significant bearing on the manufacturing cost of soap and on the particular production processes used in soap-making and fat-splitting.

Currently the economic balance for detergents based on fatty alcohols and fatty acid derivatives for wetting agents, emulsifiers, and the like must also include the value of glycerine as an important factor. There is a strong likelihood that the decline in glycerine recovered from fats has about run its course.

Of course, glycerine remains a product having world-wide ramifications on both the supply and demand side. In England and on the Continent there is the same tendency to shift from fats to synthetic detergents going on, but with a time lag of three to five years. On the other hand, a great growth-potential for soap, including good-old-fashioned bar soap, still exists in populous countries where *per capita* soap consumption is still low. In a country like India, for example, soap usage seems likely to grow for many years, and at a faster rate than the local glycerine demand. Japan is another example. Running water in the home is limited to less than 30% of the population. American exporters of tallow are actively cooperating on a program to encourage soapmaking and soap consumption in Japan. An estimated 10% increase in soap production in 1958 in Japan is expected to add to its glycerine-exporting tendency.

The adaptability of surplus fats to tomorrow's chemical processes and products is likely to be wider *via* fatty acids rather than as glycerides. This also suggests the fact that glycerine from fats will continue to be an important market factor for the foreseeable future.

A few hundred tons of foreign crude glycerine are a highly negotiable commodity with which a country like Argentina can get badly needed dollars. Existing refining capacity, not only in soap plants but in independent or user companies, is available to prepare it for market.

The producers of glycerine from propylene are keenly aware that they face a problem of building new markets, rather than simply "filling a hole" caused by the decline of domestic soapmaking. Their continuing investment in facilities confirms their belief that glycerine has the properties that make it a growth chemical potentially as well as historically.

It will be interesting to see if glycerine's growth pattern finally does fall into the rational, well-researched development pattern of the chemical marketing specialist or if, as so often in the past, some fortuitous discovery or unexpected factor in the world economy opens new horizons now unforeseen.

Dermatologic Aspects of Soaps and Detergents[1]

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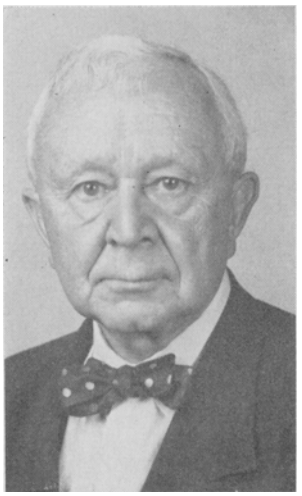
SOAP has been safely used as a cleansing agent by millions of people for hundreds of years. Practically everybody in the civilized world today uses soaps or other detergents, and the incidence of dermatitis is low indeed. However within the last few years it seems that dermatologists see more cases of dermatitis from cleansers than formerly. There may be a number of reasons for this. The importance of cleanliness as a hygienic and prophylactic measure is being more and more emphasized, consequently more and more people use cleansers more and more frequently. Cleansing compositions are now more complex than they formerly were. Where previously only soaps were used, now the syndets are coming into use; mixtures of soaps, syndets, and water-softening agents are sold on the market, especially as household cleansers. In recent years domestic help has become more and more difficult to obtain, and the lady of the house must do an increasing amount of domestic work. She washes dishes and clothes, scrubs floors, sinks, and toilets. Hence, despite the automatic dishwashers, clothes washers, and floor cleaners, a greater number of people have more contact with stronger cleansers than ever before.



Louis Schwartz

Most cases of dermatitis attributed to cleansers are not caused as much by actual allergy to the cleanser as they are by the fact that certain people have such anatomical or physiological defects of the skin that it cannot rapidly regenerate the epithelium and the secretions removed by cleansers. Drying and chapping of the skin result, especially if the skin is excessively exposed to these detergents, as in the case of domestics, housewives, washwomen, kitchen workers, soda fountain attendants, etc.

