The Handling and Storage of Raw Materials For Soaps and Detergents

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IN ORDER TO PROVIDE a bit of background material the following describes the Colgate-Palmolive Company plant at Jeffersonville, Ind. The Jeffersonville plant is the second largest of the Colgate plants. All major items of soaps, synthetic detergents, and toilet articles are produced and shipped from our plant. We employ approximately 1,100 hourly paid employees and about 175 supervisory and staff people. As is generally known, the trend away from soap to synthetics has been tremendous. In fact, the first quarter of 1956 report of the Association of American Soap and Glycerine Producers shows that synthetic detergents now represent 69% of the total market. The receipts of raw materials and the type of equipment used for handling these raw materials reflect this swing from soap to synthetic detergents at our plant as well as most other plants in the industry. There is much greater volume of alklyates and phosphates at the expense of fats and oils receipts. The field of synthetics, of course, is in it infancy, is dynamic and ever changing as research and development organizations come up with new and improved products. It is probable that many of the raw materials now being used in synthetics will be out-dated within the foreseeable future as improvements to existing products are made and as new products are developed.

Synthetic Detergents

Alkyl Benzene. Alkyl benzene, a petroleum derivative, which is the material sulphonated to make a high active ingredient base for synthetic detergents is received in tank cars and tank trucks. Each tank car contains about 60,000 pounds of this material, and several cars are unloaded daily. The tank cars are spotted on car spots immediately adjacent to two 2,300,000-pound capacity diked carbon steel storage tanks.

Unloading hoses are attached to the bottom valves of the tank cars, and by means of unloading pumps the alkyl benzene is pumped from the cars into either of the two large storage tanks. Both of these large storage tanks are manifolded, and a gravity flow feed line supplies alkyl benzene from the tanks to Stage I of the sulfonation process. This feed line is sized for the requirements of our existing plant plus an additional plant of equal capacity. An alkyl benzene feed pump (centrifugal) is provided and tied into the gravity feed line to supply the plant when the tank level is below grade. A heat exchanger is provided within the building housing the sulfonation plant to maintain a constant alkyl benzene feed temperature (about 95°F.) so that the volumetric proportioning pump which determines the rate of flow of alkyl benzene into Stage I of our process delivers a constant weight flow. A temperature controller throttles the flow of low pressure steam to the alkyl benzene heater.

During normal operation flow is from the storage tank by gravity through the alkyl benzene heater to the suction of the proportioning pump. The proportioned alkyl benzene flows through the surge tank, back pressure control valve, flow totalizer, and flow indicator to the injection point in Stage I. The displacement of the proportioning pump is periodically adjusted to provide the desired flow, as indicated by the alkyl benzene flow indicator. The flow indicator is the primary proportioning element and checks the accuracy of the proportioning pump. The flow totalizer is provided to facilitate start-up, for inventory purposes, and as a secondary check on the proportioning accuracy. The surge tank is air-loaded and smooths out the pulsation from the positive displacement proportioning pump.

Most of our alkyl benzene is received by barge on the Ohio River and is unloaded to a tank of one of our suppliers. From that tank it is transported to our in-plant storage facilities by tank truck. Some alkyl benzene is also received in railroad tank cars.

Oleum. Oleum, the acid used in the sulfonation process, is also received in railroad tank cars. These cars are spotted on car spots adjacent to our 725,000-lb. capacity carbon steel oleum storage tank. This tank is located adjacent to our largest sulfonation plant. One car of oleum is unloaded at a time by means of a rigid line being connected to the outlet on the top hatch of the car. This hookup is accomplished by experienced pipefitters because of the nature of the material being handled. Oleum is then air-blown from the car through the unloading connection to the storage tank.

