CHEMICAL
& METALLURGICAL
ENGINEERING
ESTABLISHED 1902

APRIL, 1940

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Regularizing Chemical Employment

Except for the production of fertilizers, cottonseed oil and a few special products such as anti-freeze, the chemical industries are relatively free from seasonal variations. Employment has shown greater than average stability even in the face of rather violent fluctuations in general business conditions. This desirable condition has been due not only to the diversified character of chemical manufacture and distribution, but also to careful planning and scheduling of production. A delicate balance of many competitive factors and relationships is now threatened by further invasion of Government into the affairs of private enterprise.

In a study of employment regularization among 183 member companies recently completed by a committee of the National Association of Manufacturers, it was found that the Wage-Hour Law had added a new obstacle to stabilization. Where in the past some companies have found that the averaging of work-hours among employees made it possible to provide a greater degree of employment regularization throughout the year, this method is now restricted by the Wage-Hour Law.

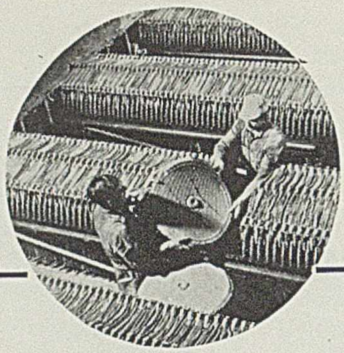
But more serious problems for chemical industry are involved in the process of fixing minimum wages under the provisions of the Walsh-Healy Public Contracts Act. Even though a firm may not be producing goods for sale under public contract, it can be affected by these wage determinations. They establish precedents that can and will be used by labor organizers. And they upset competitive relations between different divisions within an industry.

Consider, for example, the wide range in minimum wages already established within the process industries. In the case of fertilizer manufacturers a regional differentiation permitted a minimum wage in the South of 25 cents per hour (which was subsequently raised by the Wage-Hour Law to 30 cents). In the explosives industry a single much higher minimum of 57½ cents has been fixed. Presumably heavy chemical manufacturers will be given a minimum some place between these two extremes.

Now suppose that the Government is buying sulphuric acid. It might well obtain its requirements from a fertilizer company or from a heavy chemical firm or from an explosives manufacturer. In these three cases there might be three different levels of minimum wages under three separate rulings of the Secretary of Labor. The fertilizer plant could pay a minimum of only about half that required of the chemical or explosives manufacturers producing the identical product. Unless the Labor Department is able to straighten out these uncertainties, the whole system of establishing minimum wages is going to break down.

American chemical industry, as effectively represented before the Department of Labor, by the Chemical Alliance, Inc., has asked only for fair and equitable treatment. It has an employment record of which it is duly proud. Its hourly rates are higher than the average, but more important is the continuity of employment that means much higher annual wages for its employees. It has placed a higher proportion of its "key people" on a salary basis. It has done more than any other industry to develop new products and processes to offset seasonal and "custom-made" business, and to provide new jobs through research.

All this has helped to bring about a more stable level in the volume of employment in chemical industry. But we must not forget that this is regularization that has resulted from private enterprise rather than from governmental regulations.



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ATTENTION: SECOND HONEYMOONERS

Niagara Falls is noted for two things—electrochemical industry and honeymooning. Which of these was the determining factor in selecting the Buffalo-Niagara Falls area for the 32nd annual meeting of the American Institute of Chemical Engineers has not been admitted officially. But we have our suspicions. The Ladies' program lists a series of affairs labeled "Honeymoon Event No. 1," "Honeymoon Event No. 2," etc. There is an implication that husbands would not be unwelcome. Recalling the results of the nine years of research in marital relations by Drs. Burgess and Cottrell, which confirmed our views that chemical engineers make the best husbands (see *Chem. & Met.*, Dec. 1939, p. 749), we would respectfully suggest that the local committee limit its plant visits to unattached and disillusioned males.

BEAT CONGRESS TO THE DRAW

Congress should not undertake to pass on technical matters affecting new materials of war. Moreover, Congress normally would not wish to do so. But occasionally, as during March, some Congressmen get excited over what they think, or allege to be, gross neglect of new defense opportunities. These situations are often of real concern to the chemical industry.

The recent case referred to is the proposal of Lester Barlow to provide a new sort of explosive with such deadly power as to change the whole aspect of warfare. He claimed that he could not get a fair test of his invention but he did succeed in interesting certain congressmen in it. Finally four Congressional committees held a joint session to hear the claims of this inventor. Melodrama prevailed. At the end of this secret meeting, the committee ordered the stenographer to burn his notes on the committee table while the committee witnessed the destruction of the record that might otherwise have provided for the improper revealing of a tremendous military secret. The result, therefore, was merely an agreement between the Congressional group and the military authorities to test Mr. Barlow's invention.

For the moment it is not of any concern whether the invention is good or worthless. The important matter is that Congress should not have busied itself with this detail. It is unfortunate that such an incident should ever have received such sensational publicity and it should be to the best interest of chemical industry to find a way to prevent its repetition.

Three possible reasons are noted for the Congressional interest in such a case. Some Congressmen may think, as has been charged, that the explosives industry tried to suppress new developments like this one in order to protect the present market for military products. Other Congressmen seem to think that the military authorities are more at fault—that they prefer to go along with the easy way of repeating old practices indefinitely. But in some instances, it looks to the outsider as though the Congressmen were principally interested in getting their names on the front pages of the daily papers as a result of their spectacular handling ot this novel case.

Whatever the cause, the need for remedy is evident. Congress has a right to decide policy. Its members are, therefore, entitled to information about new developments, even though they may not be competent to make the technical appraisals. Perhaps some wise representative of industry will be able to work out a plan that will promote prompt adoption of meritorius inventions but will also dispose of cases lacking merit—just as promptly and to the satisfaction of any fair-minded legislator. The reputations of the military authorities and of industry will thus be protected.

FOR "PURER" RESEARCH

Prior to the World War most scientists experimented merely for the sake of experimenting. Twenty or thirty years later someone else came along and found practical applications for the results of their experiments. Today our modern researchers usually tackle their problems the other end first. They start with an application in mind and work toward a particular invention.

For lack of a better name, the older method has been dubbed "pure" research. Apparently it is held in rather low esteem in industry because most companies are unwilling to spend huge sums on a research program that may not result in immediate dollar-and-cents dividends. This they regard, as a logical business-like procedure in the use of stockholders' money. Yet by so doing these firms may neglect entirely the most fertile fields in science from which the really great new inventions will probably come.

Editorial Viewpoint

Fortunately there are companies that have both the means and the foresight to sponsor long-range programs in fundamental research. A few may employ their own staff and facilities for such work; others have worked with the colleges to set up research fellowships. An outstanding example of the latter type is the du Pont Fellowship Plan for which approximately $400,000 has been spent during the past 20 years for so-called "pure" research in university laboratories. Research subjects as well as the fellows are selected by the college professors. There are now 20 post-graduate fellowships and 6 post-doctorate fellowships and there have been almost 500 individual fellowship holders during the life of the plan.

Incidentally, it is interesting to note that only 15 per cent of these men have later joined the du Pont staff. In other words, the acceptance of the fellowship plan implies no obligation on the beneficiary as regards his future employment.

Fortunate, too, is the fact that the du Pont company has no patent on this idea. It is one that can and should be adopted more generally throughout the chemical industry. Those companies that have drawn heavily on the well of fundamental science can well afford to help in replenishing the supply.

WATCH OUT FOR TANKS!

Chemical engineers and operating men have a serious responsibility during periods of emergency caused by floods. This has again been emphasized during the recent high water on the Susquehanna River in Pennsylvania. Petroleum tankage there added fire hazard to flood. Whenever flood threatens a plant, special attention should be given to tankage as well as to operating machinery and materials in process.

Many operating men seem to overlook the fact that tanks well designed for full load and on excellent foundations for normal operations may be very vulnerable when attacked externally by flood waters. Control of explosive, flammable or corrosive contents then becomes highly important. It is often necessary to fill such tanks with water in anticipation of high water in order to secure them properly on their foundation. For example, in many cases water should be forced in under the flammable petroleum content so that the "specific levity" of the oil content may be offset by the additional weight of the water. Thus the tankage is protected, danger to surrounding properties minimized and often the contents of the tank itself not seriously harmed.

An empty tank is much less rugged than a full one. An optional treatment for protection of empty tanks, instead of filling them with water, is to cut holes at or through the bottom. Then the rising flood waters will take care of filling the tanks automatically. Top vents must be open, of course, and the emergency openings must be *at* the bottom of the empty tank, not just near the bottom. It requires only a very few inches of water to float an empty tank, and when the flood recedes it is not always possible to guide the tank back to its original position. This is particularly true when several tanks must be guided at the same time.

A GOOD TOOL WRONGLY USED

New limit markers were set up clearly by the Supreme Court late in March in its decision regarding the Ethyl Gasoline Corporation's control of motor-fuel prices. The Court made evident that regardless of the right to monopolize production under a patent, this company could not be permitted to go so far in price regulation and merchandising control as it formerly had been doing. This is not an important new principle. It merely confirms the common ruling of the Court that a legal right to do certain things may not be extended *per se* to the doing of other acts that are illegal.

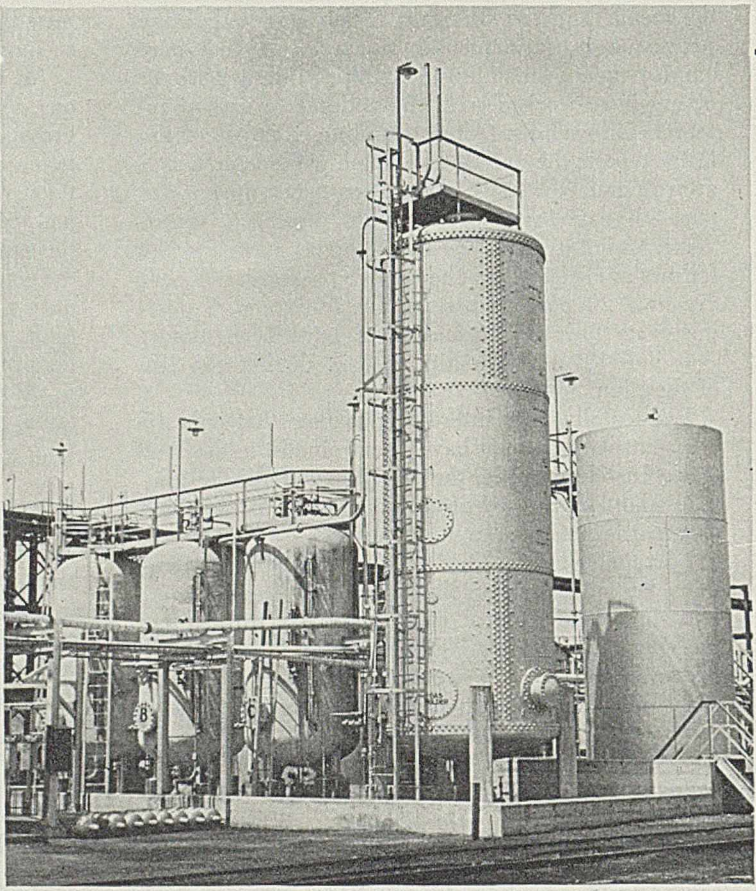
All of industry concerned with patents and licensing will study this decision carefully. Perhaps there are very few chemical patents of such fundamental nature as those governing Ethyl fluid. And surely there are still fewer which relate to commodities of a wider general popular interest. But the same principles regarding patent rights will apply to commodities of lesser importance and of less popular appeal.

The patent system has been subject to criticism by many on the ground that it gives unwarranted monopoly rights, contrary to the public interest. It may be that this decision, although unwelcome to some of industry, may really be beneficial by pointing out how excessive monopoly action should be guarded against. Thus the decision, though restrictive in nature, may tend also to protect the patent system itself. Chemical executives and engineers will wish to weigh these factors carefully for their own situations.

"Rubber" From Petroleum Gases

Synthetic rubberlike materials are attracting world-wide attention these days as more and more companies intensify their research in this direction. Butadiene and isobutylene polymers appear to offer the best possibilities of competing with natural rubber in the not-too-distant future.

DEXTER NORTH
Washington Representative
Arthur D. Little, Inc.



Pressure storage tanks for isobutylene and other raw materials used to make Vistanex, a rubber-like material, in Standard Oil Co.'s Bayway, N. J., plant. S. O. of La. will build a Buna plant at Baton Rouge

Recent announcement by the Standard Oil Co. of New Jersey that it will build a plant for production of synthetic rubber of the Buna type at Baton Rouge, La., quickens the already keen interest in synthetic rubberlike plastics. With research being carried on in this field by many nations, technological developments are moving swiftly. Commercial production in the United States, Germany, and Russia has already assumed proportions of a major industry. In Europe, particularly in the totalitarian states, availability of synthetic rubbers assumes increasing importance because of the necessity of conserving foreign exchange, and to some may mean virtual self sufficiency in rubberlike materials. In the United States, which is in the forefront of development, we are concerned more with obtaining a superior product, although not unmindful of eventual independence of an imported commodity controlled by a foreign monopoly.

Although the various synthetic rubbers are priced much higher than natural rubber, their properties are superior in many respects. Compounding with the natural product to improve its characteristics, substitution in special uses, and entirely new applications are all taking increased quantities of the synthetics. As costs become lower from perfection of process and quality and from increase in output, competition with natural rubber may become substantial in the not distant future. On the other hand, however, the fact that the price of crude rubber can be lowered substantially below what we normally pay, renders its actual displacement remote.

The accompanying list of trade names, together with their chemical type or origin includes most of the synthetic rubbers now in commercial production either in the United States or abroad.

All commercial synthetic rubbers are produced, in part at least, from one or from either one of two, of the following unsaturated hydrocarbon gases—butadiene, isobutylene, acetylene, or ethylene—which are derived from petroleum, coal, or as with butadiene in Russia, from vegetable sources. Buna rubber is derived from butadiene, obtained in Germany from acetylene ex carbide or more recently from hydrocarbon gases of synthetic petroleum production, and in the United States from petroleum gases. Isobutylene is obtained from petroleum gases. Neoprene is derived from acetylene, Thiokol from ethylene, and vinyl chloride from either acetylene or ethylene.

Probably the most extensive work is being done both here and abroad on "rubbers" derived from petroleum gases. The abundance and cheapness of this raw material, together with the versatility of derivatives promises a bright future not only for these "rubbers" but also for related synthetic resins for rigid plastics and surface coatings. Conceivably these related demands may aid materially in providing cheap primary derivatives, much as acetate rayon has done for cellulose acetate plastics and viscose rayon for transparent cellulose wrapping material.

Immense strides too have been made in "rubbers" derived primarily from materials other than petroleum gases, notably neoprene, Thiokol (one raw material comes from cracked hydrocarbons), and the polymerized vinyl chlorides in the United States and "Sovprene" in Russia. Neoprene is derived by catalytic synthesis of acetylene to monovinylacetylene and reaction of hydrogen chloride on the latter to form chloroprene. Chloroprene is then polymerized to the rubberlike material neoprene. Excellent resistance to animal, vegetable, and mineral oils, to sunlight, heat, ozone, and most chemicals has led to widespread use of neoprene in gasoline and oil hose, protective clothing, footwear, packing and gasket material, protective coverings for wires and cables, and many other uses.

Thiokol, a polymerization product of the reaction of ethylene dichloride and sodium polysulphide, is characterized by extremely high resistance to a large number of organic solvents, and high resistance to moisture absorption and permeation. Principal outlets are in the automotive industry, the oil industry, in refrigerating and air conditioning, and the printing industry. Thiokol is also available in powder form for production of molded goods.

When polyvinyl chloride is highly plasticized, rubberlike properties are imparted to it. The material is superior to natural rubber in flexing life, and in resistance to sunlight, water, oxidation, and certain oils. At least three varieties of this rubberlike material are being produced. So versatile is this type of material that its uses cover a wide range, from insulation for electric wires and chemical and oil resistant hose, tubing, and equipment lining, to wrapping material and fabric coating.

Resistoflex, or plasticized polyvinyl alcohol, one of the newest of the rubberlike plastics, was developed in Germany to meet the demand for a material unaffected by gasoline, oils, and solvents, in resistance to which it is claimed to be superior to other synthetic resins. The material possesses high tensile strength, great resistance to impact, is suitable for either high pressure or vacuum tubing, and may be used over a wide temperature range. It is not highly resistant to water, however, and therefore cannot satisfactorily be employed for water or steam lines. It is readily molded into sheets, tubing, diaphragms and other shapes, chiefly for fuel and brake lines and lubricating systems of automotive equipment; in conveying solvents, vegetable oils and minerals in the chemical and process industries; in hydraulic lines; and in fuel and oil-handling equipment. Polyvinyl alcohol is manufactured by deacetylation of polyvinyl acetate which in turn is made by the reaction of acetylene on acetic acid.

AXF, which is made by the catalytic reaction of benzene and ethyl chloride, is a somewhat elastic, unvulcanizable material of dark brown color possessing little tensile strength, but excellent resistance to most oils and solvents, and to dilute alkalies and acids. It is used principally as a compounding material to improve the working and other properties of rubber, neoprene and Thiokol.

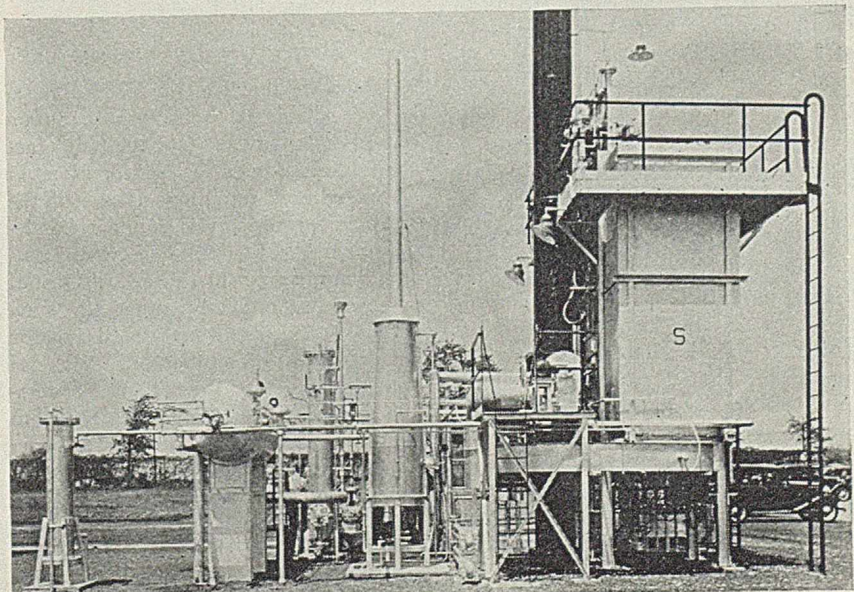
Butadiene "rubbers," however, are commanding the spotlight of attention because of Standard Oil's recent announcement. This company has acquired from the developers, the German I. G., licenses for making Buna type rubber. Plans for production before the end of the year in a plant of 10,000 lb. daily capacity at Baton Rouge, La., were announced on April 4, 1940. The raw materials, butadiene and acrylic nitrile, will be recovered or synthesized from refinery gases. It was also announced that Firestone Tire & Rubber Co. has taken out a license to manufacture its own requirements of Buna, starting in the immediate future. Another leading rubber company has informed Standard Oil Development Co. that it will purchase the synthetic material from the Baton Rouge plant.

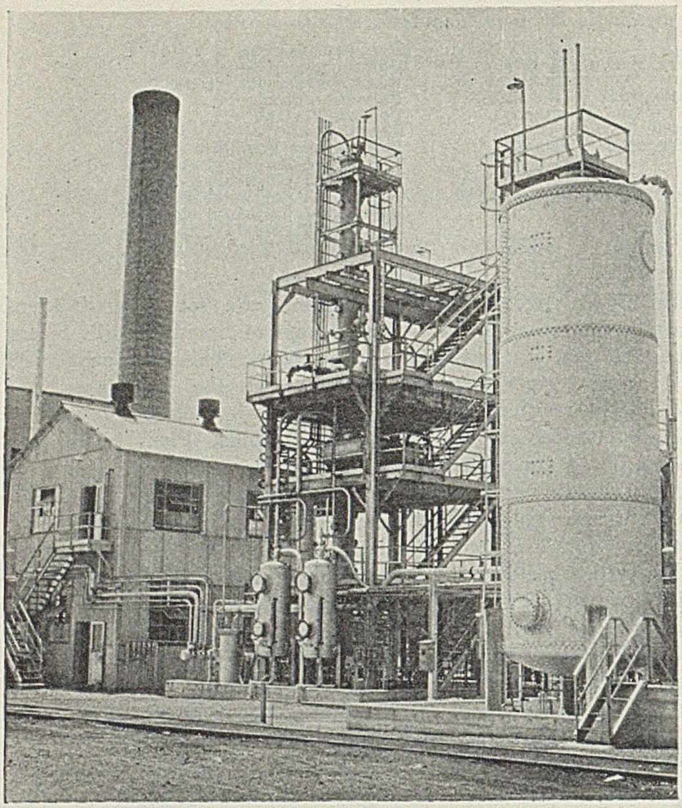
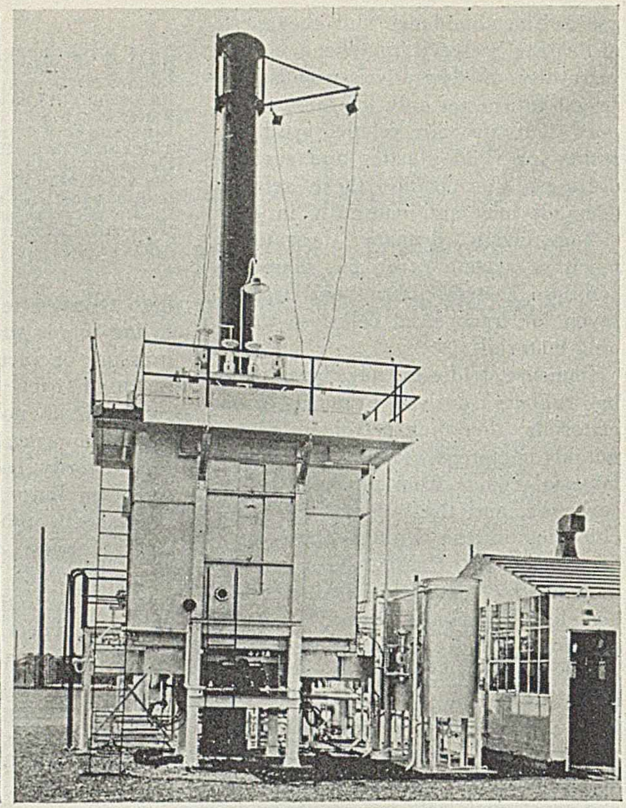
Several petroleum companies besides Standard Oil—also chemical companies and others—have been working intensively on methods of producing butadiene from petroleum gases. Some of the processes under investigation include catalytic dehydrogenation of butane or butene, cracking the hexane cut from naphthenic crudes, from cyclicized hexanes, hydrogenative cracking of benzene,

Synthetic Rubbers Manufactured Commercially

Buna S (Germany)	Butadiene-styrene
Buna N (Germany); Perbunan (U.S.)	Butadiene-acrylic nitrile
Buna NN (Germany); Perbunan extra (U.S.)	Butadiene-acrylic nitrile
Neoprene (U.S.); Sovprene (U.S.S.R.)	Polychloroprene
Vistanex (U.S.); Oppanol (Germany)	Polyisobutylene
Resistoflex (U.S. and Germany)	Polyvinyl alcohol
Thiokol (U.S.); Perduren (Germany)	Polyalkylene sulphides
Koroseal (U.S.)	Plasticized polyvinyl chloride
Flamenol (U.S.)	Plasticized polyvinyl chloride
Knightware (U.S.)	Plasticized polyvinyl chloride
Igelite (Germany)	Plasticized polyvinyl chloride
Mepolam (Germany)	Plasticized polyvinyl chloride
AXF	Polyxylenes

In this pilot plant Universal Oil Products Co. worked out its process for making butadiene from butanes and butenes. At right is the conversion furnace (S)



Left—Still for fractionating isobutylene under pressure and building for making polybutene at Standard Oil Co. Right—Side view of U.O.P. pilot plant showing the conversion furnace, cooling system and instrument-receiver house

and cracking petroleum under certain conditions to yield a mixture of butadiene and other unsaturates. Either butane or butene (obtained from refinery gases) appears to be the most likely starting material. Both the Houdry and Gyro processes of cracking petroleum are susceptible to modifications to give appreciable yields of butadiene.

Universal Oil Products Co. announced last summer a process for production of butadiene, consisting of catalytic dehydrogenation of butane at 1,000 deg. F. to butylene to butadiene. Once through yields are said to vary from 20 to 30 per cent, with ultimate yields up to 80 per cent. The novelty of the process seems to lie in the catalyst, as dehydrogenation of butane is not new.

New Plant at Chester

Phillips Petroleum Co., a large producer of butane, has been working actively on production and recovery of butadiene. United Gas Improvement Co. is erecting a plant at Chester, Pa., for the production of a series of unsaturated and aromatic hydrocarbons, including butadiene and styrene.

The Dow Chemical Co. is producing butadiene in its process for cracking petroleum to obtain ethylene for its rapid expansion in chemicals derived from the latter. The crude butadiene is now largely burned for fuel. Dow has patents covering manufacture of olefines (including butadiene) from petroleum. Whether the high ethane gas to be piped 54 miles from Temple to the Dow plant at Midland, Mich., will yield butadiene as well as ethylene is not indicated. It is reported that Dow has obtained a license for producing butadiene by the process of Universal Oil Products.

How to Purify Butadiene

None of these methods give butadiene sufficiently pure for manufacture of butadiene "rubber." In fact suitable methods of purification of the recovered butadiene is one of the principal problems in commercial development of butadiene "rubber." Tendency seems to be towards initial recovery of crude butadiene by such methods as azeotropic distillation or modified extraction methods, and final purification by formation of temporary chemical compounds, as with cuprous chloride or sulphur dioxide.

Dow Chemical Co. is the first American company to produce and sell pure butadiene. The process consists in formation of the temporary derivative butadiene-sulphone from which a resultant butadiene product of over 99.5 per cent purity is obtained. Its superiority over German butadiene is indicated in that an atmosphere of nitrogen is unnecessary for polymerization to synthetic rubber, as with the German product. Present price of this pure butadiene is in the neighborhood of 20¢ per lb., but it is hoped that large scale production will lower the cost.

Dow is cooperating with a rubber manufacturer in the development of butadiene "rubbers" of both the acrylic nitrile and the styrene types. Other rubber companies are also working actively on the compounding and applications of Buna.

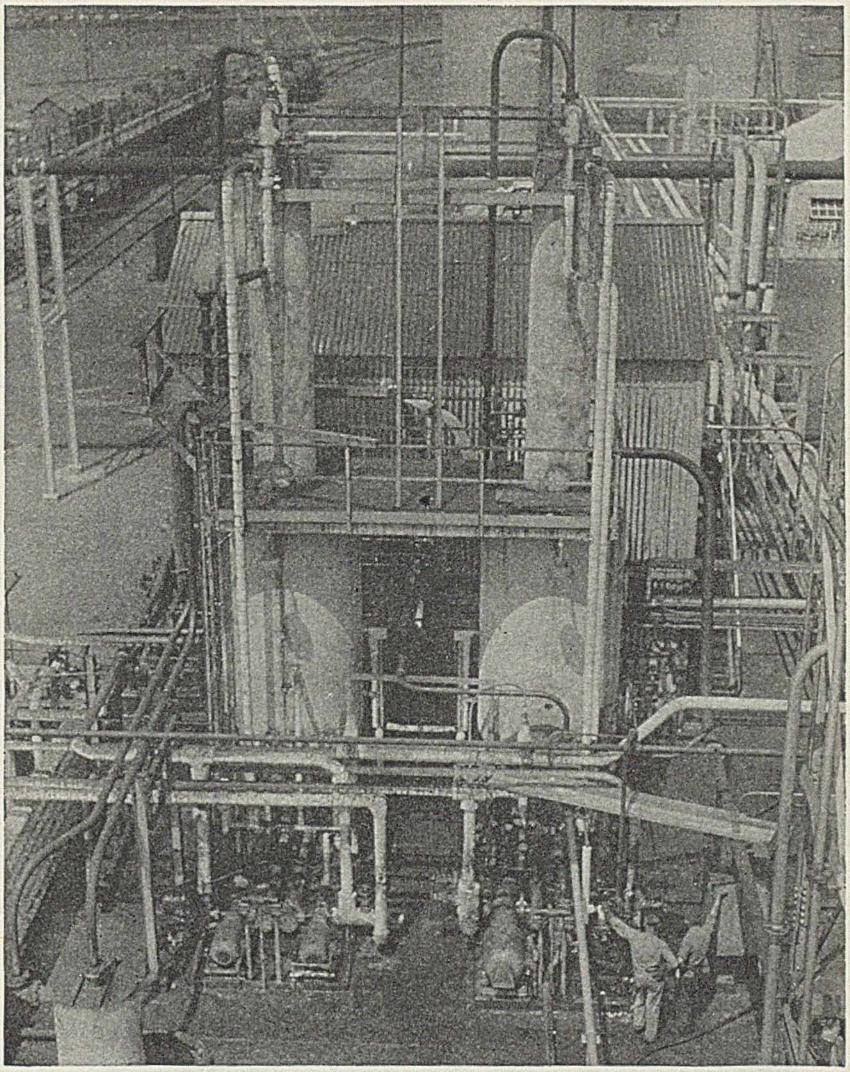
The other constituents of Buna rubber are acrylic nitrile for the N type, and styrene for the S type. The former can be made by dehydration of ethylcyanohydrin which in turn is produced from ethylene chlorohydrin and sodium cyanide, or by catalytic addition of hydrocyanic acid to acetylene. The cost of hydrocyanic acid has been reduced by a new process of synthesis from ammonia and methane. Styrene is now being made by Dow Chemical Co. from benzene and ethyl chloride. The purified butadiene is catalytically polymerized either with the acrylic nitrile or the styrene, the latex is coagulated with acetic acid, washed, dried, and antioxidants incorporated.

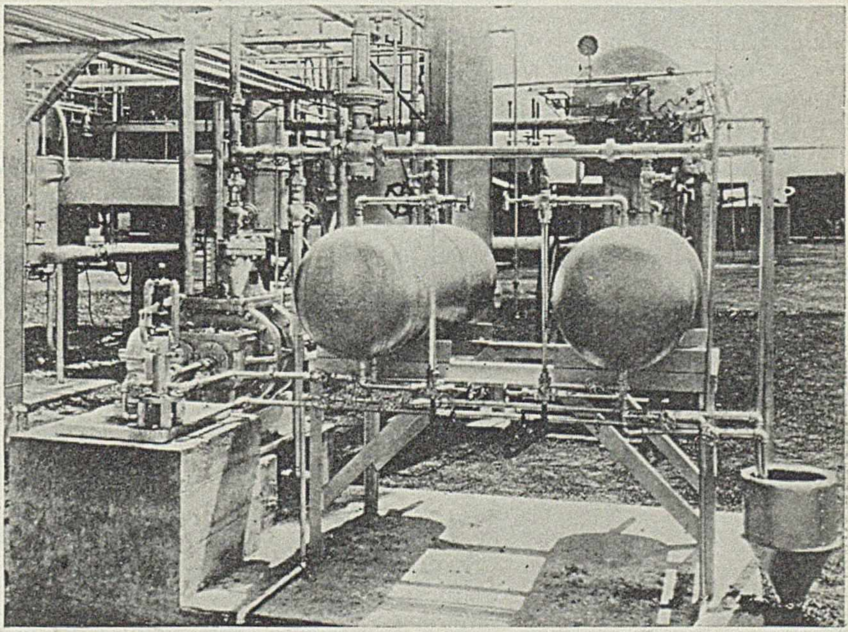
The best grades of butadiene "rubber" are Buna N and NN (in the United States, Perbunan and Perbunan extra). They are resistant to animal, vegetable, and mineral oils, but swell in aromatic hydrocarbons, ketones, alcohols and esters, and in chlorinated hydrocarbons and organic bases they swell more than natural rubber. In aging, exposure to sunlight, in resistance to heat, ozone, moisture, abrasion and flexing, in permanent set and creep, and in hysteresis loss, they are superior to natural rubber. Buna N and NN also excel the natural product in deformation at elevated temperatures, and are only slightly subject to cold flow. Being inferior to rubber in electrical properties, they are used for insulating only as oil and solvent resistant covers to protect underlying insulation.

Principal uses of Buna rubber include oil resistant mechanical goods such as gasoline and oil hose, transmission and conveyor belts, gaskets and packings, in oil and abrasion resistant wire and hose sheathing, as machinery mounting blocks, protective clothing and footwear, oil resistant artificial leather and coated fabrics, steam hose, diaphragms, and bellows.

Last summer, prior to exhaustion of supplies of imported Perbunan, the price in the United States was 90¢ per lb., compared with 65¢ for neoprene and about 16¢ per lb. for crude rubber. If a ratio of say 4 to 1 in prices is maintained, synthetic rubbers will find their markets only in special fields under special conditions, rather than in the general rubber goods field.

The potential supply of butadiene is enormous and is estimated in terms of hundreds of millions of pounds, even billions, annually. The cost of butadiene "rubber" will no doubt be substantially reduced through technological improvements in processes of production of intermediate materials and finished product, by improvement in quality of the product, and in larger volume of production. It has been indicated that the cost of pure butadiene, principal constituent of Buna rubbers, will approach 10¢ per lb. Cost of acrylic nitrile will probably be somewhat more. Reports from Germany state that a cost of 20¢ per lb. for Buna N in this country is hoped for. Cost of Buna S should be somewhat less, according to the German experience, as the cost of styrene is substantially less than that of





Top—Side view of stills used in the manufacture of polybutene-oil solutions or concentrates. Vistanex made here was developed in Germany as Oppanol
Bottom—Detail view of measuring and sampling tanks and proportioning pump in U.O.P.'s unit for making butadiene, raw material for all forms of Buna

acrylic nitrile. However, present styrene costs in the United States seem to be relatively high when viewed in the light of the hoped-for less than 20¢ per lb. Buna S.

With crude rubber selling at a normal price of say 16¢ (present price is approximately 20¢) and Buna N at 50¢ per lb., demand for the latter would still be in special uses and relatively small; with Buna at 35¢, demand would be substantial; and at 20¢, its superior properties would enable it to compete with rubber.

Isobutylene, the raw material for Vistanex, is formed in the cracking of petroleum or of natural gas, and can be recovered by relatively simple methods. At present most of it is converted to high anti-knock motor fuel, sold as fuel gas in admixture with propane or butane, or consumed in refineries as fuel. Quantities of isobutylene used in the manufacture of Vistanex are relatively small but increasing, and the potential supply is immense.

Polyisobutylene was developed in Germany by the I. G. Farbenindustrie as "Oppanol," and American manufacturing rights were granted to Standard Oil Co. of New Jersey, which produces it at Bayway, N. J., under the name Vistanex. Selling agent except in the lubrication field is Advance Solvents and Chemical Corp.

When pure isobutylene is polymerized at low temperature in the presence of a catalyst such as boron trifluoride, a series of high molecular weight linear polymers is formed, according to the extent of polymerization. These polymers are chemically almost completely saturated and therefore inert to most types of deterioration.

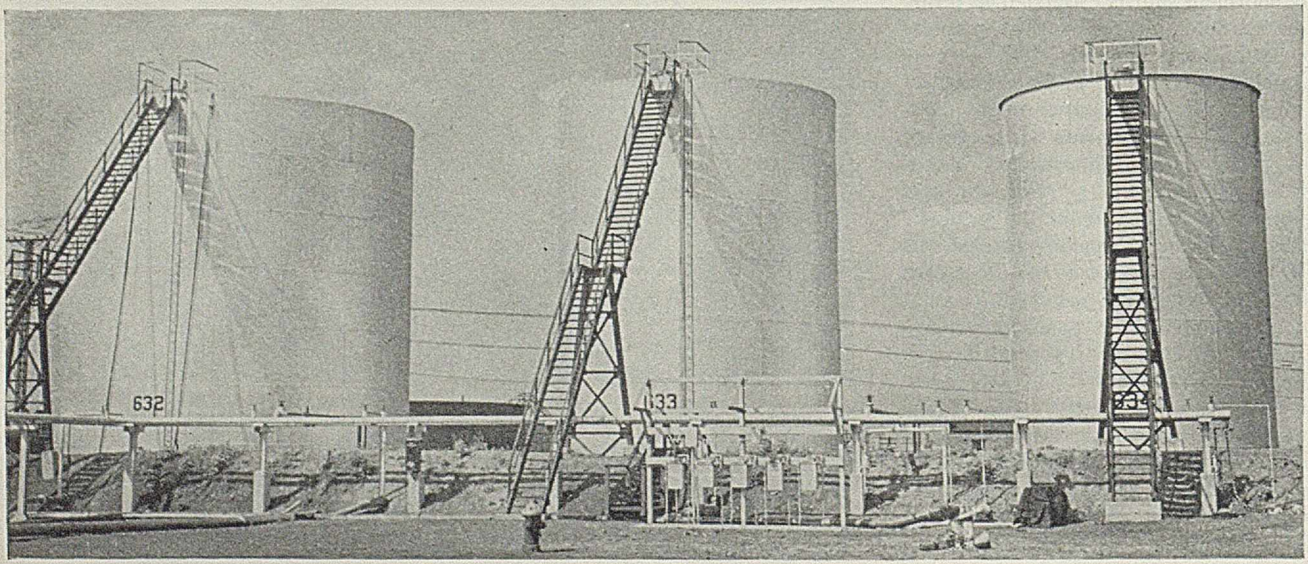
Vistanex has excellent resistance to concentrated acids and most common chemicals except chlorine and bromine. Although inert to ozone, Vistanex, particularly the high molecular weights, depolymerizes under strong sunlight. Under heat it is stable to 100 deg. C., but softens permanently if exposed for long periods above that temperature. It has little or no odor, and is non-toxic.

Unlike rubber Vistanex does not combine readily with sulphur, nor oxidize easily. In tensile strength, rebound, X-ray structure, electrical properties, elastic memory, fractional solubility, and mechanical orientation, Vistanex is similar to rubber. Partial substitution in the rubber mix improves aging, ozone and oxygen resistance, electrical characteristics, resistance to chemicals and to moisture absorption, and decreases swelling in many solvents.

The unvulcanizability of polyisobutylene has led to considerable work both in this country and in Germany on combining it with vulcanizing-type polymers. Standard Oil Development Co. has been active in this field and its combined experience in both polyisobutylene and butadiene "rubber" should be productive of interesting developments. In this direction what appears to offer an interesting and potentially large application of Vistanex is set forth in United States patent No. 2,180,082, issued November 14, 1939, to the I. G. Farbenindustrie A. G. This patent describes the formation of a rubberlike material of extremely good abrasive properties by incorporation of polyisobutylene of from 50,000 to 100,000 molecular weight into the monomer of a synthetic rubber such as chloroprene, butadiene-styrene, or butadiene-acrylic nitrile, and then polymerizing the combination. This procedure presumably makes possible the retention of the valuable properties provided by the long, fibrous molecules of polyisobutylene while introducing the vulcanizing characteristics of the copolymerized materials, and should provide substances with useful properties at low costs. Should a satisfactory and properly priced material thus be developed for automobile tires, a huge market would be open to at least two of the synthetic rubbers.

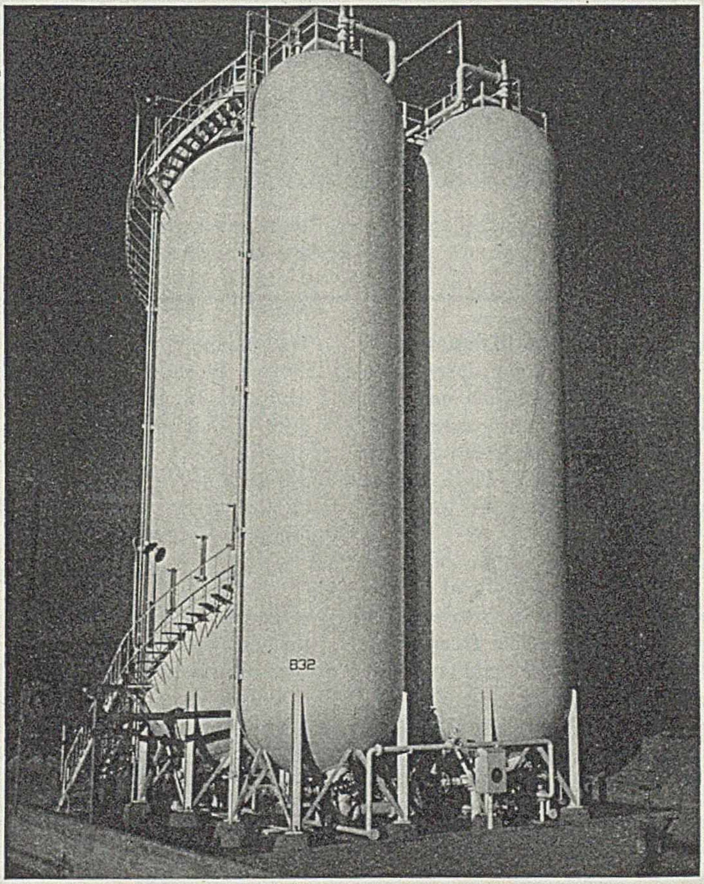
The four principal outlets for Vistanex are in compounding of lubricating oils, in various modifications of paraffin wax such as Parofilm, in rubber compounding, and in the manufacture of adhesives such as tin pastes, paper-backed metal foil, facing of bottle cap liners, and heat sealing compounds. Other uses for Vistanex are in superaging compounds, in compounds for acid resistant articles, in electrical insulation, fabric proofing, and as leather dressings and finishes. Vistanex of high molecular weight of the order of 250,000 is said to possess potentialities as a synthetic fiber. Its present applications are scarcely competitive with rubber. With costs of production on large volume basis said to approach 10¢ per lb., and with development of vulcanizable "rubbers" in conjunction with other materials, Vistanex may become an important factor in competition with rubber.

Storage tanks for Standard Oil's finished polyisobutylene-oil products at Bayway, N. J.



Neohexane for 100-Octane Plus

A new synthetic hydrocarbon made by thermal alkylation surpasses iso-octane itself as a blending agent in aviation motor fuels. Its value hinges on two important properties — high lead susceptibility and high volatility.



Blimps used for storage of liquefied petroleum gas made by the Phillips Petroleum Co. at Borger, Texas. This company has made petroleum history with the invention of a new process—thermal alkylation—whereby neohexane is made from ethylene and isobutane

MELVIN E. CLARK
Assistant Editor
Chemical & Metallurgical Engineering

What is neohexane? A lot of organic chemists mumbled in their beards when asked that question last summer, but now the term has become a byword in the petroleum industry. The prefix *neo* indicates the presence of a carbon atom attached by all four valence bonds to other carbon atoms, according to Dr. F. C. Whitmore's "Organic Chemistry." Then neohexane is merely a hexane containing a neo linkage and there can be but one—2, 2 dimethylbutane.

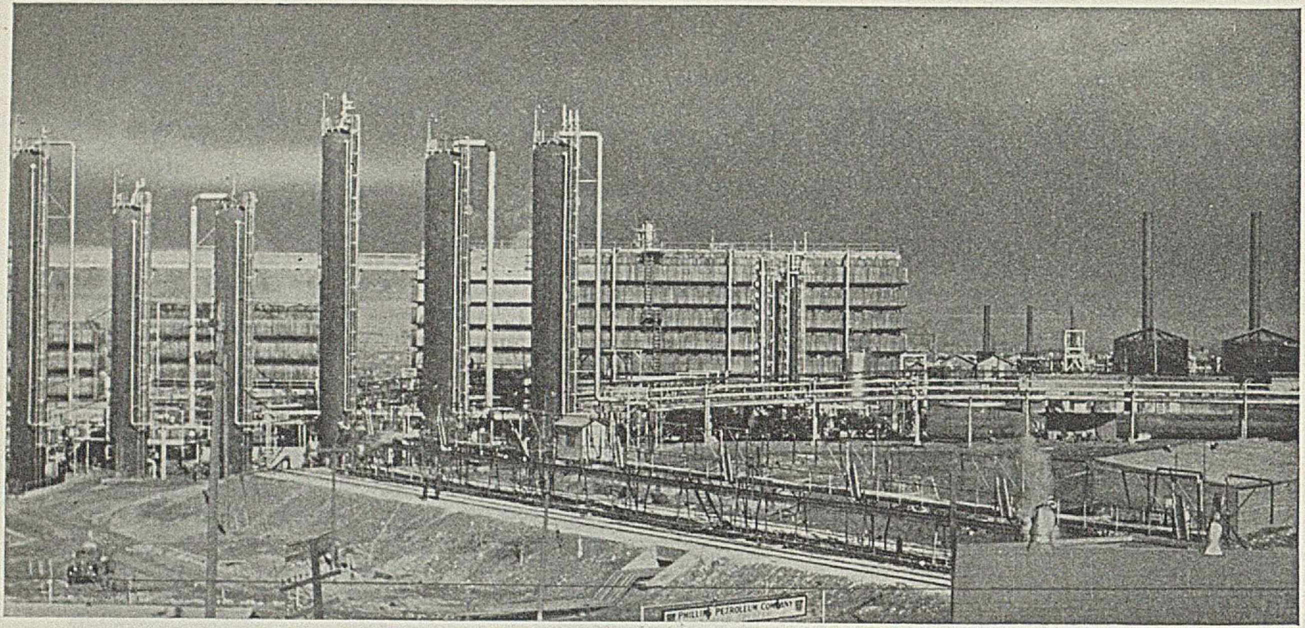
Why this compound should suddenly become so important is an interesting story. Last summer there were faint rumors from New York to Los Angeles that the Phillips Petroleum Co. had developed a new superfuel—a gasoline ingredient that had an octane rating 'way off the scale, probably 125 to 150. Then followed the report that it was called neohexane. Finally the announcement was made by Phillips that the story was partly true. They did have a new high octane motor fuel, it was neohexane, but its octane rating was only 94. However, because of its blending properties, fuels with as high as 115 octane-rating could be made with it.

