Clayton Continuous Soap Process

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Introduction

The technological advances in an industry, as a rule, reflect the general trend in other industries. There may be a lag, but sooner or later that industry will develop to such an extent that it may even become the pioneer of innovations that find applications in other industries. The development and perfection during the past decade of the Clayton Continuous Processes of Making Soap and Recovering Glycerine represent such an advance for the soap industry.

The Clayton Continuous Soap Processes are the result of the inventive efforts and foresight of Mr. Benjamin Clayton. In recent years he has had the collaboration of Mr. B. H. Thurman, who devoted his time and energy to further perfecting the processes.

The manufacture of soap is a standardized procedure. Saponification is accomplished in large kettles. The production of a charge of soap from the starting materials is a highly specialized art requiring skill and experience and takes several days. So complex are the underlying phenomena that it was not until the recent work of McBain and his students who investigated soap systems for a period of years that a rational explanation based on physical chemistry considerations was offered. The practical soapmaker produces excellent soap without having to resort to this technical knowledge available.

Soap is continuously produced and glycerine recovered by this new process in minutes where days were formerly required. The tedious, time-consuming operation of saponification in the kettle, with its multiple washings are replaced in this process by a rapid, simple, positive automatic and synchronized system. The Clayton Process offers a novel practical means of handling organic materials at high temperatures. As to soapmaking it represents a complete departure from the time honored method of mixing oil and alkali solution in a large kettle, and after several days washing out the glycerine.

General Description

The writer will endeavor in this article to describe the operation of a unit in which soap is manufactured and glycerine recovered by the Clayton Continuous Soap Process. Some of the underlying principles of rapid high temperature saponification, treatment of glycericides and reaction products at high temperatures, the handling of molten soap at high temperatures, the continuous production of soap and related subjects will be discussed.

Soap is made in the Clayton Process from common raw materials, oil and caustic alkali, as in the ordinary kettle process. The strength of the caustic alkali solution used varies. It is usually 25-30 per cent, although higher concentrations up to 50 per cent have been employed. The oil, heated to about 180°F., is pumped from a supply tank by a high pressure, gear-type, positive displacement pump through a proportioning unit, from which measured quantities of oil are forced through a preheating coil where the temperature of the oil is raised to 275°F. In a similar manner a pump delivers caustic soda solution to a proportioner from which measured quantities of it are forced through a preheating coil where the temperature is raised to 180°F. These proportioned streams of preheated oil and caustic soda solution meet in a mixing zone wherein thorough admixture in flow is affected by having the caustic impinge downwardly on the oil, the mixture of the two then twice changing direction before emerging as a well-mixed mass, at about 230°F. and under 50 lbs. pressure. A pump forces this material through two reaction coils, in the first one of which the temperature of the mass is raised to about 400°F., and in the second one of which the temperature is raised to about 550°F. The emergent pressure of the first reaction coil is about 250 lbs. per square inch while that from the second coil is 50 lbs. per square inch. The soap mass is then sprayed into a slightly domed kettle 4 ft. 6 in. in diameter and 6 ft. high. The kettle is maintained under a vacuum of about 29.0 in. The soap impinges as a liquid upon the walls of the kettle maintained at a high temperature by heated oil circulating through a jacket surrounding the kettle. The soap flows down the wall as a film thereby exposing an efficient surface for the liberation of the glycerine. The soap flows to the bottom of the kettle where it is pushed into troughs extending along the bottom by a sweep agitator that barely scrapes the bottom and sides and makes four revolutions per minute.

