipment or where a broken belt might kill or injure the operator. Operating and control stations should be placed in the most secure of positions considering the mechanical, electrical and fire hazard. In other words, the control equipment should be located at a place where men in danger will naturally run to rather than run from. This is made possible only with

ABI De-ion switch has opened short circuits of 10,000 and 20,000 amp. on 440 volts without setting fire to absorbent cotton with which the case was wrapped for the experiment



electrically operated devices such as circuit breakers and contactors. Main circuits must be kept close to the equipment, but control circuits for the operation of these devices may be conveniently and economically run al most anywhere. The use of a multiplicity of stop stations is most advantageous.

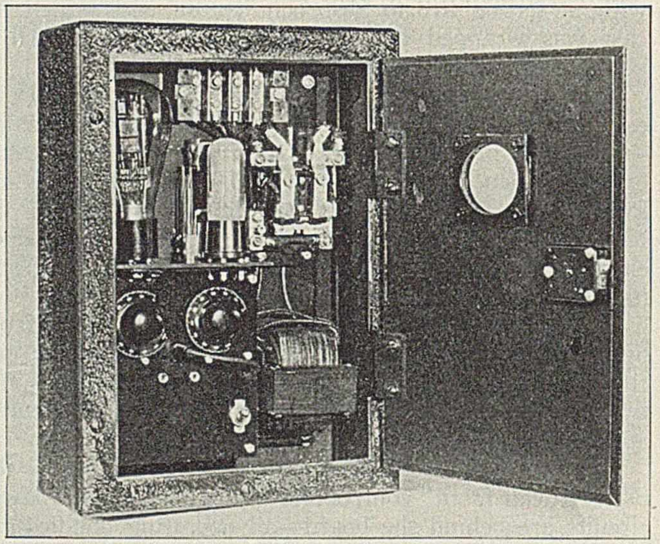
A foot- or body-operated emergency stop push-button should be located at a machine which is liable to entangle an operator's hands. A second stop station should be close by the machine but safe from it. A third stop station should be located at the supervisor's desk which should be protected from the operating room by safety glass. Here also should be located an emergency switch to shut down the entire plant.

Entire Control in Separate Room

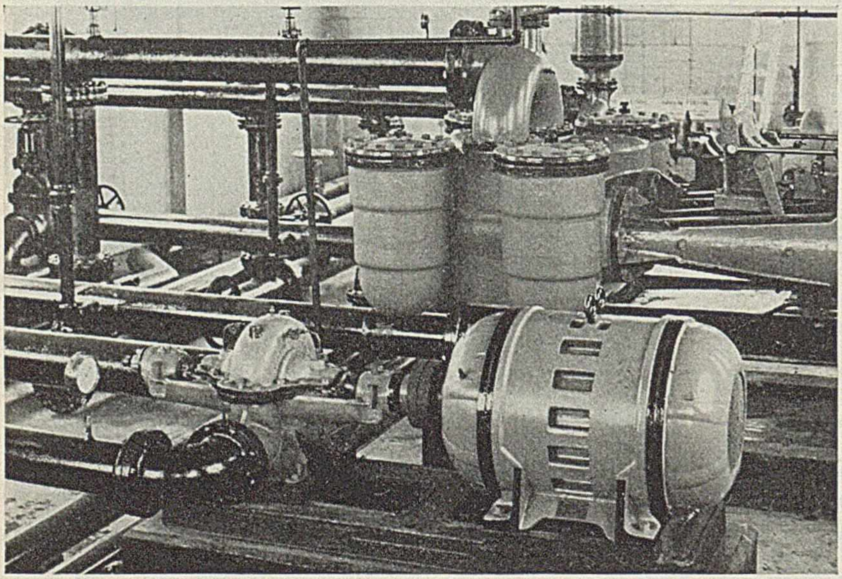
In some rare instances it is necessary to place the entire control in a room separate from and protected from the hazards of the operating room. Such a control station must have a clear view of all operating equipment and must be capable of complete control of each individual item.

The use of such simple contrivances as door switches seems hardly worth mentioning, yet I doubt if there is a plant in the country where one or more could not be used to eliminate a serious hazard. Any section, compartment or bin where electrical power must be removed for the operator's safety should not be protected by disconnect switches and a sign warning against the closure of the switch. The door to such an enclosure should be wired with a low-voltage control circuit so that while that door is open no circuit breaker or line-starter or other switch may be closed, and that door may not be closed without the key which is in the possession of the man who is in that compartment. There are many types of this sort of protection. In the Corey Interlock the key is kept in the lock of the circuit breaker, which cannot be closed unless the key is in place, and the key cannot be extracted unless the circuit breaker is open. The same key is then used to unlock the door—which door cannot again be locked without the same key. This sounds complicated, but it is worth a life.

Just as it is the unloaded pistol that does the most damage, so also is it the dead circuit that causes the most deaths. In plants with hundreds of feeders in one of the many forms of networks to improve regulation it is difficult indeed to prevent sneak circuits with certain combinations of open and closed switches. Sad to relate the unlucky combination does not always occur on the test at the completion of the new installation. To avoid this there is only one recourse—careful wiring diagrams, carefully checked, and careful workmanship. An aid to this end is the purchase of factory assembled combinations of control. One type of cabinet contains the control and feeder circuit switches for seven motors of an industrial furnace. The only wiring necessary in the field is the connection of the power leads to the incoming terminal block and the connection of the seven motors to the terminals provided therefore. Fortunately the savings made in space and installation cost are more than sufficient to pay for the increased purchase price of such units.



Adequate illumination reduces accidents. By installation of a lighting control unit it may be maintained constant regardless of variation in natural illumination



Gases escaping after an explosion within this motor in an oil refinery must escape through the bearings or through the ground metal fit of the brackets to the frame. The cooling thus obtained prevents ignition of the atmosphere outside of the motor

A roll out carbon circuit breaker installation. It will be noticed that these compartments are of the dead front type

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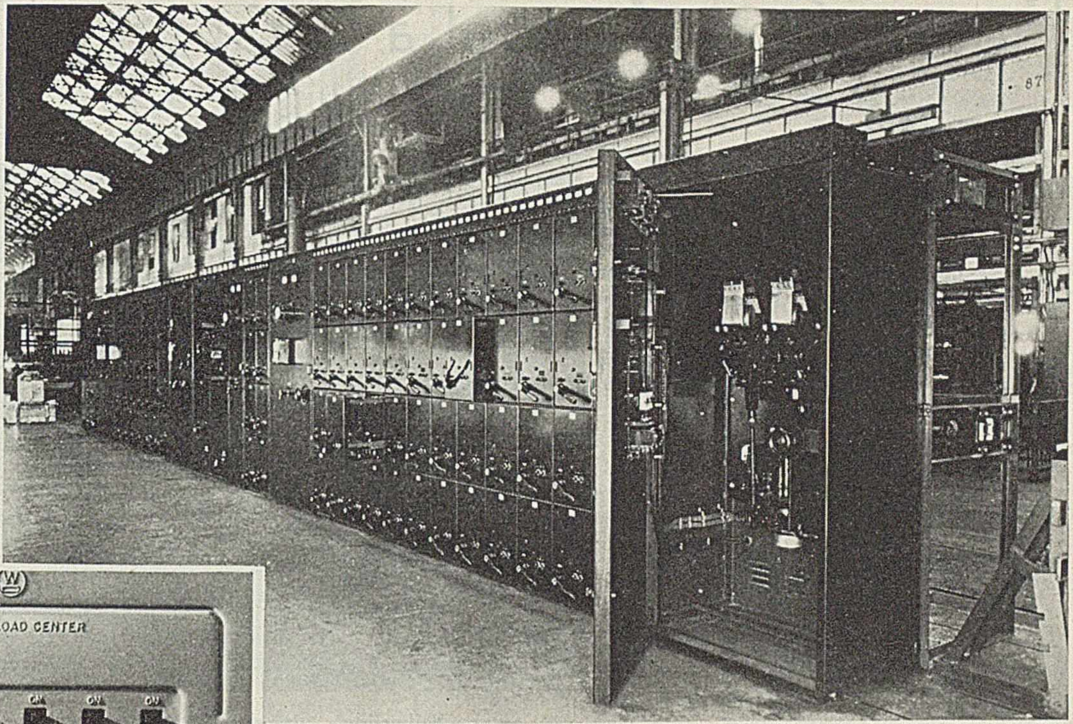
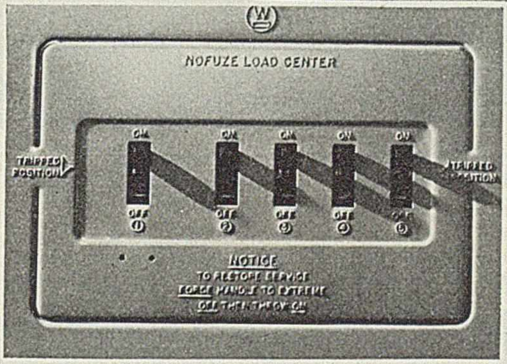




Panel board assembly of Nofuse switch units

Many hazards exist which are not subject to elimination by the selection of suitable equipment or by the most careful installation. In our transformer test department we were menaced by the danger of men falling off the top of transformers when making connection for a test. Safety belts could not be used. The same problem may be met with in many plants in the care and maintenance of any large transformer, tank or bin.

We solved the problem by building a portable sectionalized fence. The posts are held to the transformer by means of the cover bolts and the short sections supported by L-shaped bolts in the posts. By making the sections of one standard short length the economy of duplication is obtained and the assembled fence fits any shape of transformer sufficiently well to prevent an accident.

Such a portable sectionalized fence is shown in the illustration on page 532.

We cannot prevent a man from deliberately walking into danger, nor can sufficient guards always be employed to save fingers, hands or arms, but we can disconnect power and apply brakes where a man approaches or enters the danger zone. The photo tube or electric eye has made this possible, and the development of the Phototroller has made it practical.

The Phototroller is a standard device for the control of electric circuits at the demand of a beam of light. So long as the photo tube is illuminated nothing happens. The instant anything intervenes between the light source and the tube cutting off the illumination the photo-tube-plate current changes and the circuit operates to open circuit breakers or motor starters, to apply brakes or to sound warning signals.

A somewhat similar protective device pays dividends in addition to saving lives. Records have proven that adequate illumination reduces accidents, decreases spoilage and increases production. But adequate artificial illumination costs money in electric power consumed, in replacement of bulbs and in supervision. By the installation of a lighting control unit the illumination may be maintained practically constant regardless of the variations in natural illumination. The photo tube in the control units responds to the illumination at the working level. If this is deficient the electric lights are turned on—if excessive they are turned off.

This paper started out with the prevention of fires and explosions—it is therefore fitting that it should end with the extinction of fires.

The smoke detector also uses a photo tube for the reduction of a hazard. A slight wisp of smoke coming between the light source and the photo tube is sufficient to set up the circuit for the ringing of alarms or the operation of a sprinkler system.

The smoke detector has other interests for the chemical engineer. Generally, the chemical works is located where it does not need to concern itself with the quantity of smoke emitted, but the smoke recorder is nevertheless valuable as a means for improving and sustaining boiler plant economies.

Truly it can be said that the photo tube is the safety engineer's "electric eye" for danger casts its shadow before an injury occurs and the shadow falling on the photo tube can instantly set in motion alarms or corrective measures.

Process Cycle Control a Boon to Rubber Industry

By
LEONARD CHURCH
Editorial Representative
Cleveland, Ohio

Seiberling's "duo-tread" tires require the minimizing of human fallibility in curing; 16 Bristol cycle controllers handle this battery of 28 Summit tire vulcanizers

Since the inception of process cycle control in the rubber industry in 1923, the economics of its application to the curing of tires and inner tubes, to platen presses and Banbury mixer operations, has itself undergone a succession of important changes. When, a few years ago, new methods in tire and tube manufacture were developed, and accelerators introduced, the curing period was so speeded up (in some cases by as much as 300 per cent) that a new and highly critical value had to be placed on the exactness of the time allotted each individual step of the process.

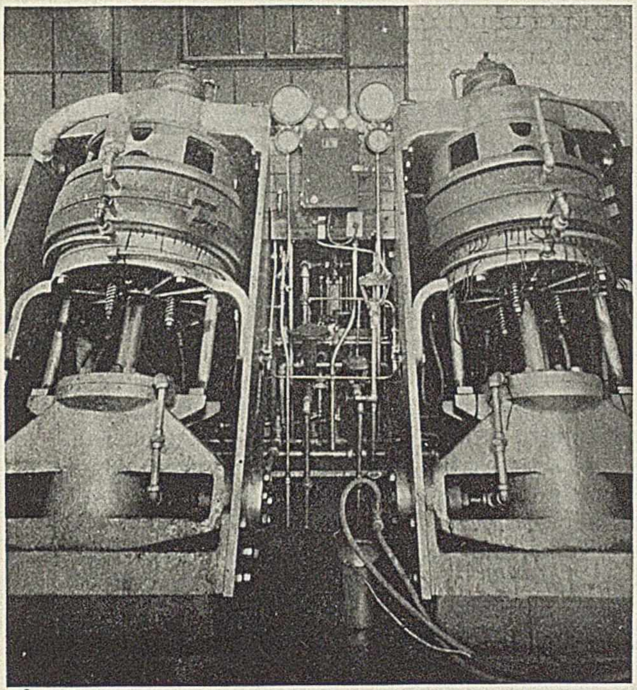
Human errors of timing that involved only minutes or seconds took on a new importance; became more directly traceable in terms of dollars and cents; and provoked a definite, practical interest in substituting machine timing for its human equivalent. The purely relative accuracy achieved by the average tire press operator became a costly approximation which mounted by leaps and bounds as modifications in tire and tube compounds and designs placed new demands upon the faithful observance of shorter and shorter curing time intervals. Whereas specifications so far as the proportions of ingredients, the vulcanizing temperature, the steam pressure, water and air pressures could be rigidly followed, the human equation in curing remained a bar to the uniform maintenance of the highest quality. After all, alarm clock technique for time control, particularly in vulcanizing rubber products, left too much to be desired.

Instrument technology has largely overcome this difficulty with the human element. Originally developed as a time cycle controller, to meet this need for an automatic exact operation of the mechanical, electrical and pneumatic controls at precisely the right time in each sequence of the rubber curing process, the cycle controller as it is known today has been considerably refined in the mechanics of its functioning. It is now a comparatively simple instrument, its complexity depending solely on the number of steps which are to be automatically controlled. Each operation can be accurately timed not only as to its own duration, but also as to its time relation to other operations in the particular process. And more important than either is the instrument's ability to repeat with unerring accuracy any sequence of steps once they have been established. The first tire and the thousandth tire can now be cured exactly alike.

The basis of the accurate timing of the cycle controller is an electrically-timed, motor-driven cam (or cams), so cut as to open and close pilot air valves according to any predetermined schedule of operations. If conditions are such that the various steps may be started in a sequence which can be stopped in the reverse order, a single-cam controller can be used. However, if the starting and stopping of the several operations overlap, a multiple-cam controller is required.

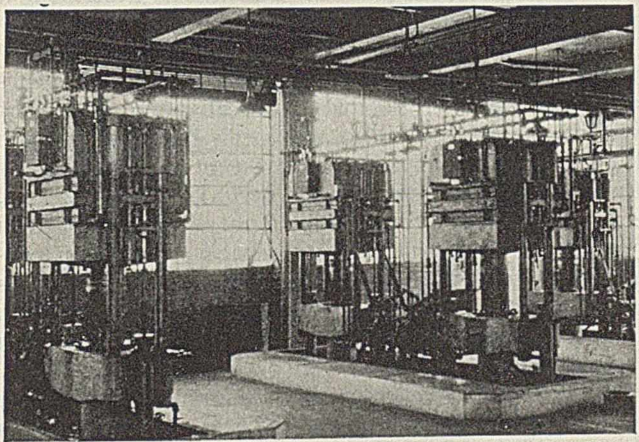
Process cycle control is not, of course, limited to any particular industry. In rubber manufacture its representative applications are found in the curing of tires and inner tubes; and in various mechanical rubber goods operations, such as molding; in Banbury mixer operation; in the controlling of tubing splicing machines and stripping machines; in shoe molds and platen presses.

An excellent example of cycle control is to be found on individual Summit Mold & Machine Co. tire vulcanizers used in the plant of The Seiberling Rubber Co., of Akron, Ohio, to vulcanize the company's "duo-tread" tires. Here 16 Bristol cycle controllers handle 28 tire presses in all the steps of curing except the actual placing of the tire in the vulcanizer and the connection of an inner hot water bag to a hot water supply line.



Close-up of two Summit tire vulcanizers showing their control through a single cycle controller

Bristol cycle controllers on platen presses for various rubber molded articles; they handle a more complicated series of operations than tires and tubes controllers



vulcanizer operation, to hold to one or two the number of men needed for supervision of the equipment, and to permit the simultaneous operation of different size presses by the same man despite different time cycles for curing.

Only one man is required for this Seiberling installation of 28 presses. Tires to be vulcanized are, however, supplied to him by helpers, who also attend to the insertion of the hot water bags—details that considerably speed the production record. The cycle controllers operate at 50 lb. air pressure and have three forward, three reverse operations. Following the insertion of the tire in the press, the inner hot water bag is connected by means of flexible copper tubes to hot water supply and discharge lines. Then the control cycle is started by closing a switch, which in turn causes a hydraulic ram operating under 1,800 lb. pressure to close the press. Hot water, under 250 lb. pressure, is turned into the inner bag and kept circulating throughout the period of cure. The curing molds installed in these presses are backed by steam cavities in which curing steam at 278 deg. F. is on at all times.

At a carefully predetermined point in the curing sequence, the cycle controller—through its air-operated pilot valves—directs hydraulic pressure to a framework carrying a circle of pins which, spaced uniformly about the circumference of the tire, are inserted about $\frac{1}{4}$ in. under the surface of the tire tread to create a row of $\frac{3}{16}$ in. to $\frac{5}{16}$ in. air holes. These constitute the secondary or "duo-tread," exclusive with Seiberling, and require the most exact timing in their production. The pins remain in the tire tread until the curing is practically finished, when they are withdrawn through the starting of the reverse sequence of cycle control operations.

When the curing operation is finished the hot water circulation through the inner hot water bag is cut off by the first reverse step of cycle control and the bag drained. The pins are withdrawn through a reversal of the hydraulic pressure. Safety rods paralleling the hydraulic ram of the press proper are tripped automatically, the 1,800-lb. hydraulic pressure released and the vulcanizer dropped open. The vulcanizer will now remain open until a new cycle is deliberately started by the operator. This automatic opening of the tire press is of considerable importance, because one of the frequent

And a recently developed special connection, already installed on half these presses, makes automatic the latter operation. Four of these tire presses have individual cycle controllers; 12 additional controllers handle two each of the remaining 24 presses. This limitation of the number of tire presses per controller to two each is to gain flexibility in

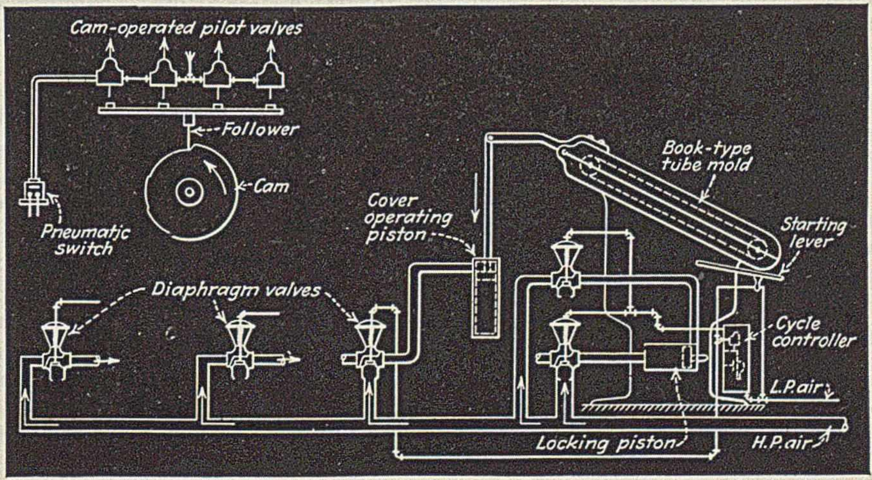


Diagram of Bristol cycle controller on a book-type vulcanizer

earlier causes of spoilage of tires came about through an operator neglecting to open a press in which the curing of a tire had been completed. A tire that thus received two successive cures was always hopelessly spoiled.