Now the new industrial chemical—surely it can be called an "industrial chemical" because it is made in substantially pure form by a chemical process—has outgrown its pilot plant. A commercial installation started operating at Borger, Texas, in January, 1940.

At last it is economically feasible to make an aviation gasoline with an octane rating over 100. This will mean better performance and more economical operation for long distance flying. Gustav Egloff has said that the increase from 87 to 100 in octane number allows a plane to carry 1,200 lb. less fuel on a 1,400 mile flight. Seven more passengers or an equivalent weight of mail or freight may be carried instead. This means $2,000 a trip for the China Clipper. The full benefit of the development of fuels over 100 octane rating cannot, however, be realized until higher-compression aviation engines are built.

Properties of Neohexane

If 2,2 dimethylbutane (neohexane) has an octane rating of only 94, what makes it the powerful fuel it is? The answer lies in the two most important properties of the hydrocarbon—high



Panorama view of part of the Borger, Texas, refinery of the Phillips Petroleum Co. shows fractionating towers and the thermal alkylation unit (in the background) where a new super octane aviation fuel is made from refinery gases

lead susceptibility and high volatility. Lead susceptibility is a property of a hydrocarbon which may be measured by the increase in octane number obtained by the addition of a given amount of tetraethyllead. It is the ability of a fuel to respond to "leading."

The accompanying graph shows the effect of adding tetraethyllead to neohexane, to iso-octane and to a 50-50 mixture of the two. The steeper the curve the greater the lead susceptibility. Note that with 3 cc. of TEL, neohexane is equivalent to iso-octane although it was only 94 octane to start compared with 100 for iso-octane. With more than 3 cc. of TEL, neohexane is superior in octane rating. Another important point illustrated here is that neohexane imparts more than its share of lead susceptibility to the mixture. In other words, a 50-50 mixture is more lead susceptible than might be expected.

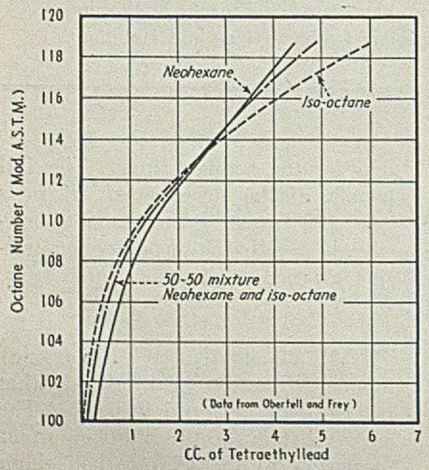
Then There Is Volatility

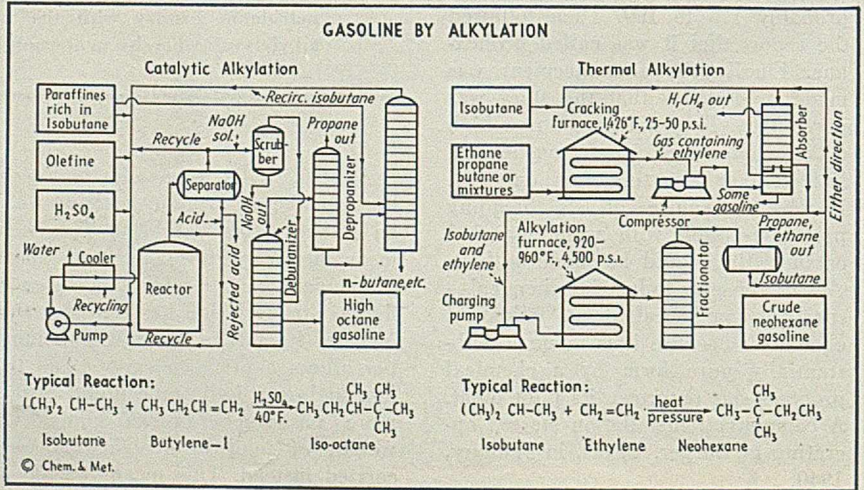
So much for lead susceptibility. If that and cost were the only considerations in blending gasoline, the task would be easy. But unfortunately the factor of volatility enters in.

Gasolines must boil in a certain range which varies somewhat with the grade of gasoline, its use, and the season of the year. Conventional aviation gasolines have an average boiling range of 180-210 deg. F. Most desirable high-octane ingredients have a boiling point much higher than that (iso-octane, 200-240 deg. F.) and so must be diluted with more volatile, less knock-resistant hydrocarbons. This reduces the octane rating of the blend.

Now with neohexane, this condition can be corrected. It boils at 121 deg. F. and also has high octane rating. Therefore, neohexane and iso-octane can be blended (with other hydrocarbons) to yield a blend in the right

At left are lead susceptibility curves for neohexane, for a 50-50 mixture of neohexane and iso-octane, and for pure iso-octane. The steepness of the curve indicates the better lead susceptibility of neohexane. At right is a flow diagram showing both the catalytic and thermal alkylation processes. Note the differences in temperature and pressure





boiling range and with much higher octane number than heretofore attainable.

Properties of Neohexane

Reid vapor pressure, lb	9.5
A.P.I. gravity	84.9
A.S.T.M. octane number	94
Boiling point, deg. F.	121.5
Specific Gravity (20/4 deg. C)	0.6494
Refractive index n_D 20 Deg. C.	1.36887
Freezing point, deg. F.	—144.8

Thermal Alkylation

The commercial process by which neohexane is made is called *thermal alkylation*. It was developed through the pilot plant stage by the research department of Phillips Petroleum Co. The reactions involved are, as in all petroleum processes, quite complex; but the most important reaction is that indicated on the flow sheet.

This is an alkylation reaction—the combination of an olefine with a paraffine. It is carried out at high temperature and high pressure in the presence of an excess of iso-butane.

Of course the process as commercially practiced does not use C.P. ethlyene or isobutane. The ethylene is derived from a mixture of paraffine gases which may include methane, ethane, propane and butane, by cracking in a tube furnace at 1,425 deg. F. and a pressure only a few pounds above atmospheric.

Products of this reaction are cooled and compressed. Heavier fractions are drawn off at this point in the form of gasoline. Ethylene, the main product of the cracking operation, is absorbed in isobutane and charged to the alkylation furnace. This is another tube coil furnace with the ethylene-isobutane mixture forced in through a number of inlets (not shown on flow sheet). A separate stream of preheated isobutane is also injected into the reaction space in the furnace where the temperature is 950 deg. F. and the pressure is in the range of 3,000-5,000 lb. per sq.in.

There are a number of products of this reaction which are separated in fractionators. Propane, ethane and any lighter products are purged from the system. Isobutane is recirculated. Neohexane and heavier products leave the process as crude neohexane gasoline to be further refined.

From this crude alkylate cut it is possible to fractionate substantially pure neohexane as well as other hydrocarbons, making the process virtually a chemical synthesis. The accompanying table shows the difference in boiling points which makes neohexane easily separable from other parts of the mixture.

Hydrocarbon Boiling Points

	Deg. F.
Isopentane	82.3
n-Pentane	96.8
Neohexane	121.5
2,3-Dimethylbutane	136.6
2-Methylpentane	140.4
3-Methylpentane	145.8
n-Hexane	155.8

In the accompanying flow sheet the author has shown the steps in the catalytic alkylation process as well as the thermal process so that the likenesses and differences may be observed. Catalytic alkylation reached the commercial stage just a step ahead of thermal, the first units beginning operations last summer.

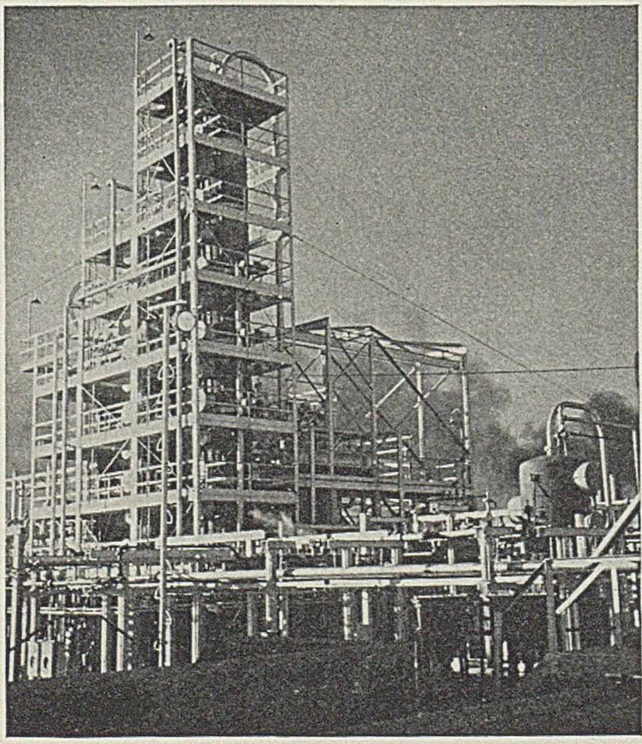
Not the Last Word

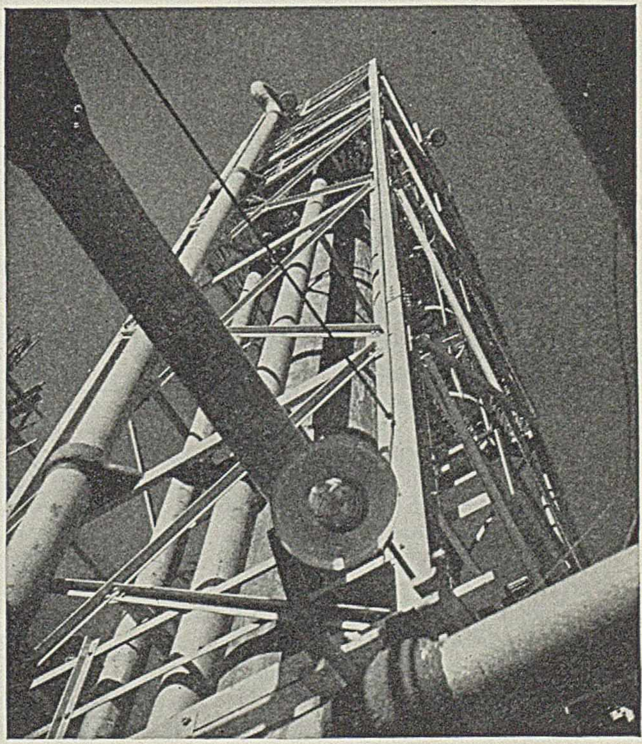
Such are the methods by which high-octane gasolines are made today. But the final chapter in this story has by no means been written. In all probability neohexane, like other valuable hydrocarbons will eventually be made by catalytic methods at much more normal temperatures and pressures. When the ultimate has been achieved with this compound, still other more highly knock-resistant compounds will make their appearance.

Even now petroleum chemists talk of making such hydrocarbons as tetramethylbutane and 2,2,3-trimethylbutane, compounds whose octane ratings are at least 125. Both are often thought of as the ultimate in motor fuel possibilities. As yet their commercial manufacture is only a dream, but chemists and engineers do a lot of research on dreams these days.

G. G. Oberfell and F. E. Frey describe thermal alkylation and the properties of neohexane mixture in greater detail in Oil & Gas J., Nov. 23 and Nov. 30, 1939.

Fractionation of crude neohexane is performed in distillation columns similar to these in Phillips' Borger refinery





Symposium Considers Drying of Air

Three papers dealing with the drying of air and gases by dehumidification methods, presented at a recent A.S.M.E. meeting, are briefly summarized here. Use of absorptive solutions, silica gel and activated alumina, are the subjects considered.

Evidence of rapidly increasing interest in the use of adsorptive and absorptive dehumidification for air and gases was presented on March 19 in New York at a Metropolitan Section meeting of the American Society of Mechanical Engineers, arranged by the Society's Process Industries Division. Three papers were offered to an interested group of about 100 engineers.

The first paper, prepared by James C. Patterson, manager of the Dehydration Division of the Carrier Corp., Syracuse, N. Y., was a general one, discussing the need for direct dehumidification by means of solid adsorbents and liquid absorbents, as distinguished from the use of refrigeration alone. The paper pointed out that dehumidification applications for solid adsorbents such as silica gel and activated alumina, and liquid absorbents such as lithium chloride and calcium chloride, are becoming an increasingly important factor in the molding of air conditioning practice. Almost any percentage of the total moisture content of air or other gases can be removed by this method without the use of mechanical refrigeration, or the need for reheating.

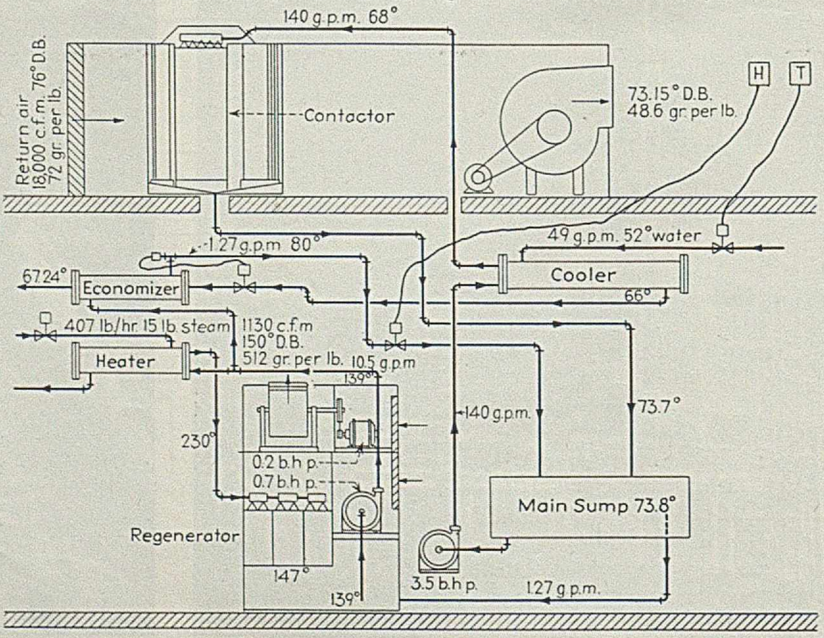
Dehumidifying by physical adsorption or chemical absorption converts the latent heat of the moisture removed from the air to sensible heat, with a corresponding rise in the dry bulb temperature. If the temperature of available water cannot accomplish the subsequent cooling, a relatively small amount of mechanical refrigeration can be used, or evaporative cooling. Of course, with refrigeration alone, the extent of moisture reduction is dependent upon the extent of temperature reduction, while with dehumidification by adsorption or absorption, the degree of dehumidifying is not a function of temperature reduction. Therefore direct dehumidification is indicated particularly where it is necessary to control the humidity independently of the dry bulb temperature; where a comparatively large part of the total load is latent heat; where economies can be obtained through the use of gas fuel or steam in the dehumidifying phase; or where cold water is available for cooling.

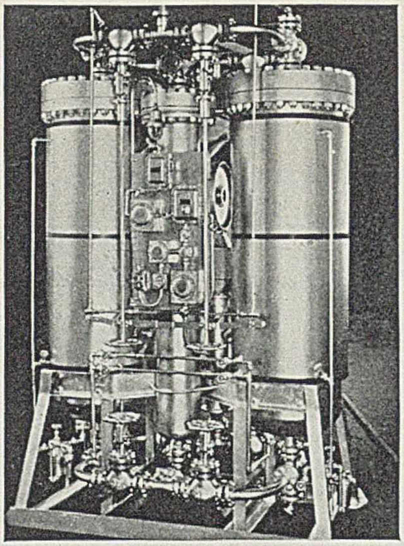
The author pointed out that solid adsorbents adsorb moisture or other condensable vapor by surface attraction and capillarity and condense the vapor until the vapor pressure of the liquid already condensed approaches the partial pressure of its vapor in the air. Application of heat readily reactivates the adsorbent. In the case of absorption, the solutions used have a lower vapor pressure of water than the partial pressure of water in the air and so when moist air is brought into contact with such a solution, the lower vapor pressure of the liquid tends to approach the higher vapor pressure of the air with a consequent exchange of moisture from air to absorbent. Constant moisture removing ability can be maintained by changing either the temperature of the solution or its density, the latter by reconcentrating the recirculated solution by the application of heat. If desired, moisture can be added to air by raising the temperature or lowering the concentration of the solution.

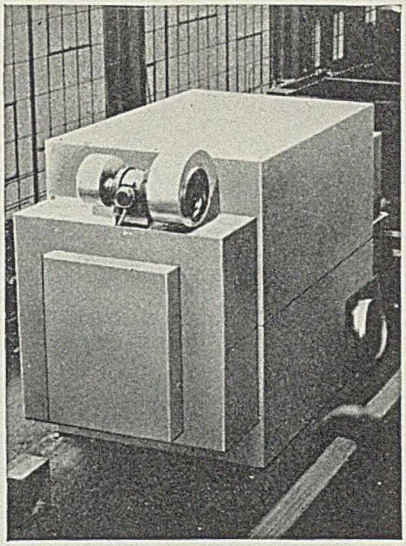
As between various types of chemical dehumidification, there is no "best" method. The choice depends upon the type of application, desired performance, fuel costs and other factors. Generally speaking, solid adsorbents become more desirable as the extent of dehumidification required increases. Final choice among refrigeration and any of the dehumidification methods must, in the last analysis, be based upon lowest overall cost, including initial and operating costs.

Normally, it may be considered that both dehydration and refrigeration require approximately the same amount of cooling water for producing equivalent work. With water available below 65 deg. F., the selection of dehydration equipment becomes desirable. Even with relatively high water tem-

Lithium chloride system maintaining air conditions for a dryer







Left—Pressure type activated alumina gas dryer
Right—Air conditioning type activated alumina adsorber for air

perature, chemical methods may be preferable where a high latent heat load exists, even if supplementary refrigeration is required. Some of the cases particularly indicating dehumidification in industrial applications are where: (a) conditions to be maintained are below the equivalent of 45 deg. F. dewpoint; (b) dry bulb temperatures above 85 deg. F. or below 60 deg. F. are required with relative humidity from 10 to 50 per cent; (c) fixed relative humidity is required with wide-range dry bulb temperature variations permissible. Among numerous known applications for dehydration equipment may be mentioned the manufacture of automobile safety glass, drying of air for cupola blast, drug manufacture, explosives manufacture, film, fish and gelatine drying, manufacture of leather, crayons, plastics and numerous other products.

The second paper, presented by E. A. Windham, engineer of the Air Conditioning Div. of Surface Combustion Corp., Toledo, Ohio, described the use of lithium chloride solutions for humidity control and gave figures relating to several specific installations. Lithium chloride solutions absorb moisture from the air owing to their low vapor pressure. For example, the commonly used 44 per cent solution of lithium chloride has the same vapor pressure at 90 deg. F. as water at 34 deg. F. By maintaining a 44 per cent concentration and controlling the temperature of the solution, either humidification or dehumidification can be accomplished. The system comprises a closed circuit of plate type contactor cell, regenerator for the lithium chloride solution, heat exchangers for heating and cooling the solution, heating or cooling coils for the air, circulating pumps and fans.

In the contactor, the humid air passes between plates which are sprayed with lithium chloride solution of the desired temperature and concentration. The solution, containing the absorbed water and heated with the latent heat of this water, flows to a sump from which it is recirculated, part going to a concentrator or regenerator, and part through a cooler (or sometimes a heater in winter) and back to the contactor. The regenerator is a plate type contactor through which regenerating air is drawn by a fan. That part of the solution passed through the regenerator is first heated to a relatively high temperature to raise its vapor pressure so that the regenerating air may sweep out the water vapor to the desired extent.

Control of the regenerator is accomplished by a density regulator which throttles the regenerating steam supply. Sometimes the lithium chloride sump is incorporated in the regenerator, sometimes it is separate. In some installations the solution cooler is operated to deliver solution of constant temperature to the contactor. In other cases, a varying temperature depending upon relative humidity is required, in which case the solution temperature is varied by a humidistat located in the leaving air stream.

One important type of application of lithium chloride can best be understood by examining the accompanying diagram, which represents a drying tunnel installation using recirculated air where constant dry bulb temperature and relative humidity are to be maintained. This installation employs a separate sump and controls the air temperature by a thermostat which regulates the cold water supply. The leaving air moisture content is regulated by a humidistat controlling the addition of concentrated solution to the circulating solution contained in the main sump.

Activated Alumina Uses

In the third paper, G. L. Simpson, vice-president and general manager of the Pittsburgh Lectrodryer Corp., Pittsburgh, Pa., described a large number of applications of activated alumina for the drying of air and other gases. Mr. Simpson pointed out that by this means moisture removal efficiencies up to 99.9 plus per cent are available. Furthermore, such a system is readily adaptable to high operating pressure and gases are now being dried at pressures up to 3,500 lb. per sq. in. An additional advantage is that almost any available source of heat may be used for reactivation. Steam pressures as low as 15 lb. per sq. in. are being used for this purpose while hot waste gases, natural and artificial gas and electric heat are also used under appropriate circumstances.

In general, two types of activated alumina equipment are employed: (1) machines for drying air or gases from atmospheric up to high pressure on an intermittent basis, using one or more adsorbers for a period of hours and switching manually, usually to a fresh adsorber, when one has adsorbed to capacity; (2) the air conditioning type, intended primarily for partial dehumidification of air at about atmospheric pressure, for comfort and industrial air conditioning, and for large-volume drying of gases, or air for dryers.

The first class of equipment is being used for drying of controlled atmospheres for metallurgy; drying hydrogen for sintering furnaces; drying compressed gases; drying compressed air for dehydrating refrigeration equipment; drying air for liquefaction; and drying organic vapors. Natural gas drying to prevent the formation of hydrates in transmission lines is accomplished in this manner. The air conditioning type is being used in the pharmaceutical industry for producing air of low relative humidity for the tabletting, granulating and storage rooms and the coating pans. It is being used in producing dry air for the drying of materials which must be processed at a relatively low temperature.

How Specialty Lubricants

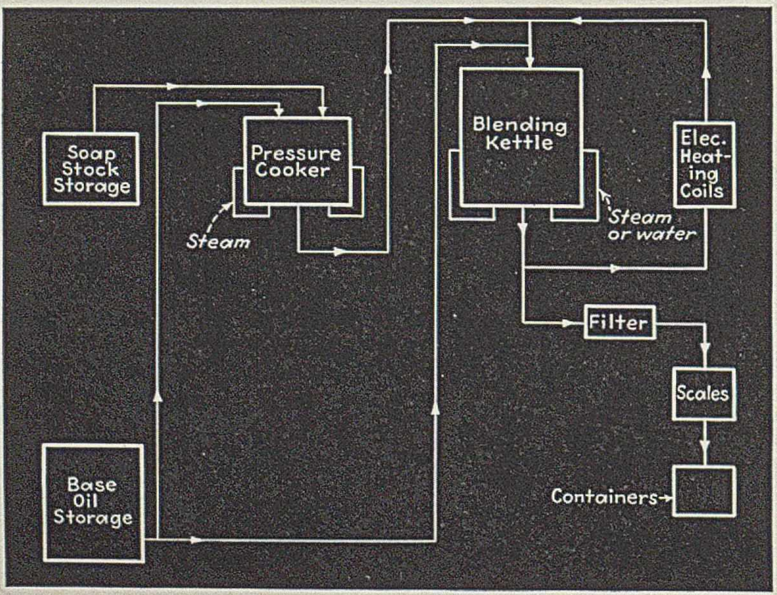
In recent years the making of lubricants has become more and more a chemical manufacturing process instead of a refining operation. Specialty lubricants in the form of oils and greases with chemicals added are made by The Lubri-Zol Corp., Cleveland, for use in hypoid gears, diesel engines and elsewhere.

D. M. CONSIDINE
Chemical Engineer
Cleveland, Ohio

During the past ten years the requirements of lubricants for automotive and various industrial uses have exceeded the capacities of untreated mineral oils and greases formerly suited for nearly all applications. The advent of the hypoid gear in motor car and heavy commercial equipment design, plus increased engine compression ratios and the extremely high temperatures and pressures encountered in diesel engine operation have increased the demands made of lubricants. The significance of the growing need for special lubricants was appreciated early by the founders of The Lubri-Zol Corp. of Cleveland, Ohio, organized twelve years ago for the study and production of additive compounds and lubricants applicable to such problems.

Extensive research offered the only practical method for the development of these products and Lubri-Zol adopted a costly research program which has remained one of the basic policies of the organization. Research in the chemical laboratory has served to discover and develop new materials for the addition to mineral oils qualifying the treated oils for use under extreme conditions. A laboratory in which untreated and treated oils are tested under actual operating conditions was established at the Case School of Applied Science with the cooperation of the Department of Mechanical Engineering. A series of single and multi-cylinder gasoline engines and a single and multi-cylinder diesel engine are used for testing crankcase lubricants. Automobiles, a Chevrolet, a Packard and a Cadillac, are used in shock testing hypoid gear and transmission lubricants. These tests are carried on over long periods of time after which the qualities of the lubricants are determined by an examination of the conditions of the pistons and rings and the tooth surfaces of the gears. Although the test set-ups in the laboratory are comparable to road testing, actual testing is carried on in cooperation with owners of large fleets of trucks and buses.

Steps in the manufacture of grease as carried out in the plant of the Lubri-Zol Corp., Cleveland. Lime, soda, and aluminum soap greases are made here

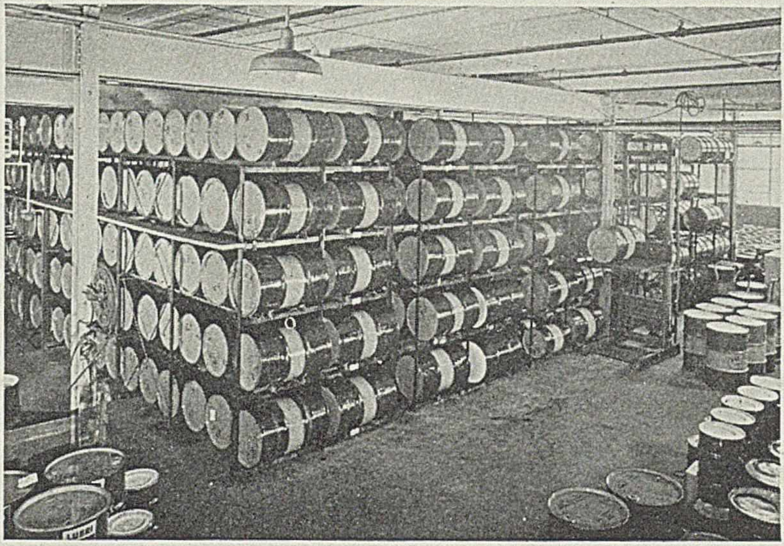


Additives for Gasoline

Service and experience are as much the product of Lubri-Zol as are the various additive compounds which it markets and licenses, as additives are recommended for use only after the refiner's untreated oil has passed extensive laboratory tests and the proper blend of additive materials and treatment has been selected and proven satisfactory. Refiners are striving to improve their lubricants and reduce engine wear by blending the proper additive materials with the untreated oil. Lubri-Zol also manufactures additive compounds for the treatment of gasoline imparting high gum solvent characteristics to the treated fuel.

The functions of additive compounds are fourfold, consisting of (1) improvement of the load carrying capacity of the lubricant, (2) reduction of friction under high loads, (3) maintenance of the chemical stability of the lubricant at elevated temperatures and pressures and (4) prevention of corrosion. Additive concentrates are organic in nature and may consist of as many as five or six constituents. The concentrate does not have merely the summation of the effects which each separate constitu-

Are Made



Lubricants with chemicals added to impart special properties are stored in neat barrel racks as shown above. Note the movable rack loader at right

ent would have if used alone, but produces results which are the cooperative effect of the several ingredients. In other words, the concentrate is endowed with properties which can only be achieved by virtue of the modifying effect of each ingredient on the other ingredients. The concentrates are added in varying proportions to the fuels or lubricants under treatment. Approximately ½ to 1 per cent by weight of additive materials is added to treated gasoline, 2 to 4 per cent to motor oils and as high as 8 to 10 per cent to gear lubricants.

Hypoind Gear Lubricants

There are three general types of treatment used in the manufacture of hypoid gear lubricants, namely, (1) lead soap, active sulphur, (2) lead soap, sulphur saponifiable, chlorine compound, and (3) organic sulphur compound, chlorinated organic compound. Calcium dichlorstearate, an example of the latter type, is manufactured by Lubri-Zol for use in the treatment of lubricants for Caterpillar diesel engines.

Dr. C. F. Prutton, professor of chemical engineering at the Case School of Applied Science, has been connected with the corporation in the capacity of consultant since 1928. Dr. Prutton and Mr. Kelvin Smith are responsible for the majority of patents taken out in this field. Professor A. O. Willey of the Mechanical Engineering Department at Case School has been a consultant for the corporation since 1934 and has been responsible for the major work done along the lines of actual mechanical testing of untreated and treated lubricants.

Processing operations at the plant in Wickliffe, Ohio, are segregated into three classes consisting of the preparation of intermediate chemicals, blending intermediates of their own preparation with those purchased from outside chemical manufacturers to produce concentrates, and manufacture of finished lubricants, including special greases, motor oils and industrial lubricants. Certain of the intermediate chemicals blended in the concentrates are produced from suitable raw materials while others are purchased. The operations are essentially batch although there are features of some of the equipment which make that particular phase of the processing automatic and continuous. The equipment has been installed to lend the optimum flexibility with the large volume and variety of products prepared with the equipment at hand.

Storage of Liquids .

Both outside and underground facilities are provided for the storage of liquid raw materials. Liquids are unloaded by gravity from tank cars to one of the ten steel tanks comprising a part of the 150,000 gal. underground storage. Storage facilities above ground consist of five 12,000 gal. and two 25,000 gal. tanks. The tanks are heated by submerged type tank heaters and a booster pump is provided at each tank in combination with four larger pumps located in the pump house for discharging the tanks. Piping and arrangments in the pump house have been designed to allow maximum flexibility and liquids may be pumped directly from the storage tanks to all large vessels in the plant. Storage space for solid raw materials is provided in a room 60x100 ft. which is maintained at a temperature just above freezing during the winter months.

Preparation of Intermediates

Preparation of intermediates from the raw materials requires such processing as mixing and reacting at ordinary and elevated temperatures, atmospheric and vacuum distillation, dehydration, washing and filtering. All intermediates do not require the same treatment and many items of equipment are designed and installed for the purpose of performing various operations.

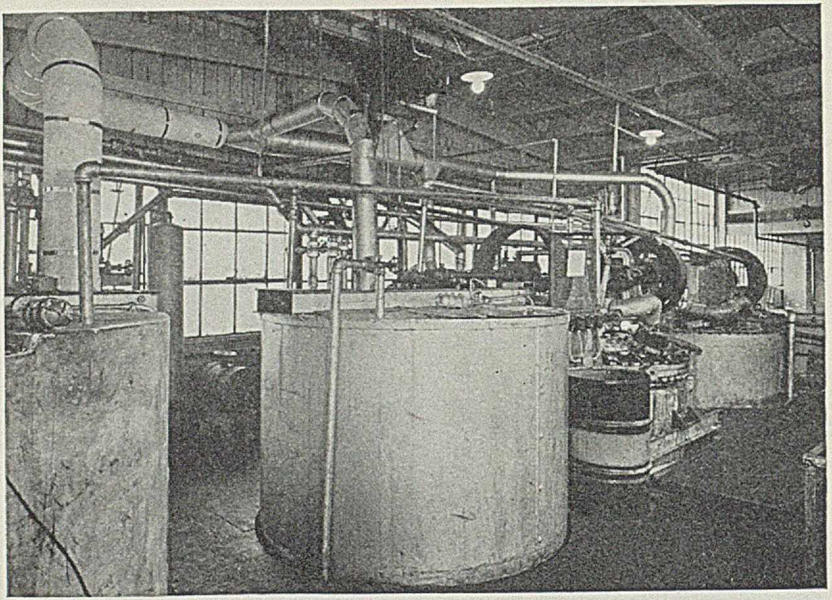
Liquid raw materials usually are pumped to one of three covered steel tanks of 3,000 gal. capacity each. These tanks are used for mixing, reacting and washing. Hot water for reactions and washing is supplied to these tanks by a Ross heat exchanger of a 50 g.p.m. capacity. The tanks are well insulated and an auxiliary steam jet is installed to make up any heat losses. Each tank is equipped with a propeller type mixer and remote temperature indicating and recording instruments. The tanks are connected in series and the material being processed may pass from one tank to another in a cycle operation.

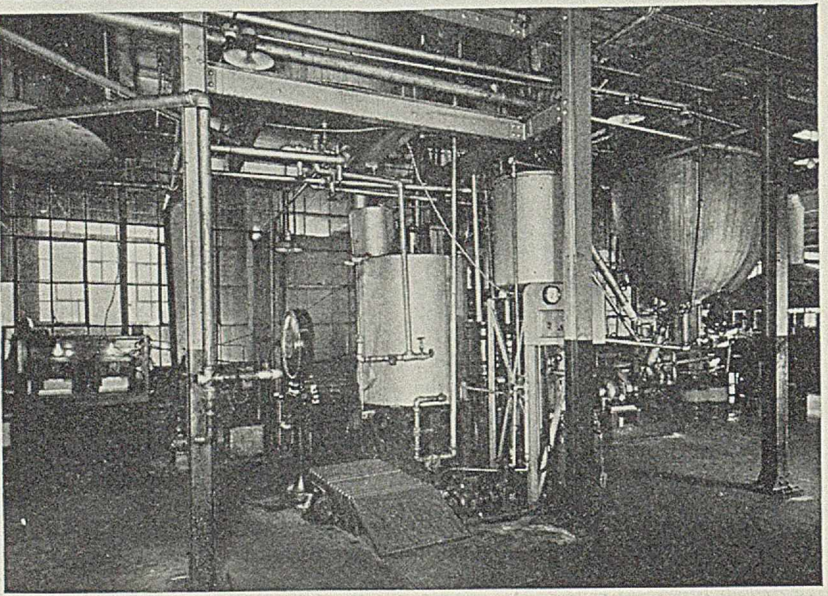
Dehydration is carried out in a steam-jacketed 2,000 gal. steel kettle equipped with an individually motor-driven planetary type agitator.

Materials requiring distillation are processed in a steam-jacketed, glass-lined still of 300 gal. capacity in connection with a 3-in. water-jacketed glass vapor column and a water-cooled pipe coil condenser. Distillation may be carried out at atmospheric pressure or under a vacuum, with remote temperature recording of both still and column.

This apparatus may be used as a still or reaction vessel. The still is equipped with a propeller-type agitator for use when the equipment is used as a reaction vessel. Gases given off during reaction are pumped from the top of the vapor column to a limestone packed stoneware absorption tower equipped with a water spray nozzle at the top. The neutralized gases in water solution are discharged to a drain. As the gases given off are dry, corrosion is a minimum consideration and an ordinary 1-in. iron pipe is used to connect the column with the absorption tower.

Cooking and blending are carried out at elevated temperatures in one of three steam-jacketed kettles. One 1,700 gal. Dopp steel kettle is operated at atmospheric pressure and is equipped with double-motion scraping type agitation. A temperature of 300 to 350 deg. F. is maintained when the kettle is heated with steam and a temperature of 450 deg. F. may be reached when the material being processed is continually recirculated through electrically heated coils. Materials requiring cooking under pressure are processed in a Dopp pressure cooker of 300 gal. capacity. Cooling in both kettles is accomplished by running cold water through the jackets. The two vessels in addition to a 2,000 gal. steam-jacketed steel blending kettle, are driven from a line shaft belted to a 20 hp. electric motor. A vent pipe connected to a central duct and blower is provided for each kettle. An electric crane serves all three kettles and the dehydrator mentioned previously. The tops of the kettles are reached by means of a platform. Temperature and pressure recording instruments and manual controls for each kettle are provided at that level. The pumps supplying the kettles can be controlled directly from the platform as well as from the pump house. A three-station telephone system provides ready communication between pump house, blending deck and laboratory. This equipment is used for blending some concentrates and for cooking solid greases, as well as for the preparation of intermediate chemicals from raw materials.





Steam-jacketed kettles, shown above, are used for cooking and blending the raw materials. Top view is taken from the control platform; bottom shows main floor

Blending and Proportioning

Intermediate chemicals are blended in exact proportions according to the specifications reached as a conclusion from the research findings and data. The constituents are proportioned by volume and mixed by means of a Lummus-Cornell homogenizer. When solid materials are added to the concentrates they are dissolved in suitable solvents, usually one of the other constituents, and then proportioned just as the other liquids through the electrically driven proportioning pumps.

The proportioning pumps are a part of the homogenizer unit and at the Lubri-Zol plant there are three units of pumps. The first unit consists of five pumps, three small and two large, all equipped with vernier settings giving facilities for proportioning five materials at one time. The two other units consist of four large pumps and two small pumps each. An indicating thermometer and presure gage is mounted on each pump and a clutch arrangement on the pump drive allows the use of any number of the pumps of each unit at any one time. All inlet and output lines on the units are equipped with recording volume meters so that a permanent record of all mixtures may be obtained and filed for future reference. The first unit is capable of pumping a proportioned volume of 30 g.p.m. while the latter two units each have a capacity of 25 g.p.m.

Automatic Homogenizer

The homogenizer proper consists of a 150 gal. aluminum tank operated under a 28-in. vacuum. Suspended approximately five inches from the top of the tank is a concave disc capable of rotating at a speed of 1,500 r.p.m. The combined liquids from the proportioning pumps are fed to the center of the disc whereupon they are stretched into a thin film which impinges upon a collector ring causing a violent turbulent action and complete mixture and homogeneity of the constituents. The homogenized film is conducted to the bottom of the tank from which the collected liquid is pumped either to an outlet for filling of drums or directly to tank cars.

The operation of the homogenizer is automatic, allowing an entire tank car to be filled after setting the proportioning pumps. The liquid level in the homogenizer is maintained within definite limits by means of a float controlling the output of the pumps. The pump which discharges the homogenizer is controlled by a pressure switch located between the discharge of the pump and the outlet valve. When filling drums, the homogenizer tank itself acts as a surge tank and the intermittent opening and closing of the outlet valve does not affect the automatic operation. Proportioning units are equipped with air traps in the feed lines which automatically cut off the pumps when a definite quantity of air is present in the lines. This device prevents entrained air from passing through the pumps and affecting the proportioned quantities.

No Cooking at the Refinery

The concentrates are prepared so that they can be blended readily with mineral oils at the refinery without further elaborate cooking and treatment. The homogenizer allows the mixing and blending of both light and heavy materials without the addition of heat and is economical from the standpoint of both heat and time consumption. Operation of the homogenizer under a vacuum minimizes air entrainment in the finished product. Samples are taken periodically during the operation of the homogenizer to check for uniformity of blends.

Manufacture of Grease

In the manufacture of soda or lime soap grease, the solid soap stocks are conveyed from storage and charged into the 300 gal. pressure cooker. A volume of base oil is also pumped into the pressure cooker and the contents are saponified at an elevated temperature and pressure. This process requires approximately two hours. The soap thus formed is blown into the 1,700 gal. steam-jacketed kettle and blended and cooked with another portion of base oil pumped from the oil storage. The contents are heated and mixed for approximately three hours, after which time the steam is turned off, water circulated through the jacket and the contents cooled. When discharging the finished grease from the kettle, the grease is passed through a Cuno edge type filter. It is then weighed and packed into 25 lb. pails, or 100 and 400 lb. drums for shipping. Aluminum base greases cannot be cooled in the kettle itself but require cooling in trays where they congeal at room temperature.

The steam generating equipment at the plant consists of one stoker-fired 150 hp. tubular boiler capable of developing 125 lb. pressure. This boiler serves to heat the plant and is used for normal heating processes. The plant is heated by means of unit type thermostatically controlled steam heaters. A 30 hp. oil-fired boiler capable of developing 150 lb. pressure is used for processes requiring a higher temperature and may be operated intermittently, as it is shut down and re-fired easily and quickly. Both boilers are completely automatic in operation. Higher temperatures for heating liquids during processing are obtained by the use of a coil pipe heater consisting of four coils made of 3-in. steel pipe. An electric immersion heater is inserted in the end of each coil and the pipes are wrapped with strip heaters. The entire apparatus draws approximately 200 amp. of current and heats materials to approximately 460 deg. F. when operating at its maximum. It is thermostatically controlled and the temperature is recorded continuously. The materials from the two Dopp kettles are continuously recirculated through the heater at the temperature required for the blending or reaction process being effected.

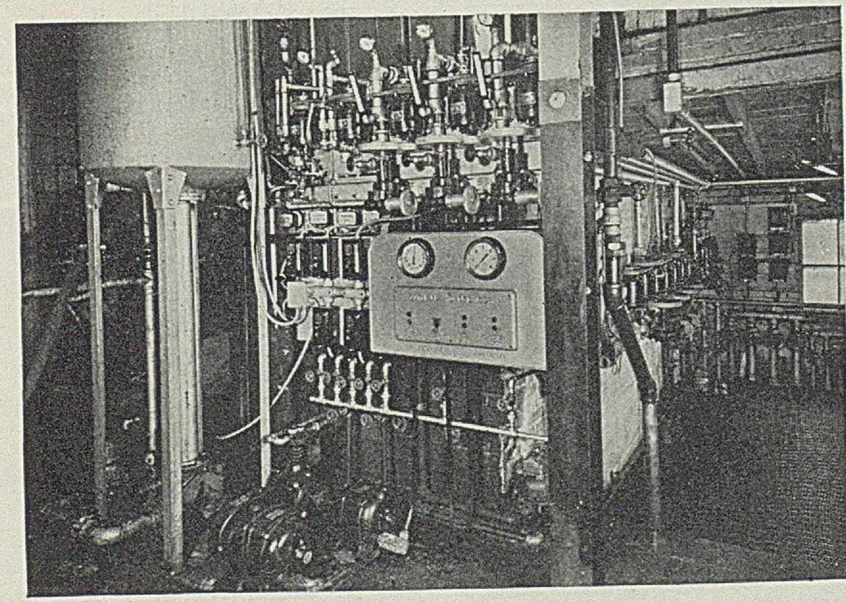
Ample Fire Protection

The plant is equipped with automatic sprinklers throughout and all kettles are equipped with water shedding covers for fire protection. In addition to the sprinkler system of protection, Foamite extinguishers are stationed throughout the plant and a 50-gal. portable foam extinguisher is at hand.

The main building is of steel and brick construction with a steel superstructure. The storage room is of steel construction with corrugated sheet metal side walls. The plant is located on a siding of the New York Central Railroad and approximately 300 ft. from a main highway. Separate loading platforms for box cars and trucks are maintained.

A control and research laboratory is located at the plant while the corporation maintains a chemical research laboratory in Cleveland, as well as the testing laboratory at Case School. Approximately 6,000 tons of products are shipped from the Wickliffe plant annually. The Company and its affiliated companies employ 40 chemists and research men and 35 salesmen, all chemical engineers, in addition to the plant and office employees.

Grateful acknowledgment is made to Mr. Arch L. Foster and to Mr. Harry E. Johnson, Plant Superintendent, who lent their wholehearted cooperation in the preparation of this article.



Intermediate chemicals are added to the lubricant in exact proportions by means of the Lummus-Cornell homogenizer and proportioning pumps shown in this view

Vaporization Equilibria

A year ago Chem. & Met. *published a chart for shortening the time required for equilibrium calculations. In the present article the time is cut still further by new charts which eliminate all but three of the preliminary trial calculations.*

MITCHELL GILBERT

Chemical Engineer

Rouses Point, N. Y.