The soap as it is pushed or slides into the troughs is in a liquid or semi-liquid condition. In each trough is a screw type conveyor that extends beyond the kettle. The part of the conveyors that is beyond the kettle is, of course, closed. The conveyors are jacketed to permit the use of cooling water as a medium to reduce the temperature of the soap. In addition to external cooling, internal cooling is provided for by having the shaft of the conveyor hollow. The soap is pushed forward by the revolving flights of the conveyors. As it advances the soap loses its flow properties as its temperature is reduced, changing its physical condition from semi-solidity to solidity as it progresses in its course through the conveyors. At the distal end of the shaft of the conveyor there is a tapered enlargement in which the flights are correspondingly smaller. This results in an increased pressure and compaction of the mass, forming a virtual "plug" that maintains any reduced pressure in the vacuum kettle constant, at the same time preventing access of air. At right angles to the two 6-inch conveyors is a single 4-inch screw conveyor into which the soap mass is fed and through which the mass is continuously advanced and progressively cooled in its traverse therethrough. It emerges from the conveyor as a friable soap, easily fractured by slight pressure and cooled to about 300°F. This temperature can be lowered readily if desired by increasing the length of the conveyors. The valve at the end of the conveyor from which the cooled soap is extruded serves to maintain the vacuum in the kettle at the start of operation before the formation of the soap plug at the junction of the conveyor, which requires but a few minutes. Then there is no further need for this valve, the plug serving as its own seal.

Soap from the conveyor passes through a breaker-plodder where the size of the particle is reduced and the temperature lowered to about 225°F. Further reduction in temperature is accomplished by passing over cooling rolls where temperature of the emergent material is about 160°F. Still further cooling can be effected by using a conveyor from which the soap is expelled at a temperature of 120°F.

As the mixture of soap, water and glycerine is flashed into the kettle kept under a vacuum of 29 in., the water and glycerine are vaporized. The vapors are withdrawn through several opening outlets at the top of the kettle which combine into a common vapor line in which they are led through a series of condensers where the glycerine may be fractionally condensed or the vapors condensed and collected in a single receiver.

The above is a general outline of the Clayton Process of making soap and recovering glycerine. For purposes of exposition the process may be divided into the following stages:

(1) Pre Saponification
(2) Reaction Zone
  (a) Medium Temperature
  (b) High Temperature
(3) Separation of Volatiles from Non-Volatiles
(4) Separation and Cooling of Soap
(5) Separation of Glycerine
(6) Finishing of Soap

1. Pre Saponification

The oil is heated to about 180°F. in a tank. The heat may be supplied by closed steam coils submerged in the oil or may be heated while flowing through a coil. It is sometimes the practice to heat the oil in a large supply tank which feeds into a smaller tank placed on platform scales with a dial registering on a calibrated scale giving the direct reading in pounds, with ½-lb. divisions. Caustic soda solution is put into a somewhat smaller tank resting on a separate platform scale of the same type as that used for the oil. The purpose of the scales is to afford a check of the actual amount of either oil or caustic solution, or both being pumped in a given interval. The saponification number of the oil and the strength of the caustic soda solution are accurately determined. The relative proportions of oil and caustic soda solution necessary for complete saponification are then known and the correct adjustment made on the proportioning unit. Periodic readings of the scale weights are made so as to check on the amounts of oil and caustic solution delivered in the interval. Other devices for measuring the amounts can be used.

The oil and caustic solutions are each separately pumped by a high pressure, gear-type positive displacement pump to a proportioning unit which consists of an upper box chamber and a lower cylindrical chamber. The upper chamber has two openings or ports leading to the lower cylinder and these ports are covered alternately by a slide valve driven by a small motor. The supply pump fills the upper box chamber with oil under pressure and as one of the ports is now open the oil passes down into the cylindrical chamber and fills the space between the head of the cylinder and the end of a floating close clearance plunger or slug.

When the motor driven slide valve moves forward the first entry port is closed and the second entry port is opened, so that the oil under pressure in the upper box now flows into the end of the cylindrical chamber behind the plunger or slug and forces the slug to the opposite end of the cylinder and in so doing drives out the measured quantity of oil filled into this space by the first stroke.

With the next movement of the slide valve the conditions are reversed and the slug travels back to its original position, driving out the measured quantity of oil in the cylindrical chamber.

