CHEMICAL
& METALLURGICAL
ENGINEERING

VOLUME 40 ESTABLISHED 1902 NUMBER 7

McGRAW-HILL PUBLISHING COMPANY, INC.

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JULY, 1933

PROBLEMS AHEAD OF PROFITS

SO MUCH OF THE permanence of business recovery depends on the balancing of so many different variables that industry can well afford to mix an element of caution with its enthusiasm for the progress of the last few months. It is true that in no comparable period in the history of the country has there been such a rapid rise in the volume of business. Yet do we know exactly why? Undoubtedly, much of this business has been placed purely in anticipation of price advances that now seem certain. Firms are laying in six months' requirements and demanding three weeks' delivery. How much of these goods is going into actual consumption? Will this new business collapse once inventories are built up? Not, we feel, if all industry moves forward together and there is no disrupting of the present favorable balance of economic forces.

The relation of production and consumption is only a part of the problem; more important is the balancing of wages and prices which, of course, determines mass purchasing power. This balance is the one that now gives most concern to the administration in Washington. The immediate problem is to put more money into the pockets of more workers. For its own good, industry must pay this present price for prospective profits. It must realize that, for the moment, the national recovery act will impose a tax on production, designed to get things started.

There is another angle, too, to the balancing of economic and industrial relations which some of us may have overlooked. It is the relation of one part to the whole of the industrial structure. As we see it, each industry must conduct its business and plan its future so as to help preserve the economic balance of the whole. Any group that fails to play its part is certain to be penalized.

The cotton textile industry has clearly blazed the trail ahead. It has shown how diverse subdivisions of an industry can be closely allied in a common purpose. The chemical industries have a comparable opportunity to set up an acceptable code of practice, bringing all existing chemical associations into alliance in a central chemical organization in which none will lose its present identity. In most of the other process industries there are strong trade associations or independent groups that can be affiliated for this purpose. In fact many are already well advanced in this work. Manufacturers of chemical engineering equipment and similar so-called capital goods face a more difficult task because of the specialized character of their production. Some presumably will ally themselves with the machinery groups being organized in the electrical and mechanical fields. Others may wish to form their own association or revive the now inactive Chemical Equipment Association and so become affiliated as a unit with the master association. The imperative need is for cooperative action. The safe road back to ultimate profit lies squarely in that direction but there are still many problems along the way.

EDITORIALS

A Good Start On a Bad Problem

IN STRIKING contrast to the feverish, impulsive activity of the NIRA, is the cool, deliberate planning of the Tennessee Valley Authority. Both agencies faithfully reflect the temperament of the men at their heads. The one is the soldier, who has spotted his objective, has his enemy on the run, and is quick to press on for every advantage in the pursuit. The other is the engineer, faced with a complicated problem, gradually accumulating his facts and scientific data in order to lay out in blueprint form a careful and logical procedure. Dr. Morgan realizes that the task of the TVA is not a part of the emergency program. Speed, in itself, is not essential. More important in building for such a great social experiment is to make sure that the foundations are secure, that haste now will not lead to waste later on.

It is fortunate for the chemical industry that TVA has adopted such an attitude in its administration of this basically important legislation. It means that action, when it comes, will be deliberate, based on adequate study. We may not always find ourselves in agreement with its rulings, but the Tennessee Valley Authority has already won our respect for the way it has taken hold of its job.

Jekyll and Hyde At the World's Fair

IF STEVENSON'S famous dual personality were to materialize himself in Chicago during this year of grace, 1933, he would find much to remind him of the strange contrasts in his own troubled, fabled existence. A memorial not alone to one century of progress in the sciences, but to many centuries, the International Exposition contrasts strangely with that Fair of only 40 years ago when the wonders that now are too commonplace to notice were first shown to an amazed world. A strange contrast, too, in that Chicago, near to bankruptcy as a city, none the less digs down into empty private pockets and miraculously produces what is undoubtedly the most costly spectacle the world has ever seen.

Strange contrasts also in the state of human knowledge after this particular century of progress, for where is the comparable progress in culture, in the arts, in religion, in politics, in human engineering? And even stranger contrasts in science, which, while it rings the electrical carillon in the Hall of Science tower, amplifies the barker's bellow; while it creates the Fair's nightly miracle of light, supplies the raw materials for the Midway.

And yet, withal, if at one minute the Fair is Mr. Hyde, the next it is certain to be Dr. Jekyll. Plenty of solidity, it has, for all a carping editor may find fault. To the man with the time and the willingness to study, it offers a liberal education. For anyone with the price of admission it draws aside tomorrow's curtain and demonstrates again the old story of the transformation of wonders into commonplaces. Twenty or thirty thousand engineers and scientists will feel themselves purified and humbled by the experience; and as many million laymen will also go home better citizens.

A New Standard For the Chemical Show

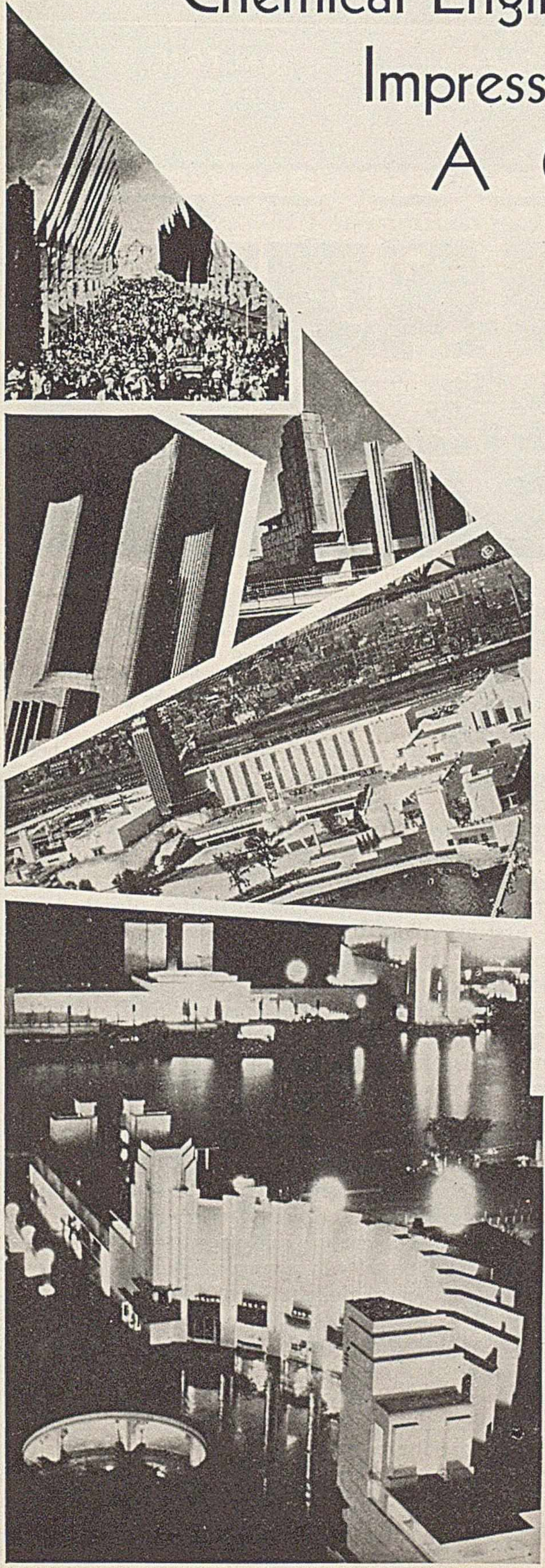
IT IS NOT too soon to be thinking about the Chemical Exposition. In fact both the exhibitors and the exposition management can find much to think about in the great wave of popular acclaim with which the public has greeted the scientific and commercial exhibits of A Century of Progress. Some will argue, of course, that the makers of chemical engineering materials and equipment are not interested in the public's reaction, that they want to reach only the limited circle of their customers—actual and prospective. Such critics may lose sight of the fact that these customers are human beings, attracted by the same tricks and willing to be instructed—and sold—if the sales story is presented in a novel, interesting and convincing way.

The lesson from Chicago is that the conventional and commonplace should no longer be tolerated in industrial exhibits. The static gives way to the dynamic presentation, the plant pictures to the dioramas, the charts to talking pictures and even to actual plant operations. A new standard of showmanship has been demonstrated and those in the process industries who wish to capitalize on chemical engineering interest next December may well begin their planning on such a basis.

A Fitting Memorial For William P. Ryan

NO TEACHER of the post-war generation more completely dedicated his life to the cause of chemical engineering education. No younger man of our acquaintance so quickly won the confidence and respect of both his associates and his students. All who came in contact with him felt that he had a keen, sympathetic understanding of their personal problems. To his chosen work Bill Ryan gave unsparingly of his time and effort. It is peculiarly appropriate, therefore, that those who were closest to him should suggest that his memorial take the form of the Ryan Memorial Scholarship for study in chemical engineering at the Massachusetts Institute of Technology. Through the Alumni Association of that institution and through appropriate committees of the American Institute of Chemical Engineers and the American Chemical Society, there is now an opportunity for contributions. No time should be lost in thus perpetuating the memory of an outstanding chemical engineer, an inspiring teacher and a true friend of so many in the profession.

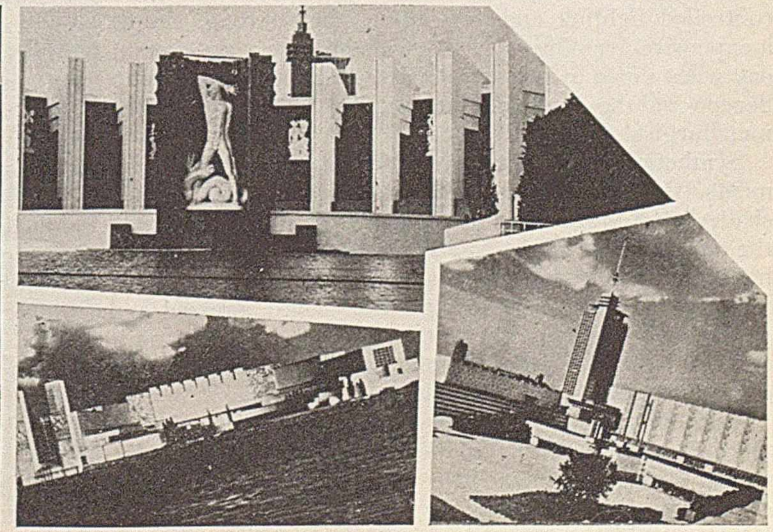
Chemical Engineering Impressions of A Century of Progress



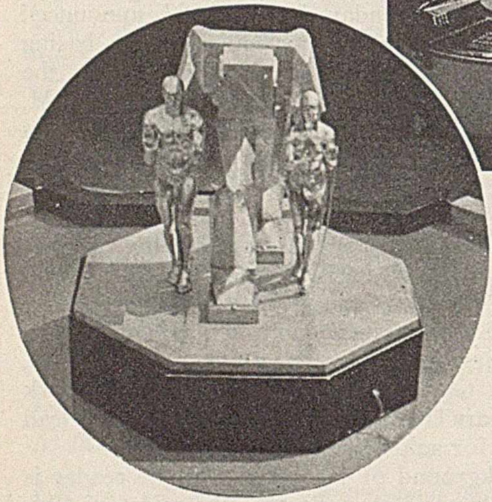
A CENTURY ago chemistry and electricity could scarcely have been regarded as the prospective bases of a world exposition of science and industry. They were still in their indeterminate infancy. An Englishman, Michael Faraday, had in 1833, announced the laws of electrolysis and electrochemical action, basing his work on facts and principles handed him by the Italian, Alessandro Volta, the Frenchman, A. M. Ampere, and the German, G. S. Ohm. Faraday was making a dynamo to harness the power of electromagnetism, thus to create the great motivating force of the century that has just come to a close.

Liebig, who began the publication of his famous *Annalen* in 1832, had laid the foundation for agricultural science and with Berzelius and Wöhler was busy carrying forward the development and application of the atomic theory, first annunciated by his contemporary, Dalton, in 1818. Gay-Lussac and Glover were at work on what a few years later (1841) was to become the lead chamber process for sulphuric acid manufacture.

From this background of 100 years ago the reader is asked to project himself abruptly into the midst of Chicago's great international exposition—A Century of Progress. Remembering the reference to the beginnings of chemistry and electricity, it is interesting to note that everywhere these two sciences dominate—not only in the



At right, a complete oil refinery, constructed of glass, realistically splits petroleum into its component fractions and prepares them for products of commerce. *Below,* the great Robot of Science bows its head in service to mankind and modern civilization



exhibits, but in the very structures of the exposition. Everywhere is chemistry, everywhere is electricity. Chemistry in color—new finishes, new metals, new light sources, new building materials, new floorings, new plastics, new photomurals of enormous size. The buildings themselves, with their practically windowless construction, their design for utility—sans flub-dubs—their controlled lighting and ventilation, their strong, simple inexpensive framing and covering, presage a not-distant day when much of our architecture will come similarly to depend on the chemist, the chemical engineer and the metallurgist.

Synthetic materials are everywhere. Many of the pigments, the transparent, highly-colored Micarta "lampshades" for the mushroom light fixtures that illuminate the garden areas of the fair grounds; much of the flooring, largely of cork composition; much of the siding material which includes composition board, pressed and various plywoods. The model housing section adds enameled steel, synthetic stone and glass brick to the earlier list of new or newly adapted materials.

With this hasty and quite inadequate introduction to the exposition as a whole, the editors of *Chem. & Met.* wish to take you on a little journey, first through the exhibits of the basic sciences and then on to the applied sciences and some of the commercial exhibits of chemical engineering concern.

To say merely that the basic science exhibits have been handled adequately would be to give scant recognition to the perseverance, ingenuity and intelligence that are evident in this most interesting section of the Fair. All science, for demonstration purposes, has been divided into seven divisions: astronomy, mathematics, physics, chemistry, biology, geology and medicine, of which all but the first are allotted a share of the Hall of Science.

Introductory to modern chemistry and physics, both located in the central portion of the great U-shaped building, is an imposing edifice, 30 ft. high and 25 ft. in diameter, representing a periodic table of all the 92 known elements. This exhibit, illustrated on the opposite page, is crowned by a large terrestrial globe demonstrating the relation of these elements in the earth's composition.

Physics claims some 90 exhibits covering all the essential phenomena of this science as it exists today. Flames sing, circuits oscillate, prisms refract, "molecules" bombard, strings vibrate before one's very eyes and ears. Fundamentals of temperature and pressure, of sound, of electricity, of light and of ray manifestations are presented in a manner to delight even the most hardened engineer.

If there is little recognition of the borderland of physical chemistry, chemistry itself, pure and applied, is treated most intelligently. In fact, throughout the basic science exhibit, the inadequacy of any descriptive pen makes strongly for a warranted but tiresome flow of superlatives. Chemistry is broken down into changes by combination, by separation, and by exchange. Operating models show the difference between physical and chemical changes and portray such reactions as the combustion of iron in oxygen, phosphorus in air, reduction of mercuric oxide to mercury, the combustion of thermit, the oxidation and reduction of sheet copper, the electrolysis of water and the use of catalysis in the oxidation of ammonia.

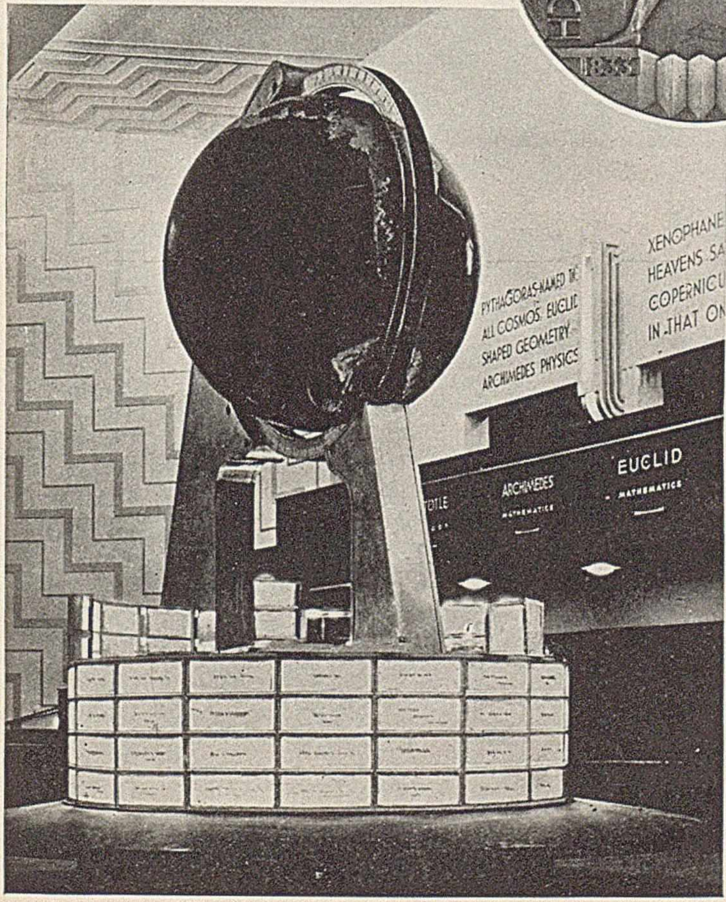
One of the most remarkable of the scale model exhibits in the applied chemistry section is the complete oil refinery constructed, as were the oil production exhibits in the geology section, under the auspices of an exhibiting committee representing all of the principal factors in the petroleum industry. The refinery illustrated on the opposite page is supplemented by dioramas of an oilfield and of a refinery as it actually looks. The model is made almost entirely of glass and covers some 300 sq.ft. of space. Except for the fire regulations which make it necessary to substitute realistic dye solutions for the various oil fractions, the model is very close to being the real thing. In the 10-foot distillation column, four fractions are taken off. The gasoline fraction goes through treating towers, the kerosene through an agitator and batch treater. The gas oil is cracked and treated, and the lubricating fraction chilled and filter pressed. Even the coke from the stills and the asphalt residual from the column are shown in the process of being removed. Synchronized voice equipment carries the visitor through the entire operation.

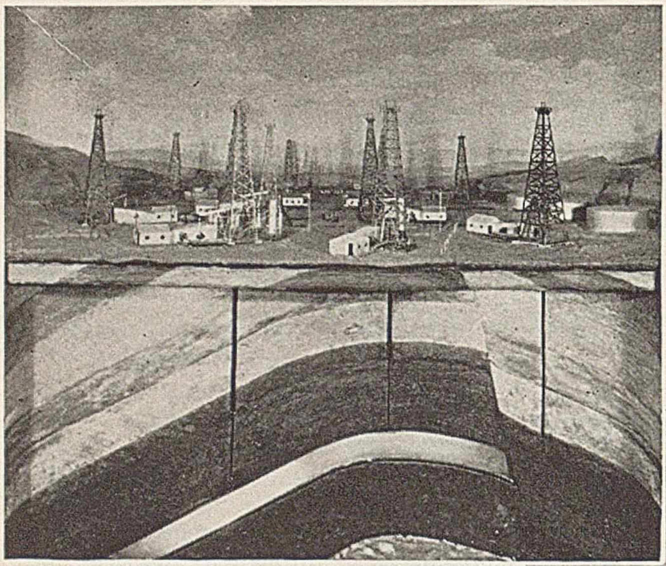
Also prominently featured in the applied chemical displays are those of rubber, sponsored by Firestone; and of sulphur sponsored by Texas Gulf. In the former, operating models show the continuous coagulation of latex by acetic acid and the electrodeposition of rubber. Another model compares the properties of vulcanized and unvulcanized rubber, the former with and without an accelerator. Still another subject unprotected and rubber-protected iron to the erosion of a sand blast. Texas Gulf Sulphur Co. contributed a remarkable working diorama of a Frasch process sulphur mine, showing both the surface and the subsurface equipment. Coupled with this appears an all-glass sulphur burner supplying SO_2 to a platinum contact plant, also of glass. The mist-evolving difficulties of an absorber supplied with weak acid are strikingly displayed through the use of a precipitator which is periodically turned on and off.

Colloid chemistry is illustrated by means of the Brownian movement, by water purification, by the grinding, tabling and flotation of gold ores, and by the making and breaking of emulsions. Union Carbide and Carbon Corp. is sponsor for a group of applied chemical demonstrations including one showing the relative properties of the components of air; another showing the spectra of air constituents; a group covering the principles of air liquefaction by cooling, by pressure and by expansion; and an electrochemical group showing electric furnaces in operation, the formation of calcium carbide; and the production of chromium plated ware; and the oxidation by air of nitrogen for the production of HNO_3 by the arc process.

Medical sciences were represented by many of the world's leading institutions. Exhibits covered medicine, dentistry and pharmacology and centered around a transparent, life-sized model of a man, built in Dresden by the Deutsches Hygiene Museum, for the illustration of body functions. One of the most fascinating of the exhibits was that of the Wellcome Research Institution of England, commemorating the work of the American, Sir Henry Wellcome, who was responsible for the conquest of yellow fever and other tropical diseases. But even though chemical engineers are human we must pass on now to the interesting commercial exhibits, or rather to a few of the many that came to our attention in some forty man-hours of browsing in the great Hall of Science.

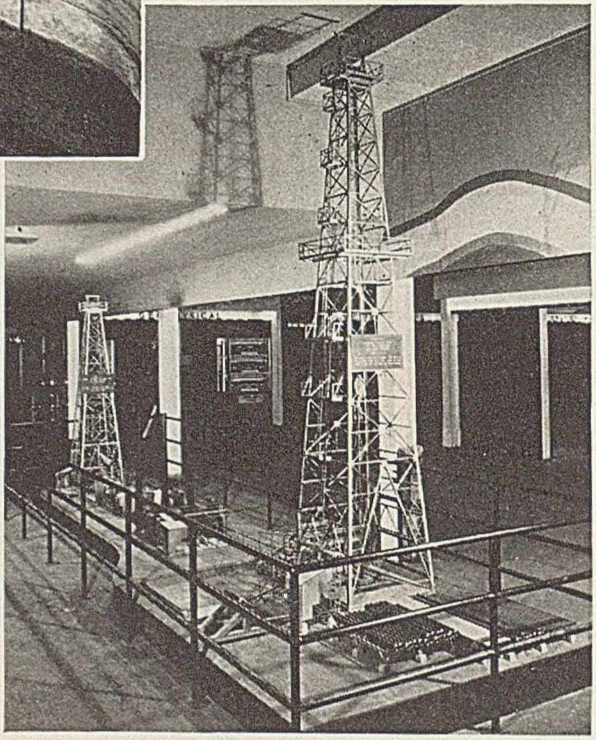
Below, the visitor to the Hall of Science is greeted by this impressive representation of the periodic table of the elements, surmounted by a huge terrestrial globe. *At right,* the official medal of the exposition, commemorating the relation of research to industry





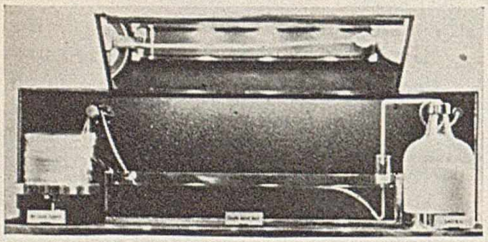
Among the applied-science exhibits are several excellent ones in the chemical and allied field, which are to be found on the ground floor of the Hall of Science building.

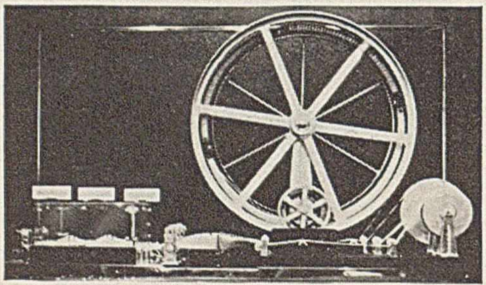
Most extensive of these is that of the Union Carbide & Carbon Corp., covering such diverse subjects as liquid air and acetylene; welding equipment; flash lights, batteries, ultra violet equipment and other carbon products; alloys; Vinylite, solvents and other chemical products. In a theater seating perhaps 100 people a demonstrator gives frequent lectures on liquid air, while at intervals a welder appears in the bottom of a copper-lined pit to

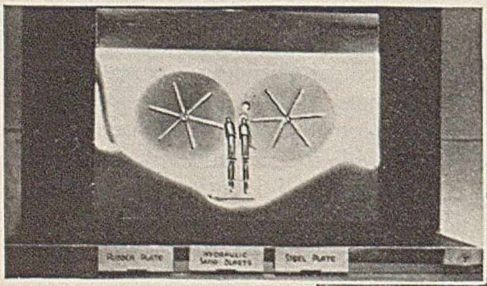


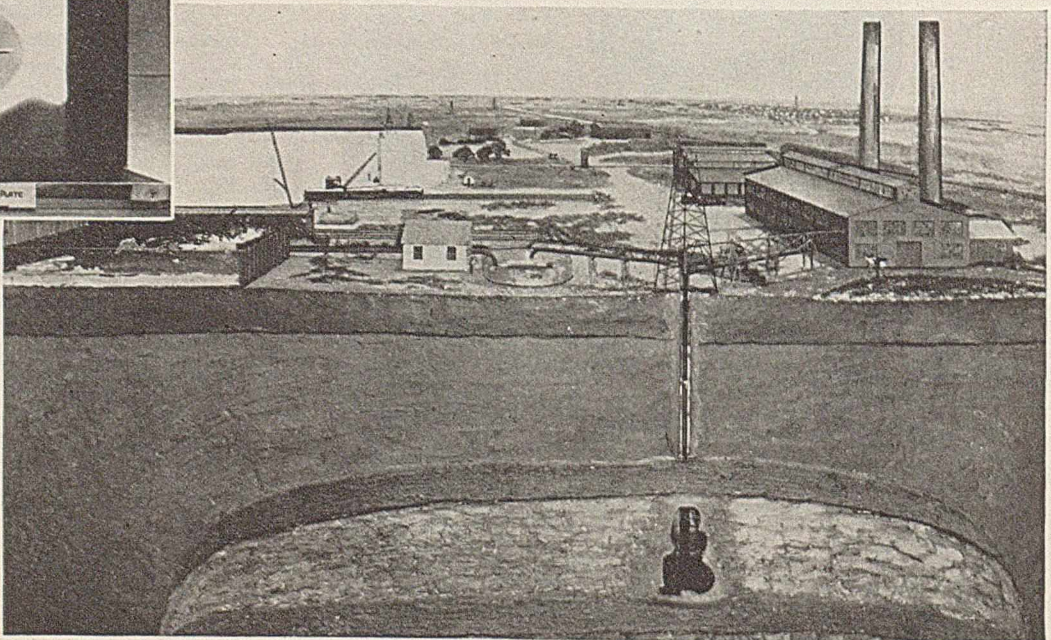
Oil field diorama with drilling operations in full blast

Scale model derricks in operation, one 10 and the other 13 ft. high (Shown by the Exhibitors' Committee of the Petroleum Industry)





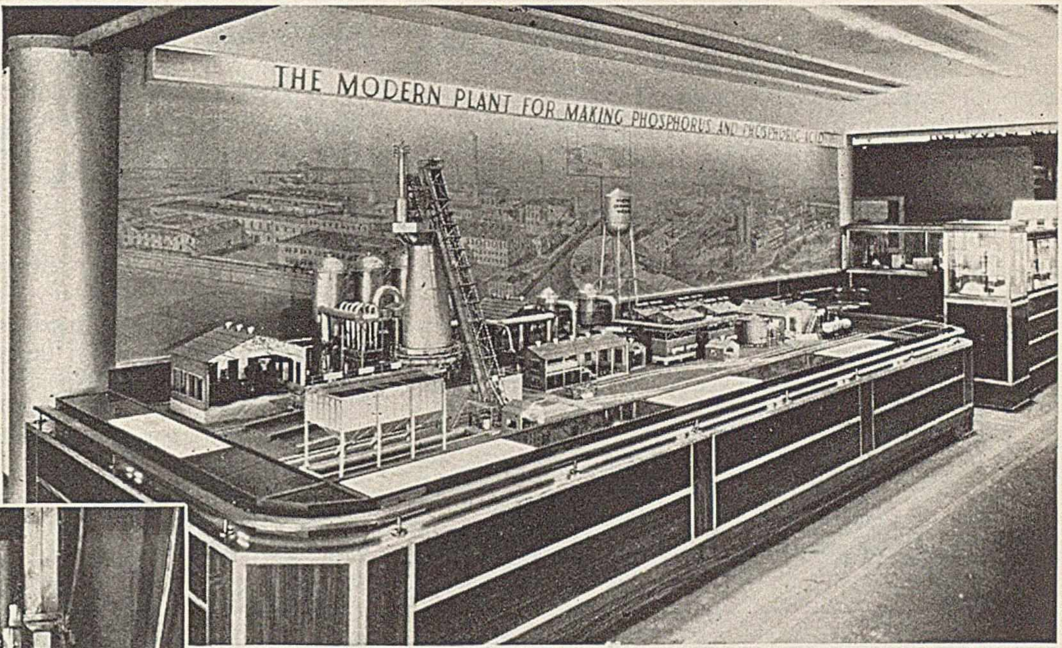


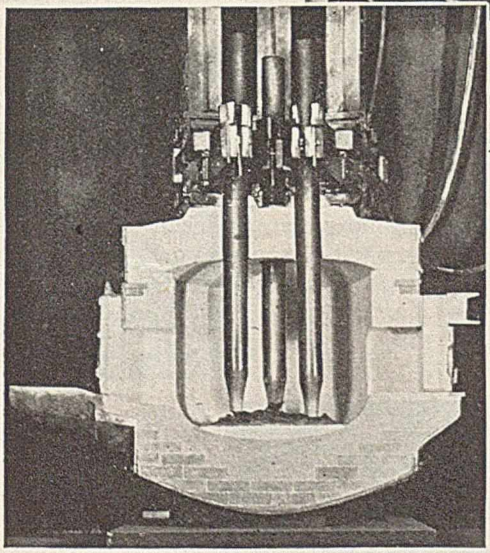


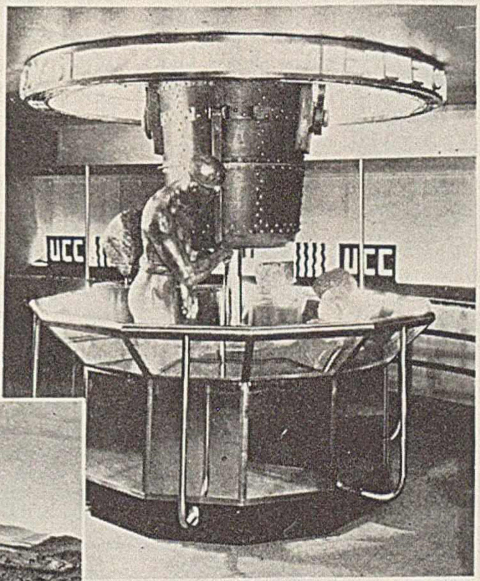
Above: Three of the rubber industry exhibits (sponsored by Firestone) showing coagulation of latex, comparison of vulcanized and unvulcanized rubber, and the comparative abrasion resistance of steel and rubber

Right: Texas Gulf Sulphur Co.'s operating diorama of a Frasch process sulphur mine

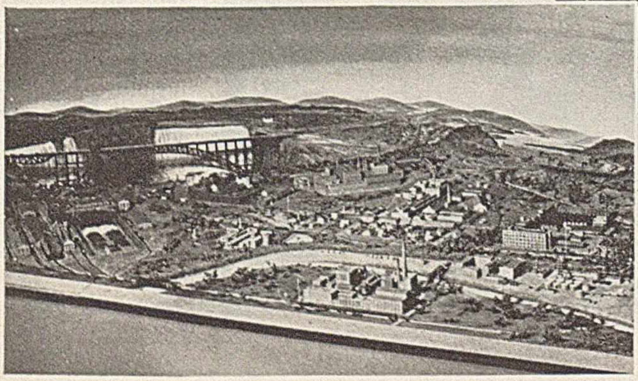
Complete to the last detail, Victor Chemical Works' operating model of its blast-furnace phosphoric acid plant shows the continuous charging of the furnace, discharge of the slag, and outflow of the acid

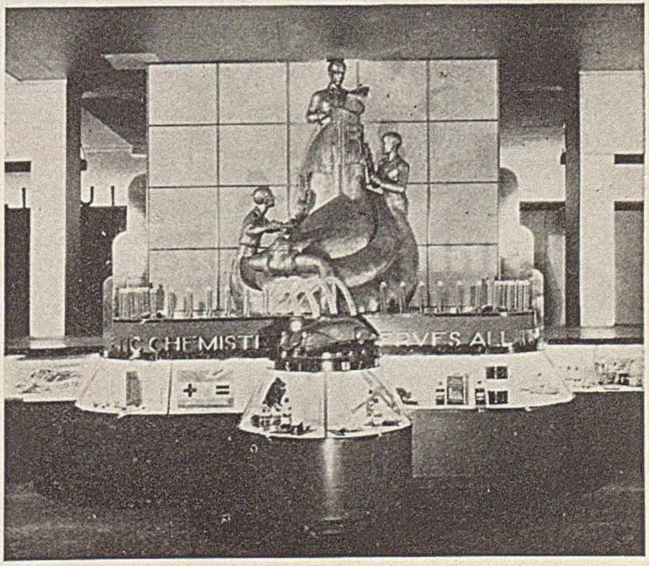






A few of the exhibits of Union Carbide and Carbon Corp., including, at the extreme left, a model electric furnace, and below it, a diorama of 16 of its plants; at right, a statue and display on ferrous alloys, and below the central group that rises above an exhibit showing the spread of synthetic chemistry





demonstrate the welding and cutting torch. One of the most striking dioramas of the entire Fair is Carbide's grouping of 16 of its 166 plants.

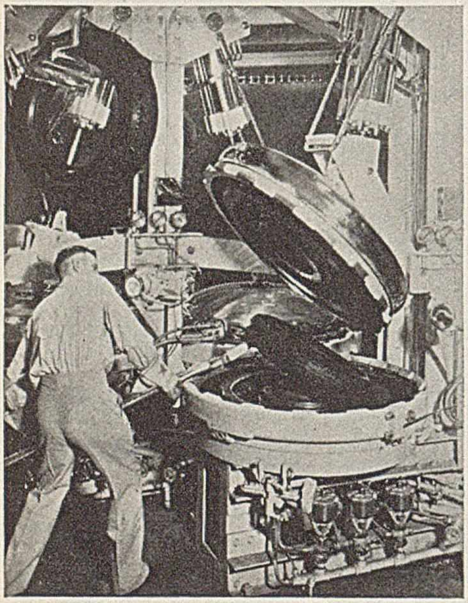
Victor Chemical Works is displaying a large model of its Nashville blast-furnace phosphoric acid plant. The model not only follows every detail of the actual plant (*Chem. & Met.,* June, 1933, p. 283), but continuously disgorges "slag" from its blast furnace and "acid" from its hydrating tower and precipitator. A demonstration of phosphoric acid's numerous uses completes the display.

Fine chemicals and pharmaceuticals likewise have their representatives in the Hall of Science. Merck & Co. makes most effective use of large masses of highly colored crystals contained within glass columns. An array of rare chemicals in uniform bottles adds to the impressiveness of the exhibit. E. R. Squibb & Sons contrasts a display of modern pharmaceuticals with a mediaeval apothecary shop carried out to the last detail. Mallinckrodt Chemical Works returns to the action theme of the basic science exhibits with working models showing the distillation of mercury and the sublimation of iodine. Abbott Laboratories goes extensively into the properties and applications of the vitamins in foods and in pharmacy.

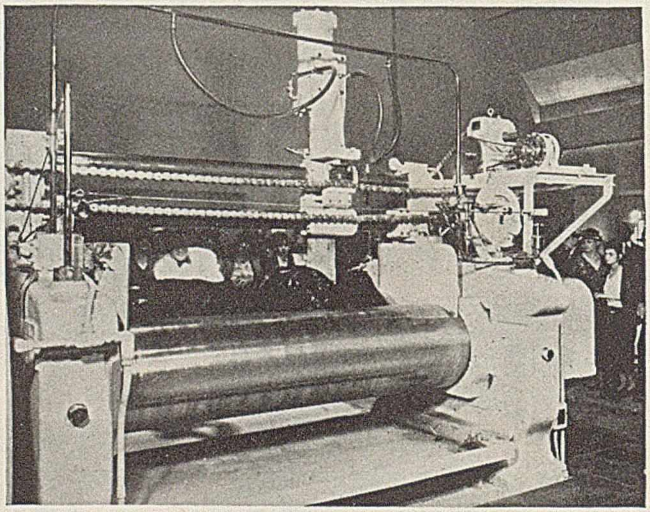
Outside the Hall of Science are other industrial displays of particular chemical engineering note. That of the Firestone Tire & Rubber Co. is the most ambitious. In addition to a very thorough treatment of all of its products, the company has set up a complete tire plant, beautifully constructed, where half a thousand potential customers can watch every step from the milling of the crude rubber to the final inspection and wrapping of the finished tires.

In the food group, Morton Salt Co. has a life-like cross section of a plant for both pan and grainer salt, while National Sugar Refining Co. of New Jersey shows another cross section of a complete sugar refinery. In the General Exhibits Building one pavillion is largely given over to U. S. Steel Corp. and its subsidiaries, where operating dioramas show the steps in steel production while numerous articles and utensils attest to the manifold uses of steel alloys. A symbolic pile in the center of the hall, illustrated below, presents the diversity of steel's applications in unforgetable fashion. Nearby is the exhibit of the Paper Foundation which contrasts the hand making of paper with machine manufacture in an operating model of a Fourdrinier machine, perfect yet but 10 ft. long.

