Specialty Soaps

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IN undertaking a discussion of the more important of the hundreds of different specialty soaps on the market today, it is well that we first define the terms "soap" and "specialty" as we use them here. A broad and quite adequate definition of the word "soap" has been adopted by the American Society for Testing Materials. It is defined as "the product formed by the saponification or neutralization of fats, oils, waxes, rosins, or their acids with organic or inorganic bases." "Specialty" here is used to indicate distinctive or uncommon soaps designed for particular purposes.

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All soaps may be pretty definitely divided into two classes distinguished from each other by their solubility in water. Our first class is the water-soluble group, which is of particular importance in the field of ordinary detergents. The organic nitrogen base soaps represent a relatively small part of this group as far as volume is concerned; triethanolamine oleate is a good example. The large part of this group of water-soluble soaps is the alkali metal salts of monobasic long-chain organic acids; the sodium and potassium soaps comprise this group.

Approximately 3½ billion pounds of soaps and detergents are produced in this country each year. We would estimate the group we classify as water-soluble specialty soaps to be over ½ billion pounds. This figure, of course, depends entirely on the scope of the products classed as specialties.

Our second class is the water-insoluble soaps. These compounds are the alkaline-earth and heavy-metal salts of monobasic, long-chain organic acids. Although insoluble in water, these materials show a marked solubility or solvation in the non-polar solvents. Important examples in this class are the aluminum and calcium stearates. Total sales of these metallic soaps for all uses is of the order of 75 to 100 million pounds per year.

Water-Soluble Soaps

There are literally hundreds of different types of water-soluble specialty soaps on the American market today. Obviously, in the time allotted to us here, we can only attempt to cover them broadly. In order to organize the discussion we have grouped these products according to the physical form in which they are ordinarily made available; that is bar soap, chips and powders, paste (jelly) and creams, and liquid soaps.

Among the best known of the specialty soaps are medicated and cosmetic bars, mechanics cake hand soap, shaving soap, naphtha soap, salt water soap, transparent bars, and blue mottled soap.

Medicated and Cosmetic Bars. The total production of medicated and cosmetic soaps is over 100 million lbs. per year. These soaps may be manufactured as bars, powders, pastes, or liquids. However by far the greatest quantity appear as milled bars because it is more convenient to incorporate the special ingredients on the mill, using a standard toilet soap base.

The percentage of coconut oil in such a base may vary widely but is usually between 10 and 25%, depending on the kind of lather desired. Coconut oil increases solubility and therefore improves the lathering qualities of the bar. In addition to coconut oil, tallow is usually used although palm oil and some hardened oils are sometimes incorporated.

As a medicinal agent, soap is in itself very important. It has marked cleansing powers and, in addition, serves to soften the epidermis. It has the property of limiting local inflammation and swelling of tissues. Its ability to remove grease and products of perspiration from the skin enables the pores to function normally. In addition to the antiseptic properties, it is also probable that some bacteria or fungi are mechanically removed in the washing process.

Over the years literally hundreds of ingredients have been added to the common toilet bar for the purpose of increasing its germicidal or cosmetic properties. These ingredients include phenol, formaldehyde, mercury salts, beeswax, almond oil, coal tar, sulfur, bismuth, cold cream, lanolin, iodine, lemon juice, oatmeal, various herbs, yeast, and Irish Moss, and now chlorophyll, to name only a very few. Undoubtedly the most important of the recent additives is one of the new synthetic chlorinated phenolic compounds known as "Hexachlorophene," first commercially used by Armour in "DIAL." This material has received a great deal of study, and much data have been developed and published. Differing from most germicidal additives, this ingredient is not adversely affected by the presence of soap. Striking results have been obtained in reducing and maintaining low bacterial counts on the skin surfaces when a soap containing 2% of this material is used daily. Since bacteria are an important cause of the putrefaction of perspiration, the reduction of bacteria count serves to control objectionable odors resulting from this decomposition.

Mechanic's Cake Hand Soap. The production of abrasive hand soaps, which includes cakes, powders, and paste is over 50 million pounds per year.