The quantity of oil expelled by each stroke of the proportioner is regulated by increasing or decreasing the travel of the plunger or slug, and this is accomplished by means of a screw which advances or retires the internal "stop" against which the slug comes to rest, in other words cuts down the length of the cylinder in which the slug travels.

A scale graduated in tenths of an inch indicates the length of the stroke and simple calibration will enable one to evaluate these readings and convert them into actual pounds of material delivered in a given time.

The operation depends upon a differential in pressure between the suction side and the discharge side of the proportioner. The supply pumps equipped with pressure regulating valves are set to maintain a higher pressure on the suction side of the proportioner, that is, on the top of the motor driven slide valve than the back pressure that exists on the discharge from the proportioning cylinder between this and the preheating coil. In a similar manner the caustic soda solution is proportioned. The number of strokes per minute can be regulated. About 80 strokes per minute is average.

The oil then goes through a nickel coil, containing about 125 ft. of ⅜-in. pipe, during the passage of which the temperature is raised, usually to 275°F. The coil is heated by direct gas fire. Other means of heating can be employed. The caustic soda is similarly heated to a temperature of 180°F.

The oil and caustic hydroxide solution meet and are mixed in a flow-type of mixing zone. The caustic hydroxide solution enters the zone downwardly and impinges at high velocity through a hole against a concave wall placed opposite the hole. Oil enters the zone at right angles to the flow of caustic hydroxide solution but contacts the latter in the area between the concavity and the outer wall of the zone. The mixture of oil and caustic then travels downwardly along the annular space between the inner wall of the outer zone pipe and the outer wall of the inner zone pipe. This space is about 0.4 in. wide, and is constricted to ⅛ in. as the mixture changes its direction to an upward flow through the inner zone pipe. Upon reaching the top of the inner zone pipe, the mixture discharges at right angles into a line that leads to the suction of the soap pump.

It is found that in order to force the mixture of oil and caustic solution, now a rather viscous mass, through the reaction coils and to overcome the friction (and back pressure) thereby produced, a pump is necessary: This pump is installed a short distance beyond the mixing zone.

2. Reaction Zone
(a) Medium Temperature

The mixture in its passage through the first reaction coil is heated to about 410°F. The reaction coils consist of a series of pancake coils surrounded by a double jacket of insulating material to conserve the heat. These coils are located above a furnace heated by gas. Any other means of heating can be employed. The coils are ½-in. nickel pipe about 275 ft. long and wound in pancake form.

2. Reaction Zone
(b) High Temperature

The saponified mixture enters the second reaction coil at about 420°F. and 250 lbs. pressure. This coil is a duplicate of the first reaction coil. The completely saponified mixture, emerging from the second reaction coil at about 550°F. and 50 lbs. pressure, is piped directly into the vacuum kettle; the single pipe is divided in the kettle into branches which direct the flow so that the streams of reaction mixture impinge on opposite sides on the wall of the kettle at a point about half way up.

3. Separation of Volatiles from Non-Volatiles

A nickel clad steel is used for the inner shell top and bottom of the kettle. The side wall of the kettle is jacketed. A heat transfer mineral oil is circulated within the jacket in order to bring the kettle up to operating temperatures and thereafter to maintain them. Sight glasses are placed on the sides of the kettle to enable the operator to observe the conditions within the kettle. A sweep agitator, driven from above through a vacuum-tight stuffing box, revolves at approximately 4 r.p.m. The blade of this agitator is 4 in. high and has a very close clearance with the bottom and the side wall of the kettle, thereby ensuring transfer of all the soap deposited into the conveyor troughs and so preventing building up of large masses of soap which would interfere with smooth operation.

The volatile materials are drawn off through four 6-in. openings situated on the dome of the kettle and are combined into one large pipe leading to a system of tubular condensers.