Lengthiness of solutions to problems in equilibrium vaporization for multi-component mixtures makes graphical methods desirable. Mindful of the fact that a certain amount of computation is unavoidable, the graphical method described herein attempts to minimize the latter. Most cut and try calculations require time out of proportion with the relative importance of the solution. When an engineer is slightly off stride, the trial and error method with its test calculations becomes an exceedingly painful affair. A maximum of three tries will suffice in the method described. It is felt that for mixtures of more than five or six components, as is often the case, the decreased number of tries and calculations should be advantageous. The working quantities have been chosen so that there is conformity with the units encountered most often.

The theory upon which the method is based is derived here for complex mixtures following Henry's and Raoult's laws, where the vapor pressures lie between those of the pure components.

Henry's law, the more general relationship may be stated as:

$$y = Kx \qquad (1)$$

$y, x =$ the mol fractions in the vapor and liquid state, respectively, for a given component.

$K =$ an experimentally determined constant for a given component.

Raoult's law, a special case of Henry's law, may be stated as:

$$y = (P/\pi)x \qquad (2)$$

$P =$ the vapor pressure of any component at the given temperature.

$\pi =$ the total pressure of the system.

Consider now a multi-component system where the original feed of X mols is vaporized at pressure, π, and temperature, t. Material balances, on a mol basis, can be made. (Subscripts denote components).

Feed, $X = X_1 + X_2 + X_3 + \ldots\ldots X_n$ (3)

Residue liquid, $L = L_1 + L_2 + \ldots L_n$ (4)

Resulting vapor, $V = V_1 + V_2 + \ldots V_n$ (5)

$X = V + L$ (6)

$X_1 = V_1 + L_1$ etc. (7)

Applying Henry's law for any given component:

$V_1/V = K_1 L_1/L$ (8)

Eliminating V_1 between (7) and (8), solving for L_1:

$L_1 = X_1/(K_1 V/L + 1)$ (9)

Equation (4) may be rewritten as:

$L = X_1/(K_1 V/L + 1) + \ldots\ldots\ldots\ldots + X_n/(K_n V/L + 1)$ (10)

Designating the denominators of the right hand terms of equation (10) as Q_1, Q_2, Q_3, etc., we may condense (10) to

$$L = \Sigma X/Q \qquad (11)$$

Now if we assign a range of values to K and plot V (in mol per cent) vs. Q, a family of curves is established. (Fig. 1) The abscissa is V, in per cent. The ordinate is $(KV/L + 0.1)$ in order to increase the clarity of the curves for the lower values of K. Hence, where it is significant in the calculation, the graphical value of Q must be corrected by the factor, $+0.9$.

In order to determine V, the mol per cent vaporization for a given mixture, first determine X, P and K for each component, from available data. Then assume three values for V over a range straddling the expected true value. For each value of V, determine Q (corrected if necessary) for each component using the appropriate K curve on Fig. 1. Determine L from Equation (11). Also determine L by simple calculation using the assumed value of the per cent vaporization, V.

In Fig. 2 are plotted the assumed and graphically determined $\Sigma X/Q$ vs. the assumed values of V. Two curves are obtained, one obviously a straight line, the other a curve depending on the slope of the dominant K curve for the mixture over the chosen range. The intersection of these two curves is the desired value of V.

An illustrative example will make clear the use of the plot and the method of solution. (The correction factor of $+0.9$ has been applied to the graphical values of Q.) Given: Hydrocarbon mixture distilled at π = 75 lb. per sq.in.abs., and t = 125 deg. F.

A study of the vapor pressures indicates that the probable value of V lies between 40-60 per cent. Assume

(Please turn to page 249)

Table I

Wt. component lb.	Mol Wt.	P, lb. per sq. in. abs.	X. mols feed	K
C_3H_8 – 575	44	255	13.08	3.4
C_4H_{10} – 450	58	77	7.75	1.03
C_5's + – 850	78	15	10.90	0.2
			31.73 mols	

Table II

V=35 per cent; L=65 per cent=20.61 mols

Component	Q	X/Q
C_3H_8	2.84	4.60
C_4H_{10}	1.58	4.90
C_5's +	1.11	9.82
		L = 19.32 mols

Table III

V=45 per cent; L=55 per cent=17.43 mols

Component	Q	X/Q
C_3H_8	3.80	3.44
C_4H_{10}	1.87	4.14
C_5's +	1.165	9.35
		L = 16.93 mols

Table IV

V=55 per cent; L=45 per cent=14.27 mols

Component	Q	X/Q
C_3H_8	5.18	2.52
C_4H_{10}	2.30	3.37
C_5's +	1.245	8.75
		L = 14.64 mols

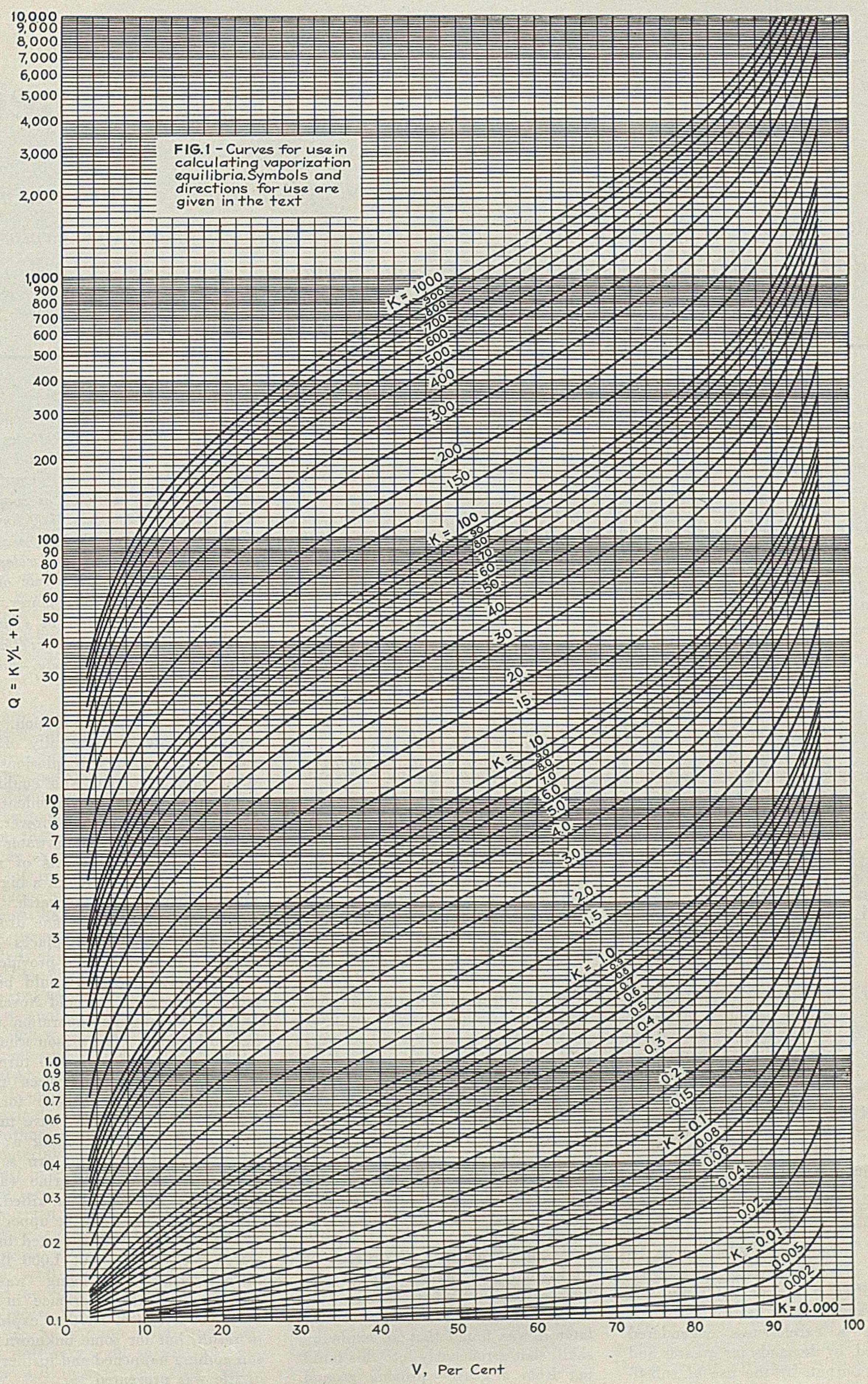


FIG.1 - Curves for use in calculating vaporization equilibria. Symbols and directions for use are given in the text
Q = K V/L + 0.1
V, Per Cent
K = 1000
K = 100
K = 10
K = 1.0
K = 0.1
K = 0.01
K = 0.000

Explosions That Weren't Planned

Once more Dr. Berl draws from his rich background of World War experience to bring us a word picture out of the past. This time it is a story of tragedy—of fires, explosions and death—resulting from carelessness in chemical plants.

NOW the story can be told. Twenty-five years ago when the Central Powers of Europe were desperately taxing the capacities of their explosives plants, accidents abounded. Strict censorship and more glamorous stories from the front kept the news comparatively secret. Later there seemed to be little point in recounting the behind-the-front tragedies. But now with a large portion of the world once more at war, belligerent explosives factories again operating at capacities and a new generation in charge, the story of a former head of the Austrian munitions industry takes on new significance. Indeed Dr. Berl's tale is a fascinating one.

The moral of his story is not that explosives are dangerous, so beware; but rather that haste makes waste. Statistics show that there are only six industries (of the 30-odd major classifications) that are safer than explosives manufacturing (accident frequency rate for 1938 was 7.53 as compared with 7.66 for automobiles, 7.93 for chemicals, 37.00 for mining and 46.38 for lumbering, according to N.S.C.) Accidents in the industry were then as now the result of carelessness, not ignorance. In war-time because of the high rate of production and oftentimes lower caliber of man-power, carelessness increases. So we join with Dr. Berl in saying to explosives makers in those nations again at war: Let not your zeal for speed replace your efforts for safety.—Editors.

ERNST BERL
Research Professor
Carnegie Institute of Technology
Pittsburgh, Pa.

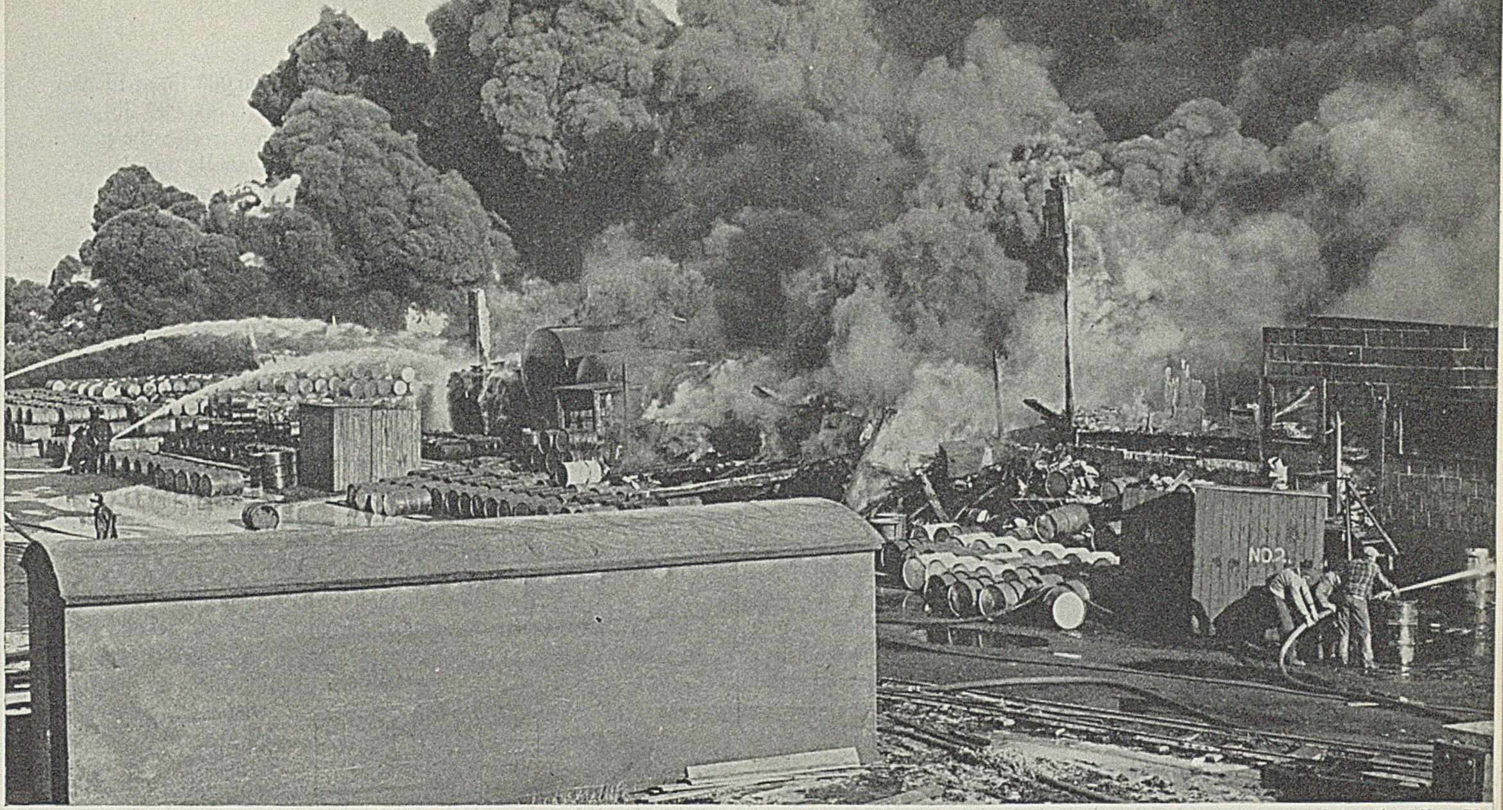
By its very nature, work in an explosives plant would seem to be unsafe. Actually the accident frequency rate in the explosives industry is much lower than in most industries. Admittedly the materials handled are more dangerous, the chances for accidents greater. Why then is the accident record so clean? There can be but one reason. Workers and employers realize the danger and are prepared for it. They are careful and take every precaution for safety.

Their knowledge and experience in safe practices has been paid for with the lives of many men. They endeavor to investigate an accident *before* it occurs rather than afterwards. Plants are equipped with all sorts of safety devices, and workers are thoroughly instructed in their use. That is the situation today.

Twenty-five years ago chemical men knew a lot about safety in explosives plants too, though not as much as today. Yet in the accidents the author is about to describe, ignorance seldom played a part in the tragedy. More often a fire or explosion was purely and simply the result of carelessness—a carelessness engendered by speed, by demands for greater and greater output, by the use of substitute workers and substitute raw materials. Now as then, production facilities in many countries are again operating at peak level, making explosives faster and faster for a world gone mad. This then is the reason the author would like to cite a few instances of disastrous accidents from his own experiences.

In an Austrian government picric acid plant about 5,000 lb. of picric acid, half of it suspended in nitric acid and half of it in a powdered, dry state, exploded. Thirty-five men were lost—30 killed by the crumbling walls and the other five who were in the room where the explosion took place, completely atomized. The terrible accident happened during the crystallization of picric acid from warm nitric acid to obtain larger crystals for detonating purposes. Afterwards hundreds of experiments were conducted to find the cause of the explosion. The phenomenon could not be reproduced and only later it was found that an exploding shell, shot erroneously into this building from a nearby proving ground, was the cause of the explosion. This case illustrates the difficulty of finding out the causes of explosions. In most cases the men who could tell something about the accident are killed, their lips sealed forever.

In another case waste water containing emulsified droplets of nitroglycerine was sent through a big container submerged in the earth. Partition walls allowed the fine droplets to settle. At certain places stop-cocks of stoneware were provided so that the nitroglycerine could be removed. It was in the cold November of 1916 when some reparation work had to be done. The mason who was in charge was asked not to turn the stop-cock because half-frozen nitroglycerine might have been formed. However, this man must have turned such a stop-cock, exploding a half-frozen crystal which in turn set off the remaining nitroglycerine (about 100 lb.). The man was killed. A block of concrete from the upper part of the reservoir was projected into a warehouse where about 1,000 lb. of nitroglycerine was being washed. Every man with experience in this field would expect another explosion to result, but for some unknown reason nothing happened and further loss of life was prevented.


International News Phot

Fire and explosion hazards still exist in chemical industry today, but as a rule chemical workers are so accident conscious that the industry has a better safety record than many less hazardous industries. Above is a view of a smoky chemical factory fire in Kearny, N. J., that caused a blackout of New York's West side on March 19, 1940. The blaze started in the disinfectant division of the White Tar Chemical Corp. A series of explosions followed as tanks of naphthalene became overheated. A high wind carried the smoke from the blaze across the Hudson river and over Manhattan

A German powder plant was destroyed completely with the loss of many lives during the war because of improper construction. Various parts of the plant were connected so that solvent vapors mixed with air, probably in the explosive range, transmitted an explosion which took place in one of the powder houses to all of the other buildings. An explosives plant must be constructed so that the various houses are not connected by any kind of channel. If explosive liquids like nitroglycerine have to be transported within the plant from one house to another, syphons should be used which work only during a rather short time and must be opened and drained at the end of each operation. Then if something happens the explosion is localized to one building.

Oftentimes these plants are built of a material which will disintegrate into dust in case of an explosion and will not form heavy pieces which may be projected into another building and cause an explosion there. Frequently, the buildings are constructed with a solid roof which cannot be pierced by incendiary bombs or by heavy pieces from explosions. Three walls are built quite solid, and the fourth wall very light so that an explosion will destroy one wall only. If possible, wood as a construction element should be avoided. The author knows of an accident which happened before the first great war when picric acid was being dried. This was done in a building made of wood and light steel construction. When a fire broke out, the wood building burned and radiated a tremendous amount of heat which overheated the 10,000 lb. of picric acid stored in the building. Probably a piece of glowing steel construction fell into the overheated picric acid and caused the explosion which took about 200 lives.

Floors and walls of workrooms in explosives factories should be made without joints; otherwise, some of the explosives may be deposited in the joints, become unstable and cause fire and explosion. A French explosives factory was destroyed by such a cause. Also jointless floors and walls should be cleaned quite often.

Naturally, smoking, open flames and the use of electric motors which give off sparks must be avoided. We know from experience how careless people become after they have handled explosives for a short time. During the war the author saw a small depot of explosives where a man was smoking a cigarette. He had before him open cans filled with calcium carbide. At any time an explosion of acetylene formed by the humidity in the room could have taken place and set off the entire depot of explosives.

In a Belgian rayon plant an accident took place whereby one of the glass capillaries which were used at that time for spinning nitro rayon, broke. A jet of collodion under a pressure of about 50 atm. was projected into the air and met an open arc lamp. The collodion was ignited, the fire went back to the spinning machine and destroyed the whole spinning room, this time without loss of life. One cannot be careful enough in all those cases where explosives and volatile flammable solvents are involved.

There is a tendency in our modern technique to substitute continuous operations using relatively small amounts of explosives for discontinuous operations using large quantities of materials. Certainly this tendency is in the right direction. Through progress in the chemical engineering field, many older plants have been improved with great success. New special safety devices are used. For example, in mixing, if a stirrer does not work, a pump which is on an independent electric circuit can carry out the necessary mixing operation. The author knows of the following case of an explosion in a large German dye-stuff plant. Benzene was to be nitrated by introducing mixed acid (nitric and sulphuric) and water into benzene. This mixture had to be stirred. The operator did not start the mixing device before the mixed acid was introduced, or else the stirrer stopped during the operation. At any rate a large quantity of the heavier mixed acid was in the bottom of the container partly filled with the lighter benzene when the stirrer was started. Suddenly a tremendous amount of heat was formed by the violent nitration. Benzene evaporated, formed an overhead flammable mixture with air and was ignited. The whole plant was destroyed. By a combination of stirrer and pump, which must be started before nitration, such an accident could not take place.

Safety Devices Now Used

All kinds of safety devices are now used in this field. If in a closed vessel a certain pressure is reached, a safety plate is destroyed and the compressed gases which otherwise would destroy the whole installation can escape before the critical pressure has been reached. The introduction of all kinds, especially of automatically registering, instruments has brought an increased safety in plant operations.

Temperature and pressure play an important role. If their control is neglected, severe consequences may follow. At a place which is now No Man's Land on the Western Front, a terrible explosion took place in the winter of 1921 which cost about 30 lives. Trinitroanisol, an explosive related to picric acid, was being converted into a kind of permissible explosive. It had to be melted and then mixed with ammonium nitrate. In spite of the use of steam pressure reducing apparatus, an overheating of the trinitroanisol took place. First a fire broke out and when men rushed to extinguish the fire, a terrible explosion took place, killing all of them.

Carelessness and combinations of unfortunate accidents are often the cause of disaster. The author knows of a case where in a TNT plant no thermometer was used. The plant was destroyed by an explosion. In another case during the war, the well-known mixture of TNT and ammonium nitrate 60/40 was being prepared to fill shells. By an accident the pipe leading this molten mixture from the reservoir to the shells was obstructed. The foreman took a piece of wire, heated it until it was red hot and tried to remove the obstruction by melting the explosive with the hot wire. The result was an explosion that cost the lives of many men and destroyed much valuable material. Another case happened in a pencil factory where nitrocellulose lacquer was sprayed on wooden pencils. Large quantities of unstable nitrocellulose were formed and accumulated in this machine. There must have been much carelessness in the plant because during the working hours a man tried to make some changes on such a machine with an electric borer. Probably by overheating or by a spark, the remaining unstable nitrocellulose material was ignited. A very hot darting flame followed by fire killed about 50 workers who were locked up in this room. For accidents of this kind there is no excuse and the responsible engineers and foremen should be imprisoned.

Other explosions of this kind took place in two nitro rayon factories. In big steel containers collodion, a solution of nitrocellulose and ether alcohol, was pressed with compressed air through filters. This operation was carried out more than 100,000 times without an accident. In these two cases accidents took place probably because some unstable guncotton ignited the compressed mixture of ether and air which was within explosive limits. Terrible destruction and loss of many lives were the consequences. This wrong system, using air, was replaced afterwards by the use of compressed flue gas poor in oxygen, or by the use of hydraulic pumps for the transportation of the honey-like collodion through filtering material.

Accidents Can Occur in Handling And Storing Explosives

Production facilities are not the only places where caution is required. Oftentimes accidents occur in the handling and storage of flammable explosive material and chemicals.

For military purposes storage of high explosives is necessary. They may be stored in light, small houses surrounded by thick inclined dams so that if by an unfortunate accident an explosion takes place in one of these magazines, it will not be transmitted to other magazines.

In 1917 a heavy explosion took place near Vienna where large amounts of explosives were stored. There were four large magazines in a line, each 1,000 ft. from the next. One contained nearly 1,000,000 lb. of black gunpowder; the next 500,000 lb. of smokeless powder in barrels; the next magazine contained shells for 12 in. mortars; and finally, another magazine contained several hundred thousand hand grenades. By an unfortunate accident an Italian mine which was stored near the black gunpowder magazine exploded, shot itself into the magazine, and ignited the black gunpowder. After a fraction of a second the second magazine containing smokeless powder exploded. The explosion wave removed the roof of the third magazine without doing any harm to the big shells and their content. Then the wave of explosion reached the fourth magazine. It released the safety pins on the hand grenades exploding them one after another.

Formula for Destructive Radius

This accident allowed the confirmation of a formula for destructive radius of explosives given by the French fire damp commission. The radius expressed in meters through which an explosion causes heavy destruction of buildings by compression and by vacuum is equal to a constant multiplied by the square root (or in some cases by the cube root) of the weight of the exploding material expressed in kilograms. The value of the constant for high explosives is about 10 and for black gunpowder is about 5. This formula seems to be right for complete explosions. Those working in this field make a distinction between explosion and deflagration. Deflagration is an incomplete explosion where the end products of a complete explosion of the nitrogen-containing explosive—nitrogen, carbon dioxide, carbon monoxide, water and hydrogen—are not obtained. One finds in the deflagration gases larger amounts of nitric oxides, hydrogen, carbon monoxide and methane.

Such a deflagration took place in 1921 when about 5,000 tons of a mixture of ammonium nitrate and ammonium sulphate were decomposed in a German dyestuff plant near the French border. Before the storage of large quantities, many experiments were made to find out if such a mixture (which was used as a fertilizer) would explode if limited amounts of permissible explosives were used for loosening the hard masses. About 30,000 shots were fired without any accident. When this accident happened a deflagration took place which took about 600 lives, injured 1,900, and completely destroyed the silo in which 5,000 tons of this apparently harmless mixture were stored. A real explosion of such a great quantity would have had worse consequences. The explanation of this unfortunate accident can be found probably in two reasons: First, this mixture of ammonium nitrate and ammonium sulphate in which ammonium sulphate acts as a diluting agent was not made carefully enough. At certain places, instead of 50 per cent ammonium nitrate, 75 or 80 per cent ammonium nitrate was present. Second, the men working in this silo may have overcharged the bore hole and caused, instead of a harmless small explosion with one or two pounds of explosives, the deflagration of those 5,000 tons of the mixture.

A similar case was observed after the war when ammon powder (a mixture of ammonium nitrate, carbon and some aromatic nitro compounds) was stored in a fertilizer plant. Under the influence of humidity of the air and certain changes in the structure of ammonium nitrate, this mixture became quite hard. When word came to ship this mixture, shots were fired in this explosive system. In this case a full explosion took place whereby lives and the whole plant were destroyed.

Powder magazines have to be protected against lightning. The so-called Faraday cage which surrounds those houses with a metallic cage has not proved to be a perfect solution for the protection against lightning. Now in most cases lightning rods are put on top of the walls and it seems that this system worked rather well.

Protect Against Heating

One has to protect the magazines in which explosives are stored against higher temperature. It is known that several men-of-war have been lost because the ship designers placed the magazines for smokeless powder above the boiler or engine room, just at those places where the highest temperature on the whole battleship exists. We know now that it is wise to cool artificially those storage rooms for explosives in battleships so that the explosives do not become unstable.

About 19 years ago a terrible explosion took place in the Southern part of Switzerland. A company produced nitrogen peroxide by freezing it out from the so-called air combustion gases. These gases contained about 1½ per cent nitric oxide which was converted into nitrogen peroxide by oxidation upon cooling. They used for this freezing out process either toluene or gasoline cooled down to about −70 deg. C. Through a leak caused by corrosion the organic material combined with the liquid nitrogen peroxide. Instead of decomposing this dangerous and unstable mixture with water, the works manager kept it for about 7 days during the heat of July, 1921, when the temperature averaged more than 100 deg. F. As a consequence several thousand pounds of the unsafe mixture exploded, destroyed the whole plant and killed about 25 people.

Also Avoid Freezing

One has to be careful not to keep dynamite at such a low temperature that the nitroglycerine may freeze. Half-frozen nitroglycerine, as mentioned previously, is very dangerous.

In 1908 when the famous Jungfraubahn in Switzerland was built, 65,000 lb. of dynamite exploded. To avoid the freezing of nitroglycerine, this dynamite was stored in a tunnel which was overheated locally by an electric oven. This explosion allowed the observation of the so-called zone of silence. The sound waves were reflected in higher stratas, returned to the earth, went back into the atmosphere, etc. At places near the explosion nothing was heard and at certain places far distant, where the reflected sound waves reached the earth, the sound could be heard.

It is of great importance not to store materials of different chemical character together in the same storeroom. In the field of explosives we know that several serious accidents have resulted from neglect of this basic rule. One should never store explosives which may decompose slowly, like dynamite or smokeless powder, with other explosives which explode directly without previous decomposition like black gunpowder. One should never store oxygen-containing material, like ammonium nitrate or chlorate, or perchlorate, in wooden barrels. These substances should be stored in fireproof buildings.

It is of great importance that in these magazines the formation of sparks should be avoided. Special electric motors and telephones must be used. If possible, they should be mounted in adjacent rooms. To avoid sparks, workmen use shoes which contain copper or bronze nails. This has the advantage that electrical charges which often can be observed may be drawn off to the earth. Electrical charges are dangerous. Several fires and explosions have been caused by the formation of sparks when dry nitrocellulose was removed from insulating bases like wood. Today we use dryers made from bronze or copper which are connected with the earth, or better, we avoid the use of strongly dielectric dry cellulose nitrate.

There was another case where again by the combination of several improbable happenings an accident took place. In a war plant ammonia gas was produced from calcium cyanamide which always contains calcium carbide. This ammonia gas, therefore, contained acetylene. The gas was stored over a saturated water solution of ammonia in a big steel container. Unfortunately, a chain was connected with a float made of copper. An explosible compound of acetylene and copper was formed. Through movement of the float, sparks formed and ignited this mixture of ammonia-acetylene and air which was unfortunately within the explosive limits. Besides the complete destruction of the container, two men lost their lives.

The storage of large amounts of flammable substances like gasoline, benzene, toluene, ethyl ether, and carbon disulphide should be made in containers which are filled with flue gas or nitrogen or any other nonflammable gas containing no or very little free or bound (for example nitric oxide) oxygen. Under these conditions no danger exists. It has been found advantageous to put into gas inlets and outlets of big reservoirs, filling material of small size or sieves. Then any source of explosion from outside cannot be transmitted to the interior of this container which may contain a fuel-air mixture within explosive limits if flue gas is not used.

Conclusion

The author has not ventured to cover the whole field of safety in producing and handling explosives and flammable substances. He has tried to point out some of the salient problems in this large field based on his own experience. He does not believe that there is a possibility of avoiding accidents 100 per cent because unhappy influences and the human element play an important role. By using the maximum of care and taking advantage of the progress science and industry have made and are making every day, accidents which take many lives and destroy valuable goods can be further reduced in number and perhaps eventually eliminated.

Chemurgical Highlights

Some of the most outstanding new products and processes based on the products of the American farm were discussed at the meeting of the Chemurgic Council.

THE SIXTH annual Chemurgic Conference of agriculture, industry and science which was held at Chicago, March 27-29, brought forth some particularly interesting technical developments. Some few of the highlights are mentioned below.

Hydrolyzed Wood Filler for Plastics—Hydrolyzed wood (that is sawdust or chips partially processed in the plastics process) makes an excellent filler for use in the production of phenolic resins. Plastics of this type have a greater flow with hydrolyzed wood than with wood-flour filler and a greater moisture resistance, 25 to 30 per cent more hydrolyzed wood than wood flour can be used; it is estimated that by this means a saving of one or two cents per pound can be effected in the production of a filled Bakelite molding product.—Carlisle P. Winslow, director, Forest Products Laboratory, Madison, Wis.

Processed Charcoal—A processed charcoal made from wood wastes will form the basis for new electrochemical and electrometallurgical industries. The Ruziclea process involves three essential steps: first, destructive distillation of wood with recovery of byproducts; second, pulverizing of charcoal and mixing with byproducts tar; third, final coking, with further recovery of byproducts, especially gases. The possible uses of wood coke, made from forest wastes, as compared with coal or coal-coke of even the highest grades obtainable, lies in its relative freedom from ash and its complete lack of sulphur and phosphorous. It is estimated that the cost of a ton of finished coke would be about four dollars per short ton.—John H. Gellert, plant manager, American Casting Service, Watertown, Wis.

Starch—An Opportunity—The sweet potato starch plant in Mississippi produced 2,500,000 lb. last season. A plant, it is estimated, may be built at a cost of $50,000, including a dehydration unit. The South could operate 200 such starch plants and thus replace the imports of foreign root starches amounting to 500,000,000 lb. annually.—Victor H. Schoffelmayer, Dallas (Texas) Morning News.

Castor Plants—It is believed that the castor plant will yield not only a prized vegetable oil but also two kinds of high grade cellulose in its tall stalks and ricin, an insecticidal poison, from its leaves. Utilization of all three products is likely to make possible a domestic castor plant industry.—Victor H. Schoffelmayer.

Ethyl Cellulose—Ethocel, ethyl cellulose can be spun, and woven into textiles, or employed in lacquers in conjunction with nitrocellulose, to which it contributes toughness and flexibility.—Donald L. Gibb, Dow Chemical Co., Midland, Mich.

Leather Finish, Wallboard—A suspension or dispersion of soybean meal in formaldehyde solution upon evaporation of the water yields a hardened protein possessing increased water resistance. It has been found to be particularly important as a leather finish, because of its mildly acid character, increased water resistance, and flexibility. Also, it has been used to produce from kraft paper a cheap, laminated board possessing high strength and having a large potential outlet in the form of wallboard and similar building material.—R. T. Milner, director, U. S. Regional Soybean Industrial Products Laboratory, Urbana, Ill.

Chemicals From Soybean—Approximately one-fourth of the weight of the soybean is made up of a carbohydrate fraction. What can be done with this material? There are galactoses, pentosans, arabans, hemi-cellulose, pentoses, hexoses and other bodies in this mixture. No processing beyond the primary meal derived on oil extraction can fail to consider this carbohydrate fraction. A vast amount of research still lies ahead before the problems in this field are worked out. This is one of the fertile fields still unexplored and unexploited.—W. C. Gangloff, chemical director, Drackett Co., Cincinnati, Ohio.

Cigarette Paper—On Sept. 3, 1939, the very day the World War No. 2 was declared, the first sheet of paper was produced by the first large American cigarette paper mill. This should have made the smokers of this country happy for it assured a domestic source of supply. A decorticating plant for defibering flax straw was established in the Imperial Valley of California, where straw was delivered by the infant but growing flax industry. The paper mill was built in Pisgah Forest, North Carolina. Four large paper machines working 24 hours a day are now turning out cigarette paper for the American cigarette producers.—Harry H. Straus, president, Ecusta Paper Co., Pisgah Forest, N. C.

Dextrose—This material can be made in great quantity, for our problems are no longer those of production but of acceptance and recognition of what dextrose is, what it will do and how well it will do it.—H. H. Schopmeyer, director of research, American Maize-Products Co., New York, N. Y.

Man's Greatest Achievement—Civilization began with the deliberate attempt to grow and to plan and to produce a more assured food supply. And civilization advances just as that supply becomes more secure. It is like the snowball rolling down hill. The freedom from fear of starvation affords the leisure to observe, to study, to plan, to research, to invent. And the fruits of such are more leisure and more development, more advances, always in a geometric progression. The best fed nation is always the most progressive, the most active in the struggle to raise its standards, however high they may already be. And we owe all to that ancient ancestor who observed the sprouting of that seed that probably fell on her husband's grave some tens of thousands of years ago. Are we not to call these beginnings of a crude agriculture as "Man's Greatest Achievement" for all we possess and enjoy above the average of the African native of the most primitive tribes—the Bushman of the Kalahari, or the Hottentot of Namaqualand—is founded on the directed evolution of the science and art of agriculture—Walter S. Landis, vice-president, American Cyanamid Co.

Series C No. 1

Chem. & Met. Report

ON

Opportunities in the Pulp and Paper Industry

TO CHEMICAL ENGINEERS

THIS INVESTIGATION was undertaken in an effort to ascertain to what extent chemical engineers and chemical engineering processes have been accepted by and have become a part of the pulp and paper industry. It is hoped that the information regarding the status of chemical engineering processes in this industry, the number and kinds of jobs available, the lines of promotion, unsolved problems, important trends, and the like, which has been gathered together may assist the young chemical engineer in determining whether he wishes to cast his lot with other engineers in this industry in preference to some other process industry. Also, this information and data which have been collected and are made available for the first time should serve the older engineer some extremely useful purpose.

CHEMICAL & METALLURGICAL ENGINEERING
Vol. 47, No. 4, April 1940

TITLE OF REPORT Opportunities in the Pulp and Paper Industry

TO Chemical Engineers

FROM Editors of Chem. & Met.

DATE March 1940

CONCLUSIONS

PULP AND PAPER MAKING is a truly chemical process industry. It is a consumer in large volumes of an impressive list of chemicals. Chemical reactions are used through out the production of all of the so-called chemical pulps: sulphite, sulphate and soda. Many unit operations and unit processes are depended upon, and chemists and chemical engineers are being employed in increasing numbers.

Although chemical engineers, have only been employed by the industry during the past few years there are already more than a thousand in the various pulp and paper mills of this country.

They enter the mills via the research and development department or as assistants to the operators, and from these beginnings soon become assistant superintendents, and superintendents. Already a few have risen to the executive positions of vice-president in charge of research and operations, and president.

In the last few years the industry has probably made more outstanding progress in the application of chemical engineering methods and processes than any other industry outside the strictly chemical field. Yet the problems that remain unsolved plus the new ones that are constantly being created by the developments occuring within the industry are so numerous that a far larger number of chemical engineers than are now employed in the industry might be kept busy for many years.

PULP AND PAPER ranks as one of America's leading industries. For many years it has been increasing steadily in size and appears headed for an even more enviable position in this country. The improved standards of living, higher educational standards and changing economic conditions have been accompanied by an increased per capita consumption of paper. We are now using paper in place of wooden boxes, as a substitute for cotton bags, and instead of glass milk bottles. In fact, the applications for pulp and paper are far too numerous even to be listed here.

The importance and tremendous size of the pulp and paper industry may be appreciated by consideration of the following data taken from the 1937 United States Census of Manufactures. There were at that time 841 pulp and paper mills, which gave employment to 151,682 persons. The total payroll was $212,621,000. Materials, fuels and purchased electric energy cost $721,101,000. The value of the products manufactured during the year was $1,205,132,000. These data could be increased 10 to 15 per cent by including the converting division of the industry. This has not been done as the manufacture of paper bags, boxes and the like is principally a mechanical operation and therefore offers little attraction to the chemical engineer.

Perhaps it would be easier to visualize the enormous size of this great industry, if it is realized that there are approximately 850 mills distributed over this country, each mill employing on an average 180 workers and producing goods valued at $1,434,000 annually. This would be equivalent to 18 mills in each of the states manufacturing products valued at over $25,000,000 and giving employment to 3,160 persons.

The pulp and paper industry is not new like the automobile, radio and airplane industries, but had its origin in antiquity. Unlike these new industries it existed long before the day of modern scientific developments and methods. It was a craft handed down from father to son, or acquired by each worker during long years of manual training. However, as Ernst Mahler, vice-president of Kimberly-Clark Co., has stated in an address before the American Paper and Pulp Association, "Economic conditions have forced the paper and pulp industry, as probably the last one of the big basic industries of the country, to the necessity of scientific management—to a recognition of the fact that their process is one of chemical engineering." Or as Westbrook Steele, managing director of the Institute of Paper Chemistry, has stated, the industry has undergone a transition from an industry founded upon an art to an industry controlled by and developed through science.

When the industry did finally come to realize the advantages to be derived from adoption of scientific methods it went to the firms of consulting chemists for advice. For years Arthur D. Little, Inc., was the official consultant for the American Paper and Pulp Association.

An instance of this sort was the case of a West Coast mill which was, in 1909, in the habit of employing Dr. Little's firm regularly. A representative of that organization made trips from Boston to the Coast from time to time, spending as much as a month on a visit to the mill. Finally, the visits became so long and the correspondence between trips so extensive and burdensome that the representative of the consultants was induced to become associated with the paper company. Thus the pulp and paper industry on the West Coast first added a full-time technical man to its staff.

The policy of depending upon chemical consulting firms for technical advice was before the days of chemical engineering. And as the custom of appealing to these chemists for assistance was practiced for many years the industry acquired the habit of speaking of all technical men as chemists, a practice it has never completely abandoned.

Truly a Chemical Industry

Pulp and paper making is truly a chemical industry. A long list of chemicals are consumed in the several processes of manufacture. Lime, limestone, sulphur, and soda ash enter into the production of pulp by the sulphite process; lime and soda ash are used in the soda process; salt cake, caustic soda, sulphur are used in the sulphate process. Titanium dioxide, zinc sulphide, lithopone and other pigments are consumed in the effort of controlling the color and opacity of papers. Chlorine and sulphur dioxide are used in bleaching. While alum, casein, starch, rosin, china clay, silicate of soda and numerous other chemicals are employed in sizing, coating and other paper making operations. In addition to the softening agents or plasticizers which have become recognized as standard raw materials, i.e., glycerine, inert sugar, corn sugar, and sulphonated oils, a number of other materials have been introduced.

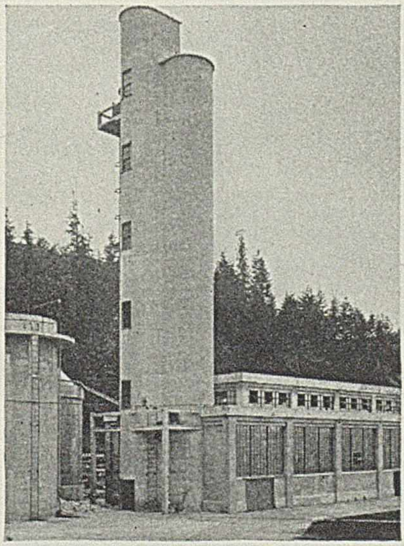
"Added evidence of the chemical nature of the industry is found in the numerous chemical transformations which take place in its processes," as John D. Rue has pointed out (*Chem. & Met.* vol. 33, p. 15-17). "Sulphur is burned to SO_2 and the latter absorbed by lime, limestone, dolomite, or soda ash to form bisulphites, sulphites, sulphurous acid and mixtures of them; soda ash is causticized with lime; salt cake is reduced to sodium sulphide; chlorine is converted into hypochlorite; not infrequently salt is electrolyzed to produce chlorine for local consumption and caustic soda for distribution, occasionally hydrogen, a byproduct of the electrolytic process, becomes the raw material for some local chemical process by which other chemical products are made for the market—sodium resinate is made to react with aluminum sulphate in the sizing of paper and is used with glue in a manner to render the latter insoluble when deposited and dried upon the fibers; casein and glue are made the basic cementitious constituents in the composition of mineral coatings for paper.

"The chemical processes enumerated in the preceding paragraph are for the most part not peculiar to the pulp and paper industry. As basic chemical reactions they are merely adapted to the needs and purposes of the pulp and paper manufacturer. The chemical disintegration of wood by the various processes of digestion is, on the other hand, especially characteristic of that industry as are also the processes by which the fibers are bleached and purified in their preparation for use in the paper mill.

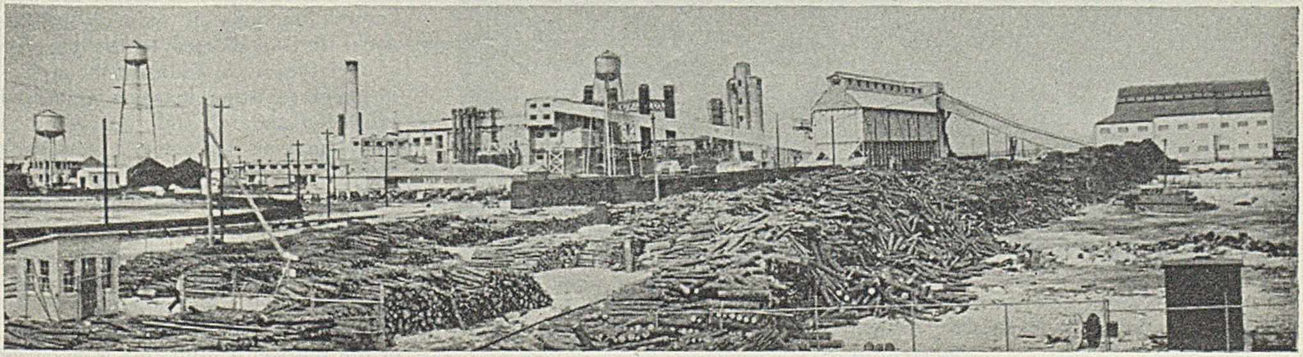
"In the manufacture of paper from the pulp, the chemical nature of the operation is frequently lost sight of in the maze of intricate, extensive and delicate mechanical operations which are required. Those mechanical operations have as their chief objective, however, the modification of the colloidal properties of the fibers, the distribution of the fibers into a wet mat or sheet, the development of cohesion between the fibers by pressing, and the removal of water and the breaking of the colloid by means of heat. Related to the major reactions are various side reactions such as the coating of the fibers with water-resistant materials, the hydrolytic disintegration of the fiber by means of heat or the action of acid, or the effect of electrolytes in the water suspending medium upon the colloidal nature of the fibers. Some of these side reactions are desirable and some are to be avoided; all should be controlled, as their effect upon the quality of the product may be vital."

Another reason for grouping pulp and paper making with the chemical industries is the fact that many of the chemical engineering unit operations and processes are employed. For example, in the production of sulphate pulp the wood is chipped, cooked, hydrolyzed in the digester, washed, screened, filtered (thickened)

Where sulphite cooking liquor is made for Shelton, Wash., mill of Rayonier, Inc.



New Rayonier bleached sulphite pulp mill at Fernandina, Fla.



refined (fibers are hydrolyzed and reduced in size). In the chemical recovery department the spent black liquor is evaporated, incinerated and smelted to a fused mass. The black ash is leached. The solution is clarified to remove suspended carbon and slime. Green liquor is causticized to form the white or cooking liquor.

In the bleaching operation, chlorination, causticization, shredding, and washing, are among the unit operations and processes. And, of course, throughout all the processes in the industry fluids handling, solids handling, heat transfer and filtration are used.