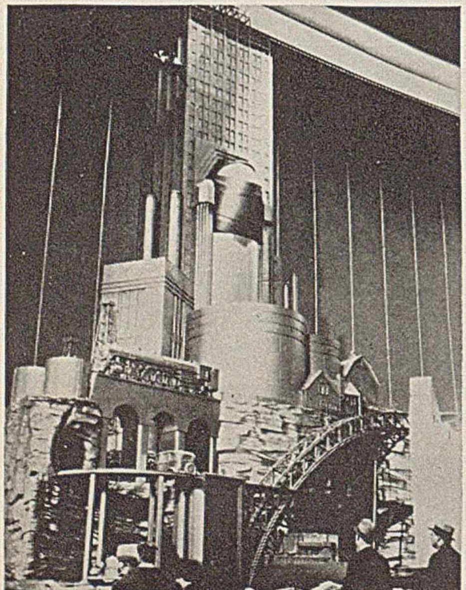
No chemical engineer, of course, will attend the Fair simply to examine his own specialties. There are profitable days to be spent in other fields: in Travel and Transport, in Motors, in Radio, Communications and Electricity, in the exhibits of Government and States, in Food, Agriculture and allied groups. He will want to peer into the future of housing and examine the newly adapted materials lavishly employed. These and a thousand other features are more than sufficient to guarantee lame muscles and worn shoes for every 1933 explorer who would discover the full meaning of A Century of Progress.



In Firestone's World's Fair tire plant: Chromium plated watch case vulcanizers that outshine any seen before; and below—



Automatic rubber roll which compounds the World's Fair tires; the traveling knife reduces the labor to mere supervision



Steel's several faces: Left, symbolic group shown by U. S. Steel to portray the material's service to humanity

Right: Steel even closer to home—the Armco - Ferro Enamel house with all exterior surfaces sheathed in enameled steel

Cement Industry Looks Toward Byproduct Potash Recovery

By P. E. LANDOLT
Consulting Engineer
New York City

WITH THE BLOCKADE against German commerce during the World War, a serious shortage of potash for fertilizer developed in the United States and prices rose to ten times their previous levels. Great ingenuity was displayed in finding new potash materials and in extracting or producing potash salts. For example, kelp, lake brines in Nebraska and California, iron blast-furnace operations, green sands, portland cement manufacture, and other sources were all called upon to help supply the demand.

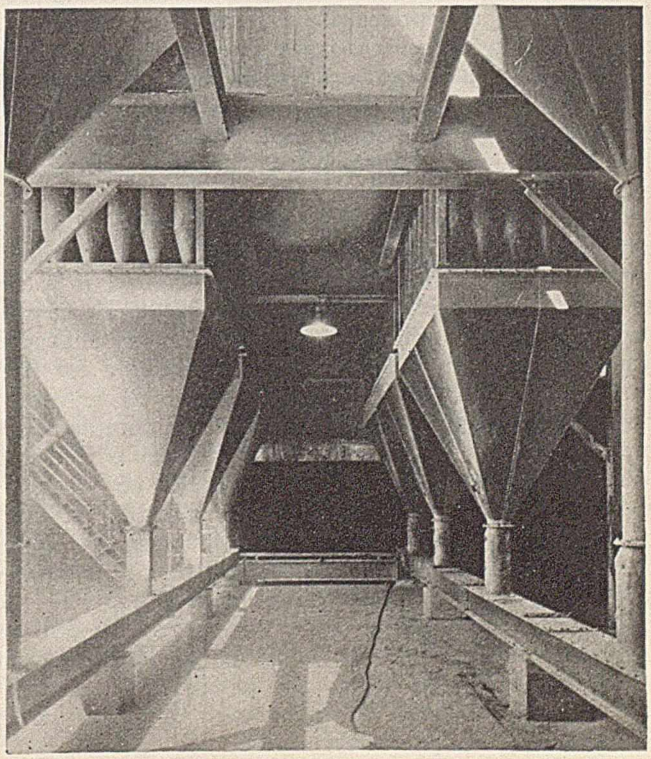
Examination of the raw materials for cement manufacture indicates that at many cement mills the limestone, or shale or clay, contains appreciable quantities of potash (and soda), usually as silicates. In most instances the ratio of K_2O to Na_2O is 3 or 4 to 1. Ordinarily one-half to two-thirds of the alkali in the raw materials remains in the clinker produced. The balance is volatilized and carried off by the flue gases in the form of fume. The volatilized alkalis combine with sulphur from the fuel or raw material to form sulphates. With a deficiency of sulphur, carbonates are formed. With chlorides present, the volatilized potash would be present in the fume as a mixture of chloride and sulphate. With powdered coal used as fuel, some of the volatilized potash combines with silica in the coal ash to form an acid-soluble potash.

The first major development of potash recovery from cement manufacture was made at the Riverside Portland Cement Co. at Riverside, Calif., in 1910-11. To abate a dust nuisance the Cottrell process of electrical precipitation was applied (Schmidt, Trans. 8th Int. Congress Appl. Chem., 1912) and large quantities of dust containing finely divided raw material, partly calcined material and alkali salts were recovered. Analysis of the raw material indicated an average potash content of 0.5 to 0.6 per cent K_2O. The dust and fume recovered in the Cottrell equipment analyzed, over an extended period, 2 to 4 per cent water-soluble K_2O. Study of kiln operations led to increased volatilization of potash and additions, such as increased lime content and salt, were made to the raw material. Also, the dust and fume collected were re-treated in a second kiln operation, resulting in a product collected from the second kiln gases containing 20 to 22 per cent water-soluble K_2O.

During the period 1915-17, a Cottrell installation was built at the plant of the Security Cement & Lime Co., near Hagerstown, Md. Another installation in the Eastern United States was built at the Dexter Portland Cement Co., at Nazareth, Pa. An installation of Cottrell equipment and a leaching plant were also built at the Ironton Portland Cement Co. at Ironton, Ohio. A further development was made at the Santa Cruz Portland Cement Co. at Davenport, Calif. (Krarup, *Chem. & Met.*, 25, 1921, p. 316). At this plant the kiln gases were scrubbed in tower washers, recirculating the wash water. After washing the gases and cooling them they were passed to excelsior filters, which were later replaced by Cottrell precipitators of a special type. Eventually, potash-bearing material containing 30 per cent or more water-soluble K_2O was produced.

Potash recovery in portland cement manufacture has several distinct limitations: first, it is dependent on the

Fig. 1—Multiclone collectors for potash-bearing dust in North American Cement Corp.'s plant



prime production of portland cement; second, on the price of potash salts obtained from salt deposits, such as Stassfurt or Carlsbad. For the manufacture of portland cement a total plant investment of $2 to $4 is required for each annual barrel of cement produced. Fixed charges on such an investment applied to potash alone would be prohibitive under normal conditions, to say nothing of the disposal of the clinker produced.

Usually, unless the raw mix for the manufacture of cement contains over 0.75 per cent K_2O, the amounts of water-soluble potash recoverable from the gases do not justify a recovery plant. At one or two plants in the United States the raw mix contains as much as 1.75 per cent total K_2O, and many plants show an analysis of raw material of 1 per cent, plus or minus. In most cases the soda content is low. An analysis in 1917 of the raw materials for cement manufacture used in the plants of the United States, made by the Bureau of Soils (U.S. Dept. of Agriculture, Bull. 572), shows that about one-third of the plants had sufficient potash in the raw materials to justify recovery. The potential tonnage thus shown approximates 50,000 tons of K_2O per annum, which is approximately 20 per cent of the average annual U.S. consumption of potash for agricultural purposes. These figures are based on a cement production of about 150,000,000 bbl. per year.

Ordinarily only one-third to one-half of the potash in the raw material can be considered recoverable. The balance is lost to the clinker. Harder burning of the raw mix in the kiln, increase in the lime content of the mix, or addition of volatilization agents may bring about an increase to perhaps 75 per cent. It may also be found practical to volatilize most of the residual potash from the cement clinker. Theoretically, all of the potash can be volatilized by increased temperature, as shown by Nestell and Anderson (*J. Ind. Eng. Chem.*, 9, 1917, p. 646), and by increasing the lime content in the raw mix. However, a prerequisite to modifications of the process of burning such a mixture to clinker is the production of quality cement. Advances in the art of cement making in general favor increased volatilization.

Powdered coal fuel operates adversely to the extent that some of the potash recombines with the silica in the coal ash. About one-half of the coal ash is combined in the clinker, about one-half is carried out of the kiln by the flue gases.

Cottrell flue dust from cement-kiln gases usually contains, in plants having potash-bearing materials, about 8 per cent total K_2O, of which about one-half is water soluble. Such material is not readily salable except perhaps as a low-priced soil dressing. It must either be leached or put through secondary volatilization for further concentration of its potash content. Either operation is so expensive as to render it unprofitable at ordinary market levels. A serious difficulty is found in leaching such material due to the formation of syngenite, a double sulphate of lime and potash, which is insoluble.

Use of scrubbers for removing dust, as had been practiced at the Santa Cruz Portland Cement Co., is expensive. For economy of wash water, provision must be made for recirculation in which an appreciable concentration of calcium sulphate builds up, rapidly salting out in the pipe lines, connections and pumps, and necessitating heavy maintenance costs, or even duplicate piping and pumping equipment throughout.

Multiclone Recovery Process

During the years 1928 and 1929 a new mechanical dust collector was developed, known as the Multiclone (Lissman, *Chem. & Met.*, 37, 1930, p. 630), with which tests were made at the plants of the Riverside and Santa Cruz Portland Cement Cos. to demonstrate its possibilities as a dust collector on cement-kiln gases. These tests indicated that the bulk of the dust was removed from the gases, and most of the fume escaped. This separation was apparently an entirely mechanical one based on the relative size of the particles, the fume particles being finer than 1 micron in diameter. Multiclones with 9-in. diameter tubes showed slightly better fractionation than those with larger diameter tubes.

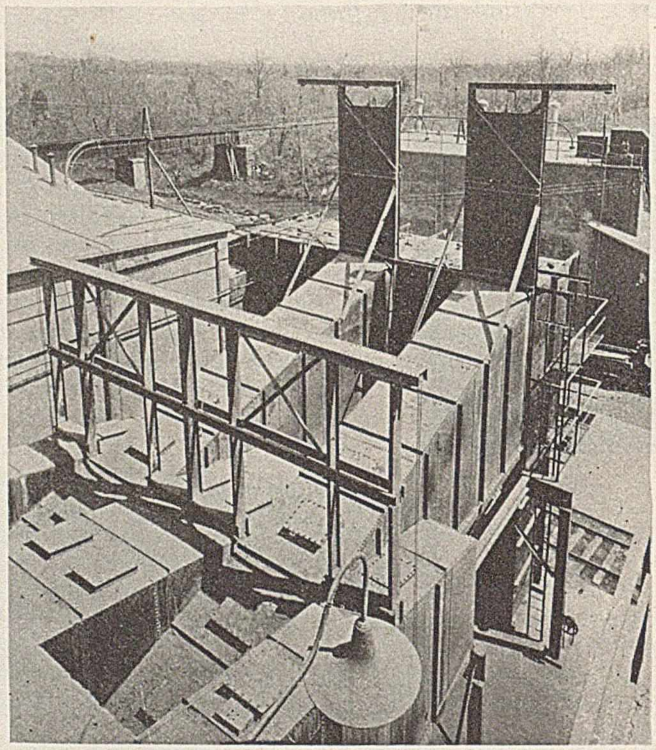


Fig. 2—Top view of Multiclone collectors

Tests were repeated at the North American Cement Corp., at Security, Md., (formerly Security Cement & Lime Co.) in 1929 and 1930 with like results, but in these tests 9-in. diameter Multiclone tubes showed a decidedly better fractionation than 16 or 24-in. diameter tubes. The variation between these tests and those made at the Western plants was probably due to the presence of coal ash at the Security tests. The kilns in the Western plants were oil or gas fired.

The Security plant has five kilns, 8 ft. in diameter and 125 ft. long, with a 40 ft. length 10 ft. in diameter. The maximum capacity is 5,000 bbl. of clinker per day, made by the dry process. Hot gases from the kilns are delivered to three waste-heat boilers, each equipped with waste-heat exhaust fans. Steam from these boilers generates all the power for plant operation, with some surplus production periodically.

In 1930 a Cottrell precipitator was installed at Security for dust recovery. With this equipment installed, and with the possibilities of the Multiclone shown, it was decided to install Multiclones and other equipment for a complete byproduct potash recovery operation. Gases from the waste-heat boiler fans were delivered to a large Multiclone installation through a connecting flue system, thence to a spray chamber, where water under high pressure was atomized into the hot gases, reducing their temperature from approximately 300-350 deg. F. to 200-250 deg. F. From the spray chamber the gases were passed through the Cottrell precipitator in which the potash concentrate was collected, and then the gases were passed through the stack for discharge to atmosphere.

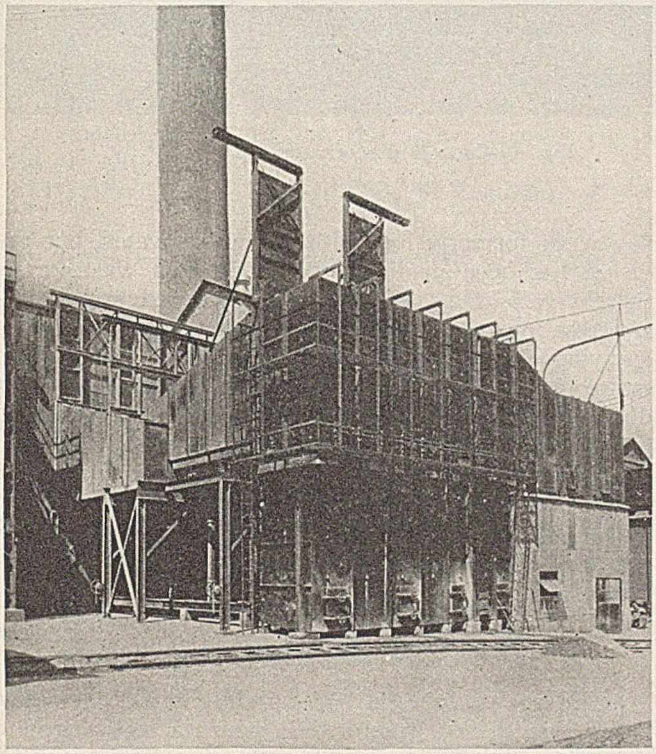


Fig. 3—Spray chamber and Multiclone unit

The Multiclone installation consists of six units, Type $10\frac{1}{4}$ VB, size 48, with a total of 288 tubes $10\frac{1}{4}$ in. in diameter. The units are set in two rows of three each, and the flues are equipped with dampers so that various combinations of units can be operated together. The flues are designed to permit the subsequent installation of four additional units. This particular type of Multiclone, rather than the 9 VA type, was installed merely because of the availability of the designs at the time. In subsequent plants, 9-in. tubes will be specified.

Reference to Fig. 1 shows outline details of the Multiclone installation. The collected dust is dropped from the hoppers by means of tipping valves to screw conveyors, which transport it to a 60-ton dust storage tank, from which it is returned to the raw grinding department by means of a Fuller-Kinyon pump system, and blended with new raw material. The top of the outlet flue of the Multiclone, which is immediately above the individual outlet tubes, is fitted with covered openings through which these tubes, and particularly the small dust throats at the bottom of the collecting tubes, can be cleaned out. Cleaning has proven necessary occasionally, particularly after a temporary breakdown of the dust-removal system when the hoppers fill up as well as part of the tubes themselves. Similar openings are also provided on the sides of the inlet flues through which the separating vanes can be blown off when necessary with compressed air.

The spray chamber was designed and installed after the rest of the equipment had been in operation for a short while and had, therefore, to be fitted into the space occupied by the existing flue from the Multiclone to the precipitator. It is nevertheless serving its main purpose satisfactorily. This structure is shown in Fig. 3 and consists essentially of a rectangular steel chamber with a flat bottom. It is equipped with about 120 small sprays inserted from the top and two sides. These consist of a small head, to give the water a whirling motion, closed by a thin disk with a small central orifice of $\frac{3}{64}$-in. diameter. At a working pressure of 250 lb. per sq.in. these sprays deliver from 0.2 to 0.3 gal. per minute, sufficiently finely atomized that about 70 per cent is actually evaporated. The water is delivered to the sprays by a high-pressure, multi-stage centrifugal pump.

Dust separated by the water collects in part on the walls, from which it is periodically dislodged by rapping the walls at designated points, or "buttons," with air hammers. Provision has been made for clarifying the unevaporated spray water in settling tanks and returning it in the form of a coarser spray to the spray chamber, while the solids are returned to the raw material dryers and thence to the blending system and kilns.

The precipitator is of the standard rod-curtain type, consisting of two units with three sections of 18 ducts each. The rod curtains are about 12 ft. long and spaced 8 in. apart with $\frac{1}{8}$-in. square, twisted rods as discharge electrodes. The effective discharge length is about 15,000 ft. Collected material is carried to the end of the hoppers by means of screw conveyors from which it is transported to the potash storage bins by means of a special Fuller-Kinyon pump.

Operating Experiences

From January to July, 1932, the operations were closely studied to determine optimum conditions of operation of the Multiclone and Cottrell precipitator, simultaneously with the operation of cement manufacture. Many variations occurred in operation which were reflected in the operation of the potash process. Also numerous small operating defects developed in the use of the Multiclones and the spray chamber, which were not unusual in the trial of new equipment under new operating conditions. These difficulties were primarily those involving the removal of the collected material, and were finally solved by a careful standardization of operating routine. In general, the operation of the Multiclones and related equipment was more or less automatic.

During the trial of this process, cement mill operation was quite irregular on account of the generally bad trade conditions prevailing at that time. The plant operated part of the time with three kilns and part with two. Production per kiln was generally low. On four kilns only

3,500 bbl. of clinker was made per 24 hours; on three kilns, 2,600 bbl.; on two kilns, 1,800-2,000 bbl.

An endeavor was made to reduce the potash in the clinker to 0.6 per cent. The raw material contained 1.0-1.1 per cent K_2O. The potash in the clinker averaged 0.8-0.9 per cent. This resulted in a lowered recovery. Kiln drafts were varied, resulting in variable dust loss and variable volatilization. Much work remained to be done to insure maximum volatilization. Parallel with the potash recovery tests, kiln operations were carefully studied, with the result that a great deal of valuable information on optimum drafts, fuel consumption, excess air, kiln output and other factors was obtained.

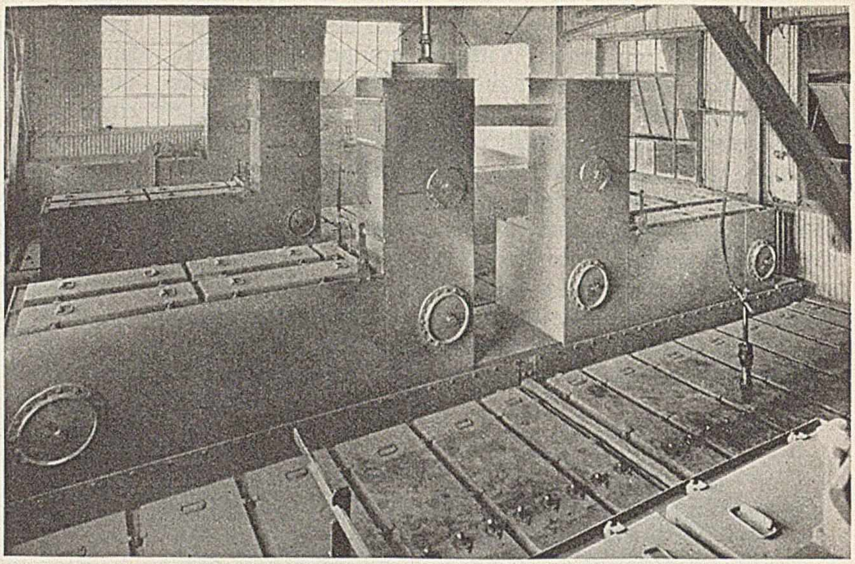


Fig. 4—Cottrell precipitator top

The Multiclones were normally operated on a pressure drop of 3-4 in. w.g., usually three Multiclones of 48 tubes operating for three kilns. There was no way of adjusting the Multiclone tubes easily to the volume passing. Multiclone dust efficiency varied widely as a result. Over 90 per cent efficiency was obtained, but at times this dropped to 80 per cent. About 45-50 lb. of dust per barrel of clinker produced was collected in the Multiclones, or about 8 per cent of the raw mix feed. At times this increased to 15 per cent. The Multiclone dust was mixed with the raw material in a blending system, with correction for the low lime in the dust.

Multiclone operation was practically automatic except for the "lancing" of the dust throats and vanes about once a week, an operation requiring about 1 to 2 hours time of one man.

The material collected in the Multiclone averaged 99 per cent through 100 mesh, 93 per cent through 200 mesh and 85 per cent through 325 mesh. The average chemical analysis of this material was as shown in Table I.

Table I—Composition of Multiclone Dust

	Per Cent		Per Cent
CaO	48.10	SO_3	12.35
SiO_2	16.36	Cl	0.20
Fe_2O_3	3.79	K_2O	5.19
Al_2O_3	5.19	CO_2	5.88
MgO	2.33		
S	0.08	Total	99.47*

*Balance Na_2O and accumulated error.

From the Multiclone the gases enter the spray chamber, where about 30 gal. of water per minute is atomized, of which about 20 gal. is evaporated and 10 gal. flows out of the bottom of the spray chamber. This evaporation and cooling reduces the temperature of the gases to about 200 deg. F., with a dewpoint of about 100-110 deg. F.

During the operation in 1932 approximately 5,000 lb. of material per day was removed in the spray chamber, largely as mud, but partly as dissolved potash salts carried away with the waste water. As a result of modifications in the equipment made during the winter shut-down the amount of material removed in the spray chamber has been appreciably reduced.

Potash salts representing about 1,500 lb. of K_2O per day were formerly lost with the waste water, but provision has been made to recirculate this waste water, thereby recovering the bulk of these potash salts.

Stress must be laid on the fact that humidification or spraying of the gases would be very troublesome if the entire quantity of dust were present. The bulk of the dust has been removed in the Multiclone, leaving only the finest and lightest material to be separated in wet condition. The spray chamber also serves some function in further increasing the concentration of the potash fume by the removal of fine dust, which is relatively low in potash. The spray-chamber dust contains less than 1 per cent K_2O.

High Cottrell Efficiency Attained

Little stress need be laid on the Cottrell operation, which was quite normal and in which a high degree of recovery was obtained. The efficiency of removal of total solids in the Cottrell installation exceeded 95 per cent, including electrode rapping periods, and periods when the "lancing" of the boiler tubes to remove dust greatly increased the dust content of the gases.

In the material collected by the precipitator the average concentration of water-soluble potash for the month of July, 1932, was almost 21 per cent. With an actual clinker production of 2,000 bbl. per day during that month, approximately 600,000 lb. of material was collected, containing about 120,000 lb. of K_2O, water soluble. About 95 per cent of the total potash in this material is water soluble. Chemical analysis of an average sample from 10 days collection in the Cottrell precipitator was as shown in Table II.

Operations in September, October and November, 1932, produced material having an average of 25-28 per cent water-soluble K_2O, with material in the third or last precipitator section having analysis as high as 40 per cent water-soluble K_2O.

A potash-recovery balance based on an average production of 3,000 bbl. of clinker per day is given in Table III.

Since the installation at Security was laid out to suit existing conditions and was planned initially for dust recovery only, its layout is not the best possible. The layout shown in Fig. 5 constitutes a more or less ideal system. Each boiler fan would be equipped with a set of Multiclones with sufficient flexibility to permit the shut-down or isolation of any Multiclone unit. The spray system would be designed to permit partial shut-down for cleaning, repairs or other attention. The Cottrell precipitator would also be designed for greater flexibility than the present unit, and the potash storage would be built as a part of the precipitator structure for economy and convenience.

In plants where waste-heat boilers are not installed, some provision for cooling must be made, but Multiclone installations built of steel can be operated up to 1,000 deg. F., and, if need be, alloy construction can be used for higher temperatures. The precipitator construction would be the same, owing to the interposition of the spray chamber. In the case of wet-process cement plants it is more than likely that the spray chamber can be entirely eliminated.

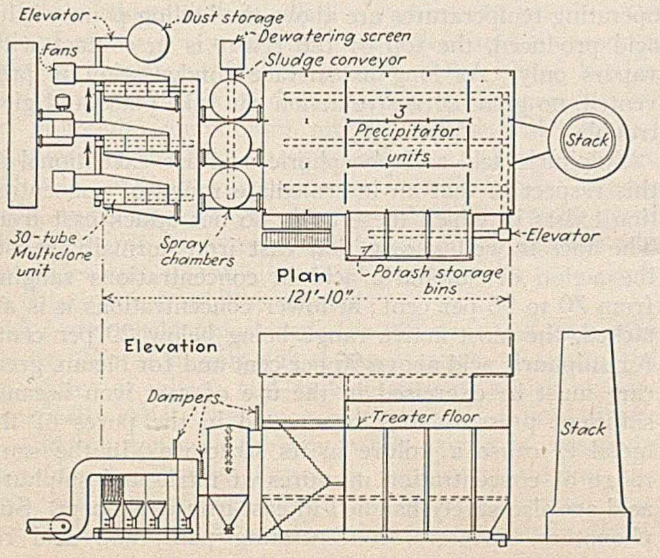
Operation of the Security installation has not been carried on over a sufficiently long period to justify full and complete cost figures, but the data of Table IV are indicative of the conditions prevailing.

Table II—Typical Analysis of Cottrell-Collected Dust

	Per Cent	Water Soluble	Per Cent
CaO	28.27	CaO	7.42
SiO_2	9.62	MgO	trace
Fe_2O_3	2.06	SO_3	23.07
Al_2O_3	3.38	K_2O	20.27
SO_3	29.83	Na_2O (est.)	1.29
K_2O total	20.80		
Na_2O	1.33		
CO_2	2.78		
S	<0.02		
H_2O	0.16		
MgO	1.16		
Cl	not determined, probably 0.5 ±		
Total	99.41		

To offset these costs, credit must be given to the dust returned to the raw mix which is ground and dried, and partly calcined, amounting to 60-75 tons per 24 hours, having a value as raw material of $0.50 per ton, or $10,000-$12,000 per annum. In the average plant equipped it would be fair to assume that the value of the dust collected and returned to the system would offset the charges for the operation of the entire byproduct plant.

Fig. 5—Suggested layout of potash recovery equipment for a 4,500-bbl. cement plant



Potash recovery on the 2,600-bbl. clinker production of 12.5 tons per day of 21 per cent K_2O would have an average worth of $125 or, annually, about $40,000. At 5,000 barrels, this would mean at least $75,000 per year. These recovery figures are based on what has been considered a reasonable average price for potash, but under present stress conditions these figures must be reduced appreciably.

Table III—Typical Potash Balance

1 bbl. of cement = 376 lb.
1 bbl. of clinker = 370 lb.
1 bbl. of kiln feed = 570 lb. plus dust returned

	Lb. K_2O Per Bbl.	Lb. K_2O Per Day
Potash in raw material, 1.05% K_2O	5.89	17,670
Clinker 0.80% K_2O	2.96	8,880
Gases	2.93	8,790
(Circulating between kiln and Multiclone, 46 lb. of dust per bbl. carrying 6% K_2O, 2.75 lb. K_2O)		
Entering spray chamber, 12 lb./bbl.	2.93	8,790
Leaving spray chamber in water 2 lb./bbl. (recoverable by recirculation)	0.57	1,710
Leaving spray chamber in gases	2.36	7,080
Collected in Cottrell precipitator	2.21	6,630
Lost in stack gases	0.15	450
Net Volatilization	49% approx.	
Net Recovery of Marketable Potash	47% approx. (including soluble K_2O in wash water)	

The foregoing indicates the possibilities of potash recovery, but there is further opportunity for trial and development which may lead to even more promising results. Such concentrated material may also be further refined at a reasonable cost to produce high-grade potash salts for other industrial purposes. By further control of kiln operation or addition agents to the mix, greater potash yields may be expected with no greater investment.

Table IV—Added Costs for Potash Recovery

	Kw.-Hr. per Day
Additional load on boiler fans to overcome resistance through Multiclones at 3-4 in. w.g.	1,500
Power for high-pressure pump	120
Power for screw conveyors and Fuller-Kinyon pump	250
Power for Cottrell equipment	600
Total	2,470
	Dollars per Day
Power from waste-heat boilers (less than $0.005 per kw.-hr.)	12
Labor, two men over three shifts	9
Repairs and maintenance	5
Total	26
Annual Total, 330 days	8,580

The potash concentrate made at Security has been regularly sold to and used by fertilizer manufacturers during the past year. Extensive tests were made to determine its suitability in standard and special formulas. The material has been added to fertilizer mixtures up to the point of desired potash concentration in the final mixture, but the amount of such material which can be used is limited by its free lime content, which is ordinarily well under 10 per cent.

Acknowledgment is made to the North American Cement Corp. and to the Western Precipitation Co. for the data used in the preparation of this article, and to the operating staff of the Security plant in the conduct of the trials and tests of this potash recovery system developed by the Western Precipitation Co.

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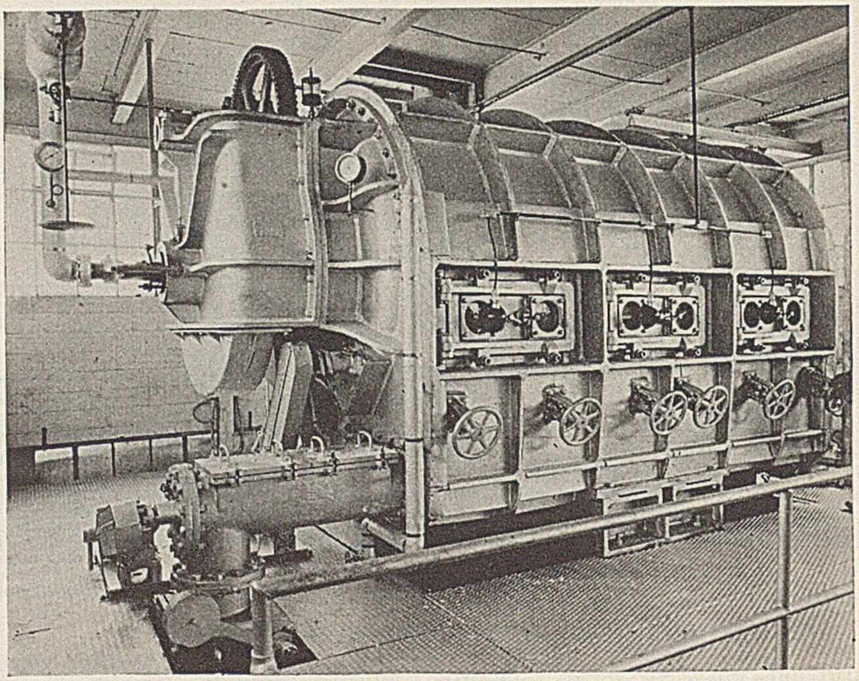
The low cost and the many desirable properties of cast iron are leading an increasing number of engineers to adopt this material in the construction of chemical equipment



Vacuum drum dryer with cast iron casing designed for tightness and resistance to pressure

UTILIZING CAST IRON IN

Modern metallurgical methods are producing cast iron of increased strength and improved physical properties such as high resistance to chemical corrosion, to pressure, and to deformation by heat. These new and improved characteristics have broadened the fields of application of cast iron in the process industries and, where this knowledge has been intelligently applied, cost of production and maintenance has been reduced.

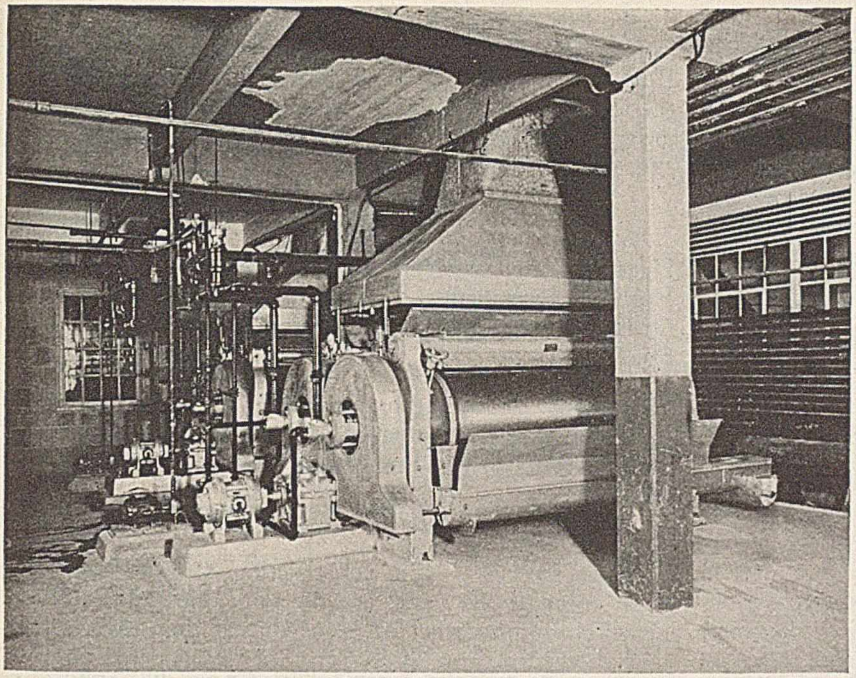
Properties governing the resistance to corrosion depend largely upon the chemical composition of the cast iron and may be regulated by altering the combination of elements in a given formula. Corrosive action during a given operation may also be materially influenced by changes in the chemical process itself. To obtain the best and maximum results in any given case, careful selection and adaptation of a proper composition of cast iron are therefore essential.

Important factors influencing the rate of corrosion by various chemicals are temperature, concentration of the chemical, working pressure, presence of air and moisture, and the formula and physical properties of the iron.

Cast iron has many important applications as an acid-resistant material provided proper consideration is given to the nature and the concentration of the acid. Resistance to the action of the weaker acids is pronounced, particularly at low or moderate concentrations. This resistance, which is ascribed to the formation of an iron-carbon-silicon alloy, in general decreases with increasing concentration, temperature, and pressure of solution.

Notwithstanding the extremely corrosive nature of the stronger acids, particularly acetic, hydrochloric, and nitric acid, cast iron retorts are successfully used in the manufacture of these acids by the action of concentrated sulphuric acid on their respective salts. Presence of sulphuric acid completely modifies the corrosive conditions, as this acid has such a great affinity for moisture, that the part of the retort in direct contact with the acid is protected against attack. In view of the fact that the operating temperatures are above the boiling point of the acid produced, the top of the retort is in contact with vapors only. As long as surface condensation is prevented, no great corrosive action can take place and give trouble.

Sulphuric acid and phosphoric acid are exceptional in this respect in that an intermediate range of concentration exists in which these acids do not attack cast iron. The fact is well known that cast iron normally resists the action of sulphuric acid in concentrations ranging from 70 to 96 per cent; at lower concentrations it is attacked, the most active range being below 20 per cent; for sulphuric acid above 96 per cent and for oleum, great care must be exercised in the use of cast iron because sufficient pressure may be created in the pores of the metal to cause a failure in its structure. In the same range of concentration mixtures of nitric and sulphuric acid are also safely handled in cast-iron equipment. Sulphonators, nitrators, concentrating pans, and acid re-



Atmospheric double-drum dryer equipped with smooth drums of machined cast iron

by a corrosive medium, the iron portion is dissolved and a coating of free or graphitic carbon is left on its surface. To a certain extent this coating acts as an insulator against further attack of the corrosive medium; if allowed to remain as formed it prolongs the life of the cast iron. When acted upon by a corrosive agent which has an oxidizing effect, silicon acts in a similar manner by forming a protective coating of silica on the surface of the cast iron.

The microstructure of cast iron shows a matrix in which free graphite is more or less regularly distributed in the form of plates. When a casting is poured, graphite is largely in solution in the molten iron and separates out during the granulation period when crystallization takes place. In accordance with the physical laws of crystallization, grain structures of metals are controlled by the cooling rate of the metal, which, in turn, to a great extent, depends upon the size, thickness, and volume of the casting. Therefore, the surface of the casting is of a finer structure than the interior, which, on account of its slower cooling rate, is coarser. In addition, an allotropic change in structure, involving the interior but not the exterior shape of the grains, occurs after solidification.

CHEMICAL EQUIPMENT

covery stills are built of cast iron of suitable grade and composition. Frequently corrosion of such equipment is accelerated by the presence of air, generally at the liquor level, both on account of its oxidizing effect and its moisture content, which may locally reduce the concentration of the acid. This action of air is particularly to be guarded against when the equipment is left idle for any length of time, and the surface is left covered with a film of acid. Fatty acid stills are also made of cast iron, as moisture has no influence in this case.

For products with an alkaline and neutral reaction, the use of cast iron is unlimited; equipment such as reaction kettles, evaporator bodies, pumps, stills, fusion kettles, and filter presses is used extensively in the manufacture of ammonia, ammonium nitrate, aniline, calcium and magnesium chloride, ferrous sulphate, phenol, sodium chloride, sodium carbonate, sodium sulphide, caustic soda, and many dyestuff intermediates. It is to be noted that cast iron is resistant to the action of sulphur and sulphides and, in the absence of moisture, to gases such as chlorine and sulphur dioxide.

As previously mentioned, the resistance of cast iron to corrosion is in part due to the presence of substantial quantities of silicon and carbon, each of which characteristically resists the action of chemicals. Silicon forms a solid solution with the iron, while carbon is present in two forms, a smaller portion in combined state with the iron, and a larger portion in a free state as graphite. Accordingly, when cast iron is subjected to a slight attack

Excellent results have been attained in modern metallurgy by introducing various alloying elements into cast iron in order to increase its resistance to corrosion. The significant fact is that alloys can be so introduced without detracting from the casting properties of the iron. The increased resistance of cast iron to corrosion through proper alloying is attained by stabilizing the grain structure of the metal whereby an improved form of graphite, more uniformly distributed, is obtained. Such irons, developed during the last few years, contain large quantities of copper, nickel, and chromium. Their higher cost restricts their application to the more corrosive products, or to cases where even the slightest contamination with iron must be avoided. Such alloys are used to prevent discoloration in the manufacture of phenol, paints, pigments, and foodstuffs, and to minimize catalytic action as, for example, the unfavorable influence of minute quantities of copper or iron on the rate of decomposition of butter-fat in milk powders.

A comparison between cast iron and steel shows that the latter, although of greater strength than cast iron, is more limited in its application as a corrosion-resisting metal, at least in the chemical industry. This is primarily due to the fact that comparatively little carbon and silicon are present in steel. Whereas the inherently resistant properties of cast iron may be increased by the addition of small percentages of suitable metals, similar results are obtained with steel only by addition of such large quantities of alloying elements that the added cost and the increased difficulties in fabrication prevent general application.