4. Separation and Cooling of Soap

The liquid soap discharged upon the walls of the kettle flows down as a thin film and collects on the bottom, and as it collects on the bottom it is swept by the agitator blades into two parallel 6-in. conveyor troughs. These troughs are located side by side, 18 in. apart, along the bottom of the kettle and as they emerge from the kettle are extended as jacketed tubes. The underside of the troughs, that is the portion within the kettle, is also jacketed. The jackets are for the circulation of cooling water.

Through the jacketed troughs and tubes run spiral screw flight conveyors which advance the soap. All the troughs and conveyors are made of stainless steel. At the discharge end of each conveyor is a tapered enlargement extending back about 18 in. In this tapered section the conveyor flights are correspondingly reduced in height so that the space between the shaft and the shell is reduced. As a result the soap masses advanced to this area are subjected to higher pressures, resulting to a compaction of the mass. As will be explained later, this is a most important phenomenon since it permits vacuum conditions within the kettle to be maintained. The shafts of the spiral conveyors are hollow and cooling water can be circulated therethrough if desired.

These two 6-in. conveyors are connected at right angles to a 4-in. single screw conveyor which runs in a jacketed tube. The compacted soap masses from the ends of the two 6-in. conveyors are forced into the bore of the 4-in. conveyor, the revolving flights of which pick the soap up and advance it towards the discharge end. The 4-in. conveyor is about 7 ft. long. All the conveyors are motor-driven through gear and chain drives. At the discharge end of the 4-in. conveyor a quick opening and closing gate valve is employed only at the start of operation to prevent loss in vacuum before the soap plug is formed at the end of the two 6-in. conveyors.

Beyond this valve is situated a motor driven breaker-plodder into which the soap is fed by the 4-in. conveyor and in which the soap masses are plodded through a perforated disc.

5. Separation of Glycerine

The vapors are drawn from the kettle and pass down through a 6-in. vapor pipe to a series of at least three plate and tube vertical condensers where fractional condensation takes place so that the gases passing from the last condenser to the barometric head and vacuum jets (or vacuum pump) are free from glycerine. The condensate is accumulated in receivers under each condenser and is pumped at intervals to a treatment tank. The glycerine condensate contains no inorganic salts and the amount of soap entrained is negligible, being about 0.1 per cent (and less). The only impurity is this minute amount of soap the removal of which is very simple compared with the treatments necessary for removal of impurities from kettle lye liquors to make them suitable for glycerine recovery. The condensate can be rapidly converted into 95 per cent glycerine and higher by the standard methods.

6. Finishing of Soap

The soap discharged from this disc is reduced in size to about that of a rice grain. The breaker-plodder also has a water cooling jacket to further cool the soap so that when the soap is first exposed to air it is about 200°F. From the breaker-plodder the soap falls into the feed hopper of a four-roll cooling mill where it is further broken up and cooled by means of the cooling water circulating within the steel rolls. Beyond these rolls an additional cooling conveyor can be installed if desired. At this point if it is desired to make flake or chip soap, the moisture and filler can be thoroughly incorporated and the mixture fed to flake or chip rolls. It is also possible to add the moisture to the soap in the 4-in. conveyor, plod the moist soap through the breaker-plodder and pass the material over flake or chip rolls.

Cake soap can be made by incorporating the requisite amount of moisture and perfume to the soap as delivered from the cooling rolls, which when plodded sufficiently will give a smooth uniform bar from which the cakes can be cut.

The soap issuing from the cooling rolls is substantially anhydrous while the glycerine content is primarily dependent on the temperature at which the reaction mass was introduced into the vacuum kettle. At temperatures of about 550°F., the glycerine left in the soap varies from 0.5 to 1.0 per cent, depending on the nature of the raw materials used.

Discussion

The heating of fatty materials in large masses to relatively high temperatures without destruction or discoloration is difficult to attain. However, if the heat is imparted to a stream in flow it is possible to raise them to relatively high temperatures without destruction or discoloration. In the Clayton Process, the temperature of the reaction mass is raised rapidly, uniformly and progressively without local overheating because the mass is streamed through a coil. Likewise, cooling of the mass takes place rapidly, uniformly and progressively because the mass of material is moved by positive mechanical means.