Chemical Engineers in the Mills

While chemists gradually became a recognized essential for testing raw materials and controlling cooking liquors, it was not until very recent years that a demand for chemical engineers developed. They first entered the paper industry via the acid plant of the sulphite mill or the chemical recovery plant in the soda or sulphate mill, solely to assist in the operation of strictly chemical processes, as Clark C. Heritage has stated. (*Chem. & Met.*, Vol. 44, p. 9-13, 1937). They did, however, soon begin to apply more or less scientific methods of evaluation to the product.

Even at the present time the industry does not have a classification of employees termed "chemical engineers" as do other industries. Nevertheless, their value is greatly appreciated and the last few years have witnessed an important influx of chemical engineers into the pulp and paper mills of this country. "The modern pulp mill now employs three to four times as many technical men as it did five years ago. Control of operations is under engineering supervision and the industry will move forward" (Harold R. Murdock, *Chem. & Met.*, Vol. 44, pp. 4-8, 1937).

Much the same thought was expressed by W. M. Shoemaker, secretary, National Vulcanized Fibre Co. (*Technical Association Papers*, Series 17. No. 1, p. 47) when he said, "... I believe it to be inevitable that technically trained men will be in charge of mill operations. It is coming to pass, it cannot be stopped. As managements employ operating men with technical backgrounds, there will not be half the difficulty we are experiencing now, with only practically trained men rubbing against only technically trained men. I think this thing will disappear in 15 or 20 years as the older type, educated in the mill only, pass away and the newer type of operating-technical man takes more or less charge with the confidence and backing of the management."

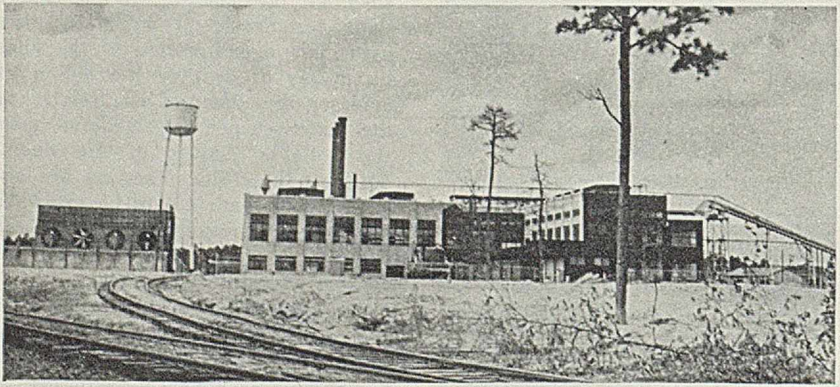
Already the number of chemical engineers in the industry has reached a thousand. A majority of these men are in the research and development department, or are assistant superintendents; many are pulp mill superintendents while a few have already reached the positions of assistant manager, manager, and other executive capacities.

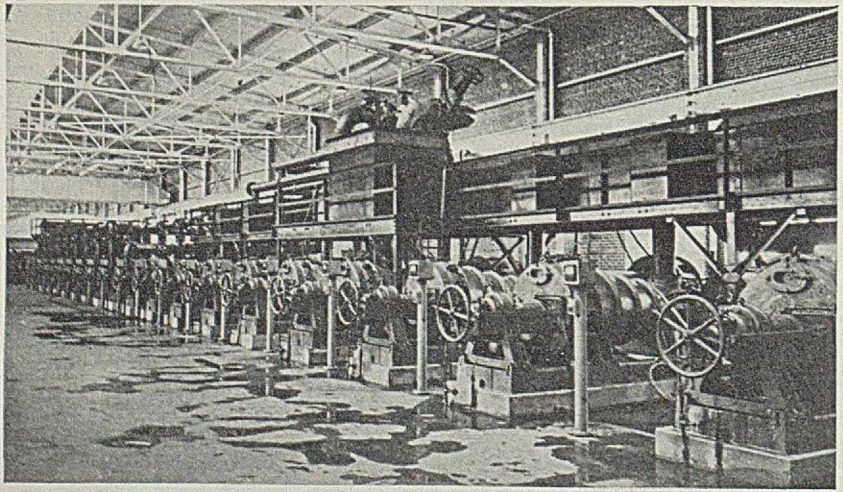
The increase in appreciation of the technically trained man, in particular the chemical engineer, also is reflected in the growth of the Technical Association of the Pulp and Paper Industry, which came into existence 25 years ago. This organization has grown rapidly during the past ten years and has a membership at the present time of over 1,600. Most of this increase is due to the influx of chemical engineering members which now number approximately 600. It is not at all uncommon to have a chemical engineer at the helm of the Association. In fact, this year, all three executive officers, secretary, vice-president and president, are chemical engineers.

Most of these engineers came from the chemical engineering departments of the Massachusetts Institute of Technology and other colleges offering a general course. However, there is an increasing demand for engineers, who have in addition to this undergraduate study, specialized training in the field of pulp and paper technology such as is given at the Institute of Paper Chemistry at Appleton, Wis. This is especially true in research and development work.

This Institution was started at Lawrence College in the fall of 1929 by 19 Wisconsin pulp and paper mills. One of its ideals is to provide a means by which men can be trained at the graduate level by specialists specifically for the pulp and paper industry. It is not intended to compete with or duplicate any of the well known functions of existing institutions. It is dedicated to the purpose of obviating in the industry the maladjustments existing between industrial education and research, according to its managing director, Westbrook Steele.

Today, the young chemical engineering graduates enter the industry as laboratory technicians or as operators' helpers. They next become operators, assistant superintendents in the pulp or paper mills, superintendents in the pulp mill. But this is not true

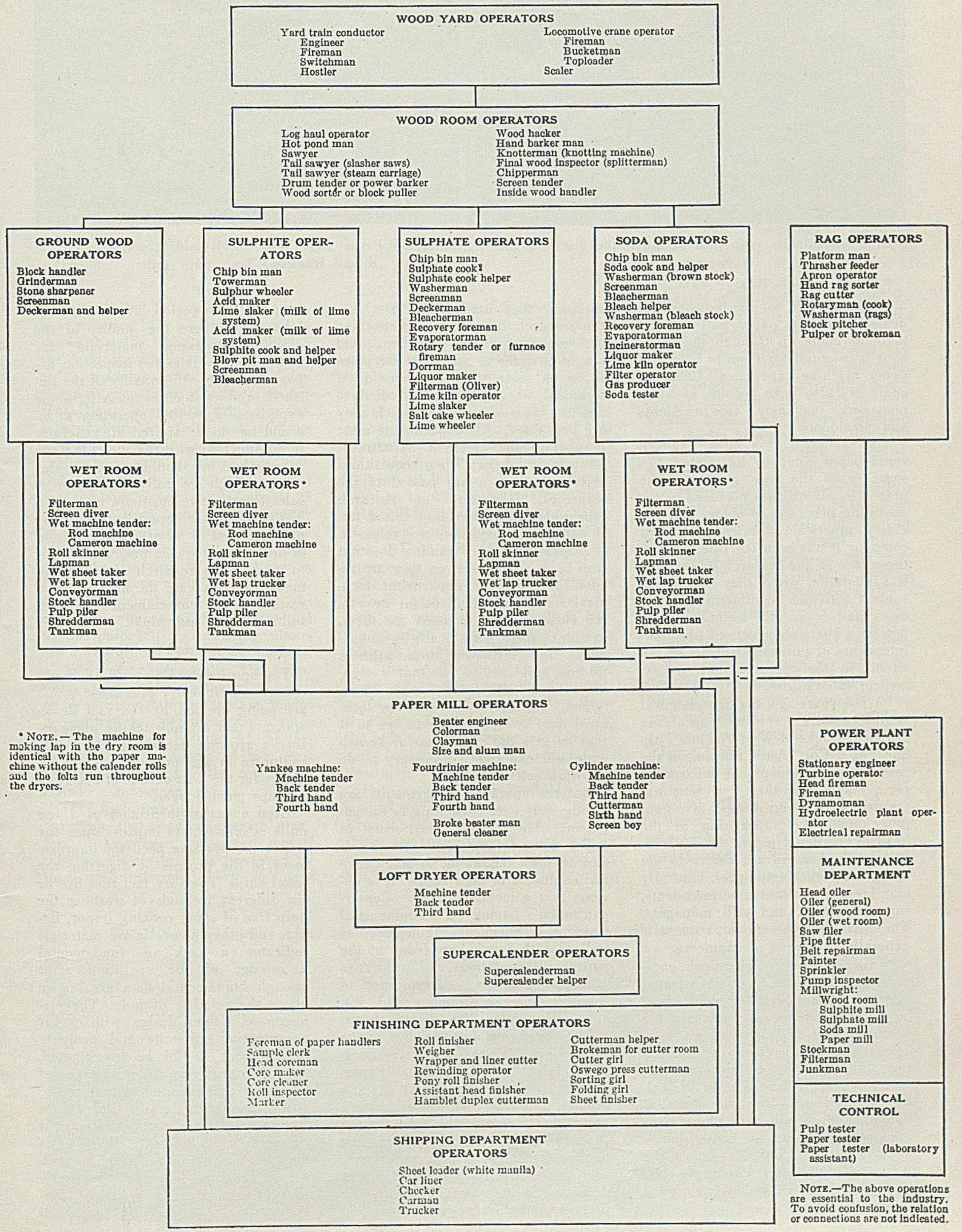




Top—First newsprint mill in the south is the Southland Paper Mills, Herty, Tex. Bottom—Refining of sulphate pulp in jordans in mill of Southern Kraft Corp., Georgetown, S. C.

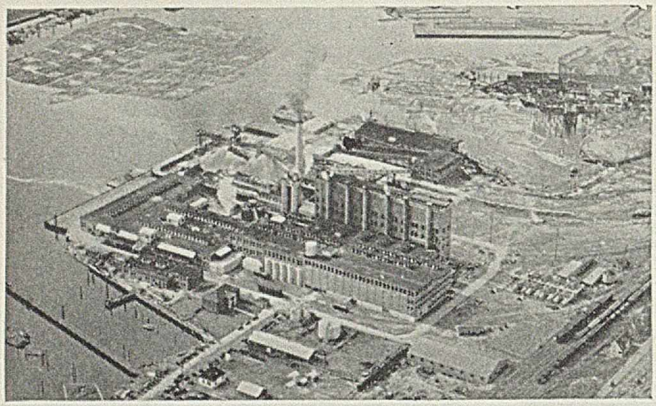
Sequence of Operators and Flow of Materials in the Pulp and Paper Industry

From Bulletin No. 168, Vocational Training for the Pulp and Paper Industry, Federal Board for Vocational Education, Washington, D. C.

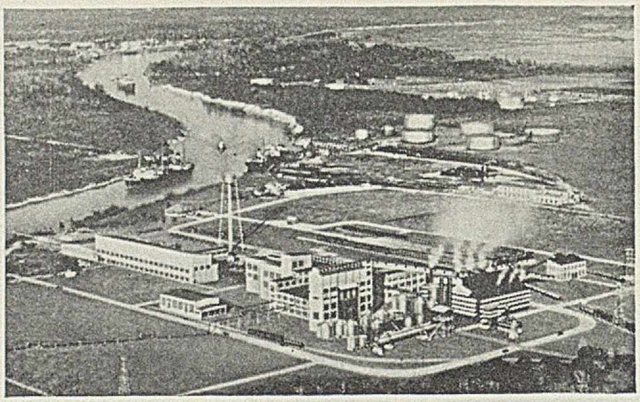


*NOTE.—The machine for making lap in the dry room is identical with the paper machine without the calender rolls and the felts run throughout the dryers.

NOTE.—The above operations are essential to the industry. To avoid confusion, the relation or connections are not indicated.



Bleached sulphite pulp mill of the Soundview Pulp Co. at Everett, Wash.



Champion Paper and Fibre Co. is adding a paper mill to its Houston, Tex., pulp mill.

in the paper mill for the industry still demands that its paper mill superintendents come up through the ranks as it is essential for them to have had paper machine experience. Chemical engineers also have become assistant managers, managers, vice-presidents and presidents.

The executive of a large Pennsylvania paper company has stated, "In some cases the new graduates are placed in subordinate positions in the operating processes to obtain the necessary practical experience. In our company it has been the rule to place these men in the research or the control laboratory where they have direct contact with the manufacturing processes and from this beginning they develop either into positions of superintendents of mill departments or positions in the research and process control laboratories."

"A few years ago, the first chemical engineers were employed," according to Thomas Luke of West Virginia Pulp and Paper Co. "After working in the research and development department for a year or two they were sent into the mill to carry on process investigation, under the supervision of the head of the department. Those engineers who demonstrate ability to get along with other employees, naturally may become assistant superintendents, superintendents, and mill managers. The chemical recovery department is generally in charge of engineers.

"Experience with chemical engineers in recent years has demonstrated that there is a definite need for them in the industry because many of the operations are of a chemical engineering nature and it is generally admitted that there is room for improvement."

Another method used to fit the college trained man into the organization of a large pulp and paper company was explained by Ernst Mahler of the Kimberly-Clark Co., before the American Pulp and Paper Association. He stated that college men must be very carefully assimilated. In his company they are passed, first into the research department where they are given technical problems and taught to refer to scientific literature so as to solve their problems in a technical way. They are studied to find the type of work for which they are best fitted. All departments must requisition the research department for technical help. When requisitions arrive, these men are passed to the technical, laboratory or research jobs which they seem best suited for. If not satisfactory, they are released. If satisfactory, their training does not stop here. From then on they are responsible to their department technical staff superintendent for growth. He outlines study courses for them, examines them periodically in knowledge, and criticizes their attitude toward problems to see that a technical or scientific attitude is maintained. In other words, the new technical man is checked up to see to it that he gets the equipment or knowledge and experience necessary to do his work satisfactorily.

But the operating departments are not the only ones beckoning to the engineer. The sales departments of paper manufacturers and sales agencies are now beginning to add chemical engineers to their staffs. It is obvious that a member of the sales organization having a fundamental training in chemical engineering, as well as a thorough knowledge of the paper mill operations and properties of its products, is well equipped to solve customers' problems and win new friends for the manufacturer.

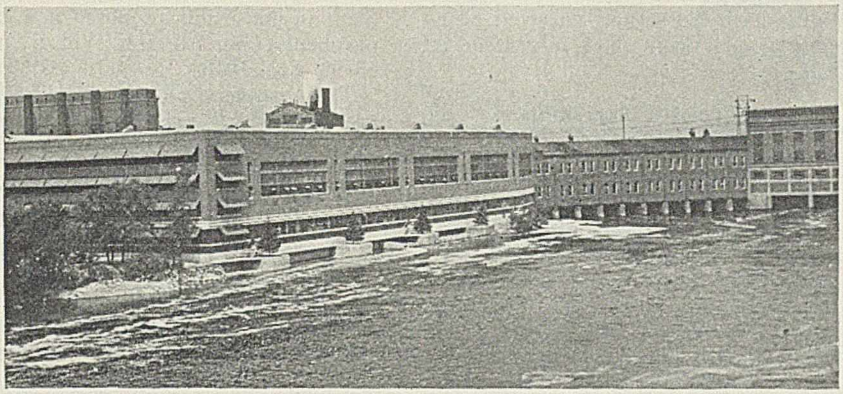
In commenting on the policy of the Mead Corp., in regard to these questions, John Traquair states, "Papermaking is no longer an art, it is a science, and as it covers so many unit operations it is a fertile field for the chemical engineer. Our practice is first to give the chemical engineer experience in the research and development divisions to acquaint him with the present and future problems; then frequently a period in the control laboratory where the quality of the raw papermaking materials are checked, as well as the inspection department where the quality of the finished product is checked. After some experience in actual operation a decision has to be arrived at, generally in conjunction with the individual, as to whether he should go into sales service which generally leads through sales to executive positions, or remain in the operating department with the ultimate goal of an executive position in the mill. Some men prefer, however, to go back to research and development. In every case the final decision rests with the temperament and capabilities of the individual."

Trends and Problems

The unsolved problems that already concern the industry plus those which are being created by the vast developments that are now taking place assure a growing demand for chemical engineers in the pulp and paper industry for the next decade at least and perhaps much longer.

Even a casual inspection of a few mills is sufficient to impress upon the visitor the pressing need for improvement in the process of digesting the wood chips. The very fact that five or six different methods of washing the pulp free of spent cooking liquor, lignin, and other non-cellulose materials indicates a lack of fundamental knowledge of the operation. Not enough fundamental data are known about the refining of pulp. The elements of refiner design with power consumption, capacity and property development should be investigated. Again, several very different types of refiners are being used at present.

A problem of major importance from a dollars and cents standpoint is corrosion of equipment. While it is most destructive in the sulphite mill, the sulphate and soda mills find corrosion of equipment a source of constant trouble. A recently completed



Consolidated Water Power and Paper Co.'s sulphite pulp and paper mill at Wisconsin Rapids, Wis.

survey of the materials of construction situation in the sulphate industry shows that the industry is groping in the dark. But materials are being tried to a surprising extent and some day the most economical metals to use for black liquor evaporator tubes, the linings of diffusers, stock lines, and the like will be established facts.

Problems such as these will multiply with the continued expansion of the industry. Since 1936, about 25 mills have been built in this country and the end of the construction program is not yet in sight. At the present time the capacities of some of these big new mills are being increased as much as 10 per cent. In one case a paper mill is being added to the pulp mill. Converting plants are springing up in the neighborhood of many of the new mills. These new mills are much larger than any previously in operation and the equipment is required to operate at far greater speeds than ever before. All of this increases the problems of the engineering staff and calls for better trained management.

The first newsprint mill in the South has just begun to operate, plans for two have been announced, and if they are successful it is predicted by those well informed in the industry that others will be built south of the Mason and Dixon Line. The newsprint is being made from Southern groundwood and partially bleached sulphate pulp, which is a radical departure in manufacture.

This great increase in the capacity of the pulp and paper industry of this country is expected to create an excess of production in lean years to come. This situation is sure to increase competition, in which case the individual mills will be forced to improve quality of paper and reduce manufacturing costs. This will call for more engineers.

The building of these enormous mills in the South, which for the most part are sulphate producers, is having its effect on the smaller sulphate mills of the Middle West. No longer can the smaller mills compete for large volume business with the great mills of the South. Nevertheless there is a very definite place for them in the industry, for they are more flexible and consequently are in a better position to bid on orders for specialties.

For generations the sulphite division of the industry had been "king." Even the advent of the sulphate industry at the turn of the century and its subsequent remarkable progress did not threaten its supremacy until the almost explosive expansion of a few years ago. But this changed the situation for the new sulphate mills gave the industry a greater capacity of sulphate pulp than sulphite for the first time in history.

With the greatly increased demand on forests for wood to supply the mills, an effort has been made to use other woods in addition to pine and a few hard woods. Just how many of the woods can be used is still unknown. Progress is slow for each wood requires the development of a special method of treatment.

Few efforts were ever made to bleach fully the sulphate pulp, but with the greatly increased volume of this type of pulp there has come a concerted effort to bleach part of the output so that some of the unbleached and bleached sulphite markets might be captured. Both the chlorine suppliers and the pulp manufacturers have cooperated in developing methods of bleaching the sulphate pulp without loss of its inherent strength. The results have been bleached sulphate pulps of a high degree of whiteness.

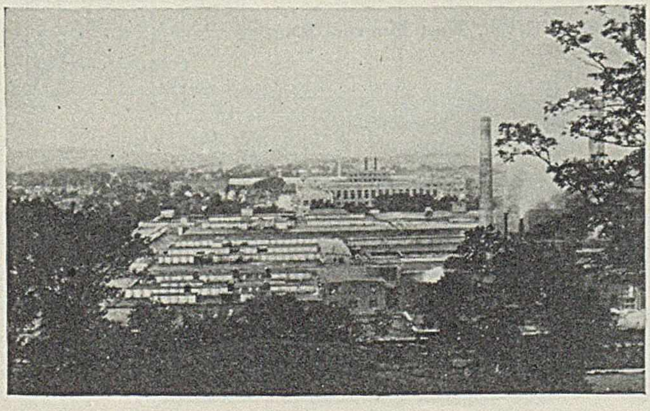
Attempts are being made to utilize southern woods for sulphate pulp that will be suitable for the rayon industry. This is a natural development since these woods are said to be most easily cooked by this process, and as most of the rayon industry is located in the south.

Waste Disposal and Stream Pollution

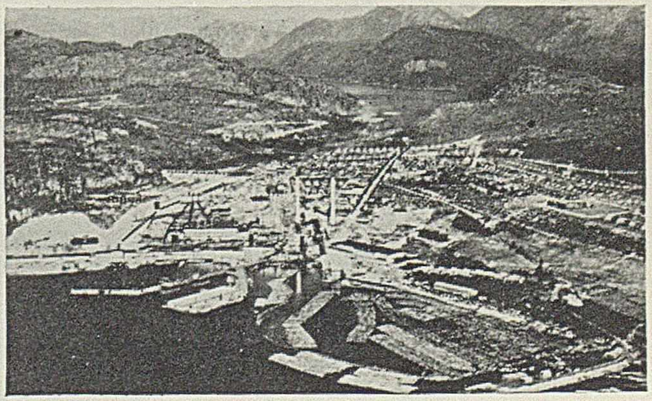
Waste disposal and stream pollution are of national importance. They have received so much attention in recent years that the mills have been giving serious thought and effort to a solution. But the problem is not an easy one, and is apt to prove to be fatal to a few mills unless an economical solution can be developed.

Waste sulphite liquors have become so troublesome in Wisconsin that ten manufacturers have announced their intention to study collectively the

Chillicothe, Ohio, mill of the Mead Corp.



Mill of the Powell River Co. at Powell River, B. C.



problem of disposal. The Sulphite Pulp Manufacturers' Committee on Waste Disposal has been organized to conduct research and other investigations.

The first work to be undertaken is the study of the biological phase of waste disposal, and the employment of a consultant of high standing has been authorized. He will have at his disposal the laboratories and facilities of the Institute of Paper Chemistry. Following this study, it is contemplated that a pilot plant will be erected and operated for the purpose of determining the feasibility of the results of the laboratory work.

Concurrently with the foregoing program, the committee has authorized a careful and exhaustive study of all presently known processes for handling waste liquors through evaporation and incineration.

Another phase of the program, which is much more profound, involves the question of utilization through the production of byproducts which may find or create an entirely new market.

The Marathon Paper Mills Co. of Wisconsin has been engaged for many years on pioneering research and commercial developments in the disposal and utilization of waste sulphite liquor. The objectives of their investigation have been first to reduce the stream pollution incident to the discharge of this liquor into waterways and second to supplement the value of the cellulose pulp by realizing on the commercial potentialities of the large tonnage of non-cellulose organic matter going to waste in such liquor.

The work has resulted in the development of the Marathon-Howard processes. Waste sulphite liquor is now being treated on a commercial scale by these processes at the Rothschild, Wis., mill resulting in a reduction in steam pollution and the manufacture of a variety of products for use by the pulp mill and for sale.

While the waste liquors from the sulphate mills give some concern they are not the problem that are the sulphite liquors. However, the sulphate mills have the serious unsolved problem of odor with which to contend at once.

Chemical Byproducts

Expansion of the boundaries in pulp manufacture are likely to include the whole field of wood utilization and particularly the development of byproducts from pulp manufacture, which will have a pronounced influence upon the fundamental economic structure of the pulp industry as D. C. Everest, then president of the American Paper and Pulp Association, stated in his address before the Canadian organization at its recent annual meeting. Here are a group of problems that rest upon the shoulders of the technologists and the foresters.

Mr. Everest was speaking from experience, for his own concern, the Marathon Paper Mills Co., has been a leader in the recovery of byproducts from pulp production. Already boiler fuel, vanillin, tanning materials, plastics and other products are being obtained from waste sulphite liquors (Guy C. Howard in *Chem. & Met.*, Vol. 46, pp. 618–619, 1939).

Another important producer of byproducts is the Champion Paper & Fibre Co. Harold R. Murdock, research director of that organization recently expressed the view that the byproducts may eventually become of equal importance with the pulp itself. (*Paper Trade Journal*, June 3, 1937.)

A source of chemicals is also found in the waste material obtained in the production of Masonite board products. When the wood is exploded, a portion of the hemi-cellulose is broken down to hexosans and pentosans and other products due to the steam pressure and to the organic acids formed during the heat treatment and explosion. These and part of the lignin are water soluble and it is necessary to free them from the fibrous material before making the board. Methods for the recovery of furfural, acetic and formic acids have been developed. This work is in the semi-commercial plant stage and plans are now being considered for the erection of a large plant to house this proposed new department (*Chem. & Met.*, Vol 47, pp. 95–98, Feb. 1940).

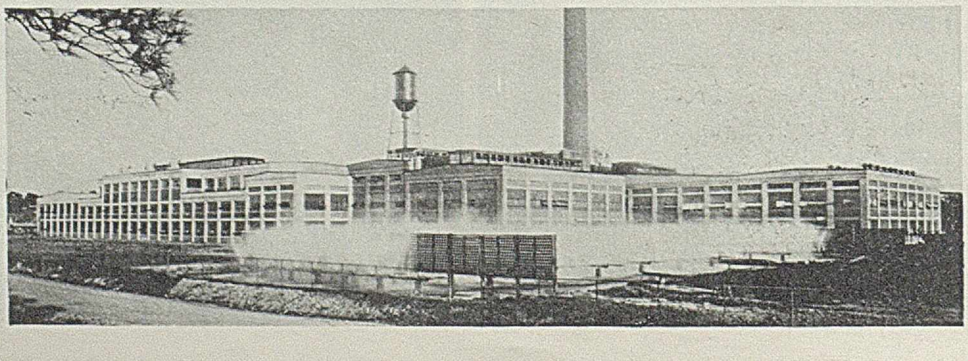
The discovery of new and useful products which may be made from lignin have been announced by the U. S. Forest Products Laboratory at Madison, Wis. They will mean the salvage of approximately 1,400,000 dry-weight tons dumped into the streams annually by paper and cellulose mills. Their commercial use will also eliminate pollution and disposal problems faced by the mills.

The importance of lignin as a raw material was emphasized by Prof. H. K. Benson of the University of Washington when he told the Canadian Chemical Convention at Vancouver, "The greatest economic waste in the world today is lignin." In the pulp industry, for every ton of pulp produced, there is roughly an equal amount of materials from the original wood to be found in the waste liquors.

For some years the sulphate mills have been recovering tall oil and crude turpentine, but recently interest in the recovery of the fatty acids has spread to many other mills. Among the other chemicals now recovered should be mentioned tannic acid and tars. Thus a whole new chemical industry is being built successfully on waste products so abundantly available as to create stream pollution problems in many parts of the United States.

The space only permits the brief mention of a few of the problems that wait solution by chemical engineers and an even smaller number of the tremendously important trends that promise to change the course of the industry. However, engineers who are interested in pursuing the subject further are referred to numerous other problems of a chemical engineering nature and industrial trends in the pulp mill that are discussed by Harold R. Murdock (*Chem. & Met.*, Vol. 44, pp 4–8, 1937) and to the problems and trends in the paper mill which are covered by Clark C. Heritage (*Chem. & Met.*, Vol. 44, pp. 9–13, 1937).

Sulphate pulp mill of the Brown Paper Mill Co., West Monroe, La.



USEFUL EMPIRICAL EQUATION FOR CORRELATION OF CHEMICAL ENGINEERING TEST DATA

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In the correlation of chemical engineering test data it frequently happens that y will plot linearly with respect to x except for a section where there is a decided bump in the curve as shown in the accompanying figure. It is the purpose of this note to show how an equation can be fitted to such data since this case is not covered in texts on empirical equations and graphical methods.

A plot of the data found in the table shows the line to be straight below values of $x = 3$ and above values of $x = 8.5$ suggesting that a linear equation might be supplemented with a correction term, δ, which would add appreciably to y for central values of x and become negligible for both high and low values of x as

$$y = a\,x + b + \delta$$

where a and b are constants and where

$$\delta = \alpha/(e^{np} + e^{nr}) \qquad (1)$$

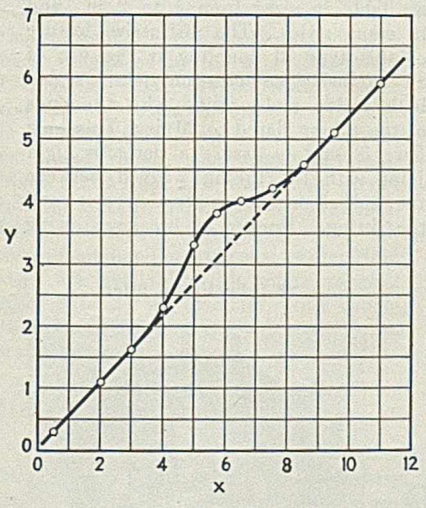
In this expression, $p = (X - x)$ and $r = (x - X)$ where X is the value of x corresponding to the maximum deviation of y from the straight line

$$y' = ax + b$$

and $\alpha/2$ is this deviation. Where $x = X$, $(X - x)$ and $(x - X)$ are zero and hence e^{np} and e^{nr} are 1 so that $\delta = \alpha/2$. Two or three trials are enough to choose a value of n such that the desired conditions are met.

In the table the column headed y' gives values of $y' = 0.5362\,x + 0.017$ and was determined by the method of averages from the initial and final three pairs of x and y values. Next follows the column headed $y - y'$ which is intended to be matched by values of δ. The maximum value of $\delta = y - y'$ is 0.7 so that $\alpha = 2(0.7) = 1.4$. This maximum value occurs at $x = 5.75$ which must be the value of X. Two or three trials indicate a suitable value of n to be 1.3. These values of n, α, and X are substituted in (1) and the equation is easily evaluated by means of a log-log slide rule or a table of exponentials. The balance of the computations are as indicated in the table; comparison of calculated and observed values of y showing agreement to be satisfactory.

Typical curve for which an equation may be derived by the method described



Tabulated Calculations and Comparison of Observed and Calculated Values

y	x	y'	$y - y'$	p	np	e^{np}	e^{nr}	$e^{np} + e^{nr}$	δ	$y' + \delta$
0.30	0.50	0.285		5.25	6.825	920	0.001	920	0.002	0.287
1.10	2.00	1.089		3.75	4.875	131.5	0.01	131.5	0.011	1.100
1.60	3.00	1.626		2.75	3.575	35.7	0.03	35.7	0.039	1.665
2.30	4.00	2.162	0.138	1.75	2.275	9.74	0.10	9.84	0.142	2.304
3.30	5.00	2.698	0.602	0.75	0.975	2.65	0.38	3.03	0.462	3.160
3.80	5.75	3.100	0.700	0.00	0.000	1.00	1.00	2.00	0.700	3.800
4.00	6.50	3.502	0.498	−0.75	−0.975	0.38	2.65	3.03	0.462	3.964
4.15	7.50	4.038	0.112	−1.75	−2.275	0.10	9.74	9.84	0.142	4.180
4.60	8.50	4.575		−2.75	−3.575	0.03	35.7	35.7	0.039	4.614
5.10	9.50	5.111		−3.75	−4.875	0.01	131.5	131.5	0.011	5.122
5.90	11.00	5.915		−5.25	−6.825	0.001	920	920	0.002	5.917

Typical applications of this type of empirical equation have been encountered in viscosity data for aqueous salt solutions and in the thermal conductivities of aqueous glycerol solutions (*Chem. & Met.* 46, 356, 1939).

VAPORIZATION EQUILIBRIA

(*Continued from page 235*)

35, 45, 55 per cent as trial values of V. For each value proceed to determine the Q from the plot, using the K determined in Table I. See Tables II, III, IV.

From Fig. 2: the plot of determined and assumed L values shows an intersection at V=50.75 per cent. For sake of accuracy this value is checked in Table V.

V = 50.75 per cent
L = 49.25 per cent = 15.60 mols

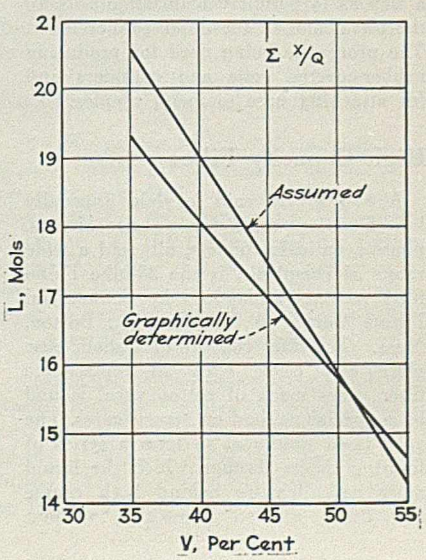
Table V

Component	Q	X/Q
C_3H_8	4.49	2.91
C_4H_{10}	2.10	3.68
C_5's+	1.211	9.00

L=15.59 mols

A review indicates that the accuracy of the method plus its time saving feature makes it more desirable than many trial and error methods ordinarily used.

Per cent vaporization is determined by means of a chart such as is shown below



Process Equipment NEWS

Machinery, Materials and Products

Stainless Industrial Fittings

A RECENT development of the Tri-Clover Machine Co., Kenoska, Wis., is a complete line of stainless steel industrial type fittings for use with light-gage seamless stainless steel tubing. Most fittings are machined with a standard Acme thread for heavy service. In certain instances, standard iron pipe threads are available. For high pressure work, gasket seat fittings may be supplied, but standard 45 deg. ground joints are ordinarily furnished. The line is made in sizes from 1 to 4 in. and includes practically all common types of fittings, such as long and short radius ells, tees, crosses, unions, flanges, reducers, adapters, 45-deg. fittings and a variety of both packed and sanitary type valves.

Rubber-Metal Bond

AFTER SEVERAL YEARS of research, the Hewitt Rubber Corp., Buffalo, N. Y., has announced a method for bonding soft rubber and neoprene to steel and aluminum by hot vulcanization. The new process is said to yield exceptionally high adhesion strength with remarkably good aging qualities. Adhesion strengths of 500 to 750 lb. per sq.in. are said to be obtained. The new bond is recommended for service temperatures up 200 deg. F. although work is continuing with the aim of extending this range to 250 deg. F. or higher.

The new process, known as Dura-Bond, modifies the rubber chemically in such a way as to permit vulcanization both to the metal and to the outer rubber layer. The process is being used for producing rubber-covered rolls and cylinders and for attaching hose to metal nipples.

High Capacity Filter

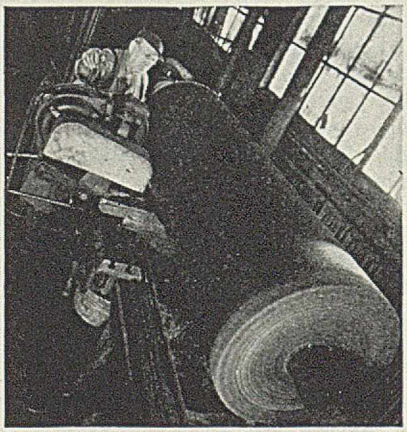
A NEW FILTER said to yield unusually low filtration costs for water, solvents, pharmaceutical products, oils and a wide range of chemicals, is the 28-tube Fulflo filter recently announced by Commercial Filters Corp., 40 Macallen St., Boston, Mass. The filter consists of a shell, base plate and cover with 28 replaceable filter tubes made of cotton yarn, wound by a special method on screen cores. The yarn is so wound as to form a series of filtering sheets through which the liquid must pass, leaving behind both coarse and finely divided impurities, without blinding, according to the manufacturer. Rates of flow up to 225 g.p.m. are claimed, and a tube life up to 1,120,000 gal., depending on the liquid and its viscosity, and the type and amount of impurities in suspension. Standard construction materials are steel and brass, while stainless steel and various alloys may be furnished to special order.

Pulp Washer

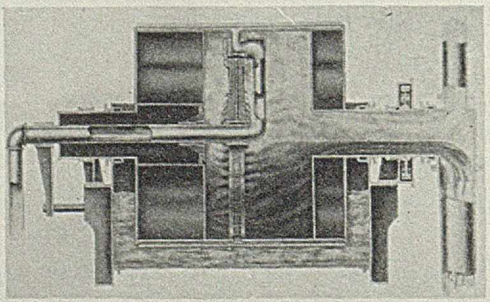
AFTER an extended field demonstration, Oliver United Filters, Inc., 33 West 42d St., New York, N. Y., has placed on the market an entirely new design of black liquor pulp washer, known as the Oliver ring valve washer. The name is derived from the type of valve used which has been designed to permit unrestricted flow of liquor through the wire cover into the drum, and to provide for sharp separation between the strong black liquor and the wash water. The valve is an annular ring encircling the inside of the drum, with outlets from each peripheral section. The ports connecting with the inside of the drum are in the sides of the ring.

In the upper part of the drum and supported by the wash liquor outlet pipe shown at the left of the sectional view are arced gates on both sides of the ring, which shut off the flow to the drum and divert it through a hopper and out the wash liquor pipe. The position of the gates may be altered angularly by rotating the wash liquor discharge pipe. The wash water can thus be separated from the strong liquor at any desired point. Outlet connections midway of the drum, short travel, and large strong-liquor discharge connections, are said to assure uniform sheet formation and high washing efficiency.

Grinding a 77x24-in. Dura-Bond rubber-covered cylinder



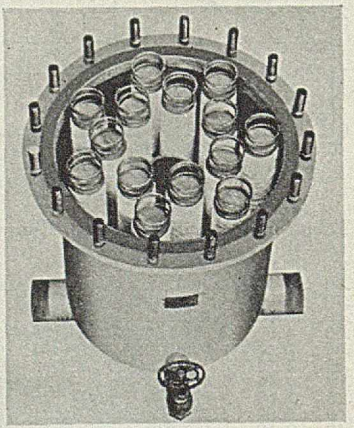
Cross-section of new pulp washer

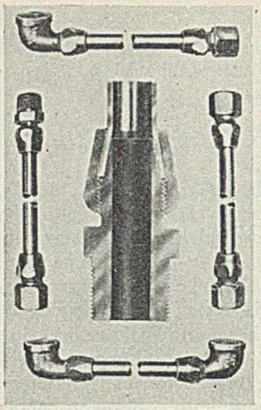


Improved Connectors

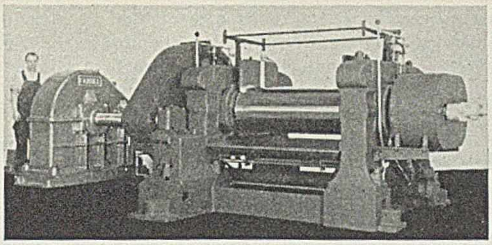
AN ACCOMPANYING VIEW shows a few of the numerous types of Superseal Connectors for aluminum, brass, copper and steel tubing which have been introduced by the Superseal Corp., 300 Fourth Ave., New York, N. Y. These connectors are available in sizes from $\frac{1}{8}$ to 2 in., and in many styles. The distinctive feature of this type of coupling is the use of an exclusive compression joint, sealed both inside and outside with the ends of the tubing flared to 20 deg. This long flare is said to assure a perfectly tight joint with the tubing wedged between the self-aligning compression nut and the fitting. Danger of breakage owing

28-tube Fulflo filter

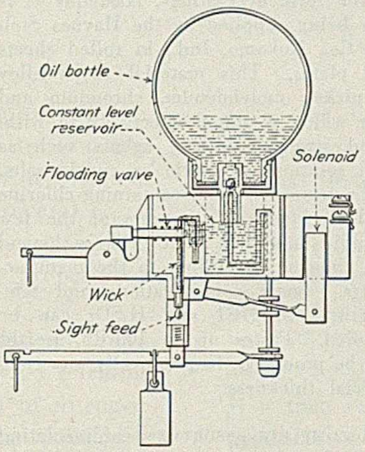




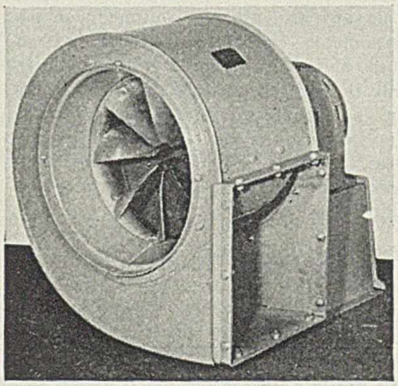
Typical Superseal fittings



Heavy duty plastics mill



New Mykrofeed lubricator



Rexvane Vent Set blower

to the cutting action of the fitting on the flared end is said to be completely eliminated. The joint can be loosened and tightened an indefinite number of times without injury.

General-Purpose Blower

An improved general-purpose blower or exhauster for ventilating, air conditioning and fume exhaust service has been announced by the B. F. Sturtevant Co., Hyde Park, Boston, Mass., under the name of Rexvane Vent Set. The fan is of the centrifugal type with direct connected motor, employing an eight-blade radial rotor with the blades curved into the inlet in the direction of rotation. This design is said to increase the volume of air handled very materially. Nine sizes are available with rotors ranging from 6 to 24 in. diameter, with capacities from 250 to 6,000 g.p.m. at $\frac{1}{2}$ in. static pressure.

Heavy Duty Plastics Mill

To meet the requirement for heavier duty milling equipment for the processing of plastics at high temperature, Farrel-Birmingham Co., Ansonia, Conn., has recently introduced a heavy duty mill of the type shown in the accompanying illustration. Mills so far installed are used for the treatment of cellulose acetate. The crystals, with coloring matter added, are crushed and mixed together between the rolls of the mill at a temperature of about 300 deg. F. The soft material after mixing is led off in thin sheets which are cooled and subsequently pulverized. The 24-in. diameter rolls are driven through an inclosed reduction unit by a 150-hp. motor. The rolls are chrome plated and carried on water-cooled, force-feed-lubricated bronze journal boxes. Oil seals are provided to keep the oil from the face of the rolls and the oil, cooled in a sump beneath the mill, is circulated by a pump located on the high speed shaft of the reduction gear unit.

Electric Lubricator

A recently announced lubricator, developed by Bromley & Son, 232 Chestnut St., Kearny, N. J., is provided with a solenoid connected into the motor circuit of the driven machine so that the lubricator automatically starts up with the machine, and shuts down when the machine is shut down. As indicated in the diagrammatic sketch, a Lucite oil container is connected through a ball valve with a constant level reservoir. When the solenoid is energized (or when the weight is moved on the lower lever), the ball valve is raised and oil flows into the constant level reservoir until sealed off by the tube. Oil flows over a dam into a wick chamber and then is raised slightly by wick capillarity, flowing down the wick and dripping through a sight feed. Adjustment of the feed rate is made by varying the number of wicks or by raising the wick slightly (and thus increasing the capillarity lift) by means of an adjusting screw. The upper lever is used to open a self-closing valve for flooding the bearing after a long shutdown. A characteristic of the lubricator is that remarkably constant feed rate is said to be maintained under all ordinary room-temperature variations.

New Products

A new line of modified polystyrene resins which has been given the name of Cyrene, has been announced by the Neville Co., Neville Island, Pittsburgh, Pa. The new resins are stated to be hard, tough and elastic and not compatible with vegetable drying oils. Suggested uses are in such fields as adhesives, plastic molding compounds and surface coatings where contact with petroleum oils is necessary. There are four principal types, having melting ranges in the range from 90 to 160 deg. C. The materials are resistant to water, acids and alkalis and soluble in aromatic hydrocarbons.

For the protection of conveyor belts the B. F. Goodrich Co., Akron, Ohio, has developed a coating material known as Goodrich R-60-T which, on the basis of tests, is claimed greatly to reduce the effect of aging. Samples of conveyor belting with covers under severe tension were coated with this synthetic material and exposed for six months to all varieties of weather. At the end of that time none of the samples to which the coating had been applied showed any evidences of cover deterioration, according to the manufacturers. It is pointed out that idle conveyor belting may suffer greater deterioration through the effects of sunlight and air than when the belting is in use.

Durez Plastic & Chemicals, Inc., North Tonawanda, N. Y., has announced a new easily preformed, high-impact phenolic molding material known as Durez 1900 Black which is said to produce an unusually smooth finish for a standard high-impact type of molding material. Particle size is so controlled that the compound is claimed to flow easily through hoppers and automatic feeding devices for which reason it has been found suitable, according to the makers, for many parts requiring a high-impact material, but which previously had been considered impractical for molding.

Equipment Briefs

A moderately-priced, direct-reading, glass-electrode pH instrument known as the Cameron One-Two pH tester has been put on the market by Wilkens-Anderson Co., 111 North Canal St., Chicago, Ill. Only two simple operations are required for reading. The instrument is readily portable, self-contained and adapted for use in the plant.

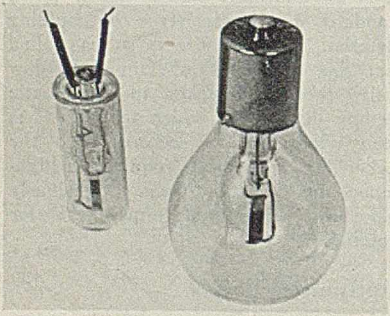
Treadwell Construction Co., 618 South 12th St., Midland, Pa., has recently introduced a line of welded steel kettles of $19\frac{1}{2}$ cu. ft. capacity having an inside diameter at the top of 42 in. and an inside depth of 24 in. Firebox quality steel, all welded construction, and an inside contour designed to assure self-cleaning when the vessel is dumped, are features.