Cast iron has greater resistance to erosion than most other metals. This is partly due to the nature of the common elements in cast iron, having regard not only to their chemical but also to their physical properties. Two conditions existing in the manufacture of cast iron serve to increase its resistance to erosion; first, the rapid cooling at the surface produces a dense, hard skin; secondly, silica sand in contact with the hot metal is burned into the surface of the cast iron. These factors tend to increase resistance to erosion as well as to corrosion.

Addition of alloying elements to cast iron also increases resistance to erosion. Equipment designed to resist erosion, as well as corrosion, should be constructed of a metal with maximum hardness, strength, rigidity, and toughness, and these characteristics are most easily obtained by the use of suitable alloys. Alloy cast iron is desirable in equipment used in agitating corrosive liquors containing solids where the abrasive action is great. While fabricated metals are generally characterized by ductility, toughness, and strength, they lack sufficient stiffness to withstand the abuse encountered in this type of equipment, and are therefore subject to distortion. Finally, special cast irons afford greater hardness when that characteristic is required. Modern metallurgy, with its thorough physical and chemical control and the use of new alloys, has enabled the foundryman to produce cast iron with any tensile strength up to 60,000 lb. per sq.in.

Heat Resistance

The ability of cast iron to resist the action of heat depends upon the stability of the carbides present in the iron. In ordinary iron the combined carbon is present as a simple iron carbide. On heating, these carbides decompose, forming graphite and iron. This is one of the causes of growth in ordinary cast iron. Stabilization of the carbides in an iron may be effected by proper selection of alloying element. With good metallurgical control, a complex carbide is produced that is very difficult to break down.

The heat-resisting properties of cast iron are important in kettles which are heated by direct contact with flue or furnace gases, to temperatures of about red heat or above. At these temperatures the metal must retain sufficient strength to sustain the weight of the contents of the kettle. This application calls for metal which will resist the action of chemicals on the one side and flue gas of high temperatures on the other side—gases which may be either oxidizing or reducing in nature. Frequently, faulty furnace construction allows the flame to impinge on the kettle. This condition should be avoided, because excessive oxidation and uneven heating cause accelerated action of the chemical on the metal, thus impairing the life of the casting. The metal must also be impervious to shock caused by sudden temperature changes. The grain structure should remain unaltered under variations in the operating conditions. Uniformity and stability of the grain structure is therefore of utmost importance.

Short time tensile tests were run at a temperature of 1,200 deg. F. to determine the properties of alloyed cast iron at elevated temperatures. These tests were conducted according to the procedure outlined by the American Society for Testing Materials in their symposium in 1924. The following table shows the data obtained in these tests with values for steel and ordinary cast iron included for comparison. These values represent averages and not individual tests.

	Tensile Strength at 1,200 deg. F.	Per cent of Strength Retained
Heat-resisting cast iron	17,800	56
High-test cast iron	14,600	30
Ordinary cast iron	12,500	40
Steel	4,000	5

"Per cent of strength retained" is calculated from strength of these materials at room temperature. The steel referred to is a low carbon steel.

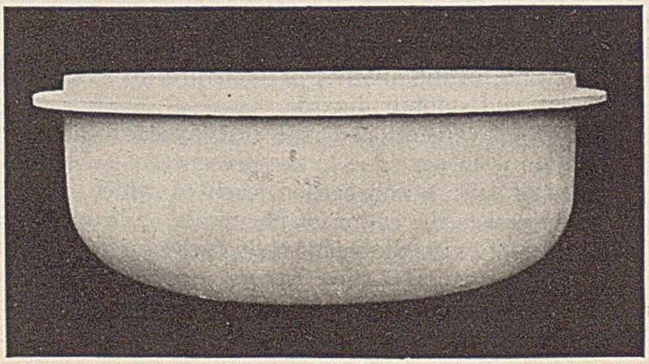
Construction Requirements

When steel is used in construction, stresses below the yield point of the metal are the only ones allowable. A nickel-chromium steel of somewhat higher carbon content showed a drop of 84 per cent in the yield point at 1,200 deg. F. (82,000 lb. down to 15,000 lb.) The safe load for this steel at 1,200 deg. F. would probably not be over 10,000 lb. per sq.in. This figure is considerably under the figure for the tensile strength of the heat-resisting cast iron. As the tensile strength and yield point of cast iron practically coincide, the tensile strength of the cast iron is directly comparable with the yield point in steel. At temperatures below 800 deg. F. cast iron retains the same strength that it has at room temperature.

Cast iron is favored in many instances because of its reliability, and because it may be cast in a single piece, thereby eliminating joints which are a frequent source of trouble. Use of cast iron also eliminates the possibility of any galvanic action at the point of contact between different metals, or between a weld and the adjoining metal. Cast iron can be made up in such manner that the dimensions are sufficiently accurate to allow the use of close fitting working parts, as for instance, kettles with close fitting agitators.

The possibilities presented in regard to the use of cast iron in the process industries are by no means exhausted, for the inherent characteristics of cast iron lend themselves to such comprehensive and varied utilization by modern metallurgical treatment that the field of general and special usefulness of cast iron in the chemical industry is becoming more and more extended.

Direct fired, cast iron kettle



New Inorganic Heat Carrier for Super-Temperature Heating

By THEODOR KAYSER

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NEED for suitable methods of accumulating heat, as well as the requirement for means to solve numerous difficult thermal processes has, in the past, given rise to the study of many substances in the hope that materials would be found to fulfill the requirements in satisfactory manner. The use of water for heat storage, to equalize fluctuations between the heat supply and energy delivery and for the improvement of thermal efficiency, is well known. Because of its high specific heat, water would seem to be quite suitable for the purpose, but it is only satisfactory when applied to processes carried on at the lower temperatures. Furthermore, as a heat carrier, it is restricted to the lower temperature ranges. At a temperature of 706.1 deg. F., it reaches its critical point, resulting in a pressure of 3,226 lb. per sq.in. Even at temperatures much lower than this, undesirably high pressures occur. Glycerine is also unsatisfactory, since it, like most organic materials, is more or less easily decomposed and is useful only within low temperature limits.

Limiting Features of Other Carriers

In recent years many other organic products, such as diphenyl, diphenyloxide and others, have been used increasingly. Other heat storage materials, including resins, metals, and salts, have only been partially successful because, in making possible high temperatures their use results in undesirable expansions, pressures and gases, which lower their capacity for heat accumulation.

Diphenyl, diphenyloxide and their mixtures have been studied extensively and found satisfactory within limits. Diphenyl, for example, boils at 491.5 deg. F. at atmospheric pressure but, of course, develops comparatively high pressures at higher temperatures. It decomposes at 980 deg. F. and is not considered useful above about 900 deg.

Let us consider the requirements of an ideal heat carrier. Such a substance should be manufactured at reasonable cost and present the highest possible heat capacity. Working temperatures up to possibly 1,650 to 1,830 deg. F. should be possible without decomposition. The substance should not corrode the ordinary metals and should be as fluid as water within the widest possible range of temperature so that excessive pressures would not be developed. By this means dangerous stresses in the heating apparatus would be avoided.

Development of "NS" Fluid

Many failures in the search for such a material have shown that there is a very limited selection of substances capable of satisfying such diverse requirements. Recently a fluid was compounded by Ernst Sander, an engineer of Berlin, Germany, and this has been named "NS" fluid (D.R.P. 519,062 and foreign patents). According to tests made thus far, the material embodies quite closely the ideal set up in the preceding paragraph. The fluid consists of a combination of different inorganic salts. A suitable mixture consists of one mol of $NaCl$ combined with one mol of $AlCl_3$. The mixture solidifies to a homogeneous mass and at 302 deg. F. liquefies into a well-defined solution which regulates its molecular ratio by expelling any excess of $AlCl_3$ which may be present. As a variant of this formula it is possible to replace the Na or Al by an optional univalent or trivalent metal, with the result that the physical properties of the fluid are altered. The general formula, therefore, becomes $R'Cl + R'''Cl_3$.

Mr. Sander's fluid is composed of the three components $NaCl$, $AlCl_3$ and $FeCl_3$. His work was first examined by Dr. von Deines of the Institute of Physics and Chemistry at Berlin University. A determination of physical data with the Bunsen ice calorimeter established the fact that the specific heat is 0.7 and the specific weight from 1.96 to 2.00. The heat-conducting capacity of the solution is so favorable that, for example, in passing water through a heater in which the temperature of the water varied from 64 to 79 deg. F., no insulating scale of crystals developed which might have hindered the satisfactory transfer of heat.

The heating-cooling curve of the fluid shows that it has a softening range that can be regulated as desired below the determined melting point of 302 deg. F. This is an important advantage in practical use because of the equalization of pressures within the apparatus. Once liquefied the solution remains in a surprisingly fluid condition, a very favorable situation. Its expansion at medium temperatures is about 10 per cent. It can easily be melted in glass tubes without breaking the latter when the solution solidifies, as would be the case with a metal. This is an important factor in heating apparatus.

When used in a closed system, the solution does not decompose. If it is heated in the open, the $AlCl_3$ sublimes at higher temperatures in small quantities, while corresponding quantities of $NaCl$ are expelled. In inclosed systems this is entirely eliminated. Water acts upon the solution by decomposing it. Exposure to the air is not advisable, therefore, since the liquid absorbs

The article on which this is based appeared under the title of "Wärmeträger in der Wärmewirtschaft" in *Brennstoff und Wärmewirtschaft*, Vol. 2, 1933. The article was translated by permission and brought to our attention by Otto Theodore Carpentier, Chicago, Ill. For greater ease of reference, all temperatures and other units have been converted to the English system from the C.G.S., which accounts for some of the apparently peculiar temperature intervals chosen.—*Editor*.

moisture and changes its characteristics. No corrosive action on iron was found to exist, which is to be expected from the composition of the fluid.

The calorific effect was measured in a large number of tests. At a demonstration by Dr. von Deines, made in the presence of Professor Hoffmann of the Physical-Technical Reichs Institute, and of the author, a water heater served as the test apparatus. This was filled with "NS" fluid and electrically heated. If not an apparatus entirely suited to scientific determination, it was nevertheless satisfactory for a practical demonstration. The results of previous work were confirmed, showing an average specific heat in the range from 570 to 750 deg. F. of 0.7. The calculated overall heat transfer coefficient shown by the test was K = 23.6 B.t.u./sq.ft./deg.F./hr. from the solution to water through iron. Within the temperature range from 302 to 1,508 deg. F. the solution remained a thin liquid somewhat like water and did not decompose despite repeated liquefying and reheating.

Of course, these were only laboratory tests, but continued later tests have been made with "NS" fluid as a heat carrier in apparatus especially designed for the purpose by a leading chemical industrial firm. The results so far have been quite satisfactory. No disturbances occurred nor was there any evidence of corrosion on iron and copper.

Fluid Suitable at High Temperature

As a result of continued tests extending over nine months in an oil distillation plant, rules were devised covering the use of "NS" fluid in practice. Owing to the limited durability of the usual construction materials, it was necessary to limit all tests to a maximum temperature not much over 1,500 deg. F. The behavior of the fluid, however, leads one to believe that it can be used successfully at still higher temperatures provided suitable construction materials are available.

Heretofore, in very high temperature operations it has usually been necessary to resort to direct firing, depending either on radiation or on the transfer of heat by means of flue gases, or both. It is obvious that the heat capacity of the latter is far below that of other heat-carrying materials. The accompanying tabulation gives a comparison between combustion gases and "NS" fluid. Necessarily, the available heat content of any given quantity of combustion gases is considerably reduced by the excess air required to effect combustion. In addition, a decided disadvantage to their use lies in the great increase in volume of gases at high temperatures. Furthermore, their useful heat content increases rather slowly with rising temperature as, for example, between 572 and 1,472 deg. F., where the difference per cubic foot of combustion gases amounts to only 1.15 B.t.u.

Still another disadvantage arises from the fact that the velocity of gases can be increased only within limits, since the utility effect decreases very quickly after passing a certain point. Under some circumstances, overheating of the heat-transfer surface is a disadvantageous result of the use of combustion gases.

It is also difficult to obtain sufficient heat-transfer surface in the oven in some cases. A typical example is to be found in the process of coking coal at low temperatures. Low-temperature carbonization has been generally disappointing so far. Difficulties, principally, have not been in incomplete knowledge of the chemical requirements nor in faulty construction of the equipment, but primarily in the lack of specially suitable heat carriers.

Comparison of Combustion Gases and "NS" Fluid

	Combustion Gases*		"NS" Fluid**
Temperature Deg. F.	Volume at Atm. Pressure Cu. Ft.	Heat Content B. t. u./Cu. Ft.	Heat Content B. t. u./Cu. Ft.
212	48.3	2.67	......
392	61.2	4.33	31,200
572	74.2	5.47	47,200
752	87.2	6.33	62,800
932	100.0	6.98	78,500
1,112	113.0	7.52	94,300
1,292	126.1	8.13	110,000
1,472	138.8	8.62	125,700
1,652	152.1	9.03	141,300

*Gases from the combustion of lignite briquets, containing 12 per cent CO^2, corresponding to 46 per cent excess air.

**The increase in volume of the "NS" fluid, which at 1,472 deg. F. amounts to about 10 per cent, has not been taken into consideration in these figures.

A comparison of the available heat, resulting from a drop in temperature from 1,472 to 572 deg. F., in the case of combustion gases and "NS" fluid, is interesting. For 1 cu.ft. of combustion gases, the available heat is approximately 1.15 B.t.u., and for 1 cu.ft. of "NS" fluid, about 70,000 B.t.u. (This takes into consideration the volume increase of the molten salt.) One lb. of water steam condensing at atmospheric pressure makes available 970 B.t.u. Without any considerable initial velocity, therefore, "NS" fluid makes it possible to transmit many times as much heat as would be transmitted by a much larger volume of combustion gases. On this account oven units can be made smaller and the cost of construction thereby reduced.

In distillation and cracking plants, it should be possible through the use of "NS" fluid to work with considerably lower temperatures. On this account, the life of the tubes should be increased and thinner tubes made possible. An important advantage for "NS" fluid in the oil industry is the elimination of the fire hazard in case of a break in the tubes. If this were to occur, the fluid would simply mix with the oil and cause no damage.

There are many other possible applications for heat carriers possessing such properties as "NS" fluid. Perhaps the most important field will be found in the utilization of waste heat and excess heat energy. One important application may be the superheating of steam between the high-pressure and low-pressure stages in turbines, because the material is capable of storing any desired degree of superheat and of giving complete uniformity of temperature.

Other applications will be found in melting, roasting and similar processes which are carried on in retorts, pipes, muffles and other equipment in the temperature range from 750 to 1,470 deg. F. In many operations, such as malting, heated air at absolutely uniform temperature is required. Electric heat assures such constant temperature, but is usually rather expensive. "NS" fluid gives the same assurance, since comparatively large quantities of fluid are placed as a buffer between the heat-taking and heat-giving elements. In such cases it is entirely possible to use ordinary fuels for firing or, through the heat storage possibilities of the substance, off-peak electric power.

A very wide field for "NS" fluid is possible in connection with household appliances, such, for example, as hot water heaters, kitchen stoves, room heaters, etc. Interesting opportunities would seem to be open to the builders of heating apparatus.

A.S.M.E. Process Group in Chicago Session

ENGINEERING WEEK, June 25–July 1, 1933, saw Chicago the host to thousands of engineers, of which more than 1,400 had registered as members of the American Society of Mechanical Engineers, assembled for its semi-annual meeting. With well over 100 papers and an attendance that gave little evidence of the depression, it was one of the most successful meetings ever held by mechanical engineers of the United States. From the standpoint of mechanical engineers in process plants, it was even more successful than the first Annual Process Meeting held a year ago in Buffalo.

The five papers given under the auspices of the A.S.M.E. process group were well attended and competently discussed. The first of the series, a paper by R. M. Hardgrove, of the Babcock & Wilcox Co., on the correlation of pulverizer capacity, power and grindability (chiefly in pulverized coal) not only drew the largest audience, but also brought forth the most vigorous discussion. Since the development of methods for determining grindability through the use of small pulverizers of special nature, in which conditions can be easily reproduced, the testing of pulverizers has become more nearly an exact science. The methods, which were described by the same author in an A.S.M.E. paper two years ago, have now been used extensively since 1926. The present paper gave data to show the several relations indicated in the title, in several different types of pulverizing system. In connection with the tests, it was noted that to be comparable, all samples have to be corrected to a standard fineness, i.e., 70 per cent through 200 mesh. A correction factor based directly on the percentage of minus 200 mesh does not agree as well with actual practice as does a straight-line correction of 2 per cent for each per cent the fineness is above or below 70 per cent through 200 mesh. This correction can be used over a range of 40–90 per cent through 200 mesh, but increases rapidly above 90 per cent through 200 mesh.

It is found, with coals of easy grindability (80–100), where the scavenging of the mill is less frequent (recirculating load of three to four), that capacity of the mill is less than proportional to the grindability. On the other hand, with low-grindability coals (30–40 grindability), where the scavenging is more rapid and the cushioning much less (circulating load as high as eight to ten), capacity is nearly proportional to the grindability. Many tests with pulverizers of the ball-bearing type have shown that above 50 grindability, capacity falls off relatively.

Among those who commented, Mr. Frisch of Foster Wheeler Corp., and Mr. O'Mara of Raymond Bros. Impact Pulverizer Co., were in agreement that capacity on the basis of grindability tests was not readily predictable. The former pointed out that the factor to use in correcting laboratory results to practice was itself a function of the grindability, while the latter maintained that a number of factors including grindability, moisture and fineness all entered into mill capacity.

In the second paper, J. M. DallaValle, of the U. S. Public Health Service, discussed the very moot topic of the mitigation of industrial dusts, with particular reference to silica, the cause of industrial silicosis. The author pointed out that the presence of free SiO_2 was not necessarily the only danger sign, however, since it has recently been found that other inorganic dusts, not in themselves poisonous, are capable of causing lung disabilities. The paper therefore outlined the physical characteristics of several industrial dusts not previously discussed in the literature.

It is now agreed that particles below 10 microns in size are the only ones of marked physiological importance. Further than this, few industrial dusts appear to be smaller than 0.5 μ. None of the many samples examined by the author showed an average particle size of less than 1 μ. The control of such dust depends largely on the nature of the process emitting the dust. The several methods recommended include wetting the source, general ventilation and the use of individual hoods, with the last for many purposes the most important. The author presented charts showing the velocity characteristics of a number of types of hood, pointing out that once the required air velocities have been established for the control of particular hazards, it is then necessary to design a hood whose velocity characteristics completely embrace the dust area.

The remaining three papers, given at the second process session, have all been published in periodicals, or will be, and cannot be treated here at great length. A paper on mechanical developments in municipal sanitation, presented by William Raisch, Municipal Sanitary Service Co., New York, was one of great interest to both mechanical and chemical engineers, since it demonstrated where engineers of today, other than sanitary, fit into the sanitation picture. This paper was published complete in the June, 1933, issue of *Mechanical Engineering*.

Profs. W. L. Woolrich and E. L. Carpenter, of the University of Tennessee, offered a discussion and progress report on the conditioning, cooking and pressing of cottonseed. This paper was abstracted at considerable length in the June, 1933, issue of *Chem. & Met.* Improvements in cottonseed processing are of vital importance to the cotton-growing sections of the United States. Until the undertaking of an extended research under Prof. Woolrich, operations had remained to a considerable extent empirical and much in need of improvement. Work now in progress, however, gives assurance that the processes will soon be better understood. Mr. Williams, of Rockford, Ill., told of interesting experiments he had made a number of years ago in adapting a paper calender with helically grooved, steam-heated rolls to the crushing and cooking of cottonseed meats. By this means he claimed the remarkable extraction of 97 per cent of the oil. The method has never been developed commercially.

In the final process paper, H. R. Straight, president of the Adel Clay Products Co., Adel, Iowa, discussed the de-airing of plastic clays, and extended the de-airing idea to numerous other products, including pencil leads, sealing wax, rubber, lacquers, cosmetics, putty, animal and vegetable oils, printing inks, etc. (Mr. Straight has been one of the pioneers in the investigation of de-airing. His paper will appear in our August issue.—Editor.

Gas Fuel Improves The Lime Kiln Efficiency

By J. B. NEALY
American Gas Association
New York, N. Y.

THE BURNING of lime is a comparatively simple process and the crude fuels, wood and coal, have been employed for this purpose from time immemorial. Recently, however, natural gas has been adopted. With this fuel the kiln capacities were increased by more than 50 per cent, considerable labor was eliminated, and a better and more uniform product obtained.

Natural gas is being used by three lime companies operating on an extensive bed of high quality limestone about 25 mi. south of Birmingham, Ala. One of these, the Keystone Lime Works, Inc., located at Keystone, produces 2,500 tons of lime monthly, most of it chemical lime. It owns 160 acres of land on which two quarries have been opened. In the first, which is about 25 ft. deep with a face 175 ft. in length, the lime is mined by the bench method—that is, the upper half is drilled and dynamited, leaving the lower half as a bench; the bench is then "shot" down and the cycle repeated. Cars of 2½ tons capacity operating on tracks laid on the quarry floor are used to haul the stone to the kilns.

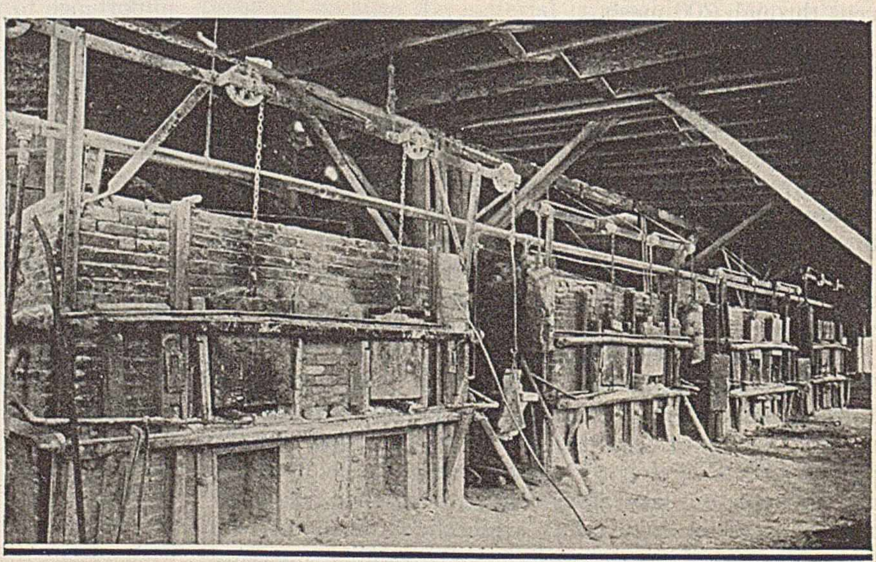
The large quarry averages 35 ft. in depth and has a curved face 1,500 ft. long. In one place a circular hole, 80 ft. in diameter, has been sunk, while quarrying, and although tracks have been laid elsewhere in this quarry, the stone from here is lifted straight up by means of a boom derrick and hoist. The rock is dropped into bottom dump cars on an overhead trestle traversing the entire row of kilns, so that it can be charged directly into the tops of the kilns.

There are 8 kilns in all, 50 ft. high and ranging from 12 to 15 ft. in outside diameter. These kilns, which formerly were fired with coal, have recently been changed to gas, with the resulting economies already enumerated. The following description of the changeover will be confined to the four largest and most modern kilns, as the others vary slightly in design. These kilns are vertical steel shells with a 30-in. firebrick lining. From top to bottom they are divided into four hypothetical zones, storage, preheating, burning, and cooling.

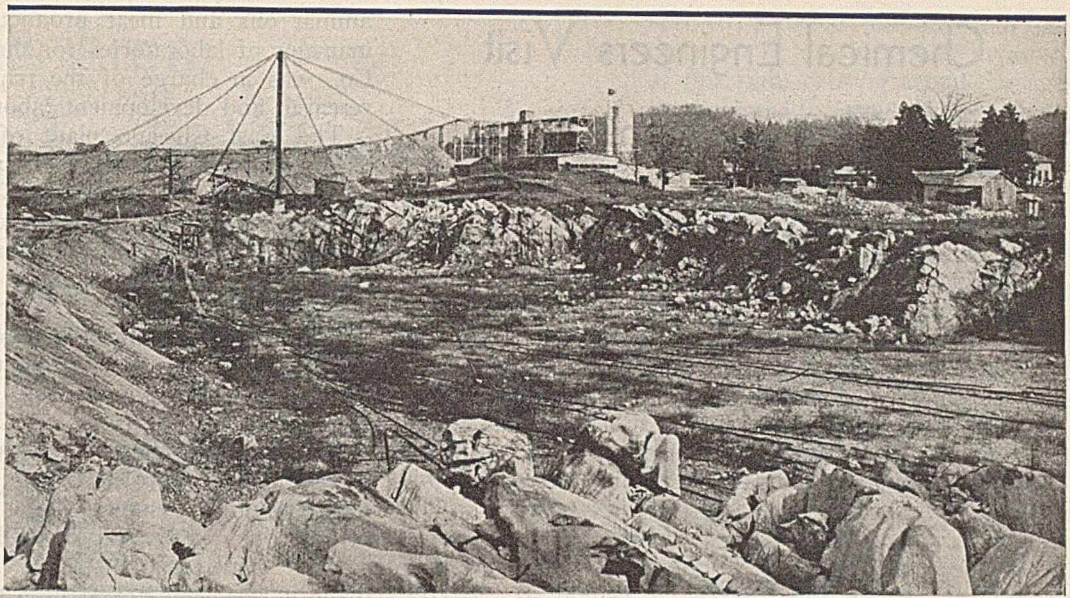
The cooling zone ends and the burning zone starts at a point about 11 ft. above the ground level of the plant, and it is here that the furnaces are built and a balcony located for the operators. Each kiln had two coal furnaces, one in front and one in the rear, both opening directly into the kiln for free flow of heat from the coal fires. Each furnace was 6 ft. long, 6 ft. high, and 10 ft. wide and had two "eyes," or fireboxes. They were constructed of steel and lined with firebrick. Natural draft, controlled by regulating the sizes of the openings in both top and bottom, is used.

Just below the firing zone the thickness of the lining is increased so as materially to narrow the kiln diameter at this point. This is known as the "breast," and here the burning charge sticks until loosened manually—or it did before gas was installed. When the charge was properly burned the fires had to be drawn, three men drew the lime from the bottom opening and then went above and cut and trimmed the lime away from the breast. The mass was still so hot that two crews were required.

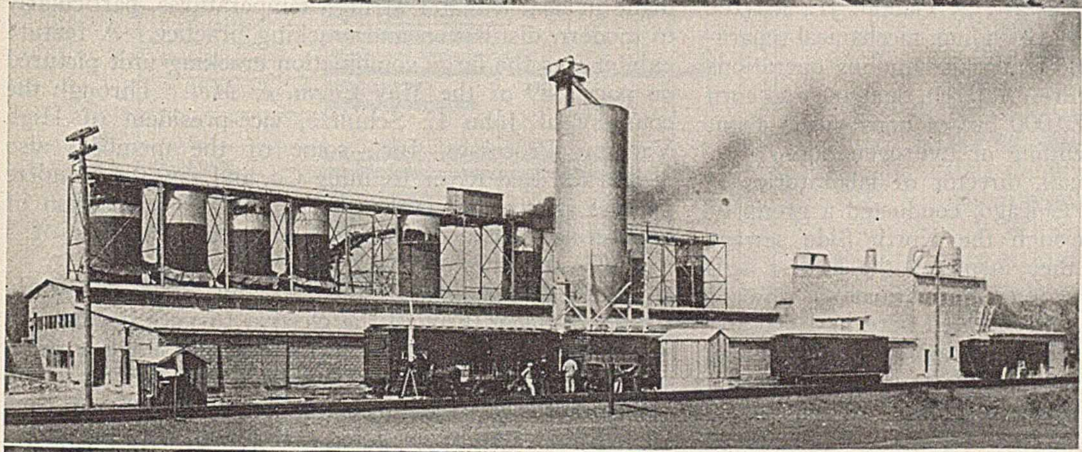
Each kiln was "drawn" every 12 hr. and then the fires had to be remade and burning started all over again. In changing over, the breasts were cut away, leaving the kiln walls straight from top to bottom, permitting continuous flow of the charge without obstruction. This eliminated the labor of cutting and trimming, drawing and remaking the coal fires. Mechanically operated steel shear blades, just below the hopper bottom mouth, served to open and close this opening. A continuous, traveling



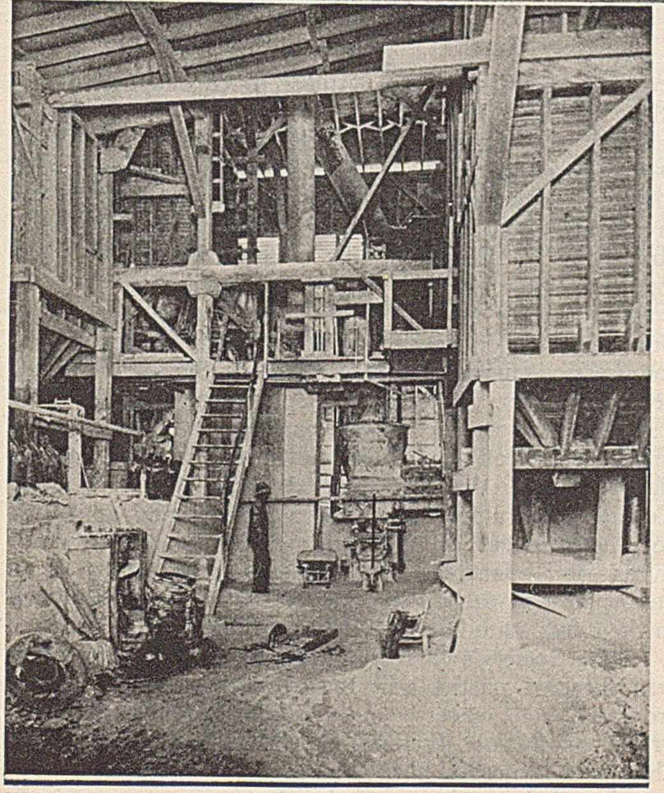
Double chambered furnaces for four of the kilns



A company at Keystone, Ala., produces 2,500 tons of lime monthly, most of it chemical lime. The lime is mined by the bench method



Plant of Keystone Lime Works, showing upper portion of lime kilns, charging trestle and car loading from storage tank



Hydration plant and equipment at above plant

conveyor below this removes the hot clinkers to the cooling floor as they pass through. With gas fuel, which burns the rock faster and makes such an arrangement possible, the kilns are drawn every 4 hr. instead of every 12 hr. as formerly. As for the coal furnaces, the grates were removed and the ash hoppers and the fireboxes, or "eyes," bricked up until an opening only 21 in. wide and 24 in. high, extending the full length of the furnace, was left. The gas burners are of the simplest type.

Part of the burned lime that is dumped by the conveyors onto the cooling floor is put through a gyratory crusher and is then elevated by bucket elevator into 200-ton steel storage bins. From these it is drawn as desired by a mechanical box-car loader, which delivers it to cars on a nearby spur track.

Product intended for chemical hydrated lime is crushed in a 3-in. crusher and elevated to a steel bin over the hydration pot, which is of steel plate, 15 ft. in diameter and 4 ft. high, and revolved by a motor. The lime is charged into it and water added until the mixture is of the right consistency, the reaction bringing the temperature up to 200 deg. F. This mixture is dumped into a cement bin and then is transferred by screw conveyor to a separator or classifier, which removes the coarse material, giving any fineness desired. The finished product is sucked into bins and finally put into sacks by means of compressed air, the sacks resting on automatic scales.

Chemical Engineers Visit Chicago Plants

A WELL ORGANIZED SERIES of plant visits under the direction of a committee headed by Walter J. Bentley of Armour Institute of Technology was one of the most valued features of the twenty-fifth semi-annual meeting of the American Institute of Chemical Engineers held in Chicago, June 14, 15, and 16. Each registrant was provided with a 15-page mimeographed prospectus describing the chemical engineering operations to be seen at the different plants, thus giving the visitor an opportunity to plan his trips in advance and select the plants or portions of the plants in which he was most interested.

At the Corn Products Refining Co. in Argo, Ill., Thomas E. Bruce and Edward S. Ganpp, Jr., led the party in an inspection of the grinding, mechanical separation, drying, fluid flow and materials-handling operations involved in the manufacture of starch, dextrine and corn oil. A daily grind of 70,000 bu. of corn yields about 12,000 gal. of oil for refining or hydrogenation.

Dr. Floyd W. Mohlman, director of laboratories of the Sanitary District of Chicago, conducted a group of about thirty visitors through the North Side sewage treatment works where they inspected the largest activated sludge plant in the world. An average flow of 200,000,000 gal. per day was treated here in 1932.

At the stockyards in South Chicago, A. Guillaudeu and R. C. Newton of Swift & Co. and T. K. Lowry of Darling & Co. aided in the inspection of their plants and those of Wilson & Co. for the production of refined animal oils and meat products. George B. Murphy, manager of laboratories for the Universal Oil Products Co., was in charge of the trip through his company's research and development laboratories at Riverside, Ill.

The East Chicago plant of the Grasselli Chemical Co. was opened to visitors through the courtesy of T. W. Ervin, superintendent, and H. M. K. Grylls, assistant superintendent, and there the visitors inspected the manufacture of silicate of soda, HCl, saltcake, H_2SO_4, insecticides, phosphoric acid, glauber salt and other heavy chemicals. W. J. Knox, superintendent of the neighboring plant of the Anaconda Lead Products Co., showed an enthusiastic group the present status of the famous electrolytic white lead process pioneered by the late Elmer A. Sperry.

A.I.Ch.E. members other than those connected with oil companies were accorded the privilege of visiting the tremendous refinery of the Standard Oil Co. (Ind.) at Whiting. Drs. R. E. Wilson and C. C. Monrad showed some of the striking advances that have been made in heat transfer at high temperatures, particularly in modern distillation and cracking practice. A feature exhibit was the large combination cracking unit pictured on page 289 of the May *Chem. & Met.* Through the courtesy of John E. Schultze, vice-president of High Vacuum Processes, Inc., some of the members also visited the Red River Refining Co. and saw the Schultze process in commercial operation for the production of lubricating oils by direct distillation at pressures of 5 mm. Hg absolute.

At the Illinois Steel Co.'s Chicago plant, H. Strain showed a party through the electric furnace department where are conducted the final refining and alloying operations in the manufacture of stainless and other corrosion resistant steels. The power plant of the State Line Generating Station at Roby, Ind., was also inspected.

Exhibits, Technical Reports Occupy A.S.T.M.

IN COMMON with the 18 other engineering societies which chose to hold summer meetings during Engineering Week, the American Society for Testing Materials convened for its 36th annual meeting in Chicago, June 26–30, 1933. In addition to its 14 technical sessions, the Society participated in the activities of Engineers' Day at A Century of Progress, and held its second exhibit of testing apparatus and equipment. As a result of the ballotting for officers it was announced that for the coming year T. R. Lawson, Rensselaer Polytechnic Institute, would be president, with Herman von Schrenk, St. Louis consultant, as vice-president.

Among the papers of greatest interest to chemical engineers were those in the second session having to do with the effect of temperature on metals. In a report of a joint committee of the A.S.T.M. and A.S.M.E. on effect of temperature on metals, new tentative test methods for short-time and long-time tension tests at elevated temperatures were offered. W. A. Tucker and S. E. Sinclair, U. S. Bureau of Standards, discussed the creep characteristics of 15 different chrome-nickel-iron alloys at 1,600 deg. F.

Under the chairmanship of Allen Rogers, Committee D–1 offered tentative specifications for test panels, solvents, diluents and certain testing procedures for preservative-coating materials. Committee D–11 reported the completion of test methods for rubber belting, vibration-absorbing rubber and hose.

At the sixth session, Committee C–8, under G. A. Bole, reported on new tentative methods for testing the compression, flexure and shrinkage of high-temperature heat insulation. The committee recommended revised tests for the porosity and permanent volume changes of refractory materials, and for the softening point of fireclay brick. In the ninth session, Gene Abson, Chicago Testing Laboratory, described a method and apparatus for the recovery of asphalt from the benzol in which it has been extracted. By distilling off the benzol in an atmosphere of carbon dioxide, the bitumen is recovered in the exact state in which it was prior to the extraction.

In the Society's corrosion session, the tenth, attention was directed particularly toward atmospheric tests of iron and steel sheets, uncoated and galvanized; of a group of 24 non-ferrous metals and alloys; and of aluminum structural shapes in comparison with steel. It was found that painting of the aluminum was necessary under certain conditions of exposure.

Profits From Trade Wastes

By SHEPPARD T. POWELL
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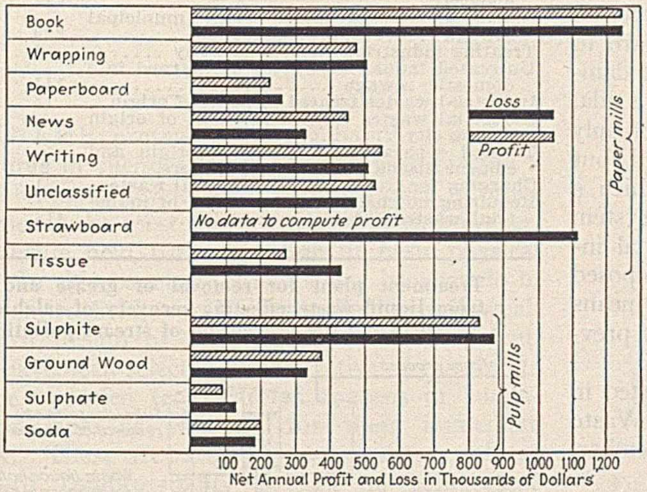


American Paper and Pulp Association

Profit and loss in fiber utilization in various pulp and paper industries

DISPOSAL of wastes by dilution only is a function of the character of the products discharged and the existing or future pollution load on the specific diluting body of waters. This method of disposal is a practical procedure of wide use. Difficulties arise only when the pollution load exceeds the safe purification of the natural water course. Although the interpretation of common laws controlling water pollution varies, it generally follows, in substance, that given in Lord Macnaghten's summary in the case of Young vs. Sankier Distillery Co. et al., decided by the British House of Lords in 1893 (Appeal cases, House of Lords and Judicial Committee of the Privy Council, 1893, p. 698; as quoted in "Solving Sewage Problems," Fuller & McClintock, McGraw-Hill Book Co., p. 19). A portion of this record is as follows:

"A riparian proprietor is entitled to have the water of the stream, on the banks of which his property lies, flow down as it has been accustomed to flow down to his property, subject to the ordinary use of the flowing water by upper proprietors, and to such further use, if any, on their part in connection with their property as may be reasonable under the circumstances. Every riparian proprietor is thus entitled to the water of his streams, in its natural flow, without sensible diminution or increase and without sensible alteration in its character or quality. Any invasion of this right causing actual damage or calculated to found a claim which may ripen into an adverse right entitled the party injured to the intervention of the court."