Soaps constitute the large percentage of skin-cleansing materials. The soaps used for skin cleansing are sodium or potassium salts of long-chain fatty acids. There is a difference in the skin irritant potential of soaps. The long-chain fatty acid soaps are less irritant than the short-chain, and soap solutions having a high pH are more irritant than those having a low pH. Soaps containing a high amount of free alkali are more irritating than those having a low amount. Rosin soaps are more apt to be irritant than fatty acid soaps. A rosin short-chain fatty acid soap with a high pH and a high amount of free alkali would be one with a high skin-irritant potential.

Cleansing Action of Soaps

The soap molecule is both hydrophilic and lipophilic. Hence soap can combine with both oil- and water-soluble substances and make a stable emulsion

[1] Dinner lecture.

with them. Soaps also lower surface tension, and this enables the emulsified soil to be flushed off the skin. Soap solutions, because they lower surface tension, have the ability to penetrate the pores and crevices of the skin and to emulsify and remove whatever soil is deposited. This ability also enables the soap to remove from the skin the natural sebum, oils, waxes, and moisture which go to make up the so-called protective "acid mantle" of the skin. The removal of stale acid mantle from the skin before it undergoes decomposition and develops offensive odors is desirable, and fortunately the skin of by far the large majority of people quickly regenerates a fresh acid mantle. But there are a few people—those with dry, thin skin—who cannot quickly regenerate the normal skin fats, and if they excessively use skin cleansers, especially in cold weather, are likely to have dry, chapped, fissured skin.

Soap solutions tend to denature the keratin of the skin by disturbing the sulfhydril groups of the keratin molecule. The denaturing of the keratin molecule is reversed by air oxidation so that if the softened keratin is not removed from its site, it soon becomes hard again. Even if some of the loose superficial cells of the keratin layer are washed away by the softening and cleaning action of soap, they are soon replaced in cases with normal young skin; but this process does not take place as rapidly in older people with dry skin.

Soaps and other detergents are both primary irritants and sensitizers.

A primary skin irritant is one which will cause dermatitis at the site of contact if it acts in sufficient concentration for a sufficient time. A primary irritant enters into chemical combination with the skin or removes from it one or more of its essential constituents. Soaps and detergents have such action on the skin.

A sensitizer is a substance which at first contact seems to have no adverse effect on the skin but which so sensitizes or conditions the skin that, after an elapsed time (five days or longer), second or further contact on any part of the skin may cause dermatitis. Soaps and detergents can act as sensitizers.

The composition of soaps vary with the purposes for which they are to be used.

Hand Soaps

Modern hand or toilet soaps are among the least irritant skin-cleansers. Government specifications require that they contain only a negligible amount of free alkali. Most of them are made of long-chain fatty acids, and skin irritation from their normal use is rare. There are however soap compositions which contain chemicals to accomplish special purposes, and these chemicals may add to the irritant properties of the soap. For instance, there have recently come on the market the deodorant soaps. They consist of a good toilet soap base, to which antiseptics or bacteriostatic compounds, such as hexachlorophene, tetra methyl thiuram disulfide, and others, are added. When the soaps are used, these chemicals have the property of accumulating on the skin and building up in sufficient concentration to reduce the growth of bacteria which decompose the skin secretions into compounds having offensive odors. While there have been some cases of allergic dermatitis attributed to these bacteriostatic compounds, the incidence is extremely low. There are also medicated soaps containing such chemicals as tar and salts of mercury, which are sometimes used in the treatment of dermatological conditions. They have a higher irritant potential than regular hand soaps.

Shampoos

Mixtures of soap with ionic or nonionc detergents are used as shampoos. Foaming agents, emollients, thickening agents, perfumes, antiseptics, etc., may also be incorporated. Various emollients and conditioning agents are often added for the specific purpose of reducing skin-irritating properties. Some of the chemicals used for emollient purposes are lanolin, natural gums, polyvinylpyrrolidone. However the best way to lower the skin-irritant properties of shampoos is to make them of detergents which have a low skin-irritant potential.