Although figures showing the savings achieved through the application of cycle control to the foregoing battery of 28 Summit presses are not available in dollars and cents, The Seiberling Rubber Co. estimates that approximately 60 per cent more tire cures per man are being achieved. And, of course, tire spoilage is minimized. Double-curing with resultant spoilage is eliminated by the automatic opening of the presses. The entrance of the dual-treading pins is made an exactly timed procedure—solving earlier difficulties which arose from variations in the timing of this step in the vulcanizing operation. Under-curing, with resultant rapid tread wear, as well as over-curing, which would cause brittleness of the tread, are both prevented.

It is of special interest to note the facility with which a plant using cycle controllers can increase its factory personnel, as required by the operation of the N.R.A. With cycle control equipment on the job, perfectly green help can be broken in quickly, and without the usual penalty of increased product spoilage during the training period.

The use of cycle controllers in the curing of inner tubes has become equally important. In fact, an even higher premium has been placed on adequate timing control for tubes, since the introduction of new accelerators has shortened the curing time to but a few minutes. Also, new anti-heat compounds are now being used to offset the destructive effects of the greater heat generated by the much smaller brake drums with which cars and trucks are being equipped as tire sizes grow smaller and wheel diameters approximate those of wheel hubs. In the vulcanization of the new tubes, the operation of the cycle control is essentially similar to that with the tire vulcanizers. The chief difference in handling a tube is in the elimination of the hot water bag, such as is inserted in a tire prior to vulcanizing. The tube itself is inflated to a pressure of 100 lb. air which is maintained throughout the period of the cure.

On National Rubber Machine Co. tube vulcanizers an additional step is interposed between the locking of the inner tube in the mold and its inflating with air, whereby a diaphragm between the lower half of the mold and the base of the vulcanizer is inflated to exactly register the mold. After the inner tube is inflated to 100 lb. air pressure, as it is with the Akron Standard mold tube vulcanizer (so-called book-type tube mold), the curing period is run.

Economics of Cycle Control

By and large, however, the application of cycle control to the vulcanizing of tires is considered more economically justifiable than is its application to the curing of inner tubes because of the much higher dollar value of the former. Partly counter-balancing this consideration is, of course, the shorter curing times for tubes which place a greater premium on an exact observance of the timing of their vulcanizing cycle.

For the present, however, with the difficulty attendant upon securing credit for plant modernization, cycle control investment must meet a strict economic test. Like most other industrial equipment investments, cycle control is of necessity being considered strictly in terms of its ability to write off in actual operating economies the initial cost of the equipment within six months to a year from its installation. Currently changing tire designs and sizes gives further reason for a general limiting of the application of cycle control to new vulcanizing equipment only, where length of service is reasonably assured beyond the period required completely to amortize the investment in instrument operation.

How the Controller Works

Though cycle controllers are used on tube splicing, tube and tire curing, bicycle tire vulcanization and a variety of mechanical rubber goods operations the principle in each application is fundamentally the same. The cycle control mechanism comprises an electric clock, a disk cam, a tappet bar with adjustable tappets, and as many air valves or pilot valves as are required to perform the several functions in the cycle. The operator starts the operating cycle by starting the synchronous-clock motor drive. Air is simultaneously and automatically applied to a main reservoir or manifold from which it is admitted to individual pilot valve lines in whatever sequence is desired. A so-called "follower" on a cam operating from the synchronous-clock motor raises tappets which directly control these pilot air valves. Air pressure may be anything from 15 lb. up; in The Seiberling Rubber Co. installation described, it is 50 lb.

Various departures from this simple sequence application are at times desirable. In the first place, cam gears are interchangeable, so that practically any length of cycle can be secured. Also, cams can be provided with adjustable sectors to accommodate time changes in any particular process cycle. If the cycle is not continuous, for instance, where the final holding period on the cam is variable, an external adjusting knob on the cam permits its manual return to the starting position. This resetting can be accomplished automatically, if desired, through the addition of a high speed pneumatic return mechanism.

On tube splicing machines, the operator loops the tube under a horn, set at a height to measure the exact length desired, and then lays the ends under the jaw of a clamp. Two push buttons, set in the top of the machine head, must be punched simultaneously to start the controller motor and the cycle. This method of control was devised as a safety measure to bring the operator's two hands away from the machine while the jaws clamp onto the tube. This cycle requires only 15 seconds. The time the operator consumes in picking up another tube from the conveyor, making it ready for splicing, removing the spliced tube and replacing with an unspliced one brings high speed production to a process which formerly required time-consuming manual work.

Maintenance of exact steam temperatures in vulcanizing is of major importance and is assured through the application of a cycle controller with a single tappet and diaphragm valve to the task of periodically blowing out the steam lines. Steam traps are made unnecessary, for with the controller cam adjusted properly, there is no possibility of condensate collecting in a steam line.

T.A.P.P.I. Assists in Celebrating A Wisconsin Anniversary

EDITORIAL STAFF REPORT

ABOUT 400 MEMBERS of the Technical Association of the Pulp and Paper Industry attended the eighteenth annual fall meeting at Appleton, Wis., September 26 to 28, 1933. This meeting was part of Wisconsin's celebration of the seventy-fifth anniversary of the establishment of the pulp and paper industry in the state, and it gave the members of the society an opportunity to inspect the new graduate school of the industry, the Institute of Paper Chemistry, located at Appleton. Of special interest was the award of the TAPPI medal to Ernst Mahler, vice-president of Kimberly-Clark Corp., Neenah, Wis. The award is made to an individual who has made an outstanding contribution to the technical development of the paper industry. Only two previous awards of the medal have been made. In 1928, Ogden Minton received the medal for inventing a vacuum process of drying pulp and paper, and W. H. Mason received a similar award for inventing the Masonite process of steam exploding wood. Mahler received recognition for his work in developing cellu-cotton, bleached groundwood, the high-speed Niagara beater and for the founding of the Institute of Paper Chemistry.

The banquet was well attended. President Allen Abrams introduced Dr. H. M. Wriston, president of Lawrence College, as toastmaster. He called on F. J. Sensenbrenner, head of the Kimberly-Clark Corp., who spoke on the future of the pulp and paper industry under NRA.

The papers presented on the first day included the 1933 Ph.D. theses of the Institute of Paper Chemistry. R. L. Davis, now with the Interlake Pulp & Paper Co., described an alkaline process for obtaining yields of pulp from aspen wood. E. H. Voigtman, with the Kimberly-Clark Corp., discussed the factors influencing the chlorination of Mitscherlich sulphite pulp. H. W. Bialkowsky, now with Gilbert Paper Co., reported on rosin sizing developments, and E. R. Laughlin of the du Pont organization, made several observations relating to the physical and chemical changes taking place in the cooking of new white rags.

Upon request of the association, H. F. Lewis and B. L. Browning of the Institute of Paper Chemistry reported on the results of an investigation into the various standard methods of determining alpha cellulose in pulp. The method investigated included those of the Bureau of Standards, Forest Products Laboratory and the American Chemical Society. The latter method was found to be most satisfactory, but several improvements to it were suggested.

B. L. Rowland of the Institute of Paper Chemistry discussed colloidal control in starch sizing. A procedure consisting of precipitating the starch on the fibers by addition of alum after the pulp refining treatment is completed was recommended.

Robert E. Wilson, vice president of the Standard Oil Co. of Indiana, was the luncheon speaker. Dr. Wilson spoke on "Research Attitude in Corporate Organizations," and advised research men to consider problems in the raw materials and distribution end as well as in the manufacturing operation.

The second day's program consisted entirely of papers by members of the staff of the Forest Products Laboratory of Madison. C. E. Hrubesky and G. H. Chidester discussed the penetration of Western hemlock chips by calcium bisulphite liquor. J. S. Martin, M. W. Bray and C. E. Curran reported that no critical temperature is evident in the sulphate process under ordinary conditions. W. A. Chilson and P. K. Baird outlined the plan of work being carried out dealing with the study of paper machine variables. Hrubesky, Billington and Baird reported that circular rods are preferable to oval rods used in a rod mill to refine pulp. The effect of relative humidity on the moisture content and bursting strength of container boards was reported by C. O. Seborg, R. H. Doughty and Baird. F. A. Simmonds discussed the capillary rise of water in fibrous sheets and developed a mathematical procedure to estimate pore diameter. Doughty and Baird outlined some factors affecting the interweb adherence of single plies used in laminated sheets. The means by which interweb strength may be controlled by means of forming, couching and pressing conditions were described. E. R. Schafer and Matti Santaholma reported the results of tests made on black gum and slash pine groundwood pulps. The lignin content of the finer fraction was found to exceed that of the coarser.

Stabilized 18-8 Alloy Welds

The third day's program was of a miscellaneous character. R. M. Cobb of the Lowe Paper Co., D. S. Chamberlin and B. A. Dombrow of the National Oil Products Co. presented a paper on emulsified paraffin wax sizes. A new pulp refiner was described by Anton Haug of Nashua, N. H. D. W. McCready and L. T. Thomason of the University of Michigan reported on an X-ray investigation of the penetration of electrolytes into wood. Penetration of electrolytes was shown to be more rapid than water alone and was greater at increased temperatures. The opacifying of paper by titanium pigment was described by W. R. Willets of the Titanium Pigment Co. M. A. Heath of the Nekoosa-Edwards Paper Co., Curran and Bray of the Forest Products Laboratory presented ammonia distillation methods for analyzing black liquors of varying sulphidity. J. D. Miller reported for the Materials of Construction Committee on tests made on regular and stabilized 18-8 alloy welds in sulphite liquors. M. A. Youtz and B. E. Lauer presented a method for evaluating pulp cord wood. The method was interesting and attracted the attention of many of the members who heard it.

A short symposium was conducted on the measurement of pulp color. L. C. Lewis of the Mead Corp. discussed the usefulness of pulp color measurements. R. S. Hatch and H. A. Hauff of the Weyerhaeuser Timber Co. described the results obtained in measuring pulp and paper color by means of the Razek-Mulder analyzer and E. S. Bissell of the Bausch & Lomb Optical Co. demonstrated a new color comparator.

BOOKSHELF

Mathematics of Debt

DEBT AND PRODUCTION; THE OPERATING CHARACTERISTICS OF OUR INDUSTRIAL ECONOMY. By *Bassett Jones*. Published by the John Day Co., New York. 147 pages, including the Appendix "A Suggested Method for the Analysis of Economic Statistics"; 17 Graphs. Price, $2.50.

Reviewed by *Crosby Field*

BY A PERFECTION of abstraction Jones makes complete the evanescent image of our present economic structure, and then applies the known data in a devastating fashion to demonstrate the incorrectness of the assumed laws of economics under which we have been led into our era of investments. In this he has not been alone, but this book commands full respect by its obvious thoroughness of study and of formulation. That old associate of the author's, "Technocracy," is not mentioned, nor are any of its disciples present as such. Instead we realize the presence only of the successful engineer and business man, whose technical achievements and direction of many companies command respectful attention for his theories.*

By "debt" Stuart Chase says Bassett Jones means "the total claim on future production derived from absentee ownership, duly capitalized" or "capital claims." Mr. Jones proceeds to examine the growth of these capital claims and of the production resulting from the plants built because of the creation of these capital claims and concludes that the possible growth of debt (capital claims) is a direct function of the growth of production. He then states the following characteristics as prerequisite for a debt structure based on production:

1. The quantity of debt at any time must have a one-to-one relation to the volume of production at that time.
2. The payment to debt at any time must have a one-to-one relation to the growth of production at that time.

As a corollary it may be written that no debt can be incurred that cannot be paid back within the obsolescence period, or the use period, of the goods produced through the use of the incurred debt, whether these be capital goods or consumers' goods.

*One of the theories of this Mathematical Iconoclast is his compromise between parabolic and exponential curves in plotting growth. He also points out the irreconcilables in the doctrines of most of our accepted leaders of economic thought. Alas, he did not include a bibliography as such! Had he collected all his references and footnotes in a single grouping, the reader would have indeed a list of contemporary idols each with clay feet properly labeled by the author.—C.F.

Mr. Jones gives four postulates of his theory of production:

1. Production of goods in all forms must reach a maximum.
2. Production of goods in all forms within our economic epoch (1800 to date) is initially either zero, or practically speaking, asymptotic to zero.
3. There are two types of production, that with renewable raw materials and that using non-renewable raw materials.
4. These two types of production are sufficient, for the analysis of all, including mixed-types.

Assembling his data and formulating them, Mr. Jones finds his curves all very near zero at A.D. 1800—a year more than coincidentally close to 1790, frequently designated as the year marking the beginning of the "Industrial Revolution." Tracing these curves forward we find that both total capital claims and total production kept in step in growth until about 1911, and so we had a stable economic system, with only minor upsets as in '73, '93, '07, (at least we are cheerfully led to believe the depression of '73 was minor in comparison with ours!) Since that time, however, we have accelerated the curve of capital claims at a far greater rate than that of production, hence according to common knowledge and in violation of Mr. Jones' second prerequisite above, we became economically unstable and due for a crash in 1929, which we got! Now Jones' curves should prevent our ever getting into that mess again, and will, if we require by law every stock salesman to carry a copy of "Debt and Production" and explain it to each prospect before selling him! There will be no sales, whether or not either of them understands the book! Strange to say, not only does Jones not blame the War for all our troubles, but proves it was of little consequence in the great scheme of things—a suspicion many of us have been secretly harboring ever since we stepped off our return transport!

The author scientifically explains his intensely interesting graphs and curves, his formulated "laws" and data substantiating them, and stops, leaving us with no picture of what to substitute for the broken economic system of the present, but with a conclusive proof, assuming mathematical rigor is equivalent to proof, that the old era, 1800 to 1929, is forever gone. In so doing, of course, he does not mention the history of the innumerable debt structures before 1800, which began, grew, and were destroyed, nor the killing of debt by change in environment due to the power of man expressed in ways other than mechanical goods production. His thesis indicates as does that of J. M. Keynes, that interest rates must fall to zero—but have they ever remained at zero in the 2,000 or more years of recorded history? He indicates not the likelihood of sudden destruction of a huge proportion of these capital claims by the artifices well known to politicians—and which have been used in history whenever the claims of absentee owners have become too burdensome for those actually producing. After all, man as such has lived through many epochs before 1800, and in each the absentee owner has grown in number and in power until the inevitable revolt which by direct or indirect legislation, with or without armed force, returned the capital goods (whether land, ship, or factory), minus the debt, to the individual or smaller groups of individuals, perhaps under a new allegiance! Although Mr. Jones' mathematics does not indicate these factors, we should all be thankful to him for proving conclusively that the time is here for destruction of much of this "debt," and the top-heavy large organization type of control rendered necessary by it. *"Delenda est. . . . . . ."*

Petroleum Chemistry

CHEMICAL REFINING OF PETROLEUM. By *Vladimar A. Kalichevsky* and *Bert Allen Stagner*. Published by the Chemical Catalog Co., New York. 451 pages. Price, $7.

NUMBER 63 of the series of A.C.S. monographs deals authoritatively with a phase of petroleum refining in which there has been an increasing degree of interest in recent years. From the old stand-bys—sulphuric acid, alkali and plumbite or "doctor" solution—the refiners turned their attentions first to the adsorbents and more recently to the great variety of selective solvents now so widely used (or proposed) for wax removal. Inhibitors of oxidation and gum formation have also become important of late. The interest in anti-knock compounds has likewise called more attention to chemical treatment.

The publication of this book results from the combined efforts of two investigators who have worked closely together for many years in collecting their material from the literature and from their own rather broad experience. The thoroughness of their effort is indicated by the 1,450 footnote references to the work of others that, with a list of more than 600 patents, supplement the thirteen comprehensive chapters. A 22-page glossary of chemical terms is a surprising but interesting addition. Helpful, too, is the complete indexing by patents as well as authors and subjects. Chemical engineers will find that what is lacking in engineering and technology of operating procedure is more than compensated by the abundance of information on the fundamental chemistry of the processes involved.

Hardy Perennials

Annual Survey of American Chemistry. Edited by Clarence J. West. Published for National Research Council by the Chemical Catalog Co., New York. 346 pages. Price, $4.

DESPITE the depression, there has been no recession in the publishing activity of American chemists so that this annual survey more than doubled its size during the first six years of its existence. This year, however, economic considerations dictated what would seem to be a commendable change of policy —namely, to review certain of the topics in rotation in cycles of two or three years. This also gives an opportunity for an occasional excursion into fields not previously covered. For example, in this volume, which is No. 7, under Major West's editorship, chemical engineering is included for the first time. Prof. Donald B. Keyes of the University of Illinois, summarizes progress of recent years in the principal unit operations and processes in the concluding chapter. He has succeeded in compressing into nine printed pages, references to almost 100 separate advances in equipment construction or process procedure.

Organic Syntheses. Vol. XIII. An annual publication of satisfactory methods for the preparation of organic chemicals. *W. H. Carothers*, editor. John Wiley & Sons, Inc., New York. 119 pages. Price, $1.75.

Thirty new syntheses are given in this volume, the first to be published since the appearance of the first Collective Volume containing the revised material of the nine first annual volumes. The index of the present volume therefore includes those of Vol. X to XII incl.

New Editions of Standard Texts

Industrial Chemistry. Second Edition. By *Emil R. Riegel.* The Chemical Catalog Co., New York. 784 pages. Price, $6.

FOUR NEW CHAPTERS have been added in the revision, treating water and sewage, synthetic organic chemicals, phosphates including baking powders, and synthetic resins. Several of the older chapters have been completely rewritten and regrouped, many new illustrations have been included, the number of problems has been greatly increased, and a list of patents has been given at the end of each chapter. Figures for production tonnages have been brought up to date and introduced more extensively.

A Textbook of Fire Assaying. Second Edition. By *Edward E. Bugbee.* John Wiley & Sons Inc., New York. 299 pages. Price, $3.

NUMEROUS CHANGES have been introduced in this edition, to clarify and improve it. Some new matter is included in the assay of gold and silver, but the principal change is the addition of a chapter on the assay of ores and other products containing metals of the platinum group.

Recent Arrivals

The following publications have been received for review or announcement in these columns:

Association Theory of Solution and Inadequacy of Dissociation Theory. By Jitendra Nath Rakshit. Published by S. C. Auddy & Co., India. 297 pages.

Brines of Ohio (A Preliminary Report). By Wilber Stout, R. E. Lamborn and Downs Schaaf. Fourth Series, Bulletin 37. 123 pages.

Electrometallurgical Resources of the North Platte River Basin, Wyoming. Bulletin XXIII, 1932. By C. S. Dietz. 235 pages.

The Practice of Spectrum Analysis. 6th Edition. Published by Adam Hilger, Ltd., London, England. 58 pages. Price, 3s. 6d. net.

Proceedings of the Chemical Engineering Group, Vol. XIII, 1931. By Society of Chemical Industry. Published by the Chemical Engineering Group, London, England. 177 pages.

Proceedings of the Chemical Engineering Group, Vol. XIV, 1932. By Society of Chemical Industry. Published by the Chemical Engineering Group, London, England. 183 pages.

Report of Committee D-2 on Petroleum Products and Lubricants and Methods of Test Relating to Petroleum Products. American Society for Testing Materials, Philadelphia. 286 pages. Price, $1.25.

Research in the Elimination of Noise in Industrial Gas Burners, Report No. 692. Published by American Gas Association, Inc., Testing Laboratory, Cleveland, Ohio. 75 pages.

A Select, Annotated Bibliography on the Hygienic Aspects of Aluminum and Aluminum Utensils. Preface by Edward R. Weidlein and an introduction by George D. Beal. Bibliographic Series, Bulletin No. 3. Mellon Institute of Industrial Research. 69 pages.

Silver Jubilee, Souvenir Volume. The Mysore Engineers Association, Bangalore. 126 pages.

A Study of the Characteristics of Burning Gas With Preheated Air. Report No. 685. American Gas Association, Inc., Testing Laboratory, Cleveland, Ohio. 76 pages.

Symposium on Steel Castings. Published jointly by the American Society for Testing Materials, 1315 Spruce Street, Philadelphia, Pa., and the American Foundrymen's Association, 222 West Adams St., Chicago, Ill. 254 pages.

Valuable Hints to Inventors. By A. F. Gillet. Published by The Inventors Publishing Co., Washington, D. C. 94 pages. Price, $1.