The principles laid down in this decision apply in general to pollution of streams by municipalities, individuals, or industries.

Equitable stream control measures are difficult, owing to our deficient knowledge of how to determine quantitatively the pollution intensity factors of miscellaneous waste and to the lack in uniformity of laws extant in states contiguous to interstate or coastal water ways. It is difficult to conceive that a simple standard can be devised for determining the admission or rejection of contaminating materials into waters. Considering the factors involved, adjustment must rest upon the judgment of the persons in whom regulatory control is invested.

It is axiomatic that the discharge into stream of certain types of matter should be prohibited. In this group are all products that are certain to result in fire hazards, or are definitely deleterious to the health, life, or comfort of persons. Aside from these specific byproducts, the admission into water courses of many waste products with or without previous treatment frequently leads to controversy, since the decision is largely a matter of viewpoint of the various groups interested in the case. Since these conditions exist, ultimate stream control methods to be equitable and effective must rest upon an educational program and an enlightened conception of economic factors involved. A careful survey of the major stream pollution programs will reveal the importance of this viewpoint. In the final analysis the solution of the problem is strictly a function of the industries, since it involves their own welfare and development. It is difficult to understand, therefore, why trade waste correction is so seldom initiated by the offending group, but is given serious consideration only after pressure from legally authorized groups.

This condition was demonstrated in a recent investigation. A steel mill in the East was discharging fairly large quantities of pickling liquors into a stream from which cooling water was drawn for use in surface condensers by a large public utility. The electric company furnished power to the offending steel mill. The acid waste was responsible for a loss of condenser tubes to the extent of about $5,000 a year. The utility company refused to discuss the matter, since the mill in question was a consumer of power. The interesting sequence of this situation is that the power company could have utilized the waste pickling liquor as a coagulant for clarifi-

Based upon a paper presented before the April meeting of the American Section of the Society of Chemical Industry.

cation of the boiler feed water and the two properties were sufficiently close to have pumped the waste directly to the water purification plant.

A similar case of pollution of a stream in Maryland by pickling liquors was partially corrected without any capital investment. In this instance the annual cost of sulphuric acid was reduced $25,000 a year, merely by accurately controlling the dumping of the wastes. Prior to the investigation these wastes were discharged whenever the operator deemed it necessary, the test procedure being merely to taste the pickling liquor and so determine its strength. The saving noted was effected by placing this operation under laboratory control.

The writer recently investigated an industry on the Eastern seaboard which has sustained a loss of salable grease amounting to more than $500,000 within a period of ten years, and has expended, in addition, upward to $100,000 on legal and expert fees in the defense of damage suits resulting from the grease discharged into a tidal water. By a relatively simple recovery system not only the grease from this industry could be recovered, but also a large quantity of organic material for which a ready market existed. The proposed recovery system could have produced a liberal return on the capital investment. The works were closed before the proposed system was installed. These examples are by no means rare cases, but indicate a state of affairs which is prevalent in many highly industrialized sections.

The American Paper & Pulp Association reported in 1928 ("Profit for the Paper Industry Through Waste Utilization and Stream Improvement," September, 1928)):

"The total net annual profit to the pulp and paper mills of the United States in the utilization of fibers is estimated at $5,262,000, while the value of fiber now lost which might be recovered through practical and economical processes is $6,389,000 annually."

The saving effected by individual companies has been startling, as noted by the following quotation from the same report:

"One mill with a daily capacity of only 100 tons reports that, with an expenditure of $41,000, the value of fiber losses was reduced from $160,000 to $30,000 annually, thus resulting in a saving of $130,000 annually. Another mill, purchasing water from a municipality, reduced its water bill $600 per month by utilization of fiber and recirculation of the white water, while another, faced with the necessity of drilling additional wells to meet its water demand, reduced its water consumption from 28,000 gal. per ton of product to 8,000, thus making its present supply ample.

"As previously stated, it is believed that the saving to the industry with efficient utilization of all waste will amount to nearly $10,000,000 annually, especially in view of the fact that the figures presented are based upon fiber losses only and do not include reduction in water consumption, power reduction due to savings in heat units, effect upon felts and other equipment, etc."

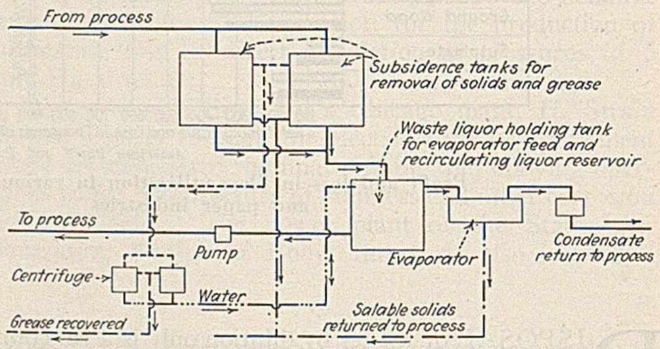
These frank admissions of enormous losses constitute a serious indictment against existing extravagances which are duplicated to a greater or lesser extent in practically every important industry in this country. In face of these facts it is difficult to account for the general apathy that, up to the present time, has been manifested toward all industrial waste problems.

Various Methods of Treatment of Industrial Wastes in 497 Cities in the United States Having a Population in Excess of 1,000

	Number of Cities	Per cent*
Total cities canvassed	497	—
Cities furnishing record of industrial waste disposal	417	—
Industrial wastes mixed with municipal sewage	229	54.9
Treating industrial waste separately	4	0.96
Untreated industrial wastes discharged into domestic sewage	141	33.8
Industrial wastes treated at point of origin	13	3.12
Industrial wastes treated at point of origin by the city	1	0.24
Treated separately at point of origin and effluent discharged into city sewers	21	5.03
Charging for treatment of industrial wastes	1	0.24
Requiring no charge for treatment of industrial wastes	416	99.76

*Based upon cities reporting.

Treatment plant for removal of grease and solids from liquid waste effecting recovery of salable products and the prevention of stream pollution



Estimated Operating Cost for Treatment of Wastes by Biological Processes. Relative Values Based Upon Average Cost of Treatment of Domestic Sewage in Terms of Equivalent Populations as Measured by Biochemical Oxygen Values of Specific Waste

Industry and Nature of Waste	Ratio Domestic Sewage To Trade Waste		Estimated Equivalent Number of Persons Contributing Domestic Sewage	Estimated Cost of Treatment of Trade Waste Dollars per 1,000,000 Gal. per Yr.		
	Oxygen Consumed	10 Day B. O. D.		Imhoff Tank Treatment	Primary Settling and Separate Sludge Digestion	Activated Sludge
				*	**	***
General paper mill	1: 1.0	......	1.0	14.79	12.33	21.40
Leather board	1: 7.7	......	7.7	114.00	95.00	164.80
Strawboard	....	1: 4.7	4.7	69.50	57.95	100.50
Strawboard and paperboard	....	1: 2.3	2.3	34.05	28.35	49.20
Wool yarn and cloth — dyeing	1: 2.9	......	2.9	42.90	35.80	62.00
Cotton yarn and cloth — bleaching	1: 3.1	......	3.1	45.90	38.20	66.40
Cotton yarn and cloth — dyeing	1: 2.4	......	2.4	35.50	29.60	51.40
Hide tanning	....	1: 6.7	6.7	99.10	82.60	143.20
Calfskin tanning	....	1: 6.7	6.7	99.10	82.60	143.20
Sheepskin tanning	1: 5.7	......	5.7	84.30	70.30	122.00
Harness leather	....	1: 5.8	5.8	85.80	71.50	124.10
Rendering	....	1: 7.1	7.1	105.00	87.50	152.00
Glue	....	1: 0.9	0.9	13.30	11.10	19.26
Grease and oil	....	1: 1.8	1.8	26.60	22.20	38.50
Soap	....	1: 2.2	2.2	32.55	27.15	47.10
Corn products	....	1: 3.0	3.0	44.40	37.00	64.20
Canning	....	1: 2.3	2.3	34.05	28.35	49.20
Dairy products	....	1:10.8	10.8	159.90	133.10	231.00
Brewing	....	1: 9.3	9.3	137.50	114.60	199.00
Rubber reclaiming	1:24.0	......	24.0	355.00	296.00	514.00

*Based upon an average cost of $14.79 per 1,000,000 gal. of domestic sewage per yr.
**Based upon an average cost of 12.33 per 1,000,000 gal. of domestic sewage per yr.
***Based upon an average cost of $21.40 per 1,000,000 gal. of domestic sewage per yr.
Basis of domestic sewage flow equals 100 gal. per capita per day.

Handling High Pressures In Chemical Synthesis

By R. V. KLEINSCHMIDT

Arthur D. Little, Inc., Cambridge, Mass.

UP TO THE present time, the handling of high pressures in chemical synthesis has been largely a rule of thumb development of experience in other fields. Some of the most important problems, however, provide a fertile field for application of basic physical principles. In this paper no attempt has been made to survey the entire field, nor is it intended to follow all the details of design of any one piece of equipment. Five items have been selected as illustrative of the results that may be expected from careful analysis of fundamental conditions, as well as for their immediate applicability. These are: closures and gaskets; valves; the effect of compressibility factors on compressor design; thermal limitations of converters; and some principles of heat transfer applicable to catalyst bed design.

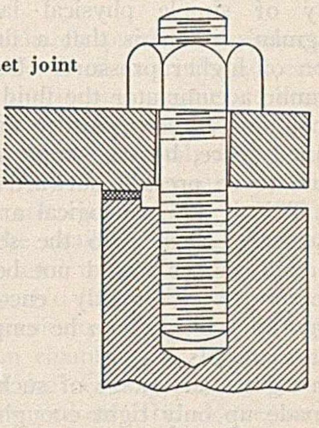
Closures and Gaskets

To make a pressure vessel strong enough is relatively simple, but it must also be rigid enough to prevent warping under combined pressure and temperature stresses, and it must also be as light as possible for economy and ease of handling. Granted that the metallurgist has given us materials not only of high strength but also uniform in properties and free from internal strains, there remains the problem of economical distribution of the metal. From this viewpoint closures represent the least satisfactory point in present designs of pressure vessels.

The simplest joint would appear to consist of two surfaces ground to a perfect fit and held together by suitable bolts or by a clamping ring. Such a joint presupposes extreme rigidity of the materials which is a condition not easily provided at high pressures. The total elastic strain of compression on the joint faces when the joint is first made up must be greater than the total deflection of the joint under load due to stretch of the bolts and the beam effect as indicated in Fig. 1. By reducing the area of contact to such an extent that the compressive stress equals or exceeds the elastic limit, the maximum amount of adjustment can be provided for.

The usual method of drawing the surfaces together with a gasket of soft material between them is also open to serious objection at high pressures, where the compression of the metals themselves produces appreciable deflections, even in solid blocks. In the first place the gasket must be properly confined since, if made soft enough to conform to any appreciable irregularities in the surfaces, it will be stressed well above its elastic limit and will flow. Under these conditions it is even more difficult to provide for the deflections of the joint. No amount of thickening of parts will completely eliminate these deflections. It is therefore necessary to provide sufficient "spring" in the gasket seats and the gasket material so that the surfaces will remain in contact as the masses of metal move apart. The most suitable gasket material is one that has a maximum contraction in compression before reaching its elastic limit. This can be obtained by low modulus of elasticity and by a high elastic limit. For such service, aluminum, although chemically very suitable, is mechanically worthless on account of its very low elastic limit and its tendency to flow at moderate stresses. It can be used only when totally enclosed so that it is subjected to practically hydrostatic conditions. It also has a large expansion coefficient with temperature. Copper and soft iron are the most generally used metals, the former having the advantage of tightening up due to expansion when heated but conversely tending to leak on cooling so that it is not suitable for locations where variable temperatures are encountered. For such conditions a material having the same coefficient of expansion as the parts joined is required. Soft iron is frequently used. A ring of piano wire, heat-treated to a soft spring condition, resting in hemispherical or V grooves (Fig. 2), forms a closure

Fig. 1—Strains on gasket joint



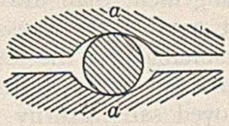


Fig. 2—Wire ring gasket

Presented before the meeting of the American Institute of Chemical Engineers, Chicago, Ill., June 15, 1933.

which appears promising and has been used successfully on a laboratory scale but has not to the author's knowledge been used commercially. Such a gasket is easily drawn up to stress the material in contact with it to its elastic limit and the gasket itself has a high strain at its elastic limit. A ring of heavy walled tubing would have an even greater elasticity, but would be difficult to fabricate. Corrugated metal gaskets are an application of the principles stated above but are not generally suited to high pressure work.

The search for suitable gasket materials is perhaps beside the point when we reflect that Prof. P. W. Bridgman at Harvard has for years been confining pressures over ten times those used in commercial practice with packings of rubber. The manner of doing this is deserving of attention by designers of high-pressure equipment, both for its direct applicability to this problem of closures and as an example of the utility of simple physical laws. The principle of Bridgman's joints is that a fluid will not leak into a region of higher pressure. Using the principle of the hydraulic accumulator the fluid to be confined is caused to maintain excess pressure on a rubber packing in a confined space, by the simple expedient of causing the closure to be pressed outward against the gasket (Fig. 3). This is a more logical arrangement than drawing the closure down onto the seat against the pressure. Although rubber would not be suitable for the higher temperatures frequently encountered in commercial work, the principle can be employed satisfactorily with other materials.

One great advantage of such a closure is that it need be made up only tight enough to seal the joint at the start and it will never leak at any higher pressure. Small joints made up hand tight have stood 12,000 atmospheres repeatedly.

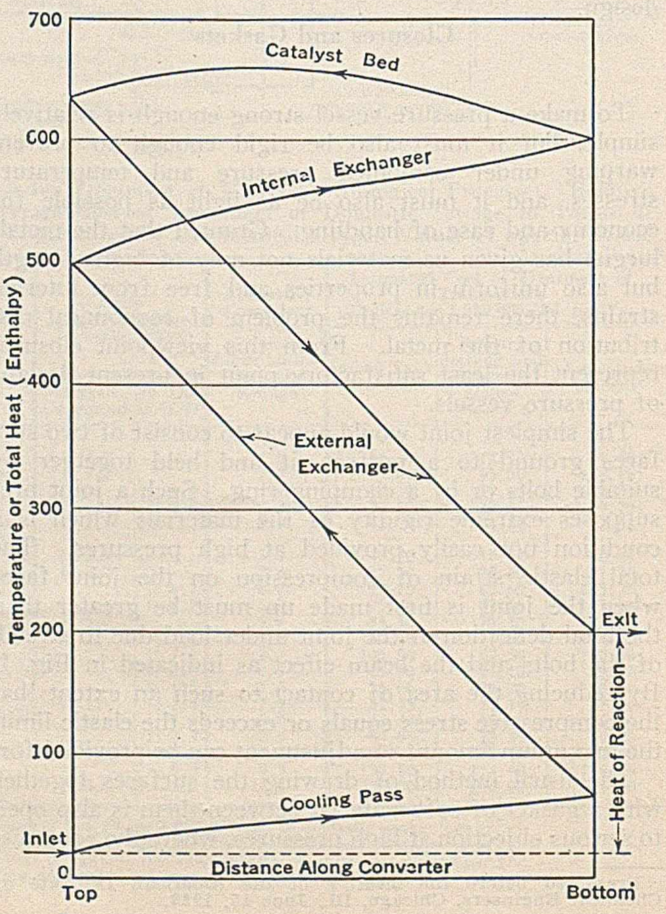
Valves

The problem of high-pressure valves is even more difficult than that of gasketed joints. Concentration of energy in high pressure gases is enormous and its release through a valve imparts high velocities to the gas. Moreover, even after initial expansion these gases have a density more nearly comparable to liquids than to ordinary gases. The combination of hardness to withstand erosion with the necessary toughness to stand the strains of operating presents a very difficult metallurgical problem. Various mechanical expedients are used to minimize the wear and tear on stop valves and flow control valves. For the former the use of two valves in series permits the second to be closed under favorable conditions and relieves it of wear. Flow control valves, especially blow-offs are frequently fitted with a coil of small high resistance tubing to dissipate the energy of expansion and reduce the velocity through the valve to a low value. In general a high-pressure valve must be looked upon primarily as a device for dissipating a large amount of energy in a small space. The labyrinth type packing used to prevent leakage around steam-turbine shafts offers a suggestion for possible development of a high-pressure valve. This packing is designed to dissipate energy of expansion in a large number of steps.

The design of high-pressure gas compressors and pumps is too complex to consider in all its phases here. Attention may, however, be called to the effect of the compressibility factor on compressor design. Deviations from the perfect gas laws will cause serious lack of balance in compressors operating above about 200 atm., even on such "perfect" gases as hydrogen and nitrogen unless proper allowances are made in design. At 1,000 atm. the volume of a hydrogen-nitrogen mixture as measured by Bartlett at the Fixed Nitrogen Research Laboratory is almost twice as great as would be computed from the perfect gas laws. The result is that the high-pressure cylinders must be made larger or must operate with higher suction pressure than would be computed on the basis of these laws. Also the displacement work will be materially greater and average bearing pressures and stresses will be higher than anticipated both in the last stage and even more seriously in the next to the last stage. Table I compares certain design figures for 6-stage 1,000-atm. compressors for use in various gases. It cannot be too strongly emphasized that compressors should be designed for the particular gas they are to handle on the basis of the best information available. This would be most conveniently handled in the form of a table of total heats, specific volumes, and entropies.

Such tables are not now available although much experimental work has been done. Unfortunately construction of suitable tables requires a rather elaborate thermodynamic study. The Institute might find the production of such tables suitable subject for a project similar to the work done by the mechanical engineers on properties of steam.

Fig. 4—Thermal relations in ammonia converter



As compared with the features just considered the design of converters is a relatively new problem to the engineer, involving some unusual aspects of heat engineering. Fig. 4 is a diagram of the thermal relations in a simple type of ammonia converter.

The heat of reaction must be removed from the converter as soon as evolved and in the correct quantity in order to prevent cooling or heating of the catalyst bed. The simplest and most practical method is to allow the products of reaction to leave the converter at a higher temperature than that at which they enter, thus removing the heat generated by the reaction. If this method is used the proportion of the gases that can be allowed to react per pass is definitely limited by the allowable temperature of the exit tube. This temperature may be limited to (say) 200 deg. C. With gas entering the converter at 20 deg. C. the heat that can be removed per unit weight of gas will then be roughly 180 times the specific heat of the gases. More accurately if Q_t is the (hypothetical) heat of reaction per unit mass at the allowable exit temperature, the per cent conversion per pass (R) is limited by the relation:

$$Q_t R \leqq C_p(Ti - Tx),$$

where C_p is the mean specific heat of the unreacted gases between the entrance and exit temperatures, and Ti and Tx are the inlet and exit temperatures respectively.

Lowering the inlet temperature is the only simple method of increasing the allowable conversion and this is limited to small amounts in most cases. Although numerous ingenious methods for introducing auxiliary cooling streams have been suggested, the important consideration is high production per unit of equipment which in turn points to high flow rather than excessive conversions per pass. Endothermic reactions are more difficult to handle and require provision for considerable amounts of electric heat.

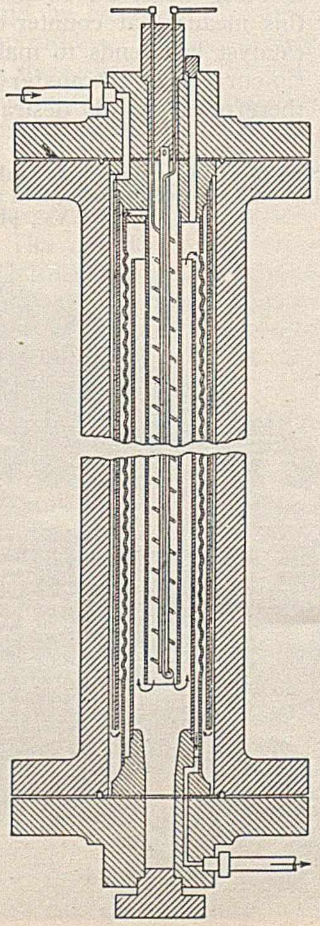


Fig. 5—One type of ammonia converter which shows the arrangement of parts

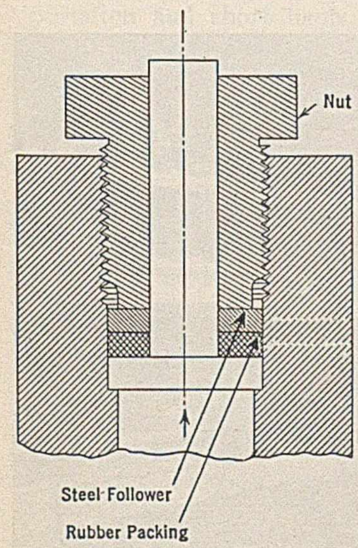


Fig. 3—Bridgman's closure

Turning next to thermal problems inside the converter we find a complex but exceedingly interesting situation.

Imagine attempting to burn natural gas and air under high pressure while maintaining the temperature of the reaction constant within 25 deg. C. This is the sort of thing that high pressure synthesis is doing. Fig. 5 is a diagrammatic sketch of one type of ammonia converter, which shows the arrangement of parts.

Although the gases must enter and leave the equipment at relatively low temperatures as noted above, the usual types of catalyst are active only at considerably higher temperatures of the order of 500 deg. C., dull red heat.

The problems that immediately present themselves are, first, insulating the converter shell from the hot catalyst bed, and second, heating the incoming gases to reaction temperature.

Insulation of the shell from the catalyst bed cannot be economically accomplished by the use of ordinary insulating materials which are relatively bulky and occupy too large a portion of the available space. Instead a stream of cooling gas is used to remove the heat that leaks through a relatively thin layer of heat insulation. This stream of cooling gas is normally the entering gas on its way to the reaction chamber. It is thus heated perhaps a total of 50–60 deg. C., but not sufficient to allow it to enter the catalyst bed directly. Moreover, the gases leaving the reaction zone are far too hot to be taken directly from the converter and must be cooled. If the conditions of percentage conversion stated above are fulfilled, the heat capacities of the entering and exit gases will be such that a proper interchange of heat between the two streams will accomplish the desired cooling of the gases leaving the converter. Since it is desired to heat the entering gases as near to catalyst bed temperature as possible and to cool the exit gases as much as possible, countercurrent exchange must obviously be used in this exchanger. The design of this "external" exchanger, so called because it is outside of the catalyst bed proper although inside the converter shell, is a straight-forward problem in design of heat exchange to get a large surface in a minimum volume. The efficiency of this exchanger controls the temperature of the catalyst bed. It is, therefore, made of ample size and its efficiency is then controlled by suitable by-passes. High velocities and pressure drop are in order at this point, and small tubes of considerable length are desirable. The heating of the incoming gases is best considered in connection with the next problem—heat exchange in the catalyst bed.

If we were to take the gases entering through the external exchanger and send them directly to the catalyst bed we would find, when the converter was steadied down, that the temperatures of the bed would increase from one end to the other by an amount about equal to the temperature difference between the entrance and the exit of the converter, or say 180 deg. C. In other words, the full rise in temperature due to the heat of reaction would occur in the bed. Such a range of temperature is never desirable and is in many reactions entirely out of the question, either because of destruction of catalyst or introduction of undesirable side reactions. It is therefore in general important to control the distribution of temperature in the catalyst bed to obtain some desired condition, either a constant temperature or a slightly rising or falling gradient. Any of these conditions can be approximately obtained by suitable combinations of co-current and counter-current heat exchange and distribution of cooling surfaces. It is not proposed to show in detail the rather elaborate process of design-

Table I—Comparison of 6 Stage, 1,000 Atm. Compressor Performance on Various Gases (Based on Ideal Isothermal Compression With no Clearance)

Design Characteristics Based on Perfect Gas Laws

Stage	Compression Ratio	Displacement Volume	Stage Pressure	Relative Work
Suction	—	—	1.37 Atm.	—
1	3.00	2700 C. + M.	4.11	1.00
2	3.00	900	12.34	1.00
3	3.00	300	37.03	1.00
4	3.00	100	111.11	1.00
5	3.00	33.3	333.33	1.00
6	3.00	11.1	1000.00	1.00
Discharge		3.7	1000.00	1.00

Actual Conditions With Real Gases

Stage	Hydrogen		Carbon Monoxide		Methane	
	Pressure	Work	Pressure	Work	Pressure	Work
	Atm.					
1	4.12	1.003	4.10	0.998	4.08	0.987
2	12.4	1.010	12.3	0.993	12.0	0.965
3	38.0	1.032	36.4	0.979	34.2	0.893
4	119.8	1.105	108.2	0.969	89.0	0.761
5	433.7	1.407	427.5	1.394	296.2	0.916
6	1000.0	1.613	1000.0	1.876	1000.0	2.066
Volume at discharge	4.62		5.63		5.40	

ing a catalyst bed but only to point out two basic principles that must be kept constantly in mind in order to obtain satisfactory results.

We must first get clearly in mind that a catalyst bed is essentially a heat exchanger in which heat is generated or absorbed as well as transferred and that the generation of heat is a function of the temperature, flow, and composition of the materials at any point. As the actual weight of solid material (catalyst) in the bed is very small compared with the quantities of material which flow through it, the "temperature of the bed" at a given point is really the temperature of the flowing stream of gas passing the point at any instant. If, therefore, we try to raise the temperature of a section of a catalyst bed by putting heat into it we actually change only the temperature *gradient* in the stream of fluid passing through the section. Whether the mean temperature is raised or lowered by thus putting in heat is entirely indeterminate except by proper analysis of the entire converter. This point of view—that we are dealing not with a mass of solid material but with streams of fluids which are constantly inacting thermally—is very generally overlooked and is costing the industry thousands of dollars annually.

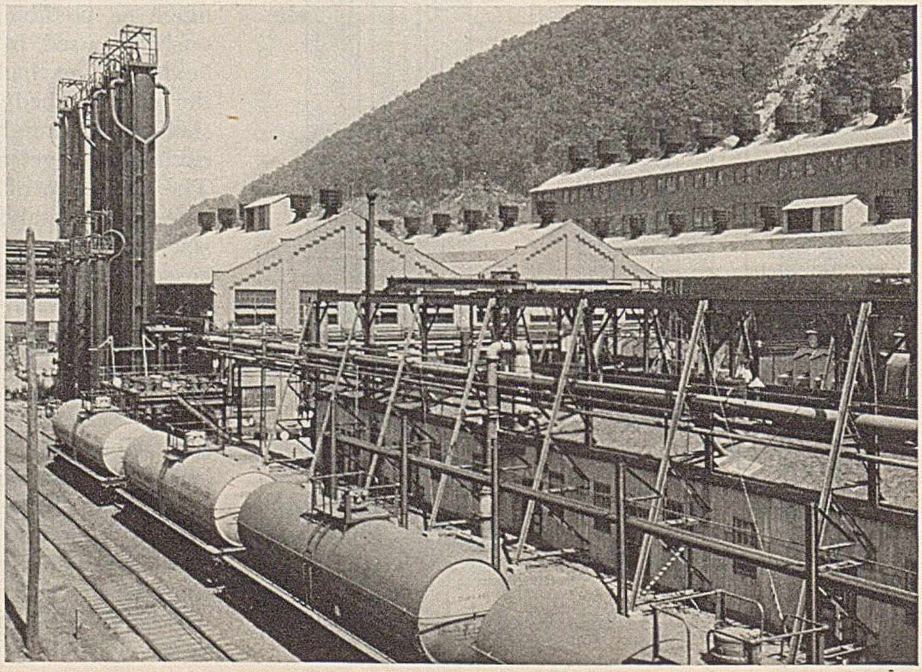
The second important principle to consider is the basic difference between co-current and counter-current heat transfer and its effect on thermal stability in a catalyst bed. Thermal stability at any point in a catalyst bed may be said to exist when any slight rise in temperature results in a greater removal of heat from the particular point in question than the increase in heat generation resulting from the increase in temperature. This may be mathematically stated in this form,

$$\frac{dQ}{dT} \leq MC_p + \frac{dC}{dT},$$

Whenever MC_p is the heat capacity (per unit time) of the fluid flowing past the point in question, (dQ/dT) the temperature coefficient of the heat of reaction, and (dC/dT) is the rate of increase of external cooling with rise in temperature. If the above expression is not fulfilled at any point in the bed, the temperature of that point will either increase or decrease rapidly and the catalyst will be over-heated or else the reaction will cease.

It is a well-recognized principle in heat transfer that counter-current transfer causes a building up of the temperature at any point where heat is being generated and a reduction of temperature at the point where heat is being absorbed or lost. Applied to a catalyst bed this means that counter-current heat transfer within a catalyst bed tends to make the bed thermally unstable. Co-current heat transfer has the opposite effect and is therefore generally desirable.

Scrubbing towers, pressure tank cars for ammonia, synthesis buildings and part of the mountain power recovery system at the Belle, W. Va., plant of du Pont



Rice: A Raw Material For Process Industries

By ELLIS C. PATTEE
Ann Arbor, Mich.

THE USE of agricultural products as raw materials for the process industries has reached important proportions in the past decade. We have only to consider the uses of some of the common crops in order to realize the possibilities offered in the industries employing chemical processing. Among such applications are, corn used for making cereals, starch, corn oil, glucose, alcohols, solvents, and cornstalk wall board; sugar cane used for making sugar, molasses, alcohol, and bagasse wall board; oat hulls used for furfural; cottonseed used for oil for soaps and shortening.

Rice and its byproducts contain many constituents which make them ideal materials for the process industries; however, the economic factor must be carefully considered in all cases. From the milling of rice are obtained hulls, bran, polish, screenings, and clean rice. A study of the compositions of the materials indicate certain uses for which each is suitable. From these potential uses can be selected one or more applications which offer possibilities of commercial development. Following is a general discussion of the products and their possible uses involving chemical processing.

Pure Cellulose

Rice straw and hulls should be considered together because of their similar compositions. Although their chemical natures may be alike, their availability for manufacturing differs greatly. The hulls are concentrated at the mills and entail little or no transportation costs to a nearby plant, while the straw must be transported from the fields to the plant; therefore, the cost of the straw is prohibitive except in ideal locations with cheap transportation and short hauls. The chemical components which offer commercial possibilities are the pentosans, the crude fibers, and the ash. The pentosans can be hydrolyzed to furfural, the crude fiber can be separated for its cellulose, and the ash can be treated for recovery of the mineral content.

Rice hulls are being used for production of pure cellulose, and this offers some outlet, but the largest use for the crude fiber and its cellulose in the hulls and the straw must be in fields offering large bulk sales. Unsuccessful attempts have been made to use these materials for paper pulp and for alcohol.

Ash is a nuisance in most materials, and that is the case where the hulls are burned for fuel at the mills, but as a raw material the hull ashes have some value. Silica can be recovered as sodium silicate by digesting the ash with caustic soda or soda ash. The silica solution obtained has a brown color, which can be reduced if desired. Another use for hull ash and carbonized hulls is as decolorizing agents, a use which has been exploited a small extent. The favorable location of the Louisiana and Texas rice mills at the great sugar and petroleum refining centers should offer great possibilities in this field. In both of these industries a new material must overcome many obstacles of prejudice, but with careful development work and good salesmanship a large market may be created.

The previously mentioned processes have been treated separately, but there is no reason why two or more can not be combined to give greater yield of products from the raw material sent into the plant.

Bran and polish constitute about 15 per cent of the rough rice sent to the mill. Probably the best use for these products is for food, because of their high nutritional value. A large portion is now used for cattle feed, but they would probably make a palatable breakfast food comparable to some of the present cereals.

The fats soluble in either consist mainly of palmitates, linolates, and oleates; these are good soap bases and are widely used at present. Manufacture of pure fatty acids from these materials offers a small outlet at a good price. After the ether extract, the residue contains carbohydrates, pentosans, and ash.

The clean rice will be considered for its starch, which is the main constituent under the nitrogen free extract given in Table I. The material available for starch is the broken grains, which have a lower value than the whole grains.

Manufacture of starch, as practiced in Europe, where all of our rice starch is obtained, is based on methods worked out many years ago and which have undergone little change in recent years. Modern chemical engineering practice permits the design of a process for starch which packs the finished starch within two days after the rice enters the steep. This is a great advantage for the rice-growing states in our country, where weather conditions are favorable for the growth of bacteria which ferment the starch during long settling periods. The modern method does not allow fermentation, and it will make starch at costs comparable with the older methods.

Starch is used on a large scale for laundry, textiles, glues and pastes, nitro-starch, paper finishing, cooking, and cosmetics. The present price prohibits the use of rice starch in quantities except for laundry and cosmetics, where its properties make it preferable. It could be sold for other uses if the price were reduced to meet the competition of other starches. This can be done on large-scale operations with modern manufacturing methods.

Table I—Average Analyses of Products of the Milling of Rice

Material	% of Rough Rice	Protein	Ether Extract	Crude Fiber	N Free Extract	Water	Ash	Insol. Ash	Pentosans
Rough rice..	100	9.55	3.02	5.97	54.38	10.27	16.8	....	....
Hulls.......	18.6	3.56	0.93	39.05	29.38	8.49	18.5	17.5	18.1
Stone bran..	12.2	9.77	7.66	20.92	36.73	9.69	15.2	12.0	13.8
Huller bran	......	14.97	16.89	7.94	41.99	9.84	7.4	1.4	7.7
Polish......	3.5	12.88	9.07	2.12	61.81	9.91	4.2	....	3.4
Clean rice...	54.4	9.01	0.50	0.40	77.02	12.57	0.5	0.1	1.7
Screenings..	9.3	Composition the same as clean rice							
Straw......	200	2.88	0.76	35.02	.....	0.0	12.9	....	17.5

Rice is used in brewing and may find application in other fermentation processes, but the commercial prospects are not favorable on account of the competition from other lower-priced starch materials. The greatest impetus for expanding the uses of the rice products must come from within the rice industry, either the growers or the millers. Chemical research, which has opened the doors of industry to many waste materials and byproducts, can do the same for the rice products.

Preventing Fog Entrainment in Continuous Distillation

By A. E. BIRCH and H. M. WEIR

Atlantic Refining Co.
Philadelphia, Pa.

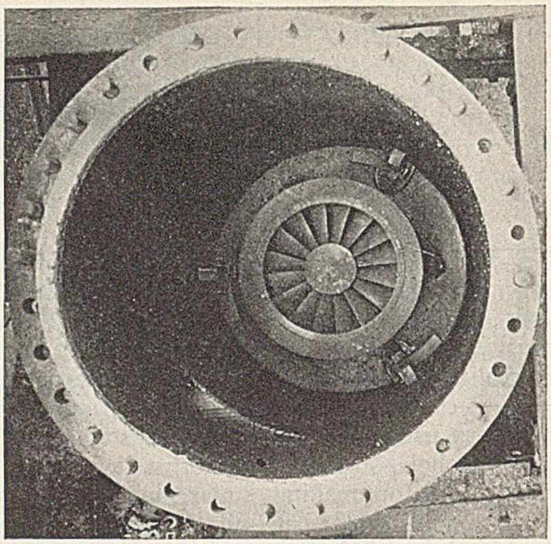


Fig. 1—Looking down on the Centrifix turbine plate

RECOGNITION of the fact that all black residuals are not equally black has led to exact determination of the contamination of overhead streams by asphalt in the continuous distillation of crude in pipe stills. The findings have formed the incentive for the installation of an effective and inexpensive centrifugal device for the removal of asphaltic fog from the vapors, which has resulted in the production of superior heavy lubricating stocks with consequent important economies in reducing such stocks to specification colors.

Modern pipe stills operate so that the liquid-vapor mixture frequently reaches a velocity of 60-100 miles per hour at the outlet of the still. At such velocities any small percentage of liquid is whipped into a myriad of tiny droplets which are accelerated by the torrent of vapors to speeds only slightly less than that of the vapors themselves.

If the mixture velocity is suddenly decreased by the insertion of an expansion drum or by injecting the vapors directly into a fractionating column a considerable portion of the droplets will settle as residue. It has been shown, however, that an important small percentage of residue in the form of a fine mist will not settle out, but is carried forward with the decelerated vapor stream, finally to contaminate the heaviest liquid overhead stream taken from the column.

Designers of pipe still equipment have surmised for a long time that such phenomena occurred in their distillation equipment, but apparently have not appreciated the serious magnitude of the contamination of viscous oil streams by residue. Some baffle arrangement has often been inserted for entrainment removal and the matter dismissed as solved. However, baffles of proven efficiency in removing the entrainment which would otherwise occur from plate to plate in a high-velocity fractionating column are quite inadequate for removal of the atomized droplets which are swept forward from the pipe-still outlet. It appears that it is impractical to remove this fog-like entrainment by any arrangement of solid surfaces in a stream of slowly moving vapors.

If the concept of baffles interposed in slowly moving streams of vapor is carried to its ultimate expression and a layer of steel wool used, excellent entrainment removal is obtained for short periods. But an operating temperature of 750 deg. F., or above, cokes the liquid enmeshed in the filaments of the wool, entailing shut downs and renewals of the material.

After a series of efforts to obtain the benefits of thorough removal of entrainment without the disadvantages just mentioned, a suitably modified Centrifix separator (Centrifix Corp., Cleveland) was inserted in the vapor line of an atmospheric pipe still, just before the fractionating column. All of the pipe-still charge passes through the device, which separates liquid from vapor by centrifugal force generated by high-speed vapors. This it accomplishes as cleanly as does a layer of steel wool.