A NEW photoelectric colorimeter known as the Lumetron and introduced by the Photovolt Corp., 10 East 40th St., New York, N. Y., has been designed for an extremely wide range of application, from simple measurements of light transmission to colorimetric and turbidimetric chemical analysis, with provision made for the measurement of extremely dark or transparent liquids. Special care has been taken, according to the manufacturer, to insure stable and linear photocell response. A general purpose instrument and three specialized types are available to cover most applications.

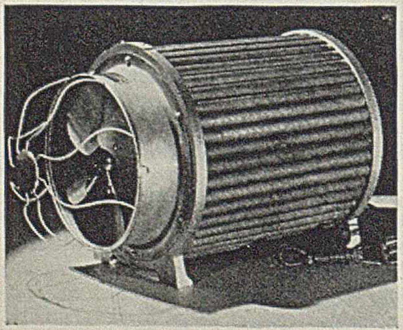
TO FACILITATE cleaning of filter presses the Enthone Co., 442 Elm St., New Haven, Conn., has introduced a new high strength filter paper which is placed over the filter cloth or screen to receive the cake, and can easily be stripped from the press during cleaning. Costing less than 1¢ per sheet, the paper is claimed to have the highest wet strength of any paper for the purpose, owing to the use of a special wet-strength treatment and the presence of exceptionally long fibers. Tight sealing of plates and frames, fast filtering and resistance to both acid and alkaline solutions are claims for the new paper.

DEVELOPED particularly for the painting of concrete, brick, asbestos siding and similar materials, a new coating known as Porce-Tite has been introduced by Bedard & Morency Mill Co., 101 North Lombard Ave., Oak Park, Ill. The new paint is said to contain no oil, casein or cement, but to be a compound of several inorganic materials, chemically treated to produce high waterproofing qualities. It is claimed to be unaffected by most industrial acids and fumes and to resist hydrostatic pressure when applied to inside surfaces. Porce-Tite is white, but can be painted over with other paints of any desired kind or color.

New radiation thermocouples



Dorex odor adsorber

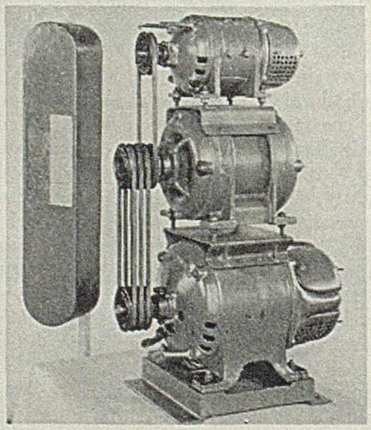


AVAILABLE until a short time ago only in the form of castings, Hastelloy C is now being supplied by the Haynes Stellite Co., Kokomo, Ind., in rolled sheets and plates. This material is an alloy of nickel, molybdenum, chromium and iron which is stated effectively to withstand strong oxidizing agents such as acid solutions of ferric or cupric salts, and aqueous solutions containing chlorine or hypochlorites. It is one of the few metallic materials that will withstand wet chlorine, according to the manufacturers. Some concentrations and temperatures of HCl and H_2SO_4 can be handled. Plates up to 100 lb. weight can be produced, in practically any commercial thickness.

A COMPLETE ASSORTMENT of insulating joints for pipe lines, made of malleable iron, and including compressed fibre insulating rings which encircle the ball member at two different points, have been announced by the Hanson-Van Winkle-Munning Co., Matawan, N. J. Such joints, for use in avoiding possibility of electrical grounds through pipe lines transmitting solutions in plants employing electrochemical processes, are tested for 125-volts d.c. service and 200 lb. per sq.in. steam pressure. A further advantage is that these joints impart an element of flexibility to the line in which they are installed.

K-16 is the designation of a new insulating firebrick recently announced by the Babcock & Wilcox Co., 85 Liberty St., New York, N. Y. Claimed to have a stability comparable to fired-clay refractories, the new material nevertheless weighs less and has an insulating value comparable with or superior to un-fired insulating materials, according to the manufacturer. Temperatures up to 1,600 deg. F. for direct exposure and 2,000 deg. F. for backing up are recommended limits. Weight is said to be approximately 19 lb. per cu. ft.

Pyramid-mounted motor generator set



Radiation-Type Thermocouple

A NEW radiation-type vacuum thermocouple for use wherever exceptionally high sensitivity and rapid response are needed in relatively high temperature measurements has been announced by the General Electric Co., Schenectady, N. Y. The thermocouple consists of a thin filament of two different metals, blackened on one side and contained within a vacuum bulb. Radiant energy falling upon the thermocouple produces an electromotive force capable of operating any suitable millivoltmeter or potentiometer calibrated in degrees. A closed-end tube mounted in the furnace wall is used to prevent fogging of the lens and to form a target upon which the thermocouple is sighted. Temperatures from 300 to 1,500 deg. C. are read directly, or higher temperatures with the addition of a protective filter.

Portable Odor Adsorber

ACTIVATED CARBON is the active material used in a new portable odor adsorber recently introduced by the Dorex Div. of W. B. Connor Engineering Corp., 114 East 32d St., New York, N. Y. As shown in the accompanying view, the device consists of a "squirrel-cage" ring of perforated metal tubes containing activated carbon through which air is drawn by means of a fan. One type is available for wall or ceiling installation, and another for application to existing ventilating or air conditioning systems. The carbon employed is said to adsorb up to 20 per cent of its own weight in odors. The manufacturers point out that one important advantage of this type of equipment is that in air conditioning installations it eliminates odors to such an extent as to reduce appreciably the amount of fresh air that must be introduced and thus reduces heating or cooling required.

Compact Motor Generator

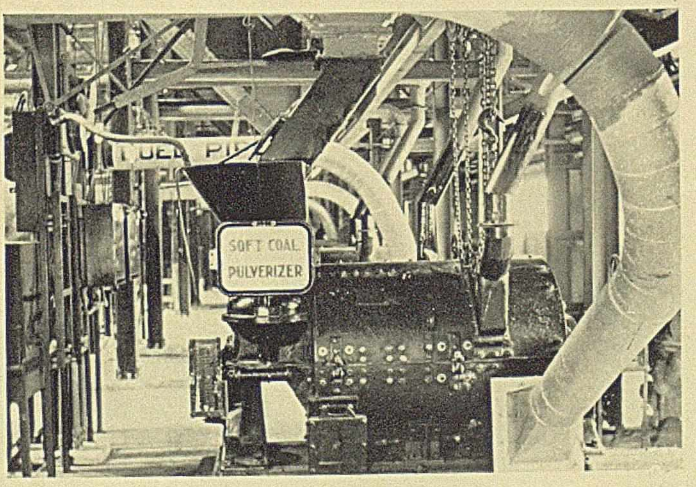
SAVING in floor space, accessibility, and the possibility of using machines of different speeds, are important characteristics of a new pyramid-mounted motor-generator set, developed at the Norwood, Ohio, works of the Allis-Chalmers Mfg. Co. The generator, motor and exciter, each a self-contained machine, are assembled one above the other, thus requiring floor space equal only to the generator mounting dimensions. The motor is mounted above the generator and in turn supports the exciter. Connections to generator and exciter are by Texrope V-belt. Present available sizes are up to and including 10 kw. An advantage of the arrangement is that different speed machines may be employed, for example, a 60-cycle generator with a 25- or 50-cycle motor.

Production of Cyanamide

THE PRODUCTION OF CALCIUM CYANAMIDE on the North American continent is limited to a single plant located at Niagara Falls, Ontario. The original unit built in 1909, has been enlarged on several occasions, reaching a capacity of 355,000 tons, equivalent to 75,000 of contained nitrogen. It is the property of the American Cyanamid Company.

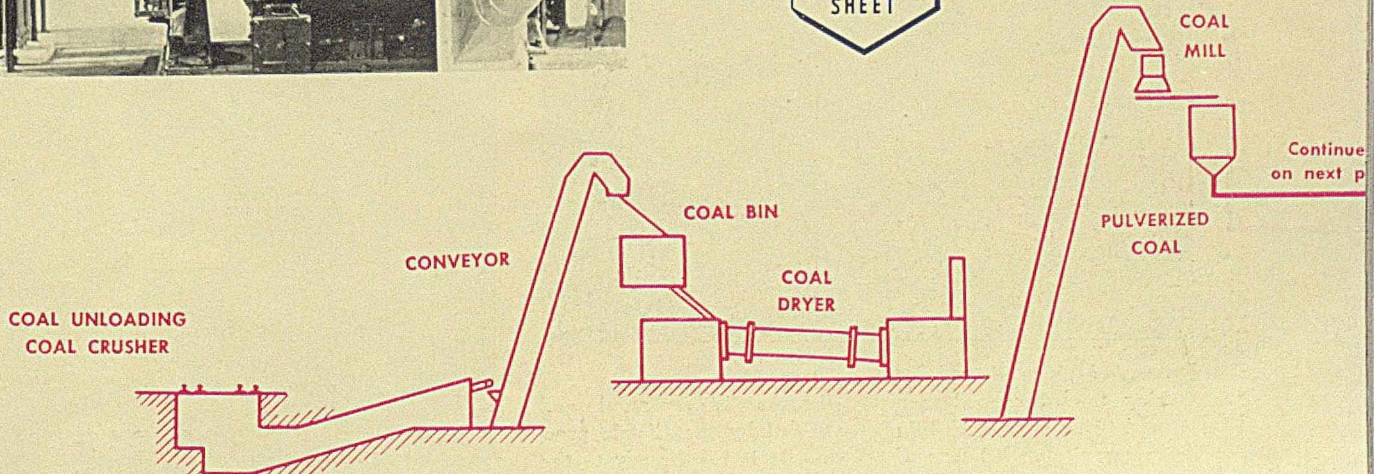
The process may be conveniently divided into four principal operations, or series of operations: burning of lime, carbide manufacture, separation of nitrogen from liquid air, and nitrification of the powdered carbide with this nitrogen. Weighed quantities of quick lime and pulverized, dried coke are charged into 30,000 hp. furnaces, with a capacity of 185 tons each. The tremendous current of electricity passing between electrodes melts the lime which combines with the crushed coke forming calcium carbide.

Nitrogen is separated and purified by the Claude process in the liquid air plant. It is led directly to the fixation ovens containing pulverized carbide and to the milling equipment. The crude cyanamide or lime nitrogen as produced in the ovens is treated before marketing. For chemical purposes, or if to be used for ammonia, a small quantity of water is added to decompose remaining traces of carbide. It is then ready to be sent to conversion plants. The product for agricultural purposes, commonly known as Cyanamid, goes to a more elaborate mixing system where oil and water are added. Oil prevents dirtiness. After cooling it is sent to storage. A diagrammatic flowsheet and photographs of the essential steps in the process are shown.



Coal pulverizers and electrical control equipment for the lime kilns are located on the firing platform for the kilns. In the Niagara Falls, Ontario, plant of the American Cyanamid Co.

A Chem&Met PICTURED FLOW SHEET



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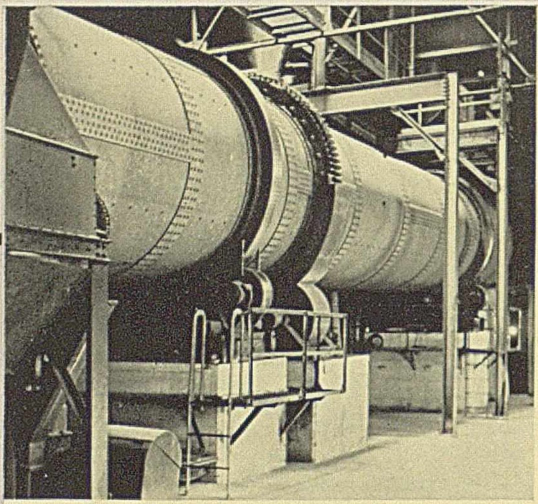
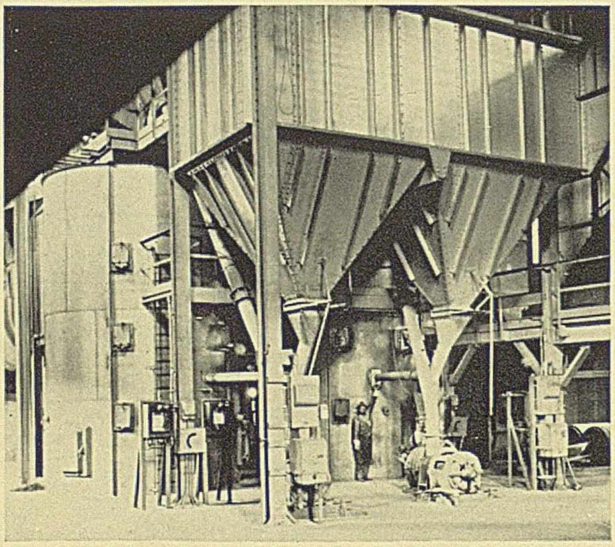
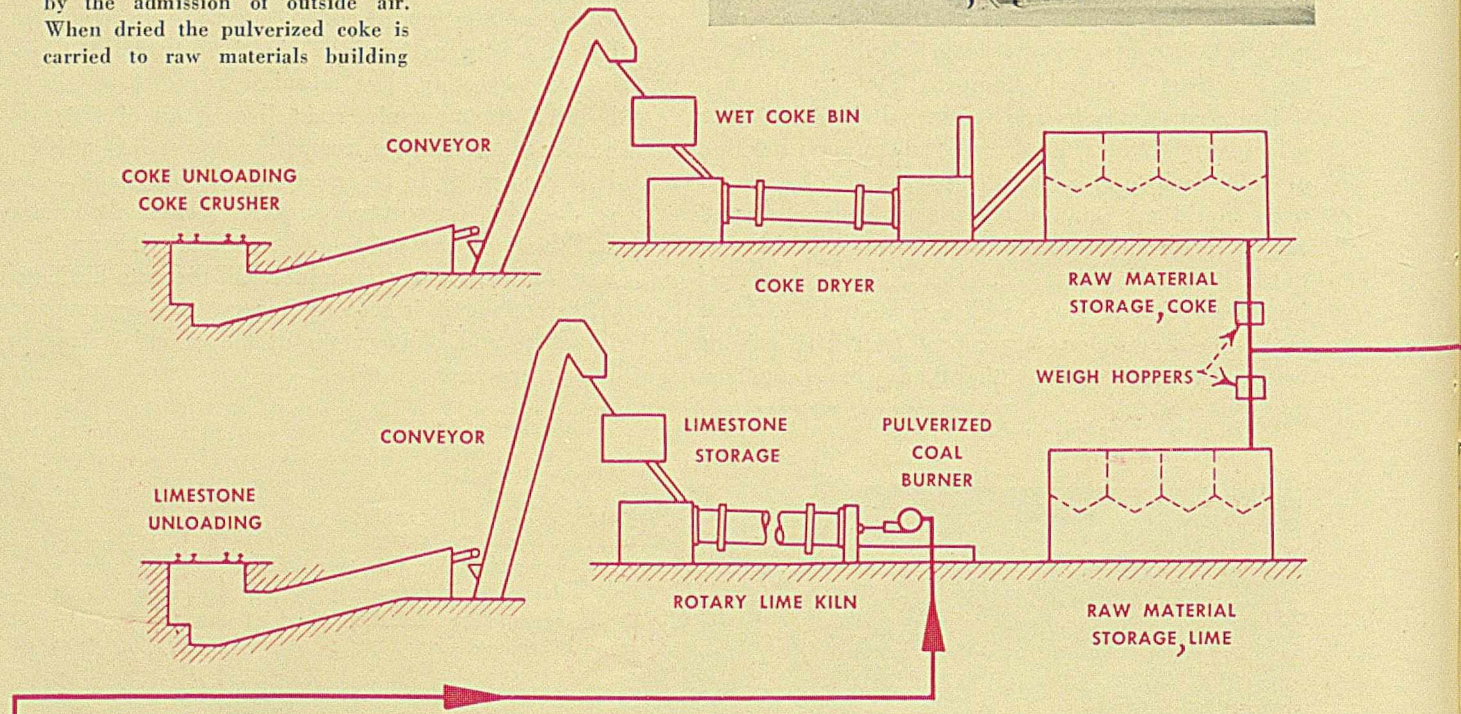
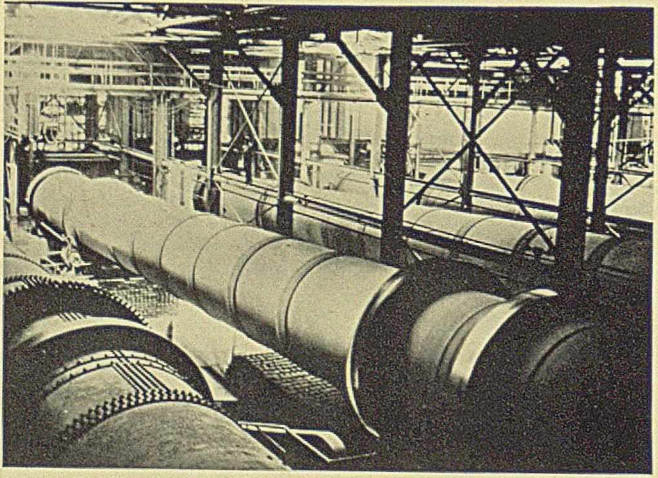


Coke is crushed and then passed to pulverized coal-fired dryers. Temperature of the gases entering the dryers is thermostatically controlled by the admission of outside air. When dried the pulverized coke is carried to raw materials building

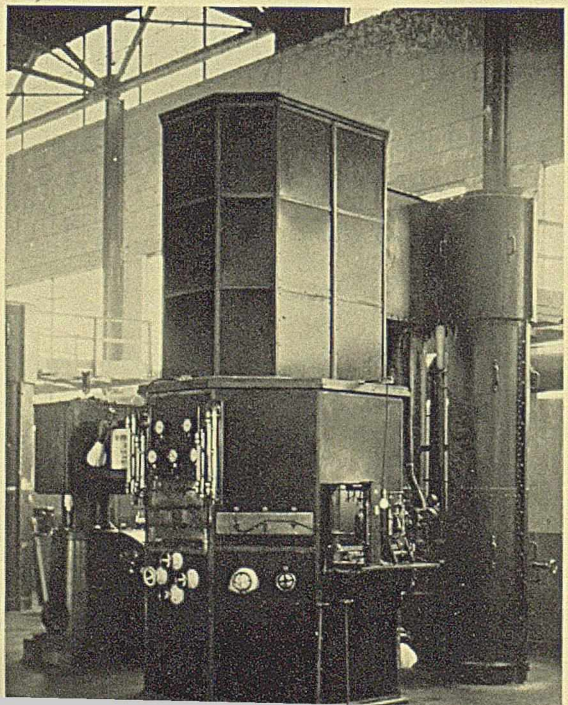


Coal bins and combustion chambers in coke drying department. The powdered coal, burned in an air blast, maintains a maximum temperature of 2,200 to 2,500 deg. F., without material injury to the brick kiln lining

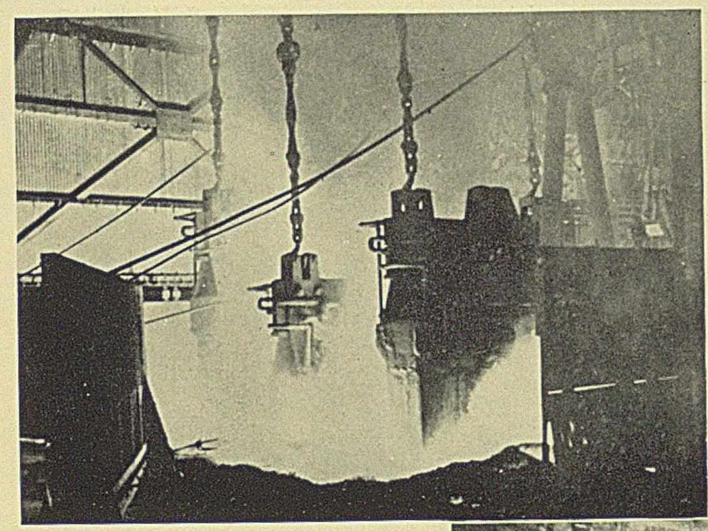




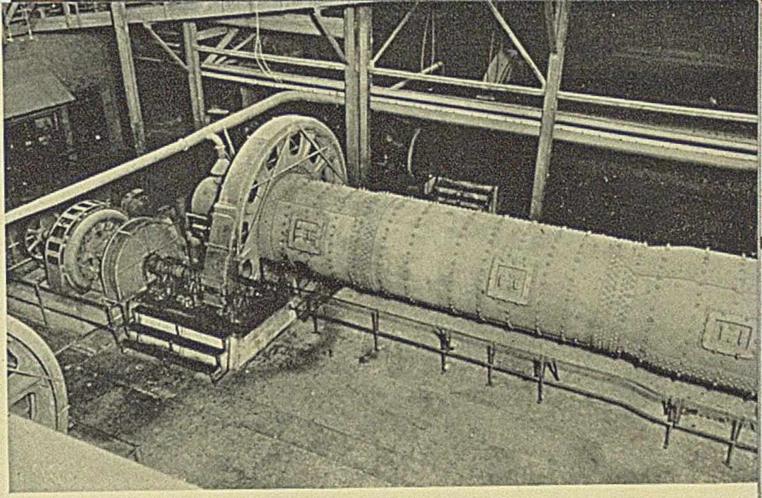
Battery of seven lime kilns looking toward control platform at firing end. Each kiln has a capacity of 100 tons of lime per 24-hr. day



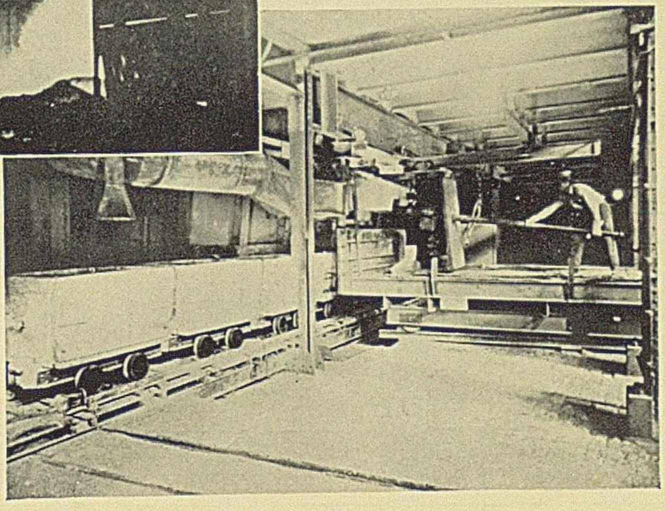
Nitrogen is separated and purified by the Claude process. It is led directly to the fixation ovens and milling equipment through an underground cast iron pipe



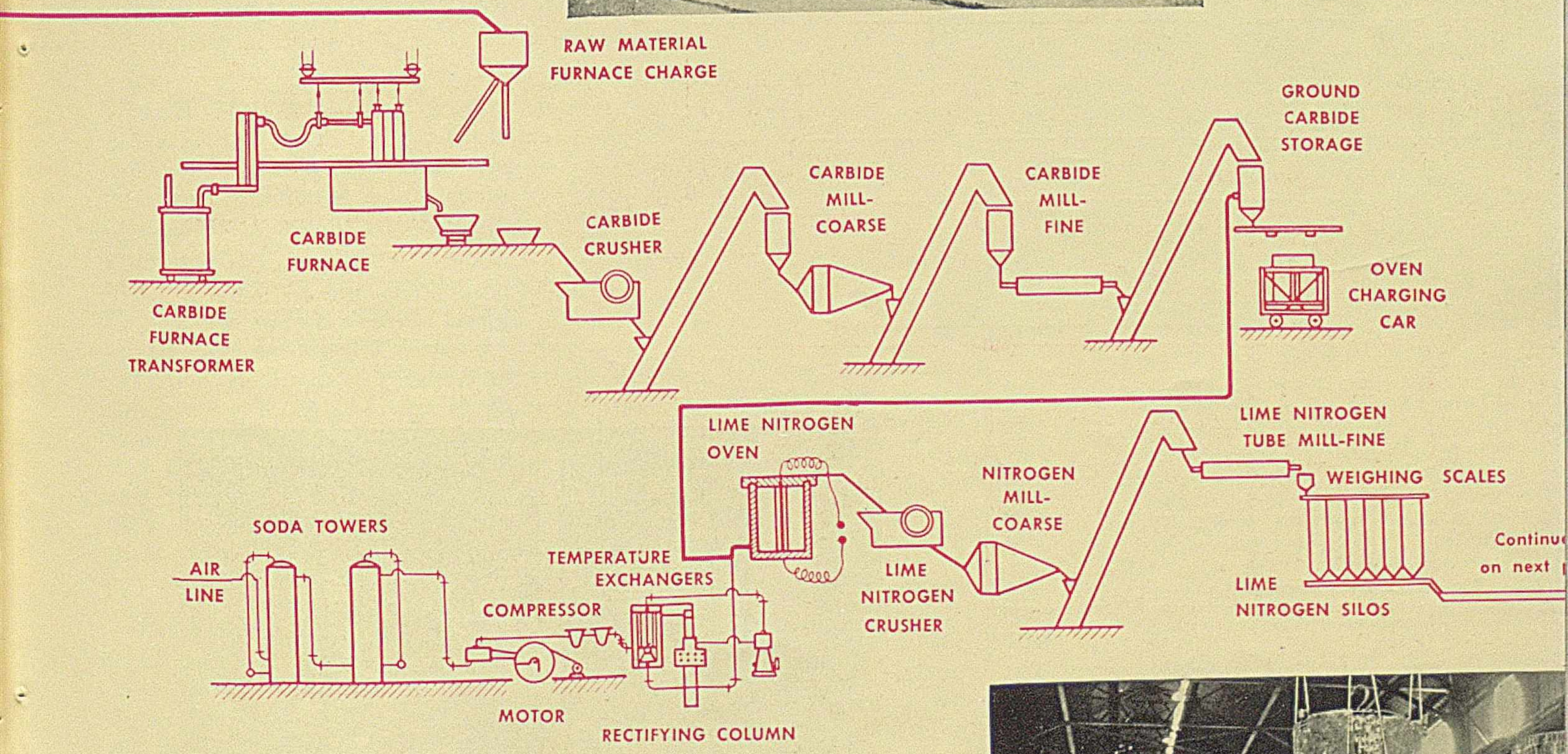
Installation of 30,000 hp. carbide furnaces greatly increased the efficiency of the plant. They have an individual capacity of 185 tons. Notice the giant electrodes suspened in the furnace



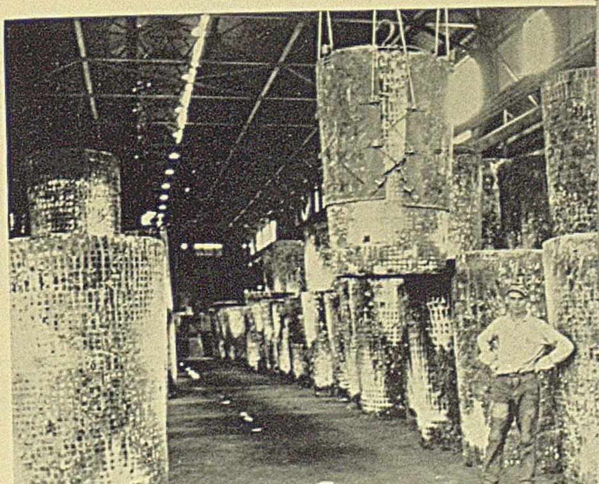
In the milling department, the cooled carbide pigs are prepared for use in the nitrifying ovens. Pigs are reduced in size first in a primary crusher and then in a Symes machine and a Com-Peb mill

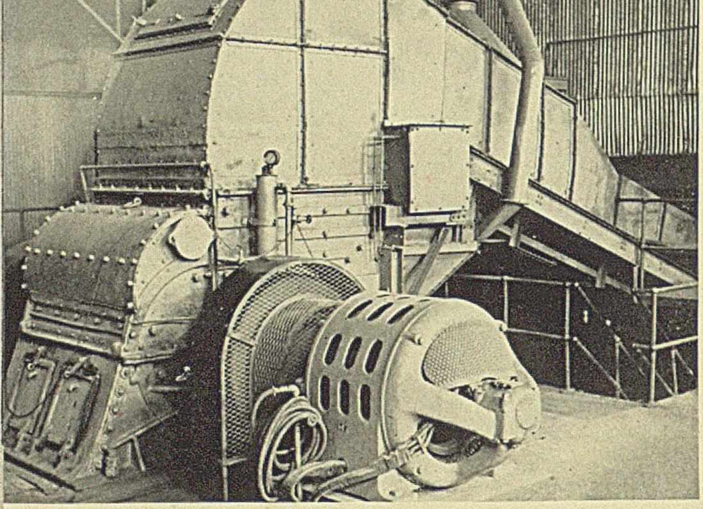


The large furnaces are tapped almost continuously. Tap holes are opened by burning with a portable electrode and carbide at 4,000 deg. F. flows into chill cars

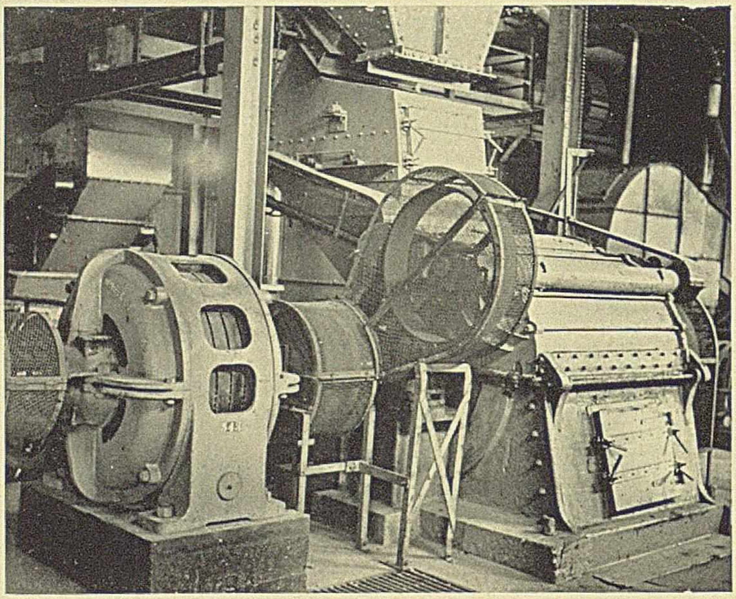


Crude cyanamide, which has sintered together, is removed by the crane operator. The ingot of lime-nitrogen weighing about six tons, is broken into several pieces which fall into a hopper and are delivered by a drag conveyor to a hammer mill which breaks them into 2-inch pieces

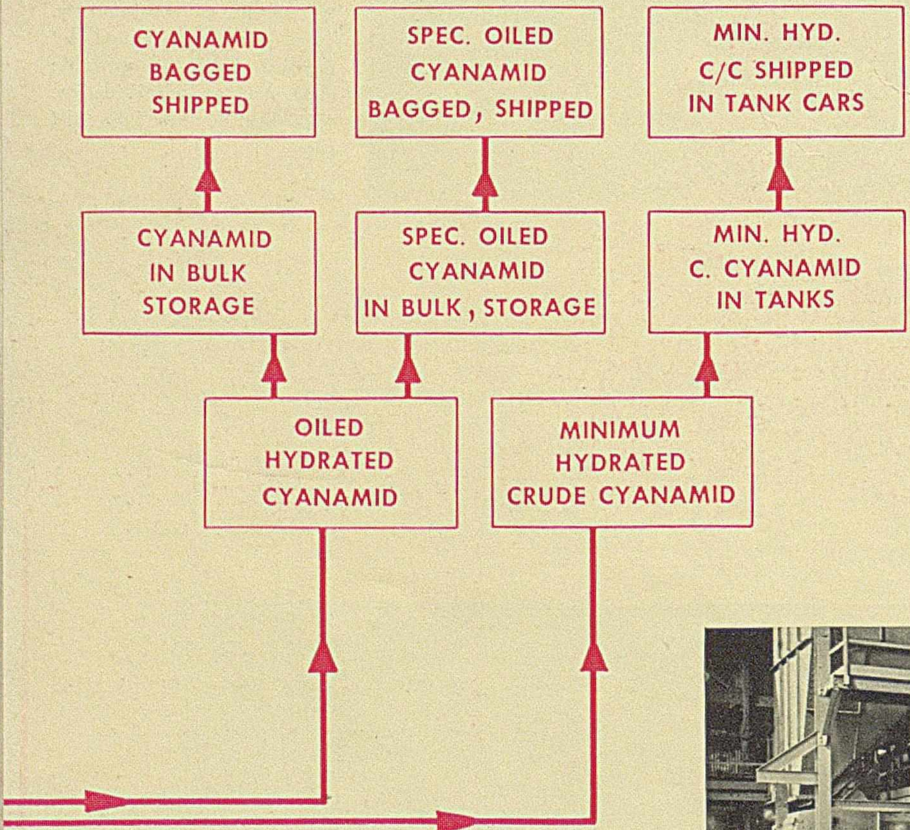




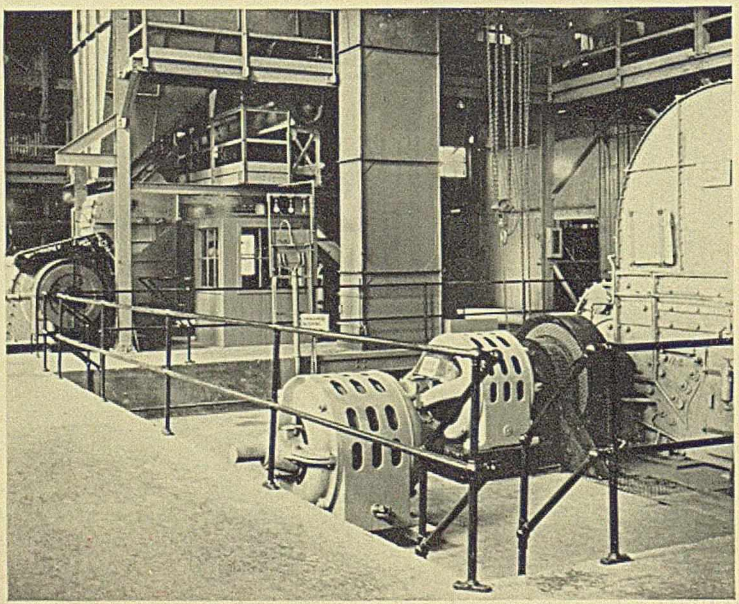
Large crude cyanamide hammer mill. After the ingot of cyanamide is broken into several pieces it is delivered to the large hammer mill which breaks it into 2-inch pieces



Small hammer mill in the crude calcium cyanamide department. A second hammer mill is necessary to complete the crushing. From this mill the crude cyanamide is conveyed by screw conveyors to storage or direct to the hydration plant



Another view of the hammer mills which are used to reduce the size of the crude cyanamide before it can be treated for marketing



Biennial Chemical Exposition Planned for Chicago

Under the auspices of the Chicago Section of the American Chemical Society, the first American Chemical Exposition will be held in the Stevens Hotel, Chicago on Dec. 11 to 15. The plan is to make this the first in a series of expositions to be held in even years to alternate with the Exposition of Chemical Industries held in New York in the odd years.

R. C. Newton of Swift & Co. was chairman of the committee which developed plans for the exposition and which will have complete control over its activities. M. W. Hinson has been selected by the committee to act as exposition manager and offices have been opened at 110 North Franklin St.

Emphasis will be placed on chemical products, Dr. Newton said in announcing the project and scientific exhibits will be included. Approximately $32,000 sq.ft. will be available for exhibits. The exposition has the endorsement of S. C. Lind, president of the American Chemical Society and of C. R. Wagner, chairman of the Chicago Section.

Serving on the Chicago Section's committee in charge of the exposition are: R. C. Newton, Swift & Co., chairman, V. Conquest, Armour & Co., E. H. Harvey, consulting chemist, L. M. Henderson, Pure Oil Co., W. M. Hinman, Frederick Post Co., R. H. Manley, Armour Institute of Technology, L. E. May, Sherwin-Williams Co., G. L. Parkhurst, Standard Oil Co. of Indiana, A. E. Schaar, Schaar & Co., R. E. Zinn, Victor Chemical Works, and Cary R. Wagner, Pure Oil Co.

Technical Sessions Arranged For A.I.Ch.E. Meeting

Recent developments in processes and equipment for chemical industries will be discussed at three technical sessions which make up the program for the 32d semi-annual meeting of the American Institute of Chemical Engineers to be held at the Hotel Statler in Buffalo, May 13-15. Plant visits in and about Buffalo will supplement the technical sessions on May 13 and 14. May 15 has been termed "Niagara Falls Day" and will be devoted to plant visits and sightseeing trips near the Falls.

As usual a separate program has been provided for the ladies. However, on Niagara Falls Day, a number of events have been planned for participation of both men and women. They are called Honeymoon Events and consist of a group luncheon, an excursion on the "Maid of the Mist," a trip through the "Cave of the Winds," and a drive along Niagara River to historic Fort Niagara.

Plant trips scheduled for Monday are: Buffalo General Electric Co., Buffalo Electro Chemical Co., Inc., Dunlop Rubber Co., Ford Motor Co., Pillsbury Flour Co., Great Lakes Portland Cement Co., Kelley Island Lime & Transport Co.

Tuesday trips, eliminating duplication, will include: Buffalo Foundry & Machine Co., Buffalo Forge Co., Buffalo Sewage Disposal Works, Socony Vacuum Oil Co. and Lapp Insulator Co.

Niagara Falls trips scheduled are: Niagara Alkali Co., Mathieson Alkali Works, Hooker Electrochemical Co., Acheson Graphite Co., Kimberly-Clark Corp., Union Carbide & Electrometallurgical Laboratories, R. & H. Chemicals Department,—du Pont, Niagara Falls Power Co.

One of the technical papers scheduled for presentation at the first session is "Chemical Industry on the Niagara Frontier" by R. B. McMullin, F. L. Koethen and C. N. Richardson. A number of papers on heat transfer will be presented. A new process for making absolute alcohol and a new inorganic heat transfer medium will be described.

Personnel of the local committees on arrangements includes: Frank J. Tone, honorary chairman; R. B. McMullin, chairman of the general committee; and several other prominent chemical engineers.

An innovation in the printed program for this meeting will be a form for pre-registration. Members and their guests may save time and avoid the crowd of 350 prospective registrants by sending their registration data beforehand.

Buna Rubber Plant To Be Built At Baton Rouge

Speculation regarding probable sites for the new plant to be erected by the Standard Oil Co. for the production of Buna rubber has been set at rest by the announcement that it will be built at Baton Rouge, La. The announcement stated that the Standard Oil Development Co. had entered into an agreement with the Standard Oil Co. of Louisiana whereby plans for producing the synthetic rubber at the southern city would be carried to completion. The proposed plant will have a capacity of about 10,000 lb. per day and production is expected to start in the latter part of this year. The announcement further stated that the Firestone Tire & Rubber Co. had taken a license to manufacture its requirements of Buna.

Electrochemists Arrange Varied Program

The Seventy-seventh meeting of the Electrochemical society will be held at Wernersville, Pa., April 24-27. Wernersville is located in the heart of one of the most important electric steel centers in the country.

The Thursday morning session will be presided over by Dr. P. H. Brace of the Westinghouse Electric & Mfg. Co., E. Pittsburgh. Both the basic and acid electric arc furnaces will be discussed, in particular the advantages of the arc furnace as compared with the open hearth in the production of special steels including the new molybdenum stainless and silver bearing stainless steels.

Physical characteristics of electrolytic copper will be the topic of the Friday morning session. Dr. William Blum of the National Bureau of Standards, Washington, will preside. Copper deposited from both the sulphate and the cyanide baths will be analyzed. Studies will be presented on stress in electrolytic copper and the growth of a single crystal of copper.

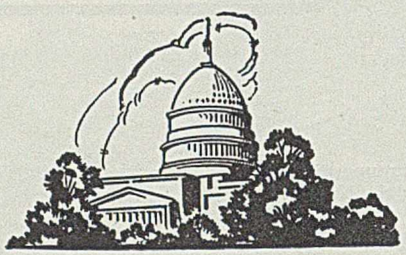
On Friday afternoon, Dr. Hiram S. Lukens, head of the department of chemistry and chemical engineering of the University of Pennsylvania, will be in charge of the session on "Galvanic Effects and Other Electrochemical Phenomena". New cells, new batteries and new electrodes will be discussed.

A session devoted to theoretical and applied electro-organic chemistry is scheduled for Saturday morning. Dr. H. Jermain Creighton, head of the department of chemistry, Swarthmore College, and president of the Society will be in charge. At the annual dinner on Friday evening, Dr. Creighton will deliver his presidential address. At this time also the Young Author's Prize and the Weston Fellowship of $1,000 for the term 1940-1941 will be awarded.

M.I.T. Offers Summer Course in Colloidal Chemistry

The fifth special summer program in theoretical and applied chemistry and physics of matter in the colloidal state has been announced by the Massachusetts Institute of Technology. The course will open on June 17 and will continue for five weeks under the direction of Dr. E. A. Hauser associate professor of chemical engineering. The program will consist of lectures, round-table discussions, practical training in laboratory and research work, and is offered to men actively engaged in industry or research.

NEWS FROM WASHINGTON



Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

WAGES of chemical production workers have been reported to the Public Contracts Division of the Department of Labor by a large number of companies, members of the Chemical Alliance. The summary of these figures is one of the bases on which the Department will proceed to fix wage requirements for companies selling to Uncle Sam.

A tremendous spread in hourly wages is disclosed, but it is evident that the typical wage of the chemical worker is well above that for many industries. The following facts are shown:

1. The median wage for all workers reported is approximately 72 cents per hour.

2. Less than 10 per cent of the workers get under 50 cents per hour; less than one quarter get under 62 cents.

3. There is a wide geographic variation. In general, states of the deep South pay much lower wages than other parts of the country.

4. States of high chemical activity like West Virginia, Delaware, California, Michigan, and New York pay the highest wages. The highest single average is for the West Virginia-Kentucky area, where the median figure is 85.8 cents per hour.

5. The accompanying table shows the number of wage earners reported by wage groups:

under 30 cents per hour	76
30—35 cents per hour	173
35—40 cents per hour	416
40—45 cents per hour	1134
45—50 cents per hour	1114
50—55 cents per hour	1637
55—60 cents per hour	2090
60—65 cents per hour	3633
65—70 cents per hour	4042
70—75 cents per hour	4213
75—80 cents per hour	3866
80—85 cents per hour	2907
85—90 cents per hour	2207
90—95 cents per hour	2064
96–100 cents per hour	1102
over $1.00 per hour	2951
Total wage earners	33,625
Number of plants	341

Median wage . . (50% get less than) 72 cents per hour
Quartile wage (25% get less than) 62 cents per hour
Decile wage . . . (10% get less than) 50 cents per hour

(For further interpretation see editorial foreword of this issue.)

Civil Service positions for chemical engineers are being announced this month by the Civil Service Commission. Numerous such jobs are to be filled from eligibles made available as a result of this "non-assembled" examination. The "examination" is in fact merely an application with summary of training and experience, and references, on the basis of which the eligibility of individuals for positions of different rank is determined. There is no written examination.

The positions to be filled range from that of assistant chemical technologist, at an initial salary of $2600, to that of senior chemical technologist, at an initial salary of $4600. Chemists positions of the same range are to be filled from similar registers of eligibles. In announcing these examinations Dr. Henry G. Knight of the Bureau of Agricultural Chemistry and Engineering points out that those interested should address the Civil Service Commission in Washington for detailed information and the required forms on which to make application.

During the next two years about 400 appointments to the regional laboratories will be made from Civil Service registers established through these new examinations. Positions will be filled requiring the services of organic, physical, and analytical chemists, and others in the fields of carbohydrate chemistry, protein chemistry, oil chemistry, cellulose chemistry and chemical engineering as well as in a number of other fields. It is hoped that every person who is now interested or is likely to be interested in the future in a position in these laboratories will avail himself of this opportunity to become eligible for appointment, even though he may not be able to accept a position at the present time.

Trade Control

Military and political considerations are now more important in determining trade control throughout the world than are the customary economic and commodity factors. Washington is now convinced that even when trade agreements are in force, there is no stability in trade arrangements which prevail even with our best friends. During March, action of British and Canadian authorities made this fact convincingly clear. The Canadians have established a quota or license system for several commodities. British authorities have done that and also have established exchange regulations which make international trade prices quite different than they would appear on the basis of current exchange quotations.

Those seeking to sell in Latin America are now confronted with a new aggressive Japanese policy. This trade practice was spotlighted in the past month by the Japanese-Argentine agreement which insures favorable conditions for goods movement between those two countries, with a decided disadvantage to the United States firms. Moreover, the French and British economic policies have been merged. This means that there will be more active trading between these two countries and their dominions and colonial empire. Furthermore, the two countries seem to be planning triangular arrangements so that one or another may dominate certain commodities and transactions in other parts of the world, including Latin America and other markets commonly favorably situated for United States merchants.