One of the prime requisites of a successful operation of a continuous process is the proper synchronization of all the component parts and processes. In this respect, among others, continuous operations differ markedly from batch. The latter usually consist of several steps, each of which is conducted with large volumes and completed before another is begun. The steps in a batch process follow a sequence. There is no element of simultaneity of the steps. Therefore, synchronization plays a minor role in batch processes, whereas in continuous processes it is the sine qua non of successful operation.

Continuous processes are further characterized by constant conditions in any given part of the system.

Whatever takes place in that part is constant from one interval to the next. This means that the same components are reacted upon to the same extent with the consequent production of the same resulting products, provided, of course, that the original reactants are the same. Constant conditions mean constant products.

Glycerides and fatty acids are heat sensitive materials especially at temperatures considerably higher than those that prevail in the kettle boiling of soap. Their decomposition is a function of time and increases markedly with increase in temperatures. Further, in the presence of air, the glycerides and fatty acids darken. It is imperative, therefore, if destruction or decomposition is to be avoided, that the fatty materials be heated rapidly in a closed system. A coil is an efficient means because the materials moving through it rapidly absorb the heat from the heating medium while out of contact with air. In addition high pressure can be safely developed or imposed because the coil is usually of relatively small diameter.

The rate of saponification of glycerides is dependent on the temperature. McBain and Kawakami found that the rate varied greatly with the oil studied. There was as much as a two hundred fold difference in the rate between some of the oils investigated, which was attributed to differences in emulsifying power of the soap first formed toward the unsaponified oil. McBain and Norris studied the saponification of oils at 212°F. Their results indicate that saponification is complete in about four hours under the conditions (intense stirring and 1.0 N acqueous sodium hydroxide solution present in equivalent amounts).

The rate of a chemical reaction varies with the temperature. In homogenous systems, the rate is doubled for every 10°C. (18°F.) rise in temperature. For heterogeneous systems such as soap-sodium hydroxide-oil, the rate is somewhat lower as McBain reports. If we assume that the rate of saponification follows a bimolecular course and the temperature rate coefficient is 1.5, the time for complete saponification of oil and sodium hydroxide solution, present in equivalent amounts, varies with temperature as follows:

Assumption: (1) Aqueous alkali (NaOH) vegetable oil stirred, at 100°C. (212°F.) reacts completely in 4 hours. (2) Temperature coefficient is about 1.5 for every 10°C. (18°F.)

Temperature	Time		
212°F.	4	hours	
230°F.	2.66	"	
248°F.	1.77	"	
266°F.	1.18	"	
284°F.	0.786	"	
302°F.	0.524	"	(1886 seconds)
320°F.	0.350	"	
338°F.	0.233	"	
356°F.	0.155	"	(538.0 seconds)
374°F.	0.103	"	
392°F.	0.07	"	
410°F.	0.0466	"	(167.7 seconds)
428°F.	0.031	"	
446°F.	0.0206	"	(74.2 seconds)
464°F.	0.0137	"	
482°F.	0.0091	"	
500°F.	0.0061	"	(21.9 seconds)
518°F.	0.0041	"	
536°F.	0.00273	"	
554°F.	0.00182	"	
572°F.	0.0012	"	

The above table shows that the reaction is complete in 21.9 seconds at 500°F., and in 6.55 seconds at 554°F. The reaction actually proceeds at even greater rate because as the temperatures increase the system becomes more homogeneous, in which case with the temperature rate coefficient of two would mean 0.023 seconds at 500°F. and .00306 seconds at 554°F. In the Clayton Process, as described here, the oil is completely saponified in its passage through the reaction coils through which the reaction mass passes in about five minutes. This interval can be reduced if desired, by decreasing length of the coils and supplying sufficient heat to raise the temperature to the same maximum.