In Fig. 1 is a view looking vertically down into the Centrifix with the top head removed. There are no moving parts in the device. Rather, a rapid rotation is imparted to the vapor-liquid stream by a pair of fan-like, alloy-steel elements with stationary blades, the upper element of which appears in the figure. The photograph was taken after 1,119 hours of continuous operation (646 hours at an average of 746 deg. F. and 473 hours at 800 to 805 deg. F.), and yet the only evidence that the device had been in crude-oil distillation service was an extremely thin film of fluffy carbon.

Fig. 3 is a vertical section of the Centrifix. *A* is the tangential vapor inlet responsible for the first spinning motion imparted to the vapor. A major portion of the liquid is thus thrown to the sidewall and forced downward to the base of the device. The whirling vapor fogged with liquid droplets then passes downward through the stationary turbine plate, *B,* which restricts the motion of the vapors to a small radius, thus increasing the rotational velocity of the mixture and decreasing the distance through which liquid particles must move to escape from the vapor stream. Liquid forced to cylindrical wall, *C,* by the rotation is further accelerated downward by the vapors and passes out of the moving vapor stream through the annular orifice, *D.* The final cleanup of fog is insured by turbine blade, *E,* and annular orifice, *F.*

Vertical skirts, *G* and *H,* are sealed against vapor flow by partial submergence in liquid in the bottom of the cylinder, which in turn is held at compensating levels by the liquid outlet seals, *J,* through which the unvaporized liquid passes to the base of the column. The completely de-entrained vapors pass downward through the vapor outlet, *K,* which is closely coupled to the column.

Differing levels of liquid are held in the annular space formed by skirts, *G* and *H,* a condition that reflects the pressure differential from inlet to outlet of the device, which is of the order of 0.5-1 lb. per sq.in. This increase of back pressure on the still has no commercial significance in atmospheric distillation practice. The power cost of the device is, therefore, nil. The absence of any moving parts accounts for its low maintenance cost, the latter consisting only in the infrequent replacement of the turbine plates.

Savings brought about by the Centrifix are large on account of the decreased weight of acid required to finish the heaviest overhead lube oil, or "Hivis," together with the greater yield of oil obtainable by reason of the smaller amount of acid used. These economies result entirely from the complete removal of entrained residue, an improvement so striking that the stocks have a green bloom frequently mistaken on casual inspection for that of a finished oil. This applies to lube stocks from East Texas and other crudes which have notoriously dark color residues as well as to the lube stock from better type crudes, such as Ranger and Burbank.

By way of explaining the accomplishments of the Centrifix, a little history is desirable. Several years ago this company adopted color measuring equipment and a mode of expressing color values of oils characterized by direct proportionality between the readings and the actual color concentration. This analytical tool has since been developed and improved under the name of the Optical Density, or "O.D.," color scale. The relation between the O.D. and N.P.A. scales is N.P.A. $= 1.081$ (O.D. color)$^{0.32}$. The important feature of this scale is that it provides a means of accurately designating the color of even the darkest oil stock, by a number which is proportional to its color content. For example, an oil of 5,000 O.D. color, when diluted with an equal volume of white oil, will show 2,500 O.D. color, just as a 10-color oil will show a 5-color resultant if similarly handled.

Shortly after the scale was established it was applied to the study of distillates and residues from experimental vacuum and atmospheric-pressure pipe stills. The methods of operation on the two stills and columns were such that when Mid-Continent-type crudes or topped crudes were being distilled to an 8 to 15 per cent bottoms, the maximum temperature attained in the vacuum column was 30 to 50 deg. F. lower than the 800 deg. F. column-inlet temperature with the single-flash atmospheric-pressure equipment. The supposition that the temperature difference accounted for the measurably darker O.D. colors of distillate usually obtained from the atmospheric-pressure unit, was appealing since it carried the weight of a conventional explanation. But it was observed that the O.D. colors of the bottoms from the several crudes were themselves quite different and that the darkest Hivis side stream invariably was produced from crudes showing very high color bottoms. Such results by themselves would hardly have excited comment had the special high-velocity design and operation of the vacuum column not been under scrutiny. A linear velocity of 40 ft. per sec. or higher was commonly being

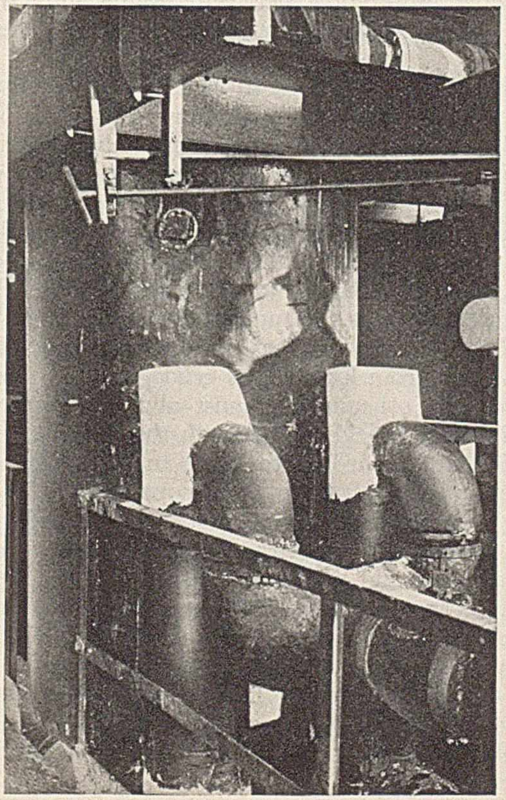


Fig. 2—Centrifix installed on a pipe still; liquid seals in foreground

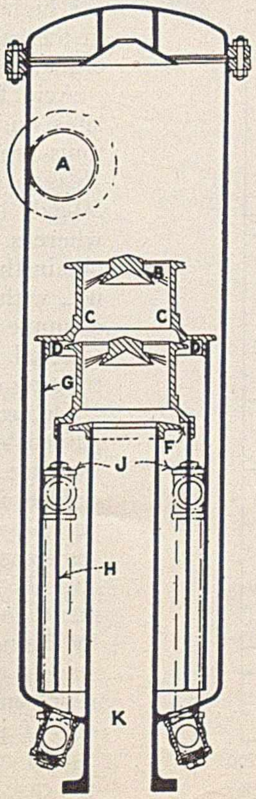


Fig. 3—Centrifix assembly in cross-section

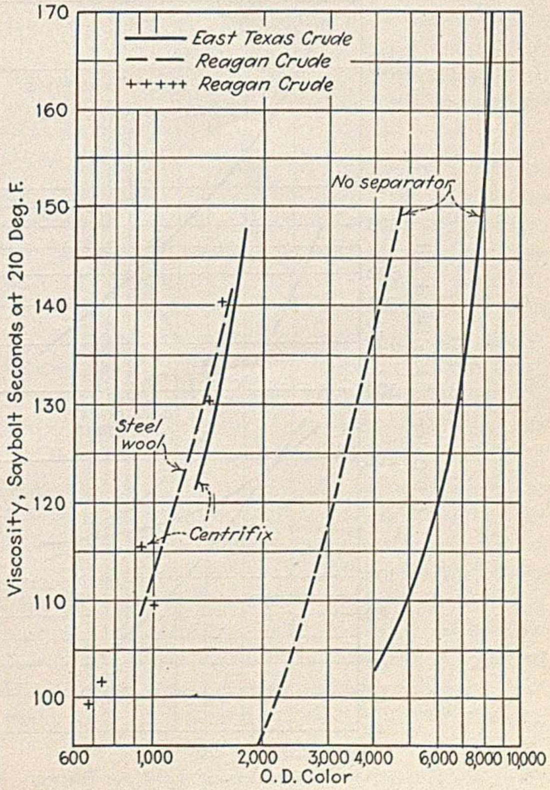


Fig. 4—Viscosity-color relations of Hivis from Reagan and East Texas crudes

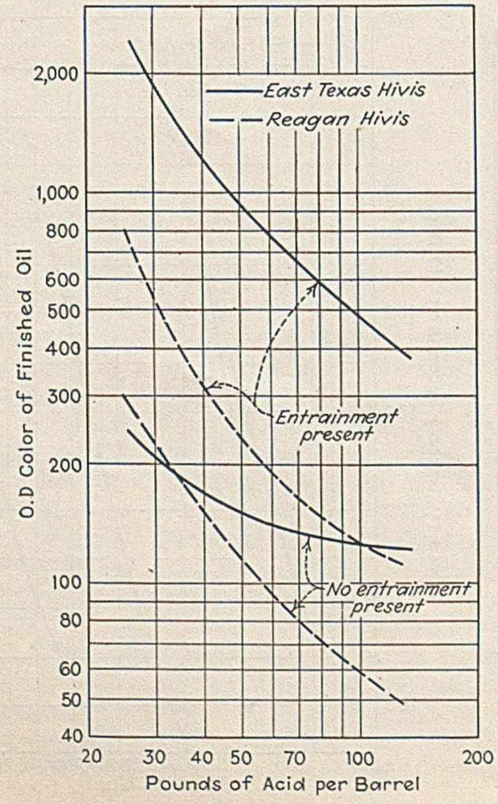
employed and some liquid entrainment was anticipated.

Hence, as evidence accumulated that both columns were producing an unnecessarily low quality distillate, it became evident that an accurate means of measuring very small amounts of entrainment must be developed to assist in the design and application of entrainment removal devices. Distillations of light hydrocarbon-oil solutions of a non-volatile dyestuff were then carried out so that velocities were substantially those used in commercial equipment. When the results were translated to fractionation of crude in the large atmospheric-pressure column, it was found that about 1 per cent by weight of unvaporized liquid would be entrained at a charging rate of from 250,000 to 300,000 gal. per day. The pipe still then in mind had two parallel passes of 4-in. tubing and the crude was flashed to about 90 per cent vapor in the 10-ft. diameter column. For the most part, this amount of entrainment reflects the fog-like condition built up by the high velocity in the pipe-still tubes, since the vapor velocity in the column influences the entrainment to a relatively minor degree.

In the experiments with the dyestuff solutions it was further found by colorimetry that a 9-in. layer of steel wool packed horizontally above the point of flash would reduce the entrainment to at least 1/20 of its original value. Calculations showed that further improvement in entrainment reduction was commercially unimportant.

A period of experimentation with steel wool, including operation on large stills, showed the very real advantages which accrue to substantially complete removal of entrainment. However, the coking difficulties which had been anticipated reduced the savings greatly because of the "down time" on the unit.

Fig. 5—Acid-treating curves for Reagan and East Texas Hivis



Typical Color Values, Residues and Hivis

	Residue or Bottoms		Hivis			
Crude	O.D. Color	Per Cent on Crude	O.D. Color, Centrifix Operating	Per Cent on Crude	O.D. Color, Centrifix Bypassed*	Viscosity at 210 deg. F.
Reagan.......	33,000	6	1,550	6	5,800	140
East Texas...	81,500	10	1,650	6	11,900	140
Lt. Panhandle	66,400	12	4,000	5	13,400	125
Barbers Hill..	29,000	17	1,500	8	3,600	145

*Approximately 1 per cent entrainment on basis of total vapor (calculated).

This fact, together with the background of experience with all types of usual baffle equipment, convinced us that it was necessary to employ an entirely new principle if success were to be attained. It was at this point that the efforts of the manufacturer were concentrated on a modification of the Centrifix, which ultimately met all our demands of efficiency and simplicity.

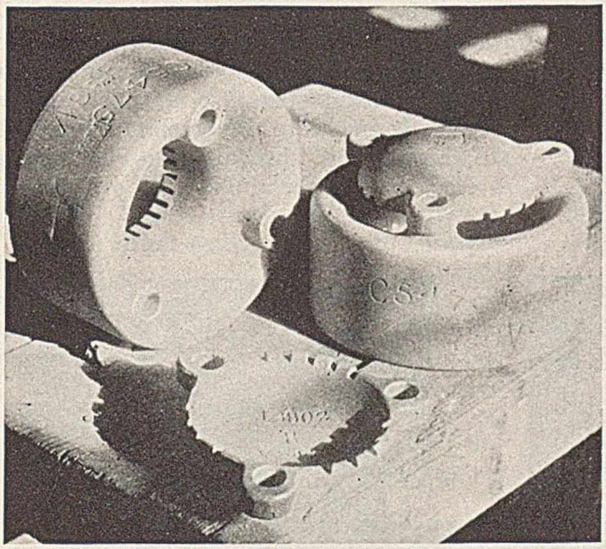
With this digression we pass to some typical results attained with the aid of the device. Fig. 4 compares the O.D. colors of the Hivis, or high viscosity distillates, with and without the use of the Centrifix device, in the distillation of Reagan and East Texas crudes. Distillate color in all cases is a function of the composition for a given viscosity so that for comparable results, such as are shown, the quality of the lighter viscosity oil which vaporizes from the Hivis section of the column must be held constant. Certain facts inherent in the curves merit attention. First, a comparison of the points marked by crosses, indicating points obtained with the Centrifix on Reagan crude, shows that the Centrifix removes entrainment as well as the layer of steel wool, the curve for which is the dashed line at the extreme left. Second, comparison of the curves for the two crudes apparently warrants the conclusion that the Centrifix is relatively more effective on East Texas crude than it is on Reagan crude. As a matter of fact, the device removes substantially the same percentage entrainment in both cases. The difference in apparent color improvement is due to the higher color differential between residue and Hivis in the case of East Texas than is the case with Reagan crude.

Acid finishing requirements of both Centrifix distillates and ordinary distillates containing entrained bottoms are shown in Fig. 5. For example, the Centrifix Reagan Hivis required 38 lb. of 66 deg. Bé. acid per 50-gal. barrel to produce a 150 O.D. color product, whereas the ordinary distillate required 85 lb. of acid to obtain this same result. Savings for the Centrifix product, with \$10 acid, amounted to \$0.24 per barrel. This example is by no means the most striking that could be selected. Much larger acid savings are possible when treating distillate from East Texas crude.

Decreased acid consumption must always be accompanied by increased yields. Although the extent of the increase will vary according to stock and treating procedure, it is apparent that the total economy will be appreciably greater than the value of the acid saved. In some cases the indications are that acid treatment may be entirely eliminated and the stock finished by clay treatment alone. It is true that overall economies to be made by the use of the Centrifix will depend upon the circumstances of each application. But, in the main, it evidently represents an auxiliary to distillation apparatus valuable out of proportion to its cost, and one which may find useful applications in distillation operations other than the case here discussed.

Craftsmanship in CHEMICAL STONEWARE

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



Intricate bubble caps produced by hand

"LEAN FARE for technocracy" is the sum of the impressions one gains after watching the infinite care and skillful handicraft with which modern chemical stoneware is fashioned. As Maurice A. Knight explained when I paid a recent visit to his plant in Akron, the star of the slap-dash chemical stoneware maker, which arose through the exigencies of war, has definitely set. Natural processes have eliminated him, or he has returned to his brick sewer-tile and his "dime-store" crockery. His product is no longer in the acid-proof market to embarrass the few survivors in the chemical field.

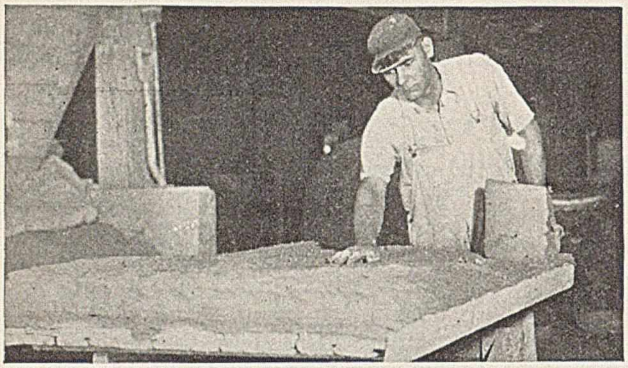
No way averse to the employment of labor-saving machinery, the Knight plant is none-the-less forced to depend largely on hand work in the forming operations. The attainment of an acid-proof product, as I was told, is relatively simple. But it is something again to produce intricate pieces to close measurements, and to make them mechanically strong. Hence, where machinery can be used without detriment to the product, it is used; but manual dexterity remains the principal reliance. Occasionally, machinery is found to improve on hand work, as in the case of the new mechanical de-airing process which is much superior to the hand operation of "wedging" and infinitely more rapid. Certain extrusion operations could hardly be replaced with hand labor. Brick formation is definitely a job for the machine. Turning and grinding operations would gain nothing were the lathe and the abrasive wheel eliminated. But the potter's wheel remains the means for forming buckets, pitchers and jugs; and the faucet parts turned on the lathe require much careful hand work in attaching connections to the body, in building flanges and in the construction of the plug. Extruded tubes must generally be hand finished, and if of the bell and spigot type, supplied with hand-formed bells. Large cylinders, square pipe, tower sections, laboratory sinks, filters and filter plates, reaction and storage vessels are all the products of hand work by men who have spent their lives in such labor, many of them for the last 27 years in the Knight plant.

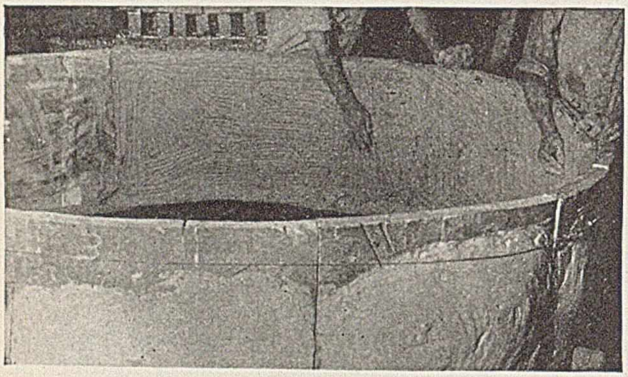
The plant itself centers around a large three-story building in which all functions except burning, finish grinding, testing, storage and shipment take place. Kiln sheds around two sides of the building house the six periodic kilns, two of 30 ft. and four of 25 ft. inside diameter. The kilns are all of the down-draft type, fired at ten points around the periphery with a special grade of low-sulphur, high B.t.u., long-flame, gas coal. A double grid floor beneath each kiln provides for proper distribution of the draft at all points in the kiln. Kiln control is by recording pyrometer, pyrometric cones and color test pieces.

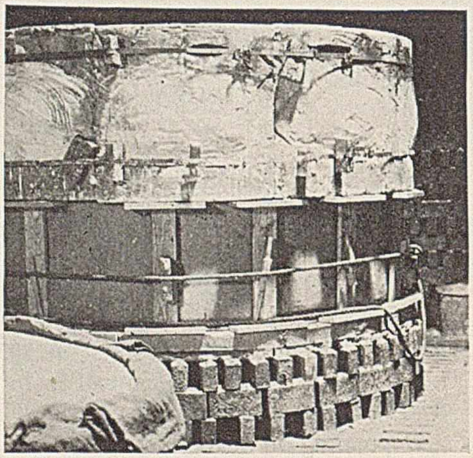
Depending on the service, the plant is prepared to manufacture regularly seven different bodies in which the density is decreased for increasing service temperature. All of these bodies are acid-proof throughout. They are composed of various mixtures of plastic domestic clays, of which three varieties principally are used, with or without a quantity of grog to supply body and assist in the resistance to thermal shock and rough handling. The grog consists of finely ground, burned ware which, after inspection and testing, has been rejected as defective.

Clays are unloaded mechanically and stored in bins in a receiving shed from which they are withdrawn as required to a dry pan (edge runner mill) provided with a perforated metal bottom. From the dry pan the clays generally go to a washing operation, or if finer grinding is needed, to a ball mill where they are reduced with manganese steel balls to 80 or 120 mesh. Grog is ground in a smaller dry pan and passed over gravity screens. Occasionally clays may be washed without the preliminary milling.

In washing, the clay is pulped with water in an agi-







Top: Producing slabs to be used in forming a large vessel

Above: Inside a kiln, building a vessel too large to move

Above: Ready to remove mold from the vessel shown above

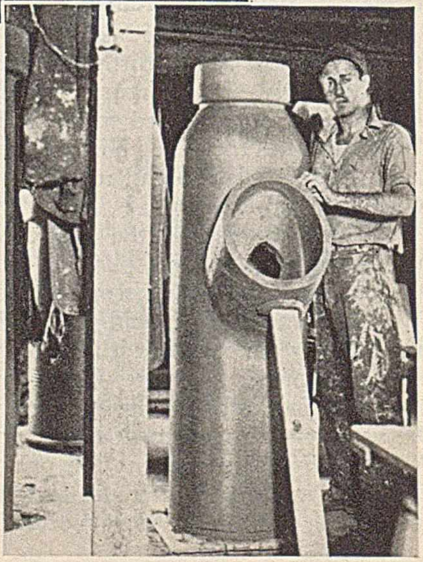
tated tank from which it is dropped over a shaking screen to an agitated sump. It is then withdrawn by a plunger pump and passed to a cast-iron, recessed-plate filter press controlled by a pressure governor. The press cakes are carefully removed and stacked up for storage until needed. At this point an aging operation, bacterial in nature, commences, but decreases shortly as the press cakes dry out.

Until the following operation in the wet pan (an edge runner with an imperforate pan), the several clays have been kept separate. The required ingredients are now measured into one of several wet pans where they are ground and "tempered" with water. The mix is eventually plowed out of the pan and packed into aging pits where, under conditions of controlled humidity, the bacterial processes are permitted to go on for a period of about three months. This aging action increases the colloidal content of the clay through the breakdown of silicates and improves its plasticity and strength so as to give better working properties.

Operations from this point on all have to do with the formation of the finished ware. If it is necessary to add water for proper consistency, this is accomplished in a pug mill, a small vertical cylinder equipped with powerful mixing blades. Or the clay may be taken directly to the Bonnot de-airing machine (see *Chem. & Met.,* May, 1933, p. 270) in which the air is expelled from the mass by a combination of working, disintegration, vacuum and pressure. The remarkable improvements attained by de-airing in increased strength of the ware both burned and unburned, in increased density, and in freedom from flaws of all kinds, have been covered briefly in the reference noted above.

Three Methods of Forming

Forming operations, in general, are of three types: Extrusion by steam ram pressure or by screw pressure (the latter in the continuous "auger machine"); "pressing"—any hand operation in which chunks or slabs of clay are formed into the finished article without the potter's wheel; and "throwing," in which the potter's wheel is employed in the molding of cylindrical and similar



Above: Forming a cooling coil with the Bonnot machine

Right: Finishing a Y-type reducing fitting

shapes. Auxiliary methods include "jiggering," where the clay is plastered inside a mold with a power-driven rotating tool, and lathe-turning operations.

Tubing up to 30 in. in diameter may be extruded, although the larger sizes are generally produced by hand "pressing" in molds. All smaller tubing is extruded, however, most of it at present by attaching a die head to the Bonnot de-airing machine. By the latter method continuous lengths of very thin-walled tubing may be produced without lamination. Shorter lengths can be made in the largest extrudable diameters with the 30-in. steam press. Brick is extruded, cut to size by means of a wire "cut-off" and then repressed to insure proper dimensions and high density.

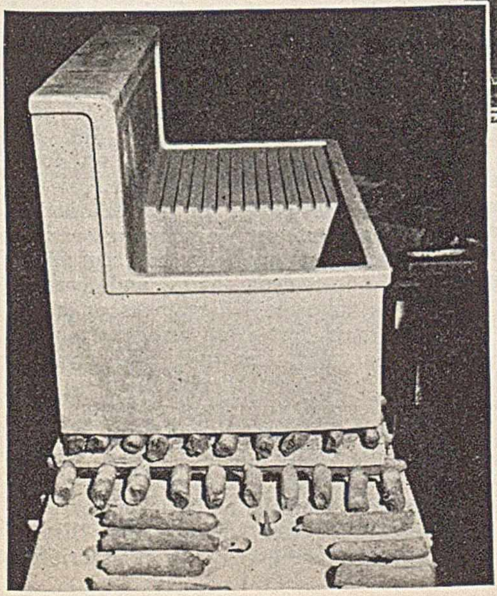
With the exception of clays used in making porous or chamotte bodies, practically all clay is now mechanically de-aired before being formed. Formerly, clay to be thrown was subjected to the time-honored process of "wedging," in which a chunk is repeatedly cut on a taut wire and the pieces pounded together to drive out the air. Having been de-aired, the clay is ready for whatever use is to be made of it, for example, pressing into more or less intricate articles in sizes ranging anywhere from a handful to a tank or fitting large enough to hold a dozen men. For this purpose, many plaster molds are kept on hand. For the larger articles, the clay is pressed and worked into slabs of suitable thickness, and these slabs then built up inside the mold into continuous shapes. Sinks are likewise built up of slabs much as a carpenter would fit together the boards from which he was building a wooden pattern. All articles, regardless of the method of their formation, require careful hand finishing.

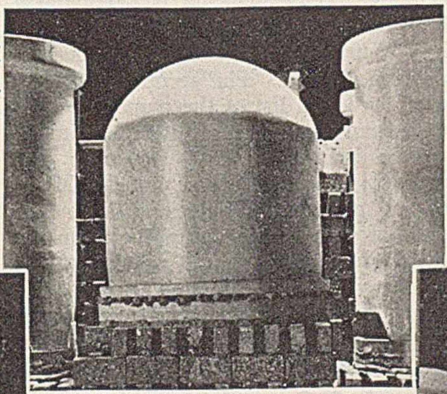
Drying of the formed ware is a long operation, demanding careful control. The largest ware is dried in place. Some vessels are so big, in fact, that they are built and dried within a cold kiln. Drying is retarded and case hardening and warping prevented by keeping the article properly covered with damp cloths. Sinks require three to four weeks to dry, and some large articles as much as two months. Drying is accelerated for some smaller ware by placing it upon a steam-heated drying floor. Very thick machine-formed ware (4 to 12 in. in section) is put through a continuous Proctor dryer in which three zones of controlled humidity are maintained.

Once dried, the ware is transported manually or on trucks to the kilns, where it is carefully placed and supported, if necessary. Sinks, for example, are set on slabs, from which they are separated by rolls of clay powdered with flint to prevent sticking. The several kiln pictures illustrate this operation. Firing then takes place at a temperature of 2,200-2,400 deg. F., requiring seven to ten days. Toward the end of the burn, salt is thrown onto the fires to produce a fusion of the clay surface ("salt glaze"). A further seven days is required to cool the contents of a kiln. This is accomplished in the early stages by natural draft, with the removal of vent covers from the kiln roof. When the ware reaches a red heat, the kiln is sealed and kept sealed until a temperature of 500 deg. F. is attained.

Grinding, where necessary, inspection, testing, packing and shipment follow. Various sorts of Carborundum wheels, including a large flat-bed grinder, are employed. Inspection includes a check-up on finished dimensions and warping, the detection of hidden or other small flaws, and pressure tests under air or water pressure. For shipping purposes, the company maintains a wood-working shop and employs two spur loading tracks and a truck-loading station.

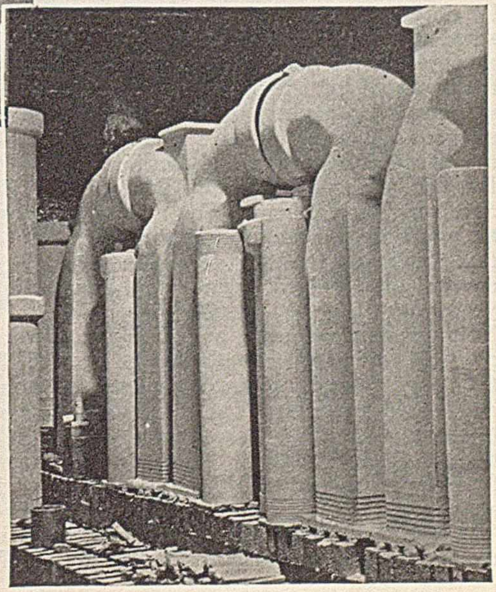
Laboratory sink set up in the kiln





Large kettles ready for burning

Pipes of various sorts in the kiln



BOOKSHELF

Underlying Chemical Engineering

PHYSICO-CHEMICAL METHODS. Second Edition, 1932. By Messrs. *Joseph Reilly* and *William Norman*. Published by D. Van Nostrand Co., New York. 822 pages. Price, $8.

Reviewed by *Donald F. Othmer*

PHYSICAL CHEMISTRY is probably the most fundamental single field underlying chemical engineering. And practical minded as he is, the chemical engineer usually looks more often to the apparatus, methods, and technique of physical chemistry than to the underlying theories for an understanding and development of his processes and plants. For this reason, the second edition of this book, which has become a handbook of the physical chemical laboratory, will be found to be of large value to the engineer who is concerned with the development and control of chemical processes.

The chemical engineer has many times been required to contribute to the data and operations of physical chemistry, in the development of his industrial projects. Notable examples would be the late Dr. Teeple's industrial development of Searles Lake brines, the work of Dr. G. G. Brown and collaborators at the University of Michigan on the vapor relations of hydrocarbon mixtures, and many more could be mentioned. This book neglects such contributions, with a few exceptions, and especially those described in American journals.

The chapter on laboratory distillation is a case in point; and the authors succeed in retaining (if indeed they do not contribute to) the mystery with which this comparatively simple operation is usually regarded by most chemists. Chemical engineering practice in the laboratory and plant is a long way beyond most of the misunderstood apparatus pictured. This is largely a copy book of antiquated apparatus of the types of fifteen to fifty years ago without a comment on the efficient methods developed in this country in the last ten years and described by Podbielniak, workers at the Bureau of Standards, and others. The misuse of the word "dephlegmator" to mean "rectifying column" instead of "reflux condenser" should have been stopped ten years ago by the second edition of Young's standard work and should not crop up to include all manner of distilling columns, fractional condensers, and dephlegmators. The theory and methods of determining vapor composition of binary mixtures are also confused by being scattered throughout this chapter.

A compilation such as this requires a tremendous amount of work and space; and even the most thorough and complete volume would omit many valuable operations. In order to keep a book, such as this for mature workers, from becoming too voluminous one plan would be to describe in detail only those methods and apparatus which by reason of newness or advanced design for specialized fields were not already adequately covered in the ordinary texts.

Notwithstanding these comments, the scattered typographical errors, and the imperfection of some of the six hundred illustrations (which on the whole add much to the clearness of the text), it is felt that this book is a valuable tool for use throughout the wide field of physical chemistry and its applications to industry; and is as near perfection as any single book covering such a wide field could be.

Britain's Plastics

BRITISH PLASTICS YEAR BOOK FOR 1933. Published by Plastics Press Ltd., London. 460 pages of text and advertising. Price, 7/6.

THIS HANDBOOK and buyer's guide to the plastics industry in Great Britain is divided into four sections. The first includes 14 articles on various phases of the resin industry. One of these articles deals with the physical and chemical properties, solvents and plasticizers, and molding of benzyl cellulose. This material is particularly interesting because so little information has been published about the recently developed resin. The second section is composed of a list of the names and addresses of the concerns interested in the plastic industry. Both producer and user of the products are listed. Many of the proprietary names with several lines of descriptive matter make up the third division. While manufacturers of chemical raw materials and equipment, molders, and associations in the synthetic resin industry are listed in the fourth section.

Chemical Control Up-to-Date

BERL-LUNGE CHEMISCH UNTERSUCHUNGS-METHODEN. Eighth Edition. Vol. II, Parts 1 and 2, and Vols. III and IV. By *Ernest Berl*. Verlag von Julius Springer, Berlin, Germany.

Reviewed by *C. E. Betz*

THE SECOND, third, and fourth volumes of the new eighth edition of this old and well-known standard work are now available. They constitute a most comprehensive compilation of up-to-date methods of analysis and tests covering a wide field of industrial materials and products.

The policy followed throughout the series is to present and to discuss impartially a variety of tried and proven methods where such exist for a given purpose. In many instances specifications and standards in current use in many European countries and in the United States are given. A.S.T.M. and Federal Specification Board standards and procedures are quoted in some sections, notably those on oil and gasoline.

As a complete reference on industrial chemical methods this new edition is invaluable to the library of any laboratory engaged in anything beyond mere routine work. The point of view is necessarily continental; for that reason it serves to shed new light on methods with which we have long been familiar, as well as to describe many obviously useful procedures not in common use in this country—a service not only valuable but stimulating to the chemist interested in applied industrial analysis.

About half of Vol. II, Part 1, which consists of 878 pages, is devoted to the analyses and tests of water, sewage, and fuels—coal, coke, fuel oil, and gasoline. In addition to the usual analyses of water for boiler and drinking purposes, many special methods are given for water and wastes in a number of industries. A section on air analysis and air pollution is followed by a thorough treatment of the analyses required in the acid and heavy chemical manufacturing industries, including a short section on compressed gases.

Vol. II, Part 2, which contains 855 pages, deals entirely with the analysis of metals. Electrolytic methods are treated in a separate section, followed by detailed discussion of each metal, its determination in ores, and analysis of its principal alloys, as well as examination of the metal itself for impurities. Typical composition of the principal ores and commercial alloys, as well as specifications and standards where such exist, are given under many of the more commercially important metals.

The first 600 pages of Vol. III which includes 1,338 pages set forth the analytical methods as well as the physical tests called for by the ceramic and cement industry, including sections on clay, clay products and porcelain, lime and cement, glass and enamel. This is followed by chapters on phosphates and fertilizers in general, soil analysis, and feedstuff. Nearly 400 pages are then devoted to special manufactured chemicals of commercial interest, both inorganic and organic, including fatty acids, esters, phenol derivatives, solvents, plasticizers, photographic chemicals, and pharmaceuticals. Under each item of this long list of substances are given a brief description of properties, the usual tests for purity, methods for qualitative determination, and at least one method of quantitative analysis.

The final 180 pages cover analysis and tests of explosives of all kinds, including the materials used in the manufacture of matches and fireworks.

The 1,079 pages of Vol. IV deal largely with the organic industries, primarily the manufacture of gas, tar, and coke, and all the allied substances and byproducts; and the petroleum industry, from crude oil to all the varied petroleum products. The text takes up one by one the processes and materials involved and presents methods for the analyses and tests called for. In addition there is a very complete section on the systematic examination and analysis of fats and waxes, and a shorter section on essential oils.

Organic Chemistry. By *F. Stanley Kipping* and *F. Barry Kipping*. J. B. Lippincott Co., Philadelphia, Pa. 613 pages. Price, $3.50—This well-known text book has been completely revised by the present authors. Containing Parts I and II, covering the aliphatic and aromatic compounds, this volume is to be supplemented later by a third section with further detail on certain branches of interest to advanced students.

Gas Associations Report

American Gas Association Proceedings 1932. Fourteenth Annual Convention. Published by American Gas Association, Inc., 420 Lexington Ave., New York. 1,030 pages. Price, $3 to members, $7 to others.

THIS IS THE customary annual resume of convention proceedings. It forms an outstanding annual contribution to the technical and economic literature of the city gas industry. All libraries claiming any completeness of coverage in this field should have the whole series.

Compressed Gas Manufacturers Association. Twentieth Annual Report. Published by the Association, 110 West 40th St., New York. 92 pages.

INCLUDES technical committee reports and papers presented before the convention held Jan. 23-24, 1933.

Proceedings of American Gas Association 1931 Convention. Published by American Gas Association, New York City. 1220 pages. Price, $7 to non-members, $3 to members—This volume of the annual proceedings of the association is somewhat reduced in completeness and therefore of somewhat smaller size than preceding years' reports. It includes, however, substantially all of the original articles and much of the convention discussion with reference to engineering, economic and trade articles, committee reports, and the proceedings of all the subsidiary sections. It represents an outstanding reference volume of new work published during the last year having any bearing on the engineering or public utility phases of gas business.

Heat With Electricity

Die Elektrische Warmbehandlung in der Industrie. By *E. F. Russ*. Verlag von R. Oldenbourg, Berlin, Germany. 259 pages. Price, 14 M.

ELECTRIC HEATING has become an important factor in the process industries. Close control of operating conditions and freedom from contamination makes it highly attractive in annealing, tempering, nitriding, case hardening, drying, calcining, and many other processes. The first chapter of this book portrays the theoretical side of the subject. Heat treatment of steel and other metals is then taken up; the next chapters deal with furnace construction, heating elements, refractories, insulation materials, electrical equipment, and temperature control. The major part of the book is devoted to the description of specific furnace types and installations.

Allgemeine und Technische Elektrometallurgie. By *Robert Müller*. Vienna: Verlag von Julius Springer. 580 pages. Price, 32.50 M. Several good books on electrometallurgy have appeared within the last couple of years, and the need for a new textbook in this field can no longer be said to be urgent. Doctor Müller's treatment of the subject which is perfectly orthodox in selection and arrangement, indicates a certain lack of first-hand acquaintance with modern American methods, a serious disadvantage in view of the fact that the predominating part of the electrolytic copper, lead, zinc, and nickel is produced on the North American continent. Scarcity of sketches and suitable illustrations is another shortcoming which is likely to come to the reader's attention.

Technical Electrochemistry

Handbuch der Technischen Elektrochemie. By *Victor Engelhardt*. Akademische Verlagsgesellschaft m.b.H., Leipzig, Germany. Part II, Vol. I. 451 pages. Price, 44 M.

LIKE THE VOLUMES already completed this one is an outstanding contribution to the literature on technical electrochemistry; it contains a wealth of well arranged and clearly presented data which cannot fail to impress the reader. Electrolysis of water and electrolysis of NaCl are the subjects treated, the former by Dr. Pfleiderer of I. G. Farbenindustrie, the latter by Professor Billiter and Dr. Fuchs, of Vienna.

Progress in the electrolysis of water has been so great during the last few years that it is difficult to find any reference book containing an up-to-date treatment of the subject. The author gives a complete review of all of the important types of cells available at the present time, with description of some of the larger installations. The latest developments in the pressure electrolysis have been included.

The section on chlorine-caustic soda electrolysis, which is equally complete, gives a review of the historical development over the last 40 years. This is followed by a theoretical discussion, and finally by a treatment of all processes which have reached a commercial stage.

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.

Sperm Oil and Spermaceti Wax. U. S. Tariff Commission, Report No. 64, Second Series; 5 cents.

Analysis of Imports for Consumption of Certain Chemicals and Similar Products "not specially provided for" in the Tariff Act of 1930. U. S. Tariff Commission; mimeographed.

The Employment of Women in Vitreous Enameling, by Ethel L. Best. Department of Labor, Bulletin of the Women's Bureau, No. 101; 10 cents.

The Monetary Use of Silver in 1933, by Herbert M. Bratter. Bureau of Foreign and Domestic Commerce, Trade Promotion Series 149; 10 cents.