The composite effect of these factors impresses the forecasters with the likelihood of restricted foreign markets for the United States, perhaps even in areas where it was thought that Uncle Sam's goods would shortly become dominant.

News "Fines"

New Alcohol Control—The third reorganization message of President Roosevelt to Congress provides that the Federal Alcohol Administration shall be merged into the Internal Revenue Bureau. From the standpoint of industrial alcohol, this means practically nothing. For the beverage industry, it probably means a little less politics and a little more attention to technical features of tax evasion. The matters of labeling and marketing of beverages will presumably be handled under the new setup substantially as during recent months. If Congress does not offer some objection, these changes will take place formally in June or July. A fourth reorganization program of probably more technical significance was scheduled for presentation about mid-April.

Foreign Purchases—It is reported that excellent progress is being made in negotiations to supply American chemicals, especially explosives, to the joint purchasing agencies of the British and French governments. In some cases American manufacturers are having advances made to them to permit expansion of factory facilities to insure prompt delivery.

Patent Report—The joint investigation of the patent system by American Engineering Council and National Industrial Conference Board has been completed. The final report was rendered by the technical staff during March and it is now subject to review by the Conference Board. The plan is for release later, jointly with National Association of Manufacturers which furnished the fund for the special study.

Margarine Standards—Food and Drug Administration is planning to initiate formal proceedings before long to establish standards of identity for various types of margarine. The result will be a probable simplification of label requirements. There may also be some clarification of present conflicting authority and regulatory requirements of the Bureau of Animal Industry and Food and Drug Administration. It is being urged on the Secretary of Agriculture that he reconcile the policies of these two agencies which he directs so that vegetable margarine and margarine made on an animal base will not be regulated by entirely different requirements. Included in the plan for standards is a provision regarding added vitamins, permissible in vegetable margarine, but not in animal-base oleo.

Pyrethrum Labels—The Food and Drug Administration has issued a new set of regulations regarding labeling of pyrethrum and pyrethrum extracts. The new standards take effect September 1, 1940.

Ethyl Gasoline Patent—The Supreme Court on March 25 ruled that the Ethyl Gasoline Corp. could not use its patent rights as it has been doing in the control of wholesale and retail prices in merchandising practices. This decision further defines the limits to which patent owners may go without encountering the restraints of the antitrust laws. The decision is widely quoted as greatly strengthening the powers of enforcement of the Federal Trade Commission and the Department of Justice.

Alcohol Tax—Representative Gilchrist, Republican of Iowa, proposes that Congress establish a new tax on all imported raw materials used in the manufacture of alcohol. This is merely a new variation of the effort to aid the alky gas cause by taxation.

Mexican Expropriation—The Mexican government last month proceeded further with its policy of taking over from American owners or operators the properties which they have held in that country. The latest industrial group to suffer is the chicle industry. In this case the government argues that the companies involved never did have a legal ownership of the land which they have been operating for 35 or 40 years. Evidently Secretary Hull and Ambassador Josephus Daniels are making progress rapidly in the wrong direction in their clearing up of American rights in that neighboring area of Latin America.

Government Purchases—There is continued effort to increase the scope of the Walsh-Healey law which places an embargo on all firms not meeting fully the prevailing labor standards when they seek to sell their goods to the Federal government. If such changes in the law take effect, these restrictions will apply to contracts as small as $2000 and will govern subcontractors and other merchandising units not now affected by the law. This would be of considerable importance to makers of chemicals also who now buy such goods in quantities too small to be governed by the present act.

Stream Pollution Bill Revised—Passage by the House of the Barkley-Mansfield stream pollution bill indicates that a law may be enacted by this session of Congress. An amendment was added in the House by Representative Mundt, however, so that the bill now requires conference action. There seems to be little chance that even mild mandatory control authority will be granted to the Public Health Service as called for by the Mundt amendment. Much more likely is authority to investigate and recommend stream protection standards. One remaining subject of argument is whether Uncle Sam will furnish money by grants or only by loans. Economy-minded Congress leans to the latter plan.

MORE THAN 3,500 ATTEND AMERICAN CHEMICAL SOCIETY MEETING IN CINCINNATI

With more than 3,500 chemists and their guests assembling in Cincinnati during the week of April 8 to listen to 450 papers and addresses in 17 major fields of chemistry, that city again became the country's chemical capital. The occasion was the 99th meeting of the American Chemical Society, presided over by Dean Samuel C. Lind of the University of Minnesota.

Most general interest centered in the opening session where Prof. Peter Debye of Berlin, 1936 Nobel prize winner in chemistry and at present George Fisher Baker lecturer at Cornell University, delivered an address in the field of pure science and was followed by William H. Bradshaw, director of rayon research of the duPont company, and Dr. Henry A. Gardner, director of the Scientific Section of the National Paint, Varnish and Lacquer Association. Mr. Bradshaw described the high-strength viscose yarn known as Cordura now used in automobile tires. The subject of Dr. Gardner's paper was "The Drying Oil Situation in America" indicating the progress being made to free the paint and varnish industry from dependence on foreign oils.

Of 56 technical sessions, the discussions of most concern to chemical engineers included a symposium on electrical insulation held under the chairmanship of Dr. F. L. Miller of the research division of the Standard Oil Development Co. and a series of papers on potential sources of vegetable proteins presented by Dr. Lawrence W. Bass, assistant director of the Mellon Institute. He pointed out that the total annual industrial utilization of proteins in this country, now largely of animal origin, amounts to more than one billion pounds with a value of $500,000,000. The chairman of the industrial division is Dr. Barnett F. Dodge of Yale University.

The division of petroleum chemistry, headed by Dr. Per K. Frolich, of the Standard Oil Development Co., sponsored a symposium on fundamental chemical thermodynamics of hydrocarbon derivatives, with discussion led by Dr. Frederick D. Rossini of the United States Bureau of Standards.

Various problems relating to America's coal production, valued at $2,000,000,000 annually, were set forth in the gas and fuel program by Dr. Harold J. Rose of Mellon Institute. The division of cellulose chemistry featured papers on cellulose derivatives by Dr. Emil Ott of the Hercules Powder Co. and on lignin by Prof. Harold Hibbert of McGill University. Water purification and stream pollution abatement were of principal interest to the division of water, sewage and sanitation under Prof. Otto M. Smith of Oklahoma A. & M. College. The division of rubber chemistry of which E. B. Curtis of the U. S. Ordnance Department is chairman, devoted his time chiefly to the discussion of the structure of rubber and its vulcanization.

Dr. Alfred Springer, 86, dean of Cincinnati chemists, was the honorary chairman of the meeting and Proctor Thomson, head of the Standards Department of the Chemical Division of the Procter & Gamble Co., was general chairman. The executive committee consisted of Walter H. McAllister, Arthur W. Broomell, and Ronald C. Stillman. Subcommittee chairmen included F. E. Ray, M. B. Tucker, Wayland M. Burgess, A. O. Snoddy, W. G. Gangloff, E. R. Brunskill, Howard Ecker, Eugene B. Duffy, D. J. Kooyman, J. T. R. Andrews, S. B. Arenson, H. W. Greider, C. H. Allen and Mildred Pfister.

Dow Will Construct New Unit For Dowmetal

Last month, the Dow Chemical Co. announced that it had purchased a large tract of land at Freeport, Texas which would be used as a site for a new chemical plant. Since then announcement has been made to the effect that a new rolling mill would be erected at once at Midland, Mich. The building and equipment will cost in the neighborhood of $500,000 and is scheduled to provide at least a 50 per cent increase in production of Dowmetal in sheet form at Midland.

Chem. & Met. Flow Sheets Again Available

A few months ago we found it necessary to note in these columns that "100 Flow Sheets of Process Industries" was out of print. Now we are glad to announce that the flow sheets are again available—this time in a new and enlarged edition. Twenty-one new flow diagrams, some revisions, a comprehensive index and 4 pages of data about the chemical process industries combine to make the new edition a 128-page book. Ask for "*Chem. & Met.'s* Chemical Engineering Flow Sheets." Price $1.25.

Purchasing Agents to Observe Silver Anniversary

The National Association of Purchasing Agents will hold its 25th Annual International Convention and Inform-a-Show at the Netherland Plaza Hotel, Cincinnati, June 3-6. The association will celebrate its silver anniversary with 61 affiliated chapters and a membership of 5,500 purchasing executives from every line of industry. The Inform-a-Show which is an industrial exposition held in conjunction with the convention will be made up of 75 exhibits presenting a wide variety of products and processes.

GERMANY PLANS MORE INTENSIVE AGRICULTURAL EFFORT TO MEET WARTIME FOOD DEMANDS

From Our German Correspondent

THE problem of supplying food in wartime for the German Reich's 80 million population—difficult even in peace time because of the northerly climate and limited area—is being vigorously attacked by governmental and private agencies, and in this the chemical industry is playing no small part.

According to a recent survey, the Old Reich is now 83 per cent self-sufficient in food supply, Austria 75 per cent, the Sudetenland 80 per cent, the Protectorate (Bohemia-Moravia) 100 per cent, and Poland 105 per cent. Since the eastern districts contain rich soil and smaller population (185 acres per 100 population in Polish areas as against 104 in the Old Reich), it is estimated that with more intensive agricultural methods the new areas will probably help to offset the 17 to 25 per cent shortage in other parts of the Reich. Grain yields in the re-annexed provinces of Warthe and Danzig-West Prussia had dropped considerably in the last two decades due to the extensive methods of agriculture pursued under Polish administration, and considerable work will be required to restore production to the pre-World War levels. One of the first steps will be to increase the supply of commercial fertilizers available from Germany and from the four existing Polish nitrogen plants. By working at full capacity the latter plants will be able to double their production. By providing proper drainage in agricultural areas, by supplying improved seed, and by applying scientific crop rotation, it should be possible to raise farm yields considerably. German experts plan to increase the grain and also the potato crop in these areas. This should provide more fodder for hogs, which would in turn supply more fat to help fill the fat shortages, where the Reich is most vulnerable.

Contrary to World War practices when food rationing was not seriously instituted until the third year of the war, this time rationing was inaugurated from the outset in order to economize on reserves built up during the past few years. Present food rationing in Germany is apparently not much severer than in Britain and France, and is considered quantitatively, although not qualitatively, adequate. An evidence of this is to be seen in the nationwide anti-rachitic campaign now being carried on in the Reich. Until the end of May it is planned to give all city schoolchildren from 10 to 13 years of age one vitamin C tablet daily to make up for lack of natural vitamin C ordinarily supplied by fresh vegetables.

Aside from the "blackout" nuisance, the lack of good soap due to the fat shortage and the almost complete absence of regular coffee due to the practical cessation of overseas trade, have become the greatest annoyances to the Reich's civilian population. German chemists are developing caffeine synthetically from domestic raw materials and are "innoculating" the caffeine into grain coffee, while army chemists have been conducting tests of their own to see how synthetic caffeine will go with substitute coffee made from rye and barley and what effect it has as a stimulant. As a matter of fact, the coffee substitute industry in the Old Reich, comprising 700 establishments, only 10 per cent of which are large plants, however, is enjoying a boom and is working overtime. In the World War roasted chicory provided one-third of the substitute coffee in Germany, while fig coffee was preferred in Austria. This time grains are being generally used, especially malted barley.

Despite the war, German cigarette production was higher in 1939 than in 1938. Germany continued securing tobacco imports from Balkan countries, including Turkey, and, the latter country's commitments to the Allies notwithstanding, the Reich still is her biggest potential trade partner. In October the Reich was Turkey's largest supplier and second biggest customer. The General Gouvernement Poland produces 5½ billion cigarettes annually, and tobacco production in the Cracow district alone yielded nearly 4½ million pounds last year. Meanwhile, larger areas of tobacco have been planted in Germany itself, notably in the Palatinate district in the south, which is producing tobacco claimed to be similar in taste and aroma to American Virginia tobacco.

Conserving Motor Fuel

How Germany is effecting savings in motor fuels to build up reserves to supplement imports and synthetic domestic production, was indicated recently in an announcement of the Reich Ministry of Transportation. Increased savings of gasoline have of course resulted mainly through cutting down all but the most urgent civilian automotive transport. More and more motor buses are using liquid gas, and stationary engines are using wood gas.

Considerable savings are also expected from standardization of types of motor vehicles, instituted under the second Four Year plan. Formerly 120 different types of motor trucks were built; now there are only 20. Passenger cars have also been cut down from 52 to 20 types, and motorcycles from 150 to 30 types. This standardization movement effects economies in raw materials, motor fuels, and replacements. With curtailed domestic use, and thus of demand for, passenger cars, the German automobile industry has been pushing exports. Sales contracted for by foreign buyers for delivery during the first five months of 1940, total as many cars as were exported during the entire year 1939.

Active in the movement to obtain economies through standardization of products in the automotive as well as other fields, has been Major General Dr. Fritz Todt, who has just been elevated to the post of Minister for Arms and Munitions. Dr. Todt planned the German system of super-highways, most of the Westwall fortifications, and has been head of the Bureau of Science and Technique for several years. As General Commissioner of Building, he raised total building in the Reich from 2.3 billion RM in 1932 to 11.5 billions in 1938. Responsible for this expansion were the highway building projects, gigantic replanning of Berlin, Nuremberg, Munich, and other cities, including apartment and low-cost housing projects, erection of military and industrial buildings, and, of course, fortifications. At present the city replanning programs have been partly suspended to release man power for the army, and attention has also shifted to housing and other construction for settlement and repatriation of Germans in Polish and other areas. The labor shortage has caused the importation of foreign farm labor. This year 30,000 Italian farm laborers will come to Germany for planting and harvesting, and 133 special trains are being arranged to transport Polish seasonal laborers to rural sections of Germany.

In connection with labor shortages it is of interest to observe the various stages through which industries have gone since the beginning of the war. The glass industry is an example. At first it was thought that production should be curtailed considerably since this was not considered a war-vital industry. In the meantime, however, it has been deemed better to continue full production, to save technical skills of workers, to prevent furnaces from becoming unusable through disuse and cooling, but more important, to build up reserve supplies, especially of window glass. Glass raw materials are all available domestically, but coal transport has caused some difficulties. The glassware industry, while not producing so much for domestic consumption, found ready foreign buyers, especially from Southeastern Europe at the Leipzig and Vienna trade fairs held at March. At the 1939 Leipzig fair 30 per cent of the total European orders were from north European countries, 28 per cent from southeastern Europe, and 42 per cent from the still neutral countries Netherlands, Belgium, Italy, and Switzerland. At the Leipzig fair this year a number of new glass, porcelain, aluminum and general metal-replacing products attracted most attention.

A new material recently patented in Germany is called "Ingraf." Made of vegetable tissue saturated with albuminous matter, it is a synthetic parchment of hornlike quality, which is proof against scratches, shocks and abrasions, and is almost incombustible. It is cheaper than natural parchment and can be used for interior decorating in airplanes, railroad cars and homes, and for coverings of furniture, table tops, and the like.

FACTORY CONSUMPTION OF OILS AND FATS GAINED LAST YEAR DESPITE LOSS IN EDIBLE FIELDS

THE AMOUNT of animal and vegetable fats and oils consumed in domestic factory operations last year is reported by the Bureau of the Census at 4,802,989 thousand pounds or an increase of about 3.6 per cent over the amount so consumed in 1938. This increase was attained in the face of a rather sharp drop in the volume of oils and fats converted into edible products. For example, the Bureau credits the shortening industry with consumption of 1,406,318 thousand pounds of oils and fats in 1939 as against 1,512,299 thousand pounds in 1938. Manufacturers of oleomargarine also cut down their requirements for oils and fats last year.

The explanation for the drop in manufactured edible products is found in increased use of lard as such. Production of lard in 1939 was reported at 1,414 million pounds. Exports and increases in stock holdings were about 335 million pounds which indicates a total domestic consumption of 1,064 million pounds with only a little more than 15 million pounds of this going into factory use. In 1938, production of lard was approximately 1,163 million pounds. Exports and increases in stocks amounted to 258 million pounds, leaving less than 906 million pounds for total domestic consumption of which nearly 10 million pounds went into edible products. Hence it becomes evident that the drop in factory consumption of edible oils and fats last year was more than offset by the increase in direct consumption of lard.

Based on consumption of fats and oils, soap production last year was the largest in the history of the industry. Data for industry consumption of oils and fats have been presented by the Bureau of the Census from 1931 to date and the Biennial Census for 1929 places soap consumption of oils and fats in that year at little under 1,500,000 thousand pounds which was the former record year. The low prices which prevailed for tallow and greases last year gave these products a preference in soap making and substantial increases for soap account were reported over preceding years. Restricted supplies palm-kernel oil were reflected in smaller buying of this oil by soap makers. In view of the larger output of soybean oil, its increased use in soap making was surprisingly small, whereas both coconut and babassu oils registered appreciable gains. Fears that shipping conditions in the final quarter of the year would affect the supply of palm oil were not realized, as imports continued on a somewhat higher scale and while consumption held up well, there was a gain in domestic stocks in the last three months of the year.

Paint and varnish manufacture accounted for 423,113 thousand pounds of oils and fats or a gain of about 18.3 per cent over the total used in 1938. It is worthy of note that castor oil has been gaining in importance as a paint-making oil. In 1939, 11,439 thousand pounds of castor oil are reported as going into paints and varnishes.

Data for linseed oil give 1939 production as 564,507 thousand pounds, factory consumption as 344,975 thousand pounds and an increase in stocks of 840 thousand pounds all of which adds up to a total consumption of 563,667 thousand pounds of which 218,692 thousand pounds was in non-factory use with net foreign trade figures indicating that the total was decreased by export shipments of something more than 2,500 thousand pounds. Linseed oil was used more widely in the paint and varnish trade last year but failed to equal the percentage gain registered by the industry. In contrast, very sharp gain was noted in the case of soybean oil and since the turn of the year reports have been heard to the effect that paint makers were taking on liberal amounts of soybean oil.

Industry consumption of oils and fats 1938–1939

	Per cent of total 1938	1939
Shortening	32.6	29.3
Oleomargarine	6.7	5.0
Other edible products	8.1	8.9
Soap	31.7	34.4
Paint and varnish	7.7	8.8
Linoleum and oilcloth	1.9	2.2
Printing ink	0.5	0.5
Miscellaneous products	5.7	7.2
Loss, including foots	5.1	3.7
	100.0	100.0

Factory Consumption of Oils and Fats by Industries

(Thousands of pounds)

	Edible Use	Soap	Paint and Varnish	Linoleum and Oilcloth	Printing Ink	Total*
1939	2,074,076	1,653,704	423,113	107,721	22,873	4,802,989
1938	2,200,290	1,468,535	357,625	85,362	21,884	4,634,135
1937	2,372,430	1,475,756	457,785	102,763	26,213	4,993,914
1936	2,296,646	1,394,538	441,282	101,882	20,206	4,784,226
1935	2,172,757	1,312,690	404,705	81,031	18,000	4,494,287
1934	1,721,340	1,474,415	329,894	67,811	15,544	4,028,003
1933	1,418,689	1,311,263	297,560	69,938	13,419	3,514,641
1932	1,325,340	1,375,416	254,251	57,515	10,431	3,355,555

* Includes miscellaneous uses and losses.

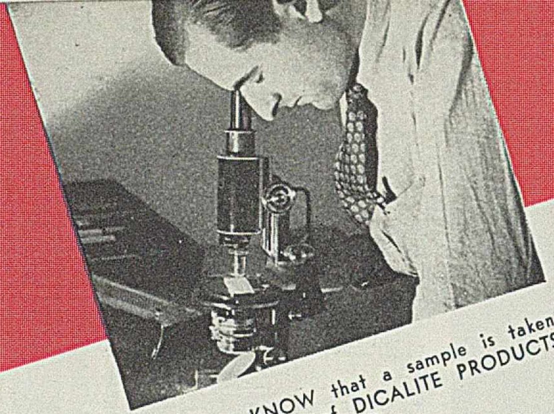
Factory Consumption of Primary Animal and Vegetable Fats and Oils, by Classes of Products, Calendar Year 1939

(Quantities in thousands of pounds)

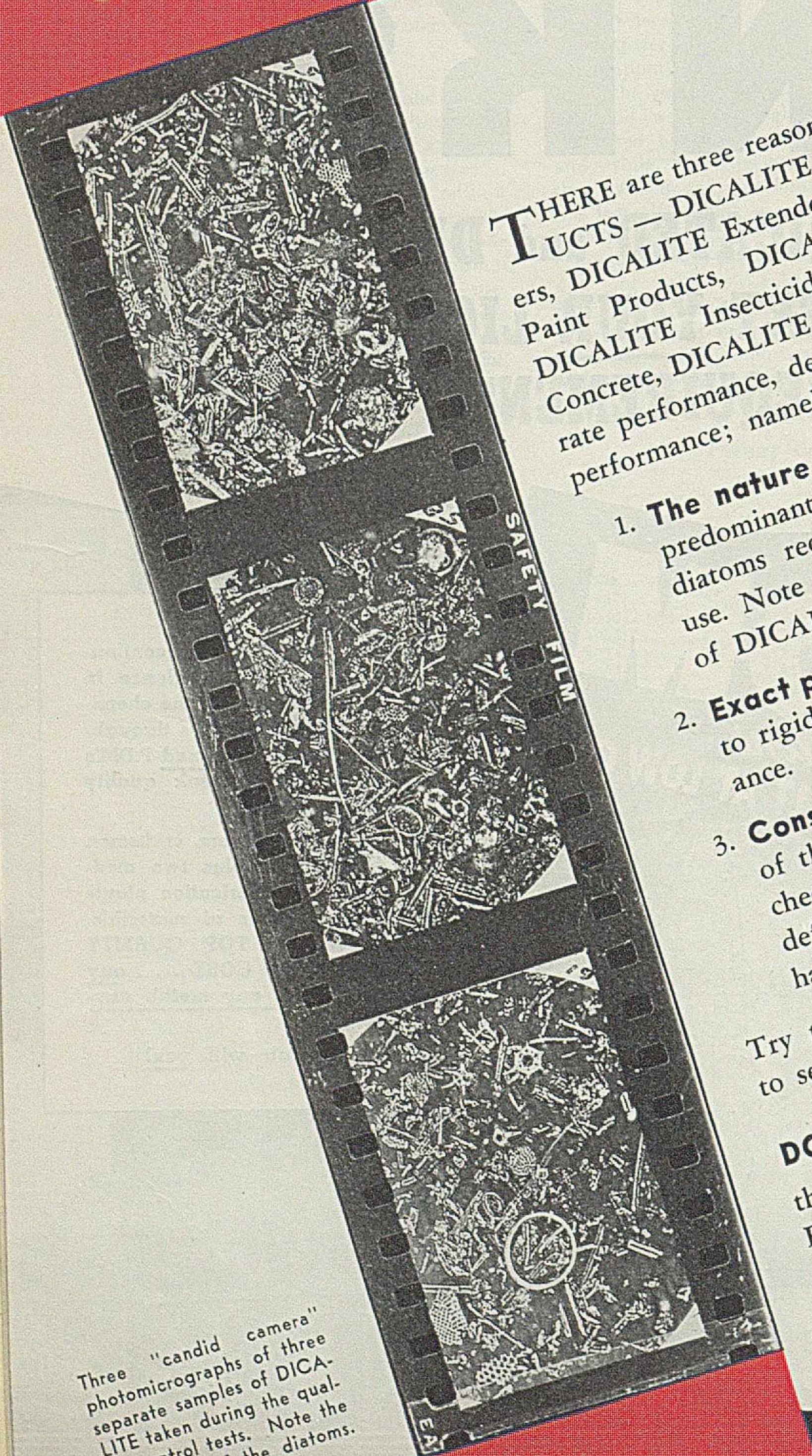
	Total	Shortening	Oleomargarine	Other Edible Products	Soap	Paint and Varnish	Linoleum and Oilcloth	Printing Inks	Miscellaneous Products	Loss (including oil in foots)
Total	4,802,989	1,406,318	241,705	426,053	1,653,704	423,113	107,721	22,873	344,281	177,221
Cottonseed oil	1,321,190	904,950	98,657	233,442	1,061	51	....	192	2,017	80,820
Peanut oil	67,093	51,713	2,445	8,678	805	....	....	....	161	3,291
Coconut oil	529,154	20,659	38,516	43,931	388,912	707	....	3	3,852	32,574
Corn oil	84,067	1,453	489	65,384	4,441	155	....	....	1,586	10,559
Soybean oil	369,760	201,599	70,822	32,345	11,177	21,720	6,438	62	9,332	16,265
Olive oil, edible	3,983	....	....	3,798	54	....	....	....	131	....
Olive oil, inedible	5,514	....	....	....	1,439	14	....	....	4,061	....
Sulphur oil or olive foots	19,370	....	....	....	19,068	....	....	....	302	....
Palm-kernel oil	10,554	266	473	5,292	3,657	....	....	....	36	830
Palm oil	271,046	113,078	1	1,352	102,146	1	....	5	29,681	24,782
Babassu oil	63,193	506	13,944	8,459	37,633	....	....	....	6	2,645
Sesame oil	2,266	724	....	1,102	14	....	....	....	290	136
Rapeseed oil	6,577	37	....	....	2	79	....	....	6,459	....
Linseed oil	344,975	....	....	....	1,780	246,965	68,023	17,526	10,564	117
Tung oil	90,720	....	....	....	....	82,307	3,763	2,105	2,545	....
Perilla oil	42,546	....	....	....	1	28,674	10,758	1,915	1,198	....
Castor oil	41,090	....	....	....	946	11,439	88	317	28,277	23
Other vegetable oils	35,852	887	....	9,181	7,364	5,816	1,264	78	10,709	553
Lard	15,253	7,398	1,355	6,317	50	....	....	2	28	103
Edible animal stearin	32,285	25,574	3,069	3,142	278	....	....	2	160	60
Oleo oil	12,911	470	11,865	147	67	....	....	....	362	....
Tallow, edible	62,246	56,671	69	3,483	418	....	....	1	1,445	159
Tallow, inedible	874,099	....	....	....	785,041	97	1	4	88,795	161
Grease	210,911	....	....	....	120,856	47	1	449	89,038	520
Neat's-foot oil	5,678	....	....	....	11	24	....	4	5,622	17
Marine animal oils	58,650	12	....	....	51,522	36	....	4	7,002	74
Fish oils	222,006	20,321	....	....	114,961	24,981	17,385	204	40,622	3,532

DO YOU KNOW WHY DICALITE PRODUCTS ?

are accurate—dependable—uniform



DO YOU KNOW that a sample is taken from every bag of DICALITE PRODUCTS for quality control tests?



Three "candid camera" photomicrographs of three separate samples of DICALITE taken during the quality control tests. Note the uniformity of the diatoms.

THERE are three reasons why DICALITE PRODUCTS — DICALITE Filteraids, DICALITE Fillers, DICALITE Extenders and Flatting Agents for Paint Products, DICALITE Insulating Materials, DICALITE Insecticide Carriers, DICALITE for Concrete, DICALITE for Asphalt, etc. — give accurate performance, dependable performance, uniform performance; namely:

1. **The nature** of the DICALITE rock which is predominant in spicular or elongated type diatoms recognized as the best for industrial use. Note the uniformity of the three samples of DICALITE at the left.

2. **Exact processing under experienced men** to rigid specifications of quality and performance.

3. **Constant quality control** from the analyses of the DICALITE rock to the final bag-to-bag check-up of the finished products to determine definitely that DICALITE'S rigid specifications have been adhered to.

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PERSONALITIES

James T. Pardee and W. J. Austin were awarded honorary degrees by Case School of Applied Science at the Founders' Day Convocation

✦ James T. Pardee, co-founder and chairman of the board of the Dow Chemical Co., and W. J. Austin, president of the Austin Co., were awarded honorary degrees by Case School of Applied Science at its 60th anniversary Founders' Day Convocation, March 14. Mr. Pardee, one of the first to receive a degree from Case, was awarded the degree of doctor of commercial science in recognition of his leadership and example. "As a pioneer in the creation of a great industry and in guiding its fiscal operations with high integrity." Mr. Austin received the degree of doctor of engineering.

✦ Otto C. Voss, advisory superintendent of the tank and plate shop at the Allis-Chalmers plant in West Allis, Wis., and an authority on the oxy-acetylene process, will receive the 1939 James Turner Morehead Medal, sponsored by the International Acetylene Association. The medal, awarded annually for outstanding work in the production or utilization of calcium carbide and acetylene gas, will be presented to Mr. Voss during the opening session of the annual convention, April 10, at Milwaukee.

✦ Kenneth K. Bowman, M. A. Edwards, and Francis Mohler were among the engineers to receive the Charles A. Coffin Foundation awards, the highest honor conferred by General Electric upon its employees. These awards are made annually to those employees adjudged to have made the most outstanding contributions to their company and to the electrical industry. In this case the award was made for the work in improving control equipment to perform high power, complicated operations with speed and precision.

✦ W. F. Rockwell, president of the Pittsburgh Equitable Meter Co. and Merco Nordstrom Valve Co., has been elected a director of the Commercial National Bank & Trust Co. of New York.

✦ John V. Jirasek has recently joined the Worthington Pump & Machinery Corp. as a special representative to the petroleum and chemical industries. He is a graduate chemical engineer from the University of Prague and did postgraduate work at the Sorbonne in Paris. Recently Mr. Jirasek was associated with the Compagnie Technique des Petroles, European representative for the M. W. Kellogg Co. and with the Sharples Solvents Corp. of Philadelphia.

✦ Ralston Russell has recently joined the research staff of the Westinghouse Electric & Mfg. Co., where he will be in charge of the work on ceramics. Dr. Russell graduated from Ohio State University in 1932 and again in 1933, and 1938. He has been employed with the A.C. Spark Plug Division of General Motors and the General Ceramics Corp.

✦ Edward J. Charlton has been appointed general manager of Lukenweld, Inc., a division of Lukens Steel Co., Coatesville, Pa., according to an announcement by Everett Chapman, president of the company.

✦ Robert L. Bunting has been promoted to superintendent succeeding Roland J. Whiting, resigned. George M. Snyder has been made chief engineer. Dean Bruce Johnston has been appointed manager of development and research. Gordon A. Coleman, formerly with Struthers-Wells Co., Warren, Pa. as process engineer, is now with the Barrett Company, at Philadelphia. He is connected with the research and development department.

✦ George W. Phillips of the Georgia School of Technology has accepted a position with the U. S. Industrial Chemicals, Inc.

✦ Norbert Kreidl has recently been appointed professor of glass technology in the department of ceramics at Pennsylvania State College. Dr. Kreidl will work in collaboration with Professor Woldemar Weyl, on a research project sponsored by Monsanto Chemical Co., concerning the use of phosphate in glasses and other ceramic products.

✦ S. B. Applebaum, vice president and secretary of the Permutit Co., manufacturers of water conditioning equipment, was elected a director at the company's annual meeting on March 20, it has been announced by W. Spencer Robertson, president.

✦ Ralph E. Gibson of the Geophysical Laboratory of the Carnegie Institution, has been awarded the Hillebrand prize of the Washington section of the American Chemical Society. The award was made for the discovery of the hitherto unsuspected mechanisms governing the behavior of liquids under high pressures ranging upward from 1,000 times the weight of air.

✦ H. V. Powers was elected chairman of the Akron Rubber Group at the meeting of March 29. Other officers elected at the same meeting were L. V. Cooper, vice-chairman and T. L. Stevens, secretary-treasurer.

✦ Paul A. Kind, manufacturing chemist of Camden, N. J., has been reelected a member of the board of trustees of the Philadelphia College of Pharmacy and Science.

CALENDAR

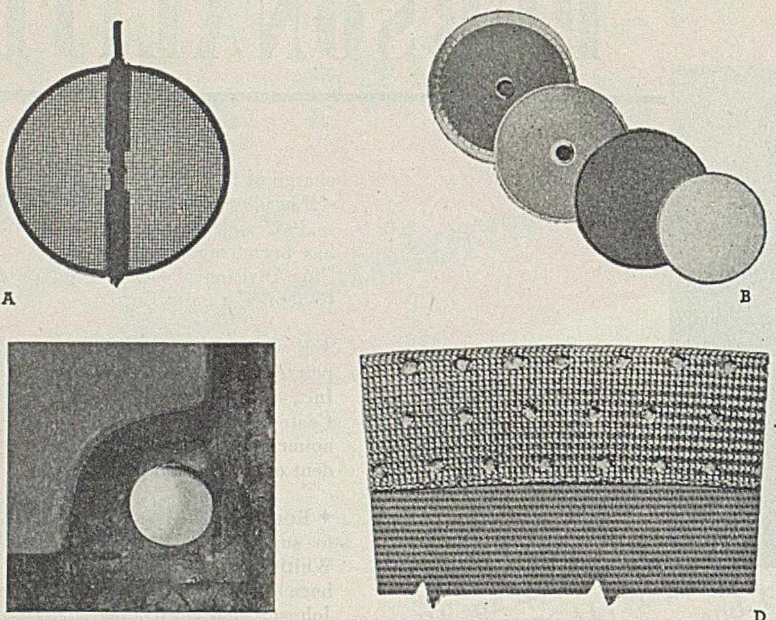
APRIL 24-27, Electrochemical Society, annual meeting, Galen Hall, Wernersville, Pa.

MAY 13-15, American Institute of Chemical Engineers, Buffalo.

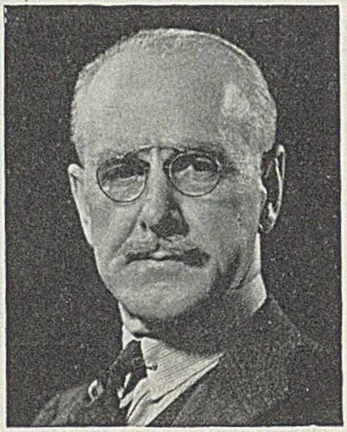
MAY 27-31, American Petroleum Institute, mid-year meeting, Fort Worth, Tex.

AUG. 20-23, Technical Association of the Pulp & Paper Industry, fall meeting, Olympic Hotel, Seattle, Wash.

SEPT. 9-13, American Chemical Society, fall meeting, Detroit, Mich.



✦ William B. Lawson, formerly of the Harshaw Chemical Co. and the International Nickel Co., has announced the formation of W. B. Lawson, Inc., dealing in industrial chemicals, oils and non-ferrous metals. His offices are in Cleveland.



William B. Lawson

✦ H. E. Dralle has been appointed manager of the petroleum and chemical section of the Industrial Engineering Department of the Westinghouse Electric & Mfg. Co. Born in Quincy, Ill., and graduated as an electrical engineer from the University of Illinois in 1916, Mr. Dralle has been associated continually with Westinghouse; following general engineering activities including special work with Dr. Frank Conrad, assistant chief engineer at Westinghouse, Mr. Dralle has specialized in the application of electricity to cement, glass, railroad and petroleum industries.

✦ R. R. Robley, for many years superintendent of operations of Portland General Electric Co. at Portland, Ore., has been named assistant to the vice president in the staff reorganization of the company.

✦ Robert H. Heyer has been added to the staff of Battelle Memorial Institute, Columbus, Ohio. Mr. Heyer is a graduate of the University of Minnesota and has served a time in the research department of the American Rolling Mill Co.

✦ Hugh M. Corrough, recently appointed manager of the Alco Products Division of the American Locomotive Co., is a graduate of Iowa State College. He has been with Alco since June, 1936, and served in the capacities of chief mechanical engineer, assistant manager of engineering and manager-engineering, which position he held up to February 1, when he assumed his new responsibilities.

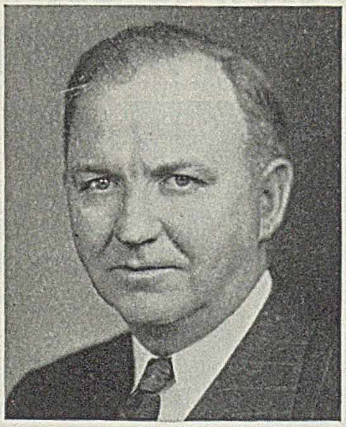
✦ D. S. Kerr has been appointed manager of the Atlanta office of Allis-Chalmers Mfg. Co.

✦ Edward A. Rudigier, a director of Standard Oil Co. of N. J. and manager of refining operations in the southern division, retired April 1 after nearly 42 years with the company. He was succeeded in the management of the Baltimore and Charleston units by Dr. Merle R. Meacham, general superintendent of the Bayway Refinery.

✦ Donald L. Ferguson, assistant general superintendent of the Bayway refinery of the Standard Oil of New Jersey, moved into the top position at Bayway, April 1. He is a graduate of Purdue University's chemical engineering department. In 1926, he left Bayway to go to the Colonial Beacon's Everett refinery as assistant manager, becoming manager and a director of that company in 1931. In 1934 he went to France to manage the Port Jerome refinery of Standard Franco-Américaine de Raffinage, returning in 1938 as assistant general superintendent at Bayway.

✦ A. P. Fowler, Jr., has been transferred from the research and control laboratory of the Dicalite Co. to New Orleans, where he has taken up his duties as district manager. He completed his education at the School of Chemical Engineering, Louisiana State University, and has since continued his interest in the sugar industry.

✦ Robert D. Kent, who was connected with the research and control laboratory of the Dicalite Co., has been transferred to New York where he will make his headquarters. Mr. Kent is a graduate of the School of Chemical Engineering, California Institute of Technology.



H. E. Dralle

✦ Henry J. Guzewicz has been transferred from the northern New Jersey territory to sales and service activities in Brooklyn and New York for the Dicalite Co. He is a chemical engineering graduate from Tufts College.

✦ Leo Harner has been appointed to act as service engineer in the California territory for the Porcelain Enamel & Mfg. Co. of Baltimore. After graduating from the ceramics department of Ohio State University, he became associated with the porcelain enameling industry. For the past eight months he has been connected with Pemco in both technical and service capacities.

✦ Roy A. Shive of the Calco Chemical Division of American Cyanamid Co., received one of the important awards made at the Modern Pioneers' banquet of the National Manufacturers Association. The award was made for achievement in the fields of resin and paint.

✦ Jay Irwin has been appointed Chicago district manager of the Steel and Tube Division of Timken Roller Bearing Co. In 1937, he became associated with the metallurgical department of the Timken organization and since October of that year he has been a salesman in the Chicago branch office.

✦ R. K. Turner of the Carbide & Carbon Chemicals Corp., has been elected chairman of the Chemical Engineers Club of Charleston, W. Va. Other officers are W. T. Nichols of Westvaco Chlorine Products Co., vice chairman; J. R. Williams of E. I. duPont de Nemours & Co., Inc., secretary-treasurer.

Hugh A. Galt

✦ Howard A. Marple was honored at a dinner of the House Magazine Institute of America at Hotel Astor, New York City, on March 13. The magazine of which he is editor, *Monsanto Magazine*, has been judged the best internally sponsored publication in the United States. Before becoming editor, Mr. Marple was in the research laboratory of Monsanto Chemical Co. at Everett, Mass.

✦ Frank W. Hurd has been appointed a member of the staff of the chemical engineering division of the Research Foundation of Armour Institute of Technology. neering division of the Research Founda- he was engaged in photo-chemical research with Dr. R. S. Livingston as well as physical chemistry researches in the radiology department of the University Hospital at Minneapolis. His work at the Research Foundation will be in the field of special fuel development problems.

✦J. B. Templeton, formerly vice-president of Templeton Kenly & Co., Chicago, was elected president of the organization at the annual meeting, to succeed W. B. Templeton, who is now chairman of the board of directors.

✦Gordon A. Coleman, formerly connected with Struthers Wells Co., is now associated with the Barrett Co. at Philadelphia. He is in the research and development department.

✦Hugh A. Galt has retired as vice president of Pittsburgh Plate Glass Co. after 40 years of service. He also relinquished his position as president of Southern Alkali Corp. and Columbia Alkali Corp.

✦Arthur W. Hixson, professor of chemical engineering at Columbia University, is recovering from a ten-weeks illness.

✦A. J. V. Underwood, joint honorary secretary of the Institution of Chemical Engineers of London, was guest of the American Institute of Chemical Engineers at luncheon at the Chemists' Club in New York, April 4. He returned to England, April 5 following a hurried business trip to Canada and the United States.

✦David C. Jones, vice president and general manager of the Lunkenheimer Co., Cincinnati, died on March 11, after a brief illness. He was born in Cincinnati in 1876 and entered the employ of The Lunkenheimer Co. in 1894.

✦Lyndon H. Oak, European representative of E. B. Badger & Sons Co., Boston, Mass., died March 3. Prior to 1934 he was in charge of the Badger office at Tulsa, and in 1937 rejoined the company, becoming its representative in London, where he remained until the commencement of the war. He then went to France to take charge of the construction of equipment to be used for making aviation gasoline.

✦Hutton H. Haley, Detroit district sales representative of the American Foundry Equipment Co., died March 1.

✦DeWitt Page, formerly president and general manager of New Departure and director and vice president of General Motors Corp., died suddenly at Hialeah Park, Fla., Feb. 28.

✦Charles Arthur White, secretary-treasurer of the Leeds and Northrup Co., died March 2 at Germantown Hospital in Philadelphia, after a two weeks illness. He was 58 years of age.

✦C. K. Francis, technical editor of the *Oil & Gas Journal*, died in Tulsa, Okla., on March 25. Prior to joining the editorial staff Dr. Francis had been a chemical consultant in the petroleum industry.

✦J. J. Geer, formerly manager of the black powder operations of Hercules Powder Co., died March 19 in his home at Swarthmore, Pa.

Results From "Young Ideas"

To the Editor of Chem. & Met.:

Sir:—I read with considerable interest M.H.B.'s letter in the February issue of Chemical and Metallurgical Engineering commenting on your editorial entitled "Young Engineering and Young Engineers."

I have no idea whether we have any suitable opening available at this time, but it seems to me that any one who can give such a good account of himself deserves a chance—that is, provided his adversity has not embittered him so much that he will not be able to fit into a technical organization. In any event, I am attaching a qualification record, with the suggestion that you ask your friend to fill it in and return it to me.

This ought to be convincing proof of how thoroughly your esteemed publication is being read in some quarters!

Director of Laboratories
New York, N. Y.

To the Editor of Chem. & Met.:

Sir:—Your correspondent hit the nail on the head when he identified the "plight of the young engineer" with that of the millions of unemployed youth in other fields. However, he seems to have missed one point, and that is the fact that chemical engineering is actually a young profession—one whose development dates only from the turn of the century. So it would seem that there are many fields for us to conquer. Indeed, the road to success lies open before us, the only trouble being that it is in a bad state of repair, with no sign-posts and no wayside inns. To put it in plain words, chemical industry often needs us, but sometimes does not realize it. Observations in the last few years have led me to the conclusion that many of the men in senior positions in chemical industry are not quite certain as to the nature of a chemical engineer's training and ability. Many of those men received their education in the days when our profession was in the embryonic stage. I have had the personal experience of writing to some large firms as a "senior chemical engineering student in search of employment for after graduation," only to be informed by return mail that there are "no vacancies in our research laboratory at present."

There are now in Canada only two schools giving courses in unit operations, although a number of others offer courses in industrial chemistry. These two schools together turn out less than 50 new chemical engineers per year. Now, if new construction for 1939 is any criterion, Canada should have openings for at least 100 new men each year, if the United States has room for 1500, as stated in your January editorial. In spite of this, there is still a relatively large number of Canadian chemical engineering graduates who are either unemployed, taking graduate courses, or working in fields outside the scope of their profession.

The above statements apply especially to Canada, but may have some significance from the American point of view as well. To put it crudely, chemical industry "doesn't know what she's missing" in allowing so many good men go to waste.

What chemical engineering needs is more publicity. In other words, chemical industry must become aware of our existence. Industry has what we need—jobs. Does industry know that we have what industry needs—new ideas? If this gulf could be bridged, all would benefit.

Sydney Abbey
Chemical Engineering Student,
McGill University

To the Editor of Chem. & Met.:

Sir:—The communications under the heading "Young Engineering", in your February issue, together with your editorial in the January issue, deal with one of the most urgent problems of the present time.

Unfortunately, finding more jobs for young engineering graduates, does not, of necessity, increase the total number of men employed and therefore does little towards solving the great national problem of unemployment as a whole. "Charity begins at home," and our personal problem is, how to get more jobs for unemployed engineers.

To do this it is obvious that we must create more jobs or get for members of our own profession more of the jobs which already exist. It is quite clear that at the present time, there are not enough jobs to go round. The creation of more jobs is really a matter of increasing the business prosperity of the country as a whole, and hardly lies within our scope. Although considerable effort is now being made to teach young graduates how to go after a job, it is quite clear that if one man gets it, the other doesn't so we are just about where we started.

I think that we are perhaps suffering from too great a tendency to play up the professional side of engineering, as well as to overspecialize, at least at too early an age. We commit the crime of encouraging our young men to believe that they can become engineers, and sometimes specialists as well, by going to technical schools, for four years. You can't become a first class mechanic in that time.