The oleum feed system is very similar to the previously described alkyl benzene system. Oleum is supplied by gravity flow from the yard storage tank to the suction of the proportioning pump of Stage I of our base-making process. A heat exchanger maintains the oleum at a temperature of 80°F. to insure proportioning accuracy. A saturated white oil is used as the heating medium. This oil must have a low viscosity, and since the oil is heated by 5 p.s.i. steam, its flash point must be higher than the steam temperature (228°F.). Several grades of white oil meet these requirements. Standard Oil Company's Bayol 50 has a flash point at 290°F. and low viscosity. A low flash point prevents the use of kerosene, which in all other respects would be acceptable as a heating medium.

A proportioning pump, surge tank back pressure control valve, flow totalizer, and flow indicator are provided as in the alkyl benzene system. The alkyl benzene and oleum proportioning pumps are driven by the same variable speed motor, and each pump has a variable stroke. The oleum pump stroke can be adjusted while the pump is running; however the alkane pump must be stopped for stroke adjustment. Adjustments must be made periodically to maintain proportioning accuracy. Oleum may also be pumped from the aforementioned receiving storage tank up to two other intermediate storage tanks which supply our other base-making plants.

Very rigid safety precautions must be taken in handling oleum. All personnel involved in hooking up cars for unloading, etc., must wear safety goggles, gloves, and other items of protective clothing.

Oleum used to be received by barge on the Ohio River and unloaded in a tank at the Jeffersonville Boat and Machine Works approximately two miles from our plant. It was then supplied to our in-plant storage facilities by a shuttle tank car service. Because of a lower rail rate we now receive all oleum in over the road tank cars.

Caustic. A caustic tank is also located immediately adjacent to our sulfonation plant. This is a 13,500-gal. storage tank to supply caustic requirements for neutralization of sulfonic acid. Caustic is pumped to this tank daily from a larger in-plant storage tank. A centrifugal pump pumps caustic from this storage tank through a flow totalizer, through a pH control valve and into the injection point at the flash cooler. The sulfonated alkyl benzene is very stable to hydrolysis and is not readily decomposed by strong alkalies; therefore no dilution system is provided, and the total solids of the base in the flash cooler are held constant by manually setting the rate of water feed to the flash cooler.

City Water. Process water is required to supply dilution water for our second stage of sulfonation and solids control in the third stage. A city water tank is elevated above our flash cooler in Stage III to provide sufficient head for gravity feed. Thus a constant head is provided to eliminate pressure surges in the line. This tank also isolates the city water main from the process as required by law.

The water rate to the second stage is governed by a flow controller. This flow from this unit is adjusted manually to give proper ratio to alkyl benzene as observed on the alkyl benzene rotameter.

The water rate to Stage III is governed by a Kates regulator. This instrument is a self-contained controller which corrects for pressure fluctuation to maintain a constant pressure differential between its upper and lower chambers and thus maintain the flow at its original set rate. It is also set according to the alkyl benzene rate to give the desired total concentration at the flash cooler.

High Active Ingredient Base. The end-product of our sulfonation plant, the neutralized high active ingredient base, is withdrawn from the outer draft tube of the flash cooler and pumped by means of a steam pump to either of two premium metal storage tanks of 60,000-lb. capacity. These tanks are used alternately, one tank being filled while the other is emptied. A third tank of approximately 30,000-lb. capacity is used to store off-quality material, which then may be pulled back through our flash cooler and reworked or blended into the base storage tanks in such a ratio that the final product quality is not affected.

The base from either of the storage tanks is pumped to further processing in the crutching system of our spray drying towers by means of one of two base transfer steam pumps.

Pentasodium Tripolyphosphate. Our systems for the handling of TPP which is used in all of our spray dried synthetic detergents are essentially suction systems, in which material to be handled is introduced into a conveying line at the pick-up point and air flow transports this material to the desired location. There an automatically operated receiver discharges the material at a predetermined rate into storage bins or silos. Each suction type of conveyor is actuated by a vacuum pump, which maintains a partial vacuum throughout the system. It is best suited to delivery of material from several pick-up points to one destination and, being under suction, is relatively dust-free.