International Acetylene Association. Official Proceedings, Thirty-third Annual Convention, Philadelphia, Nov. 16-17-18, 1932. 201 pages.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Fuel Oils, Recorded Standard of the Industry, 2nd Edition. Bureau of Standards, Commercial Standard CS12-33; 5 cents.

Thermal Properties of Petroleum Products, by C. S. Cragoe. Bureau of Standards, Miscellaneous Publication 97; 10 cents (reprinted with addition of errata, 1933).

Discussion of Some of Principles of Acoustical Insulation, by V. L. Chrisler. Bureau of Standards Circular 403; 5 cents.

Distributing Agencies. Bureau of the Census; $2.50 (Cloth), 988 pages. Census of Distribution, v. 1 retail distribution, Part 1, summary of United States and statistics for counties and incorporated places of 1,000 population and over.

Cotton Production in the United States, Crop of 1932. Bureau of the Census, unnumbered pamphlet; 5 cents.

Cottonseed Industry. Senate Document No. 209, Part 13, 71st Congress, 2nd Session. A summary report of the investigation conducted by the Federal Trade Commission.

Fishery Products. U. S. Tariff Commission, Report No. 69, Second Series; 25 cents.

Bibliography of Information on Air Conditioning. Bureau of Foreign and Domestic Commerce; mimeographed.

Graphited Lubricants. Bureau of Standards, Letter Circular LC-387; mimeographed.

Potash, by Bertrand L. Johnson. Bureau of Mines, Economic Paper 16; 10 cents. A summary of the world potash situation.

Pulp-Wood Crops in the Northeast, by M. Westveld. Department of Agriculture, Leaflet No. 57; 5 cents.

Wages and Hours of Labor in the Dyeing and Finishing of Textiles, 1932. Bureau of Labor Statistics, Bulletin 588; 10 cents.

Mineral Trade. Minerals Division, Bureau of Foreign and Domestic Commerce; 5 cents. Charts of world production, imports, and exports of major minerals of industry, 1929.

Mineral Resources of the United States 1930, Part I, Metals. Bureau of Mines; $1.50 (Cloth), 1142 pages.

Minerals Yearbook 1932-1933. Bureau of Mines; $1.25 (Cloth), 819 pages. This takes the place of Mineral Resources of the United States.

Crude Petroleum and Petroleum Products in 1931, by G. R. Hopkins and A. B. Coons. Bureau of Mines, Mineral Resources Series; 10 cents.

Static Electricity in Nature and Industry, by Paul G. Guest. Bureau of Mines, Bulletin 368; 10 cents.

Coke-Oven Accidents in the United States, 1932, by W. W. Adams and L. Chenoweth. Bureau of Mines, Technical Paper 559; 5 cents.

PLANT NOTEBOOK

Correcting Weir Flow Calculations for Velocity of Approach

By Dale S. Davis
D. S. Davis Associates
Watertown, Mass.

IN CONNECTION with the weiring of industrial effluents it is frequently noted that the stilling box dimensions do not conform to the best practice, usually because of lack of sufficient space or some other local condition. As a result the pool above the dam is far from quiet and the velocity of approach before the crest may be considerably too high, causing the calculated rate of flow to be lower than the actual value.

Even a velocity of approach as low as 0.8 ft. per second can introduce errors up to 8 per cent in the calculated flow, while at higher velocities the discrepancy between the true and apparent rates of flow rises very rapidly. Since an excessive velocity of approach cannot always be avoided, it is evident that a simple and accurate means of determining the proper corrections is needed.

C. M. Baker ("White Water Surveys," American Paper and Pulp Assn., p. 8) presents data for making such corrections in the case of rectangular weirs. The material, however, is in the form of a family of curves between which interpolation is at once difficult and uncertain. The accompanying line coordinate chart presents the same data in a more convenient form, inasmuch as all interpolation can be accomplished on closely graduated scales.

The velocity of approach, V, in feet per second may be calculated from the apparent rate of flow (which has itself been computed from the head on the weir) by the expression,

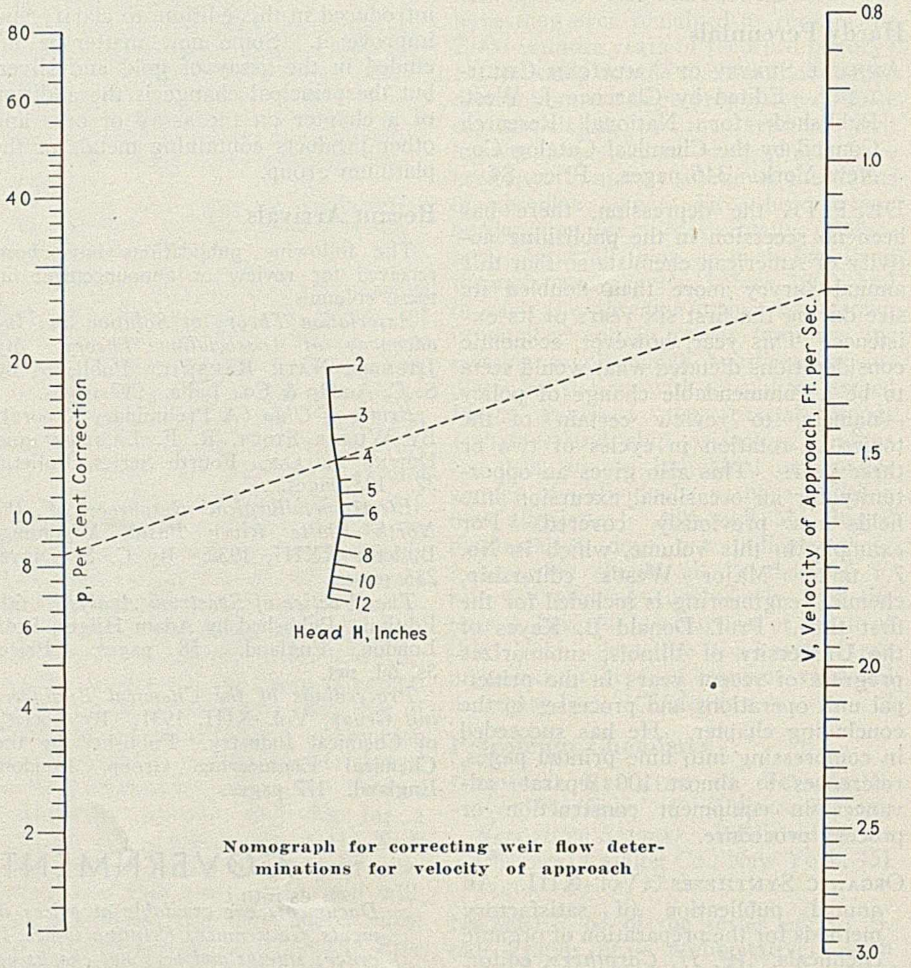
$$V = \frac{450\,A}{q}$$

where q is in gallons per minute and A is the sectional area of the channel in square feet.

The velocity of approach and the percentage correction in rate of flow are related by the empirical equation,

$$\log (p + 1) = \frac{a}{173 + 100V} + b$$

where p is the percentage by which the apparent flow is to be increased and where a and b are functions of the head which need not be mathematically defined.



Nomograph for correcting weir flow determinations for velocity of approach

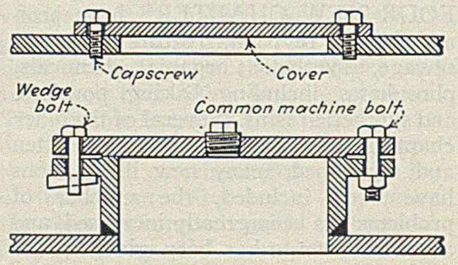
The broken line shows that the apparent rate of flow as calculated by the usual Francis formula must be increased by 8.5 per cent when the head on the weir is 4 in. and the velocity of approach is 1.2 ft. per second.

Hints for Designers of Process Equipment

By F. D. Hartford
Denver, Colo.

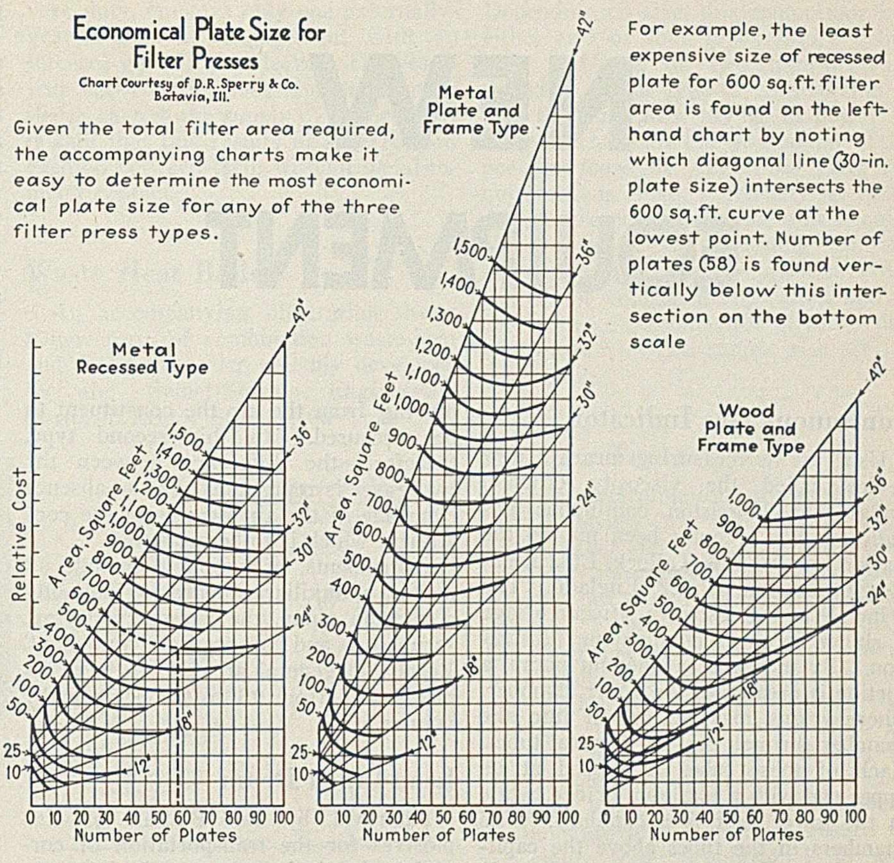
CHEMICAL EQUIPMENT designers providing cleanout openings at the proper places frequently fail to make them large enough or strong enough for practical purposes. The cleanout openings should usually be large enough to admit a good-sized hoe or shovel, together with a stick carrying an electric light. They should also be wide enough to allow the hoe to reach all corners of the vessel. Since cleaning often necessitates the use of heavy tools, cleanouts need to be built accordingly. A temporary steel or wooden casing inserted in the cleanout openings of lead or thin metal equip-

Right (below) and wrong (above) in cover bolts



ment will prevent damage by cleaning tools.

Then, here's another point, often overlooked, that can save a lot of trouble. Inspection covers, cleanout and manhole lids, pyrometer pockets, and the like are best attached by common machine bolts or wedge bolts rather than by studs or cap screws. Threads so frequently become corroded tight, requiring the use of the burning torch or drilling out, that they should be utilized only in their simplest and cheapest forms. The upper illustration shows a type of flanged opening that is certain to make trouble. The lower pictures another that will rarely cause the plant operator grief.



Booster Compressor Conquers a Low Temperature Problem

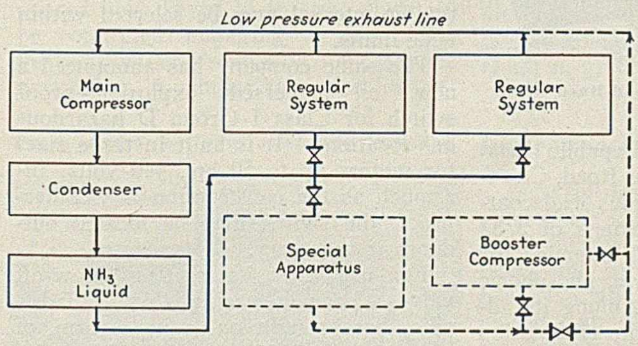
By Charles W. Selheimer, Jr.
Cincinnati, Ohio

FREQUENTLY it happens that the refrigerating system for a plant or laboratory is inadequate for the peak load, or that different temperatures are desired in various parts of the system.

This latter condition is difficult to attain since the temperature obtained is largely a function of the evaporating pressure of the refrigerant. Installation of larger equipment to handle the entire load is undesirable because of the cost, for usually the peak load exists but part of the day.

The problem of obtaining very low temperatures for experimental apparatus (—30 deg. C. or lower) on an ammonia system operating at atmospheric exhaust pressure was solved by installing in the system a small steam-driven air compressor which had the bronze valves and valve seats replaced with steel and cast iron parts. In this low-temperature circuit (as shown by the dashed lines in the diagram), the intake of the booster was connected to the exhaust side of the expansion coils, thereby creating a very low pressure on this particular piece of apparatus without disturbing the rest of the system. The booster exhausted into the main exhaust line of the system. When not in use, the booster was bypassed.

Advantages of such a set-up are as follows: low initial cost of equipment; flexibility and ease of control; independence of varying conditions in the system; ease of installation or removal; and the lessened danger of pulling inert gases into the main system by having only a small part of the system at low pressure. The power cost for such an installation is extremely low.



Addition of an auxiliary booster compressor in this layout made it possible to maintain especially low temperature in one piece of apparatus

Removing Broken Studs

According to a suggestion in a recent issue of *Oxy-Acetylene Tips*, a broken stud can easily be removed by building it up ½ in. or more above the surface with a welding torch and steel rod, after which it is permitted to cool and is then backed out with a pipe wrench. Studs up to 1½ in. have been so removed.

Protecting Lead Apparatus From Excessive Vacuum

CHEMICAL EQUIPMENT made of sheet lead—sulphuric acid chambers, towers, coke boxes, and the like—are particularly susceptible to damage by excessive suction. The accompanying picture of a collapsed chamber shows what happens occasionally.

Accordingly, in such equipment it is advisable to place liquid traps or seals that will break and admit sufficient air before the negative pressure can build up to dangerous intensity. Such traps should be non-freezing, they should be designed to avoid spilling of liquid when the suction is suddenly released, and they should be provided with an inspection hole to check the liquid level.

This could not happen in a properly protected chamber plant

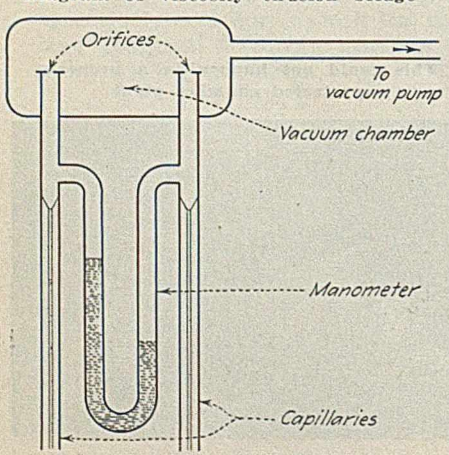
NEW EQUIPMENT

Continuous Gas Indicator

Using as its measuring means a new device called the viscosity effusion bridge, the Fageiston continuous gas indicator has recently been put on the market by Griffin & Tatlock, Ltd., Kemble St., London, W.C.2, England. The principle of the viscosity effusion bridge is shown in the accompanying illustration. By means of a vacuum pump, a suction is created in the upper chamber, whereby gas may be drawn into the chamber through the two vertical tubes. Each of these tubes is capped at its upper end with a platinum orifice, while in the lower part is a capillary. The chambers in the tubes above the capillaries are connected together through a sensitive manometer. When the same gas is drawn through both tubes, there will be no difference in the manometer level. However, if the gases differ in density and viscosity (or in either density or viscosity), a difference in level will result. One of the gases may be air, used for reference, and the other a mixture of air with other constituents; or one may be air contaminated with a solvent or other vapor, while the other is the same air with the contaminating material removed.

Using these principles, two indicating instruments have been developed. One, known as the "Air type," uses atmospheric air as the reference gas, while the other, known as the "Petrol type," employs absorption equipment for removing from the air the constituent to be measured. In this second type, therefore, the difference between the two gases is represented by the absence from one of the air streams of the constituent which is to be measured.

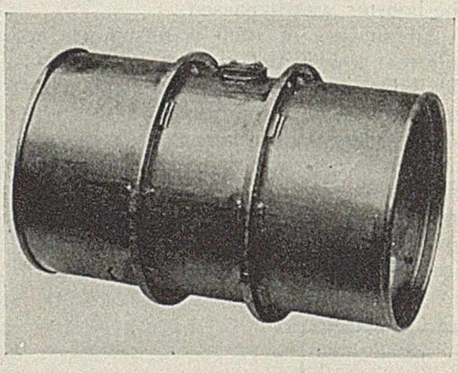
Diagram of viscosity effusion bridge



Instruments, as supplied, include all necessary auxiliary apparatus, including a vacuum pump, the necessary drying, scrubbing and absorption equipment. Results in general are said to be accurate within from 0.1 to 0.2 per cent by volume.

Lead-Lined Drum

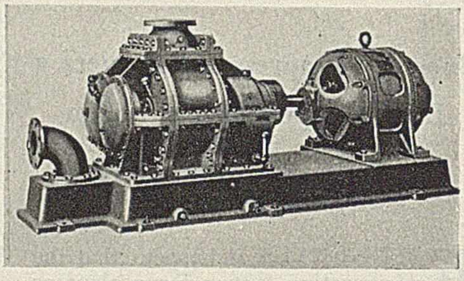
Approval by the Bureau of Explosives for the transportation of corrosive chemicals has recently been accorded to the I.C.C. 5 H lead-lined steel drum developed by the Republic Lead Equipment Co., 7930 Jones Road, Cleveland, Ohio. A homogeneous lead coating with a minimum thickness of 3/32 in. is used. The drum is intended for such materials as sulphuric, phosphoric and hydrofluoric acids. Among its advantages are mentioned the elimination of breakage and the saving of space in transit.



I. C. C. 5H homogeneous-lead-lined drum

Rotary Vacuum Pump

Roller bearings, readily adjustable; pressure lubrication, a muffling device built into the base, and protection of gears and bearings from damage by water and impurities, are features of the new Hi-Speed Connersville Vacuum Pump for suction rolls and flat boxes in paper mills, recently introduced by Roots - Connersville - Wilbraham, Connersville, Ind. This pump is of the cycloidal type, but differs in numerous respects from earlier models. It operates with top inlet and bottom discharge to avoid trouble with water and is designed for considerably higher speeds than older type pumps. Consequently, better volumetric efficiency is claimed together with lower power consumption and smaller floor space required. Sizes range from 7x7 to 18x21 in., and capacities from 338 c.f.m. to 4,450 c.f.m. at 10 in. vacuum. The vacuum capacity may be as high as 20 in.



New direct-connected vacuum pump

Equipment Briefs

Bausch & Lomb Optical Co., Rochester, N. Y., has developed a new photoelectric opacimeter for paper, after the design of Dr. M. N. Davis of Kimberly-Clark. The instrument gives both printing opacity and contrast ratio without calculation; by the use of a Weston Photronic cell and filter, it closely approximates the reaction of the eye.

General Electric Co. has a new all-electric timer which can operate a signal or terminate a process at the end of a predetermined period. The timing element is a Telechron motor and the timing interval may be selected within wide limits.

The same company has announced a new oil-immersed explosion-proof switch for Class I Group D hazardous gas locations. It is built in three sizes for motors up to 50 hp., 440 volts. Inasmuch as the construction is weatherproof, the switch may be located outdoors if necessary.

For use with its seatless blow-off valves, Yarnall-Waring Co., Philadelphia, has brought out a new form of laminated packing consisting of stainless steel rings alternating with long-fiber asbestos packing. On tests the new rings were found to eliminate leakage even at pressures as high as 2,100 lb. and under throttling service.

Non-inductive loads up to 25 amp. at 250 volts may be interrupted with a new mercury tube relay switch brought out by the Hart Mfg. Co., Hartford, Conn. Such switches are especially important in hazardous atmospheres.

Virtual elimination of silicosis hazards is claimed for a new mask introduced under the designation of Style 601 by the Chicago Eye Shield Co., Chicago, Ill. The protection against dust is said to be higher than 99 per cent and is obtained by the use of a soft, molded-rubber face piece designed to adapt itself to any facial contour. Air is supplied under pressure through a hose and filter.