I am of the opinion that the engineer, and especially the engineering schools, have come to lay too much emphasis upon specialization. While specialization is often a necessity as far as the welfare of the individual is concerned, it is often a necessary evil as it not only limits his scope of employment but his professional outlook as well. It is surprising how many of the older engineering graduates, really know nothing about the practical application of engineering principles, outside their own specialty, and too often they seem to take pride in their ignorance.

It might not be a bad thing if our technical schools went on some kind of a sit down strike and told some of our industrial leaders that if they want specialists for their own particular line of business it is up to them to provide the training themselves. I am not denying the necessity for this specialization but the general field of engineering is now so broad that in four years the schools can only give their men a bare outline of it. The problem should not be further complicated by a demand for a high degree of specialization.

Fifty years ago a man who called himself an engineer would be ashamed to admit that he did not have at least a superficial knowledge of the whole field of engineering. Today such a broad scope of knowledge is impossible, but if we are not to further limit that scope, we must stop pretending that we can turn out men who have a liberal technical education and who are specialists.

In these times, I think that what is really required, is a broader definition of the term "Engineering" and having broadened that definition it is up to us to sell the idea to the public. This is an engineering age and if our young engineers are to go after any kind of job they can handle, they have got to have

a pretty broad technical education. They must stop going around telling people that they are specialists in some line in which no one wants to employ them.

James O. G. Gibbons
Mechanical and Electrical Engineer
Bloomfield, N. J.

To the Editor of Chem. & Met.:

Sir:—All the comments which you have forwarded to me, coming from Montreal, from New York and other points have certainly proved a surprise. Not only am I taken aback at the complete unanimity of approval which my words received, but also by the interesting volume of replies. If I may, I would like to deal with a few of these replies.

One correspondent, a senior in chemical engineering at McGill University writes about the lack of realization on the part of the men of authority in the chemical industry to the fact that chemical engineers are not only research men but likewise can be trained and used for supervision in plant departments, in administrative posts, purchasing, public relations and later in sales. He, the correspondent, doesn't say all this but cites instead one of the standard replies to the letters of application which are sent by young men to the plants, to wit: "there are no vacancies in our research laboratory at this time." This is a common reply, I have quite a few examples on file myself.

The foregoing should prove that jobs can be created for more than a thousand chemically trained young men if only the men in industry will begin to understand that today's graduate has had a broad general training and that he is fit for many types of work which our older men could not take for lack of knowledge. Not that today's man is smarter . . . but that he has had a broader foundation than his predecessor. This is because the colleges want the men to get jobs, sometimes catch-as-they-can if necessary. So, it gives catch-as-catch-can education in marketing, economics and the like to equip the student for any eventuality.

I think that the engineering and chemical societies should have frequent visits to the educational as well as the industrial plants. Gentlemen, some of you would be re-educated to what chemical engineering really is today.

The director of the chemical division of laboratories of one of the country's larger oil companies sent an application. He wrote that he had no idea if a suitable vacancy was open but . . . He also thought M.H.B. deserved a chance "if his adversity has not embittered him so much that he will not be able to fit into a technical organization."

Of course I sent that application in. I told my correspondent that I was still far from a radical, chiefly because the South, where I live is solidly Democrat, also because unlike other adversities, this one still left me capable for hearty eating, even though I wasn't given a chance to work. But I must point out that radicalism grows from seeds sowed by a society unwilling to care for its own creation. If the chemical industry will persist in sowing unemployment it will reap a harvest in keeping with its practice.

Other letters received extend the remarks I made, one of which adds something which I don't believe, namely that today's engineers are too specialized. Except for a small number of colleges which frankly specialize, I don't think any man with a new degree in chemical engineering is in any way a specialist. He is really a neophyte and knows it and he is anxious to get some real practical training so that, if he is any good, he can later specialize in something he knows well.

It is true that the young engineering graduate must compete, once he does land a job, with the high school trained young mechanic who now has at least a four year lead in practical work over him. The trained engineer, however, has learned the way to study, he can apply himself more directly and widen his practical knowledge through additional study. The practical mechanic flounders around, unless he is an unusual exception, never quite getting all the fundamentals, going by routine rather than reason and technical knowledge. The young engineer may start behind the young mechanic. It cannot be doubted he usually ends up far ahead.

All in all, I was pleased by the comments I received to my letter. I still feel, however, as I did when I wrote my original letter. Chemical engineering unemployment is common to the problem of general college graduate and ordinary unemployment. For many of the unemployed there are no jobs; we must provide for these people through our government — that is common human decency. For unemployed chemical engineers we need not look to outside agencies. Ours is the youngest engineering field in the world, a field which is expanding tremendously every year. For our unemployed, old and young, there can be jobs — there are jobs. A little thought on the part of each operating technical man who may read this will probably create jobs. What do you want done better, more intelligently? Hire a young chemical engineer for the job. It doesn't matter if it is dirty work, if the pay is comparatively small. The young fellow isn't working at all now . . . he'll jump at the chance. And an amazing number will make good. Visit your own plant today, see what you are missing by not having a technically trained man in one place or another; see what you may gain by having a technically trained additional salesman for trouble-shooting, a chemically trained bookkeeper or office assistant to work in your office, a chemist-route-and-traffic-man and so on.

And visit your old alma mater, or someone else's close to you. You'll be mighty pleased, greatly surprised, at the crop soon to be reaped. Give us a fair chance, gentlemen. You'll get your money's worth, and more!

M. H. B.

Junior Chemical Engineer
Norfolk, Virginia

FACTS ON FILTERING

Representative case histories on widely varied clarification problems condensed from field reports of Johns-Manville Filtration Engineers

Filter Cleaning Reduced 800%

(Reported by J-M Engineer R. J. Amberg)

DETROIT DISTRICT—Slow filtering operations were setting up a bottleneck in this automotive-equipment manufacturing plant. High-speed copper-plating solutions came through filters at low flow rates. Production had to be stopped every three hours for filter cleaning.

This company was using Hyflo Super-Cel as a filter aid, but a check-up showed that the drum for filter-aid addition was incorrectly placed. This resulted in lowering the level of liquid to a point where the pump could not handle necessary volume. The tank was elevated well above the pump and a new method recommended for using Hyflo.

One week later, this filtration was again checked. Filter cleaning was reduced from once every *3* hours to once every *24* hours. This means that the cycle has been increased *800%*.

Linseed Oil Comes Clean for Soap Company

(Reported by J-M Engineer W. J. Bucklee)

PHILADELPHIA DISTRICT — This company reported extreme difficulty in filtering hot cresol linseed oil solution. The material is filtered at a temperature of 200° F. and contains slimy foots that come from the oil.

After a thorough check-up of operations and equipment in the plant, piping was rearranged to permit better precoating. A different type of Johns-Manville Celite Filter Aid was specified and an actual run started.

Between 3 and 4:30 o'clock that afternoon, more than 800 gallons of the linseed oil solution were filtered. Clarification was complete and accomplished at unusually high flow rates. Company men agreed that it was the best run ever seen in the plant.

Settling Time Eliminated in Ferric Hydroxide Filtration

(Reported by J-M Engineer O. A. Mockridge)

NEW JERSEY DISTRICT—In this chemical plant, it had been standard practice to let ferric hydroxide settle for 24 hours before filtration. A suggestion was made to perform the entire clarification operation by pressure filtration, with J-M Hyflo Super-Cel Filter Aid.

This recommendation was carried out. Plant operators are enthusiastic about the results. Using ½% Hyflo, the 24-hour period formerly required for settling was eliminated entirely and the filtration cycle reduced from 6 *hours* to 20 *minutes*.

Celite Mineral Fillers Improve Hundreds of Products

Paint, silver polish, match heads, paper . . . are just a few of the wide range of materials made better with J-M Celite Fillers. These mineral inerts are entirely different from ordinary fillers. They consist of microscopic hollow shells in an infinite variety of irregular shapes. They are absolutely inert, and being unusually porous, they absorb more than 200% their own weight in liquid. Furthermore, because Celite Fillers offer tremendous surface area . . . they can frequently be used to replace from 2 to 6 times the amount of heavier fillers.

Celite Fillers have proved their ability to add new quality to hundreds of widely varied manufactured articles. A J-M Engineer will gladly help you choose the type and grade that will give best results in your products. For details, write Johns-Manville, 22 East 40th Street, New York, N. Y.

What Do You Filter?

The cases cited on this page represent just a few of the many plants where operators have saved time and money or improved filtrates with the help of the Johns-Manville Filtration-Engineering Service.

A J-M Engineer may be able to make similar savings for you. Let him inspect your plant . . . show you if your filtering can be improved in any way.

For details on this service and information on the complete line of modern high flow-rate J-M Celite Filter Aids, write Johns-Manville, 22 East 40th Street, New York, N.Y.

JOHNS-MANVILLE PRODUCTS

JOHNS-MANVILLE CELITE FILTER AIDS

FILTER-CEL . . . STANDARD SUPER-CEL . . . CELITE NO. 512 . . . HYFLO SUPER-CEL . . . CELITE NO. 501 . . . CELITE NO. 503 . . . CELITE NO. 535

Fats, Oils, Water and Gases

SULFATED OILS AND ALLIED PRODUCTS. By *Donald Burton* and *George Robertshaw.* Published by the Chemical Publishing Co., New York, N. Y., 163 pages. Price $5.

Reviewed by *W. L. Abramowitz*

THERE ARE few industries which do not employ surface-active chemicals (wetting, foaming, emulsifying, or dispersing agents, detergents, etc.) Next to ordinary soap, sulfonated or sulfated materials are the most widely used. This book is essentially a review of the analytical methods used in the analysis of sulfated oils and deserves a place in every laboratory handling such oils. Contrary to the implications of advertising men, sulfated materials are not analyzed commercially by the duck-sinking method. The chapter devoted to the chemistry of sulfation, although brief, is cogent. No mention is made of the increasingly important sulfonated esters and amides of fatty acids.

The authors seem to have written this book from the viewpoint of leather chemists. Overemphasis is placed on A.L.C.A. methods. The methods of the A.S.T.M. and the S.O.M.A., some of which are superior to those of the A.L.C.A., have not been included. An example of this is the procedure for determination of unsaponifiable matter. This method, as outlined, will give misleading results in the case of sperm oil as shown in the 1939 report of the Committee on Methods of Oil Analysis (A.L.C.A.). The S.O.M.A. method is accurate. These criticisms are not meant to detract from the undoubted utility of the book.

RANCIDITY IN EDIBLE FATS. By *C. H. Lea.* Published by Chemical Publishing Company, New York City. 230 pages. Price, $4.

IN SPITE of its title, chemical engineers engaged in work with inedible fats and oils will profit by familiarity with this book. The current state of knowledge concerning rancidity of fats and fat-containing foods is compiled in a very readable manner. Although emphasis has been laid on the scientific aspects of the problem, many details of methods likely to prove of practical value in the diagnosis and correction of faults have also been included.

The author introduces the subject with a brief resume of the chemistry of fats and then devotes the principal part of the book to the deterioration of fats by atmospheric oxidation. The relation between chemical tests and rancidity is discussed, as are also methods of measuring the susceptibility of fats and oils to oxidation. Considerable space is also devoted to the factors which influence the rate of oxidation.

The action of micro-organisms on fats is the subject of one chapter. The lesser causes of rancidity and types of rancidity specifically encountered in a few of the more important fat-containing foods complete the volume.

Charts, tables, and illustrations are numerous throughout and bibliographies are found at the end of each chapter.

THE DETECTION AND IDENTIFICATION OF WAR GASES. Published by Chemical Publishing Co., New York, N. Y. 53 pages. Price $1.50.

WRITTEN for Britain's A.R.P. department, these "Notes" give physical and chemical properties of the war gases, principles and methods of detection, chemical identification and also the duties and responsibilities of identification officers.

FUEL—FLUE GASES. Edited by *C. G. Segeler.* Published by American Gas Association, New York, N. Y. 198 pages. Price $5.

EXECUTIVES, managers and salesmen can discover in this book what the chemist engaged in analytical works does and why he does it. Such an understanding would be of material assistance to those looking for interpretation and applications of the chemists' findings. Five of the eight chapters deal largely with fuel gases. Others cover furnace atmospheres, deposits in distribution systems and atmospheres other than those from combustion. Numerous charts, tables, equations and illustrations will make the book a very convenient reference for chemists, engineers and students.

PROPERTIES OF ORDINARY WATER-SUBSTANCE. Compiled by *N. Ernest Dorsey.* Published by the Reinhold Publishing Corp., New York, N. Y. 673 pages. Price $15.

Reviewed by *F. C. Nachod*

IN THIS handy reference book, the eighty-first of the American Chemical Society's monograph series, Dr. Dorsey has compiled with painstaking care nearly 700 pages full of excellently and critically chosen data. After some introductory notes explaining documentation, symbols, units and equivalents, the properties are listed in logical order: synthesis, dissociation, single systems (gas, liquid and solid state), multiple phase systems and phase transition. The term "water-substance" is meant for water of the normal isotopic composition. Referance for deuterium oxide is given.

It will be far more convenient to consult this well-rounded monograph if one needs quick information than to try to locate data in the more voluminous "Landolt-Boernstein's Tabellen" or in the "International Critical Tables." The book, however, is not meant to replace those standard works; but, as the author points out in his preface, to help workers in other fields, to "furnish a well-digested survey of the progress already made and to point out directions in which investigation needs to be extended."

The literature references at the bottom of each page and a well organized index make the book most valuable to workers in the fields of chemistry, physics and physical chemistry.

MATHEMATICAL METHODS IN ENGINEERING. By *Theodore V. Karman* and *Maurice A. Biot.* Published by McGraw-Hill Book Co., Inc., New York, N. Y. 505 pages. Price $4.

Reviewed by *C. K. Lawrence*

THE AUTHORS of this book have tackled the problem of inducing students of engineering to apply the fundamentals of their mathematical training. Starting with an assumed knowledge of algebra, analytical geometry, and "ordinary calculus," the student is taken through the theory and immediate application of advanced mathematics to numerous specific problems. Many applications are developed in satisfying detail in the text, and others, with answers supplied, are assembled for the cutting of wisdom teeth.

In the introductory chapters it is gratifying to find an index of symbols used in standard tables on the Bessel functions, and explicit directions for reduction of elliptical integrals to standard forms.

The scope of the text may be indicated by the broader fields and some of the topics treated. For example, under dynamics are discussed gyroscopes, single and double pendulums, resonance, damping, airplane paths of flight, airplane wing flutter, vibration dampers, with methods of treatment based primarily on Newton's Laws of Motion, vectors and Lagrange's equations. Under structures, bending, deflection, vibration and buckling of beams are treated. And under periodic and transient phenomena the authors cover impedance (electrical and mechanical), superposed periodicities and suddenly applied forces.

The indexing appears adequate and includes the subject matter of many of the problems.

These authors have been notably successful in conveying the physical significance of equations in specific problems and have thus gone far toward their stated goal. A required rigorous college course with this text would have a salutary influence on engineering in this country. The engineer out of school is not likely to have his specific problems solved for him in this book but may well derive profit and even pleasure from working with it.

ELECTROCHEMISTRY AND ELECTROCHEMICAL ANALYSIS. Volume I. Electrochemical Theory. By *H. J. S. Sand.* Published by Blackie and Son, Glasgow. Available from the Chemical Publishing Co., New York, N. Y. 134 pages. Price $2.

Reviewed by *G. F. Kinney*

READABILITY, thoroughness and conciseness mark this comparatively complete account of modern theories of electrolytes. The volume is intended as an introduction to a treatment of electrometric analysis and other electrolytic determinations. The nature of this introduction, however, is such that it is complete in itself as a summary of present ionic theory, treating in turn the passage of electric current through solutions, electrode potentials and irreversible electrode processes. The completeness is indicated by inclusion of many topics too often omitted from more pretentious treatments; topics such as buffer capacity, rH, redox indicators, the polagraph, throwing power and others. Well indexed, the volume belongs on the bookshelf as a readable exposition, an authentic summary and a handy reference work.

COLOR ATLAS FOR FIBER IDENTIFICATION. By *John H. Graff.* Available from The Institute of Paper Chemistry. 21 pages, five color charts. Price $12.50.

COOPERATIVELY financed by The Institute of Paper Chemistry, the American Paper and Pulp Association and the Technical Association of the Pulp and Paper Industry, this book will be a new tool for the paper industry.

Fiber composition is determined by means of color reactions with a series of dyes or stains, observed under a microscope. The Atlas gives directions for the preparation and application of seven stains and the charts show their reactions on a wide variety of paper-making fibers. Produced from water color paintings, the charts will be of value in research, development and in quality control. An extra set is included in order that the book need not be subjected to laboratory conditions.

REFERENCE BOOK OF INORGANIC CHEMISTRY. Revised edition. By *Wendell M. Latimer* and *Joel H. Hildebrand*. Published by The Macmillan Co., New York, N. Y. 561 pages. Price $4.

ESSENTIAL facts are presented briefly and clearly and in due relation to other facts and principles in this reference which is a thorough revision of the 1929 edition. Larger type makes the new book easier to read; new data and recent theories modernize the contents. Together they add more than 100 pages to the length of the first edition. Chemical engineers might find the book useful for bringing themselves up-to-date on such concepts as covalent bond energies, molecular structure and other theories which have changed or developed in the past ten years.

CAST METALS HANDBOOK. 2nd Edition. Published by American Foundrymen's Association, Chicago, Ill. 504 pages. Price $5.

THE 1940 EDITION is completely revised from the previous edition and contains about 30 per cent more material. Not only has the material contained in the old edition been thoroughly revised but chapters on the design of steel castings, effect of alloys on cast iron, specific uses of alloy cast irons, several new non-ferrous alloys, a section on the proper application of non-ferrous castings, and a chapter on the significance of strength and ductility tests of metals especially prepared by W. F. Moore, Research Professor of Engineering Materials, University of Illinois, Urbana, Illinois, have been added to the new edition.

In other words, this 1940 edition records the further progress made in the field of cast metals and castings and brings the reader right up to date with the latest developments in this ever growing and important field.

THE FABRICATION OF U.S.S. STAINLESS STEELS. Published by Carnegie-Illinois Steel Corporation, Pittsburgh, Pa. 91 pages. Price $1.

DIVIDED into three sections, this new book, discusses the technical and practical aspects of stainless steel fabrication. The first section is devoted to welding, riveting, soldering and joint design. Part two takes up machining, cutting, forming, annealing and pickling operations. Section three discusses surface finishing and protection. Laboratory corrosion data are presented for four types of stainless steels.

SYMPOSIUM ON THERMAL INSULATING MATERIALS. Published by American Society for Testing Materials, Philadelphia, Pa. 123 pages. Price $1.50.

FOUR TECHNICAL PAPERS comprise the Symposium on Thermal Insulating Materials. The first is "Factors Influencing the Thermal Conductivity of Materials" by J. B. Austin. This is a discussion of the properties of materials which affect thermal conductivity, in addition to fundamental principles of heat flow. H. H. Rinehart's paper "A

Discussion of Test Methods for Determining the Physical Properties of Thermal Insulation" studies various problems for the purpose of developing proper standards for gaging the acceptability of materials. The third paper by E. T. Cope and W. F. Kinney is entitled "One Consumer's Problems in Selecting Thermal Insulation." This presents some of the difficulties encountered in purchasing and using materials. It is expected the work of the society may help to correct, or at least alleviate, these difficulties.

The last paper "The Effect of Solar Radiation on the Heat Transmission Through Walls" by F. C. Houten, Director, Carl Gutberlet and Albert A. Rosenberg of the Research Laboratory of the American Society of Heating and Ventilating Engineers, discusses the fundamental principles of the cyclic heat flow through the walls of buildings under the influence of solar radiation. This is contrast with the usual concern with heat flow through insulation under steady state conditions.

The book concludes with discussions of the various papers included.

A.S.T.M. Standards on Rubber Products. Published by the American Society for Testing Materials, Philadelphia, Pa. 210 pages. Price $1.25.

THIRTY widely used specifications and test methods are given in their latest form in this compilation. Fourteen of the standards pertain to general methods of preparation, chemical analysis, tension testing, abrasion resistance, adhesion and so forth. Rubber hose and belting are covered in three standards. Five items cover rubber gloves, matting and tape, and five are standards covering various types of insulated wire and cable, including rubber sheath compounds. Other standards pertain to rubber cements, sponge and hard rubber products. An eight page bibliography provides references to many sources of information.

Symposium on Lime. Published by the American Society for Testing Materials, Philadelphia, Pa. 118 pages. Prices $1.50 (cloth), $1.25 (paper).

ELEVEN technical papers comprise this symposium and they deal especially with problems in the practical application of lime in its various forms. This is the Society's first technical symposium in many years devoted entirely to this subject and it is a compendium of data and information which has been in course of development during recent years.

RECENT BOOKS and PAMPHLETS

Matters of Procedure Under Government Contracts. By O. R. McGuire. Published by the Fidelity and Deposit Co. of Maryland. 78 pages. Gratis. A booklet, study of which could conceivably save money and time for industries supplying goods or services to the Government. The seven chapters discuss the bid, the contract, contracting agencies, contracts with Government corporations, settlement of claims under Government contracts and Government sales. The author was formerly counsel to the Comptroller General of the United States and has had much experience in handling cases involving disputes between the Government and its suppliers and contractors.

Cracking Art in 1938. Edited by Gustav Egloff. Published by Universal Oil Products Co. 458 pages. As in previous years, Dr. Egloff again reviews all the important developments in cracking during the year. The book contains domestic and foreign statistics for the industry, developments in research as published in technical journals, and abstracts of all the important patents issued both in the United States and abroad. The scope of the book has been broadened to take in alkylation, polymerization, dehydrogenation, cyclization, aromatization in addition to pyrolytic and catalytic cracking. It is illustrated with flow sheets and plant pictures.

German-English Glossary for Civil Engineering. Circular No. 40. By A. A. Brielmaier. Published by the University of Illinois, Urbana, Ill. 37 pages. 45 cents. Approximately 2,300 German words taken from modern works and current technical periodicals. The English equivalents given are those which would be employed in American practice.

International Trade Statistics 1938. Published by the League of Nations. Available from Columbia University Press, New York, N. Y. 345 pages. Price $3. Contains statistical tables of foreign trade of 67 countries for 1936-38, and indicates respectively the imports and exports of goods per year and per month, imports and exports by country of provenance and destination, and the imports and exports by principal articles, the imports and exports by groups according to the new international classification (League of Nations "Minimum List"). Includes about 300 tables.

Carbon Bisulphide Vapour. Published by the Department of Scientific and Industrial Research. (Great Britain.) Available from the British Library of Information, New York, N. Y. 8 pages. 10 cents. A booklet of the series "Methods for the Detection of Toxic Gases in Industry." These booklets list properties, occurrence, poisonous effects, methods of detection, instructions for carrying out tests for the vapor and first aid. Others of this series which have been received are Chlorine (10 cents), Aniline Vapour (10 cents), Phosgene (75 cents) and Arsine (75 cents). The latter two have color charts of standard stains produced by test methods.

The Canadian Mineral Industry in 1938. Published by the Bureau of Mines, Canada. Publication No. 804. 102 pages. 25 cents. Reviews by the staff of the Canadian Bureau of Mines. Includes statistics and figures for production, imports and exports for 21 metals, 39 industrial minerals and 6 fuels.

Lignite—Occurrence and Properties. By Irvin Lavine. Published by the Department of Chemical Engineering, University of North Dakota. 178 pages, mimeographed. An ambitious attempt to bring together all of the available information which could be found in the literature concerning the occurrence and properties of the lignite in the United States. Numerous maps, tables and charts accompany the text.

Standard Specifications, Procelain Enameling Supplies. Prepared by L. C. Athy and G. H. Spencer-Strong. Published by The Porcelain Enamel & Manufacturing Co., Baltimore, Md. 33 pages. A useful guide for the enamel industry, this booklet is a collection of more than two dozen specifications which will give accurate and detailed information to purchasing agents and plant superintendents. It sets up standards of quality for the purchase of chemicals for enameling plant mill and pickle rooms.

CORRECTION

The notice of "List of Inspected Fire Protection Equipment and Materials" published last month indicated that this booklet was priced at 75 cents. In reality, it is distributed gratis and may be obtained from the New York, Chicago or San Francisco offices of the Underwriters' Laboratories.

Manufacturers' LATEST PUBLICATIONS

Air Conditioning. The Trane Co., La Crosse, Wis.—Data Book D-400-5—76-page data book on this company's "Climate Changers," with descriptions and dimension data on various types, specifications, fan capacity data, cooling coil data, tables of useful information, and other features.

Belting. Chicago Belting Co., 113 North Green St., Chicago, Ill.—24-page condensed catalog describing this company's method of producing "Tension Welded" leather belts with information on control and testing, applications, brands, engineering data, leather specialties, belt cements and technique of making belts endless.

Boilers. Babcock & Wilcox Co., 85 Liberty St., New York City—Bulletin G-28—16 pages on this company's Design 32 cross-drum boiler for pressures to 250 lb. with heating surface from 1,000 to 6,000 sq.ft.

Centrifugals. Tolhurst Centrifugal Div., American Machine & Metals, Inc., East Moline, Ill.—16-page book describing design and construction of this company's suspended centrifugals for process industries applications with detailed information on drives, special baskets and factors effecting performance.

Colorimeters. Photovolt Corp., 10 East 40th St., New York City—6-page folder describing in detail photoelectric colorimeters available in four standard models from this company.

Ducts. The Philip Carey Co., Lockland, Cincinnati, Ohio—44-page service manual on this company's asbestos insulated ducts for air conditioning, with information on types, sizes, construction of fittings, erection and an extensive data section dealing with sound absorption, insulating characteristics, friction loss and other factors.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—GEA-1184D, 2 pages on a-c magnetic motor-starting switches; GEA-2915A, 8 pages on general-purpose capacitor motors; GEA-3301, 6 pages on this company's Reactrol system for controlling electrically heated equipment.

Electrical Equipment. Westinghouse Electric & Mfg. Co., Dept. 7-N-20, East Pittsburgh, Pa.—Publications as follows: Folder F-8524-A, 8 pages describing two new air circuit breakers especially developed for paper mills, synthetic fiber plants and general industrial applications; Data Booklet DD-36-116, 28 pages on indoor disconnecting switches in ratings to 6,000 amp. for various voltages to 34,500; Catalog Section 29-460, 5 pages on De-ion circuit breaker panels designed particularly for service under corrosive conditions.

Electrical Precipitation. Research Corp., Chrysler Bldg., New York City, and Western Precipitation Corp., Los Angeles, Calif.—24-page book on the Cottrell process of electrical precipitation for the cleaning of gases, with information on the function of electrical precipitation, its history, development, principles, equipment, types and applications in numerous industries.

Equipment. F. J. Stokes Machine Co., Tabor Road, Philadelphia, Pa.—6-page folder describing Standard semi-automatic molding presses handled by this company in sizes from 20 to 300 tons capacity, with information on design and advantages. Also folder describing this company's water stills in sizes from ½ to 6 gal. per hr. capacity.

Equipment. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: Bulletin H-620-B22, 6 pages on balanced-angle, two-cylinder air compressors; S-550-B7, 8 pages on vertical four-cycle gas engines; W-341-B7, 4 pages on single-stage volute centrifugal pumps.

Fans. Hartzel Propeller Fan Co., Piqua, Ohio—Catalog 12—32 pages illustrating and describing this company's entire line of propeller type fans and blowers, with air delivery tables on each type. Many new models are described.

Fused Silica. The Thermal Syndicate, Ltd., 12 East 46th St., New York City—Bulletin 5—4 pages describing a variety of special apparatus and equipment produced in transparent Vitreosil fused silica.

Grinding. Raymond Pulverizer Div., Combustion Engineering Co., 1324 North Branch St., Chicago, Ill.—Bulletin 44—4 pages describing this company's bowl mill as used in the direct firing of rotary kilns.

Heaters. American Instrument Co., 8010 Georgia Ave., Silver Springs, Md.—Bulletin 2075-CM—28-page catalog on this company's Lo-Lag electric heaters and controls, including immersion heaters, space heaters, and convection-type room heaters.

Heaters. The Electric Air Heater Co., 555 South Byrkit St., Mishawaka, Ind.—Bulletin 15—2-page leaflet describing this company's industrial portable electric space heaters.

Heat Protection. Metallizing Engineering Co., 21-07 41st Ave., Long Island City, N. Y.—Bulletin P11—8-page bulletin describing the new process of Metcolizing for the protection of iron and steel and in some cases copper and bronze against oxidation and scaling at elevated temperatures and for the protection of nickel and nickel-chrome alloys against attack by sulphurous gases.

Instruments. The Brown Instrument Co., Philadelphia, Pa.—Catalog 2203—12 pages describing this company's mechanical flow meters with information on construction and types available; also Folder 80-37, 4 pages describing this company's steam flow meters and CO_2 meters for boiler use.

Instruments. Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa.—Publication 2100—4 pages describing this company's new Linameter, and area type flow meter with remote electrical indication and recording, particularly suitable for viscous and corrosive fluids.

Instruments. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—Catalog E-50B (3)—24 pages on this company's Type K potentiometers and accessories.

Linings. Homogeneous Equipment Co., Downingtown, Pa.—Leaflet briefly describing types of metal, rubber and synthetic plastic linings applied by this company to vessels, tanks, pipes, blowers and other equipment.

Materials Handling. Lewis Shepard Sales Corp., 295 Walnut St., Watertown, Mass.—Catalog 21—56 pages covering the wide variety of types of materials handling equipment made by this company. Among the 175 principal types described and illustrated are lift trucks, stackers, portable cranes, floor trucks, skid platforms and a wide variety of special purpose equipment.

Materials Handling. The Yale & Towne Mfg. Co., Philadelphia Div., Philadelphia, Pa.—Catalog PD-25—44 pages on hoisting equipment, including chain hoists, winches, trolleys, electric hoists and various special types of hoists.

Mixers. Mixing Equipment Co., 1090 Garson Ave., Rochester, N. Y.—Form B-68—16 pages on this company's nozzle-mounting, top-entering mixers for pressure, vacuum and open tank service, with information on many types, details of mountings and stuffing boxes, and descriptions of special mixers.

Ovens. The Gehnrich Corp., Skillman Ave. and 35th St., Long Island City, N. Y.—Catalog 107—32 pages on this company's industrial ovens and dryers, describing typical construction features and heating systems and showing pictorially a large number of typical applications.

Piping. The Copper Alloy Foundry Co., Elizabeth, N. J.—Data sheet describing this company's split clamps for Van Stone type joints for use on alloy pipe connections. Also data sheets on stainless steel butt welding fittings, and low-pressure flanged fittings.

Plastics. Tennessee Eastman Corp., Kingsport, Tenn.—Three new books on Tenite thermoplastic molding compositions including a 28-page book on the material itself, describing properties and typical uses as a plastic; also a 40-page technical handbook on the methods employed in molding Tenite articles, with information on different types of molds, mold construction, molding temperatures and pressures; and a 28-page book on Tenite specifications giving specific data on physical properties in graph and tabular form to aid in selection of proper formulas.

Power Transmission. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Catalog 151—34-page loose-leaf collection of data sheets revising and superseding previous horsepower ratings for multiple V-belt drives, providing engineering information on selection of sizes of belts for horsepower ratings, speeds, center distances and sheave diameters.

Proportioning Pumps. Milton Roy, 3160 Kensington Ave., Philadelphia, Pa.—Bulletin 1039—4-page leaflet briefly describing construction features of this company's chemical proportioning pumps for pressures up to 15,000 lb.

Separators. Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa.—Publication 2950—8 pages on baffle type moisture and oil separators for use in vertical or horizontal steam, gas and air lines.

Solvent Recovery. Carbide and Carbon Chemicals Corp., 30 East 42d St., New York City—30-page book on the use of Columbia activated carbon for solvent recovery, with information on types of solvents recovered, types of installations and equipment, operating costs, applications and other information.

Sprays. Spraying Systems Co., 4021-29 West Lake St., Chicago, Ill.—Catalog 20—20-page catalog on this company's many types of spray nozzles with engineering data and information on typical applications.

Stainless Steel. Copper Alloy Foundry Co., Elizabeth, N. J.—4-page leaflet describing this company's new electrolytic process for cleaning, polishing and passivating stainless steel castings and announcing the standard use of this process on this company's stainless steel pipe fittings and valves.

Steel. Republic Steel Corp., Republic Bldg., Cleveland, Ohio—Form Adv353—40 pages on this company's "Double-Strength" steel, a low-alloy copper-nickel-molybdenum steel possessing high tensile strength, workability and resistance to atmospheric corrosion. Gives information on properties and applications. Also on fabrication methods.

Traps. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Publication T-1735—16 pages on this company's Impulse steam trap, describing principles, types and selection, with information on typical installations and on installation and operation.

Tubes. Babcock & Wilcox Tube Co., Beaver Falls, Pa.—Technical Data Card 6—Briefly summarizes data relating to the application of this company's Croloys and other tubular materials for high temperature service, including data on 15 different materials for almost all high temperature tube applications.

Valves. Jenkins Bros., 80 White St., New York City—30-page data book entitled "Jenkins Recommends," giving information on valve selection, with diagrams showing piping for various purposes and indicating accepted practice for installing valves in specific applications.

Editorial Reprints and Supplements for the Chemical Engineer's Data File

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R. "Utilization of Electric Energy and Disposition of Products of the Electrochemical and Electrometallurgical Industries." Supplement to September 1938 issue. 6-page wall chart........ **Price $0.25**

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Import Statistics. The U. S. Tariff Commission has just issued a report entitled "United States Imports and Trade Agreement Concessions", in eight volumes covering the following subjects: Chemicals, ceramics, metals, wood and paper, agricultural products, textiles, sundries, and free list products. Copies of each or all of these volumes are obtainable from U. S. Tariff Commission, Washington, D. C.

Reciprocal Trade: A Current Bibliography. Supplement to the Third Edition issued in 1937. U. S. Tariff Commission; processed.

Reference List of Publications of the National Resources Planning Board and Its Predecessors. National Resources Planning Board, Washington, D. C.; mimeographed.

Railway Statistics. Annual report for year ended December 31, 1938, giving data for railways and other common carriers (except motor carriers). Interstate Commerce Commission, Bureau of Statistics; $1.50 (cloth).

Digest of Recent State Laws on Transportation and Public Utilities. Library of Congress, State Law Index, State Law Digest Report 2; 15 cents.

Rock Drilling, by C. E. Nighman and O. E. Kiessling. Works Progress Administration, National Research Project Report No. E-11. Works Progress Administration, 1734 New York Avenue, Washington, D. C.

Explosibility of Semianthracite, Low-Volatile Bituminous-Coal, and Medium-Volatile Bituminous-Coal Dusts, by H. P. Greenwald. Bureau of Mines, Report of Investigations 3489; mimeographed.

Annual Report of the Metallurgical Division, Fiscal Year 1939. Progress Report 34—Metallurgical Division, by R. S. Dean. Bureau of Mines, Report of Investigations 3480; mimeographed.

The Causes and Prevention of Nitrous Fumes Poisoning. Division of Labor Standards, Industrial Health Series No. 14; 5 cents.

The Causes and Prevention of Metal Fume Fever. Division of Labor Standards, Industrial Health Series No. 15; 5 cents.

The Causes and Prevention of Ammonia Poisoning. Division of Labor Standards, Industrial Health Series No. 16; 5 cents.

The Causes and Prevention of Manganese Poisoning. Division of Labor Standards, Industrial Health Series No. 17; 5 cents.

The Significance of the Excretion of Lead in the Urine, by Lawrence T. Fairhall and R. R. Sayers. U. S. Public Health Service, Reprint No. 2113; 5 cents.

Soda, Caustic (Lye); (For Cleaning Purposes). Federal Specification P-S-631a; 5 cents.

Digest of State Laws Relating to the Problem of Interstate Trade Barriers for States Whose Legislatures Convene in 1940. Prepared by The Marketing Laws Survey, Works Progress Administration, at request of Department of Commerce and Interdepartmental Committee on Interstate Trade Barriers. Available from Department of Commerce, Washington, D. C.

Survey of American Listed Corporations, Volume II. This second volume gives information on 9 manufacturing groups as compiled from reports for fiscal period ending June 30, 1939 filed with Securities and Exchange Commission. These groups include aircraft and aircraft equipment, non-ferrous metals and their products, oil refining and distributing with producing facilities, chain grocery and food stores, chain variety stores, dairy products, department stores, mail order houses, and motion picture production and distribution. Available for limited distribution only from Securities and Exchange Commission, Washington, D. C.

Comparative Susceptibility of Crop Plants to Sodium Chlorate Injury, by Annie M. Hurd-Karrer. U. S. Department of Agriculture, Technical Bulletin No. 648; 10 cents.

Nutritive Properties of Certain Animal and Vegetable Fats, by Ralph Hoagland and George G. Snider. U. S. Department of Agriculture, Technical Bulletin No. 725; 5 cents.

Production and Agricultural Use of Sodium Nitrate, by Albert R. Mertz and C. C. Fletcher. U. S. Department of Agriculture, Circular No. 436 (revised); 5 cents.

Dangerous Cargoes. Hearings before House Committee on Merchant Marine and Fisheries, 76th Congress, Third Session; 15 cents.

Skin Hazards in American Industry, Part III, by Louis Schwartz. U. S. Public Health Service, Public Health Bulletin No. 249; 35 cents.

Seasonal Workers and Unemployment Insurance in Great Britain, Germany, and Austria, by Franz Huber. Social Security Board, Bureau of Research and Statistics, Bureau Report No. 4; 20 cents.

Annual Report of Civil Aeronautics Authority for fiscal year ended June 30, 1939, with additional activities to November, 1939; 25 cents.

Army Regulations: List of Current Pamphlets and Changes; Distribution. War Department, Army regulations No. 1-10; 5 cents.

Army Regulations: Procurement of Supplies; Contracts, Formal and Informal. War Department, Army regulations No. 5-200; 5 cents.

Standard Field Tables and Trigonometric Formulas, Supplement to the Manual of Instructions for the Survey of the Public Lands of the United States, 5th edition. Interior Department, General Land Office; 75 cents (cloth).

Plastic Calking Materials, by J. J. Tregoning et al. National Bureau of Standards, BMS Report 33; 10 cents.

Legal Weights Per Bushel for Various Commodities. National Bureau of Standards, Circular 425; 5 cents.

Federal Specifications. NN-B-591, Boxes; Wood-Cleated-Fiberboard; ZZ-H-561b, Hose; Suction, Water, Smooth-Bore; ZZ-H-481b, Hose; Oil-Suction and Discharge; TT-V-71a, Varnish; Interior; KK-B-211, Belting; Round, Leather, Vegetable-Tanned; TT-P-86, Paint, Red-Lead-Base; Linseed-Oil, Ready-Mixed; UU-T-111, Amendment 2, Tape; Paper, Gummed (Kraft); P-S-618, Amendment 2, Soap; Toilet, Liquid. The above specifications are 5 cents each.

Fats and Oils Trade of the United States in 1939, by Charles E. Lund. Available only from Bureau of Foreign & Domestic Commerce, Foodstuffs Division; 10 cents.

Annual Report of the Explosives Division, Fiscal Year 1939, by Wilbert J. Huff. Bureau of Mines, Report of Investigations 3490; mimeographed.

Effect of Vertical Ducts in Combination with Openings in Manhole Covers on the Natural Ventilation, by G. W. Jones, W. E. Miller, and John Campbell. Bureau of Mines, Report of Investigations 3496; mimeographed.

Accident Experience of Four Louisiana Petroleum Refineries, 1929-38, by F. E. Cash and Eric H. Brown. Bureau of Mines, Information Circular 7099; mimeographed.

Accident Experience at Pebble-Phosphate Operations in Florida, 1930-38, by Frank E. Cash and George W. Colbert. Bureau of Mines, Information Circular 7100; mimeographed.

Nonmetallic Mineral Industries in 1939, by Paul M. Tyler and Oliver Bowles. Bureau of Mines, Information Circular 7106; mimeographed.

Electrolytic Recovery of Antimony from Antimonial Gold Ores, by J. Koster and M. B. Royer. Bureau of Mines, Report of Investigations 3491; mimeographed.

Flocculation as an Aid in the Clarification of Coal Washery Water, by H. F. Yancey et al. Bureau of Mines, Report of Investigations 3494; mimeographed.

The Eykometer—A New Device for Measurement of the Yield Point of Clay suspensions and Oil-Well Drilling Muds, by A. George Stern. Bureau of Mines, Report of Investigations 3495; mimeographed.

Cooperative Fuel Research Motor-Gasoline Survey, Summer 1939. Bureau of Mines, Report of Investigations 3492; mimeographed.

Revising Specially Denatured Alcohol Formula No. 42 in Appendix to Regulations No. 3. Bureau of Internal Revenue, Treasury Decision 4967; mimeographed.

Methods Used at the Forest Products Laboratory for Chemical Analysis of Pulps and Pulpwoods, by M. W. Bray. U. S. Dept. of Agriculture, Forest Products Laboratory, Mimeograph R19. Obtainable only from Forest Products Laboratory, Madison, Wis.

Preservation of Timber by the Steeping Process, by R. M. Wirka. U. S. Department of Agriculture, Forest Products Laboratory, Mimeograph R621. Obtainably only from Forest Products Laboratory, Madison, Wis.

Economic Review of Foreign Countries, 1938. Bureau of Foreign and Domestic Commerce, Economic Series No. 7; 30 cents.

Sugar and Molasses Trade of the United States in 1939, by Albert S. Nemir. Available only from Bureau of Foreign and Domestic Commerce, Foodstuffs Division; 10 cents.

Killing Poison Ivy with Chemicals, by L. W. Kephart. Bureau of Plant Industry, Department of Agriculture; mimeographed.

Regulations governing production of distilled spirits (other than alcohol) and removal therefrom from distillery. Bureau of Internal Revenue, Regulations 4. Published in Federal Register, March 2, 1940; 10 cents.

Regulations governing production of brandy. Bureau of Internal Revenue, Regulations 5. Published in Federal Register, March 5, 1940; 10 cents.

Code of Federal Regulations. Many thousands of federal regulations are being summarized in a series of volumes of which those listed below are now available. The purpose of these books is to bring together in a code the many rulings and regulations in a systematic arrangement for the convenience of users. There will be about 16 volumes issued altogether. **Vol. 1,** not yet available, will probably be an index to the rest of the series. **Vol. 2,** Title 7—Agriculture; **Vol. 3,** Title 8—Aliens and Citizenship, Title 9—Animals and Animal Products, Title 10—Army: War Department, Title 11—Bankruptcy, Title 12—Banks and Banking; **Vol. 4,** Title 13—Business Credit, Title 14—Civil Aviation, Title 15—Commerce, Title 16—Commercial Practices, Title 17—Commodity and Securities Exchanges; **Vol. 5,** Title 18—Conservation of Power, Title 19—Customs Duties, Title 20—Employees' Benefits, Title 21—Food and Drugs; **Vol. 6,** Having General Applicability and Legal Effect in Force June 1, 1938 (1939), First Edition, Title 22—Foreign Relations, Title 23—Highways, Title 24—Housing Credit, Title 25—Indiana. The price of the above volumes is $2.25 each (buckram).

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CONSUMPTION OF CHEMICALS FAILED TO SHOW SEASONAL GAINS IN MARCH

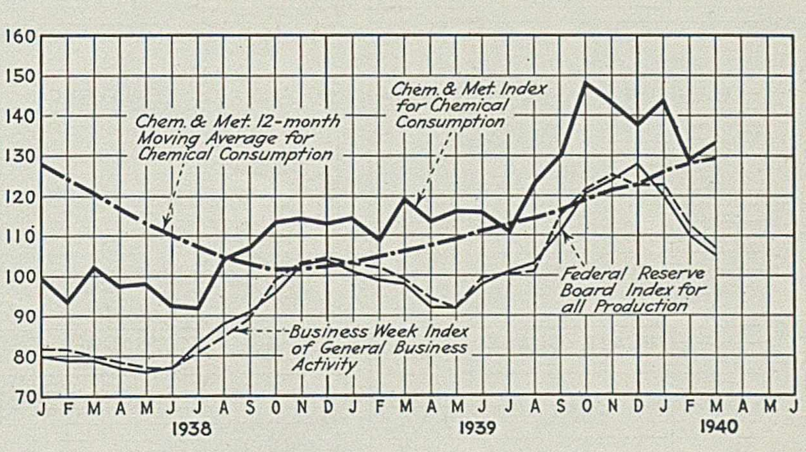
CHEMICAL plants entered this year with operations on a high plane. With few exceptions an even rate of production was maintained throughout the first quarter. Domestic consumption of chemicals was unusually heavy in January but eased off in February and from current reports, did not show the usual seasonal growth in March. Early April reports were more encouraging for some industries but export buying was said to have fallen off appreciably. The importance of foreign trade in the first quarter of this year may be inferred from the fact that outward shipments of chemicals carried a valuation of about $20,000,000 in excess of that reported for the first quarter of 1939. This figure refers to chemicals as included in Group 8 in the Monthly Summary of Foreign Commerce and does not include sulphur, naval stores, and vegetable oils. Export data also offer an explanation of why production of chemicals has exceeded domestic consumption without bringing about large surpluses.