The mechanic's cake hand soap is still fairly popular for specialized usage; however the pastes and powders are currently more widely used. These products are designed for the removal of grime, grease, and imbedded soil from hands and arms.

The bar soaps, termed also, hand grit and pumice soaps, usually are made from a toilet soap fat stock fairly high in coconut oil. They generally contain from 25 to 30% of an abrasive such as pumice, sand, silica, or volcanic ash with some 50 to 60% soap.

Shaving Bar. The popularity of the shaving bar or cake has decreased considerably in the last 20 or 30 years. However there are still over 5 million pounds of this type of product produced annually. A new lease on life was given in recent years by the ready-filled wooden and ceramic bowls which have sold with assorted male cosmetic items. This bar is gradually being replaced by the lather and no-lather creams.

A good shaving soap must produce a heavy, creamy, easy rinsing lather which will remain moist and visible on the face until shaving is completed. It should have a mild masculine-appealing type of perfume and should be non-irritating to the skin. Ordinarily, a shaving bar soap is softer than toilet soap, but it should not waste away rapidly with use.

Shaving bars may be based on a fat stock of 20 to 25% coconut oil, and about 50% stearic acid, with the balance tallow. Stearic acid is important in this formulation since this soap must give a close creamy lather. It must be potash-saponified because sodium stearate is quite insoluble. The coconut oil and tallow are usually soda-saponified in a kettle and mixed with the potassium stearate in a crutcher. Glycerine is sometimes added to give a softer bar and for emollient purposes.

Naphtha Bar. The naphtha bar laundry soaps were at one time quite popular with the housewife; however modern granulated soaps and detergents have taken such a large share of the household laundry market that laundry bars of any type have been relegated to a relatively unimportant position.

These soaps are however still sold and usually contain approximately 5% of naphtha added to a soap base made up of approximately 35% rosin, with the balance tallow or grease. So-called white laundry bar soaps were heavily built white soaps containing about 40% coconut oil, with the balance tallow or grease.

Salt Water Bar. Because of periodic and late very regular demands by our armed forces, which under field conditions must use various types of hard and sea water, there continues to be a requirement for salt water soaps. Production during the last year has been in excess of 10 million pounds. Most of this has been in 4-oz. wrapped bars. Prior to World War II these soaps were 100% coconut oil because such soaps gave a lather in almost any kind of water. However during the last world war when the supply of coconut oil was limited, a new type of salt-water or all-purpose bar was found to be more satisfactory. This soap is still being used in somewhat modified formulation. Present specifications permit either a framed or milled bar, which is usually composed of 25% or more of an alkyl aryl sulfonate synthetic detergent and as much as 40 to 50% tallow or tallow and coconut oil soaps. Starch and complex phosphates also have been used in this bar. Marked improvements have been made in these soaps since the last war.

Transparent Bar. In this country transparent soaps are mainly used as novelty items although they were an item of some importance several decades ago. They are usually based on a tallow-coconut oil fat stock. The transparency of the soap may be induced by the use of either sugar, alcohol, glycerine, free fatty acid, and castor oil, or a combination of these ingredients. It is influenced by a fast rate of cooling. Considerable experience in the "art" is required to make a really attractive transparent soap which will remain transparent.

Blue Mottled Bar. Blue mottled soaps are an item that has never been very popular in the United States except for localized markets. The bulk of this product is exported to the West Indies to satisfy a demand originally established by the Germans before the first World War. There is also considerable "art" in making a true blue mottled soap. Customarily, the fat charge is 20 to 40% coconut oil, with the balance tallow. The finished, soda-saponified soap, contains 1½ to 2% of salt and ¼% of ultra-marine blue. It is usually finished with 0.2% free caustic and at 40% moisture. It is the proper boiling procedure plus the high salt and free caustic in combination with slow cooling in frames which results in the mottled appearance.

An imitation blue mottled soap sometimes referred to as "blue streak soap" is often made by mixing blue colored soap and either white or yellow soap as the mix flows into the frames. This requires less care and less equipment and space for slow cooling since these frames may be cooled in the normal manner.