Metallic lead is the protective element in a new lubricant called Bestolife, made by the Armite Laboratories, of Los Angeles. The lead, very finely divided, constitutes between 15 and 65 per cent of this material. For pump packing, for pipe joints and for lubricating heavy machinery, this material is said to withstand temperatures up to 430 deg.

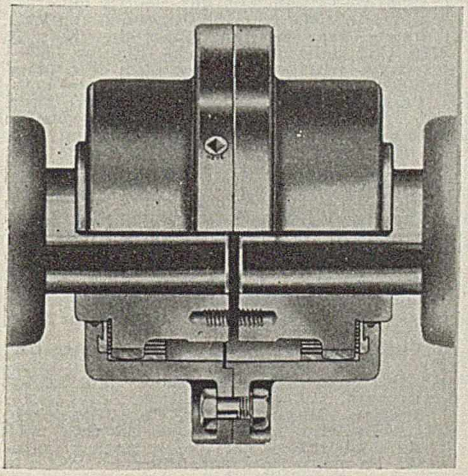
Weston Electrical Instrument Corp., Newark, N. J., has put on the market an inexpensive Photronic control kit for engineers who want to do their own experimenting with photoelectric control. The kit is said to contain all equipment necessary for numerous applications.

A new series of industrial lubricants, introduced under the name of Sta-Put, has been announced by E. F. Houghton & Co., Philadelphia, Pa. These products are made by polymerizing pure mineral oil with a consequent increase in film strength. The lubricants range in consistency from light machine oils to heavy cup greases.

Gear-Type Coupling

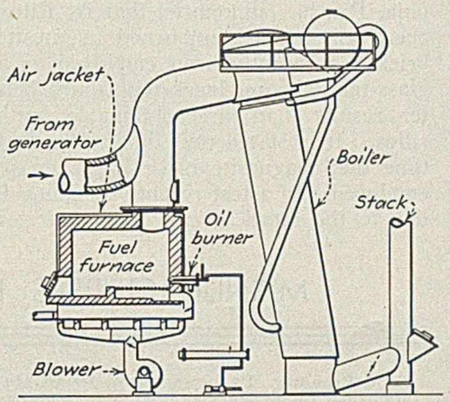
High-speed capacity and a high degree of flexibility are incorporated, according to the Farrel-Birmingham Co., of Buffalo, N. Y., in a new line of flexible couplings known as "Gearflex," recently added to its line. The double-engagement type, illustrated, consists essentially of two externally-geared hubs keyed to the two shafts to be connected, engaging an internally-geared floating sleeve which encases the two hubs. A similar type, for less severe duty, employs only one externally-geared hub in engagement with an internal gear in the sleeve. The reservoir between the hubs and the floating sleeve carries the supply of lubricant. It is said that this results in a perfect oil cushion between teeth without metal-to-metal contact.

Cross-section of new gear-type coupling



Waste Heat Boiler

An accompanying illustration shows a new form of combination waste-heat and fuel-fired boiler recently developed by the Semet-Solvay Engineering Corp., 40 Rector Street, New York City.



Combination waste-heat and fuel-fired boiler

This boiler, designed for use in water-gas plants, may be operated either by the blast gases alone or by the blast gases in automatic cycle with a fuel-fired combustion unit. Air for the latter, which is intended to burn surplus tar or low-grade oil, is preheated by passage through an air jacket surrounding the combustion space. Among the advantages of the new equipment the manufacturers point to its small floor space, its lack of additional plant labor, and its automatic operation. The boiler is said to be of high efficiency and to result in greatly lowered steam cost.

Improved Compressors

Ingersoll-Rand Co., 11 Broadway, New York City, has recently developed two improved compressors, one a heavy-duty air or gas compressor, called Class ES, and the other a two-stage air-cooled compressor for stationary service, known as the "Motorcompressor." The first is a single-stage, double-acting, horizontal crosshead type for heavy, continuous service at moderate speeds. It is built in sizes from 10 to 125 hp. and for pressures from 5 to 150 lb. It is adapted to various sorts of drives including direct, synchronous-motor connection.

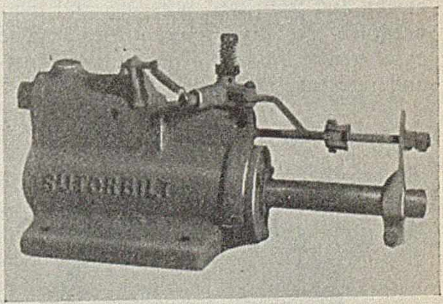
The second compressor, for 100 lb. discharge pressure in the range from 20 to 50 hp., employs a built-in motor. Depending on size, this compressor has either two or four low-pressure cylinders and one or two high-pressure cylinders. This type of construction is said to result in a saving in power of 15 per cent with the production of 23 per cent more air. The floor space requirement is small, practically no foundations are needed, and the unit is quiet and vibrationless, according to the manufacturer. The compressor is designed for continuous operation and is said to avoid carbonization of valves due to operation in two stages with air inter-cooling.

Moisture Tester

Quick determination of moisture in such materials as sand, coal, coke, oxides, paper and other materials is possible with the "Speedy" moisture tester recently introduced by the Alpha-Lux Co., 192 Front St., New York City. The apparatus consists of a small shaker in the bottom of which is a pressure gage calibrated in terms of percentage moisture content. The material to be tested is weighed into the shaker, to which is added a measured volume of a chemical which, in combination with the moisture in the material, results in a pressure rise proportional to the moisture content. The shaker is sealed and shaken until the pressure indicated on the dial remains constant. It is stated that tests can be made in as little as one to two minutes with variations in duplicate tests not greater than one-tenth per cent.

Slow-Speed Vibrator

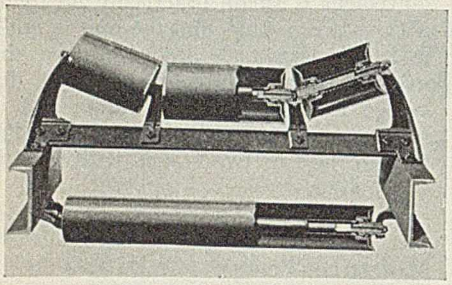
Compressed air at 30 to 100 lb. pressure is the operating medium for the new Woodpecker vibrator recently announced by Sutorbilt Corp., 2008 East Slauson Avenue, Los Angeles, Calif. This device is used for dislodging dust from dust arresters and shaking down material deposited into sacks, etc. Air consumption is about 1 cu.ft. per minute and operation is adjustable for speed and intensity of the blow. The range of vibration speeds is from 50 to 200 blows per minute.



Air-operated slow-speed vibrator

Universal Belt Idler

Application in all fields where belts are used for materials handling, is claimed by the Jeffrey Mfg. Co., Columbus, Ohio, for its new Reliance line



Cutaway view of new Reliance idlers

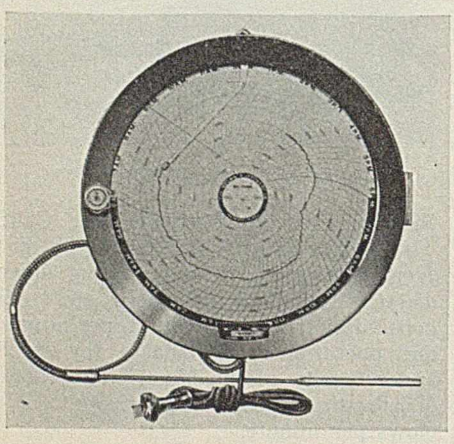
of belt idlers. These idlers feature one-piece balanced rolls; self-aligning, tapered roller bearings; double labyrinth grease seals; a large grease reservoir between the bearings; one-piece malleable iron stands; and self-cleaning bases. These features are evident from the accompanying cutaway view. The rolls are easily removable and are available in 4, 5 and 6 in. diameters for belt widths up to 60 in.

New Recording Instrument

Both thermometers and pressure gages are included in a new and improved line of 8-in. and 12-in. circular-chart instruments recently announced by the Brown Instrument Co., Philadelphia, Pa. The thermometers include indicating and recording types for temperatures from minus 40 deg. up to 1,200 deg. F. The gages, for both pressure and vacuum, range from 10 in. of water up to 5,000 lb. All types are available in one-, two- and three-pen models.

These instruments feature electric clocks and improved pressure and temperature sensitive mechanisms. The cases are of die-cast aluminum, of dust- and moisture-proof design.

Improved recording thermometer



Enamel-Lined Tanks

After some four years of experience in the coating of steel pipe lines with glass enamel, the A. O. Smith Corp., Milwaukee, Wis., has announced the extension of its glass-coating service to the large steel storage tanks of its manufacture. The company is prepared to supply such tanks for the storage and aging of beer, and for other purposes for which the protection of glass lining is required.

New Refractory Use

General Refractories Co., Philadelphia, Pa., has announced that its Ritex chemically-bonded, unburned magnesite brick has recently been employed as a glass-tank checker brick with much better results than are obtainable with silica. It is stated that this is the first time that magnesite brick has been so employed. In a test recently conducted, due to the attack of the fluxes carried over into the checker chamber, silica brick lost 30 per cent of their volume in five months. Ritex brick during this period were unaffected.

Continuous Foam Generator

For converting a fire line from a continuous water stream to a continuous foam stream, the Pyrene Mfg. Co., Newark, N. J., has introduced the Phomene Hopper, a device in which water and Phomene powder are continuously mixed for discharge through a hose line. The water enters at one side of the apparatus, Phomene powder is poured into the hopper and foam is continuously discharged. The flow of powder is governed automatically by the pressure and amount of water available, and the foam production is rapid. The device weighs only 42 lb. and is readily carried in one hand. The foam produced blankets burning liquids and solids and is said to result in quick smothering of the fire.

MANUFACTURERS' LATEST PUBLICATIONS

Acid-Proofing. Patterson Foundry & Machine Co., East Liverpool, Ohio — 4-page pamphlet describing the use of this company's Porox ceramic lining material and cement for acid-proofing new and old containers.

Apparatus. Pfaltz & Bauer, Inc., 300 Pearl St., New York City—This company is announcing new literature on scientific apparatus manufactured by C. Reichert, Vienna. Includes microscopes and other optical apparatus.

Balsa Wood. Balsa Wood Co., Brooklyn, N. Y.—8 pages on the properties and uses of Lata Balsa.

Crushers. Traylor Engineering & Mfg. Co., Allentown, Pa. — Bulletin 2110 — 14 pages on this company's Type TZ Bell-Head gyratory crusher.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-1654A, 16 pages on photoelectric relays; GEA-1800, automatic electric water heaters for industrial use; GEA-937C, 36 pages on three plastic products made by G.E., with price lists.

Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis. — Bulletin 1451-F — 12 pages on Dodge and Blake standard and sectional jaw crushers; 2164, leaflet briefly illustrating crushing, screening and washing plant machinery.

Equipment. Steam and Combustion Co., 1559 Sheffield Ave., Chicago, Ill.—8-page bulletin describing the use of this company's boilers and burners at A Century of Progress Exposition.

Equipment. Worthington Pump & Machinery Corp., Harrison, N. J. — Bulletins D-316-S1 and W-317-S1A, respectively vertical and horizontal Freflo centrifugal pumps for handling solids-containing liquids; Bulletin L-600-B3 and L-622-S1, covering types and specifications on vertical, duplex-type refrigeration compressors.

FlakIce. FlakIce Corp. of N. Y., 185 Montague St., Brooklyn, N. Y.—Bulletin 10 —4 pages describing the advantages of this company's equipment for flaked ice production.

Instruments. Amthor Testing Instrument Co., 309 Johnson St., Brooklyn, N. Y. — Circular 108 — Lists and briefly describes humidity indicators and recorders.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Folder briefly describing indicating, recording and controlling instruments for temperature, flow, carbon dioxide, pressure, speed and liquid level. Also folder describing recent improvements in this company's recording thermometers and pressure gages.

Instruments. Foxboro Co., Foxboro, Mass.—Leaflet describing recent improvements in this company's pressure gages.

Lubrication. Acheson Oildag Co., Port Huron, Mich.—Bulletin C-200—Covers the mechanics of lubrication with colloidal graphite.

Lubrication. Pure Oil Co., Chicago, Ill.—Mechanical Bulletin 57 — 50-page educational booklet on the lubrication of bearings, discussing this subject in relation to the various types of bearings, types of bearing metals, types of lubricants and application of lubricants.

Materials Handling. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill.—Data Book 1289—128 pages with engineering data and price lists on screw conveyors; Folder 1665, 4 pages on conveyor chains for handling glassware.

Metals and Alloys. H. Boker Co., 101 Duane St., New York City—Bulletin 1—12 pages on methods for fabricating this company's nickel-clad steel.

Mixers. Ransome Concrete Machinery Co., Dunellen, N. J.—Bulletin 501—6 pages on rotary, dustproof mixers and blenders for chemicals, fertilizers, and similar materials.

Motors. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo. — Bulletin 174-5-1—2 pages on three types of vertical motor.

Power Generation. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Booklet C 1959-A—12 pages on gas-electric generating sets in sizes from 800 watts to 100 kva.

Power Transmission. Diamond Chain & Mfg. Co., Indianapolis, Ind.—Catalog 583—96 pages with engineering data and price lists on transmission chains and sprockets.

Pumps. Chicago Pump Co., 2300 Wolfram St., Chicago, Ill.—New 400-page general catalog including about 40 individual bulletins covering this company's entire line of pumps, ejectors, screens and liquid samplers. Information on pump selection is included.

Pumps. Warren Steam Pump Co., Warren, Mass.—16 pages on centrifugal and steam pumps manufactured by this company.

Refrigeration. Ingersoll-Rand Co., Phillipsburg, N. J.—Form 9043—12 pages on steam-jet refrigeration, describing principles and applications.

Regulators. Northern Equipment Co., Erie, Pa.—40-page catalog on this company's feed-water regulators and allied equipment.

Testing. Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 100—4 pages on this company's laboratory service in testing materials for magnetic separability.

NEWS OF THE INDUSTRY

Outlook for capital goods industries improved by work of NRA to further sales and financing. The Chemical Engineering Equipment Institute also is working toward the same end. Objections voiced by smaller producers to code as drawn for wood distillation industry. Selden upheld in appeal of vanadium catalyst case.

▼

Chemical Equipment Makers Push Work on Code

FURTHER progress on the tentative code of the Chemical Engineering Equipment Institute was made at a meeting of the officers and board of directors, held at the Chemists' Club in New York on Sept. 22. Several changes were accepted as a result of suggestions received from the membership but a proposal that the Institute should be restricted to manufacturers was vigorously opposed on the ground that the distributors and erectors were an essential part of the chemical engineering equipment industry. The code will shortly be ready for submission to the NRA, presumably through the offices of the Machinery and Allied Products Institute, with which the chemical group is affiliated.

The annual meeting of the Institute will be held at the Chemists' Club, 10 A.M. on Tuesday, Oct. 31. At that time permanent officers will be elected, following a report of the nominating committee of which Arthur Wright, of Arthur Wright and Associates, is chairman. The members include—E. C. Clark of Bethlehem Foundry and Machine Co., Maurice Knight of Maurice Knight, Inc., James E. Moul of the Turbo-Mixer Corp., and W. H. Scott of the Duriron Co.

Membership in the Institute continues to grow, eleven firms having joined or made application since the last announcement in the September *Chem. & Met.* These are as follows: John F. Abernethy & Co., Inc. of Brooklyn; Acme Coppersmithing and Machine Co., Philadelphia; The Biggs Boiler Works Co. of Akron, Ohio; Chemical Equipment Co. of Montpelier, Ind.; J. P. Devine Manufacturing Co., Mt. Vernon, Ill.; Isolantite; Inc., of Belleville, N. J.; Mixing Equipment Co., Rochester, N. Y.; Pulverizing Machinery Co., Roselle Park, N. J.; Robinson Manufacturing Co. of Muncy, Pa.; Stebbins Engineering & Manufacturing Co., Watertown, N. Y.; Arthur Wright and Associates, of New York.

Group Sessions Arranged For A.P.I. Meeting

AT THE fourteenth annual meeting of The American Petroleum Institute to be held Oct. 24-26 at the Stevens Hotel, Chicago, eleven group sessions of the Divisions of Production, Refining, and Marketing will be held and nearly one hundred of the Institute's working committees will meet. The Division of Production will hold five sessions; the marketing division three sessions, and the refining two sessions, in addition to a joint session of the Divisions of Refining and Marketing.

Papers of chemical engineering interest to be presented include: "Corrosion—Fatigue and Protective Coatings," F. N. Speller and I. B. McCorkle, National Tube Co.; "Corrosion Fatigue and Sucker Road Failures," Blaine B. Wescott and C. N. Bowers, Gulf Research and Development Corp.; "Combating Corrosion of Production Equipment," Stanley Gill, Consulting Engineer; "Special Alloys for Working Barrels and Balls and Seats," W. F. Rogers, Gulf Production Co.

"Solvent Extraction and Its Application," J. W. Poole, J. M. Wadsworth, Foster-Wheeler Corp.; "Refining of Lubricating Oils by Solvent Extraction with Furfural," R. E. Manley, B. Y. McCarty, and H. H. Gross, The Texas Co.; "Scope and Flexibility of the Edeleanu Processes," O. P. Cottrell, The Edeleanu Co.; "The Nitro-Benzene Process—Construction and Operating Costs," S. B. Ferris, W. A. Myers, and A. J. Peterkin, The Atlantic Refining Co.; "Chlorex Process for Producing High-Grade Lubricating Oil," W. H. Bahlke, A. B. Brown, and F. F. Diwoky, Standard Oil Co. (Indiana); "Relation of Duo-Sol Process to Other Processing Steps Necessary for Lubricating-Oil Manufacture," Malcolm Tuttle and Max B. Miller, Max B. Miller Co.; "The Use of Phenol as a Selective Solvent in the Production of High-Grade Motor Oil," R. K. Stratford, O. S. Pokorny, and J. K. Hugett, Standard Oil Development Co.

Washington Pulp Companies Plan Merger

PENDING favorable action by their respective boards of directors and stockholders, three pulp companies in Washington are planning to merge. The companies involved are The Ranier Pulp & Paper Co. at Shelton, The Soundview Pulp Co. at Everett, and the Olympic Forest Products Co., at Port Angeles.

The Rainier Pulp & Paper Company has specialized in the production of chemical pulp used primarily in the manufacture of rayon and cellophane and has developed world-wide markets for its output. It may be necessary as a measure of economy in operation to remove the machinery from Shelton to one of the other plants.

The new company would have assets representing an original investment of $15,000,000 which have a present depreciated value of $10,000,000. Also it would have net capital assets of more than $1,000,000 for operations. The total output of the new company will be in excess of 150,000 tons of pulp a year, which is somewhat less than their combined capacity.

DuPont Company Refutes Charge of A. F. of L.

IN A bulletin issued to its stockholders, the E. I. du Pont de Nemours & Co. refers to a statement attributed to the American Federation of Labor and appearing in the public press of Sept. 20. In part the statement reads: "William Green, president of the American Federation of Labor, today laid before General Hugh S. Johnson, recovery administrator, a mass of evidence which, he asserted, shows the various types of effort being made by certain great corporate powers to defeat the labor section of the National Recovery Act." The du Pont company was specifically mentioned as one of these corporations. In refutation the du Pont bulletin described Mr. Green's charges as a deliberate and direct attack upon the Employes' Representation Plan of E. I. du Pont de Nemours & Co.

The bulletin states: "This plan does not provide for a labor union, nor a company union, nor is it an 'organization' of any sort. It is simply a plan offered to the employes whereby they may elect representatives, and whereby those representatives may confer with an equal number of representatives of the plant management, and discuss employe-employer relations and make such requests upon the management as the representatives see fit. No membership is required of the employe, no dues are required and no expense to the employe is involved."

It further reads: "It is the belief of the management of E. I. du Pont de Nemours & Co. that the company's employes may organize under the American Federation of Labor, if they see fit; or they may join any other union, if they see fit; or they may cooperate through an Employes' Representation Plan, if they see fit, or each employe may bargain individually with the company. The contention of the American Federation of Labor seems to be that the National Industrial Recovery Act compels employes to organize only under the American Federation of Labor."

Selden Upheld in Vanadium Catalyst Appeal

APPEALING the decision of the U. S. District Court in which its Slama and Wolf patent on the use of vanadium and kieselguhr as a sulphuric acid catalyst had been held not to be infringed by the Selden Co., (*Chem. & Met.*, July, 1932, p. 408) the General Chemical Co. took the case to the U. S. Circuit Court of Appeals, Third District. In an opinion filed on Sept. 20, 1933, Judge Buffington of that court found "no flaw in the trial court's reasoning or error in its finding of non-infringement." Pointing out that the plaintiff had made no use of the Slama and Wolf patent until after the defendant had commenced to use a vanadium catalyst, the court commented, "Indeed, its [the plaintiff's] first and only use of vanadium with kieselguhr was taught them, not by their patent, but by the defendant's practice."

