1917

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by

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A

THESIS

submitted to the faculty of the

SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI

in partial fulfillment of the work required for the

DEGREE OF

Chemical Engineer,

Rolla, Mo.

1917

Approved by O. H. Gottschalk

Professor of Chemistry.

We propose to discuss in this thesis the organization of The N. K. Fairbank Company, particularly with reference to the duties of the Chemical Division, Operating Department in this organization. From a broad viewpoint, we believe that the particular organization by which The N. K. Fairbank Company secures application of its chemical ability to manufacturing operations as well as to special problems, is characteristic of a widespread movement taking place for recognition of the chemical engineer in industry. This is particularly true in those industries where manufacturing operations are based primarily upon practical applications of chemical principles.

The N. K. Fairbank Company, allied with the American Cotton Oil Company and the Union Seed and Fertilizer Company, may be regarded outside of fertilizer production activities as divided into the Soap and Edible divisions. In the former division all effort is directed to the production of soaps, soap powders, distilled fatty acid, hydrogenated oils, and glycerine; while in the latter edible fats, cooking compounds, and oils are manufactured. Casual consideration of the nature of this business leads to the conclusion that the operations involved are largely chemical, and as such, require careful control by those skilled in this branch of science.

The financial and general executive control of

The N. K. Fairbank Company is quite similar to that in other large organizations. Stock holders through the Executive Committee are in close touch with the President and Comptroller. It is, perhaps, in the next detail of organization that The N. K. Fairbank Company is unique. Directly in touch with the President there is the Manager of the Operating Department. This department may, perhaps, best be described as a clearing house through which all business correspondence, factory operations, policy changes, raw material purchases, sales campaigns, etc. are approved and developed. Much of this work is executive in nature. However, it will be appreciated that other features such as the control of factory operations, for instance, requires practical and experienced factory management. This is secured by dividing the Operating Department, under its manager, into two divisions. These are known respectively as the Power and Equipment Division and the Chemical Division. Each of these divisions in turn has a manager responsible for conditions in his particular field.

The Manager of the Power and Equipment Division is responsible for the supply of power and the upkeep and installation of machinery and equipment. The Manager of the Chemical Division is responsible for all formulas

used in the production of the various products, and also, to a certain extent for production operations as carried out in the various factories. This department is also responsible for process changes, quality of raw materials and of finished products.

Inasmuch as we desire to concern ourselves primarily with the duties of the Chemical Division, Operating Department, we will eliminate discussion of duties of the Power and Equipment Division of the Operating Department. In doing this, it will, of course, be appreciated that many problems which arise require the joint attention of the Engineering and Chemical Divisions. This is due to the fact that the application of chemical principles in industry, in nearly all cases requires, for successful operation, the development of special machinery or apparatus. It is, therefore, to the interest of the Company that the closest co-operation exist between Engineering and Chemical Departments to the end that best results may be secured.

In order to more clearly understand the duties of the Chemical Division, Operating Department, it is, perhaps, well to bear in mind that the Fairbank Company operates five factories at widely separated points in the United States and Canada. These factories are lo-

cated at Chicago, St. Louis, New Orleans, New York and Montreal. The Chicago Factory produces both edible and soap products as well as distilled fatty acid, glycerine and hydrogenated oils. On the other hand, the St. Louis Factory is confined to the production of soap products and distilled fatty acid. The Gretna Factory is concerned with the production of only edible products. At the New York Fairbank Plant large quantities of soap powders are produced as are also edible products and oils, similar in nature to those manufactured at the Chicago and Gretna Plants. The N. K. Fairbank Company, Limited, at Montreal, Canada operates with the same division of products noted for the New York Factory, namely, soap powder and edible compounds and oils.

Each of the factories mentioned has its own local manager with his assistants; also each factory has its own laboratory where the necessary chemical work and control is carried on. So far as individual plants are concerned, they are entirely independent of each other. They are, however, connected indirectly through the Operating Department of the organization which is located at Chicago. All correspondence passing between the various factories clears through the Operating Department. Direct correspondence is not permitted. Also all

authorizations for processes or changes in formulas or methods of operation are issued directly from the Operating Department head or the Power and Equipment Division or Chemical Division of the Operating Department. It will thus be seen that, graphically speaking, the Operating Department may be regarded as the hub of the wheel of which the various factories constitute the rim. All correspondence, authorizations, or information desired, centers in the hub of this wheel or the Operating Department, and this department is the central authority in all matters relating to policy or operation.

As pointed out above, the duties of the Chemical Division, Operating Department, cover a comparatively large field. This is due to the fact that the nature of business in which the Fairbank Company is engaged is essentially chemical in nature. The duties of this department may be roughly classified under three headings.

(1) Examination and control of quality of raw materials received.

(2) Chemical control and standardization of factory operation.

(3) Maintenance of quality standard in finished products.