Some of the specialty uses for soaps in the flake and powdered forms are similar to those already discussed for bar soaps; others are quite different. Among the uses for chips and powders are: medicated and cosmetic powders, mechanic's powdered hand soap, shaving powder, dentifrices and ointments, textile soap, synthetic rubber soaps, and wire drawing soaps.

Medicated and Cosmetic Powders. These soaps are manufactured in powdered form in a limited quantity principally for dispenser use in office buildings and industrial establishments. Since workmen and office employees judge these soaps by the lather they produce, a good toilet soap base is recommended. The medicants or additives may be almost as varied as in the bars.

Mechanics' Powdered Hand Soap. Depending on the use to which these powdered hand soaps are to be put, various other ingredients are often added. For reducing costs and giving free flowing properties, talc, volcanic ash, and bentonite are added; for soluble cleansers, borax, modified soda, etc., are added; for abrasive cleaning, corn meal, ground corn cobs, pumice, and sawdust are used.

These powdered hand soaps containing abrasive materials are commonly known as mechanics' powdered hand soap. They may or may not contain added medicants. They are important for the removal of grease, grime, and imbedded soil.

Shaving Powder. The use of shaving powders has decreased in the last three decades much the same as shaving bar soap. The main use for shaving powder today is by the barber because of the sanitary feature of dispensing it. While the volume is not large, the production of such soaps is an important part of the business of certain small soap manufacturers.

The qualities to be desired in a good shaving powder are identical with those in a good shaving bar. The powder is produced by pulverizing a soap very similar in composition to the bar except for the use of more soda lye and less potash lye in its production. Ordinarily, a small percentage of talc is added to the soap as it is being pulverized.

Powdered Soap. Powdered soap is particularly important in the preparation of certain types of creams, polishes, ointments, emulsions and in the preparation of dentifrices. In this group the preparation of dentifrices is by far the largest. Although no figures are available on the total amount of powdered soap finding its way into these preparations, it will suffice to say that dentifrices are a 100-million dollar business. The most important type of powdered soap used in the preparation of toothpastes and powders is the neutral white soap which is made from refined grades of coconut oil and tallow of much the same composition of a fine white toilet soap. These finished boiled soaps

must be dried to not over 3% moisture before they can be pulverized. Pulverizing is usually carried out in high speed mills. The modern equipment incorporates the principles of air separation to produce a product of 100 to 200-mesh. Good stability against discoloration or rancidity is of extreme importance in this type of product. In addition to the powdered soap, toothpastes and powders contain a flavor type of perfume and a mild abrasive, such as chalk or magnesia.

Textile Soap. One of the largest volume items which might be considered as a specialty is the textile soap. This is sold as a chip or flake soap; however there is a large market for the solid pack kettle or crutcher soap. The production of these soaps is estimated at about 25 million pounds per year. The textile soaps are used on four different types of materials, i.e., wool, silk, cotton, and synthetic fabrics.

The wool soaps are used in three steps: scouring of raw wool, scouring of yarns, and in fulling or (shrinking) of woolen cloths. In the scouring of raw wool and in the fulling of woolen cloth, a soda soap of coconut oil and tallow and grease, or palm oil is often used. Titer is generally of the order of 38 to 39°C. The soap should contain not more than 1% of alkali builders. Olive oil was formerly used but is quite high in price to merit much consideration.

In the scouring of wool yarns and fabrics the purpose is to remove the spinning oil. In some yarns the oil to be removed is red oil, and a red oil soap is recommended. In the other yarns that have been oiled with mineral oil, a soap of greater detergent power is desired. All soaps must rinse well from the fibers.

The silk soap is used for two purposes, degumming (removing sericin-gummy coat) and dyeing. Probably the most popular soap for degumming is the red oil soap which is considered excellent, easily soluble and odorless. Olive oil and especially olive oil foot soaps are also used. Palm oil and lard oil soaps are occasionally used but are not as soluble. Tallow soap is never used since it is too slowly soluble.

In the dyeing operation the preferences were formerly for soaps similar to those used in degumming. However synthetic detergents of the non-built variety are finding ready acceptance because acids such as acetic and sulfuric are frequently used in this bath.