The Development of an Electrolytic Method for the Determination of Inclusions in Plain-Carbon Steels, by G. R. Fitterer and others. Bureau of Mines Report of Investigations 3205; mimeographed.

Abstracts and Summaries of the Bureau of Standards Publications on Stray-Current Electrolysis, by E. R. Shepard. Bureau of Standards Circular No. 401; 5 cents.

The Properties and Testing of Foundry Sands. Bureau of Standards Letter Circular 363; mimeographed.

Production Statistics From 1931 Census of Manufactures—printed pamphlets on: Wood Preserving; Turpentine and Rosin; Soap; Asbestos Products, Steam and Other Packing, Pipe and Boiler Covering and Gaskets, China Firing and Decorating not done in Potteries, Graphite Ground and Refined, Statuary and Art Goods (Except Concrete), factory production; Paints and Varnishes, Bone Black, Carbon Black, and Lampblack; 5 cents each.

Mineral Production Statistics for 1931—Separate pamphlets from Bureau of Mines on: Natural Gasoline, by G. R. Hopkins and E. M. Seeley, 5 cents; Barite and Barium Products, by R. M. Santmyers and B. H. Stoddard, 5 cents; Stone, by A. T. Coons, 5 cents; Ore-Concentration Statistics, Metallurgical Results and Flotation Reagents, by T. H. Miller and R. L. Kidd, 5 cents.

Mineral Production Statistics for 1932—Preliminary mimeographed statements from Bureau of Mines on: Talc and soapstone; lead; manganese; iron and steel; magnesium; carbon black; molybdenum; rolled zinc; aluminum salts; gold and silver; salt, bromine, calcium chloride, and iodine; abrasive materials; natural sodium compounds; copper; magnesite; asphalt; lead and zinc pigments and zinc salts; crushed and broken stone; road oil.

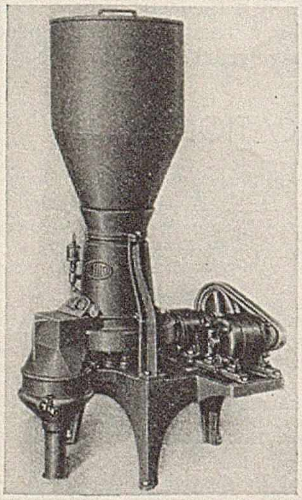
NEW EQUIPMENT

Stoneware Container Jar

For the storage and shipment of C. P. chemicals and reagents, the U. S. Stoneware Co., 50 Church St., New York City, has recently developed the new "Loxeal" container jar which is said to be entirely airtight by reason of the new "Loxeal" closure which attaches the cover under uniform tension by means of a patented spring lock. The inside of the jar is white, the outside being finished in a special brown glaze. Sizes range from ½ to 6 gal. capacity.

Dry Chemical Feeder

Accurate volumetric measurement of dry powders, pulverized or granular materials is the function of the new Infilco No. 8 dry chemical feeder recently introduced by the International Filter Co., 59 East Van Buren St., Chicago, Ill. This machine is designed to handle quantities from a fraction of a pound per hour up to as much as 150 lb., depending on the material being fed. The mechanism consists of an adjustable knife fitted in a stationary ring, which cuts off a section of a revolving cylinder of the material contained in a revolving drum on a revolving table. During each revolution a definite quantity is cut off by the knife and discharged from the edge of the table. It is reported that a large number of these feeders have recently been installed in water works for the feeding of powdered carbon, hydrated lime, alum, etc.



Infilco dry-chemical feeder

Improved Refractory Brick

Under the name of "Tercod," the Electro Refractories & Alloys Corp., Buffalo, N. Y., has recently announced a new silicon-carbide refractory which is said to be entirely satisfactory for use in electric furnaces. The brick consists of a mixture of silicon carbide with or without graphite, a carbon bond, and a protective boro-silicate glaze to prevent oxidation. The brick is inert to acid and neutral slags, but is attacked by basic slags. The thermal expansion is exceptionally low, being only one-ninth that of silica brick. The electrical and thermal conductivities are much higher than those of silica refractories. The carbon bond gives rigidity up to the dissociation temperature of silicon carbide. Tercod is inert to non-ferrous metals and to cast iron containing more than 3 per cent carbon.

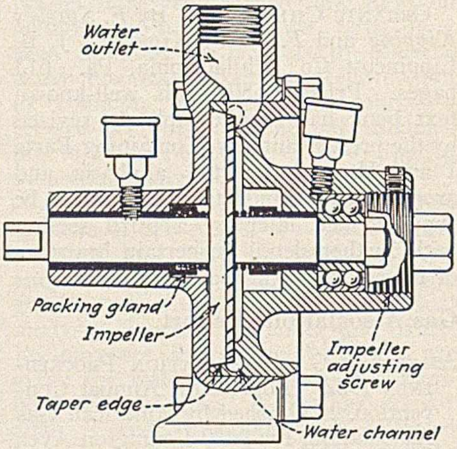
Cement-Lined Pipe

Cement-lined pipe has been used in water lines for more than 100 years. In an effort to perfect linings so formed, the National Tube Co., Pittsburgh, Pa., conducted an extensive research program with the result that a special corrosion-resistant lining, known as "Duroline," was developed. The new lining is said to have only about one-third the solubility of ordinary portland cement mixtures. During setting, special curing methods result in a minimum of shrinkage. The pipe used is of the same quality as this company's regular black or galvanized wrought pipe. Lining is accomplished by a centrifugal process combined with a method of curing involving the use of moist air, steam and hot and cold water treatments extending over a period of several days.

This pipe is intended primarily for carrying waters or solutions which rust, corrode and otherwise attack unprotected metal pipe. The lining is said to be resistant to salt water and many dilute chemical solutions.

Turbine-Type Pump

Roots-Connersville-Wilbraham, Connersville, Ind., has just announced a new line of turbine pumps suitable for handling capacities from 5 to 300 g.p.m. at heads up to 350 ft. Among the advantages claimed for the new pump is a patented taper-edge impeller which gives the ability to vary the quantity when the pump is running. There is a slight increase in capacity as the head falls, with a noticeable decrease in power consumption. This characteristic is said to differ from that of the centrifugal pump in which a marked increase in both capacity and power consumption occurs when the head falls.



Cross-section of new turbine pump

These pumps are supplied in various corrosion-resisting metals and alloys. They are built in two types, one with annular bearings for higher heads and one with plain bearings for lower heads.

Conveyor Belt Cleaner

Complete insurance against the building up of material on conveyor belt pulleys is claimed for a new cleaning device recently introduced by the Stephens-Adamson Mfg. Co., Aurora, Ill. This cleaner is placed just back of the discharge point on the return run of the belt. It consists of a row of thin spring-steel plates set perpendicular to the surface of the belt but diagonal to the belt travel. Each plate is mounted on an individual spring which presses it firmly against the belt.

The connection to the spring is made by means of a pivot which causes the scraper plate to seat perfectly against the belt. When properly adjusted, this device is said to be 100 per cent efficient.

Motor-Operated Controller

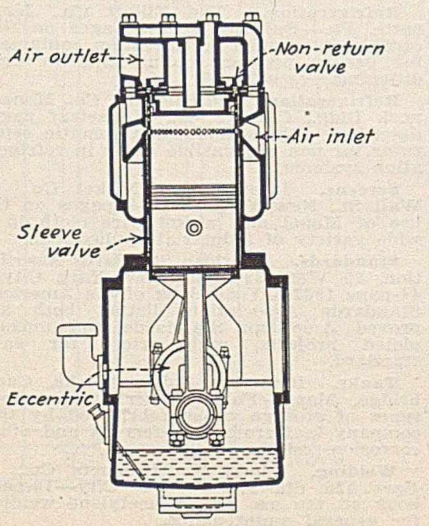
To meet the demand for a sturdy, but inexpensive, two-position controller, the Automatic Temperature Control Co., Philadelphia, Pa., has added the new Type 2 controller to its line. The new controller can be supplied to operate valves of the globe type in sizes up to 3 in. for pressures up to 250 lb. per sq.in. For lower pressures, the controller has sufficient power to handle larger globe valves. In combustion-control work, the motor will handle an air valve up to 4 in., in combination with a ½-in. fuel-oil valve.

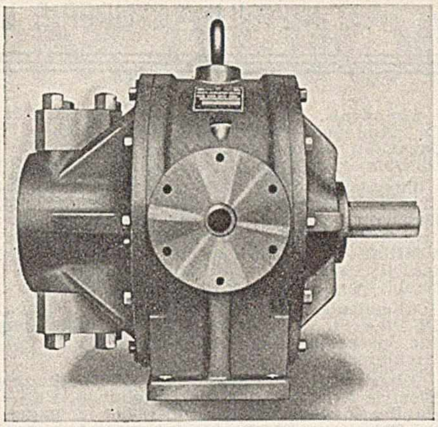
Sleeve-Valve Compressor

Compressors in both stationary and portable types, featuring a new sleeve-valve design, have recently been put on the market in the United States by the Mercer Engineering Works, 30 Church St., New York City. The accompanying illustration shows the principle employed. The valve member is a single reciprocating sleeve, sealed by piston rings and operated by an eccentric on the crankshaft. Ports in the sleeve communicate with a slot in the cylinder wall at the appropriate moment. This construction is said to make the inlet area much larger than it is possible to obtain in a plate-valve compressor.

When the piston is about half-way up on the compression stroke, the top of the sleeve opens a port formed by a special type of sealing ring and this puts into communication with the cylinder the completely water-jacketed discharge space. As the clearance volume is only 2 per cent the pump is said to have exceptionally high volumetric efficiency.

Sleeve-valve compressor in section





New radial hydraulic pump

Hydraulic Pump

Hydraulic Press Mfg. Co., Mt. Gilead, Ohio, has recently announced a new and complete series of radial pumps for operating hydraulic-powered machinery. The new pump is of the positive-displacement, multiple-radial plunger type in which the pressure medium is oil. Delivery is infinitely variable within limits and is reversible in direction of flow, through varying of the eccentricity. These pumps are available in six sizes, ranging from 1 to 100 g.p.m. with pressure capacities up to 3,000 lb. per sq.in.

Alundum C.F. Aggregate

For producing a permanently non-slip surface in cement and asphalt flooring, the Norton Co., Worcester, Mass., has developed a new grade of Alundum aggregate which has been given the special designation C.F. This consists of particles of ceramically bonded aluminum oxide abrasive. In addition to the non-slip qualities of floors employing this material, it is stated that the floor will withstand the most severe traffic. The product is available in two sizes, one ranging from $\frac{1}{32}$ to $\frac{1}{8}$ in. and the coarser size from $\frac{1}{8}$ to $\frac{1}{2}$ in. This company has also introduced a line of safety treads for stairways; this product consists of Alundum aggregate securely bonded in a reinforced base of hard, tough rubber.

Sound-Isolating Base

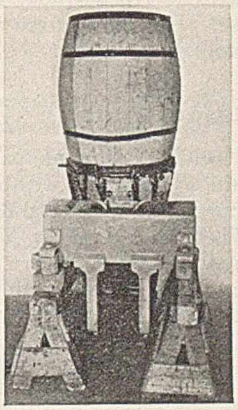
To reduce motor vibration and sound, the General Electric Co., Schenectady, N. Y., has developed a new motor base in which the motor is supported on a floating member suspended on a specially developed isolating material so inclosed and mounted that long life and freedom from damage are said to result. A sliding base for the motor is provided with a screw adjustment for regulating belt tension. The stiffness of the sound-isolating material is said to be sufficient to maintain motor alignment for any reasonable belt tension. This base is effective from a motor speed of 100 per cent down to 66 per cent of normal, or even lower in some cases. Depending on the size, type and speed of the motor, bases are built for motors ranging from fractional to 50 hp.

Photoelectric Cell

Under the name of Visitron F2, the G-M Laboratories, 1735 Belmont Ave., Chicago, Ill., has introduced a new photoelectric cell which requires no battery or other source of voltage. The sensitive element is a disk hermetically sealed into a metal case. The cell is suitable for use with current indicating meters for light intensity measurements, or with sensitive electromagnetic relays without vacuum tube amplification.

Vibrating Barrel Packer

Applying the same magnetic vibrating principle used in its conveying and screening equipment, the Traylor Vibrator Co., Denver, Colo., has developed a barrel packer, capable of very intense action. Sand, for example, may be packed to maximum density in about a minute, with a 16-per cent increase in density. It requires about 5 minutes to reach the maximum density of gypsum or lime and the increase in density is 75 per cent.



Trayco barrel packer

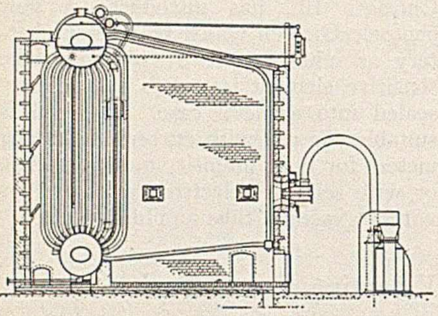
As appears in the accompanying illustration, the new packer may be operated speedily, for the barrel is not fastened to the platten surface. The packer is available in various sizes to meet the demands of different industries.

Lubricating Pastes

For the lubrication of packings in service, the Garlock Packing Co., Palmyra, N. Y., has developed two new compounds, Lubricating Paste No. 2 for steam and water packings, and Lubricating Paste No. 3 for packings working against gasoline and oils. These compounds are said to have high lubricating value and to prolong packing life materially. They are regularly supplied in 12-oz., 24-oz. and 5-lb. cans.

Small Steam Generator

For capacities from 8,000 to 40,000 lb. of steam per hour, the Combustion Engineering Corp., 200 Madison Ave., New York City, announces a new standard design of steam generating unit in



Cross-section of steam generator

which compactness and economy in cost and operation are featured. As appears from the accompanying illustration, the unit requires low head-room and small floor space. It may be fired with pulverized fuel, oil or gas.

Straight-Gap Weld

A new welding technique particularly suited to the joining of heavy plates, has been announced by the Metal & Thermit Corp., 120 Broadway, New York City. By this method plates require no beveling. The method is used with arc welding and employs a backing strip placed beneath a narrow gap between the plates. Because preparatory work is eliminated and the quantity of weld metal is reduced, welding speed is said to be doubled and cost materially decreased. Independent tests on straight-gap welds are said to have shown them physically superior in many ways to welds produced by other methods. The company has also introduced a new line of heavy, mineral-coated electrodes known as "Murex Universal" for use on mild steel.

High-Speed Hoist

A safety overload governor has been incorporated in a new high-speed chain hoist recently developed by the Chisholm-Moore Hoist Corp., Tonawanda, N. Y. This feature in combination with an adjustable load brake is said to make possible maximum safety and speed and to require minimum operating effort. The new hoist is available in capacities from ¼ to 40 tons. The internal gears are packed in grease in an oil-tight, dust-proof housing.

MANUFACTURER'S LATEST PUBLICATIONS

Chemicals. E. I. duPont de Nemours & Co., Ammonia Dept., Wilmington, Del.—31 pages on the properties and uses in fertilizer manufacture of urea-ammonia liquor.

Chemicals. E. I. duPont de Nemours & Co., R. & H. Chemicals Dept., Wilmington, Del.—6-page reprint of an article on the "Hazards of Gas Leakage as Affected by Ventilation," with special reference to toxicity and flammability hazards, particularly with regard to methyl chloride.

Chemicals. International Selling Corp., 70 Pine St., New York City—16 pages on the properties and uses of "Pechiney" trichlorethylene.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Publications as follows: C-1969, 12 pages on Thermoguard thermostat-protected motors; 25499, Leaflet on combination line-starters; 5571, 4 pages on copper-oxide rectifying units.

Equipment. Cameron Machine Co., 61 Poplar St., Brooklyn, N. Y.—6-page folder describing rewind shafts and mill-roll shafts made by this company.

Fabrication. Allegheny Steel Co., Brackenridge, Pa.—10-page folder completely describing methods of fabrication of this company's stainless steels, covering various welding methods, forming, machining and other operations.

Fans. B. F. Sturtevant Co., Hyde Park, Boston, Mass.—Catalog 391—12 pages on a new line of small-sized, high-speed, high-efficiency, forced-draft fans produced by this company under the name of "Rexvane."

Furnaces. Ajax Electrothermic Corp., Ajax Park, Trenton, N. J.—Bulletin 8—4 pages on small high-frequency furnaces for melting and heat-treating.

Gas Analysis. The Hays Corp., Michigan City, Ind.—Bulletin 2006—16-page reprint of an article on the handling of the Orsat gas analyzer; Catalog TSE-33, 24 pages describing this company's portable gas analyzers.

Gaskets. Goetze Gasket & Packing Co., New Brunswick, N. J.—Leaflet briefly describing a wide range of gaskets and sheet packing for many purposes made by this company.

Instruments. The Foxboro Co., Foxboro, Mass.—Folder briefly describing this company's dial-type thermometers.

Instruments. Mishawaka Industrial Instrument Mfg. Laboratory, 936 Washington Ave., Mishawaka, Ind.—6-page leaflet describing this company's line of thermo-electric pyrometers.

Instruments. Mason Regulator Co., 1190 Adams St., Dorchester Center, Boston, Mass. —Bulletin 3000-C—32 pages on compensated temperature controllers, recording and nonrecording; also recording thermometers and accessories.

Lacquer Films. Hercules Powder Co., Wilmington, Del.—Form 524—6-page booklet describing a new method developed by this company for the measurement of chalking of lacquer films.

Materials Handling. Jeffrey Mfg. Co., Columbus, Ohio—Folder 558—Describes this company's Triple "E" rivetless chain for conveyor service.

Metals and Alloys. Bridgeport Brass Co., Bridgeport, Conn.—24 pages on the properties and uses of this company's three Duronze bronzes.

Metals and Alloys. A. M. Byers Co., Pittsburgh, Pa.,—Booklet entitled "The New Story of Ancient Wrought Iron," an illustrated exposition of the manufacture of this material.

Metals and Alloys. International Nickel Co., 67 Wall St., New York City—Wall chart of the "window" type, showing compositions, approximate physical properties and heat treatment recommended for suitable nickel alloy steels of yield point up to 175,000 lb. per square inch, for use in bars, shafting, simple forgings, etc.

Metals and Alloys. Republic Steel Corp., Youngstown, Ohio—Form 114—12-page folder on the properties of Toncan iron.

Metals and Alloys. Riverside Metal Co., Riverside, N. J.—14 pages on this company's beryllium copper alloy, describing properties and listing suggested applications.

Metallizing. International Metallizing Assn., 214 Provost St., Jersey City, N. J. —20-page book describing equipment for producing sprayed metal coatings and concerning a wide range of uses for such coatings.

Mixing. National Engineering Co., 549 West Washington Blvd., Chicago, Ill.—12-page general catalog illustrating seven sizes of Simpson intensive mixer made by this company.

Motors—Century Electric Co., 1806 Pine St., St. Louis, Mo.—4 pages describing the construction of this company's line of splash-proof motors.

Pipe Compounds. Technical Products Co. Sharpsburg Sta., Pittsburgh, Pa.—Folder 5 —Briefly describes a number of technical cements and compounds for sealing joints and gaskets.

Piping. Air Reduction Sales Co., Lincoln Bldg., New York City—12 pages summarizing the advantages of welded piping for use in buildings.

Piping. The Crane Co., 836 South Michigan Ave., Chicago, Ill.—Two 12-page booklets, "After Three Years of Starvation Maintenance" and "Born of Retrenchment," the latter on the opportunities for improved plant piping and the former an illustrated check-sheet to assist in locating piping in need of modernization.

Piping. Taylor Forge & Pipe Works, P.O. Box 485, Chicago, Ill.—8-page booklet describing the design of welded piping installations.

Plastics. American Catalin Corp., 230 Park Ave., New York City—Booklet describing the properties of this company's cast plastic material, Catalin.

Power Generation. The Elliott Co., Jeannette, Pa.—Bulletin H-8—4 pages on mechanical-drive turbines with built-in reduction gearing.

Power Transmission. D. O. James Mfg. Co., 1114 West Monroe St., Chicago, Ill.—48-page catalog describing spiral bevel gear reducers and spiral bevel gears, with prices and engineering data.

Power Transmission. Poole Foundry & Machine Co., Woodberry, Baltimore, Md.—General Catalog on single, double and triple herringbone-gear units with complete engineering data on each type.

Proportioning. Proportioneers, Inc., 737 North Michigan Blvd., Chicago, Ill.—8 pages describing improved proportioning equipment of various types supplied by this company for the feeding of reagents.

Pumps. DeLaval Steam Turbine Co., Trenton, N. J.—Reprint of an article comparing the merits of seven kinds of pumping equipment.

Refractories. McLeod & Henry Co., Troy, N. Y.—16-page booklet describing this company's refractories and refractory cements including its new "Steel Mixture" Oil Brand firebrick for use in oil-fired furnaces at temperatures up to and in excess of 3,000 deg. F.

Refrigeration. The Elliott Co., Jeannette, Pa.—Bulletin G-4—4 pages on this company's vacuum refrigeration equipment for use in process cooling and air conditioning.

Refrigeration. The Hill Mfg. Co., Monadnock Bldg., Chicago, Ill.—Looseleaf pages describing this company's automatic separator for non-condensible gases in refrigeration systems.

Screens. International Nickel Co., 67 Wall St., New York City—8 pages on the use of Monel and nickel wire cloth in a wide variety of industrial applications.

Standards. American Standards Association, 29 West 39th St., New York City—44-page 1932-3 Year Book of the American Standards Association, listing both approved American Standards and uncompleted projects, with prices for each standard.

Tanks. Riverside Boiler Works, Cambridge, Mass.—Folder describing various types of storage tanks fabricated by this company in ferrous, non-ferrous and other corrosion-resisting metals.

Welding. Linde Air Products Co., 30 East 42d St., New York City—16-page book on the use of oxy-acetylene welding for general maintenance.

PLANT NOTEBOOK

Curing a Difficult Expansion Problem In a Low-Pressure Gas Scrubber

By Bernard Kramer
Mechanical Engineer
Pittsburgh, Pa.

STRAIGHT volumetric expansions and contractions of solid bodies due to temperature changes are comparatively easy to foresee and to guard against in engineering equipment. But it is more difficult to take care of differential expansion, where different parts of the same unit do not expand and contract equally, or at the same time. The uneven cooling of castings, for example, may result in cracks or cause unsuspected, damaging strains that will eventually give trouble. The connection of a series of tanks to a common header without proper provision for flexibility will often result in damage to the piping or to the tank nozzles.

The case here described, showing how the effects of differential expansion were counteracted by means of a one-piece, plate expansion joint, is rather special but typical in its kind. It is that of a vertical riser, or downcomer pipe alongside of a gas-scrubbing, purifying, or cooling tower (Fig. 1). The gas enters the lower end of the tower where it passes upwards through a system of hurdles over which an absorbing medium is sprayed. The gas outlet, near the top of the tower, is connected to a downcomer pipe which, if more than one absorber is used in series, joins the inlet header as shown in the figure.

Since both the tower and downcomer pipe are constructed of the same material, it is assumed that they should expand and contract equally. As a rule there are no appreciable variations in temperature of the gas through the scrubber and outlet pipe so the assumption is correct as long as the tower continues in good operating order. However, the hurdles eventually become clogged by impurities in the gas, and the tower has to be shut down for cleaning.

It is at this stage that the trouble begins. When steamed, the tower shell expands while the downcomer remains cold. Such towers are sometimes built as high as 100 ft., and the expansion during the steaming period would tend to lift the downcomer off its base, straining and distorting the outlet nozzle on the tower. Of course, this condition can be counteracted by steaming the riser pipe also and in some plants an open steam branch line is provided to make sure that in steaming the clogged hurdles, steam will be admitted also to the gas outlet pipe.

Even this arrangement, however, cannot be regarded as a positive remedy because the large tower filled with plugged hurdles cannot heat up as quickly as the comparatively small outlet pipe. Hence the latter expands ahead of the main tower with results almost as damaging to the outlet neck. This situation would be exaggerated on cooling.

A slip expansion joint would eliminate all uncertainties but the regular commercial type would be quite costly and bulky especially in the large sizes. Following is a description of a special joint made entirely of steel plate, riveted or welded. Fig. 2 shows a typical enlarged section and details. The outer rim may be made of a flanged steel plate or a 5 in. or 6 in. light channel bent to shape. The two disks, from two to three times the diameter of the pipe, are made of soft steel about ⅛ in. thick. A guide sleeve is welded to the upper pipe terminal and is allowed to slide freely in the lower. The joint is placed near the outlet nozzle so that only a small portion of the pipe is suspended from the neck. Saddles and straps hold the riser pipe to the tower shell somewhat loosely to allow for a free up-and-down movement.

Expansion joints of this type have been made to work successfully in many sizes ranging from 12 to 48 in. They have also been used in horizontal runs, but in that position a valve or cock should be provided at the low point to permit the draining of moisture. Where there are solids in suspension, a handhole is provided. Of course, this joint is only suitable for low-pressure gas work, or occasionally, low pressure or exhaust steam. It cannot be used in medium- or high-pressure lines, nor would it be suitable for piping to convey liquids.

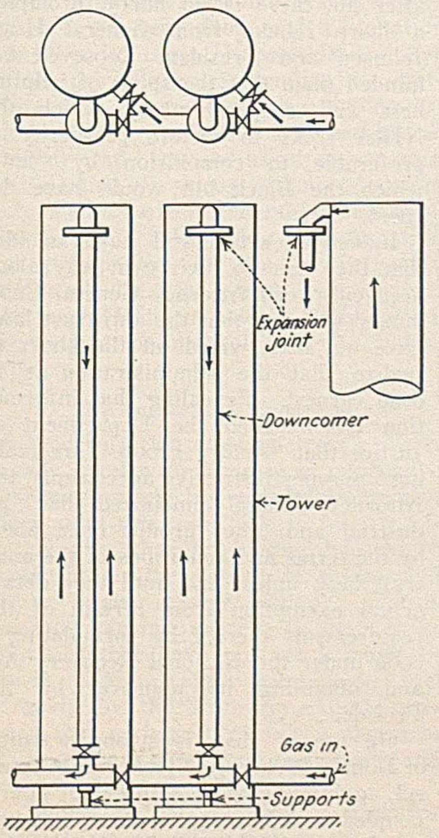
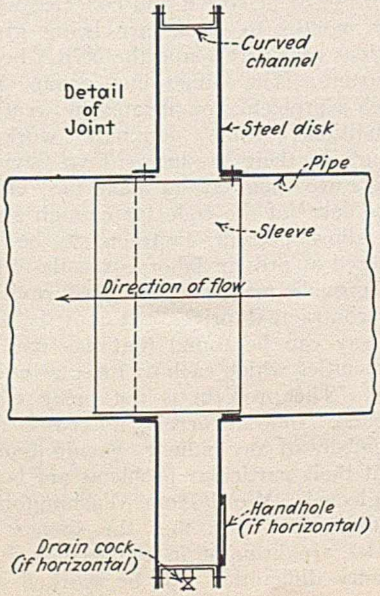


Fig. 1—(Left) Gas scrubbers with downcomers

Fig. 2—(Below) Detail of plate-type expansion joint



WHAT THE NATIONAL INDUSTRIAL RECOVERY

THE National Industrial Recovery Act became a law on June 16. It remains in effect two years, unless the President, by proclamation, declares the "emergency" of the depression past. It authorizes industry to organize, to proceed with agreements under a virtual suspension of the anti-trust laws, to control the fair competition within their groups by all types of cooperation and discipline of members of the group, and, what is more important than all from the Administration viewpoint, to fix minimum wages and maximum hours of work. It is a labor bill, frankly, to put 12,000,000 men back to work, to shorten hours, to raise pay. This is to be done through codes of fair competition submitted and approved by industry, or by agreements between unrelated elements of an industry or, these failing, or being unduly delayed, by a system of licensing which would close all the industries of the country, large and small, unless they are directly licensed by the President.

There have been many developments in the few weeks that the NIRA has been in effect. Many of these came out during the hearings on the first code, that of the cotton textile industry; others were decided upon in the course of the discussion of forthcoming codes with the staff of the NIRA.

Plant Modernization

Among others, the question of modernization and replacement of obsolescent machinery has been brought up. The cotton textile code provides that machinery may be replaced, but no new machines put in without special authority from the committee watching over the industry under the provisions of the code. General Johnson has stated at various times that machines should not be put in order to throw men out of employment; the issue apparently remains open as to whether they cannot be installed (as replacements) to increase the production of the factory under its limitations of machine hours. In the cotton textile industry this was 80 machine hours a week, but this is not final for all industrial groups by any means. The battle over the rights of machines to raise purchasing power by reducing the costs of products is still on.

Wage scales are causing some inquiries and difficulties in the specialized industries. There have not yet been enough decisions, but it seems likely that there will be some recognition of the four classes of workers suggested by one of the witnesses at the cotton textile hearings, that is, unskilled, semi-skilled, skilled and highly skilled. There is great fear, however, that if minimum wages are set for various classes of labor that these minimums will tend to become maximum wages; it is expressly provided in the law that this must be avoided.

It is interpreted that the provisions for a minimum wage establish a guaranteed minimum rate of pay per hour of employment regardless of whether the employee's compensation is otherwise based on a time rate or upon a piece work performance. This is to avoid frustration of the purpose of the code by changing from hour to piece-work rules.

Foreign Competition

The competition of foreign goods, which may be dumped in the United States as a result of the increased costs due to higher wages and shorter hours, is provided against by what is virtually a quota system where such dumping is threatened. It is to work, however, only for those industries which file their codes, and if industries who delay filing are forced to raise wages because plants in the same towns raise theirs under codes, they will have no more protection than they now have, against dumping. It is another of the baits to bring in the apathetic—if there *are* any after the government gets through with its sweeping-up campaign.

Industries which have a long period between the start of production and delivery, and therefore contracts which will not be delivered and collected upon for months to come, are being given serious consideration at the NIRA headquarters. The limestone group has such a problem, complicated by weather conditions which dominate working hours in their product. Two obvious ways are open, one to make the "effective date" of the code far enough away to allow present contracts to be delivered at present labor costs, the other to provide machinery for the revision of contractual prices. It may be that a way can be found that has not the difficulties which each of these solutions has. The problem is not being overlooked. Indeed, there is no reason that members of any industry should assume that their particular problems are being neglected. Word from Washington is definite, however, that the sooner the codes are brought in the earlier these knotty difficulties will be worked out. No issue to going to be solved in theory; there is no time for that. The need of an early submission of draft codes, in order to make specific industry problems practical instead of merely theoretical for the NIRA, is important.

It is pointed out in every communication from Washington that the demand at the beginning is for simple codes dealing with labor and "chiseling" problems, and over as large groups as possible. Beyond that, other codes, and specific codes for subdivisions of industry, should be pushed in to Washington. Hearings will be increased in number so that the decisions may be made and the men put back to work. Prosperity is the slogan and good wages and high purchasing power (with time to spend it, due to shorter work hours) the first goal. The bribe is opportunity to organize, to iron out innumerable difficulties under which industries have been smarting for years, and to put American industry back on its feet.

All Industries Must Join

Although industry is expected to respond voluntarily, the invitation to join the NIRA cannot be refused. The attitude in many industries, after the first panicky sensations wore off, that, after all, there is no hurry, prompted a sharp rebuke from General Hugh Johnson and President Roosevelt reminded them that the spirit of helpfulness and cooperation by which the NIRA seeks to restore prosperity is preferable to compulsion by "fiat," which the Black bill would have decreed.

Industries which still have an idea that they can go their own way alone need only read Attorney General Cummings' warning that the anti-trust laws have not been wiped off the books to realize that the administration is in dead earnest. Revealing that information has reached the Department of Justice that "sundry groups" are making improper restrictive agreements, the Attorney General announced that "industrial and other groups must abide by the terms and conditions of the anti-trust laws unless and until they obtain actual exemption from certain of the requirements thereof by formulating a code under the National Recovery Act and obtaining its approval by the President."

On top of that, is strong warning of Donald Richberg, NIRA's chief counsel, against the waste of previous hours, coupled with objurgation that if industry lags and NIRA fails, the advance of political control of private industry is inevitable.

The disposition in numerous industries to mark time may be explained to some extent, however, by the inability of General Johnson's staff to answer many perplexing questions and a natural desire to see how the cotton textile code finally turned out. General Johnson and his deputies have emphasized repeatedly that the textile code should not be regarded as a pattern and that the standards of minimum wages and maximum hours established therein should not be taken as acceptable to the Recovery Administration for all industries.

General Johnson's organization hopes to avoid in the subsequent codes any territorial wage differentials. The preferred alternative is a wage basis determined roughly by the density of population, regardless of industrial lines, as this is reflected in living costs. The wage paid for unskilled labor in a city of 1,000,000 would be higher, for example, than in a smaller city or town, and the rate in rural districts would be lower.

The limitation on machine hours which, in the textile code, is fixed by two 40-hour shifts a week, is not regarded as a precedent for other industries. Johnson's organization wants, in fact, to get away from such a limitation in other industries, if possible, and also from price-fixing, as tending to interfere with economic forces. Selling below cost of production will become an unfair trade practice in all codes; open publication of prices without revealing the identity of customers, is welcomed, but absolute price-fixing and allocation of production will not be favorably entertained except where it appears to be unavoidable in order to stabilize the operations of natural resource industries.

No Increase in Capacities

Modernization of plant doesn't necessarily involve an increase in productive capacity on which General Johnson also frowns at this time. He is frankly apprehensive that production boosted to cash in on the upturn in prices will leave buying power behind. This is already causing concern in several industries that have not yet brought in their codes. They have been told frankly by the Recovery Administration that perhaps the fault is theirs in failing to act quickly on their codes and establish discipline in the ranks.

Industries that are hanging back for fear that they will lay themselves open to foreign competition or that they will run afoul of state laws are assured that they will be protected; that, if necessary, the operative date of their codes will be postponed until protective measures are applied. The Recovery Administration has established a close liaison with the Tariff Commission and also with state attorneys general.

Sitting down to write a code is a mean job but becomes a much easier task if organization of the industry is accomplished first. If that effort goes to smash, action by any group will be sufficient to bring the others into line eventually. General codes governing maximum hours and minimum wages for an entire industry may be supplemented by codes dealing with the peculiar conditions or problems of the branches of the same industry.

All that is expected of an individual manufacturer, in the first instance, is to join his association or establish contact with the group that is taking the initiative in his industry. Number as well as volume will be considered by the Recovery Administration in determining whether a group is truly representative. An individual manufacturer may take sides if there is a split on some provision of the code to be presented to the Administrator. After a code has been submitted, he will be given a hearing, even if he doesn't represent any other viewpoint than his own, provided that he also files a brief. Eventually, he must subscribe and adhere to the code, as approved by the President, or continued operation will be subject to license.

It is expected that other industries will follow the lead of the cotton textile industry in continuing, as a "planning and fair practice agency," the committee that drafts its code. By this means, it is anticipated that codes will not only be enforced but that adjustments may be made from time to time to meet changing conditions. The textile committee plans, for example, to keep a "live" record of statistics and accounts so that data may be available immediately when changes in working hours, wages, or other provisions of the code seem to be warranted; to aid in engineering and service to small units; to cooperate with the Recovery Administration in exchanging price information for the purpose of exposing chiselers; to regularize credit practices for the benefit of small as well as large plants; to iron out other inequalities that may arise; and to keep a weather eye on the seaboard for evidence of detrimental competition from imports.

The Recovery Administration's thinking tends to erase the demarcations between industries and between trades, in considering the welfare of workers. The tendency is to classify and group industries as their employment problems are related.

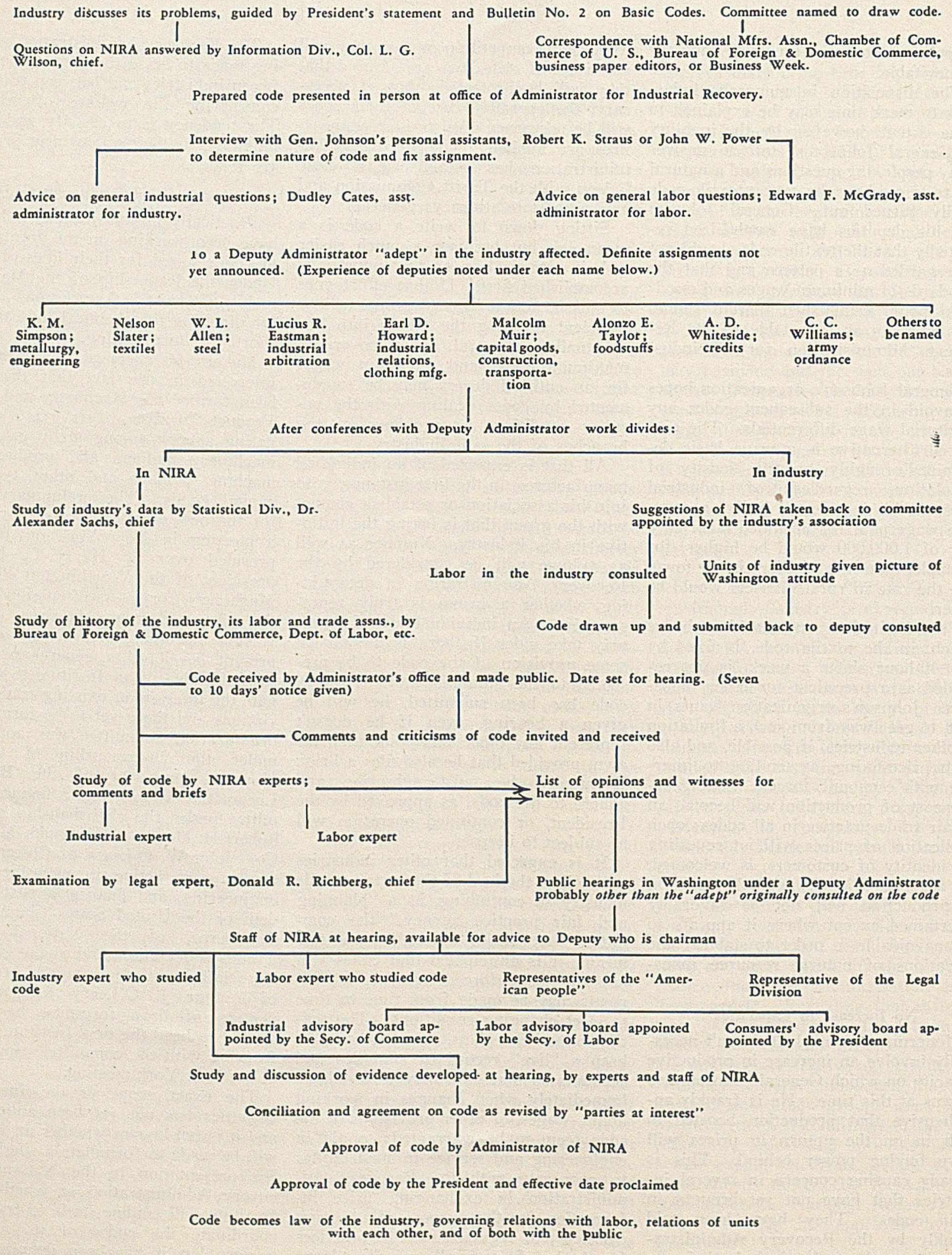
Chemical and Equipment Codes

Practically all the leading industries have been working on the formulation of codes suited for their lines of trade. Under the leadership of the Manufacturing Chemists' Association, a plan for directing the chemical industry will shortly be forthcoming.