So far as the examination of raw materials is concerned, this work is largely routine and is carried on

by local laboratories operated in connection with each plant. It would, perhaps, not prove of general interest to discuss in detail the nature of the examination work carried out on the various raw materials received. It is needless to say this examination thoroughly covers all points of commercial importance and is done for the purpose of safeguarding quality and insistence upon fulfillment of contract obligations on the part of the seller. The nature of materials received are varied and, under these circumstances, the analytical work required is of wide variety. As would be expected, however, the chemical work involved is largely organic, although necessity for inorganic work is by no means infrequent.

All of the Fairbank Laboratories are thoroughly equipped. Also the personnel employed is the best that can be secured, and it may be said to the credit of the Fairbank Company that the general policy pursued in connection with chemists has been decidedly liberal and progressive. This is in keeping with proper recognition of services rendered.

In order to illustrate the duties mentioned under the second heading above, we may take the system in force at the Chicago Factory as representative in general.

The manufacture of soaps, soap products, as

well as the distillation of fatty acid and other technical processes, such as the recovery of dynamite glycerine and the hydrogenation of fats and oils, requires careful chemical control in order that uniform results may be secured as well as assurance being guaranteed that the operations are at all times carried out in the most economical manner. The operation of soap boiling, for instance, while actually carried out by men possessing long practical experience, nevertheless needs the technical chemists' attention in order to secure data necessary both for accounting records and maintenance of quality standards.

Each glycerine lye taken from a kettle of soap, the amount of soap being manufactured in one kettle some times being as high as 300,000 pounds, is carefully measured in calibrated tanks and the glycerine content calculated after necessary data is obtained by chemical analysis. This lye is then followed through by an established system, and the Glycerine Department is automatically held responsible for the proper yield of dynamite glycerine therefrom. Also the finished or settled operation has been carried out in prescribed manner, which assures a normal moisture content to the finished soap as well as the authorized glycerine content permitted in the finished product.

The control of kettle operations in the manner briefly cited appears quite simple, but where the system in operation requires the handling of enormous quantities of lyes as well as soaps, the matter at times becomes quite complicated and involved due to the intricate pumping and storage systems necessary.

The operation of the Dynamite Glycerine Plant, Distillation Plant, and the Hydrogenation Department are entirely technical. The operations of these plants are also quite complicated and require careful technical control.

All glycerine recovered is received in the Glycerine Department either in the form of saponification lyes or what is known as sweetwater, which is glycerine liquor obtained in the Twitchell operation in the Distillation Plant. Necessarily the quality of these glycerine liquors varies greatly, dependent upon the character of fats or oils from which they were derived.

While the character of the glycerine liquors with which the Glycerine Department is supplied varies greatly in nature, the quality of the finished product or dynamite glycerine must be maintained absolutely uniform and conform to careful drawn specifications. The chemical treatment, therefore, which these lyes must receive requires careful attention. In fact, the work

is so systematized that the lyes enter the Glycerine Department in prescribed amounts, which at the Chicago Factory is set at 40,000 pounds per pumping. Each pumping is upon receipt in treating tanks carefully examined and treated on miniature scale before the operation is carried out in the treating tanks.

The chemicals and acids used do not vary to a large extent at the Chicago Plant. Sulphuric or hydrochloric acid is used to neutralize the sodium carbonate and caustic alkali in the received lyes, while aluminum sulphate is used as the coagulating agent to precipitate the albuminous and entrained soap from the lyes. After receiving the chemical treatment described, the lyes are pumped through large filter presses to storage tanks from which they are drawn into triple or double effect evaporators for the concentration operation. These evaporators are provided with suitable steam chests in which salts in the lyes are automatically concentrated and dropped after certain concentrations of liquor are reached. After eliminating the salts from glycerine lyes, the liquor is passed to other evaporators where further concentration is carried out with the production of so-called crude glycerine. The glycerine content of this crude glycerine is approximately 83-1/3% C. P. The crude glycerine in turn is sucked under vacuum into stills,

where under the highest vacuum attainable and through the action of expanded and preheated steam the glycerine is distilled.

This operation produces three products, namely, low gravity dynamite glycerine, sweetwater glycerine, and glycerine foots. The two former products are obtained in condensers, the low gravity glycerine being retained in air-cooled condensers while the sweetwater, so-called, is the final condensation product obtained in a water-cooled condenser at the end of the still condensing system. The glycerine foots is the product remaining behind in the still. These glycerine foots are removed systematically from the still and given special treatment for further recovery of glycerine in a separate department. The low gravity glycerine and sweetwater glycerine are now passed to concentrating apparatus where the remaining moisture is evaporated under high temperature and vacuum. After concentrating to a specific gravity of 1.2620 the glycerine is considered finished. This is known commercially as dynamite glycerine and is sold in steel drums to powder or explosive manufacturers or further refined for the production of C. P. glycerine to be used in medicinal work.