In cleaning cotton yarn a "Kir" boil is made, using either a red oil flake or a jelly soap to remove waxy material. For cleaning cotton fabrics an ordinary chip soap is suitable. Alkaline builders do not harm cotton and thus facilitate the removal of dirt.

The alkyl aryl sulphonate synthetic detergents are quite popular for cleaning the synthetic fabrics, such as rayon and nylon.

Synthetic Rubber Soap. A specialty soap which was non-existent until recent years is the soap which is produced for use in the emulsion polymerization of synthetic rubber. The 1951 usage of this soap was in excess of 75 million pounds, and it is estimated that it will reach 100 million pounds this year.

In the manufacture of synthetic rubber of the butadiene-styrene type the ingredients are emulsified in a water solution of about 5% soap and then polymerized to form a synthetic latex. In the so-called hot process, which is carried out at 122°F., a soda soap meeting very rigid specifications is desired. These specifications were established by the Rubber Reserve Company. They not only specify the fat to be used but to a certain extent the processing.

Generally these soaps are produced by soda-saponifying a hydrogen-stabilized fat stock of tallow or grease. Among the specifications is the important requirement that the polyunsaturated fatty acids be reduced by hydrogenation to well under 1%. This control is accomplished by use of a spectrophotometer employing an ultraviolet light source.

Recently a number of installations have been made in which the polymerization is carried out at low temperatures of about 41°F. Because of the limited solubility of these stabilized soda soaps, potash soaps are being used. These include the potash-saponified stabilized tallow chip soap and also certain potash-modified, rosin-based products.

Wire Drawing Soap. Another powdered soap specialty use of some importance is that of wire drawing. This requirement is for a powdered material, and while solubility has no bearing on this usage, about 5 million pounds of a soda-saponified tallow soap are used each year. In addition, some 10 million pounds of water-insoluble calcium soap is also used. This product will be discussed in more detail later.

Although we will not discuss in detail the many specialty uses of the soap pastes, jellies, and creams, it would be well to list the more important: shaving cream, cream shampoos, cosmetic creams, toothpastes, mechanics' paste hand soaps, synthetic rubber soap, drycleaning soaps, and leather soaps.

Shaving Cream. As we have already stated, the shaving creams of the lather and of the no-lather type are more or less replacing the shaving bars and powders formerly used. Production of soap based products, which we will discuss, is over 20 million pounds per year.

In composition there is not a great deal of difference between the soap-based shaving creams of the lather and those of the no-lather type. In both creams it is important that they remain soft on storage in collapsible tubes and that they extrude as creams without losing form. They must cover the face readily and remain moist; they must not smart or irritate the face during or after shaving; they must rinse readily from the razor; they must not attack or corrode the tube; and they should be acceptably perfumed and attractively packaged. The lather cream must, in addition, give a close, abundant lather that remains visible and moist until shaving is completed.

The manufacture of a shaving cream which will meet all of these requirements is not easy. A basic fat formulation for a shaving cream of the lather variety would consist of about 80% stearic acid, 10% coconut oil, and 10% tallow. The tallow-coconut oil blend should be soda-saponified and the stearic acid potash-saponified, leaving 3 to 5% free stearic acid. The total soap in the cream should be of the order of 35 to 50%. Five per cent of glycerine is usually added along with small amounts of such materials as boric acid, mineral oil, witch hazel, and perfume.

The brushless or no-lather shaving creams possess certain advantages over the lather creams. They require no brush and thus are easier to carry when traveling. They may be applied rapidly. They give a more comfortable shave because they soften the beard thoroughly. They leave the face with a thin coating of oil which protects skin susceptible to chapping.

As in the lather cream, stearic acid is the principal ingredient. Ordinarily, 10 to 25% of the fat used is coconut oil, although this is eliminated in many cases since lather is not desired. The soap is usually potash- or triethanolamine-saponified. Skin-conditioning ingredients, such as borax, boric acid, glycerine, mineral oil, beeswax, spermaceti, and lanolin, are used in more liberal quantities than is possible in a cream which must lather. A wetting agent is sometimes added for the purpose of increasing spreading power and rinsing qualities. Certain germicidal substances, such as hexachlorophene, have been used to give antiseptic qualities.