Saponification should be substantially complete when the reaction mass reaches the high temperature, as otherwise there is danger of discoloration owing to the presence of unsaponified fat. Consequently properly proportioned amounts of oil and alkali solution must be mixed. There must be enough alkali present to combine with the glycerides. Inasmuch as the proportioning system used provides a positive flow of proportioned quantities of alkali solution and oil at very frequent intervals, the reactants are present in the correct proportions from the time they meet. The proportioner makes about 80 strokes per minute. At the rate of 8.0 lbs. of oil and 5.0 lbs. of caustic solution per minute, it means that in every ¾ of a second 0.1 lb. of oil and 0.062 lb. of caustic solution are co-mingled. There is thus formed small reaction masses, each of which contains the correct amount of reactants. Under these conditions there is very little likelihood of local over or under reaction. In a sense it makes the large scale operation as efficient in this respect as a test conducted in the laboratory in a small beaker to study the variables of a saponification system. It is important to have correct proportions of reactants from the very beginning because no further additions are made and because it eliminates the dangers of discoloration and decomposition of unreacted masses when the high temperature zone is reached. Thorough mixing of the reactants when they meet ensures uniformity from the start, the components being uniformly distributed in correct proportions throughout the mass, the reaction proceeds uniformly and the reaction mass responds rapidly and uniformly to the rise in temperature which means that soap is formed uniformly to an extent dependent on the temperature. The advancing mass becomes uniformly richer in soap as the temperature increases. Also with every succeeding second, because of the progressive increase in temperature, a larger percentage of the remaining unsaponified material is saponified. The soap formed acts as a solvent for the unsaponified material. Thus the tendency is towards greater homogenity with uniform increase in temperatures.

When the highest temperature zone is reached saponification is *uniformly substantially complete*. These high temperatures (425-600°F.) are imposed as much to attain complete saponification rapidly as to condition for the rapid removal of the glycerine when the reaction mass, now soap, glycerine and H_2O, is released into the kettle under vacuum.

In the Clayton Soap Process there are enough heat units in the materials *before* introduction into the zone, where the volatiles and non-volatiles are separated from each other, to vaporize all the volatile materials. It is therefore possible to cause extremely rapid volatilization of water and glycerine when the reaction mass is sprayed against the kettle wall.

One of the achievements of the Clayton Soap Process is the rapid removal of the glycerine from the soap. It was found that glycerine can be rapidly removed from a soap mass in a molten condition. Glycerine not volatilized immediately when the soap mass is sprayed into kettle rapidly leaves the soap, as the latter flows as a thin film down the walls, which are kept hot enough by oil circulating through a jacket to maintain the film flowing. Release of volatiles from a flowing film occurs much more readily than from solid masses. The volatilization of glycerine from the soap thus proceeds rapidly in the kettle because (1) the temperatures are high enough for it to be vaporized at the reduced pressure prevailing, usually 28 to 29½ inches (2) the soap mass is molten (3) the soap is flowed as a thin stream.

Having very rapidly removed the glycerine from it, the soap, now, a molten, plastic mass at 450-600°F. in an atmosphere of 29 in. vacuum, presents the formidable problem of how to get it out without darkening, "burning" or decomposition in the kettle or subsequent darkening or decomposition after removal from the kettle when exposed to the atmosphere. Those who have had the opportunity of working with this material in this condition realize the difficulties. On the one hand there is the problem of maintaining the vacuum in the kettle because this soap at the high temperature darkens immediately upon contact with air nor can the soap be kept at these temperatures for long periods without decomposition, and on the other hand there is the problem of advancing the molten soap, cooling it, as part of a synchronized, rapid continuous system. A solution of this problem required a special study of the form of pump that could be most satisfactorily employed in overcoming the difficulty of handling a molten soap which becomes semi-plastic when cooled slightly and which would not readily work in a system where a high vacuum existed on one side and high pressure on the other. This problem was surmounted by the use of the screw type of pump, which has the advantage of working on pressure only and which is easily designed so as to seal itself by packing the material which it is handling. By its employment there is no problem of handling a product which readily changes its consistency with differences in temperature; and it has the advantage of affording means of extrusion.