On our newest spray drying tower we require 284,000 lb. of TPP per day. The phosphate is received in hopper cars which contain 110,000 lb. of phosphate each. We therefore must unload an average of 2½ cars of phosphate per day. Phosphate is stored in a cone bottom carbon steel storage silo of 495,000-lb. capacity located in the yard outside the building and in a 150,000-lb. in-process storage silo inside the building above the crutching center.

The hopper cars containing TPP are spotted on three car-unloading spots immediately adjacent to the building which houses our spray drying equipment as well as adjacent to the aforementioned yard storage silo. Flexible unloading hose connections are provided at these three car spots for unloading TPP to the storage silo in the yard. Unloading hose connections are provided at two of these three spots for unloading TPP to the 150,000-lb. capacity in-process bin which is located inside the synthetic detergents building. Four single-pan type of intake hoppers with 6-in. built-in pickup nozzles are provided for direct attachment to car gates. These units have quick acting clamps for attachment to car outlets. Two of these are for mounting on the car gates of each car, one connected by hose and one ready to receive the hose when switch to full section of car is required. The rate of flow of material into the unloading hose is determined by observation of a vacuum gauge located near the hose connection.

Two pneumatic car vibrators (Dracco Corporation 6-in. Air Vibrators) and air hose connections are provided. The vibrators are attached to the sides of the car to keep the material flowing with a minimum of manual rodding.

Phosphate is reclaimed automatically at the rate of 12½ tons per hour from the storage silo in the yard near the track to the in-process storage silo on the fourth floor of the building by means of a Kilroy ⅓ and Full Pitch screw feeder discharging into a non-flooding type pickup hopper (No. 10 gauge) with built-in 7-in. adjustable nozzle. The screw feeder is installed through the bottom cone of the silo, and its principal purpose is to create a "live bottom" effect so that material will not arch and hang up in the bottom cone of the silo. In addition, a system of Fuller aerating blocks is provided in the bottom cone. These blocks are supplied with air from an independent blower. A gate is provided at the bottom of the silo cone for emergency emptying of silo contents. Reclaiming conveyor lines are run from the pick-up hopper to a Fuller receiver on the roof of the building. The material is separated from the conveying air in the cone of the receiver and discharges into a motor-operated diverter gate which directs the material to the proper bin. Conveying air entering the receiver passes upward through 60 cotton sateen collector bags to the Roots Connersville vacuum pump, from which it is discharged to the atmosphere. The vacuum pump has a capacity of 1800 CMF @ 10-in. Hg. Vac.

Conveying air is drawn through conveyor lines and receiver bags by the vacuum pump connected to the receiver and is discharged to the atmosphere through a silencer, a Burgess type of exhaust muffler. A protective filter in the suction line to our vacuum pump prevents flow of material through the pump in the event of bag breakage in the receiver. A differential pressure switch actuated by pressure drop across the protective filter will stop the vacuum pump and thus direct attention to the bag breakage.

Fuller Bin Level indicators are installed in process bins on the fourth floor of the building. These indicate high, low, and intermediate levels. These level indicators guide operators in determining when material can be delivered into the bin. A high level indicator is also installed on the phosphate storage silo in the yard inasmuch as this silo receives material from cars and may become full during unloading operations. Two control panels are provided for this installation, one near the car unloading station in the yard and one in the vicinity of the crutching station on the third floor of the building.

From the in-process storage bin TPP is conveyed to the crutchers as required by means of Fuller airslide conveyors. Formula amounts of the material are conveyed and automatically weighed into the crutchers by the operator pushing a button which activates the flow of material to the crutchers by starting the airslide blower and opening the cutoff gates. Guillotine gates are employed as cutoff gates in the air-slide conveyors. These quick-closing gates prevent overweighing of phosphate to the crutchers.