Amalgamation Planned for Paint Associations

AT THE annual conventions of the National Paint, Oil and Varnish Association and the American Paint and Varnish Manufacturers Association which will open in Chicago on Oct. 30, the question of amalgamating the two organizations will come up for ratification.

A report for the amalgamation committee on the merger proposal was submitted to the executives of the associations September 25.

The committee found a general feeling that a necessity exists for reorganizing the association set-up of the industry in order to cope with problems arising in connection with the administration of the National Industrial Recovery Act. It was also considered necessary to simplify the functioning of organization in the minds of many members of the industry where confusion apparently exists because of the present set-up. After careful consideration, the executive boards approved the recommending to the Chicago conventions of amalgamation of the two associations. A committee on constitution and by-laws was appointed to submit to the conventions a new constitution and by-laws covering the new organization.

Research Foundation Gains Support in Northwest

INDUSTRY is joining with university authorities in the development of Northwest Research Foundation, a nonprofit organization for the development and utilization of resources. The interpretation of natural resources is a very broad one, extending to agricultural, mineral, and other types, particularly in Minnesota and nearby territory, but extending westward as far as activities may be feasible. The Foundation itself undertakes to raise funds for the doing of necessary research. The investigations are to be directed by a staff at the University of Minnesota, and in some cases parts of the investigations may also be placed elsewhere but subject to this university's general charge.

Large Attendance Predicted For Chemical Show

ACCORDING to reports from the committee in charge, interest is increasing in the Fourteenth Exposition of Chemical Industries which will be held the first week of December at Grand Central Palace, New York.

The Exposition is classified broadly to include: raw materials, finished products, machinery and equipment, and educational exhibits. There will be sections devoted to materials handling equipment, and instruments of precision. Plastics will be the subject of a special group. Some of the phenomenal new applications of these materials will be displayed for the first time. The Brewing Industries Section, a new feature this year, recalls the chemical background of the ancient industry now entering its American renaissance. The modern chemical aspects of the brewing industry are not only from the side of process chemistry. From the viewpoint of chemical engineering the latest technique in unit processes, such as distillation, is valuably applied to the old art.

The number of exhibitors, at this time in advance of the Exposition, is already greater than in previous years. The audience attendance seems bound to establish a new high record, and this not only because the Exposition is longer established—it has constantly increased its attendance figures. There is another factor, this year, and that is the reawakened and concentrated industrial interest, and the desire of everyone, in every line, to take advantage of unusual opportunities to acquire information not otherwise available.

Visitor admission is by invitation and registration only. The reason for this, as in the past, is to provide the most favorable conditions for the Exposition audience.

Chrome Ore Deposit in Philippine Islands

AN extensive and rich deposit of chromite ore has been discovered in the Philippine Islands and preparations are being made to work the find at once, according to a dispatch to the Department of Commerce. The deposit lies near tidewater on Lagomon Gulf in the province of Caramines Sur, Island of Luzon, and is estimated to contain some 50,000 tons, analyzing about 50 per cent chromic oxide and 15 per cent iron oxide. It was discovered after 7 months prospecting by the Floramine Mining Co., and is to be mined jointly by the Benguet Consolidated Mining Co. and the Cadwallader-Gibson Lumber Co.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

SUMMARIZING the commitments for power development and transmission and for industrial projects under its control, the T.V.A. Board recently indicated the earmarking of funds provided in the initial appropriations incident to its establishment. Approximately $34 million has been set aside to build Norris Dam at Cove Creek. Seven million has been allotted for the transmission line from Muscle Shoals to the new dam. Fertilizer investigations, development, and marketing prospectively require $3,500,000 to $4,000,000.

Initiating its fertilizer program, the chemical engineering division is having commercial-scale projects studied, particularly for the manufacture of phosphorus. The production of this fertilizer element at low cost is an essential first step to the achievement of the obligations of the Authority, as described in the organic act. Various types of blast furnace, electric furnace, and other novel unit designs are being studied. An early decision between processes is expected in order that more detailed plans may be drawn and actual construction undertaken in the early winter. No official announcements have been made as to the prospective capacity of such plant.

Arrangement has been made by T.V.A. with the Research Corporation of New York City and the Bureau of Chemistry and Soils, to carry on additional work. Under this research directed by P. H. Royster on blast furnace recovery of phophorus from phosphate rock will be accelerated. Engineering data needed for the completion of designs of a commercial unit of this type will thus be made available at the earliest possible date.

H. C. McKenzie, of the H. C. McKenzie Company, Walton, N. Y., claiming authorization to speak for small plants in Delaware county, southeastern New York, all of them with a capacity of less than 40 cords of wood per day but with a combined capacity of 125 cords, offered criticism at the hearing on the code for the hardwood distillation industry on Oct. 3. He stated that these plants exist to furnish charcoal to New York City, and have considerable difficulty getting an adequate wood supply and they require from six to nine man hours per cord, as compared with three hours for the larger plants.

He also attacked the wage provisions on three scores: Costs at small plants will be increased in greater proportion than at large plants, causing them to close down; all executives should be exempted from the maximum hour provision, not just those, as stipulated in the code, receiving more than $150 per month, as small plants do not pay their executives that much; teamsters should be permitted to work ten hours a day and six days a week, as bad weather will automatically cut down their average to about forty-eight hours a week, and they should be permitted to work as much as possible in good weather.

There is a distinct movement within NRA to concentrate more fully than in the past months on the problem of the capital goods industries. The research and planning division, under Dr. Alexander Sachs, has a group of economists working on all phases of this problem, to find not only the place of encouragement of capital goods purchases, but also the possibilities of financing these purchases with government aid or encouragement.

The capital goods group of economists is made up of Stephen duBrul, sales economist of General Motors, Dr. A. J. Hettinger, Jr., former assistant professor of economics at Harvard, and Donald Woodward of Moody's Investment Service. They have been working rapidly into the heart of the capital goods problem, taking up first construction, second the railways and third the plant equipment and obsolescence problem. They have broken the back of the first two issues, and are now devoting attention to the third. Behind them is a group of some twenty experienced authorities in their various fields.

The accounting problem has taken much attention in their studies. They have found that while depreciation charges are fairly well fixed, the issue of obsolescence does not have the attention it deserves, and that a piece of equipment may be obsolete long before it is amortized and the operating company continue using it although modern equipment would save in operating cost far more than the depreciation charge on the old equipment. This sort of study is typical of the approach which is being made to the problem of reviving American industry at NRA. Behind all the panoply of code making, and the screech of the Blue Eagle, this sort of study continues to spread out into far fields in Washington, making the "research and planning division" of NRA literally the center of the whole thought of Washington on this vital topic.

Reduced costs of production—not labor-saving methods—are the slogan of the movement, which Dr. Sachs and his assistants state frankly is tied in with the increased purchasing power of the NRA plan, and is an essential part of it. Rising prices interest these specialists not at all—the principle is to reduce costs by making things under better methods and with equipment that saves money to the manufacturer and so to the consumer.

Thus following the editorial drive of the McGraw-Hill Publications, NRA is taking this turn, among many others of far-reaching importance, to put the manufacturing industries of the country on the same sound basis as that on which they have built their present and past importance, efficiency and sound methods, backed by adequate modern machinery and taking advantage of all the accumulated experience of the past.

Chemical engineering equipment was represented at an all-day meeting held in Washington, Oct. 5 to consider means of reviving the capital goods industries. John W. O'Leary, president of the Machinery and Allied Products Institute, under whose auspices the conference was called, directed attention to the necessity for settling certain policies of the NRA in order to bring about a real recovery in the machinery industry that in 1929 boasted a collective payroll running well into the billions of dollars.

Present at the meeting were the trade association representatives of the employers of 180,000 skilled workers, the survivors of a highly paid personnel that in normal times averaged well over 400,000 men. The Chemical Engineering Equipment Institute was represented by its secretary, D. H. Killeffer; the Heat Exchange Institute by Russell C. Jones, vice-president of Griscom-Russell Co.; and the Hydraulic Institute by C. E. Searle, executive vice-president of Worthington Pump and Machinery Co.

Although there is no intention at present to set up a master code for the whole machinery industry, the separate groups have generally agreed to hold out for the so-called merit clause and for a 40-hr. week. Further, they will insist that in the manufacture of equipment, a plant should operate under a single code that covers the majority of its operations. Sale of equipment, on the other hand, must of necessity be governed by the various codes applying specifically to the product being marketed. The precedent for this seems to have been established in the case of the grey iron castings code which applies only to manufacture for sale and therefore excludes the manufacture of castings for a company's own use.

NEWS FROM ABROAD

By Special Correspondents of Chem. & Met. at Berlin and Paris

Berlin

GOVERNMENT and industry are now competing in their efforts to combat the results of the economic depression. In the chemical industry alone about 6,600 men have been re-employed during the last two months. A good illustration of the importance of the government's assistance to German commerce was furnished by the fall convention of the German Society for Petroleum Research, founded a few months ago, where the government secretary, Dipl. Ing. Gottfried Feder, among other things emphasized the importance of the plan for creating a network of automobile roads. Not only the asphalt and the tar industry will be greatly affected by this move, but production of motor fuels must be increased, which will make new demands on the coal, lignite, and petroleum industries.

Of great importance to the producers of motor fuels are the investigations on technical hydrogenation made by Dr. Pier of I. G. Farbenindustrie. One of the greatest difficulties encountered in this development was the sulphur content of the raw materials. This evil could be eliminated by the use of catalysts containing sulphur. It was believed that a method had been found whereby a product clear as water could be made in one operation, but by increasing production to a commercial scale the efficiency of the catalyst was found to have suffered by absorption of higher fractions of the tar. Operations were therefore divided into two steps, the liquid phase (also called the sump phase) and the gas phase; a temperature of about 325 deg. C. is assumed to be the dividing line between the two phases. In the sump phase relatively small quantities of cheap catalysts, such as lignite breeze, charcoal, or similar materials (finely dispersed throughout the raw material) are used; the regeneration of these is not considered, but the ensuing loss is of no economic importance. Alkalinity of the catalysts is prevented by addition of acids when necessary. In the gas phase steam at 470 deg. C. is passed over solid catalysts, whereby 30-70 per cent is converted into gasoline and "middle oils," which are returned to the process. By increasing the temperature a greater formation of gaseous hydrocarbons and unsaturated "middle oils" results. From the latter is again obtained unsaturated antiknock gasolines. On this the so-called "aromatisiening" process (conversion into aromatic compounds) depends. By the use of newly discovered catalysts it was found possible to carry the process out at a 50 deg. C. lower temperature whereby the formation of gaseous hydrocarbons is greatly reduced; most important of all, the throughput is three to five times that obtained with the old catalysts. This important improvement made it possible to increase the capacity of the hydrogenation plant at Leuna 200-300 per cent. As a last and most important achievement resulting from the experiences with new catalysts in the "sump" phase I.G. has now developed the successful hydrogenation of lignite on a commercial scale. Lubricating oils, equally as good as the Russian types, may also be produced from lignite by this procedure.

About 3,500,000 tons of coal—that is, about 2.5 per cent of the German output, is necessary to produce the hydrogen and the power required in the manufacture of 1,000,000 tons of gasoline from coal tar.

Osmose Gesellschaft, Bad Kissingen has developed a process for protection of the wood in the forest, which, unlike the older processes, utilizes osmosis instead of diffusion. The green wood, after removal of the bark, is painted with a composition containing a concentrated solution of the protective material. Such solutions will penetrate up to 5 cm. in four to eight weeks. The painting of a bare stripe just above the roots offers a method of protecting the tree against the most harmful beetles.

A new method for production of glass wool has been developed by Dr. Schoop, with the use of his well-known metallizing pistol. With this pistol large quantities of the finest and most uniform glass wool may be made in a short time. On account of the high viscosity of glass no atomizing takes place, but the glass is blown to long fibers. The method may be used for the production of insulating materials.

Dr. H. Nordlinger, Florsheim chemical factory, has succeeded in making a paving material of great adhesive power by passing chlorine into coal tar, the fluidity of which has been increased by gentle heating or by addition of some solvent. The improvement in quality is not accompanied by any appreciable increase in viscosity.

The Lurgi Co., Frankfurt a. Main, has brought a new type of activated carbon, Benzorbon, on the market; in addition to complete recovery of benzene from coke-oven and illuminating gas this carbon also offers an important improvement in gas purification. The gas is almost completely free from residual tar, naphthalene, ammonia, resinous materials, and nitrogen oxides; organic sulphur compounds and hydrocyanic acid are also removed to a very large extent. One gram of this material has an active surface of 650 sq.m. Several large plants in France and England are already using this material. The quantity is said to be $\frac{1}{4}$ to $\frac{1}{8}$ of that used with the regular types of activated carbon.

I. G. Farben has succeeded in hardening gypsum by the use of a hardening agent called Oppan; this makes it exceptionally resistant to moisture and weathering effects and imparts to it great mechanical strength. This company also makes the so-called Iporit used in the production of light concrete. Building stone from concrete made from cement, sand, water, sodium silicate, and Iporit offers great advantages over ordinary brick. It may be sawed and hammered and it is also a good insulating material. A 20-cm. Iporit wall is equal to a brick wall of 38 cm. thickness.

Paris

SOME industries experienced fairly satisfactory progress in September, especially the tanning industry, where an appreciable boom in hides has taken place, a boom which still continues; also the bleaching industry and the textile printing, the styles this year calling for printed textile goods. This in turn, has led to a demand for tanning products, bleaching materials, and dyes. In regard to other dyeing industries the pace has varied greatly, according as orders have come in; they have experienced periods of intense activity followed by quiet spells. The Lyons district, where the silk industry is centered, is thus still far from having any prosperity.

If then the situation as far as domestic sales of chemical products is not entirely satisfactory, it is at least tolerable; this, however, does not hold true for exports, where difficulties seem rather on the increase, on account of further tariff regulations, quotas, and import restrictions, and above all the prohibition of capital exports in certain countries, although a chamber of compensation created to deal with this situation has achieved most satisfactory results.

In the meantime, some export industries have been able to maintain business at a normal level. Exports of pharmaceutical products, for instance, during the first six months of the year, amounted to 143,000,000 fr., an increase over the corresponding period of the preceding year, while exports of synthetic dyes was 31,000,000 fr., or almost normal.

On the other hand, the glue and gelatine industry which had been in a difficult position on account of Russian exports at very low prices, against which a defense by quota regulation had offered some protection, has received another blow from the increase in British tariffs, this country being a large importer of gelatine. The difficulties of this industry may also be judged by the fact that French exports, which in 1929 were about 7,000 tons, fell to 1,300 tons for the first six months of 1933. This explains the poor financial results of several companies; Coignet, one of the oldest firms in this field, closed last fiscal period with a loss of 4,600,000 fr., against a slight profit in the preceding period.

An attempt is being made to develop new outlets for glue and gelatine by the European group which includes the different l'Epidos factories; a certain number of prizes and awards have been offered, beginning in 1934, for new applications.

In regard to quotas, it should be noted that from Oct. 1 the government has decided to modify the conditions, and not to release more than 25 per cent of the previously fixed quota, using the 75 per cent thus made available to obtain by negotiations with foreign countries, preferential tariffs or exchange for French manufactured products. The problem, in summarizing, resolves itself to the application of some reciprocal formula for equalizing as far as possible the trade balances with the countries which export to France, but which buy only a few French products. This measure has been quite well received by industry.

Unfavorable conditions in the agricultural industry have had an appreciable effect upon the sales of phosphate fertilizers, such as superphosphate and Thomas slag, the consumption of which has constantly diminished. While it was 390,000 tons (calculated as P_2O_5) in 1913, it was not more than 380,000 tons in 1931. But even a better illustration is that while 200,000 tons of superphosphate was exported in 1930, 120,000 tons was imported in 1932, and the exports of Thomas slag fell from 990,000 tons in 1930 to 545,000 tons in 1932.

As a result, consumption of natural phosphates by the chemical industry has fallen from 1,730,000 tons in 1929 to about 1,000,000 tons in 1932. Here may be mentioned that negotiations are under way between the North-African phosphate producers and the American producers, in effort to arrive at some agreement regarding this important raw-material, of which the French colonies produced 3,250,000 in 1932, almost half of the world production which was 6,800,000 tons.

On the other hand, if there has been a decrease in the consumption of phosphate fertilizers, this has not been the case with nitrogen fertilizers the consumption of which has gone up; consumption of potash fertilizers was practically the same in 1932 as in the two preceding years. Imports of Chilean nitrate showed a drop, only 143,660 tons in 1932, compared with 324,920 tons in 1930-31. Attention is, however, called to the increase in imports of synthetic sodium nitrate which reached the same figure as that of Chilean nitrate with 143,000 tons for the period 1932-33. An important part of this nitrate was of German origin, as French production is yet too small to satisfy domestic demands.

In regard to international conventions attention is called to the recent negotiations between the nitrate producers, at Ostende, and also to the fact that Germany has withdrawn from the agreement among the producers of artificial silk, completed not quite a year ago.

Acetylene Association Meets in Chicago

ACETYLENE interests, producers, marketers and users joined in a well-balanced program at the meeting of International Acetylene Association at Chicago, Sept. 26 to 29. Four programs for technical papers and reports made clear the tremendous recent progress of acetylene in steel treatment, railway maintenance and operation, production of equipment for refrigeration and air conditioning, pipe welding, process industry equipment, and a multitude of other industrial services.

The Morehead Medal award was a high-light of the convention, an annual recognition of a service advancing the "industry or the art of producing or utilizing calcium carbide or its derivatives." The award was to the Rev. Dr. Julius Arthur Nieuwland, professor of organic chemistry, University of Notre Dame, South Bend, Ind., for pioneer and scholarly achievements in research on reactions of acetylene and the development of the derivatives. This work, begun as early as 1904, was continued uninterrupted as a part of the academic efforts of this distinguished Catholic scientist.

Entertainment features of the convention were limited because of the Chicago Century of Progress, but included a dramatic production of "The Prosperity Process," an industrial drama written particularly for I.A.A. Members of the industry constituted a most effective cast, affording both entertainment and a novel, but none the less effective, presentation of the service possibility in rebuilding an equipment plant for profit making through extensive use of modern acetylene equipment.

Newly elected officers included: President, H. B. Pearson, Compressed Industrial Gases, Inc., Chicago, Ill.; vice-president, Philip Kearny, K-G Welding & Cutting Co., New York; the re-elected secretary, H. F. Reinhard, and treasurer, W. E. Cotter.

Foreign Representatives Attend Gas Convention

GAS men of America were joined by foreign representatives for the Fifteenth Annual Convention of A.G.A. in Chicago, Sept. 25-29. This international characteristic was accounted for by the designation of the convention as International Gas Conference and participation on the program of a number of distinguished foreign representatives. It is notable that the convention also was held under the presidency of the distinguished Canadian gas engineer, Arthur Hewitt, of the Consumers Gas Co. of Toronto.

Merchandising, rates, and public relations obviously today constitute the outstanding problems of the industry, as was evidenced by the character of the general programs. The same characteristics affected even the programs of the Technical Section, as much less emphasis than usual was given to the engineering subjects of production and transmission. This fact can, however, be largely accounted for by the extensive program dealing with chemical engineering and related phases of the industry at the time of the Production Conference of A.G.A. last spring (see *Chem. & Met.*, p. 310, June, 1933).

Newly elected officers of A.G.A. for 1933-34 include: President, H. O. Caster, Henry L. Doherty & Co., New York City; vice-president, P. S. Young, Public Service Electric & Gas Co., Newark, N. J., and Technical Section officers: Chairman, O. S. Hagerman, American Light & Traction Co., Chicago, and vice-chairman, C. A. Harrison, Henry L. Doherty & Co., New York City.

The annual Beale Medal award was made this year to S. S. Tomkins, assistant chief chemist, Consolidated Gas Co. of New York. This award recognized his paper on "Gas Detection Instruments," presented last year, as the outstanding technical contribution given before A.G.A. meetings.

Names in the News

L. C. Hughes, consulting engineer in the alkali and salt industries, sailed for the Argentine on Oct. 14 to be gone about six months. He has been engaged to make a survey of the possibilities of developing certain heavy chemical industries in South America.