Chem. & Met. Index for Consumption of Chemicals

	January	February
Fertilizer	34.23	28.14
Pulp and paper	18.10	17.95
Glass	12.96	11.94
Petroleum refining	14.01	13.26
Paint and varnish	9.31	8.60
Iron and steel	10.97	8.73
Rayon	11.28	10.93
Textiles	9.20	8.33
Coal products	9.01	8.04
Leather	4.10	3.72
Explosives	5.06	4.53
Rubber	3.32	3.07
Plastics	2.60	2.57
	144.15	129.81

Preliminary figures point to an index of approximately 133 for consumption of chemicals in March. This compares with a revised figure of 129.81 for February and with 119.82 for March last year. Increased number of working days was offset in some instances by slower rates of operation and the normal increase from February to March was cut down to a relatively light percentage. The revised data for February also brought a downward revision in the index number for that month. In the textile industry, cotton consumption has been holding up but silk and wool have been in less demand. Rayon production was on a steady basis over the three-month period. Production of paperboard in February amounted to 399,970 tons which is a record for the month. Sales of paint and varnish were disappointing in February and while improved did not come up to expectations in March. On the other hand petroleum refining in March showed a marked gain over the preceding months of this year.

Domestic consumption of chemicals for the first quarter ran about 20 per cent ahead of that for the first quarter of 1939. The index for the second quarter of 1939 was 115.58 and the index for the current quarter would have to average 138.70 to maintain the rate of increase which obtained in the Jan.-March period. The prospects for this quarter as anticipated by the 13 Shippers Advisory Boards are for an 18.1 per cent increase in the movement of goods by freight cars. For chemicals and explosives a gain of 14.9 per cent is forecast. For some of the other groups the increases in shipments expected for the quarter were as follows: Iron and steel, 13.6 per cent; automobiles and parts, 31.5 per cent; fertilizers, 9.9 per cent; paper, 9.1 per cent; petroleum, 4.6 per cent; and coal and coke, 48.8 per cent.

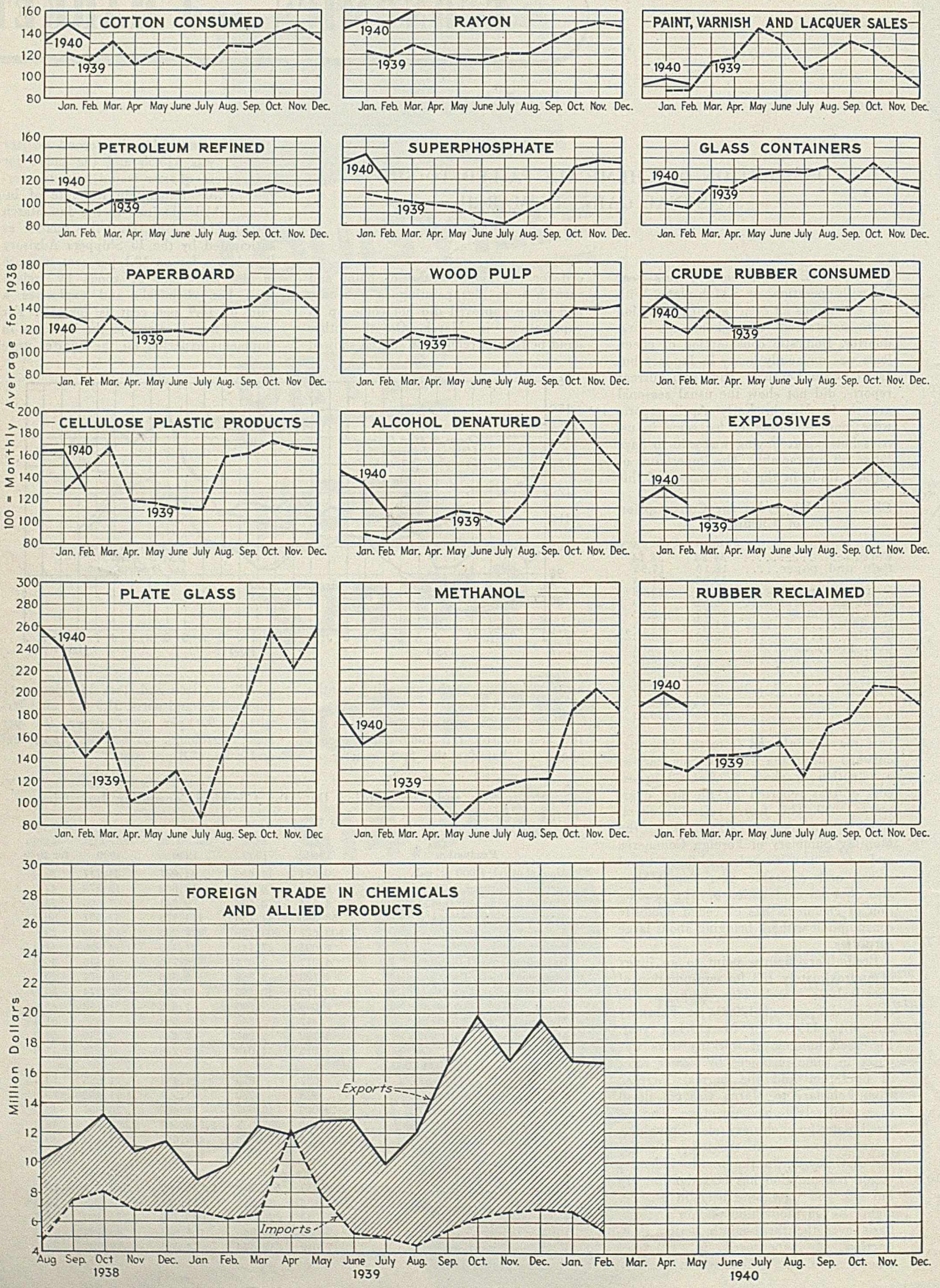


Production and Consumption Data for Chemical-Consuming Industries

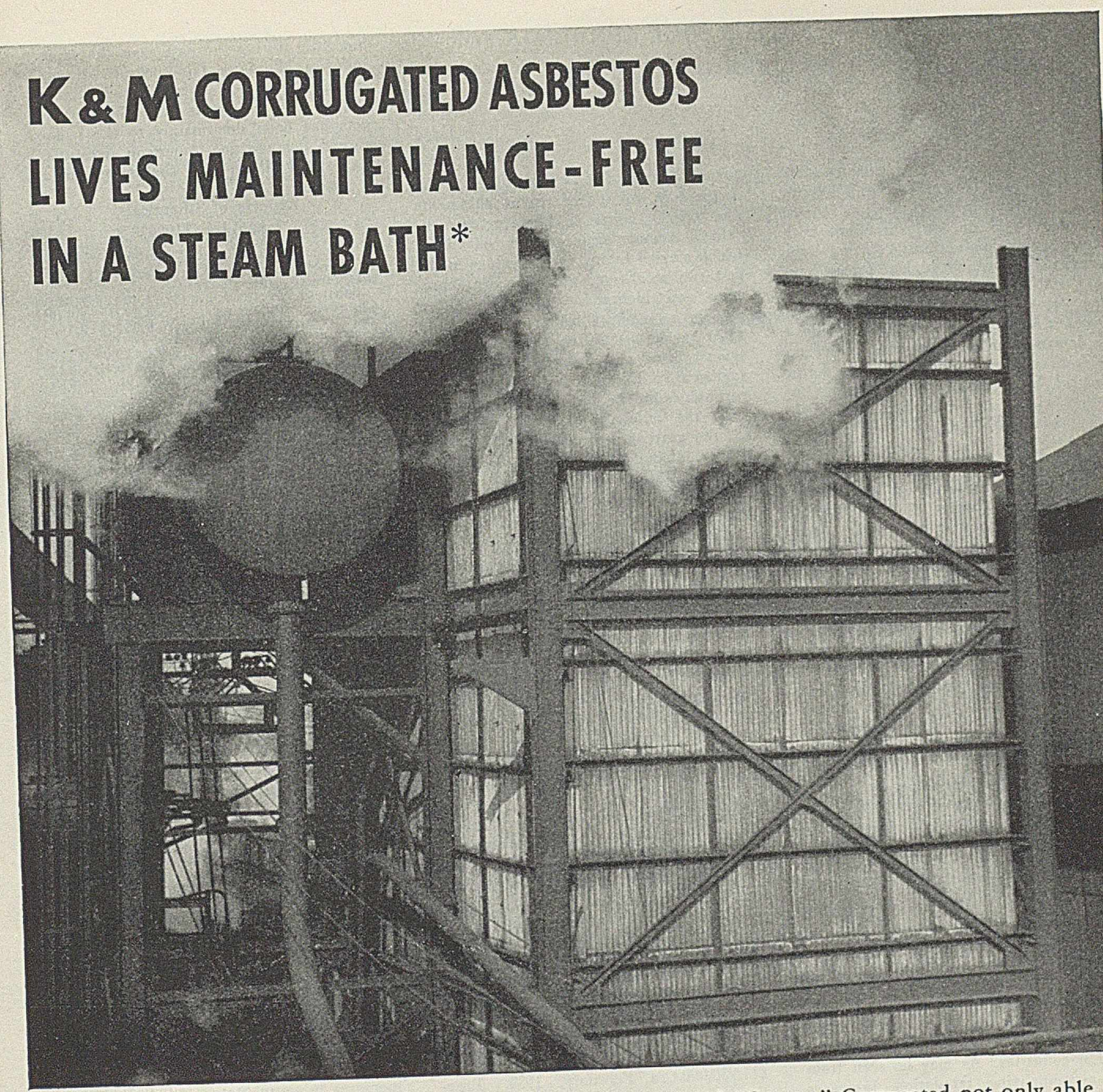
Production	Feb. 1940	Feb. 1939	Jan.–Feb. 1940	Jan.–Feb. 1939	Per cent of gain for 1940
Alcohol ethyl, 1,000 pr. gal.	20,381	14,650	41,037	31,717	29.4
Alcohol denatured, 1,000 wi. gal.	8,460	6,446	18,858	13,273	41.3
Ammonia aqua, 1,000 lb.	4,534	3,573	9,341	7,505	24.5
Ammonia sulphate, tons	53,885	41,780	114,278	87,537	30.5
Automobiles, sales, no.	403,627	303,220	835,728	645,388	29.5
Benzol, 1,000 gal.	9,695	7,141	21,119	14,929	41.4
Byproduct coke, 1,000 tons	4,017	3,078	8,724	6,445	35.4
Glass containers, 1,000 gr.	4,123	3,386	8,386	6,971	20.3
Plate glass, 1,000 sq.ft.	13,175	10,165	30,432	22,374	36.0
Window glass, 1,000 boxes	1,099	809	2,512	1,752	43.4
Methanol, crude, 1,000 gal.	447	336	904	688	31.4
Methanol, synthetic, 1,000 gal.	3,782	2,267	7,235	4,730	52.9
Nitrocellulose plastics, 1,000 lb.	1,016	1,049	2,256	1,973	14.3
Cellulose acetate plastics, 1,000 lb.					
Sheets, rods, and tubes	637	989	1,494	1,885	20.7*
Molding composition	878	770	1,901	1,452	30.9
Rubber reclaimed, tons	19,060	13,093	39,460	26,856	46.9
Steel barrels and drums, heavy	802,960	597,953	1,940,503	1,383,544	40.3
Steel barrels and drums, light	204,398	151,753	452,619	321,452	40.8
Consumption					
Cotton bales	662,659	562,580	1,392,802	1,160,712	20.0
Silk bales	22,485	33,219	51,991	74,035	29.8*
Explosives, 1,000 lb.	31,035	26,592	65,725	55,850	17.7
Rubber, crude, tons	49,832	42,365	104,832	88,599	18.3
Rubber reclaimed, tons	17,019	12,626	34,619	25,626	35.1

* Per cent of decline.

Production and Consumption Trends



K & M CORRUGATED ASBESTOS LIVES MAINTENANCE-FREE IN A STEAM BATH*



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LOWER PRICES PREVAIL FOR SOME CHEMICALS FOR SECOND QUARTER DELIVERIES

WHILE the majority of chemicals are unchanged in price for delivery over the second quarter, there have been some revisions in both directions with declines predominating. Among the materials for which higher prices have gone into effect is acetone. For a long time acetone had been under selling pressure with production running ahead of demand and a consequent piling up of stocks. Export demand in the latter part of last year increased sharply together with a larger call from domestic consumers. As the statistical position improved the market quickly gained strength and while contract deliveries were made at the old price levels, sales on new account were at advanced figures. The general rise in price for April forward appears to be largely an adjustment to a fair price level which formerly price-cutting competition had made impossible. What is true for acetone is not to be construed as extending over the solvents industry. With the increase in methanol plant capacity, that market has been under pressure and consumers in the present quarter are obtaining deliveries at reduced prices.

Surveying the market for the first quarter of the year, it is found that the majority of chemicals have moved into consumption in a large way. The high rate established in the final quarter of last year has not been maintained but a vast improvement was made over the similar period of last year. Some of the large consuming industries were taking on a more active appearance in the latter part of March and early April found a better inquiry for chemicals.

One factor which has been prominent in the movement of chemicals for the year to date is the large increase both in quantity and volume, of shipments to foreign countries. As may be seen from the accompanying tabulation, increases were general throughout the various groups which are included under this general heading. While some of the chemicals exported carried a price higher than that reported a year ago, there are also some lower average prices for the current year and it is probable that the increase in volume of export shipments was nearly equal to the increase in value. Among some of the chemicals which carried higher export values in the first two months of this year are: chromate and bichromate of soda, 13.17c per lb. as against 6.50c; caustic soda 2.22c as against 2.01c; acetone, 8.7c as against 5.4c; and formaldehyde 5.6c as against 3.7c. Compared with average export values for the first two months of last year, the following declines are noted for the current year; butanol 7.5c from 8.6c; methanol 35.3c from 37.9c; phenol 15c from 18c.

Prices for chemicals in the spot market still show that premiums are being obtained for certain selections which are in limited supply. Bichromates which have sold at high prices on spot may be affected by the report that a new plant is under construction at Wilmington and will have a capacity of 500 tons a month. Among other new developments announced during the month were the first domestic production of water-soluble methyl cellulose, a new process which turns out a microscopic sulphur, and the commercial production of potassium permanganate in a fine powder.

Casein has continued to hold an easy position. Exports of casein for the Argentine last year were the highest in recent years and the United States was the largest buyer. Argentine production last year is estimated to have run close to 18,000 metric tons with stocks at the close of the year at about 8,600 tons.

The report of the Department of Commerce stated that foreign demand for American chemical products continued active in February when exports of such products were valued at $19,436,000 compared with $20,432,000 in January and $11,958,000 in February, 1939. Practically every item entering into the chemical export trade shared in the gains recorded in February and other recent months and every country and trading area of the world is now buying more American chemicals and related products.

Analysis shows that during the six-month period following the outbreak of hostilities in Europe—September 1939 to February 1940, inclusive—foreign countries purchased $127,000,000 worth of American chemical products, a 60 per cent increase over the $79,600,000 worth of similar materials sold abroad during the corresponding months of 1938–39.

While increases in February were general throughout the chemical export list, outstanding gains were recorded in shipments of industrial chemicals, coal-tar products, medicinal preparations, naval stores, and paint products.

Exports of industrial chemicals were valued at $4,727,000 compared with $1,799,000 in February, 1939, a gain of more than 160 per cent. Since the price level of these products has gained but little during the past year, the value increase affords a fair measure of the volumes involved.

The gain in exports of coal-tar products has been due mainly to the widespread demand for American dyestuffs. Exports of all types of coal-tar products

Exports of Chemicals
Jan.-Feb. ($1000)

	1940	1939
Coal-tar products	$5,316	$1,958
Medicinal and pharmaceutical	4,454	2,632
Chemical specialties	6,174	4,040
Industrial chemicals	8,933	3,568
Pigments, paints and varnish	4,429	3,115
Fertilizer and materials.	2,420	1,833
Explosives and fuses....	652	445
Soap and toilet preparations	1,559	1,283
	$33,937	$18,874

were valued at $2,420,600 in February, compared with $876,500 in the corresponding month of 1939. Shipments of dyestuffs during these periods increased in quantity from 752,000 to 2,583,700 lb. and in value from $387,000 to $1,116,400.

A report from Washington says the Senate probably will approve a bill, already passed by the House without fanfare, which seeks to protect patent holders against importation of products made by processes patented in this country. Such importations would be declared an unfair trade practice unless produced under license granted by the patentee. This legislation would provide much more expeditious protection against such competition than afforded by the present rather cumbersome system of filing complaints with the Tariff Commission.

March fertilizer sales, as indicated by the sale of tax tags, amuonted to 1,640,000 tons in the 17 reporting States. This represented an increase of 4 per cent over March 1939 and about the same increase over March 1938. Sales were below March 1937 but with that exception were the largest for the month since 1930.

Aggregate sales in the South exceeded last year by 4 per cent, the result of increases in seven States and declines in five. The largest drop was reported by North Carolina, where a reduction in tobacco acreage has taken place. The effect of this has not been fully offset by a reported increase in cotton acreage. Largest gains took place in Mississippi, Arkansas, Louisiana, and Texas.

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base = 100 for 1937

This month	98.65
Last month	98.84
April, 1939	97.48
April, 1938	100.22

Higher prices went into effect on April deliveries of carbon black and acetone but methanol, formaldehyde, lead oxides, tin salts were lower and the weighted index declined.

CHEM. & MET.

Weighted Index of Prices for

OILS AND FATS

Base = 100 for 1937

This month	78.06
Last month	81.53
April, 1939	68.25
April, 1938	77.28

Linseed oil was easier for part of the period but recovered earlier losses. China wood was but little changed. Other oils sold at lower levels. Large stocks of lard have had a bearish effect on oils and other fats.

Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.07½–$0.07½	$0.07¼–$0.07½	$0.05¾–$0.06¼
Acid, acetic, 28%, bbl., cwt	2.23 – 2.48	2.23 – 2.48	2.23 – 2.48
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. reagent	10.25 –10.50	10.25 –10.50	10.25 –10.50
Boric, bbl., ton	106.00–111.00	106.00–111.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.21½– .25
Formic, bbl., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	.90 – 1.00	.90 – 1.00	.70 – .75
Hydrofluoric 30% carb., lb	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05¼	.05 – .05¼
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.10¾– .12	.10¾– .12	.10¾– .12
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.54 – .56	.54 – .56	.40 – .45
Tartaric, powd., bbl., lb	.37¼–......	.37¼–......	.27¼–......
Tungstic, bbl., lb	nom.	nom.	2.75 –......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.101–......	.101–......	.101–......
Alcohol, Butyl, tanks, lb	.09 –......	.09 –......	.07½–......
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.54 –......	4.54 –......	4.54 –......
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, bbl., gal. wks.	.29½–......	.29½–......	.28 –......
Alum, ammonia, lump, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb	.03¾– .04	.03¾– .04	.03¾– .04
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.60 – 1.70	1.30 – 1.55	1.30 – 1.55
Aqua ammonia, 26°, drums, lb	.02¼– .03	.02¼– .03	.02 – .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.15½– .16
tanks, lb	.04½–......	.04½–......	.04½– .16
Ammonium carbonate, powd. tech., casks, lb	.09 – .12	.09 – .12	.08 – .12
Sulphate, wks., cwt	1.40 –......	1.40 –......	1.40 –......
Amylacetate tech., tanks, lb	.11½–......	.11½–......	.09½–......
Antimony Oxide, bbl., lb	.15 –......	nom.	.11 – .12
Arsenic, white, powd., bbl., lb	.03 – .03½	.03 – .03½	.03 – .03½
Red, powd., kegs, lb	.15¾– .16	.15¾– .16	.15¾– .16
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.07 – .08	.07 – .08	.07 – .08
Blanc fixe, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f. o. b., wks., drums, cwt	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	48.00 –51.00	48.00 –51.00	48.00 –51.00
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	1.90 –......	1.90 –......	1.65 – 1.75
Arsenate, dr., lb	.06 – .06¾	.06 – .06¾	.06¾– .07
Carbide drums, lb	.04¾– .05	.04¾– .05	.05 – .06
Chloride, fused, dr., del., ton	21.50 –24.50	21.50 –24.50	21.50 –24.50
flake, dr., del., ton	23.00 –25.00	23.00 –25.00	23.00 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05 – .06	.05 – .06	.05 – .06
Tetrachloride drums, lb	.04¾– .05½	.04¾– .05½	.04¾– .05½
Chlorine, liquid, tanks, wks., lb	1.75 –......	1.75 –......	1.75 –......
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.67 – 1.70
Copperas, bgs., f. o. b., wks., ton	17.00 –18.00	17.00 –18.00	15.00 –16.00
Copper carbonate. bbl., lb	.10 – .16½	.10 – .16½	.10 – .16
Sulphate, bbl., cwt	4.60 – 4.85	4.60 – 4.85	4.35 – 4.60
Cream of tartar, bbl., lb	.30¾–......	.28¾–......	.22¾–......
Diethylene glycol, dr., lb	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt.	1.80 – 2.00	1.80 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb	.06½–......	.06½–......	.061–......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05¾– .06¼	.05¾– .06¼
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, ref. drums, lb	.16 – .17	.16 – .17	.12½– .14
Glaubers salt, bags, cwt	.95 – 1.00	.95 – 1.00	.95 – 1.00
Glycerine, c.p., drums, extra, lb	.12½–......	.12½–......	.12½–......
Lead:			
White, basic carbonate, dry casks, lb	.07 –......	.07 –......	.07 –......
White, basic sulphate, sck., lb	.06½–......	.06½–......	.06½–......
Red, dry, sck., lb	.07½–......	.07¾–......	.0735–......
Lead acetate, white crys., bbl., lb	.11 – .12	.11 – .12	.10 – .11
Lead arsenate, powd., bag, lb	.08½– .11	.08½– .11	.11 – .11½
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, pwd., csk., lb	.06½–......	.06¾–......	.0635–......
Lithophone, bags, lb	.036– .04	.036– .04	.04¼– .05
Magnesium carb., tech., bags, lb	.06¼– .06½	.06¼– .06½	.06 – .06¼

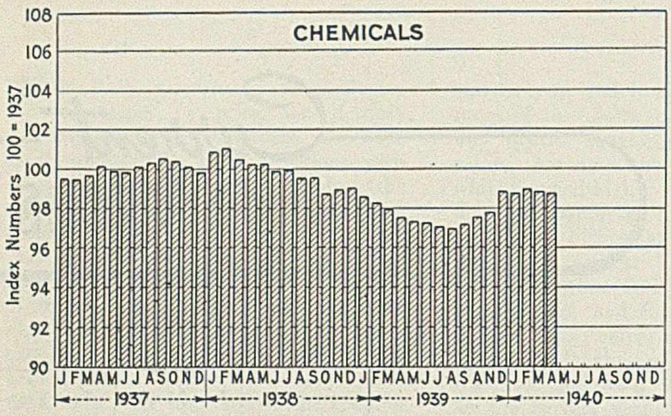
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to April 13

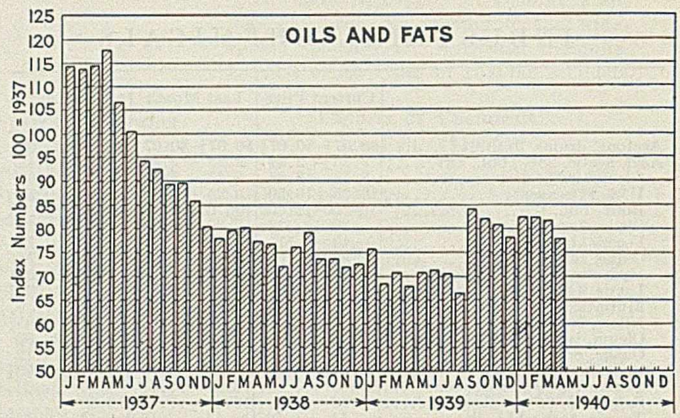
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.31 –......	.31 –......	.31 –......
97%, tanks, gal	.32 –......	.32 –......	.32 –......
Synthetic, tanks, gal	.30 –......	.33 –......	.33 –......
Nickel salt, double, bbl., lb	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb	.10¼–......	.10½–......	.10¼–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.08½– .09	.08½– .09	.08½– .09
Carbonate, 80–85%, calc. csk., lb	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.09½–......
Hydroxide(c'stic potash) dr., lb	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 80% bgs., unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb	.15 – .16	.15 – .16	.14 – .15
Sal ammoniac, white, casks, lb	.05½– .06	.05½– .06	.05 – .05½
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	23.00 –......	23.00 –......	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, works, bbl., lb	.04 – .05	.04 – .05	.04 – .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.06¾– .07	.06¾– .07	.06¾– .07
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Chlorate, kegs, lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.35 – 2.40	2.35 – 2.40	2.20 – 3.20
Nitrate, bulk, cwt	1.45 –......	1.45 –......	1.45 –......
Nitrite, casks, lb	.06½– .07	.06½– .07	.06½– .07
Phosphate, tribasic, bags, lb	2.25 –......	2.25 –......	1.85 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.09½– .10
Silicate (40° dr.) wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb	.02¾– .03½	.02¾– .03	.02¾– .03
Sulphite, crys., bbl., lb	.02¼– .02½	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	18.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb	.52 –......	.52 –......	.50 –......
Crystals, bbl., lb	.36½–......	.37 –......	.36 –......
Zinc. chloride, gran., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl, lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.07¾–......	.07¾–......	.06½–......
Zinc oxide, lead free, bag., lb	.06½–......	.06½–......	.06½–......
5% lead sulphate, bags, lb	.06½–......	.06½–......	.06½–......
Sulphate, bbl., cwt	2.75 – 3.00	2.75 – 3.00	2.75 – 3.00

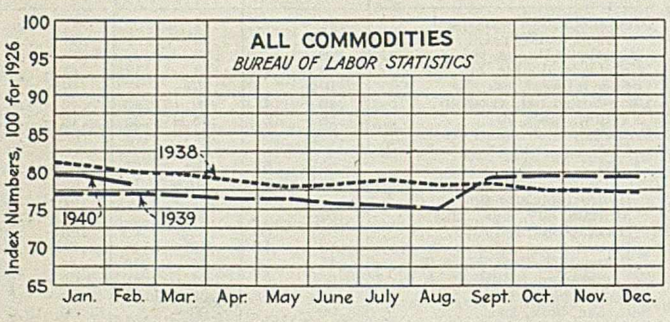
OILS AND FATS

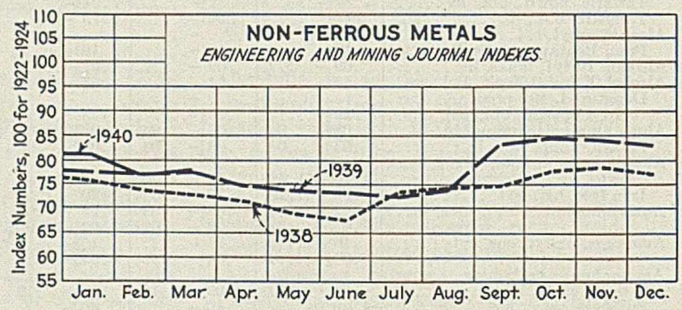
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.11½–$0.12	$0.11½–$0.12	$0.09½–$0.10
Chinawood oil, bbl., lb	.24½–......	.27 –......	.15½–......
Coconut oil, Ceylon, tank, N. Y., lb	.03¼–......	.03¼–......	.03¼–......
Corn oil crude, tanks (f. o. b. mill), lb	.06½–......	.06½–......	.05½–......
Cottonseed oil, crude (f. o. b. mill), tanks, lb	.05⅝–......	.06½–......	.05½–......
Linseed oil, raw car lots, bbl., lb	.108–......	.106–......	.089–......
Palm, casks, lb	.04½–......	.04½–......	.03½–......
Peanut oil, crude, tanks (mill), lb	.06½–......	.06½–......	.05½–......
Rapeseed oil, refined, bbl., gal	1.00 –......	1.00 –......	.80 –......
Soya bean, tank, lb	.05½–......	.05½–......	.04½–......
Sulphur (olive foots), bbl., lb	.08½–......	.08 –......	.07 –......
Cod, Newfoundland, bbl., gal	nom.	nom.	.38 –......
Menhaden, light pressed, bbl., lb	.073–......	.075–......	.066–......
Crude, tanks (f. o. b. factory), gal	.33 –......	.36 –......	.30 –......
Grease, yellow, loose, lb	.04⅝–......	.05 –......	.04½–......
Oleo stearine, lb	.05½–......	.06½–......	.06½–......
Oleo oil, No. 1	.06½–......	.07 –......	.07½–......
Red oil, distilled, d.p. bbl., lb	.08 –......	.09 –......	.07½–......
Tallow extra, loose, lb	.04½–......	.05½–......	.05½–......

Chem. & Met.'s Weighted Price Indexes









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal	.16 –......	.16 – .18	.16 – .18
Beta-napthol, tech., drums, lb	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb	.09½– .10	.09½– .10	.10 – .11
Cresylic acid, dr., wks., gal	.58 – .60	.58 – .60	.69 – .71
Diethylaniline, dr., lb	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluen, bbl., lb	.15½– .16	.15½– .16	.15 – .16
Dip oil, 15%, dr., gal	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb	.25 – .27	.32 – .36	.32 – .36
H-acid, bbl., lb	.50 – .55	.50 – .55	.50 – .55
Naphthalene, flake, bbl., lb	.06¾– .07	.06¾– .07	.05¾– .06
Nitrobenzene, dr., lb	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums lb	.13 –......	.13 –......	.14½–......
Picric acid, bbl., lb	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal	1.70 – 1.80	1.70 – 1.80	1.55 – 1.60
Resorcinal, tech., kegs, lb	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal	.27 –......	.27 –......	.26 –......
Tolidine, bbl., lb	.86 – .88	.86 – .88	.86 – .88
Toluene, drums, works, gal	.30 –......	.30 –......	.27 –......
Xylene, com, tanks, gal	.27 –......	.27 –......	.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	.09½– .13	.10 – .14	.07½– .11
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	.028– .30	.02¾– .30	.02½– .30
Prussian blue, bbl., lb	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb	.11 – .26	.11 – .26	.10 – .26
Chrome green, bbl., lb	.21½– .30	.21½– .30	.21 – .27
Carmine red, tins, lb	4.85 – 5.00	4.85 – 5.00	4.00 – 4.40
Para toner, lb	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb	2.46 – 2.50	2.85 – 2.90	1.58 – 1.60
Chrome yellow, C.P., bbl., lb	.14½– .15½	.14½– .15½	.14¼– .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb	.06 – .06½	.06 – .06½	.06 – .06½
Gum copal Congo, bags, lb	.08 – .30	.08 – .30	.06 – .30
Manila, bags, lb	.09 – .15	.09 – .14	.09 – .14
Damar, Batavia, cases, lb	.10 – .22	.10 – .20	.08 – .24
Kauri, cases, lb	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. N.Y.), ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	50.00 –......	50.00 –......	50.00 –......
Pumice stone, lump. bbl., lb	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb	.03 – .04	.03 – .04	.03 – .04
Rosin, H., bbl	6.35 –......	6.95 –......	6.20 –......
Turpentine, gal	.34½–......	.36½–......	.30½–......
Shellac, orange, fine, bags, lb	.27 –......	.28 –......	.19 –......
Bleached, bonedry, bags, lb	.25 –......	.25 –......	.18 –......
T. N. Bags, lb	.14½–......	.16½–......	.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 –......

INDUSTRIAL NOTES

THE UNITED STATES STONEWARE CO., New York, which is celebrating its 75th anniversary this month, is adding a new machine shop unit to its plant at Tallmadge, Ohio, also a new building for the manufacture of tank lining materials.

THE HAYS CORP., Michigan City, Ind., has appointed Charles M. Chapman as representative for southern Ohio and contiguous territory in Kentucky and Indiana. Mr. Chapman makes his headquarters in the Schmidt Bldg., Cincinnati.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., recently elected H. A. Feldbush vice-president. Mr. Feldbush has gone to Holyoke, Mass., where he is in charge of air and refrigerating equipment manufacture.

INTERNATIONAL SALT CO., Jersey City, has absorbed four of its principal operating subsidiaries—INTERNATIONAL SALT CO., INC., RETSOF MINING CO., DETROIT ROCK SALT CO., and AVERY SALT CO. The parent company will continue the plants and offices previously operated in the names of the subsidiaries.

BABCOCK & WILCOX TUBE CO., Beaver Falls, Pa., has advanced Joe S. Thompson to the position of sales manager of the Chicago office.

THE FAIRBANKS CO., New York, has opened a warehouse in the M.&M. Bldg., Houston, Texas.

LINK-BELT SPEEDER CORP., Chicago, has opened a sales and service office at 856 East 136th St., New York. E. H. Kliebenstein is in charge.

THE WHITLOCK COIL PIPE CO., Hartford, Conn., has changed its name to THE WHITLOCK MANUFACTURING CO. The management of the corporation, the character of its organization, and its products remain unchanged.

THE DURALOY CO., Scottdale, Pa., has appointed F. B. Cornell and C. H. Knappenberger as its agents for the State of Michigan. This new agency is known as THE DURALOY CO. OF DETROIT with offices in the Ford Bldg.

THE CONSOLIDATED PRODUCTS CO., New York, is liquidating the machinery and equipment of the plant at Evansville, Ind., formerly operated by the AMERICAN SOYA PRODUCTS CO.

THE WALL CHEMICALS CORP., Detroit, a subsidiary of LIQUID CARBONIC CORP., has taken over the plant of the ACETYLENE GAS & SUPPLY CO., Toledo.

HEWITT RUBBER CORP., Buffalo, has appointed Benjamin T. Moffat as manager of sales for the New York metropolitan area.

"In these days you're lucky to make a profit."

"We don't figure it's luck. We figure we have to be alert to every chance to "save a profit". In this case a simple change in one agitating process saved $1500 a year in power costs—and that's easier than making a 6% profit on a $25,000 job!"

The recommendation of "Nett-co" engineers to change from the existing power wasting set-up using TWO "portable" type 25 H.P. units in one tank (50 H.P.!) to ONE 20 H.P. "Nett-co" turbine unit, made this power saving possible.

The broad background and experience gained from the 5789 "Nett-co" agitator applications ranging from the simplest liquid mixing to the most complex problem, gives you the assurance that your own problems will be approached with a certainty of solution that only such experience can give.

Write fully for specific recommendations to—New England Tank & Tower Co., 87 Tileston Street, Everett, Mass.

NETT-CO
Proved Agitation

New CONSTRUCTION

	—Current Projects—		—Cumulative 1940—	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	....	$115,000	$40,000	$195,000
Middle Atlantic	$690,000	840,000	7,725,000	1,767,000
South	1,040,000	1,000,000	10,995,000	13,125,000
Middle West	50,000	940,000	6,685,000	2,110,000
West of Mississippi	1,300,000	4,995,000	9,255,000	9,391,000
Far West	1,000,000	....	1,905,000	3,780,000
Canada	1,295,000	200,000	2,745,000	200,000
Total	$5,375,000	$8,090,000	$39,350,000	$30,568,000

PROPOSED WORK

Cement Plant—Alberta Cement Co., Ltd., Cardston, Atla., Can., contemplates the construction of a plant. Estimated cost $75,000.

Chemical Plant—R. & H. Chemical Dept. of E. I. du Pont de Nemours & Co., Buffalo Ave., Niagara Falls, N. Y., plans extensive improvements to its plant and equipment. Estimated cost $400,000.

Chemical Plant—Shawinigan Chemical Co., Ltd., Shawinigan Falls, Que., Can., plans to reconstruct its plant recently damaged by fire. Estimated cost $40,000.

Explosives Plant—Canadian Industries, Ltd., Beaver Hall Hill, Montreal, Que., Can., is negotiating for a site at Parry Sound, Ont., for the construction of a plant. Estimated cost $1,000,000.

Grease Manufacturing Plant—Pan American Refining Corp., c/o D. J. Smith, Vice-Pres., 122 East 42nd St., New York, N. Y., plans to construct and equip a grease manufacturing plant to manufacture polishes, waxes and lubricants on a site adjacent to its present plant at Texas City, Tex. Estimated cost $1,000,000.

Insecticide Plant—Chemical Plant Foods, Ltd., c/o Norman S. Robertson, Temple, Bldg., Toronto, Ont., Can., plans to construct a plant for the manufacture of insecticides, nutrient solutions, etc. Estimated cost $40,000.

Oil Refinery—Canadian Oil Co., Ltd., Terminal Bldg., Toronto, Ont., Can., plans to build an addition to its oil refinery at Petrolia, Ont., also two $2,000 bbl. crude oil storage tanks and 18 mi. of 4 in. pipe line from refinery to Froomfield. Estimated cost $90,000.

Oil Refinery—Sinclair Refining Co., 630 Fifth Ave., New York, N. Y., and Corpus Christi, Tex., plans to construct and equip a modern oil refinery at Tidewater near Corpus Christi, also a large oil terminal to provide port loading and unloading facilities and steel tanks at tank farm. Cost will probably run into several hundred thousands of dollars.

Paper Mill—Alex K. Sessions, Waycross, Ga., plans to construct a paper and pulp mill. Estimated cost will exceed $40,000.

Powder Plants—E. I. du Pont de Nemours & Co., Nemours Bldg., Wilmington, Del., plans to construct powder plants at Memphis and Nashville, Tenn. Estimated cost $500,000 each.

Refractory and Acoustical Products Plant—Johns-Manville Corp., 22 East 40th St., New York, N. Y., contemplates the construction of a plant at Zelienople, Pa., for the manufacture of refractories and acoustical products.

Roofing Factory—Certain-Teed Products Corp., 105 West Adams St., Chicago, Ill., plans to construct a 2 story addition to its factory at Marseilles, Ill. Estimated cost $50,000.

Roofing Factory—Certain-Teed Products Corp., 100 East 42nd St., New York, N. Y., and York, Pa., Arnold H. Miller, Vice-Pres. in charge, plans to modernize and improve its plant on South Richmond Ave., York. Estimated cost $250,000.

Salt Refinery—Leslie Salt Co., 310 Sansome St., San Francisco, Calif., plans to construct a vacuum salt refinery and milling plant, including warehouse, at Newark, Calif., to be known as "Newark No. 2". Estimated cost $1,000,000.

Wood Preserving Plant—Northern Wood Preservers, Ltd., Port Arthur, Ont., Can., plans to construct an addition to its plant. Estimated cost $50,000.

CONTRACTS AWARDED

Calcium Chloride Plant—Brunner Mond Canada, Ltd., W. Haas, Gen. Mgr., Amherstburg, Ont., Can., will construct an addition to its plant and install special equipment. Work will be done by own forces. Estimated cost $50,000.

Celanese Plant—Canadian Celanese, Ltd., Drummondville, Que., Can., has awarded the contract for an addition to its plant to Stewart Construction Co., Ltd., 7 Dufferin St., Sherbrooke, Que. Estimated cost $60,000.

Chemical Plant—Consolidated Chemical Co., Petroleum Bldg., Houston, Tex., has awarded the contract for a 100x177 ft. chemical plant to Austin Co., Second National Bank Bldg., Houston, Tex. Estimated cost $40,000.

Chemical Plant—Dewey & Almy Chemical Co., 62 Whittemore Ave., Cambridge, Mass., has awarded the contract for a 2 story, 120x175 ft. chemical plant at 51st St. and Meade Ave., Chicago, Ill., to Robert G. Regan Construction Co., 228 North La Salle St., Chicago. Estimated cost $100,000.

Chemical Plant—Dow Chemical Co., Midland, Mich., has awarded the contract for plant buildings, laboratories, offices, etc., for proposed chemical plant on 800 acre site recently purchased at Freeport, Tex., to Austin Co., 16112 Euclid Ave., Cleveland, O., at approximately $2,000,000. Total estimate $4,500,000.

Chemical Plant—Naugatuck Chemical Co., Elm St., Naugatuck, Conn., has awarded the contract for an addition to its plant to W. J. Megin, Inc., 51 Elm St., Naugatuck, at $74,781.

Chemical Plant—U. S. Industrial Chemical, Inc., 400 Doremus Ave., Newark, N. J., has awarded the contract for interior and exterior alterations to its factory to J. W. Barney, Inc., 101 Park Ave., New York, N. Y. Estimated cost $40,000.

Chemical Processing Plant—R. T. Vanderbilt, Inc., 33 Winfield St., East Norwalk, Conn., has awarded the contract for a 2 story 40x75 ft. chemical processing plant to W. L. Oestreicher Co., Inc., 10 May Ave., Great Neck, L. I., N. Y. Estimated cost $40,000.

Chemical Products Plant—Detroit Soda Products Co., 35 Perry St., Wyandotte, Mich., has awarded the contract for a 2 story addition to its plant to be used for the manufacture of chemical products to Bennage & McKinstrie, 4612 Woodward Ave., Detroit, Mich. Estimated cost $50,000.

Dewaxing Plant—Sinclair Refining Co., Gulf Bldg., Houston, Tex., has awarded the contract for the construction of a dewaxing plant to Lummus Co., 420 Lexington Ave., New York, N. Y. Estimated cost $1,500,000.

Factory—Permatex Co., Inc., 1702-20 Avenue Y, Brooklyn, N. Y., manufacturer of auto chemicals, has awarded the contract for a 3 story addition to its factory to Caye Construction Co., Inc., 351 Fulton St., Brooklyn, N. Y. Estimated cost $100,000.

Laboratory—Ballinger & Co., Archts. & Engrs., 105 West 12th St., Philadelphia, Pa. has awarded the contract for a laboratory at Beacon, N. Y., for the Texas Co., 135 East 42nd St., New York, N. Y., to James Stewart Co., 230 Park Ave., New York, N. Y. Estimated cost $200,000.

Oil Refinery—Winkler & McQueen, Duncan, Okla., will construct a 700 bbl. per day capacity oil refinery. Work will be done by purchase and hire plan. Estimated cost $40,000.

Paper Factory—Cromwell Paper Co., 4801 South Whipple St., Chicago, Ill., has awarded the contract for an addition to its factory to Heidel & Beck, 6235 South Michigan Ave., Chicago. Estimated cost $40,000.

Pyroxylin Plant—Canadian Industries, Ltd., 1135 Beaver Hall Hill, Montreal, Que., Can., has awarded the contract for a pyroxylin unit at its fabrikoid plant at New Toronto, Ont., to Dominion Construction Co., Ltd., 217 Bay St., Toronto. Estimated cost $50,000.

Rayon Mill—Industrial Rayon Corp., H. S. Rivitz, Pres., West 98th St. and Walford Ave., Cleveland, O., has awarded the contract for 90x455 ft. addition to spinning room, 80x225 ft. addition to process room and two 80x140 ft. additions to chemical preparation room at plant at Painesville, O., to George A. Rutherford Co., 2725 Prospect Ave., Cleveland. Estimated cost $750,000.

Recycling Plant—Grapeland Oil Co., Crockett, Tex., will construct a recycling plant near Grapeland. Work will be done by owners. Estimated cost $175,000.

Recycling Plant—Hunt Oil Co., Tucker, Tex. (mail Palestine, Tex.), will construct and equip a recycling plant at Tucker. Work will be done by day labor and subcontract. Estimated cost $300,000.

Recycling Plant—Lone-Star-Trinity Gas Co., Grapeland and Crockett, Tex., has awarded the contract for a recycling plant at Grapeland to Frick-Reid Co., 108 North Trenton St., Tulsa, Okla. Estimated cost $150,000.

Reforming and Thermal Polymerization Unit—Socony-Vacuum Oil Co., 230 Park Ave., New York, N. Y., and Magnolia Petroleum Co., Beaumont, Tex., will construct a reforming and thermal polymerization unit at its refinery near Beaumont, Tex. Work will be done by force account. Estimated cost including equipment $750,000.

Rubber Factory—Dunlop Tire & Rubber Goods Co., Ltd., 870 Queen St. Ea., Toronto, Ont., Can., has awarded the contract for remodeling and building an addition to its factory to Foundation Co. of Canada, Ltd., 1158 Bay St., Toronto, Ont. Estimated cost $40,000.

Soap Factory—H. B. Meyer & Son, 1413 Camp St., Dallas, Tex., has awarded the contract for a factory for the manufacture of soaps, polishes and disinfectants, to Percy Carpenter, 1906 Marydale St., Dallas, Tex. Estimated cost $40,000.

Synthetic Rubber Plant—Standard Oil Development Co., 26 Bway., New York, N. Y., has made an agreement with the Standard Oil Co. of Louisiana, North Baton Rouge, La., for the construction of a Buna synthetic rubber plant at Baton Rouge, La. Work will be done by own forces. Both companies are subsidiaries of Standard Oil Co. of New Jersey, 30 Rockefeller Plaza, New York, N. Y. Estimated cost $1,000,000.

Trinitrotoluene Plant—Atlas Products Co., Wilmington, Del., will construct seven additional buildings at its plant at Duenweg, Md. Work will be done by sub-contract basis and local labor. Estimated cost $500,000.