Sodium Sulphate (Na_2SO_4). A similar system of bulk handling and storage is employed for sodium sulphate. Again we receive sulphate in hopper cars with the cars being spotted on the track in the yard immediately adjacent to a large carbon steel storage silo which holds 550,000 lb. The unloading operations are exactly the same as for phosphate, the utilizing of unloading intake hoppers which are attached to the cars, unloading hose, pneumatic vibrators, etc. Conveying air is supplied from a vacuum pump and sulphate is also unloaded at a rate of 12½ tons per hour.

Again we have an in-process storage bin holding 150,000 lb., which is located on the fourth floor of the building. Sulphate is reclaimed from the yard storage silo to the fourth floor bin by means of screw feed to a pickup hopper and by conveying air supplied by a vacuum pump to a receiver on the roof of the building, through a motor operated diverter to the in-process bin. From the bin it is fed to the crutchers in formula amounts by air-slide conveyors and automatically weighed to the crutchers.

Sodium sulphate usage is small as compared with phosphate; therefore reclaiming from the yard silo is done for only a short time each day. Incidentally this yard silo for sulphate also represents the sulphate storage facilities for the towers spraying other spray-dried detergents. A separate feeding system from this silo to the other towers is employed. This consists of air-slide conveyors in the flat bottom of the silo, which convey sulfate to a feed hopper from which it is carried by conveying air supplied by a vacuum pump to storage hoppers above the crutchers.

In the event that the need arises, either TPP or sulfate may be unloaded directly from rail cars to the in-process storage bins on the fourth floor of the building rather than unloading to the yard silos and reclaiming from these silos to the bins.

Minor Dry Materials. The small quantity dry materials used in our heavy duty detergents are received by truck in multi-wall paper bags. These materials are stored in pallet load quantities in a storage building adjacent to the synthetic detergents-making building and transported in pallet load quantities by fork lift tractor as needed to the floor above the crutching floor of the building. These materials are preweighed and premixed with the discharge of the premixing operation being located immediately adjacent to the crutching station. The premix is weighed out in formula amounts to small drums, which are fed manually to the main crutching station as required.

Silicate. Silicate, another of the materials used in the synthetic detergents formula, is pumped to us directly from a small plant of the Philadelphia Quartz Company located immediately adjacent to our plant. A private pipe line for this material is maintained between the two points. Silicate is stored in one of four steel silicate tanks of total capacity of 300,000 lb. in a building immediately adjacent to the synthetic detergents building. Silicate is pumped from this main storage tank to a head tank on the floor above the crutching floor. From the head tank formula amounts of silicate are weighed into the crutchers automatically by an operator, who pushes a crutcher addition button that activates the flow of material. An automatic valve stops the flow of silicate when the scale beam balances, indicating that the correct formula amount has been added.

Iphol. Iphol, an odor inhibitor used in the synthetic detergents formula, is received in drums. These drums are transported by fork lift tractor to a mixing station on the floor above the crutching station. By means of a small portable pump iphol is pumped from the drums into a mixing vessel, where it is thoroughly mixed with a small quantity of mineral oil. By means of a semi-automatic weighing device which is fed by gravity from the mixing vessel, the iphol-mineral oil mix is weighed in formula amounts to the crutchers.

Perfume. Sulphonate detergent perfume, which is used in our synthetic detergents, is formulated for all Colgate plants at our Jersey City location and shipped to the other plants in stainless steel drums. When received, these drums are for the most part stored on the fourth floor of our synthetic detergents building adjacent to the perfume feed station. The drums are attached to a line to a perfume metering tank, from which the perfume is pumped to perfuming spray nozzles inside a rotary drum where the perfume is sprayed on the already spray-dried product as it passes through the drum. The amount of perfume sprayed is controlled by a Wallace and Tiernan weigh belt, which weighs the amount of product being run and automatically signals to meter out the proper amount of perfume to the perfume spray nozzles.