Almon G. Hovey has been engaged by Beck, Koller & Co. as director of research in charge of the company's Detroit laboratories. In 1924 he joined the research staff of the General Electric Co. and has been employed in development of synthetic resins, plastics, and electrical insulation materials.

Frank Kerze, formerly connected with the United States Rubber Co., is now at the Edgewater, N. J., plant of the Barrett Co.

Arthur D. Camp, associated for ten years with the National Carbon Co., Inc., has joined the Thomas and Hockwalt Laboratories, Dayton, Ohio, as liaison man between the laboratory and its clients. His activities will also include securing new outlets for the research services of the company.

Ernest J. Sweetland, chairman of the board of Oliver United Filters, was seriously injured recently in an automobile accident in California and is at the Peralta Hospital in Oakland.

H. B. Pearson, president Compressed Industrial Gases, Inc., Chicago, was elected president of the International Acetylene Association at the recent annual convention. He succeeds E. J. Hayden of the Linde Air Products Co.

Adolph G. Rosengarten was elected to the board of directors of the Pennsylvania Salt Manufacturing Co. at its recent meeting.

William R. Hainsworth, director of research at the Electrolux Refrigeration Laboratories, Evansville, Ind., was presented with the annual Charles A. Monroe award for "the most outstanding contribution by an individual to the advancement of the gas industry." Mr. Monroe, the donor of the award, presented it personally to Dr. Hainsworth at a recent meeting.

Photo by Blank-Stoller

Herbert Kaufmann

Herbert Kaufmann has been elected president of the Mutual Chemical Co. of America, of which he has been vice-president and general manager since 1908. Dr. Kaufmann succeeds Frederick W. White, who resigned as president to assume the duties of the newly created office of chairman of the board of directors.

Charles J. Brand, who has been serving as co-administrator of the Agricultural Adjustment Act, terminated his services on Oct. 1, and returned to full-time activity as secretary and treasurer of the National Fertilizer Association.

M. Funder, formerly chief engineer for the Diamond Alkali Co. and more recently engaged in professional work in Russia (see *Chem. & Met.* Nov. 1932) is entering consulting work in chlorine and alkali manufacturing at 331 Madison Ave., New York City.

W. J. Baeza, director of the Industrial Research Co., New York, N. Y., is now retained by the National Guarantors Corp., of the same city, as technical director.

A. V. King has resigned from his position as graduate assistant at Rutgers University and is now with the Connecticut State College.

Milo A. White, a recent graduate of the chemical engineering department of the University of Michigan, has been appointed to the staff of the department of ceramics at Rutgers University.

Arnold Lowan, formerly with Combustion Utilities Corp., has been appointed to a fellowship at the Institute for Advanced Study, Princeton, N. J. Dr. Lowan will work under the direction of Drs. Einstein, Vehlen and Von Neumann.

G. S. Stamatoff, who recently completed his study for a Ph.D. degree at Columbia University, has joined the research staff of A. C. Horn Co., Long Island City, N. Y.

Walter A. Cook has been appointed head of the department of chemistry at Akron University. He succeeds H. E. Simmons, now president of the University. Dr. Cook has been connected with the chemical department for seven years.

Howard I. Cramer, research chemist, Goodyear Tire & Rubber Co., will have charge of the classes in rubber chemistry at the University of Akron.

Lawrence D. Whiting was honored at a dinner given by the St. Louis and Central States Section of the American Association of Cereal Chemists at Evansville, Ind., on Sept. 9. Mr. Whiting is now chief chemist for the Ballard & Ballard Co., Louisville, Ky.

Julius Stieglitz, of the University of Chicago, has retired from administration work of conducting the chemistry department to devote his time to research. A dinner in his honor was given on Sept. 11, by former students and leading chemists in this and foreign countries.

H. J. Rose, a senior fellow of Mellon Institute of Industrial Research, Pittsburgh, has been elected chairman of the

CALENDAR

American Institute of Chemical Engineers, fall meeting, Roanoke, Va., Dec. 12, 13, 14.

Technical Association of the Pulp and Paper Industry, spring meeting, New York, Feb. 19-22, 1934.

American Petroleum Institute, Chicago, Ill., Oct. 24-26.

Federation of Paint & Varnish Production Clubs, convention and paint show, Chicago, Ill., Oct. 26-28.

Fourteenth Exposition of Chemical Industries, New York, week of Dec. 4-9, 1933.

American Chemical Society, spring meeting, St. Petersburg, Fla., week of Mar. 25, 1934.

gas and fuel division of the American Chemical Society for 1933-34.

R. L. Copson, a chemical engineer until recently with Vacuum Oil Co., has been named to take charge of the experimental semi-works scale laboratory, established in Knoxville, of the Tennessee Valley Authority. This laboratory will be developed in quarters leased from the University of Tennessee.

Roy Heaton, an electric furnace specialist until recently at Tacoma, Wash.; and P. E. Howard, statistician with Fixed Nitrogen Research Laboratory, Bureau of Chemistry and Soils, have been appointed by Dr. Harry A. Curtis to the chemical engineering staff of the TVA.

R. L. Huntington has received appointment as associate professor of petroleum engineering at the University of Oklahoma, Norman. Two years ago he resigned his position as general superintendent of natural gasoline plants of the Skelly Oil Co. and took up graduate work at the Massachusetts Institute of Technology and later under Prof. G. G. Brown at the University of Michigan. Dr. Huntington succeeds Prof. F. W. Padgett, who has joined the Sun Oil Co.

H. L. Derby, Jr., has been appointed manager of the Chicago office of the American Cyanamid & Chemical Corp. His district embraces the territory west of the state of Ohio extending to the Rocky Mountains.

Ernest Mahler, vice-president of Kimberly-Clark Corp., Neenah, Wis., was awarded the T.A.P.P.I. medal at the recent convention of the society in recognition of outstanding contributions to the technical development of the pulp and paper industry. Only two other individuals have received the award, namely Ogden Minton and W. H. Mason.

A. C. Eide, sales engineer with the American Zinc Oxide Co., sailed for England on a business trip Oct. 13.

Otto Stern, experimental physicist and former head of the institute of physical chemistry at the University of Hamburg, his assistant, I. Estermann, and Ernst Berl, eminent chemist and professor at the Technical University at Darmstadt, are the new members who will join the scientific staff of the Carnegie Institute of Technology.

E. B. Auerbach, formerly president of the Berlin Chemical Society and active in the German compressed gas industry, has accepted a position with the Keith Dunham Co. of Chicago.

OBITUARY

Herbert S. Cobb, formerly with Allied Chemical and Dye Corp., died on Sept. 30, at his home in Chelsea, Mass. Mr. Cobb had been ill for five years. He was 32 years old.

Charles Barefoot of the Phillips Pipe Line Co., East St. Louis, Ill., died Oct. 5. He was a victim of an explosion of gasoline in several large tanks. Mr. Barefoot had risked his life when he climbed to the top of one of the tanks and shut off a valve, preventing further spread of the flames. It was said that he probably saved the lives of a number of other employees. Howard Carver, another chemist, was killed by the same fire. He was 24 years old.

Herbert Thompson

Chauncey B. Forward, inventor of the Forward process for high compression gasoline, died Sept. 29 at his home in Urbana, Ohio. He was 75 years old. Many years ago he became interested in the oil refining industry and organized the Forward Reduction Co. and the Forward Process Co. The latter was merged with the Doherty Research Co.

James P. Millwood, chief chemist for the Okonite Co., Passaic, N. J., died Sept. 24 at his home in that city. He was 65 years old. Mr. Millwood was born in Ireland and was educated at Queens College, Cork, and St. Calman's College, Fermoy, Ireland. He came to this country in 1891 and shortly afterwards joined the laboratory at the Brooklyn Navy Yard. In 1901 he was made chief chemical engineer. Fourteen years later he joined the Okonite Co.

Frank P. Monaghan, general manager of the Glen Falls Portland Cement Co., died Sept. 18. He was 51 years old. Mr. Monaghan was a graduate of the University of Michigan and chief chemist for the Bert Cement Co. He went to Glen Falls 14 years ago from the Alpha Cement Co.'s plant at Alpina, Mich.

Herbert Thompson, general traffic manager of the Union Carbide and Carbon Corp., died Sept. 30, at his home in New York, N. Y. He was 53 years old. Mr. Thompson joined Carbide and Carbon in 1913.

Paul Witteck, former superintendent of the American Hard Rubber Co. plant, Butler, N. J., died on Sept. 12, from pneumonia.

Rudolph Ruetschi, plant engineer of the Mathieson Alkali Works, died at Saltville, Va., on Aug. 7. Mr. Ruetschi was born in March, 1855, at Aaran, Switzerland, and came to America in 1880.

Charles Piez, who with Charles M. Schwab, directed the war time work of the Emergency Fleet Corp., died Oct. 2, at the Garfield Hospital, Washington, D. C. He was chairman of the board of Link-Belt Co., Chicago.

Mr. Piez was a past president of the A.S.M.E. and he served twice as president of the Illinois Manufacturers' Association. The deceased was 67 years old. While pneumonia was the direct cause of his death, his health has been failing for the past 5 years, and since February, 1932, he had been inactive in business. Last May Mr. Piez moved from Chicago to Washington, where he made his home.

Robert A. Chesebrough, who was inventor of petroleum jelly and owner of the trade-mark Vaseline for that product, died Sept. 8 at Spring Lake, N. J., after a short illness. He was 96 years old.

Mr. Chesebrough studied abroad for several years and upon returning to this country in 1858 began making petroleum products. After several years of experimentation in distilling petroleum he developed the jelly which brought him great wealth. And in 1876 he incorporated his business as the Chesebrough Manufacturing Co. and served as its president until he retired 20 years ago.

John C. Henderson, inventor of cast Nichrome, died in the Elizabeth General Hospital, Elizabeth, N. J., Sept. 25. He was 56 years old. Mr. Henderson held 30 or more patents and for the last 20 years has been consulting engineer for the Driver-Harris Co., Harrison, N. J.

Theodore J. Dosch, formerly plant manager for the Niagara Sprayer and Chemical Co., Middleport, N. Y., died Sept. 7, in a San Bernardino, Calif., hospital. His death was the result of injuries received in an automobile accident. He was 52 years old.

CHEMICAL ECONOMICS

While different branches of the chemical industry advanced their rate of operations last month there were recessions in other directions which checked the expansion programs which had been in force since last April and the average rate of production for the industry as a whole fell slightly below that reported for the preceding month.

CONSIDERABLE variation in the rate of productive activity within the chemical industry was reported for September. Fairly substantial gains over the preceding month were made by some branches. However, the slower call for materials on the part of some consumers appears to have influenced many producers to hold inventories down and they failed to maintain the operating rate established in August. There was no material decline, however, as the index number for September was 130.4, which is identical with that reported for July but fractionally below the 131.2 reported for August.

Definite figures are not available for activities since the turn of the month but in some cases, at least, production has been speeded up beyond that attained in September. As an offset, consumption of raw materials in some consuming outlets is expected to decline in the present month.

Statistics for important branches of the chemical-consuming and chemical-producing industries reveal that much higher rates of operation were maintained in August than was the case in August, 1932.

September automobile production by members of the National Automobile Chamber of Commerce totaled 139,153 cars and trucks compared with 173,172 in August and 47,897 in September, 1932, according to an estimate by the Chamber.

The decrease in September from August was 20 per cent, and the increase over September, 1932, was 190 per cent. Including the estimate for September, output by Chamber members for the first nine months of the year was 1,294,582, an increase of 54 per cent over 841,552 units in the like period last year.

Satisfactory maintenance of the productive activity of the country during September, despite a slight downward tendency, was reported by the Department of Commerce in its monthly survey of current business.

All major manufacturing industries for which data are currently available have shown declines with the exception of the lumber and tobacco industries, it was said. Mineral extraction also continued to increase, but increases in output in the coal industry were below seasonal expectations. However, it was added, all the major industries were operating at a substantially higher rate than a year ago.

	Aug. 1933	Aug. 1932
Production		
Acetate of lime, 1000 lb.	3,593	1,179
Methanol, crude, gal. ..	262,446	98,872
Methanol, refined, gal. ..	181,625	150,686
Methanol, synthetic, gal.	860,314	792,641
Automobiles, No.	236,480	90,325
Byproduct coke, 1000 tons	2,923	1,474
Glass containers, 1000 gr.	2,492	1,660
Plate glass, 1000 sq.ft.	11,768	1,843
Cottonseed oil, crude, 1000 lb.	70,878	46,012
Cottonseed oil, refined, 1000 lb.	58,090	39,780
Pyroxylin spread, 1000 lb.	3,691	4,450
Rosin, wood, bbl.	42,961	31,141
Turpentine, wood, bbl. ..	6,779	4,861
Sulphuric acid produced in fertilizer trade, ton	131,492	58,345
Rubber reclaimed, ton ..	11,005	3,101
Consumption		
Cotton, 1000 bales	589	403
Silk, bales	42,852	59,905
Wool, 1000 lb.	55,694	41,361
Sulphuric acid in fertilizer, ton	116,322	52,272
Paint, varnish, and lacquer, sales $1000	20,621	16,032

Freight-car loadings in the fourth quarter of 1933 will be about 15 per cent above actual loadings in the same quarter of 1932, according to the estimate of the Shippers' Regional Advisory Boards.

Every one of the thirteen shippers' boards, the aggregate membership of which is 20,000, throughout the United States reported an increase in the estimated car loadings for the fourth quarter.

Of the twenty-nine commodities covered in the forecast, it is anticipated that twenty-three will show an increase. They are flour, meal and other mill products, hay, straw, alfalfa, cotton, citrus fruits, potatoes, poultry, dairy products, coal, coke, ore, concentrates, gravel, sand, stone, salt, lumber, forest products, petroleum, petroleum products, sugar, syrup, molasses, iron, steel, machinery, boilers, brick, clay products, lime, plaster, agricultural implements, vehicles other than automobiles, automobiles, trucks and parts, fertilizers of all kinds, paper, paperboard, prepared roofing, chemicals, explosives and canned goods, which includes all canned food products.

The six commodities for which reductions are estimated are all grain, cottonseed and products except oil, fresh fruits other than citrus, fresh vegetables other than potatoes, live stock and cement.

Shipments of rayon registered a substantial increase for September as compared with August and with four exceptions were the largest for any month on record, the result being that stocks of yarn in producers' hands today are at the lowest point, relative to production, in the history of the industry and are less than a one week's supply, according to the Textile Organon, published by the Tubize Chatillon Corp.

The outlook in rayon, continues the publication, is for a continuation of the demand of the previous months on through the rest of this year.

The Textile Organon indices of rayon deliveries (unadjusted index) for September and previous months follow:

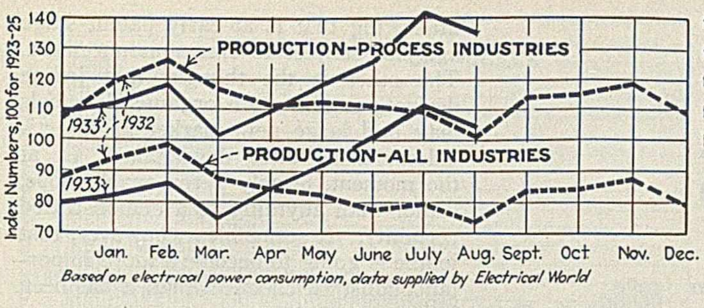
(Daily average 1923-25 equals 100.)

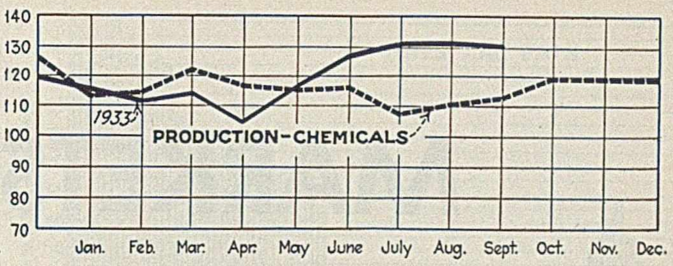
	September	August	July	June	Yearly Average
1933	442	420	470	450	*393
1932	478	406	213	137	293
1931	335	349	312	288	317
1930	304	219	179	225	244
1929	337	281	240	254	277
1928	242	197	169	178	214
1927	211	195	190	194	214
1926	151	138	118	71	181
1925	127	128	124	121	132
1924	116	86	71	77	93
1923	70	50	70	68	75

*Daily average for 1933 to date.

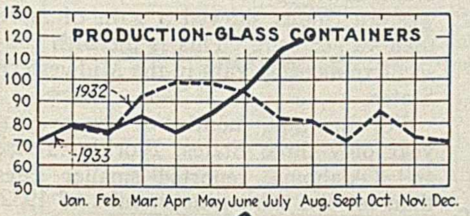
Index numbers used on the graph on the following page are as follows:

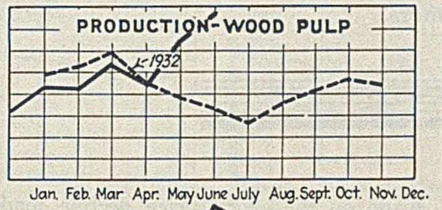
	August
Chemicals	131.2
Glass containers	121.1
Cotton consumed	129.7
Paint, varnish, and lacquer	88.9
Byproduct coke	110.7
Rubber reclaimed	107.2
Plate glass	162.5
Sulphuric acid	103.3

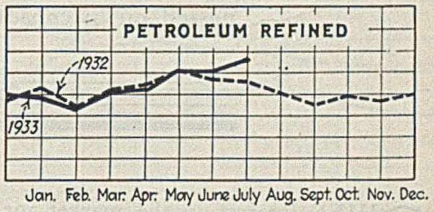


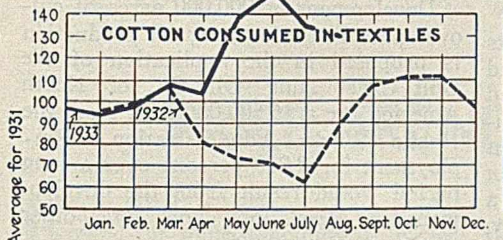


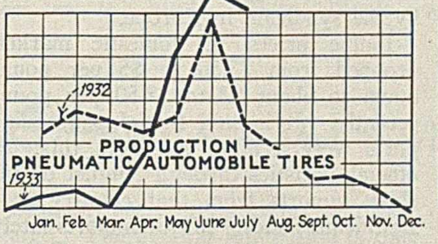
TRENDS OF PRODUCTION AND CONSUMPTION

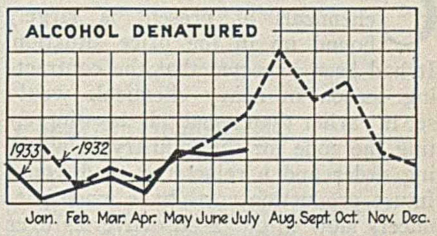


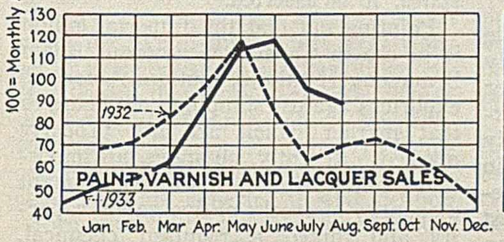


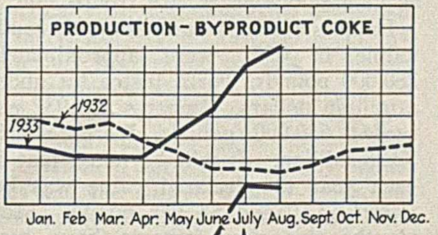


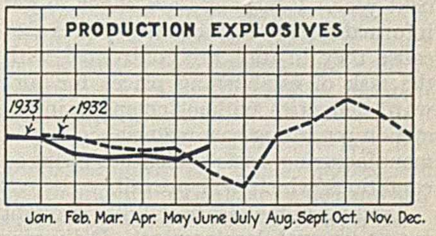


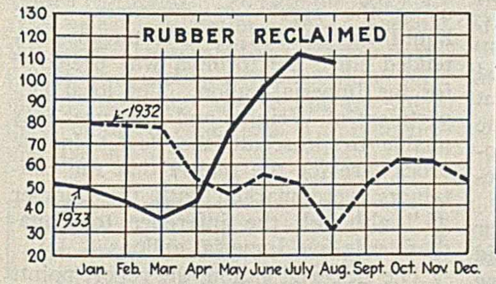


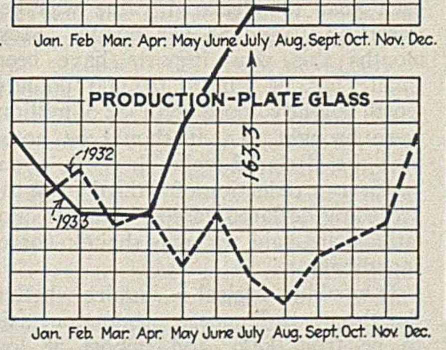


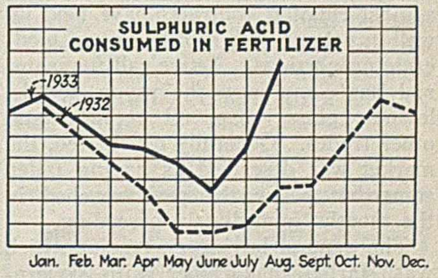


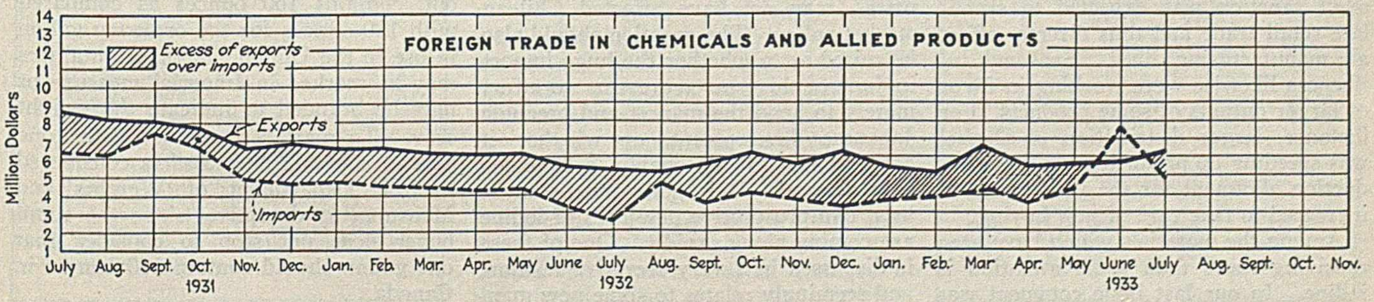












MARKETS

Uncertainty about future production costs defers announcement of new contract prices for alkalis and other heavy chemicals. Contract deliveries hold up well in volume with only moderate interest in the spot market. The price movement last month showed no decided trend but belief prevails that higher manufacturing costs will be passed on to consumers.