Cream Shampoos. It is estimated that the total production of shampoos in the U. S. is of the order of 100 million pounds per year, being very roughly ⅓ soap base and ⅔ soapless. A good shampoo should cleanse the hair, leaving it soft with natural lustre. It should not leave the hair excessively dry or oily. Cream shampoos are sold as liquid creams and solid creams. Essentially they are composed of soap or wetting agents which are super-fatted with lanolin, cetyl alcohol, and/or waxes. The cream shampoo is a fairly recent development in this field, but, because of large scale advertising and an acceptable product, it is rapidly gaining favor. In the soap type triethanolamine and coconut fatty acids are commonly used while the soapless products may contain a wide variety of synthetics such as alkyl aryl sulphonates, alkyl sulfates, etc.

Toothpastes. In the manufacture of certain toothpastes, a potash paste soap is used in preference to the powdered soda soap previously mentioned. The fat for this type of soap is usually soya or corn oil or their fatty acids. This type of product is finished neutral and with about 40 to 60% soap. It is compounded with a mild abrasive, such as chalk or magnesia, and a suitable flavor type of perfume.

Mechanics' Paste Hand Soap. The production of abrasive paste hand soaps is about equivalent in volume to the abrasive powdered hand soap. They are used for the same purposes of removing imbedded grease and soil. They are often preferred by the mechanic because the paste can be taken on the hands and worked into the soil prior to using water whereas the bar and powdered products require preliminary wetting before use.

These hand pastes are generally made by mixing an ordinary soap chip with water to form a paste. To this is added about 5% silicate of soda and a little glycerine. The abrasive used may be pumice, fine sand, or silica. In some cases sawdust is used as an abrasive filler. A perfume such as sassafrass, citronella, or pine oil is often used. The finished products ordinarily contain from 10 to 30% soap; 25 to 50% abrasive with the balance moisture and other additives. The small percentage of silicate aids in forming a firm paste and helps to prevent the abrasive from settling out. Petrolatum, flour, and starch are sometimes incorporated for the same purpose.

Drycleaning Soaps. The total production of drycleaning soaps is of the order of 25 million pounds annually, and while the process in which these products are used does not differ greatly from ordinary laundering, the process for making them presents problems not encountered in the usual soap-making operations. The equipment used in drycleaning resembles the wash wheel of a commercial laundry except that it is set up for the use of petroleum or chlorinated solvents instead of water.

There is still a considerable quantity of paste and liquid type of soap-based products being produced and used for drycleaning. However the liquid detergent containing synthetic wetting agents is very important on today's market.

The soap-based type product contains up to 50% anhydrous soap and usually contains from 10 to 20% free fatty acid. The balance of the product is mainly organic solvent, a minimum of water being present. The fatty composition is principally stearic and oleic. Various alkalies such as soda, potash, ammonia, calcium, and triethanolamine are used. It is important that there be no separation of the organic solvent and the soaps. These soaps are made especially for use in either petroleum or chlorinated solvent by incorporating such solvents in the soap product at the time of manufacture.

The drycleaning products containing synthetic wetting agents are mainly liquid.

Leather Soaps. While quantities of soap are sold as leather soaps to be used in leather finishing, in composition they are similar to those used by the textile industry. Special uses for soap in connection with the leather industry involve shoe cleaners, whiteners, creams, polishes, leather dressings, and so-called saddle soap. We will not attempt to discuss these in detail, but it is interesting to note that in spite of the passing of the horse and buggy days considerable quantities of saddle soap are still used in cleaning miscellaneous leather goods. A saddle soap is essentially a soda-saponified palm oil soap containing a little rosin and 1 or 2% of a hard wax.

The liquid soaps in our group of specialty products are shampoos, medicated liquid soaps, and sanitary supply soaps.

Liquid Shampoos. For shampoo usage the liquid product still remains at the top in sales. In discussing the liquid shampoos, it is customary to consider them as soapless and soap based products. The soapless shampoos may be lathering or non-lathering. The lathering product is most popular today and generally contains from 15 to 25% of an alkyl sulfate or about the same amount of an alkyl aryl sulfonate. Due to the drying characteristics of these synthetics, a hair-conditioning additive is often used. The soapless shampoo of the non-lathering variety has lost much of its popularity. It is based primarily on a sulfonated oil, such as castor or olive oil.