Tergitol (Igepal). Another raw material used in increasing quantities is a base material called tergitol, particularly with the advent of controlled sudsing detergents. This material is received in tank car lots and is unloaded by means of an unloading hose connected to the bottom valve of the tank car. The material is then pumped from the car to a premium metal storage tank adjacent to the car unloading spot on the track. From the tank this material is pumped as required to an intermediate crutcher, where it is mixed with a suds depressant in formula quantities. This mixture then flows by gravity to an intermediate storage tank where it is stored until required in the main crutcher formula. Then it is pumped and automatically weighed to the main crutchers in formula amounts.

Cleanser

Silex. Silex, one of the major raw materials used in our cleansers, is received in railroad hopper cars, each containing approximately 140,000 lb. of material. In order to meet the requirements of two shift operations in our Cleanser Department it is necessary to unload approximately three hopper cars per day. All unloading is performed by a single unloader on the day shift.

The three cars are spotted on the railroad track immediately adjacent to our Cleanser Manufacturing Building with the northernmost hopper of the northernmost car being spotted over an unloading pit between the rails of the track. A flexible canvas connection is attached to the bottom of the hopper of the rail car, the gate at the bottom of the hopper is opened, a pneumatic Dracco type of car vibrator with attached air hose is hooked up to the side of the car and started in order to keep the material flowing from the car to the unloading pit with a minimum of rodding from the top of the car hopper by the operator.

The silex flows from the hopper of the rail car by gravity into the unloading pit between the track rails. From the unloading pit the silex is conveyed by means of a short length of screw conveyor to the mixing chamber of a Fuller Kinyon pump, which is located in a pit approximately seven feet below ground level and immediately adjacent to the Cleanser Building. The material enters the mixing chamber, where it is aerated by means of air jets, and from that point it is pumped by the Fuller Kinyon pump through the transport line, a 6-in. carbon steel line which carries the material to one of two carbon steel storage silos on the roof of the three-story building. A rotary compressor which provides air pressure must be started prior to starting the motor of the Fuller Kinyon pump. The silos on the roof of the Cleanser Building hold 250,000 lb. and 560,000 lb. of material, respectively; therefore at the present level of operation on a two-shift basis we have approximately a two-day storage capacity.

As soon as one hopper on a car is emptied, the flexible canvas connection is disconnected, the car is moved down the track until the second hopper is over the unloading pit, and the car is again hooked up for unloading as previously described. After all hoppers on the first car are unloaded, that car is moved down the track and the first hopper of the second car is spotted over the unloading pit and the same unloading procedure is followed.

The silos on the roof of the building are both equipped with Fuller High Level indicators which are interlocked to shut off the short length screw conveyor from the unloading pit to the Fuller Kinyon pump when high level is reached and also to sound an alarm that will make the operator aware that his silo has reached high level. Capacity of this system is designed to permit an unloading rate of 22 to 25 tons of silex per hour to be unloaded from hopper cars to the silos.

To reclaim silex from the two storage silos on the roof to the cleanser-making mixtures on the third floor of the building a system of air-slide conveyors is employed. Both silos are equipped with air-slide conveyors in their bottoms, which convey material from the silo to another set of air-slide conveyors on the third floor ceiling, which in turn carry material to a pair of making-mixers.

To insure dry air for the operation of the air-slide conveyors a Pittsburgh Electrodrier is utilized in the system to dry the air. This is an activated alumina system which removes moisture from the air by a principle of absorption. A Roots Connersville blower is employed to supply air to all air-slide conveyors in this system.

If the equipment has been shut down for any prolonged period of time such as overnight, it is necessary to operate the air-slide blower manually for several minutes to aerate the material in the storage silos. After aeration the blower is put on automatic, and the material is ready for conveying. As a precaution that dry air will be supplied at all times, the blower cannot operate until the Electrodrier is turned on.

When material is ready for conveying, the Mixer Operator sets his scale beam for the formula amount of silex and pushes the silex-charging button on his panel board. This automatically starts the air-slide blower, opens the air operated cutoff gate in the air-slide, conveying silex to the mixer, opens a solenoid valve in the perfume spray line, starts a timer which controls the perfume pump and starts the perfume pump. The silex is then charged to the weigh mixer through the air-slide conveyor, and the perfume is sprayed into the silex as it enters the mixer. After the correct amount of perfume has been added, the perfume pump stops automatically. When the formula amount of silex has been added to balance the silex scale beam, the air-slide blower stops, the cutoff gate closes, and the solenoid air valve closes, thus stopping all flow of material.