Makers of chemical equipment are interested in the fact that there has been formed the Machinery and Allied Products Institute, to serve as a coordinating agency among many groups of machinery builders and producers of machine supplies and other types of capital goods. The preliminary plans for the new organization were made at a meeting in New York on June 23 presided over by Harry C. Beaver, president of the Worthington Pump & Machinery Corp. As discussion among the sixty-odd representatives of the various machinery and allied industries present developed a general sympathy with the idea of an Institute to coordinate the interests of existing trade associations and those yet to be formed, an organization committee was appointed under the chairmanship of George Houston, president of the Baldwin Locomotive Works, and a finance committee under the chairmanship of Col. Robert H. Morse, of Fairbanks, Morse & Co. John W. O'Leary of Chicago, for many years active in manufacturing, engineering, and finance, a past president of the United States Chamber of Commerce, of the National Metal Trades Association, and of the Chicago Association of Commerce, and president of Arthur J. O'Leary & Son Co., makers of drop forgings, has been elected to head the new Institute and is working with the committees appointed at the New York meeting.

The exact scope of the Institute's activities has not yet been announced, and it is not known whether an attempt will be made to formulate a single code for presentation to the National Recovery Administration or whether the Institute will confine itself to trying to coordinate the codes of its member groups, but it has been definitely determined that the new body will take the form of a federation, and that membership will be open to trade associations only.

Flow Chart of Typical Code Through Set-up of the National Industrial Recovery Act



Note: Unless terminated by a proclamation of the the President that the "emergency" is past, the code remains in effect until June 15, 1935, when it expires. The period of the legislation may be extended by act of Congress.

Reproduced from Business Week

NEWS FROM WASHINGTON

By PAUL WOOTON
Washington Correspondent of Chem. & Met.

POLICIES of the Tennessee Valley Authority on fertilizer manufacture and on the generation of power have not yet been delineated. The board's disposition is to step lightly on such a vast scheme of planned economy. Its object is to wed agriculture and industry and its thought is not to push the development of either beyond the other or to let exploitation of the valley's resources outstrip the market.

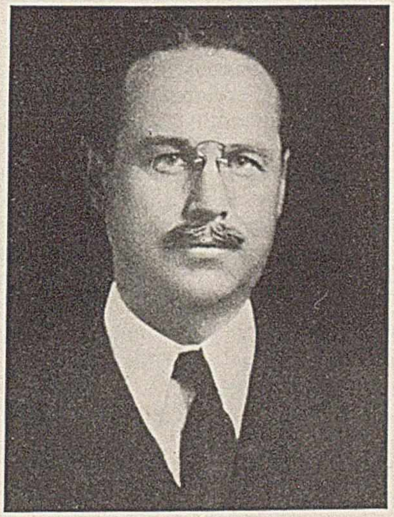
The economic aspects of the experiment are subordinated by Dr. Arthur E. Morgan and his associates on the board to the social advancement of the valley's 6,000,000 population. Dr. Morgan is annoyed by the "boom" that land speculators are promoting and the board's reticent, deliberate attitude may be attributed partly to the desire to discourage such unhealthy, and almost invariably self-destructive activity.

Dr. Morgan insists that the Tennessee Valley development is not part of the administration's emergency program of which speed is the essence and so far the White House has not intervened.

If the board is not rushing forward with far-flung plans, it is not because it doesn't have its goal clearly in mind or that it does not see a market for more power, more fertilizer, more of everything. Dr. Morgan is not disconcerted by the great over-capacity of the fertilizer industry today. There may be over-production of fertilizer at a cost of, say $90 a ton for the ammonium content but, he remarks, if the cost can be cut down to possibly one-third of that figure, a market is available that fertilizer at its present price cannot touch because of the small margin.

The board's policy on fertilizer manufacture will wait, however, until it has scientific data on which to move. As Dr. Morgan remarks, a plant might be obsolete before it is finished, if it is built before processes are perfected. The board has initiated studies with reference to the manufacture of phosphoric products. In the disposition of nitrate plants No. 1 and No. 2, the board may elect any one of 4 alternatives: It may lease the plants, may use them as is, may renovate and use them, or keep them in stand-by condition.

Doubt is expressed by Dr. Morgan whether the Swann Corp., of Birmingham, would build a fertilizer plant, as proposed in its recent offer to the board, until it knows whether the board is going to build. Dr. Morgan has discussed with Theodore Swann the offer made several weeks ago to transfer to the Valley Authority title to two power sites on the Nolichucky and Hiwassee rivers in southeastern Tennessee in return for power to operate a plant that the company would erect on a leased site on the Government reservation at Muscle Shoals. The board is running back the corporation's title to the land and appraising the value of surrounding land but this, according to Dr. Morgan, does not indicate any intent by the board to accept the offer. Superficial examination of the price of $1,300,000 quoted by the corporation seems high, in Dr. Morgan's opinion. If the board should accept the offer, the reason would be that there is an excess of power at present. The Swann Corp. has offered to take payment for the power sites in current delivered at the rates set for other industrial customers.



Malcolm Muir

Mr. Muir has accepted an appointment as deputy administrator in the National Industrial Recovery Administration. Mr. Muir, a former business manager of *Chem. & Met.*, has been president of the McGraw-Hill Publishing Co. from 1928 to date. He is past president of the Associated Business Papers, was a member of the National Committee for Industrial Rehabilitation and chairman of its New York board. He also is a director of the National Publishers' Association, the American Arbitration Society, the Advisory Board of the Army Ordnance Association for the New York district, and the Merchants Association of New York

The Valley Authority is still engaged in determining where it stands with reference to federal and state laws and in formally effecting the transfer from the War Department of the property at Muscle Shoals and the civilian staff. The only project in the immediate foreground is Cove Creek dam but it will be 6 months or more before construction commences. This $34,000,000 job will spread over a 4-year period. When completed by the Army Corps of Engineers this month, the plans will be forwarded for review to J. L. Savage, chief designing engineer of the U. S. Reclamation Service.

Illinois Adds to A.I.Ch.E. Accredited List

THE University of Illinois becomes the twenty-first institution on the list of schools and colleges whose chemical engineering courses have been accredited by the American Institute of Chemical Engineers. This announcement was made in Chicago on June 14 by Dr. Harry A. Curtis, chairman of the committee on Chemical Engineering Education, who reported that as a result of recent changes in curricula and organization, Illinois now met all of the requirements of the Institute and has been accorded a favorable vote.

The Chicago meeting of the committee also gave considerable attention to the subject of laboratory instruction in chemical engineering. Considerable divergence of opinion regarding details of methods and equipment was evident as a result of the discussion. There was a corresponding difference in view regarding the purpose and type of laboratory manual best suited for chemical engineering instruction. The meeting went on record as favoring a symposium at which the whole subject of chemical engineering laboratory work might be discussed by leaders in chemical engineering education and industry.

Glidden Wins Decision In Duco Case Appeal

ON July 10 Judge Learned Hand for the Second Circuit Court of Appeals handed down an opinion reversing Judge Campbell in the Brooklyn District Court in the now famous Duco case. The plaintiff appellant was duPont and the defendant appellee was the Glidden Company.

Judge Campbell decided that the Flaherty patent on which the case was finally tried in the lower court was invalid for lack of invention. To support this finding he stated that it was clearly proved that the relationship between the viscosity of the cotton and the thickness of the coating of lacquer made from the cotton was well known before Flaherty's disclosure.

NEWS FROM ABROAD

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

London

THERE SEEMS to be quite a healthy undertone in the chemical markets. The best evidence of this may be found in renewed activity which manifests itself in new products, contributions for the technical press, increased advertising and more optimistic company reports and speeches foreshadowing development and extensions of plant. The Technical Societies and Institutions are also active, and among these may be cited the Food and Plastics Group of the Society of Chemical Industry, whose meetings are given wide attention.

The annual report of Imperial Chemical Industries is satisfactory reading, and on this occasion Sir Harry McGowan displayed unusual optimism, supported by an increased dividend. The business of this concern is definitely improving, although there is still a long way to go before its nitrogen business can be considered satisfactory, or likely to enable the company to write off in a reasonable time the heavy depreciation in the value of its Billingham factory. Another disturbing factor in the balance sheet is the depreciation of £4,000,000 in the value of marketable and other investments, but against this the reserve of nearly double this amount may fairly be set off.

Attention was drawn to the prospects of the research on the direct hydrogenation of coal which is being actively pursued, but it is too early to say whether it is feasible to bring this development to a stage when it can really be economic, and it seems difficult to believe that this, any more than low temperature carbonization, can ultimately become a basic industry.

The appeal of British Celanese against the verdict given in favor of Courtaulds, Ltd., in the rayon patent dispute was before the Court of Appeal for about three weeks during May, and the judgment which was delivered on June 26 was on lines which had been generally expected, the appeal being dismissed with costs. Notice has been given since for a further appeal to the Supreme Court in the House of Lords, where five judges will be called upon to review the unanimous verdict of the four judges who have already given the case the closest attention, and it seems somewhat unlikely that British Celanese can save anything from the wreck.

During the present hearing, which proceeded on lines similar to those in the Lower Court, British Celanese, Ltd., abandoned their appeal in respect of patent No. 203,092, which dealt with means for ensuring uniformity in spinning conditions. This patent accordingly stands revoked, as well as the other patents abandoned at the first hearing, so that the case which goes to the House of Lords has now been narrowed down to the cap spinning and lubrication patent No. 198,023 and the dry spinning, evaporating and outside winding patent No. 165,519.

New types of acid resistant linings for chemical plants are now marketed in this country by H. Windsor & Co., Ltd., with considerable success. These include tiled flooring, storage tanks of special interlocking construction and various putties, cements and lacquers, which apparently enable concrete, metal and wood structures to be lined to resist any acid, alkali or oil risk.

Considerable attention has been aroused by the report of a new bleaching process developed by the Wool Industries Research Association. This has been adopted by some of the largest textile firms in the country, and is apparently being kept a secret, and for the use of British members of the association only, who are able to obtain licenses. The main feature is permanent whiteness of woolen material and improved laundering, apparently obtained by special control methods.

Berlin

THE annual meeting of the German Chemical Society in Würzburg was affected by the National Socialistic revolution. As a representative of the party in power Dipl. Ing. Feder stated as follows: "It is a regrettable fact that in this age of modern technical development the chemist and the technician have allowed the parliamentary system of government to take away from them the control of state and commerce." "It should be welcomed," he stated, "that the German Chemical Society, after the coup d'etat by Adolf Hitler, had been able to read the signs of the times and was ready to cooperate in the development of a national government. In protection against aerial attack and in many other fields the German chemist had an important national political task."

In the Dechema group, Direktor Plinke spoke about a new ceramic material of greatly improved strength, the composition of which was not given. Deutsche Ton-u. Steinzeug A.-G., Berlin, builds pumps and similar apparatus with this material; these are not protected by the cast iron armor generally used for such equipment. This armor adds to the cost and is also subject to corrosion. The new material has also unexpectedly shown high resistance to temperature changes. A small centrifugal pump, a fan, and a screw pump designed for the textile industry have been made, and the new material will later be used for larger models.

Dr. Bergius, Heidelberg, spoke about production of sugar from wood by his hydrolysis method, according to which cellulose, hemi-celluloses, hexosane, and pentosane are hydrolyzed by treatment for a few hours with 40 per cent hydrochloric acid. The acetic acid formed is also dissolved and may be separated from the hydrochloric acid by a special process, the latter being used in the subsequent cycle for treatment of more wood. Hundred parts of dry wood yield 66 parts of sugar and 4 parts of acetic acid, the remainder being lignine. Dry sugar, obtained by atomizing the sugar solution in a drying apparatus, is used for cattle feed. A brief heating of the sugar changes the polymeride components into monomerides, which may be fermented. Bergius emphasizes that this sugar may efficiently be converted into alcohol (35 liter per 100 kg. dry wood); into yeast used for feeding purposes, which is of great economic importance, as it takes the place of imported proteins; or into organic acids. Wood sugar may be crystallized as glucose, a simple method of obtaining this compound in chemically pure state. The glucose may also be obtained in partly polymerized state as glucose syrup, which is used in the food and textile industries. In addition, pentroses are formed, which in pure state are used as food by diabetics.

Prof. Rassow spoke on the Scholler-Tornesch method of producing alcohol from wood. Whereas Bergius obtains 35 liters of alcohol from 100 kg. dry wood, this method, which treats much more dilute solutions, gives only 24 liters. Combination of the method with processes for recovering tanning extracts appears promising and should permit the use of German woods, which at present, owing to their low content of tannin, cannot compete.

A continuous method of producing gas without making any coke, capable of meeting great fluctuations in operating conditions, was discussed by Prof. Drawe, Charlottenburg, at the Weimar meeting of German Gas and Water Engineers. It operates at high pressure, with addition of oxygen during the gasification. About 90 per cent of the calorific value of the raw material is available. Careful tests show that oxygen may be produced at a cost of 0.016 Rm. per cu.m.

Paris

SINCE the recent Gas Congress the introduction of butane has been much discussed in France. This is extracted from American natural gas and sold in 25-kg. flasks containing 15 kg. butane, which, with a colorific value of 12,000 col. per kg., corresponds to 35 cu.m. coal gas of 4,500 col.

It may be recalled that coal gas, prepared by distillation of coal and with a yield of at least 30 cu.m. per 100 kg. coal, has, in pure state, a calorific value of 5,200-5,500 col., according to the quality of the coal and the method of distillation used. Yet, in most contracts made by gas companies, with municipalities of the large cities at least, the calorific value is specified at 4,500. This value has been adopted to permit adding to the pure, rich coal gas, water gas made from coke, in order to utilize this byproduct which is difficult to sell, and also to keep down imports of coal. This addition of water gas has been developed since the war; it is regulated to bring the calorific value down from 5,200 to 4,500. Such reduction in calorific value has also permitted the removal of benzene from the gas, a method first used during the war to produce the benzene required for production of explosives, which has now become compulsory, in the larger gas works at least. About 15,000 tons benzene are thus produced, of a total of 80,000 tons, of which 65,000 tons is used for production of a domestic fuel by mixing with anhydrous alcohol.

At this point may be mentioned a new process announced by M. Jarry at the Sté d'Industrie Minérale for extraction of phenols from coal-tar by use of liquefied ammonia. The tar is mixed vigorously with the ammonia and then allowed to separate. The top layer contains the excess ammonia with dissolved phenols and the lower layer the hydrocarbons with about a fifth of the ammonia used. This done, it is of advantage to wash the upper layer with butane or some other light hydrocarbon in order to eliminate all hydrocarbons which may yet be dissolved. After evaporation and recovery of the ammonia the phenols are obtained in pure state and may be used directly for manufacture of synthetic resins. As for the hydrocarbons of the wash, which contain the hydrocarbons of the tar, these may be utilized for fuel for explosion motors.

Work to Start on Corpus Christi Alkali Plant

ANNOUNCEMENT was made the latter part of last month that work would start at once on the erection of a plant for the Southern Alkali Corp., at Corpus Christi, Texas. Southern Alkali Corp.—a joint project of American Cyanamid Co. and Pittsburgh Plate Glass Co.—made public more than a year ago its intention to establish an alkali plant in Texas but owing to industrial conditions the carrying out of the project was deferred until the present.

The site for the plant, which will cover approximately 350 acres located directly on Nueces Bay, has been purchased. After the port dredging has been completed a dock will be constructed (contract already let to be handled by The Nueces County Navigation District) to provide a direct deep sea port. Already under lease are 6,000 acres of gas land within a few miles of the plant location, guaranteeing an almost unlimited supply of gas for many years.

The salt brine supply will be furnished by The Palangana Salt Dome, located about 60 miles away, and will necessitate the construction of a 12-inch brine line from the Dome into the plant site at Corpus Christi. This line has already been surveyed, and together with the gas lines, will be handled by a company under the name of The Southern Pipe Line Corp., already organized.

All of the engineering and designing for this plant has been carried out by The Southern Alkali organization, with headquarters in Barberton, Ohio. (The Columbia Chemical Co., division of The Pittsburgh Plate Glass Co., is also at this location.) The field engineering will be handled by The H. K. Ferguson Co. of Cleveland, under direction of Southern Alkali Corp. engineers.

Total expenditure will approximate $7,000,000 and plans call for the plant to be in operation late in 1934.

Arrandale Wins Chemical Engineering Prize

THE winner of the American Institute of Chemical Engineers' annual prize and an honorarium of $100 for his solution of a chemical engineering problem in the national contest, is Roy S. Arrandale, twenty-one years old, of Streator, Ill., according to Dr. L. A. Pridgeon, chairman of the Institute's Contest Committee. W. M. Yates, of Washington University, St. Louis, and F. C. Schroeder, Iowa State College, were awarded second and third prizes and honorariums of $50 and $25 respectively.

Commercial Solvents Bids For Rossville Business

IN A letter to stockholders issued under date of June 28, H. I. Peffer, chairman of the board of Rossville Alcohol & Chemical Corp. stated that an agreement has been entered into between Commercial Solvents Corp. and Rossville Alcohol & Chemical Corp. providing for the sale, to Commercial Solvents, of Rossville's industrial alcohol business, the New Orleans plants, the plant of the California subsidiary and certain of the current and working assets of the corporation and its subsidiaries, including inventories. In consideration for these assets, the agreement provides that Commercial Solvents will pay to Rossville 105,000 shares of Commercial Solvents stock and cash in the amount of the book value of the current and working assets to be sold.

The assets of Rossville and its subsidiaries, not covered by the agreement with Commercial Solvents, comprise principally cash, notes and accounts receivable, and the plants at Lawrenceburg, Ind., and Carthage, Ohio, and certain other facilities which may be adaptable to the manufacture and sale of alcoholic beverages.

A special meeting of the Rossville corporation has been called for July 18 at which time stockholders will take action on the proposed sale.

Code for Fertilizer Industry Discussed at Convention

LEADERS of the fertilizer industry from all parts of the country assembled at White Sulphur Springs, June 19-21 to attend the annual convention of the National Fertilizer Association. The provisions of the National Industrial Recovery Act and the formulation of a code for the fertilizer industry occupied a prominent place in the discussions of the convention.

The board of directors was raised from twenty-two to thirty-three, in order to provide representation for the smaller units in the industry through two members from each of the eleven districts in addition to the eleven directors chosen at large by the association as a whole. All restrictions on membership were removed, so that a properly filled application blank provides automatic membership without approval of the directors.

John J. Watson of the International Agricultural Corporation, New York, was elected president, and C. T. Melvin of the Gulf Fertilizer Company, Tampa, was elected vice-president. Charles J. Brand was re-elected executive secretary and treasurer.

Names in the News

William T. White, formerly a research chemist for the Combustion Utilities Corp., Long Island City, N. Y., is now with the Natural Products Refining Co., Jersey City, N. J.

Howard A. Young, formerly with the Oliver United Filters of New York, N. Y., as sales engineer, is now connected with the United States Rubber Co.

G. H. Clamer, president and general manager of Ajax Electrothermic Corp., has been awarded the honorary degree of doctor of science by Ursinus College. Also he is recipient of the Joseph S. Seaman gold medal for outstanding achievements in the casting industry.

George E. Riches has been appointed manager of the chemical department of the American Agricultural Chemical Co. He will supervise sales of heavy chemicals and insecticides. Mr. Riches graduated from Stevens Institute where he majored in chemical engineering.

John J. Felsecker has been added to the consulting staff of D. W. Haering & Co. of Chicago.

J. F. Walsh, formerly vice-president of the Celluloid Corp. and for the past two years with Arthur D. Little, Inc., Cambridge, Mass., during which period he directed their work for the American Maize-Products Co., has accepted the position of research director of the company with headquarters at Robey, Ind.

P. S. Wilcox, for several years vice-president and general manager of the Tennessee Eastman Corp. of Kingsport, has been elected president.

Horace M. Albright, director of the National Park Service, has resigned to become vice-president and general manager of the United States Potash Co., operating mines and refineries at Carlsbad, N. M. Mr. Albright's resignation will become effective Aug. 9.

William E. Vaughan has resigned his position as instructor in the chemical department at the University of Chicago to accept a research position at Harvard.

Carl B. Everitt has been named superintendent of the Columbia River Paper Mills plant at Vancouver, Wash. He succeeds M. F. Herb who died recently. Previously, Mr. Everitt was associated with the Puget Sound Pulp & Paper Co.

George M. J. Mackay

George M. J. Mackay has been appointed director of research for the American Cyanamid Co. He is a graduate of Dalhousie University, Halifax, N. S., where he specialized in chemistry and physics. His graduate work was done at the Massachusetts Institute of Technology under Dr. A. A. Noyes. Mr. Mackay was appointed research assistant to Dr. Irving Langmuir in 1910, and is at present in charge of the research and development work in the insulation section of the General Electric Company Laboratories at Schenectady.

Edmund L. Lind has resigned his position with the Chicago public school system to accept an appointment as research chemist with the Pure Oil Co.

J. A. Singmaster is visiting Italy, Germany, and England in the interest of clients. He expects to return about Aug. 1.

Fred Weleber is now chief chemist of the Oregon City plant of the Hawley Pulp & Paper Co. He succeeds Ray Schadt.

C. P. R. Cash has joined the executive staff of the St. Helens Pulp & Paper Co., St. Helens, Ore. Mr. Cash came to the St. Helens organization from the Union Bag Co.

James G. Ramsey is now general superintendent of the Everett Pulp & Paper Co. Formerly he had the corresponding position in the Jessup & Moore Paper Co.'s plant. Mr. Ramsey succeeds George MacNaughton.

Lawrence Zeleny has become associated with Visual Display, Inc., at Le Sueur, Minn., as research chemist. Dr. Zeleny was formerly in the division of agricultural biochemistry at the University of Minnesota.

Ray Hatch has become director of research of the Weyerhaeuser Timber Co., of Longview, Wash. He was connected with the Pulp Bleaching Corp. as technical director.

Paul Austin, formerly at the Rockefeller Institute, has transferred his activities to the duPont Experimental Station at Wilmington, Del.

L. F. Deditius, a recent graduate from the University of Illinois, has been employed by the Lubrite Refinery of St. Louis, Mo.

W. M. Hayes has become a research chemist for the Rhinelander Paper Co. at Rhinelander, Wis. He was formerly associated with the Consolidated Water Power and Paper Co.

Arthur L. Halvorsen, formerly vice-president of the Emulsified Asphalt Process Corp., has joined the Barber Asphalt Co.

W. R. Willets, a research chemist with the Western Electric Co. at Kearny, N. J., has resigned to join the Titanium Pigments Co. in Brooklyn, N. Y.

D. A. Wallace has joined the Kraft-Phenix Cheese Co. as research chemist.

Virgil Scarth, formerly at Geneva College, has joined the Derby Oil Co., Wichita, Kan., as chemist.

William Niven has entered the employment of the Great Western Sugar Refining Co. He is in the company's chemical laboratory at Billings, Mont.

CALENDAR

American Institute of Chemical Engineers, fall meeting, Roanoke, Va., Dec. 6-8.

Electrochemical Society, fall meeting, Chicago, Ill., Sept. 7, 8, 9.

American Chemical Society, 86th meeting, Chicago, Ill., week of Sept. 11, 1933.

Technical Association of the Pulp and Paper Industry, fall meeting, Appleton, Wis., Sept. 26-28.

National Metal Congress and Exposition, Detroit, Mich., Oct. 2-6, 1933.

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

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

OBITUARY

William Patrick Ryan, head of the department of chemical engineering of the Massachusetts Institute of Technology, is dead. He died at his home in Wollaston, Mass., on June 1, at the age of 38 years.

Professor Ryan was born at East Medway, Mass., on March 11, 1895, and graduated from Phillips Andover Academy and M.I.T. During the World War he did valuable work in the Chemical Warfare Service. He returned to the Institute in 1920 as instructure at the Bangor Station of the School of Chemical Engineering Practice. Later he served at the Boston and Buffalo stations and in 1927 was promoted to the head of the practice school. Two years later he was placed in charge of the department of chemical engineering at the Institute.

Two of his associates, Prof. Warren K. Lewis and Prof. Harold C. Weber, writing for the *Nucleus,* said, "Those of us who had the good fortune to be associated with William P. Ryan find it impossible adequately to express the feeling of loss which his passing has brought. To us he was a chemical engineer of recognized ability, a wise counsellor, a kind, sincere friend and a man whose generosity, high moral code, and philosophy of life exerted a profound influence on those around him."

Henry M. Toch, president of Toch Brothers, paint manufacturers, and chairman of the board of directors of the Standard Varnish Works, died July 2, after a long illness at his home in New York City. He was 70 years of age.

Mr. Toch was born in New York City in August, 1862, and graduated from the College of the City of New York in 1882. He was associated in business with his brothers, Dr. Maximilian Toch and Frank Toch. An extended illness compelled Mr. Toch to relinquish active interest in the manufacturing enterprise carrying his family name, but he continued to attend to his duties as chairman of the board of the Standard Varnish Works.

Edgar H. S. Bailey, emeritus professor of chemistry and metallurgy at the University of Kansas, died June 2 at his home at Lawrence, Kan. He was 84 years of age.

Dr. Bailey was born in 1848 at Middlefield, Conn. He was educated at Yale University, Strasburg, and Leipzig, receiving his Ph.D. degree from Illinois Wesleyan University in 1883. Before going to the University of Kansas he served as an instructor in the chemical departments of Yale and Lehigh. Although continuing his work at the University of Kansas, he was in 1885 appointed chemist for the Kansas State Board of Agriculture, and in 1899 chemist for the State Board of Health.

Roy B. Robinette, a former president of the National Paint, Oil, and Varnish Association, and vice-president, secretary, and treasurer of the Tropical Paint & Oil Co. of Cleveland, died June 7, at his home in the Ohio city of a heart attack which he suffered several weeks earlier. He was 55 years old.

Mr. Robinette was born in Bedford, Ohio, in 1878. His first employment was in the offices of the Standard Oil Co. In 1903 he became associated with George C. Hascall in a partnership known as the Tropical Oil Co. The company later became the Tropical Paint & Oil Co.

Bachrach

William P. Ryan

Clayton W. Bedford

Edward W. Parks, superintendent of E. S. Parks Shellac Co., died June 28 at his home in Fall River, Mass. He was 42 years old.

Clayton W. Bedford, research chemist for The B. F. Goodrich Co., died June 19 at his home in Akron, Ohio, from complications which followed an operation for appendicitis, several weeks earlier.

Mr. Bedford was born in June, 1885, at New Windsor, Ill. After graduating in chemical engineering from the University of Michigan in 1910 he joined the New York research organization of the Western Electric Co., and later served as instructor in organic chemistry at the Case School of Applied Science. In 1912 Mr. Bedford commenced his work in the rubber industry when he joined the Goodyear Tire & Rubber Co. He transferred his activities to the Goodrich organization in 1922. Four years later he was appointed manager of compounding research, and for the past year and a half he had devoted himself to the development of the cushion used on the new stream-lined autotrams.

Mr. Bedford's death is a great loss to the rubber industry, for he had contributed to many developments, was the patentee of several inventions covering accelerators, and had contributed many articles to the literature of rubber chemistry.

Arthur Lee Browne, a member of the firm of Penniman and Browne, died June 17 at his summer home on the Magothy River, near Baltimore. He was 66 years of age.

Dr. Browne was educated at Johns Hopkins University, where his father was Professor of English. In 1895 he returned to the university as a guest student of the late Dr. Ira Remsen, specializing in organic chemistry, and later served for several years as professor of chemistry at the Baltimore Medical College.

W. Acheson Smith, president of the Acheson Graphite Co. and a vice-president of the National Carbon Co., died July 12 in Johns Hopkins Hospital, Baltimore, Md., after a brief illness. He was 54 years of age.

Mr. Smith was born in Port Jervis, N. Y., and attended the University of Pittsburgh. In 1908 he entered the services of the Acheson Graphite Corp. and remained with this organization until his death, serving in several important capacities before being elected to the presidency. He was also a director of Carborundum Corp. and the Power City Trust Co. of Niagara Falls. During the World War he served on the War Industries Advisory Board. He was a member of the board of managers and a former president of the Electrochemical Society.

CHEMICAL ECONOMICS

Following a rise of more than 12 per cent in May, production of chemicals in June was further speeded up and registered a gain of more than 9 per cent over May operations. June rate of operations not only topped that of June, 1932 by more than 8 per cent but also exceeded that of any month in 1932.

REPORTS of sharp rises in demand for chemicals are borne out by reference to productive activities in the last two months. On a basis of electrical energy consumed, the index of chemical production for May was established at 116.5 or a gain of more than 12 per cent over the preceding month and just over the level reached in May, 1932. Returns for June point to a further expansion in the output of chemicals with the index number climbing up to 125.9 or a rise of more than 9 per cent for the month. This not only represented a gain of more than 8 per cent over the corresponding period of last year but also surpassed the level reported for any month throughout last year.

While the improvement in production in June showed considerable variation with some manufacturers reporting a large increase and others noting only a moderate gain, the general trend of expansion appears to have held true for all divisions of the industry and for all sections of the country.

While data for June manufacturing operations are not yet available, the tenor of reports and estimates has indicated an increase over those of May. Basic industries, such as steel, report a substantial improvement over May and the output of automobiles likewise was on an expanding scale. Textile mills called for larger deliveries of silk in June with a total of 53,627 bales involved which not only was a gain of 6,476 bales over the preceding month and of 16,161 bales over June, 1932, but also was a new all-time high for the month of June. The position of chemicals in June may be inferred from a report issued by one of the largest producers of an extensive line of chemicals, which stated that the tonnage of its products shipped in June was the largest since October, 1930.

Production data for some of the chemical branches and for some of the industries into which chemicals enter as raw materials are given in the following table:

	1933 May	1933 April
Production		
Acetate of lime, 1000 lb....	2,519	2,438
Methanol, crude, gal.......	184,921	174,201
Methanol, synthetic, gal....	366,015	425,333
Byproduct coke, 1000 tons..	1,921	1,656
Explosives, 1000 lb.........	15,781	16,005
Glass containers, 1000 gr...	1,693	1,586
Plate glass, 1000 sq.ft......	7,922	4,680
Sulphuric acid by fertilizer trade, tons.....	90,605	73,900
Automobiles, no.	218,171	180,667
Pyroxylin spread, 1000 lb...	3,920	3,039
Rosin, wood, bbl.	31,045	24,926
Turpentine, wood, bbl.	5,028	3,831
Rubber reclaimed, tons	7,864	4,340
Consumed		
Cotton, 1000 bales.........	621	471
Silk, bales	47,151	41,910
Sulphuric acid in fertilizers, tons	67,162	71,649

With few exceptions the above figures indicate increases in outputs for May compared with the preceding month. The rise in automobile production was an important factor in increasing plate glass output and lends support to reports that consumption of lacquers and certain solvents also was considerably extended in May.

In some instances where production in May was lower than in the preceding month, the inference that consumption was similarly affected does not hold true. For instance, production of synthetic methanol has been held in check in order to cut down stocks and as shipments in May amounted to 761,369 gal. compared with 576,646 gal. propuced, it becomes evident that consumption was on an ascending scale and also that stocks in manufacturers hands were reduced.

The outlook for industry during the third quarter of this year is definitely estimated in compilations made by the thirteen Shippers Regional Advisory Boards who find that freight car loadings for the quarter will be approximately 10 per cent higher than those for the third quarter of 1932.

The movement of chemicals and explosives for the July-September period as indicated by prospective car loadings will represent an increase of 10.9 per cent over the comparable period of 1932. Increases estimated for some of the other groups are as follows: Automobiles, 49.1 per cent; iron and steel, 47.1 per cent; salt 2.1 per cent; machinery and boilers, 22.9 per cent; brick and clay products, 16 per cent; lime and plaster, 11.9 per cent; fertilizers, 14.8 per cent; and paper, paper board, and prepared roofing, 13.1 per cent.

Foreign trade in chemicals and related products has declined this year both as regards outgoing and incoming shipments. Coal-tar products stand out in the export trade as the only group which surpassed the total for last year according to the latest available data.

Import and export statistics for the first five months of the year follow, the totals representing the government groupings of materials classified as chemicals and related products:

Exports

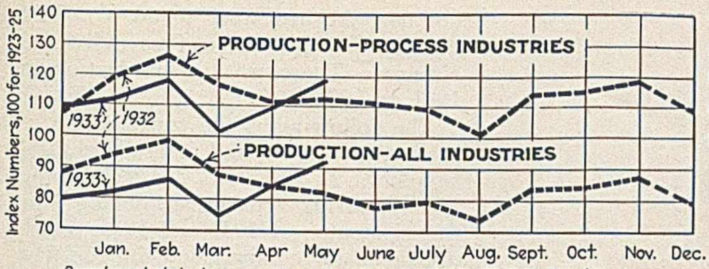
	January-May 1933	January-May 1932
Coal-tar products.......	$5,183,318	$3,753,532
Medicinal and pharmaceutical products......	4,085,293	4,629,014
Chemical specialties.....	4,058,069	4,361,069
Industrial chemicals.....	5,933,034	6,836,018
Pigments, paints, etc....	3,895,876	4,647,636
Fertilizer and materials..	2,407,384	3,723,925
Explosives..............	537,595	551,176
Soap, toilet preparations..	2,063,593	2,784,836
Totals..............	$28,164,162	$31,287,206

Imports

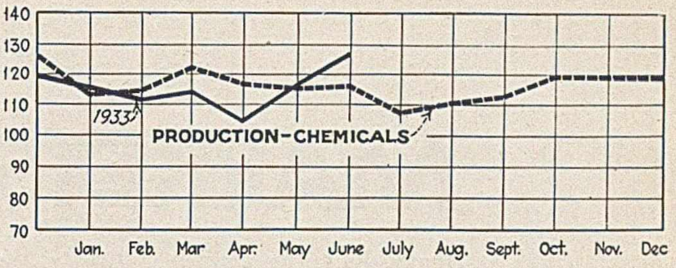
	January-May 1933	January-May 1932
Coal-tar products.......	$3,003,024	$3,857,963
Medicinal and pharmaceutical products......	1,589,812	1,415,419
Industrial chemicals.....	4,416,730	6,434,288
Pigments, paints, etc....	598,865	674,861
Fertilizer materials......	9,118,170	8,843,084
Explosives..............	145,221	255,961
Soap, toilet preparations..	633,589	922,571
Ordinarily dutiable but imported free.........	33,583	44,899
Totals..............	$19,538,994	$22,449,046

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

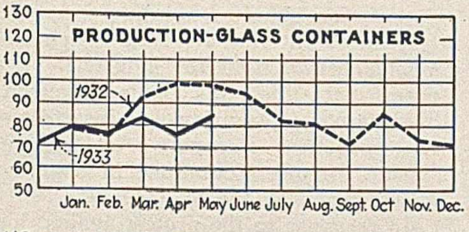
	May
Chemicals	116.5
Glass containers	82.3
Petroleum refined	99.7
Cotton consumed	136.7
Byproduct coke	71.0
Explosives	61.5
Rubber reclaimed	76.6
Plate glass	109.4
Sulphuric acid	59.6

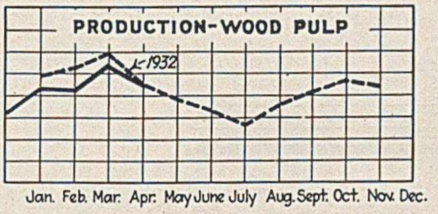


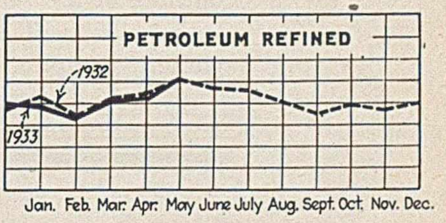
Based on electrical power consumption, data supplied by Electrical World

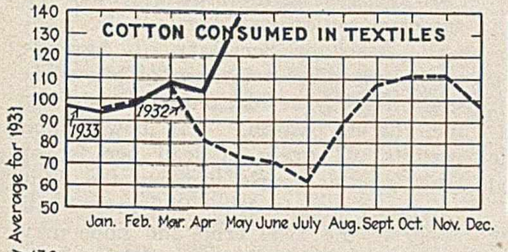


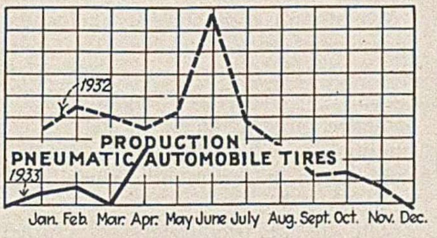
TRENDS OF PRODUCTION AND CONSUMPTION

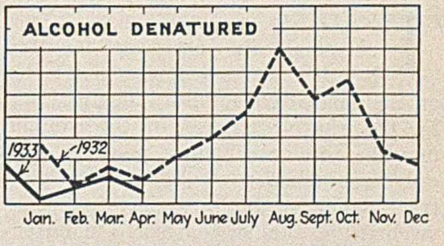


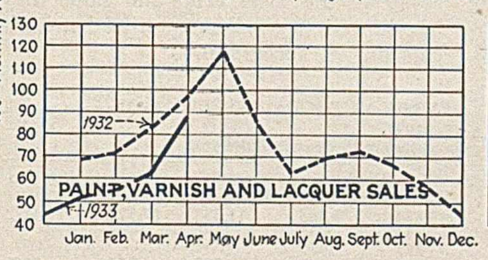


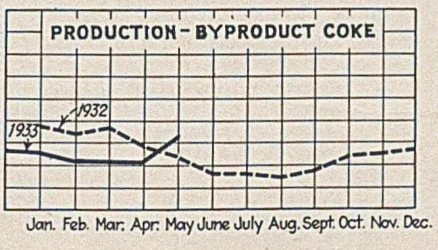


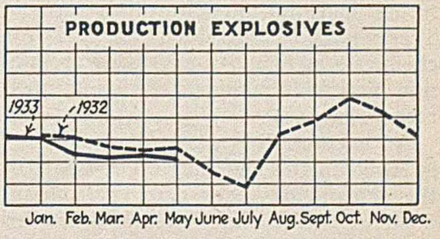


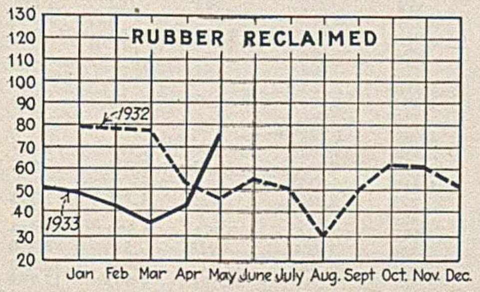


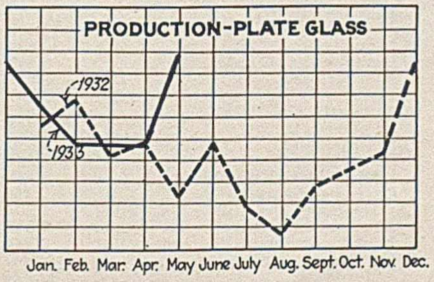


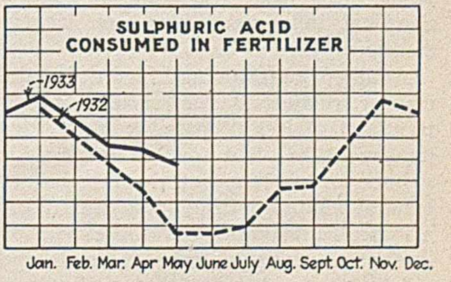


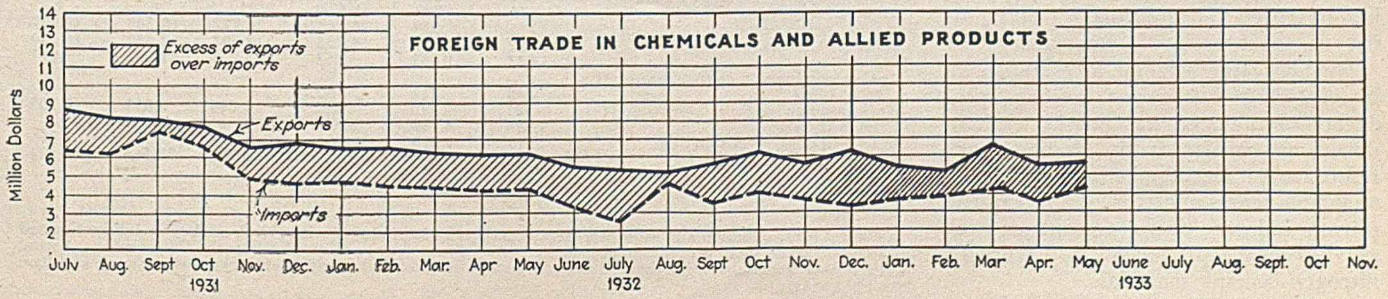












MARKETS

Heavy deliveries against contracts combined with new buying orders brought about a sharp increase in the tonnage movement of chemicals in June with distribution reported to have been in excess of production. The price trend continues upward and as production costs are expected to rise under industry control, the price trend should continue in the same direction. Tariff Commission will conduct hearing on synthetic camphor.