The distillation of fatty acids consists fundamentally of two operations, namely, the split or saponi-

fication of the neutral fat into glycerine and fatty acid and the distillation of fatty acid obtained from the saponification process. The splitting or saponification of fats is generally carried out by either the autoclave process or by the Twitchell process. In the former case the fat is split in autoclaves under high pressure and temperature and in the presence of proper catalytic agent. In the Twitchell process on the other hand, the operation consists of boiling the fat while on a slight acid water with so-called Twitchell re-agent or saponifier. In either case the glycerine is recovered from the fat in resultant liquor or sweetwater attendant the operation. The fatty acid after being separated from the sweetwater liquor is pumped to storage tanks, from which in due course it is sucked into large stills, where under the action of superheated steam and under high vacuum it is distilled and condensed in copper water-cooled condensing tubes, after which it is available for soap making purposes or may be pressed for recovery of Red Oil and stearine.

Of course, it will be understood that the distillation process is used only upon very low grade fats. These fats contain a large amount of albuminous and coloring matter which render them unavailable for use in soap products until they have been freed from the objectionable coloring matter. This is done in the

stills where the fatty acids are volatilized and carried over in the presence of superheated steam as the carrying agent. Coloring matter and other impurities on the other hand remain behind in the still in the form of pitch. This pitch in the final course of operation is drawn from the stills and barreled. Both the pitch and the distilled fatty acids have a comparatively high market value as compared with the original low grade fat from which they were produced.

The hydrogenation process consists of conversion of the linoleic and oleic acids in the fat to stearine by the addition of requisite amount of hydrogen to each molecule of fat. This operation, on a commercial scale, is carried out by catalisis. While there are a number of catalysts which may be used, in most commercial plants metallic nickel is used. The hydrogen necessary in processing the oil may be produced in a number of ways. Perhaps two of the most successful as well as economical are the electrolytic method and the so-called iron sponge method. These processes of hydrogen generation are commercial operations and the necessary equipment for production may be purchased from numerous sources on the open market.

It would, perhaps, be interesting to call attention to the fact that hydrogenation of oils and

fats has assumed a very important field in connection with both the soap industry and the packing house industries in general. It enables, from the viewpoint of the soap manufacturer, a much wider choice in the selection of raw materials, and hence, renders available fats and oils which under other conditions would not be economical to use. The hydrogenation process has assumed a very important roll in the oil and fat market and this importance is justified through economies resulting in its commercial application.

As pointed out above, the Chemical Division is responsible for the quality of finished products. It naturally follows if the proper system is inaugurated and fulfilled for the grading and sorting of raw materials and for the control of manufacturing operation that the finished products will prove satisfactory and up to standard. This feature, therefore, is largely dependent upon proper execution of the first two duties mentioned. Nevertheless, all finished products are automatically sampled. These samples are sent to the laboratory for examination, and should any defect in quality be noted, the matter is immediately investigated and necessary correction applied.

The Chemical Division, Operating Department held responsible for the quality of finished products,

automatically assumes considerable responsibility for the purchase of raw materials. In other words, since this department develops and standardizes all formulas, it is necessary that it should keep in close touch with the Purchasing Department. The Purchasing Department is thereby informed as to materials considered necessary in manufacturing operation. Standard formulas for the various grades of products, edible as well as soap, are worked out far in advance. Information is then obtained as to the approximate sales expected for the various grades of materials during the ensuing year. With this data in mind, it is possible for the Purchasing Department to go into the market and cover for the necessary supply of raw materials in the form of oils and fats.

It may be interesting to know also that should conditions arise at any factory under which the local manager should find it impossible to conform his production to the authorized standard formula, the matter is automatically referred to the Chemical Division, Operating Department. This department takes up the trouble direct with the manager in question. The local manager under no condition changes a manufacturing formula or process without proper authorization from the Operating Department. This assures a uniform quality

of product as well as fixes responsibility for any variation in quality which may be the basis for complaint from the consuming public.

We have thus described briefly and in general manner the operations of The N. K. Fairbank Company as well as the responsibility of the Chemical Division, Operating Department of this corporation. In the brief description of technical processes involved we have eliminated discussion of problems connected with the production of edible fats and compounds. These operations and processes, however, bear the same relation in the Edible Department of the Fairbank business to the Chemical Division as processes involved in the production of soaps and toilet articles. For the purpose, therefore, of showing the relation of the chemical engineer to operations in general, the description offered in connection with the Soap Department holds good for all edible production.

It is felt that recognition of the importance of chemical engineering ability in the Fairbank Company is characteristic of a general movement taking place in all large corporations. As stated at the beginning of this thesis, this is particularly true of those industries dependent, in production process, upon application of chemical principles. It is undoubtedly true

that this movement and recognition of the chemical engineer would not have developed without being justified by results secured. As the chemical engineer makes good in the new responsibilities placed upon him, the importance of his work will receive increased recognition.

It is, of course, undoubtedly true that the movement for recognition of the chemist in industrial organization has received great impetus through the general economical situation existing through the influence of the present world wide war. However, while this catastrophe has hastened the recognition of the chemical engineer, the movement is based upon the solid foundation of need, and it is our opinion that it will not only be permanent but that recognition of applied chemistry in industries, supervised by the chemical engineer, will receive even greater recognition during the period of restoration and adjustment of industries following settlement of peace.