Detergent for Cleanser. The detergent for cleanser is, of course, produced in our Synthetic Detergents Division and is conveyed by vibrating conveyors to a station where the material falls by gravity into stainless steel Tote Bins. Each Tote bin contains approximately 1,000 lb. of detergent. These bins are then transported by fork lift tractor to the mixing station of the Cleanser Department. A Tote bin is placed on an air-operated tilt device with the discharge door toward the tilt hopper. The tilt device is raised by opening the proper air control valve which controls the air-hoisting cylinder. The Mixer Operator then pushes his detergent feeder button on his panel board. This starts a screw feeder on the Tote tilting device, which feeds detergent from the Tote bin to the weigh mixer. When the formula amount of detergent has been added, the screw feeder automatically stops.

Sodium Perborate. Sodium perborate, the bleach material used in our cleansers, is received in 100-lb. multi-wall paper bags in unit load shipments via railroad box car. The bags are received prepalletized, 20 bags to a pallet, on disposable wooden pallets. The bottom layer of bags is spot-glued to the pallet, and each succeeding layer of bags on the pallet is spot-glued to the bag below it in order to prevent shifting of the load in transit. The pallet loads are removed from the box car by fork lift tractor and transported to the mixing floor of the Cleanser Department. Inasmuch as the formula quantity of perborate used in each batch of cleanser is small, this material is weighed and dumped manually to the weigh mixers by the Mixer Operator.

Cleanser Perfume. Perfume for scouring cleanser is received in 55-gal. and 110-gal. stainless steel drums. These drums are emptied from outside the Cleanser Building with a Viking unloading pump. Perfume is pumped from the drums at ground level to a stainless steel perfume storage tank on the third floor of the Cleanser Building near the weigh mixers. The perfume storage tank is equipped with a low level alarm, which lights a pilot light and sounds an alarm on the third floor panel board. This alarm is set to sound when the perfume in the tank drops to 35 gal. Since the storage tank holds 150 gal., one 110-gal. drum or two 55-gal. drums may be pumped into the storage tank after the alarm sounds. Perfume is fed from the storage tank to the mixers at the same time silex is charged to the mixers, as previously described.

Soaps

The basic raw materials used in the manufacture of soaps are fats and oils, caustic soda, salt (NaCl), and to a lesser degree rosin.

Fats and Oils. Fats and oils are received in tank cars and tank trucks. Tank car receipts average 60,000 lb./car. Tank truck weights will range from 12,000 to 30,000 lb., depending on the size of truck used by the supplier. These tank cars and trucks are equipped with closed steam coils to enable us to heat the oil preparatory to sampling and unloading. Once the material is in a liquid state, it is sampled with a bomb sampler. This sampler is a compartment fastened to the end of a rod which is longer than the diameter of a tank car. It is so constructed that the compartment can be opened and closed at will. The use of this type of sampler enables us to take samples from various levels in the tank car or truck in proportion to the quantities represented by the volume at the various levels, *e.g.*, to get a representative sample of a tank car of tallow, we take one bombfull of fat from the bottom of the car; two bombfulls one-third of the distance from the bottom of the car to the top; three bombfulls one-half the way up; two bombfulls two-thirds of the way up; and one bombfull from the top of the car. These samples are all composited in a large pail, where they are thoroughly mixed. A dip sample is then taken of the mixed samples. The prepared samples are submitted to the quality control laboratory for grading (color, acid, titre, moisture, and insoluble materials). Any differences between the suppliers' grading and our own laboratory's results are resolved by the Purchasing Department before a tank car is unloaded. On tank trucks where smaller quantities are involved, we will unload the truck rather than tie it up, but we park the fat or oil in a small holding tank until the differences are settled.