One of the hazards of shampoos is eye irritation. Cases have been reported of severe conjunctivitis from shampoos containing the quaternaries, and one of the requirements of the Food and Drug Administration for shampoos is tests on the eyes of rabbits wherein the eye-irritating property of the shampoo is compared with that of a standard soap. The method was developed by Dr. Draize of the F.D.A.

Syndets

While soap is a manufactured product, nevertheless it is not classed as a syndet. The syndets have certain advantages over soap. For instance, they can be used in hard and soft water. They can be made to have a pH corresponding to that of the skin and therefore can be used by some people who are allergic to alkaline soaps. Some of them have greater wetting, penetrating, degreasing, and detergent properties than soap. Some of them have marked antiseptic and fungicidal properties.

On the other hand, the syndets as a class have greater defatting, drying, penetrating, and sensitizing effect on the skin than soaps.

The syndets can be classified into three classes according to their electrolytic properties.

1. The anionics were the first to appear on the American market. Examples are Gardinol, Igepon, Nacconol, Aerosol. The anionics are miscible with soap and the nonionics.
2. The cationics, also known as quaternary ammonium compounds, have germicidal and fungicidal properties. The Hyamines, Roccals, Emulsepts, are examples of quaternary ammonium compounds. The cationics are miscible with the nonionics but not with the anionics or with soap.
3. The nonionic detergents are widely used in cosmetic preparations. Examples of nonionic detergents are the Spans, Tweens, Tritons, Antarox, Pluronics. The nonionics are miscible with soaps, anionics, and cationics.

While each particular syndet has its own skin-irritant potential, studies show that as a class the nonionics are less likely to irritate than the anionics, and the anionics are less likely to irritate than the cationics.

Industrial Soaps

Manufacturers are aware of the fact that cleanliness is the best preventive of industrial dermatitis, hence the great increase in the use of industrial cleansers.

Industrial soaps are available as solids, liquids, and powders. The solid or cake soaps are similar to the toilet soaps described above. They are mostly used by workers at washstands and by industrial workers in shower baths.

Liquid soaps are solutions of the potassium salts of fatty acids. They are suitable for the removal of light soil and are chiefly used by offiee workers and in public toilets.

Powdered soaps are most frequently used in industry for the removal of heavy soil from the hands. To facilitate the removal of imbedded dirt, substances are added to the soap which will assist in scrubbing the foreign soil from the skin. These are known as scrubbers.

Some of the scrubbers are water-soluble; the friction element ceases as the scrubber dissolves. The soluble scrubber consists of a granular or coarsely powdered chemical, such as borax, which before it dissolves in the water tends to scrub away the soil, thus helping to remove it from the skin.

The insoluble scrubbers may be either vegetable or mineral. The vegetable insoluble scrubber consists of ground vegetable matter such as cornmeal, wood flour, rice hulls, peanut hulls, etc., ground so finely that they will not abrade or scratch the skin. The scrubbing action of a powdered industrial soap can be best obtained by first moistening the hands with water and then placing some of the granular material on the palms and rubbing it so that it makes a paste. This paste can then be thoroughly rubbed into the hands and fingers before more water is added. This procedure is continued until the soil is removed from the skin. The mineral insoluble scrubbers usually consist of pumice, silica, or finely ground sand. They are used in cake soaps and paste grit soaps as well as in powdered soaps and are used for the rapid removal of heavy tenacious soil from the hands. The mineral scrubbers, unless very finely powdered, may abrade the skin.

Some manufacturers of industrial soaps add a certain amount of lanolin, cholesterol, lecithin, or protective colloid to their soap. The superfat may be added either to the soap or to the scrubber. There is some disagreement as to the value of superfat in soap. Dr. Unna, the great European dermatologist, has stated that superfatting of soaps ameliorates their defatting action on the skin. I myself subscribe to this theory, especially if the superfat is added to the scrubber instead of to the soap.