The liquid soap type of shampoo is preferred by many users. It is generally based on coconut oil, potash saponified, although in recent years soya, corn oil and red oils have been used to replace up to 50% of the coconut oil. This reduces the lathering properties but also makes the product milder in use. These products are sold in concentrations varying from 15 to 40% solids. Perfume, alcohol, glycerine, propylene glycol, borax as well as many of the additives given earlier for medicated and cosmetic soaps have been added to these shampoos. Tar and almond oil shampoos were quite popular at one time.

Medicated Liquid Soaps. The use of additives in these liquid shampoos leads us directly into our next classification of medicated liquid soaps. The history of these products is quite similar to that of the medicated bar soap. The synthetic chlorinated phenol, hexachlorophene, is now being incorporated into liquid

soaps by a number of manufacturers. It is being sold mainly for use in dispensers by hospitals and institutions. It has proven popular in certain hospitals for use in surgical scrub because of possible economy of use where bars may be wasted after a single scrubbing operation.

Sanitary Supply Soaps. Specialty soaps for the sanitation field has grown into a 100-million-pound business. Where formerly only such products as hotel bar soap, washing powders and the like were available, a full line of specialty products has developed. These include dishwashing compounds, liquid hand soaps, liquid scrub soaps, and liquid disinfectants. One characteristic seems predominant in the volume products used in this field, i.e., the use of potash soaps.

One of the volume items is the scrub soap. This should be mild in action, dissolve readily in lukewarm water, rinse off readily and cleanly, produce good suds, should not damage floor surfaces, and should leave a pleasant odor. The pine oil scrub soap which contains about 15% soap and 2 to 5% pine oil serves these requirements except for use on asphalt or rubber tile. Here it has been found advisable to use a potash soft soap based on soya, corn or linseed oils, or their fatty acids. This soap may be made up to about 80% solids and thus saves freight on volumes of water. It is diluted to a liquid before use.

The 15% liquid hand soap is another volume item in the sanitation field. It is usually 100% potash-saponified coconut oil although it sometimes contains up to 50% of other oils, such as soybean. Its principal use is in dispensers. Developments with sequestering agents have produced a very acceptable product.

Water-Insoluble Soaps

We seldom consider that there is a wide field of useful soaps which are not even soluble in water. As a manufacturing operation in a separate establishment, production of such products is of the order of 75 to 100 million pounds per year. Figures are not available on the quantity produced directly in the plant in which they are used, but it is in the millions of pounds.

These water-insoluble soaps are generally known as metallic soaps. The number of metallic soaps extends into the hundreds. Their principal uses are in driers, lubricants, textiles, papers, and pharmaceuticals. The group consists of all the alkaline earth and heavy metal soaps except for sodium and potassium.

The fatty or organic acid anion of the soap may be from practically the same sources as are used for the common detergent soaps such as coconut oil, lard, linseed oil, soybean oil, and tallow. Commercially, pure acids such as stearic, palmitic, naphthenic, and oleic are also quite important. Rosin and tall oil are also used in fair quantities.

The metallic soaps are important because of their unusual properties. Although insoluble in water, they are quite soluble in many solvents and oils and are dispersible or jel-forming in others. The specific fatty or organic anion used influences the solvent and oil solubility and, where this is important, controls the choice of acid. Acids of low molecular weight naturally react with greatest quantity of metal. Straight chain acids and saturated acids have the least solubility whereas branched chains and unsaturated acids are more soluble. The naphthenates, linolates, and resinates are more soluble than the stearates and palmitates. As to the solvent, in general, the lower the molecular weight, the lower its solvency for the soaps. Naphthenic solvents are twice as effective as aliphatic solvents and aromatic solvents about four times as effective.

This property of solubility in non-polar solvents and drying oils plus the ability of the metallic soaps to act as catalysts in the oxidation and polymerization of paints and varnishes is the basis of their use as driers. The efficiency of a particular metallic soap as a drier is dependent on the specific metal cation.