The closed screw conveyor systems represent a practical solution of this most difficult pumping problem. The physical condition of the soap that is swept into the troughs located in the bottom of the kettle varies with the temperature and nature of the soap. The more unsaturated the glycerides, or the lower the titre, the more liquid the soap at the high operating temperatures. With these very liquid soaps it is sometimes necessary to circulate cooling water through the jackets of the troughs. This cools the liquid soap in contact with the cooled surface of the trough and forms a solid or semi-solid crust into which the flights of the revolving conveyor grip and propel the contents forward into that portion of the conveyor beyond the kettle where they are cooled, and in being cooled, the soap passes through the plastic, semi-solid to the solid state.

As explained above, the soap in the kettle must be kept out of contact with the air and the vacuum maintained. If access of air is allowed the soap is darkened and if the vacuum is not maintained the volatiles (glycerine) will not be removed rapidly and some of the volatiles may be condensed in the kettle. After considerable experimentation a very simple practically automatic system, not requiring elaborate mechanical devices, was evolved This consists of two systems of conveyors, at right angles to each other. The shafts of the two conveyors along the bottom of the kettle tapered outwardly as they approached the ends at the junction of the single conveyor. The space betwen the shell and the flights was correspondingly reduced in this area. This meant that the soap masses, when they come within this area, are subjected to very high mechanical pressure. The soap is compacted in this area, forming a plug tight enough to prevent leaks of air from the open end of the breaker-plodder and to maintain the reduced pressure conditions within the kettle. Once formed the plug is constantly self-renewing as long as the whole unit is in operation. The soap becomes solid as it is cooled in its traverse through the conveyors. Moving masses of soap are cooled by circulating cooling water. The revolving flights advance and mix the soap, exposing new soap surfaces to the cooling surface of the shell.

Soap produced in the above Clayton Process is substantially anhydrous, contains about 1.0 per cent or less glycerine and exhibits the singular property of friability, that is, it fractures easily upon slight pressure. It has the appearance of a super-cooled vitreous mass which may indeed account for its ease of decrepitation. Rapidly cooled masses are full of strains. Consequently the large masses are easily disrupted into smaller ones.

Soap has been made by the Clayton Soap Process from the common oils and fats: cocoanut, palm, palm kernel, cottonseed, tallow, teaseed, olive, etc. Some materials that present difficulties in the soap kettle are easily transformed into soap by the Clayton system of saponification. Such a material is hydrogenated fish oils, the saponification of which proceeds with great difficulty in the soap kettle, but which is converted readily into soap by the Clayton Process.

The technique of the Clayton Soap Process is practically the same for every oil, whereas in the kettle process, the procedure varies with their composition. Thus, any combination of oils and fats in the supply tank can be made into soap continuously under practically the same conditions so far as saponification and glycerine removal are concerned. There is, therefore, an incentive to experiment with various combinations of soap making materials for special purposes. It is possible to try out combinations based on purely theoretical considerations: simulation of high-priced oils with cheaper ones to get similar resulting soaps; the final product is available in a matter of minutes.

Volatile unsaponifiable matters present in the oil are removed from the soap mass in the kettle. Sperm oil was saponified and the cetyl alcohol removed from the soap by the Clayton Process. The temperature of the mixture to the kettle was raised to about 600°F. before discharging the mass into the kettle where the cetyl alcohol is substantially completely removed from the soap, and condensed and recovered. A fairly pure product was obtained directly and required little or no further purification.

Red Palm oil yields a soap that is considerably reduced in color as the result of the Clayton processing. Cocoanut oil soap, containing less than 1.0 per cent glycerine has been produced. As a powder it is a snow-white, very finely divided, extremely soluble product.