Antibacterials Added to Soap

It has been known for many years that soaps themselves have considerable antibacterial action, but it was only about 15 years ago that it was shown that certain chemicals, when added to soap, considerably augment their antibacterial action. These antibacterials are now added to industrial as well as toilet soaps.

The first of these chemicals was G-11 Hexachlorophene (2,2′-Dihydroxy 3,5,6,3′,5′,6′-hexachloro diphenyl methane). It was shown that repeated washings with soaps containing G-11 builds up a concentration of the chemical on the skin and, by diminishing the bacterial flora, markedly reduces the bacterial decomposition of the skin secretions, acting as a deodorant as well as tending to prevent superficial skin infections. There are available a number of industrial soaps as well as toilet soaps containing such chemicals.[2]

Repeated daily use of soaps containing these antibacterials will maintain the cumulative effect, but discontinuance of the use of the bacteriostatic soap and the use of an ordinary soap will remove the accumulated bacteriostat from the skin and the bacterial flora will again reach normal. The incidence of dermatitis from soaps containing these antibacterials has been no higher than from ordinary soaps.

Sulfonated Oils

The wetting properties of the sulfonated oil have long been known in the textile industry. It was from the use of Turkey Red oil used in the textile industry that it occurred to me to use sulfonated oils as hand cleansers for those who cannot use soap without developing dermatitis.

The sulfonated oils can be made with a pH approximating the skin, and they can be superfatted with unsulfonated vegetable oil for the use of workers who must frequently remove heavy soil from dry, defatted alkali-sensitive skin.

The sulfonated oils used as industrial cleansers may be sulfonated castor oil or other vegetable oil and even sulfonated mineral oil. Sulfonated oils are anionic and may be mixed with all but the cationic syndets. The antibacterials may also be incorporated into them. The sulfonated oils are good skin cleansers and may be used to advantage by workers to remove from the skin tar, petroleum oils, organic solvents, and other skin-defatting chemicals. Some workers object to their use because they do not foam.

Waterless Hand Cleansers

In the last few years waterless skin cleansers have come on the market and they are being extensively used, especially where greasy, tenacious soils are contacted, such as in machine shops, automobile service stations, etc. They do not require additional water to act as cleansers as do other cleansing agents and therefore are of use at the work benches when soap and water are too far away for frequent trips to remove soil from the hands. Waterless cleansers are useful for temporary removal of soil from the skin, mostly to facilitate the gripping of objects with the fingers and hands. Even after using waterless cleansers, the hands should be washed with water-soluble cleansers several times a day in order to keep the skin really clean and to remove from the skin the strong chemicals in the waterless skin cleanser.

The early formulations of waterless cleansers contained solvents and strong alkalies which often caused skin irritation. The modern waterless cleansers contain a minimum of these materials. In addition to a highly refined deodorized petroleum hydrocarbon, they may contain wetting agents such as the Spans, the Tweens, emollients such as lanolin, a perfume, and a large percentage of water, the last denying the name "waterless" hand cleanser. The sulfonated oils can act as waterless hand cleansers.

Waterless hand cleansers provided at the work bench discourage the worker from using the irritating industrial degreasing compounds, such as solvent naphthas, Stoddard Solvent, etc., for rapidly cleaning greasy soil from the skin.

Household Cleansers

These may contain soap, anionic detergent, nonionic detergent, or mixtures of these types. They may also

[2] Dial containing Hexachlorophene; Lifebuoy containing Thiurad (tetra methyl thiuram disulfide); and Actamer (2,2 Thiobis (4.6, dichlorophenol).

contain considerable percentages of such alkaline salts as sodium carbonate, sodium silicate, tri-sodium phosphate, sodium tri-polyphosphate, tetra sodium pyrophosphate, chelating agents, sodium sulfate, and small amount of bleaches.

The so-called heavy-duty household detergents such as Tide, Fab, All, Rinso, Cheer, etc. contain considerable percentages of the polyphosphates, and they add considerable to the potential irritant properties of these cleansers, especially if the hands are frequently immersed in them.