CHIEF interest in the market for chemicals at present is largely bound up in the price situation. It had been expected that the contracting season in heavy chemicals would set in earlier than usual. Delays in getting the code for the industry in working order and a reluctance to discount future production costs have made producers slow to quote on deliveries over next year. Consumers are eager to get information on forthcoming prices because they in turn are confronted with the task of establishing prices for forward deliveries without complete information regarding raw material costs and manufacturing costs under the changed conditions which will prevail.

Trading in the last month has brought out no unusual developments. Deliveries against running contracts have held up well in volume with spot buying of moderate proportions. Active call for material has come from the rayon, textile, leather, glass, soap, oil refining and other trades. Generally considered, the market was described as having fallen somewhat below the peak reached in the months immediately preceding.

The general buying movement which was started in October with government sanction was expected to stimulate retail trade and thus directly affect all manufacturing lines. Seasonal influences likewise were working in favor of larger outputs of some products. For instance, larger distribution of alcohol was speeding up production and the production allotment for the year has been increased to take care of new buying.

Among the materials which have been receiving more than usual attention is iodine. In our last issue comment was made on the sharp price decline made by the syndicate in Europe.

Iodine prices in domestic markets dropped from $3.50 to $5 per pound down to about $2 to $2.50 per pound recently. It is said that Japanese imports were a large factor in this, but official statistics through August do not show imports from that country as a significant factor. Major imports lately, as in previous years, are from Chile.

Imports for consumption of crude iodine in 1931 were approximately 280,000 pounds, worth just a bit under a million dollars. Imports in 1932 exceeded 630,000 pounds, worth nearly $2.25 million. It will be noted that in each year the declared value was between $3.50 and $4 per pound. Most months this year imports have been small; but in June 1,102,000 pounds, worth slightly more than $2.5 million, were brought in. It should be noted that the declared value here is about $2.25, or a reduction of a third from the preceding declared values. Market quotations are said to have shrunk correspondingly.

It would be logical to inquire whether the threat of Japanese production, said to be from kelp, and import at low prices, may not have affected Chilean market policy. The question should also be raised as to whether the huge import in June of this year represents an effort merely to flood the market and preclude Japanese development, or whether it corresponds to reasonably anticipated new demand. It is understood that at least two prospective new uses of iodine are coming along rapidly. One of these is discussed in a very secretive fashion, and seemingly relates to some new manufacturing that is at early patent stage and not subject to free announcement. The other is the thought that iodine derivatives of certain organic chemicals may find large new market as insecticides. This latter development is, at the moment, largely a reasonable hope, rather than anything of a demonstrated certainty. It seems clear, however, that iodine is going to become a more important industrial chemical than it has been hitherto.

Fairly good demand has been felt for fertilizer chemicals with a good period anticipated over the remainder of the year.

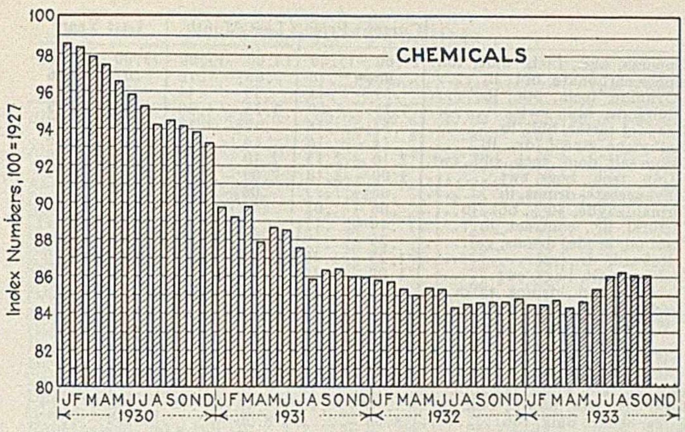
September fertilizer tax tag sales, as compiled by the National Fertilizer Association were 3 per cent less than the sales for September, 1932, in the Southern States, while the sales in the Midwestern States showed a gain of more than 40 per cent. This is the fifth consecutive monthly gain in the Midwestern States.

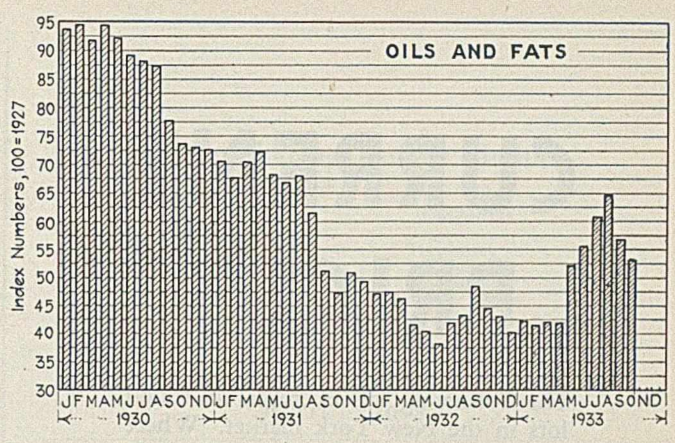
For the nine months of the present year only three States, Florida, Texas and Oklahoma, reported smaller sales than for the same nine months of 1932.

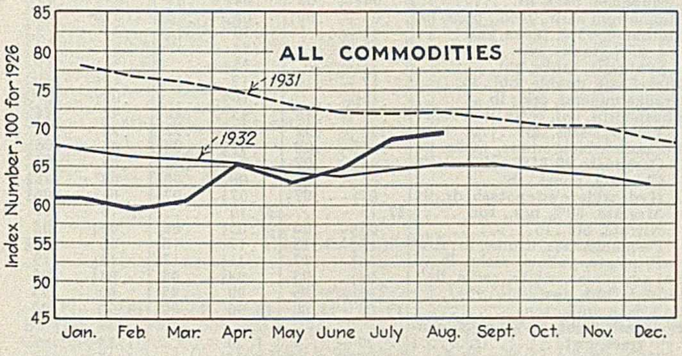
Development of 900,000 acres of cutover pine lands for tung oil production is proposed in the application of the Gulf Coast Tung Oil Co. of North America for a $6,500,000 loan from the Public Works Administration. Employment for 2,000 persons over a long period would result from the development in Mississippi and five other states, it is asserted.

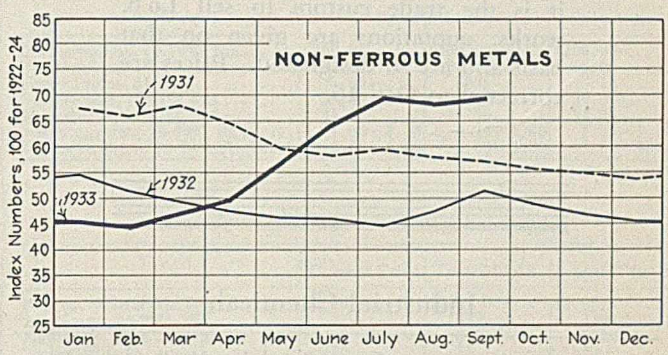
Pointing out that the Imperial gallon is in use in Canada, vice-consul Adam Beaumont, Hamilton, cautions American exporters against shipping containers to that market which are not properly marked. Recently, he states, an important manufacturer in his district bought a quantity of crocks of five-gallon capacity and mixed a required chemical, using the crocks as measures. The liquid was spoiled for the purpose intended since the formula was prepared for the Imperial gallon. The local Department of Weights and Measures was unable to prosecute the dealer in the crockware for the reason that the containers were marked with the number "5," although the inference to Canadians was five Imperial gallons.

The Imperial gallon, the report points out, contains 160 ounces as compared with 120 ounces for the ordinary gallon in use in the United States. Containers may be marked in Imperial measure or may be branded to indicate the weight only. To mark a container both "one gallon" and "120 ounces" is considered by the Department of Weights and Measures as deceptive, since the retail buyer does not stop to consider that one gallon should contain 160 ounces in Canada.









PRICE TRENDS—CHEM. & MET.'S WEIGHTED INDEXES

FOLLOWING a slowing up in demand for some selections, an easier price tone ruled for some chemicals in the last month but this was largely offset by price advances in other directions. As a result there was very little change in the weighted index number. New contract prices for important heavy chemicals have been awaited with interest because they are expected to give definite information regarding the trend which values will follow. To date the new contract prices have not been announced and the delay is attributed to uncertainty regarding regulations which will govern manufacture and the extent to which these changed conditions will influence production costs.

Chem. & Met. Weighted Index of Chemical Prices

Base=100 for 1927

This month	86.05
Last month	86.09
October, 1932	84.63
October, 1931	86.37

Price changes in the market for chemicals during the last month were more numerous on the up side, yet the weighted number was slightly lower because of the greater importance of the materials which were lowered in price.

Basically conditions have not been altered. The general impression is that practically all manufacturing costs will be increased, first because of higher raw materials and second because of higher fabrication costs.

Delays in drawing up codes and getting them into operation undoubtedly have checked activities in many industries and the slower trading movement which ensued served to defer any general tendency of price modification. Greater importance, however, is attached at present to production costs than to the degree of trading activity.

The agreement under which the naval stores industry will operate—if approved in its present form—contains no provisions for price control. It does propose, however, to hold rosin and turpentine production down to the levels of consuming demand and to have producers operate under license. Under such conditions price-cutting competition will be eliminated and market values can be maintained with due regard to profit margins. Turpentine held an easy price position throughout the last month and was largely responsible for holding the average level of chemicals below that of the preceding month.

Mineral acids have been working into a stronger position which has been evidenced not so much in actual changes in the quoted prices as in the fact that these prices have been more closely approximated in making sales.

More active buying in the market for fertilizer materials has stiffened values but in some cases imported material is competing keenly and prevents any general uplift in values.

Vegetable oils and animal fats followed the downward trend reported last month and are influenced by demand and supply, by the position of foreign markets, and by the course of the grain markets. While the statistical position favors higher prices for some of the oils, the immediate prospect would not indicate any drastic changes from existing price levels.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base=100 for 1927

This month	53.07
Last month	56.70
October, 1932	44.51
October, 1931	47.40

Vegetable oils almost without exception were under selling pressure during the period, and the general price trend was downward. Animal fats followed the course of oils and sold at lower levels.

CURRENT PRICES

The following 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 Oct. 16.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.10 -$0.10½	$0.08½-$0.09	$0.10 -$0.11
Acid, acetic, 28%, bbl., cwt	2.90 - 3.15	2.90 - 3.15	2.65 - 2.90
Glacial 99%, drums	10.02 -10.27	10.02 -10.27	8.89 -......
U. S. P. reagent, c'bys	10.52 -10.77	10.52 -10.77	9.64 - 9.89
Boric, bbl., lb	.04¾- .05	.04¾- .05	.04¾- .05
Citric, kegs, lb	.29 - .31	.29 - .31	.29 - .31
Formic, bbl., lb	.11 - .11½	.11 - .11½	.10 - .11
Gallic, tech., bbl., lb	.60 - .65	.60 - .65	.50 - .55
Hydrofluoric 30% carb., lb	.07 - .07½	.07 - .07½	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18° tanks. cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05¼	.05 - .05¼	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb	.09 - .10	.09 - .10	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -......	15.50 -......	15.50 -......
Tannic, tech., bbl., lb	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb	.24½- .25	.24½- .25	.22 - .23
Tungstic, bbl., lb	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.415-......	2.415-......	2.53½-......
Alcohol, Butyl, tanks, lb	.095-......	.095-......	.113-......
Alcohol, Amyl.	......-......	......-......	......-......
From Pentane, tanks, lb	.15 -......	.15 -......	.182-......
Denatured, 190 proof			
No. 1 special dr., gal	.33½-......	.33½-......	.34½-......
No. 5, 188 proof, dr., gal	.34 -......	.34 -......	.38½-......
Alum, ammonia, lump, bbl., lb	.03 - .04	.03 - .04	.03 - .04
Chrome, bbl., lb	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb	.03 - .04	.03 - .04	.03 - .04
Aluminum sulphate, com., bags, cwt	1.25 - 1.40	1.25 - 1.40	1.25 - 1.40
Iron free, bg., cwt	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02¾- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb	.15¼- .15½	.15¼- .15½	.15½- .15½
tanks, lb	.05 -......	.05 -......	.05¾-......
Ammonium carbonate, powd. tech., casks, lb	.08 - .12	.08 - .12	.10 - .11
Sulphate, wks., cwt	1.20 -......	1.20 -......	1.025-......
Amylacetate tech., tanks, lb., gal	.14½-......	.14½-......	.16 -......
Antimony Oxide, bbl., lb	.08½- .10	.08½- .10	.07 - .08
Arsenic, white, powd., bbl., lb	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb	.14 - .14½	.13 - .14	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	61.50 -65.00	61.50 -65.00	63.00 -65.00
Nitrate, cask, lb	.07¼- .07½	.07¼- .07½	.07 - .07½
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Borax, grain, bags, ton	40.00 -45.00	40.00 -45.00	40.00 -45.00
Bromine, cs., lb	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	3.00 -......	3.00 -......	2.50 -......
Arsenate, dr., lb	.07 - .08	.07 - .08	.05½- .06½
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	17.50 -......	17.50 -......	18.00 -......
flake, dr., wks., ton.	19.50 -......	19.50 -......	21.00 -......
Phosphate, bbl., lb	.07½- .08	07½- .08	.08 - .08½
Carbon bisulphide, drums, lb	.05½- .06	.05½- .06	.05 - .06
Tetrachloride drums, lb	.05½- .06	.05½- .06	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.01¾-......	.01¾-......	.01¾-......
Cylinders	.05½- .06	.05½- .06	.05 - .06
Cobalt oxide, cans, lb	1.15 - 1.25	1.15 - 1.25	1.25 - 1.35
Copperas, bgs., f.o.b. wks., ton.	14.00 -15.00	14.00 -15.00	13.00 -14.00
Copper carbonate, bbl., lb	.08¾- .16	.08¾- .16	.07 - .16
Cyanide, tech., bbl., lb	.39 - .44	.39 - .44	.39 - .44
Sulphate, bbl., cwt	3.75 - 4.00	3.75 - 4.00	3.00 - 3.25
Cream of tartar, bbl., lb	.17½- .18	.17½- .18	.17 - .17½
Diethylene glycol, dr., lb	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	2.10 - 2.15	2.10 - 2.15	1.70 - 2.00
Imp., tech., bags, cwt	2.00 - 2.10	2.00 - 2.10	1.15 - 1.25
Ethyl acetate, drums, lb	.08½-......	.08½-......	.10 -......
Formaldehyde, 40%, bbl., lb	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal	.75 -......	.75 -......	1.10 - 1.20
Refined, dr., gal	1.25 - 1.30	1.25 - 1.30	1.80 - 1.90
Glaubers salt, bags, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.10¼- .10½	.10¼- .10½	.10¼- .10½
Lead:			
White, basic carbonate, dry casks, lb	.06½-......	.06½-......	.06½-......
White, basic sulphate, sck., lb.	.06 -......	.06 -......	.06 -......
Red, dry, sck., lb	.08 -......	.08 -......	.06¾-......
Lead acetate, white crys., bbl.. lb.	.10½- .11	.10½- .11	.10 - .11
Lead arsenate, powd., bbl., lb	.10 - .13	.10 - .13	.10 - .14
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb	.07 -......	.07 -......	.05¾-......
Lithophone, bags, lb	.04½- .05	.04½- .05	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06¼	.06 - .06¼	.05¾- .06
Methanol, 95%, tanks, gal	.33 -......	.33 -......	.33 -......
97%, tanks, gal	.34 -......	.34 -......	.34 -......
Synthetic, tanks, gal	.35½-......	.35½-......	.35½-......
Nickel salt, double, bbl., lb	.12 - .12½	.12 - 12½	.10½- .11
Orange mineral, csk., lb	.10½-......	.10½-......	.09¼-......
Phosphorus, red, cases, lb	.45 - .46	.45 - .46	.42 - .44
Yellow, cases, lb	.28 - .32	.28 - .32	.28 - .32
Potassium bichromate, casks, lb.	.07⅝- .08	.07⅝- .08	.08 - .08½
Carbonate, 80-85%, calc. csk., lb	.06¾- .07	.06¾- .07	.05 - .06
Chlorate, powd., lb	.08¼- .08½	.08¼- .08½	.08 - .08¾
Hydroxide (c'stic potash) dr., lb.	.07⅛- .07½	.07⅛- .07½	.06⅛- .06¾
Muriate, 80% bgs., ton	37.15 -......	37.15 -......	37.15 -......
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05¾- .06
Permanganate, drums, lb	.17½- .18	.17½- .18	.16 - .16½
Prussiate, yellow, casks, lb	.16½- .17	.16½- .17	.18½- .19
Sal ammoniac, white, casks, lb	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt	1.20 -......	1.20 -......	1.15 -......
Dense, bags, cwt	1.22½-......	1.22½-......	1.17½-......
Soda, caustic, 76%, solid, drums, contract, cwt	2.50 - 2.75	2.50 - 2.75	2.50 - 2.75
Acetate, works, bbl., lb	.04¾- .05	.04¾- .05	.05 - .05½
Bicarbonate, bbl., cwt	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb	.05 - .05½	.05 - .05½	.05 - .06
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb	.03 - .04	.03 - .04	.03⅜- .04
Chlorate, kegs, lb	.05¾- .07½	.05¾- .07½	.05¾- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., lb	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt	3.25 - 3.40	3.25 - 3.40	3.60 - 3.75
Nitrate, bags, cwt	1.295-......	1.295-......	1.245-......
Nitrite, casks, lb	.07½- .08	.07½- .08	.07¼- .08
Phosphate, dibasic, bbl., lb	.02 - .023	.02- .023	.0255 - .0275
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (40° dr.) wks. cwt	.70 - .75	.70 - .75	.70 - .75
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, cyrs., bbl., lb	.02¼- .02½	.02¼ .02½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb	.03½- .04	.03½- .04	.03½- .04
Dioxide, cyl., lb	.06½- .07	.06½- .07	.06½- .07
Flour, bag, cwt	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin Oxide, bbl. lb	.50 -......	.50 -......	.28 -......
Crystals, bbl., lb	.35½-......	.35½-......	.24½-......
Zinc chloride, gran., bbl., lb	.05½- .06	.05½- .06	.06½- .06¾
Carbonate, bbl., lb	.09½- .11	.09½- .11	.10½- .11
Cyanide, dr., lb	.38 - .42	.38 - .42	.41 - .42
Dust, bbl., lb	.07- .07¼	.07 - .07¼	.04½- .05
Zinc oxide, lead free, bag, lb	.05¾-......	.05¾-......	.05¾-......
5% lead sulphate, bags, lb	.05½-......	.05½-......	.05½-......
Sulphate, bbl., cwt	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.09¾-$0.10	$0.09¾-$0.10	$0.09½-$0.10
Chinawood oil, bbl., lb	.07⅝-......	.07¾-......	.06 -......
Coconut oil, Ceylon, tanks, N. Y. lb	.03 -......	.03⅛-......	.03¾-......
Corn oil crude, tanks, (f.o.b. mill), lb	.04⅜-......	.04¾-......	.04½-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.03⅞-......	.03⅞-......	.03¼-......
Linseed oil, raw car lots, bbl., lb	.101-......	.105-......	.061-......
Palm, Lagos, casks, lb	.04⅛-......	.04½-......	.04 -......
Palm Kernel, bbl., lb	.04 -......	.04¾-......	.04½-......
Peanut oil, crude, tanks (mill), lb.	.04 -......	.04½-......	.06¾-......
Rapeseed oil, refined, bbl., gal	.50 - .52	.65 - .67	.36 - .37
Soya bean, tank, lb	.07 -......	.08 -......	......-......
Sulphur (olive foots), bbl., lb	.06 -......	.06 -......	.04½-......
Cod, Newfoundland, bbl., gal	.31 - .32	.29 - .30	.21 - .26
Menhaden, light pressed, bbl., lb.	.053-......	.053-......	.04½-......
Crude, tanks (f.o.b. factory), gal.	.17 -......	.17 -......	.12 -......
Grease, yellow, loose, lb	.02¾-......	.02⅞-......	.02¾-......
Oleo stearine, lb	.05½-......	.05¼-......	.06 -......
Red oil, distilled, d.p. bbl., lb	.06⅛-......	.06⅛-......	.06⅝-......
Tallow, extra, loose, lb	.03¼-......	.03⅞-......	.03⅛-......