Lead soaps are excellent polymerization catalysts. They are generally used along with good oxidation catalysts such as cobalt and manganese soaps. Cobalt is a very fast oxidation catalyst and for this reason is used in inks which must surface-dry very rapidly. Zinc, calcium, and iron soaps are also important to the paint and varnish maker. Calcium and manganese soaps are fume-proof and are used to prevent staining that would result from dark lead sulfides. Iron soaps improve gloss and toughness of baked finishes.

Another important property of certain of the metallic soaps is toxicity. The toxic effect of copper, mercury, and zinc toward fungi is so marked as to render them valuable for treating wood, concrete, cloth, rope, and other materials which are deteriorated by fungi. The metallic soaps are an ideal form in which to use these metals since they are relatively insoluble in water and thus rain does not destroy the effectiveness of the cation. The lead and mercury soaps are used in pharmacy for producing ointments for treatment of skin troubles.

The metallic soaps might be called a surfactant in that they can change the surface activity of any substance to which they can be made to cling. This is the basis of their use in sizing, waterproofing, dispersing, lubricating, and other surface actions. These properties are important in waterproofing materials all the way from textiles to concrete highways.

The ability of certain of the metallic soaps to form jels is of basic importance for their use in the manufacture of lubricating greases. Calcium, lithium, and aluminum stearates are the most widely used metallic soaps for grease-making. For this use they are compounded with petroleum oils. Aluminum stearate greases, when properly made, have a buttery, nonbleeding, transparent structure. The jelling property of aluminum soap is also important in the production of jellied gasoline, better known as "Napalm." With mineral spirits it is used to prepare silk screen paints. The aluminum soaps are also used as carriers for penicillin to extend the effective time of injections up to 96 hours.

Another property of the metallic soaps is their ability to plasticize resins and harden waxes and asphalts. Manufacture of wax crayons and candles is an example of this property in use.

The property of unctuousness or lubricating value is also very important. There are numerous illustrations of this property. A few are a) zinc stearate used for dusting powder in cosmetics; b) barium, calcium, lead, and zinc stearates used as dry lubricants in plastic molding; c) calcium and zinc stearates used in powder metallurgy where they lubricate metal powders as they are molded into shape; d) calcium and magnesium stearate used in the manufac-

ture of pills; e) calcium and aluminum stearates used for wire drawing to prolong the life of dies; f) zinc stearate used to prevent unvulcanized rubber from sticking together; and to leave a glossy surface after vulcanization. These uses serve to illustrate the wide application of insoluble soaps as well as their properties.

Metallic soaps are often made in specially designed plants. However considerable quantities are produced in the plant in which they are to be used. For example, in sizing paper aluminum sulfate and a sodium soap are mixed into the pulp and converted to aluminum soap during paper-making operations. Another example is in the rubber industry, where zinc oxide and fatty acids are milled into crude rubber to form metallic soaps later during curing.

As a separate operation the metallic soaps are produced by one of two processes, i. e., fusion, or precipitation.

The fusion process is the simpler and requires less expensive equipment to operate. By this process the organic acids are mixed directly with sufficiently reactive forms of the metals and heated to a relatively high temperature. Volatile solvents are sometimes added to improve fluidity of the mix and aid in distilling off the water. Disadvantages of this process are that some metals are not readily available in a sufficiently reactive state and the organic acids used are often too weak to react completely so an excess of one or the other or both is possible. Excessive temperatures and prolonged heating causes other reactions, such as polymerization and darkening, which may impair the utility of the product.

In the precipitation process the reaction is by double decomposition. The acids and metals are both used in a water-soluble form as 10 to 25% solutions, and, when mixed, the water-insoluble metallic soap is precipitated. The precipitate may be a floating oily layer or a granular solid depending on the organic acid and metal used. The precipitate is washed free of soluble salts and dried. In this process almost any soluble form of the metals and organic acids may be used. Usually the metal salts used are the chloride, sulfate, or acetate. The acid is generally used in the form of the sodium soap. Where it can be used, the precipitation process gives the purer product since the impurities can be washed out. In general, it requires more equipment, such as tanks and filters, than does the fusion process.

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