The light-duty detergents such as Dreft, Breeze, Vel, etc., contain these chemicals in smaller proportions than do the heavy-duty cleansers. The liquid household detergents, both light- and heavy-duty, are aqueous solutions of the above compounds except that the polyphosphates are usually the potassium rather than the sodium salts.

Clinical Appearance of Dermatitis from Cleansers

The usual site of dermatitis from cleansers is on the hands (housewives' eczema, dishpan hands). In acute cases the back of the hands may be red, swollen, blistered, and oozing. The inflammation may spread up the forearm. The skin in the finger webs may also be affected. Secondary fungus and bacterial infections may complicate the condition; the skin around the nails may be affected and may even contain pus. A generalized dermatitis may result from soaps used in the bath.

The cases of chronic dermatitis from skin cleansers may also involve the palmar surfaces of the hands and fingers. The palms may be dry, fissured, and thickened. The back of the hands may be red, dry, and scaling. The skin around the nails may be red and indurated and contain pus. Such chronic dermatitis occurs among scrubwomen, dishwashers, laundry workers, soda fountain attendants, and others who have their hands wet with cleansers for many hours of the day.

Treatment

Treatment of acute dermatitis from cleansers consists in avoiding contact not only with the particular causative detergent but with all detergents until the inflammation subsides. The acutely inflamed skin can be cleaned, if necessary, with olive or other vegetable oil. If the eruption is vesicular and oozing, it is well to first apply wet dressings of evaporating lotions such as an aluminum acetate solution 1–200 until the inflammation and oozing subside. Afterwards soothing ointments containing Cortisone or its derivatives may be applied. After the inflammation subsides, the skin can be cleaned with the sulfonated vegetable oils, and rubber gloves should be worn if the hands must again be immersed in the detergent solution which caused the trouble.

Chronic dermatitis is treated by avoiding contact with the cleanser which caused it and by applying soothing Cortisone ointment, over which cotton gloves are worn. If it is necessary to continue work, rubber gloves over white cotton gloves should be worn. The skin can be cleaned with sulfonated vegetable oil, and a hand lotion containing a fatty emollient should be used after each washing of the hands and before retiring. Secondary infection may be treated with antibiotics topically or internally.

Prevention

The prevention of dermatitis from skin cleansers begins with the manufacture of the cleanser. Skin cleansers should be composed of surfactants having low skin-irritant potentials—as low as possibly consistent with the cleansing duties they are to perform. It is not enough however to know the skin-irritant properties of the components of the cleanser. The skin-irritant properties of the cleanser itself must be tested. In performing these prophetic patch tests, a control should always be used. The control should be a cleanser long on the market for the same purpose as the intended cleanser, which has not caused any undue amount of skin irritation. The prophetic patch test should always be followed by a limited usage test for several months in a small community. Such a test must be satisfactorily passed by the cleanser before it is manufactured in sufficient quantities to place on the general market.

The users of cleansers must not abuse them, that is, the hands should not be washed too frequently, even with a recognized good toilet soap. The hands should be wiped dry after each washing. The hands should not be immersed in solutions of cleansers for long periods of time. If it is necessary to do so, impervious gloves should be used or water-repellent protective creams, or both.

The skin should not be exposed to the action of household detergents. When household detergents are used, wear gloves or use protective creams, or both. If the skin has been exposed to them, it should be rinsed off with water and dried, and an emollient cream or lotion should be applied to the skin. The same is true of cleaners meant for sinks, bath tubs, floors, walls, etc. It is not the proper use of cleansers that causes damage to the skin but rather the abuse, over-use, or improper use of them.

Young, oily skins can withstand more abuse by cleansers than can older or drier skins. Nevertheless even young people with active oily skins should also adopt the above outlined preventive measures.

The reasonable and proper use of cleansers is beneficial, sanitary, and esthetic, but the over-use or improper use may cause dermatitis.