While we are waiting for the laboratory results, the car is "hooked" up. Flexible hoses are attached to the outlets on the bottom of the cars. This gives more freedom of operation and requires less exact positioning when "spotting" the car. When the grade is determined, the oil is pumped from the cars by steam pumps to the proper storage.

A problem of primary importance in the receiving and storage of fats and oils is that of handling the material in such a way as to reduce to a minimum the probability of the fats and oils becoming rancid. It is the generally accepted theory that rancidity in fats and oils is the result of oxidation of fatty acids which are present in the fats. These fatty acids are the result of hydrolysis that takes place when a fat or oil, containing enzymes present in seeds and fruits of vegetable oils and tissue in animal fats, is stored in the presence of water, air, and light. For this reason, particular care must be taken to keep the fat or oil as water-free as possible. When a receiving sample shows an excessive amount of moisture, the fat is pumped to an intermediate settling tank, where the water can be drawn off before pumping to final storage. Frequent checks are also made of the storage tanks themselves to assure no great accumulation of water.

It has also been found that certain heavy metals act as catalyst in hastening rancidity. Copper and bronze are especially dangerous. Special precautions are taken to see that no bronze fittings or pump parts can come in contact with the fats and oils. Most of our fats and oils are stored in covered steel tanks (with capacities from 60,000 to 2,000,000 lb.), thereby eliminating as much as possible the conditions so conducive to rancidity.

Experience has shown that there is a marked relationship between the increase in the free fatty acid content of the oil and the time it is held in storage. Because of the objectionable characteristics of high F.F.A. oils in the production of high quality soaps, we find it necessary to pass all fats and oils used in making toilet soaps through an alkali-refining process. The F.F.A. is removed in the form of "foots," which must be degraded to lower grade soaps.

The hydrolysis process also liberates glycerine from the neutral oils that are hydrolized. The glycerine thus liberated is lost through the water drawn off the storage tanks from time to time. To hold at a minimum the costs of excessive degradings and glycerine losses, we are very careful to vary our storage operations to assure minimum storage time of oils and fats.

Further quality improvements are also realized by processing the fats and oils, to be used for high quality soaps, through our continuous oil bleach plant. Here the fat or oil is passed through a pressure vessel, where it is heated to approximately 220°F. and is mixed thoroughly with bleaching clays and carbons. From the bleaching vessel the oil is cooled and passed through a plate type of filter press where the bleaching materials are removed. The bleached oil is then further cooled and sent to storage.

Formulation of kettle charges takes place in one of two large scale tanks (150,000-lb. and 250,000-lb. capacities). The correct amount of fats and oils is pumped by steam pump to the scale tank. It is then pumped by centrifugal pumps to the soap kettles in the boiling department.

Proper boiling procedures call for the oil charge to be added to the kettle (containing boiling lye) in such a manner as to never stop the kettle from boiling during the addition of the oil charge. The use of centrifugal pumps allows the soap boiler to throttle down the flow to maintain the boiling condition in the kettle.

Caustic Soda. All of our 50° Bé caustic soda is received by barge on the Ohio River and is unloaded into black iron storage tanks at the Jeffersonville

Boat and Machine Company. We have several tank cars in shuttle service to transfer the caustic to the plant.

Because of the nature of the material being handled, several precautionary measures are taken to insure safe operations, *e.g.*, the caustic is sampled in the barge before unloading. Since there is usually a fairly strong breeze on the river, the sample man must be sure he is on the up wind side of the manhole to prevent the caustic from being blown from the sampler rod onto him. Proper clothing and protective devices are also a prerequisite to safe handling. Cotton clothing, rubber gloves, rubber shoes, and goggles are worn by the sampler and the pumper. All instruments and handling equipment are washed immediately after use.