TRADING in the market for chemicals in June was featured by the active call for deliveries on the part of consuming industries and by the sharp increase in the volume moved from producing points. Not only was there a steady call for contract deliveries but new buying orders swelled the total so that some manufacturers had difficulty in filling orders. Trade opinions credited demand for chemicals as being in excess of production with a consequent drawing upon reserve stocks.

An encouraging aspect of the market is found in the fact that a good part of the demand has been coming from industries which had greatly curtailed buying for the last year or more. Seasonal influences have been largely disregarded.

Another outstanding factor in the market relates to the steadily rising trend of prices. Possibly the price movement has had some effect on the volume of trading but the increase in general manufacturing industries offers a logical explanation for the expansion in the movement of raw materials and refutes the probability that recent buying has been for the purpose of building up inventories of materials.

Evidently the attempt to establish an international agreement among producers of nitrogen has not been abandoned as reports from Europe make reference to recent meetings at Ostend at which representatives of the Chilean nitrate industry were present as well as European producers of synthetic nitrogen-bearing materials.

Washington developments included an announcement that the Tariff Commission will hold a hearing on July 26 for the purpose of ascertaining the ratio of domestic production to domestic consumption, by quantity, of synthetic camphor in the six-months period ended June 17, 1933.

The actual production of synthetic camphor in the United States was ascertained by the Commission, but cannot be published since to do so would disclose the operations of an individual concern. There was no production in 1931 or 1932.

The following is the consumption of synthetic camphor and of crude natural camphor, as reported by consuming manufacturing concerns, during the first 6 months of 1931 and 1932, which are taken for comparison with the first six months of 1933: 1931, synthetic, 1,783,979, natural, 600,471 lb.; 1932, synthetic, 573,174, natural, 1,222,418 lb.; 1933 (June consumption estimated), synthetic, 434,437, natural, 980,815 lb.

In raising the federal gasoline tax from 1 to 1½c. per gal., Congress specifically exempted industrial benzol. When the 1c. tax was imposed a year earlier, the Manufacturing Chemists Association obtained a ruling from the Bureau of Internal Revenue which exempted benzol used for industrial purposes but this was later reversed. The statutory provision was inserted in the Industrial Recovery Act by the Senate Finance Committee in response to a petition by the M. C. A.

In response to the protest against his summary action last April, R. G. Tugwell, Assistant Secretary of Agriculture, has raised tolerance of allowable lead in spray residues on fruit during the current season. The new notice permits .02 grain of lead per lb. of fruit for this year's crop but the limit originally proposed, of .014 grain, will apply to the 1934 crop and none may be allowed if work on non-lead arsenicals proves successful.

PRODUCTION AND SALES COAL-TAR DYES BY METHOD OF APPLICATION—1932 AND 1931

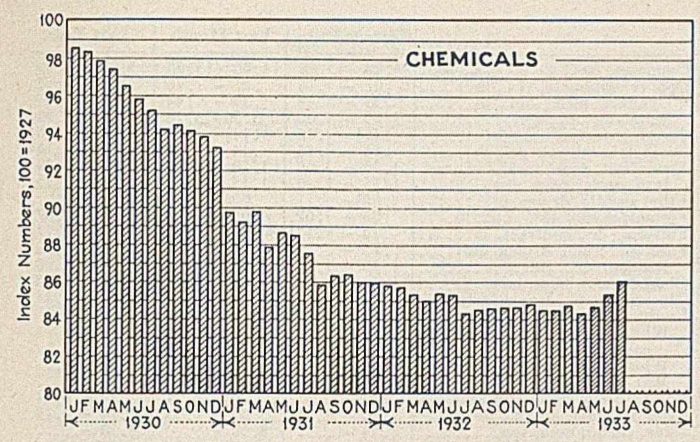
(Quantities in thousands of pounds, values in thousands of dollars)

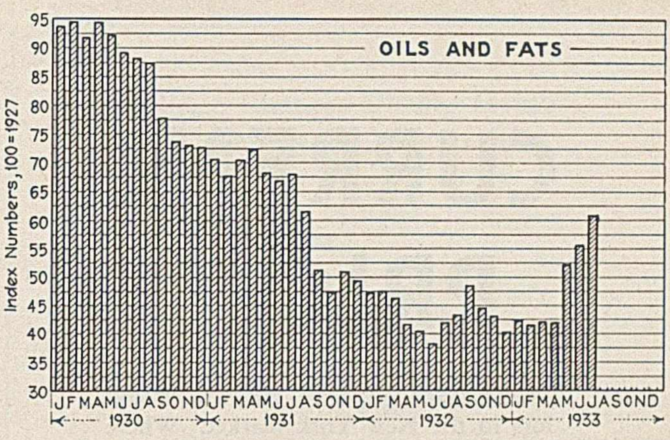
	1932			1931a		
	Sales Quantity	Sales Value	Production Quantity	Sales Quantity	Sales Value	Production Quantity
Acid dyes, total	8,538	$5,573	8,343	11,373	$7,324	11,471
Acid black 10B (C.I. 246)	931	354	751	[1]	[1]	[1]
Nigrosine, water sol. (C.I. 865)	1,013	291	975	[1]	[1]	[1]
Food dyes	252	594	240	303	782	293
All other acid dyes	6,342	4,334	6,377	[1]	[1]	[1]
Basic dyes, total	3,397	2,956	3,509	3,779	3,103	3,701
Auramine (C.I. 655)	680	624	654	[1]	[1]	[1]
Methyl violet (C.I. 680)	460	316	482	[1]	[1]	[1]
All other basic dyes	2,257	2,016	2,373	[1]	[1]	[1]
Mordant and chrome dyes total	3,167	1,904	2,920	4,317	2,690	4,329
Chrome blue black U (C.I. 202)	812	235	760	[1]	[1]	[1]
All other	2,355	1,669	2,160	[1]	[1]	[1]
Direct dyes, total	16,350	7,860	16,600	19,551	9,150	19,414
Direct blacks, total	6,746	1,990	6,636	7,603	2,276	7,088
Direct black EW, (C.I. 581)	5,418	1,418	5,335	[1]	[1]	[1]
Developed colors	2,152	1,273	2,260	2,228	1,279	2,313
Developed black BHN (C.I. 401)	1,204	389	1,131	[1]	[1]	[1]
All other direct dyes	7,452	4,597	7,704	9,721	5,595	10,013
Lake and spirit soluble dyes, total	2,980	2,186	3,274	3,928	2,510	3,398
Sulfur dyes, total	14,747	2,636	15,195	15,179	2,869	15,940
Sulfur blacks	12,074	1,587	12,601	12,101	1,585	12,942
Sulfur brown	1,100	320	1,060	[1]	[1]	[1]
All other sulfur dyes	1,573	729	1,534	[1]	[1]	[1]
Vat dyes (including indigo) total	23,796	8,539	20,763	26,772	10,548	24,907
Indigo, 20 per cent paste (C.I. 1177)	16,322	2,487	13,752	18,003	2,540	16,330
Other indigoids	3,583	1,432	3,257	3,923	1,997	4,071
Anthraquinone vat golden orange G (C.I. 1096)	146	212	135			
Anthraquinone vat blueGCD (C.I. 1113)	351	210	223	4,846	6,011	4,505
Other vat dyes	3,394	4,198	3,396			
Unclassified dyes, medicinal dyes	615	1,290	666	320	371	366
Total dyes	73,591	32,944	71,269	85,220	38,564	83,526

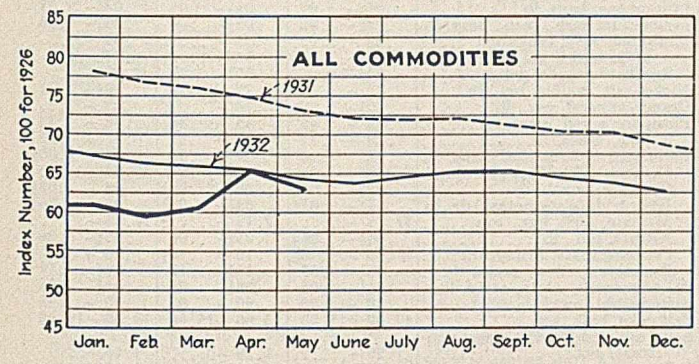
[1] Not available.

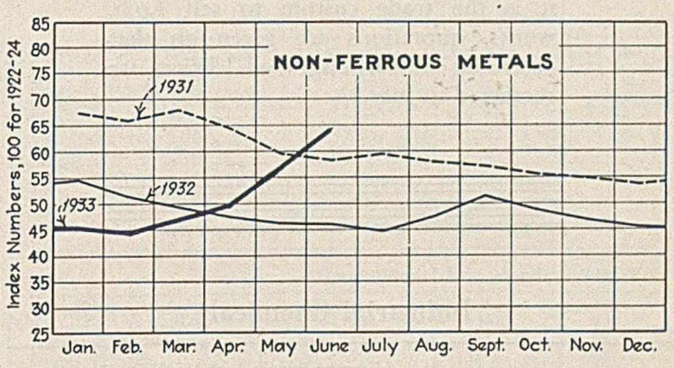
[2] Increase.

a Figures for production and sales represent total domestic production inasmuch as they include estimated production for the small percentage of firms for which figures were not obtained by the Commission. Actual figures obtained included more than 90 per cent except for lake and spirit soluble dyes (66 per cent) and food dyes (80 per cent).









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

PRICES for chemicals, as well as for other raw materials, have been going through a period where the influences have been conducive to higher levels. In the first place there has been a decided improvement in demand for supplies with a corresponding decline in selling pressure. With an upward price swing thus started, the rise in raw material costs was passed on to the finished products. The trend for raw materials is still upward and when industry control becomes operative, production costs will be further increased which gives assurance that values in the immediate future will be higher than they are at present. In other words, the present price movement has not reached its maximum and will not, according to reports, until the levels of 1924-1925 has been attained.

With production costs advancing and destined to move still higher, it is apparent that contracts for certain chemicals calling for monthly deliveries over 1933, will not prove profitable where the original profit margin was very slight. While the intent of the recovery plan is first to increase wages and employment, it is not yet clear whether long-term contracts are to be adjusted or at least whether some provision will be made to safeguard producers. Assurance has been given that problems peculiar to an industry will be given full consideration and possibly the position of existing contracts will be dealt with as a separate problem.

Inflation, whether potential or actual, is present as a price factor. It is of particular importance at present in a consideration of foreign trade. With the first intimation of inflation American exporters began instructing their customers abroad to deposit payments in their currencies in specified foreign banks. In this way a large total has escaped the devaluation that has been forced upon the dollar. In fact, it is believed that large stocks of unordered goods were exported and stored in other countries. German experience proved that there is no way of preventing some flight of capital by this means, even when all exports are licensed and an accounting required to show disposition of all the money received in payment.

American exporters, however, have not had to evade any regulations. No request for the licensing of exports has been asked. On the contrary the announced policy of the administration is to reduce tariffs and to offset the unemployment that would be created by increased imports in the increased employment in export industries that would follow reciprocal agreements on tariffs.

Increase of the cost of production will make exporting more difficult. For that reason it is anticipated that no effort will be made to license exports which would impose a formidable barrier in the way of the movement of goods.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	86.01
Last month	85.37
July, 1932	84.33
July, 1931	87.51

Values for metal salts continued to show a rising trend but a firmer price tone was in evidence practically throughout the entire market. Higher prices were in effect for alkalis on spot transactions as well as for bichromates, phosphates, acetic acid, casein, and mercury.

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

Base = 100 for 1927

This month	61.44
Last month	55.73
July, 1932	41.95
July, 1931	68.05

The price level for vegetable oils was sharply higher last month. Basic oils, such as cottonseed and linseed, led in the upward movement but higher prices also applied to China wood, corn, peanut, and other vegetable oils although coconut oil failed to follow the general trend.

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 July 13.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.08½–$0.09	$0.08½–$0.09	$0.10 –$0.11
Acid, acetic, 28%, bbl., cwt.	2.90 – 3.15	2.78 – 3.03	2.65 – 2.90
Glacial 99%, drums	10.02 –10.27	9.58 – 9.83	8.89 –......
U. S. P. reagent, c'bys	10.52 –10.77	10.08 –10.33	9.64 – 9.89
Boric, bbl., lb.	.04¾– .05	.04¾– .05	.04¾– .05
Citric, kegs, lb.	.29 – .31	.29 – .31	.30 – .31
Formic, bbl., lb.	.10 – .11	.10 – .11	.10 – .11
Gallic, tech., bbl., lb.	.55 – .60	.50 – .55	.50 – .55
Hydrofluoric 30% carb., lb.	.06 – .07	.06 – .07	.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 – .05½	.05 – .05½	.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.	.08½– .09	.08½– .09	.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.	.23 – .24	.20 – .21	.23 – .24
Tungstic, bbl., lb.	1.40 – 1.50	1.40 – 1.50	1.40 – 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.53½–......	2.53½–......	2.53½–......
Alcohol, Butyl, tanks, lb.	.095–......	.095–......	.113–......
Alcohol, Amyl	......–......	......–......	......–......
From Pentane, tanks, lb.	.15 –......	.143–......	.182–......
Denatured, 190 proof			
No. 1 special dr., gal.	.34½–......	.34½–......	.34½–......
No. 5, 188 proof, dr., gal.	.38½–......	.38½–......	.35½–......
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	.02½– .03
tanks, lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.15¼– .15½	.15¼– .15½	.15¼– .15½
tanks, lb.	.05 –......	.05 –......	.05¾–......
Ammonium carbonate, powd. tech., casks, lb.	.08 – .12	.08 – .12	.10½– .11
Sulphate, wks., cwt.	1.125–......	1.05 –......	.90 –......
Amylacetate tech., tanks, lb., gal	.135–......	.135–......	.16 –......
Antimony Oxide, bbl., lb.	.07½– .08	.07½– .08	.06½– .08
Arsenic, white, powd., bbl., lb.	.04 – .04½	.04 – .04½	.04 – .04½
Red, powd., kegs, lb.	.11¼– .12	.10½– .11	.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.	.03 – .04	.03 – .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 –......	2.50 –......	2.50 –......
Arsenate, dr., lb.	.07 – .08	.05½– .06½	.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	.05 – .06	.05 – .06
Tetrachloride drums, lb.	.05¼– .06	.05¼– .06	.06¼– .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.	.07 – .16	.07 – .16	.07 – .16
Cyanide, tech., bbl., lb.	.39 – .44	.39 – .44	.39 – .44
Sulphate, bbl., cwt.	3.75 – 4.00	3.50– 3.75	2.75 – 2.90
Cream of tartar, bbl., lb.	.15½– .16	.14½– .15	.17½– .18
Diethylene glycol, dr., lb.	.14 – .16	.14 – .16	.14 – .16
Epsom salt, dom., tech., bbl., cwt.	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Imp., tech., bags, cwt.	1.35 – 1.40	1.15 – 1.25	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	.10¾– .11
Lead:			
White, basic carbonate, dry casks, lb.	.06½–......	.06 –......	.06½–......
White, basic sulphate, sck., lb.	.06 –......	.05½–......	.06 –......
Red, dry, sck., lb.	.07¾–......	.07½–......	.06½–......
Lead acetate, white crys., bbl., lb.	.10½– .11	.10 – .11	.10 – .11
Lead arsenate, powd., bbl., lb.	.10 – .13	.09 – .13	.10 – .14
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, pwd., csk, lb.	.07 –......	.06¾–......	.05½–......
Lithophone, bags, lb.	.04½– .05	.04½– .05	.04½– .05
Magnesium carb., tech., bags, lb.	.05¼– .06	.05¼– .06	.05¼– .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–......	.10 –......	.09 –......
Phosphorus, red, cases, lb.	.45 – .46	.45 – .46	.42 – .44
Yellow, cases, lb.	.28 – .32	.28 – .32	.31 – .32
Potassium bichromate, casks, lb.	.07⅝– .08	.07¼– .08	.08 – .08½
Carbonate, 80-85%, calc. csk., lb	.05¼– .06	.05¼– .06	.05 – .06
Chlorate, powd., lb.	.08¼– .08½	.08¼– .08½	.08 – .08½
Hydroxide (c'stic potash) dr., lb.	.07⅛– .07½	.06⅛– .06¾	.06⅛– .06¾
Muriate, 80% bgs., ton	37.15 –......	37.15 –......	37.15 –......
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05¾– .06
Permanganate, drums, lb.	.16 – .16½	.16 – .16½	.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.	.04½– .05	.044– .05	.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.	.07 – .08	.07 – .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.	1.345–......	1.345–......	1.77 –......
Nitrite, casks, lb	.07¼– .08	.07¼– .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.	.03 – .03½	.03 – .03½	.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 bichloride, bbl., lb.	nom.–......	nom.–......	nom.–......
Oxide, bbl., lb.	.47 –......	.43 –......	.25½–......
Crystals, bbl., lb.	.35½–......	.33½–......	.22 –......
Zinc chloride, gran., bbl., lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Carbonate, bbl., lb.	.10½– .11	.10½– .11	.10½– .11
Cyanide, dr., lb.	.38 – .42	.38 – .42	.41 – .42
Dust, bbl., lb.	.06¾– .07	.06¾–...07	.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.	$0.08¾–$0.09	$0.08¾–$0.09	$0.09½–$0.10
Chinawood oil, bbl., lb.	.08¼–......	.06⅜–......	.05¼–......
Coconut oil, Ceylon, tanks, N. Y. lb.	.03½–......	.03½–......	.03½–......
Corn oil crude, tanks, (f.o.b. mill), lb	.06¼–......	.04¾–......	.03 –......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.04¾–......	.04¼–......	.03¼–......
Linseed oil, raw car lots, bbl., lb.	.109–......	.09 –......	.058–......
Palm, Lagos, casks, lb.	.04⅛–......	.04⅛–......	.03¾–......
Palm Kernel, bbl., lb.	.04¾–......	.04¾–......	.04½–......
Peanut oil, crude, tanks (mill), lb.	.06 –......	.04¼–......	.03½–......
Rapeseed oil, refined, bbl., gal.	.49 – .50	.49 – .50	.29 – .30
Soya bean, tank (f.o.b. Coast), lb.	nom.–......	nom.–......	nom.–......
Sulphur (olive foots), bbl., lb.	.05¾–......	.05⅝–......	.04½–......
Cod, Newfoundland, bbl., gal.	.24 – .25	.24 – .25	.21 – .22
Menhaden, light pressed, bbl., lb.	.051–......	.047–......	.04 –......
Crude, tanks (f.o.b. factory), gal.	.15 –......	.15 –......	.11½–......
Grease, yellow, loose, lb.	.03½–......	.03½–......	.01¾–......
Oleo stearine, lb.	.05 –......	.05 –......	.04½–......
Red oil, distilled, d.p. bbl., lb.	.06⅞–......	.06⅝–......	.06⅛–......
Tallow, extra, loose, lb.	.03¾–......	.03⅝–......	.02½–......

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.	.40 - .42	.42 - .45	.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......	.04¾- .05	.04¾- .05	.03¾- .04½
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...........	.11¾- .13½	.10½- .11½	.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...	.02¼- .20	.02¼- .20	.02¼- .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	5.25 - 5.40
Para toner, lb...............	.80 - .85	.80 - .85	.75 - .80
Vermilion, English, bbl., lb.....	1.32 - 1.35	1.20 - 1.30	1.35 - 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 - .08½	.07 - .08½
Gum copal Congo, bags, lb......	.07½- .09	.06 - .08	.06 - .08
Manila, bags, lb............	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.....	.12½- .13	.08½- .10½	.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...........	40.00 -......	40.00 -......	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................	5.50 -......	4.75 -......	3.80 -......
Turpentine, gal...............	.53½-......	.47 -......	.44½-......
Shellac, orange, fine, bags, lb....	.20 - .21	.19 - .20	.20 - .25
Bleached, bonedry, bags, lb...	.22 - .23	.20 - .22	.15½- .16
T. N. bags, lb...............	.12½- .13	.11½- .12	.08½- .10
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.........	.14 - .15	.14 - .15	.16 - .20
Beeswax, ref., light, lb.........	.22 - .27	.20 - .30	.25 - .27
Candelilla, bags, lb..........	.09½- .10	.09½- .10	.11 -......
Carnuba, No. 1, bags, lb........	.30 -......	.26 - .28	.21 - .23
Paraffine, crude 105-110 m.p., lb............	.02¾-......	.02¾-......	.03¼- .03¾

Price Changes During Month

Advanced	Declined
Acetate of lime	None
Acetic acid	
Tartaric acid	
Copper sulphate	
Lead oxides	
Potassium bichromate	
Tin salts	
Casein	
Mercury	
Vegetable oils	

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.......	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton....	78.00-.....	68.00-.....	72.00-75.00
Ferrochrome, 65-70%..........	.09½-....	.09½-.....	.10-.....
Spiegeleisen, 19-21% ton.........	24.00-.....	24.00-.....	27.00-.....
Ferrosilicon, 14-17%, ton.........	31.00-.....	31.00-.....	31.00-.....
Ferrotungsten, 70-80%, lb.......	.95- 1.00	.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...........	$0.09 -......	$0.08 -......	$0.05½-......
Aluminum, 96-99%, lb...........	.229-......	.229-......	.229-......
Antimony, Chin. and Jap., lb.....	.06½-......	.06¼-......	.05 -......
Nickel, 99%, lb................	.35 -......	.35 -......	.35 -......
Monel metal blocks, lb..........	.28 -......	.28 -......	.28 -......
Tin, 5-ton lots, Straits, lb.........	.46½-......	.37¾-......	.21½-......
Lead, New York, spot. lb.........	.045-......	.041 -.....	.027-......
Zinc, New York, spot, lb.........	.0522-......	.0467-......	.0295-.....
Silver, commercial, oz...........	.37⅞-......	.35⅝-......	.26¾-......
Cadmium, lb..................	.55 -......	.55 -......	.55 -......
Bismuth, ton lots, lb............	.85 -......	.85 -......	.85 -......
Cobalt, lb....................	2.50 -......	2.50 -......	2.50 -......
Magnesium, ingots, 99%, lb......	.32 -......	.32 -......	.30 -......
Platinum, ref., oz..............	31.00 -......	28.50 -......	35.00 -......
Palladium, ref., oz..............	19.00 -......	17.00 - 18.00	19.00 - 21.00
Mercury, flask, 75 lb............	62.00 -......	56.00 -......	56.00 -......
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.....	14.00 -18.50	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 - ...	.25 - .27
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...............	10.00 -10.50	10.00 -10.50	10.00 -10.50

INDUSTRIAL NOTES

The American Agricultural Chemical Co., with executive offices in New York, has appointed George E. Riches manager of the chemical and wholesale department to supervise sales of heavy chemicals and insecticides.

Homestead Valve Manufacturing Co., Coraopolis, Pa., has made the Clark-Wilcox Co., Boston, Mass., exclusive sales representatives for its vapor spray machine for New England.

Roller-Smith Co., New York, announces the appointment of H. R. Houghton, 211 North Calvert St., Baltimore, as its sales agent for Maryland.

The Babcock & Wilcox Co., Beaver Falls, Pa., has appointed T. F. Thornton as its sales manager in the Detroit district. Mr. Thornton will have his headquarters in the Ford Building, Detroit.

Felt Products Manufacturing Co., Chicago, Ill., has placed W. J. Andrews in charge of the industrial division of metallic and fibrous packing of the company.

Pure Carbonic, Inc., with executive offices in New York, will carry stocks for consumers in Colorado and vicinity in a warehouse recently opened at 2161 Blake St., Denver.

First Machinery Corp., handlers of new and used equipment at 405 East 15th Street, New York, is moving to new quarters at 419 Lafayette Street.

Thiokol Corp., Yardville, Trenton, N. J., announces that an arrangement has been made with Monsanto Chemical Works, Ltd., London, whereby "Thiokol" will be made available for distribution in Europe.

General American Tank Car Corp., Chicago, at its annual meeting voted to change the name of the company to the General American Transportation Corp.

Spencer Kellogg & Sons, Inc., manufacturer of linseed oil and other vegetable oils, Buffalo, N. Y., has elected V. A. Acer, vice-president. Robert C. Boggess succeeds Mr. Acer as general sales manager of the company.

The American Potash & Chemical Corp., has appointed William J. Murphy as manager of its borax and boric acid sales division with headquarters in the New York office.

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	70,000	57,000	$235,000	$165,000
Middle Atlantic	124,000	744,500	2,955,000	2,503,500
Southern	406,000	288,000	3,123,000	569,000
Middle West	274,325	85,000	1,076,325	357,000
West of Mississippi	....	13,140,000	10,771,000	13,814,000
Far West	571,500	28,000	1,833,500	896,000
Canada	1,204,000	91,000	4,205,000	222,000
Total	$2,649,825	$14,433,500	$24,298,825	$18,526,500

PROPOSED WORK BIDS ASKED

Foundry — Canadian Ohio Brass Co., subsidiary of Ohio Brass Co. of Mansfield, Ohio, plans the construction of a new foundry and factory on Stone Rd., Niagara Falls, Ont., and may call for bids about July 15.

Cement Plant—Huron Portland Cement Co., Alpena, Mich., will soon call for bids for a 75,000 bbl. cement plant, 13 rein.-con. tanks 80 ft. high, packing plant, etc.

Drug Factory—The Halitosine Co., 2602 Iowa Ave., St. Louis, Mo., contemplates the construction of a 2 story, basement, 100x200 ft. drug factory on 5001-07 Fyler Ave., St. Louis. $40,000.

Explosive Plant—E. I. du Pont de Nemours Co., contemplates constructing hexite stills and repairing explosive plant at Gibbstown, N. J. Private plans. $28,000.

Fertilizer Plant—Keeling Easter Corp., Norfolk, Va., plans constructing a fertilizer plant. $28,000.

Fertilizer Plant—Porto Rico Fertilizer Co., San Juan, Porto Rico, subsidiary of Virginia-Carolina Chemical Corp., Richmond, Va., plans to rebuild fertilizer plant destroyed by hurricane. Maturity indefinite. Estimated cost to exceed $75,000.

Factory—Flintkote Co., Bergen Turnpike, Little Ferry, N. J., completed plans for a 2 and 3 story factory on Bergen Turnpike. Private plans. $28,000.

Factory—Pittsburgh Plate Glass Co., 7312 Maie Ave., Los Angeles, Calif., are having plans prepared by H. D. Bounetheau, supervising archt., 222 South Cliffwood St., Brentwood, Calif., 3 story, steel factory for paint and varnish division. $28,500.

Storage—Owens-Illinois Glass Co., Streator, Ill., contemplates constructing a storage building. $45,000.

Glass Factory—Owens-Illinois Glass Co., Gas City, Ind., will soon receive bids for a 2 story addition to glass furnace factory. Private plans. $29,325.

Glass Plant—Libby-Owens Glass Co., Toledo, Ohio, are having plans prepared at the Company Eng. Office, Toledo, for an 80x350 ft. addition to East Broadway plant. $100,000.

Lime Plant—The Virginia Lime Products Corp., M. D. Langhorne, pres., J. W. Seay, genl. mgr., Eagle Rock, Va., have purchased the plant and quarries of the former Moore Lime Co. including commissary. Plant will be placed in operation as soon as possible producing high calcium lump and hydrated lime, also all sizes of crushed limestone products. $75,000.

Lacquer Plant—J. Kane, Kearny Ave., North Arlington, N. J., contemplates building a lacquer manufacturing plant on 14th St. $40,000.

Paint Factory—Corporation, c/o Manchurian Paint Co., Dairen, Manchuria, plans the construction of a paint and varnish factory at Mukden, Manchuria. $100,000.

Plant—Atlantic Pyroxylin Waste Co., 316 River Rd., North Arlington, N. J., contemplates the construction of a plant and storage building at 316 River Rd. or other location. $28,000.

Factory—Fibreboard Products Co., 4444 Pacific Blvd., Vernon, Calif., plans constructing an addition to factory on Pacific Blvd. $150,000.

Plant—United Paper Co., 46 Park St., Holyoke, Mass., contemplates replacing plant recently destroyed by fire. $70,000.

Pottery Plant—Corporation composed of John H. Kohler and E. A. Price, Pensacola, Fla., Phillip and Gordon Knall, Ontario, Canada, and J. H. McKinnon, East Liverpool, Ohio, purchased land 3 mi. North of Pensacola, Fla., on which they plan to erect a pottery plant. $50,000.

Lubricating Plant—Union Oil Co., Mills Bldg., San Francisco, Calif., are having plans prepared and will soon call for bids for an addition to lubricating plant at Oleum. Contract for tanks awarded to Berkeley Steel Constr. Co., 2nd and Camelia Sts., Berkeley. $500,000.

Refinery—Gulf Refining Co., Brunswick, Ga., have completed preliminary plans for a plant on River Front at Brunswick, Ga. Mr. Henderson, c/o Gulf Refining Co., Pittsburgh, Pa., is engr.

Oil Refinery — Cedar Grove Refining Co., Shreveport, La., contemplates constructing refinery plant for gasoline reduction, equipment, etc., at Jackson, Miss. $90,000.

Smelting Plant—Jas. H. Carson and Dr. R. F. Holland, Charlotte, N. C., are seeking Government funds from the Bureau of Mines to construct a smelting plant for gold ore that is being mined in Mecklenburg, Gaston, Iredell, Anson, Montgomery and Stanly Counties. $60,000.

Sulphur Refinery—New Mexico Acid Co., Jemez, New Mexico, are having preliminary plans prepared for a 150 ton sulphur refinery. T. T. Eyre, University of Southern Calif., Los Angeles, is the engr.

Sulphate Plant—Ube Chisso Kogyo Kaisha Ltd., c/o Y. Watanabe, Ube, Oita-Ken, Japan, plans the construction of an ammonium sulphate plant, 50,000 tons annual capacity, in the vicinity of Ube.

CONTRACTS AWARDED

Plant—Fisher Brass Co., Marysville, Ohio, awarded separate contracts for 1 story, 36x72 ft. additions to plant incl. equipment.

Chemical Plant—The DuPont Co., Waynesboro, Va., will make additions to their recovery plant in connection with their local plant for manufacture of Rayon. Work will be done by local labor and company forces.

Chemical Plant—Southern Alkali Corp., Corpus Christi, Tex., awarded contract for a group of buildings, at Corpus Christi, to H. K. Ferguson Co., Hanna Bldg., Cleveland, Ohio. $7,000,000.

Factory—United Fertilizer Co., Carrollville, Wis., awarded separate contracts for remodeling fertilizer plant.

Factory—Fairmount Glass Works, 1601 South Keystone St., Indianapolis, Ind., awarded contract for a 1 story, 86x101 ft. factory addition, to Hetherington & Berner, 701 Kentucky Ave., Indianapolis. $29,000.

Warehouse—Owens Illinois Glass Co., Huntington, W. Va., awarded contract for 55,000 sq.ft. addition to warehouse, to Rust Engr. Co., Koppers Bldg., Pittsburgh, Pa. $60,000.

Factory—Diamond Match Co., Oswego, N. Y., awarded contract for 2 story, 80x100 ft. and 40x50 ft. factory, to James Leck & Son, Oswego, N. Y. $50,000.

Paper Mill — Hammermill Paper Co., East Lake Erie Rd., Erie, Pa., have awarded contract for a 2 story, 194x198 ft. paper mill annex on East Lake Erie Rd., to Henry Shenk Co., 12th and Sassafrass Sts. $160,000.

Factory—Spencer Co. of Canada Ltd., Lottridge St., Hamilton, Ont., have awarded contract for a 1 story, 30x60 ft. and 25x50 ft. factory addition for manufacturing paper, felts, blankets, to Tope Construction Co., 945 Main St. W. Additional special equipment to be installed.

Mill—Franklin Rayon Co., 86 Crary St., Providence, R. I., awarded general contract for 1 story, basement, 45x160 ft. mill addition on Crary St., to A. F. Smiley Constr. Co., 202 Oak Hall Bldg., Providence, R. I. $28,500.

Cracking Plant—Atlas Pipe Line Co., Inc., Shreveport, La., have awarded contract for the construction of a cracking plant and other new units to be modernized at Jewella refinery, to Alco Products Co., Inc., 220 East 42nd St., New York, N. Y.

Refinery—The Canfield Oil Co., Coraopolis, Pa., awarded contract for a continuous tube steel with a fractionating tower 5 ft. in diameter, 100 ft. high, secondary fractionating tower for further gas and naphtha refinement, storage tanks, pumps, receiving and control house, to Alco Products Co., 220 West 42nd St., New York, N. Y. $100,000.

Refinery—Wolverine Empire Refining Co., Oil City, Pa., awarded contract for 20,000 bbl. crude still unit, return unit, pumphouse and tanks, to Alco Products Co., 220 East 42nd St., New York, N. Y. $200,000.

Refinery—Cosden Oil Co., Big Springs, Tex., are constructing with own forces an oil refinery plant for manufacturing gasoline, lubricating oil and by-products, 7,000 bbl. daily capacity.

Refinery—American Petroleum & Transport Co., c/o J. A. Whitely, Purch. Agt., Mexican Petroleum Co., 122 East 2nd St., New York, N. Y., have awarded separate contracts for the construction of a 25,000 bbl. daily capacity refinery plant at Texas City, Tex. $6,000,000.

Refinery—U. S. Smelting & Refinery Co., Midvale, Utah, will build by separate contracts lead smelter and refinery at Midvale, Utah.

Retort—City Council, St. Thomas, Ont., has awarded contract for building a new retort at the municipal gas plant, to Parker Russell Co., St. Louis, Mo.

Factories—Hodgman Rubber Co., Herbert St., Framingham, Mass., awarded contract for two 2 story, basement, 100x100 ft. and 60x60 ft. factories near Herbert St., to Julius Conirser Co., 333 Washington St., Boston, Mass. $28,500.

Rubber Plant—Manhattan Rubber Mfg. Division, Willet St., Passaic, N. J., awarded contract for 1 story, 30x90 ft. rubber manufacturing plant on Willet St., to The Austin Co., Broad St. Station Bldg., Phila., Pa. $28,000.

Storage—Dayton Rubber Mfg. Co., Dayton, Ohio, awarded contract for storage building, to Henry Stock & Son, 55 Brandt St., Dayton, Ohio. $28,500.

Smelter—Compania Mineral de San Rafael, Zacatecas, Mexico, awarded separate contracts for 5,000 tonsore daily capacity smelter.