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb..	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb............	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb..	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb....	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb.........	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb....	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb.........	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.....	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb....	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal..	.22 - .23	.22 - .23	.20 - .21
Beta-naphthol, tech., drums, lb..	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.........	.10½- .11	.10½- .11	.10½- .11
Cresylic acid, 97%, dr., wks., gal.	.45 - .46	.45 - .46	.49 - .52
Diethylaniline, dr., lb..........	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb..........	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb...........	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal...........	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.........	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb...............	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.....	.06 - .07	.04¾- .05	.03¾- .04¼
Nitrobenzene, dr., lb...........	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb........	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb.......	.14¼- .15	.14¼- .15	.14¼- .15
Picric acid, bbl., lb............	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal..............	.90 - .95	.90 - .95	1.50 - 1.80
R-salt, bbl., lb................	.40 - .44	.40 - .44	.40 - .44
Resorcinal, tech., kegs, lb.......	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.....	.40 - .42	.40 - .42	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.26 -......	.26 -......	.26 -......
Tolidine, bbl., lb..............	.88 - .90	.88 - .90	.86 - .88
Toluene, tanks, works, gal......	.30 -......	.30 -......	.30 -......
Xylene, 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..........	.14 - .15	.14¾- .15	.06 - .10½
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...	.02¾- .20	.02¾- .20	.02¾- .20
Prussian blue, bbl., lb........	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.......	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb........	.26 - .27	.26 - .27	.27 - .30
Carmine red, tins, lb.........	3.65 - 3.75	3.65 - 3.75	3.90 - 4.50
Para toner, lb...............	.80 - .85	.80 - .85	.75 - .80
Vermilion, English, bbl., lb.....	1.35 - 1.40	1.35 - 1.40	1.25 - 1.50
Chrome yellow, C. P., bbl., lb.	.15 - .15½	.15 - .15½	.16 - .16½
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.	.07 - .08½	.07 - .08¼	.07 - .08½
Gum copal Congo, bags, lb......	.08 - .09	.08 - .09	.06 - .08
Manila, bags, lb.............	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.....	.15 - .15½	.15 - .15½	.16 - .16½
Kauri No. 1 cases, lb.........	.20 - .25	.20 - .25	.45 - .48
Kieselguhr (f.o.b. N.Y.), ton...	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton...........	50.00 -......	50.00 -......	40.00 -......
Pumice stone, lump, bbl., lb....	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb..........	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.................	5.05 -......	5.25 -......	4.05 -......
Turpentine, gal................	.46½-......	.47 -......	.45½-......
Shellac, orange, fine, bags, lb....	.24 - .25	.24 - .25	.20 - .25
Bleached, bonedry, bags, lb...	.24 - .25	.24 - .25	.18 - .19
T. N. bags, lb...............	.13 - .14	.15 - .16	.10½- .11½
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
300 mesh (f.o.b Ga.), ton....	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton..	13.75 -....	13.75 -.....	13.75 -.....
Wax, Bayberry, bbl., lb.........	.15 - .16	.14 - .15	.16 - .20
Beeswax, ref., light, lb.........	.22 - .27	.22 - .27	.20 - .30
Candelilla, bags, lb..........	.09 - .09½	.09 - .09½	.12 -......
Carnuba, No. 1, bags, lb.......	.27 - .29	.29 - .30	.26 -......
Paraffine, crude 105-110 m.p., lb............	.04 -......	.03¼-......	.03⅛- .03¼

Price Changes During Month

Advanced	Declined
Acetone	Rosin
Antimony	Turpentine
Platinum	Vegetable oils
Mercury	Animal fats

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.......	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton....	82.00-.....	82.00-.....	68.00-.....
Ferrochrome, 65-70%...........	.09½-....	.09½-.....	.10-.....
Spiegeleisen, 19-21% ton.........	27.00-.....	27.00-.....	25.00-.....
Ferrosilicon, 14-17%, ton.........	31.00-.....	31.00-.....	31.00-.....
Ferrotungsten, 70-80%, lb.......	1.05- 1.20	.95- 1.00	1.00- 1.10
Ferrovanadium, 30-40%, lb.......	2.60- 2.80	2.60- 2.80	3.05- 3.40

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb..........	$0.08½-......	$0.09 -......	$0.06¼-.....
Aluminum, 96-99%, lb...........	.229-......	.229-......	.229-......
Antimony, Chin. and Jap., lb.....	.07 -......	.06¾-......	.05⅜-......
Nickel, 99%, lb.................	.35 -......	.35 -......	.35 -......
Monel metal blocks, lb..........	.28 -......	.28 -......	.28 -......
Tin, 5-ton lots, Straits, lb........	.48¾-......	.45¾-......	.243-......
Lead, New York, spot, lb.........	.045-......	.045 -......	.0345-.....
Zinc, New York, spot, lb.........	.0512-.....	.0502-.....	.034 -.....
Silver, commercial, oz...........	.39⅜-.....	.36¾-.....	.28¼-.....
Cadmium, lb....................	.55 -......	.55 -......	.55 -......
Bismuth, ton lots, lb............	1.20 -......	1.20 -......	.85 -......
Cobalt, lb......................	2.50 -......	2.50 -......	2.50 -......
Magnesium, ingots, 99%, lb......	.32 -......	.32 -......	.30 -......
Platinum, ref., oz..............	36.00 -.....	33.00 -.....	33.00 -.....
Palladium, ref., oz.............	21.00 -.....	19.00 -.....	18.00 - 19.00
Mercury, flask, 75 lb...........	66.00 -.....	63.00 -.....	47.00 -.....
Tungsten powder, lb............	1.25 -.....	1.25 -.....	1.45 -......

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.......	$6.50 -$8.25	$6.50 -$8.25	$6.50 -$8.25
Chrome ore, c.i.f. ports, ton.....	16.00 -20.00	14.00 -18.50	17.00 -20.00
Coke, fdry., f.o.b. ovens, ton......	2.25 -......	2.25 -......	3.25 - 3.75
Fluorspar, gravel, f.o.b. Il., ton...	17.25 -20.00	17.25 -20.00	17.25 -20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit..........	.19 -......	.19 - ...	.23 -......
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb..............	.45 -......	.45 -......	.45 -......
Monazite, 6% of ThO_2, ton......	60.00 -......	60.00 -......	60.00 -......
Pyrites, Span. fines, c.i.f., unit....	.13 -......	.13 -......	.13 -......
Rutile, 94-96% TiO_2, lb..........	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit..............	12.00 -......	12.00 -......	10.00 -10.50

INDUSTRIAL NOTES

The Superheater Co., New York, has acquired an interest in and assumed management of The Air Preheater Corp., Wellsville, N. Y. Manufacturing will continue at Wellsville but executive offices will be consolidated with those of The Superheater Co. in New York.

Roots - Connersville - Wilbraham, Connersville, Ind., has appointed James T. Castle, 424 First Ave., Pittsburgh, Pa., its representative for western Pennsylvania, north West Virginia, and the border counties of Ohio.

The Enterprise Engineering Co., with offices at 2949 Eighteenth St., San Francisco, Calif., has been formed by Carl A. Rietz to market heavy equipment made by the Enterprise Foundry.

Glyco Products Co., Inc., Brooklyn, N. Y., has appointed Marshall Dill Co., San Francisco and Los Angeles, to act as selling agents in California.

Beaumont Birch Co., Philadelphia, Pa., has appointed the Ernest E. Lee Co., 115 So. Dearborn St., Chicago, as its representative in the Chicago territory.

American Agricultural Chemical Co., New York, has appointed M. O. Wilson as manager of its Baltimore office to succeed E. F. Daniel who died last May.

The Barrett Co., New York, has announced the opening of sales offices in Raleigh, N. C., and Columbus, S. C., with W. M. Perry and L. G. Duval in charge.

American Cyanamid & Chemical Corp., New York, has appointed H. L. Derby, Jr., manager of the Chicago office located at 20 N. Wacker Drive.

Edge Moor Iron Co., Edge Moor, Del., announces the formation of Edge Moor-Irwin Gas Boiler Division. The company has acquired exclusive right to manufacture and distribute the Irwin automatic gas fired boilers.

Homestead Valve Mfg. Co., Coraopolis, Pa., has named D. W. Lawler, 1911 Rutherford Ave., Louisville, Ky., as its exclusive representative in that territory.

The Falk Corp., Milwaukee, Wis., announces the appointment of T. F. Scannell, who has been their St. Louis representative for several years, to the Dallas, Texas territory. Mr. Scannell will have charge of oil field sales in Texas and Oklahoma. His office will be located at 1410 Magnolia Building. The St. Louis territory has been taken over by Fitch S. Bosworth, 5475 Cabanne Ave.

NEW CONSTRUCTION

Where Plants Are Being Built in Process Industries

	This Month		Cumulative to Date	
	Proposed Work and Bids	Contracts Awarded	Proposed Work and Bids	Contracts Awarded
New England.....	$28,000	....	$504,000	$165,000
Middle Atlantic...	85,000	$202,000	7,021,000	4,186,000
Southern.........	5,567,000	3,616,000	12,121,000	7,163,000
Middle West......	177,000	293,000	1,600,000	1,021,000
West of Mississippi	2,440,000	28,000	13,464,000	14,092,000
Far West.........	40,000	500,000	4,590,000	2,844,000
Canada..........	654,000	....	5,553,000	359,000
Total.........	$8,991,000	$4,639,000	$44,853,000	$29,830,000

PROPOSED WORK BIDS ASKED

Asphalt Plant—City, Division of Public Works, Cincinnati, O., plans the construction of an asphalt plant to serve the western section of the city. $62,000.

Chemical Plant—Natural Sodium Products, Ltd., Dunkirk, Sask., Can., plans an addition to its chemical plant for the dehydration of natural sodium sulphates.

Distillery—Colonial Distilleries Products, Inc., c/o L. E. Scott, 418 Olive St., St. Louis, Mo., plans to either remodel its present whiskey distillery or build a new plant.

Dehydration Plant—United Fruit Co., 1 Federal St., Boston, Mass., contemplates the construction of a dehydration plant at Kingston, Jamaica. Estimated cost to exceed $50,000.

Dry Kilns—Paducah Cooperage Co., Paducah, Ky., plans to construct two additional dry kilns for bourbon barrels. $50,000.

Gas and Oil Development—Colonial Natural Gas Co., Ltd., Hamilton, Ont., Can., L. Stanhope Parsons, Mgr., plans to develop oil and gas resources here.

Gas Products Plant—L. B. Dapron, 232 East 7th St., Hanford, Calif., plans the construction of a factory for the manufacture of gas products and carbon black on Dudley Ridge. Estimated cost to exceed $40,000.

Gas Plant—Sterling Gas Co., Ltd., Toronto, Ont., recently incorporated at $500,000, plans a gas development here. J. Howard Young is president.

Ink Factory—John Maff, Inc., 9 Delancey St., Newark, N. J., plans to construct an ink manufacturing factory on Frelinghuysen Ave. near East Petty St. $28,500.

Knitting Mill—Zwieker Knitting Co., 416 North Richmond St., Appleton, Wis., will soon receive bids for a 2 story, 40x96 ft. knitting mill. Orbison & Orbison, 215 East Washington St., Appleton, are architects. $40,000.

Woolen Mill—Appleton Woolen Mills, E. J. Harwood, pres., 614 South Oneida St., Appleton, Wis., contemplate the construction of an addition to their mill. $40,000.

Textile Mill—Lullwater Mills, Thomson, Ga., plan to recondition their plant and install new equipment.

Paper Plant—Western Straw Paper Co., G. K. Guild, 10638 91st Ave., Edmonton, Alta., Can., plans to equip a plant for the manufacture of building, wrapping and insulating papers from straw. Estimated cost $30,000.

Pulp and Lumber Mill—Hawk Lake Industries, Ltd., Toronto, Ont., plans to establish a pulp and lumber mill here. Estimated cost $40,000.

Pulp Plant—Minas Basin Pulp & Paper Mills, Ltd., Hantsport, N. S., Can., plan the construction of a plant for the manufacture of moulded pulp articles and also for increasing capacity of groundwood pulp mill. $250,000.

Pulp Mill—National Wood Fibre Growers Association, recently organized by W. L. Wilson, Barnett Bank Bldg., Jacksonville, Fla., and R. A. Smith, Fernandina, Fla., plan the construction of a wood fibre pulp mill at Fernandina. The Company has applied for a loan of $5,500,000 from Federal Administration of Public Works.

Lacquer Factory—United States Lacquer Corp., 166 Coit St., Irvington, N. J., plans to rebuild its lacquer factory on Coit St. $28,000.

Refinery—Imperial Oil Co., Tampico, Mexico, contemplates rebuilding its refinery recently damaged by a hurricane. Estimated cost $200,000.

Refinery—Midwest Refining Co., Alma, Mich., and c/o B. J. Skinner, Grand Rapids, Mich., plans to construct a skimming plant at its refinery. Estimated cost exceeds $35,000.

Pressure Boosting Oil Station—Ocate Oil Co., Tulsa, Okla., had plans prepared by J. E. Miller, Engr., Tulsa, for a pressure boosting oil station. $12,000.

Refinery—Taxman Oil Refining Co., Wichita Falls, Tex., contemplates the construction of a refinery, including a cracking tower. Estimated cost to exceed $150,000.

Soap Factory—Kayer Manufacturing Co., Stephen S. Kayer, Pres., 1113 South Elnora Ave., Elizabeth, N. J., is having plans prepared for a soap manufacturing plant at 542-48 Pine St. $28,000.

Metal Refining Plant—Chamber of Commerce, Grand Junction, Colo., and Western Colorado mining interests, plan the construction of a metal refining plant at Grand Junction. Will apply to Federal Administration of Public Works for loan of $2,200,000.

Lead and Zinc Mine—Lawyers Lead & Zinc Co., c/o C. J. Hindman, McBirney Bldg., Tulsa, Okla., plans to take over and remodel mills and other property of New Chicago Mines Corp., near Picher, Okla., and install new equipment including jigs, conveyors, milling machines, etc. $50,000.

Ore Mill—Jackson Manion Consolidated Mines, Ltd., Red Lake, Ont., D. M. Thomson, Engr., contemplates the construction of a 50 ton ore mill and is interested in prices of machinery and equipment.

Feldspar Development—Orford Soap Co., Manchester, Conn., manufacturers of "Bon Ami" plan to begin mining operations at a large area at the head of Big Crabtree Creek in Mitchell Co., near Little Switzerland, N. C. W. W. Robertson is manager.

CONTRACTS AWARDED

Asbestos Plant—Johns-Manville Corp., M. Renton, Plant Engineer in charge, Manville, N. J., awarded contract for altering plant here to Wigton-Abbott Corp., 143 Liberty St., New York, N. Y. Work will include installing new crane runway for electrically operated overhead traveling crane. Estimated cost $28,000.

Bromine Plant—Ethyl-Dow Chemical Co., 135 East 42nd St., New York, N. Y., awarded contract for constructing plant to extract bromine from sea water for conversion into bromine, on shore at Kure Beach, 20 mi. south of Wilmington, N. C., to N. A. Underwood Co., Wilmington, Del. Estimated cost $3,000,000.

Chemical Plant—Commercial Solvents Corp., South First St., Terre Haute, Ind., plans additions and alterations to its chemical plant here. Company awarded contract for rack houses to W. R. Heath Construction Co., Greencastle, Ind.; warehouse and denaturing buildings to G. R. North Construction Co., Terre Haute. Estimated cost $190,000.

Chemical Plant—Richards Chemical Works, 190 Warren St., Jersey City, N. J., awarded contract for chemical plant at 106-14 Essex St., to Billington Bros., 198 Fairmount Ave., Jersey City, N. J. $60,000.

Chemical Plant—Tennessee Eastman Corp., Kingsport, Tenn., awarded contract for addition to plant to be used as filtration unit to Ridge Construction Co., c/o Eastman Kodak Co., Rochester, N. Y.

Cardboard Box Plant—Arvey Corp., 612 North Michigan Blvd., Chicago, Ill., awarded contract for addition to cardboard box plant, to Ullman & Nelson, 5940 North Barnard St., Chicago, Ill. $28,000.

Gasoline Absorption Plant—Standard Oil Co. of Louisiana, Baton Rouge, La., will construct a new gasoline absorption plant. Work will be done by day labor. Estimated cost $586,000.

Lubricating Plant—Union Oil Co., Mills Bldg., San Francisco, Calif., is building an addition to its lubricating plant. Work is being done under supervision of Roy Heise, Oleum, Calif. Estimated cost $500,000 or more.

Leather Belt Factory—Bernstein Bros., 9 Keen St., Paterson, N. J., awarded contract for factory for the manufacture of leather belts, to I. Yankeleosky, 304 East 24th St., Paterson, N. J. $28,000.

Laboratory and Factory—International Paint Co., A. R. Smiles, Mgr., 21 West St., New York, N. Y., awarded contract for altering factory at Morris and Elmwood Aves., Union, N. J., to W. D. Sherman, 286 West Broad St., Elizabeth, N. J. $28,000.

Paint Factory—Phelan-Faust Paint Manufacturing Co., 1215 Pine St., St. Louis, Mo., will lease factory at 3434 Wyoming St., St. Louis, to be built by Gamble Construction Co., 620 Chestnut St., St. Louis.

Refractories Factory—McDanel Refractories Mfg. Co., Beaver Falls, Pa., awarded contract for 2 story factory to Leroy Freed, Beaver Falls, Pa.

Rubber Factory—Lee Tire & Rubber Co., Conshohocken, Pa., awarded contract for 1 story, 60x100 ft. addition to factory, to Stoffley & Tillotson, Wesley Bldg., Philadelphia, Pa. $30,000.

Soap Factory—Andrew Juergens Co., Spring Grove Ave., Cincinnati, O., awarded contract for 6 story, 28x62 ft. factory for the manufacture of soap to Parkway Construction Co., Keith Bldg., Cincinnati. $75,000.