The cars are weighed into the plant and spotted on a railroad siding adjacent to the caustic storage tanks. Here special (Paranite wire-reinforced, alkali-resistant) hose with safety clamps are connected to the discharge line on the bottom of the car. The cars are also fitted with safety locks in addition to the regular foot valves on the outlets. The caustic is unloaded by centrifugal pump into storage. Two of our storage tanks have a capacity of 1,530,000 lb. each. There are also two smaller tanks with a combined capacity of 1,255,000 lb. Our storage tanks and lines are of black iron construction, and all caustic lines are painted a color that identifies them from the maze of lines in our Raw Stock Department. All pumps have guards, and every flange has a metal seal around it to prevent spraying if a gasket should go.

From our storage center, caustic is disbursed to the points of usage throughout the plant. The majority of the caustic is used at full strength (50° Bé); however there are some operations which require weaker solutions (refining), and special diluting facilities are provided for these.

Salt (NaCl). A concentrated brine solution (pickle to the soap industry) is used in the graining of soap in the boiling operations. The salt is received in hopper cars in the form of rock salt. The car is spotted over a pit, from which the salt is conveyed by a screw conveyor into the salt lixiviator where water is added to dissolve the salt. The pickle is then pumped to wooden storage tanks, preparatory to using it in the kettles.

Conclusion

No laboratories are deeper in research than those of the soap and synthetic detergent manufacturers. W. L. Sims, president of Colgate-Palmolive Company, was quoted recently in the New York press as follows: "probably 70% of the volume in our business today comes from products that didn't exist 10 years ago. The same thing will be true 10 years from now."

This statement bears out the ever-changing dynamics of the industry. Much of the equipment and many of the materials covered in this presentation did not exist a few years ago, and as research and engineering create new and improved products and new and improved automated equipment, our means of handling these and other raw materials, even though they represent the best available today, will be replaced by even more efficient methods and equipment.

Recovery and Purification of Glycerol

N. W. ZIELS, Lever Brothers Company, Hammond, Indiana

IN A DESCRIPTION of the recovery and refining of any product it is well to define the end-product. U.S.P. Glycerine of highest purity may still contain 1–2% water but must retain only small amounts of other organic or inorganic impurities. Any such traces which might make it unfit or unattractive for human consumption are rigidly defined. Specifications for grades of refined glycerine most generally accepted in this country are United States Pharmacopoeia (U.S.P.), Chemically Pure (C.P.), High Gravity Dynamite, and Yellow Distilled.

N. W. Ziels

Probably the most widely quoted in this country is the specification for U.S.P. glycerine, which is substantially C.P. glycerine. Among other requirements the product shall contain not less than 95% of glycerol[1] and shall have a specific gravity not less than 1.249 measured at 25°C. Tests are defined and limitations set on non-volatile residue, ash, carbonizable substances, neutrality, chlorides, arsenic, heavy metals, acrolein, glucose and ammonium compounds, fatty acids and esters, color and odor.

The United States Federal Standard Stock Catalogue O-G-491 gives detailed requirements of high gravity glycerine (dynamite glycerine). The specific gravity shall be not less than 1.2620 at 15.5/15.5°C. This corresponds to 98.7% glycerol. The color shall be not greater than 80 Y 20 R on a 5½-in. Lovibond scale. Also delimited are appearance, odor, acidity or alkalinity, ash, and chlorides.

The same catalogue gives the following detailed requirements for yellow-distilled glycerine. The specific gravity shall be not less than 1.2550 at 15.5/15.5°C. This corresponds to 96% glycerol. The color in a 5¼ in. depth shall be not greater than 80 Y 20 R on the Lovibond scale. Also delimited are ap-

[1] The term glycerol is accepted as a proper commercial name for the compound $C_3H_5(OH)_3$ and designates it as a chemical substance or as a descriptive adjective. The term glycerine applies to commercial products of glycerol of whatever grade or degree of purity. Soap lye or spent lye describes the alkaline-brownish liquor containing small quantities of glycerol settled from the soap-boiling process. Sweetwater is the term for glycerol containing waters from Twitchell or Autoclave splitting of fats.