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DETERGENT COMPOSITION

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This invention relates to a soap composition and more particularly to a detergent composition containing soap together with a mild acidifying agent and a dispersing agent capable of maintaining the detergency of the soap at low pH values.

Ordinary soap (by which term is meant the alkali metal salts of higher fatty acids such as stearic, palmitic, oleic acid and the like) is strongly alkaline when in aqueous solution, since it is a salt of a weak organic acid with a strong base. Thus, for example, even high grade toilet soaps exhibit a pH of about 10.0–10.5 in water solution. It has long been recognized that this degree of alkalinity has a harmful and irritating action on the skin, and recently it has been shown that severe cases of dermatitis are traceable to this cause. It is a principal object of the present invention to provide a soap composition in which the natural alkalinity of the soap is reduced to a range wherein these undesirable properties are avoided.

It is a well known fact that soap loses its detergency upon the addition of water-soluble acids or acidic materials, even when it is only partially neutralized. Thus, for example, acidification to a pH of only 8.5 will result in a complete loss of wetting and detergent properties, and at a pH of 8.0 the soap loses about 10–20% of its fatty acids content. When the acidification is continued to pH values of 7.2 to 7.4 about 50–60% of the fatty acids of the soap are liberated. These fatty acids possess no detergent properties and will separate out as a scum on the sides of the vessel and upon objects being washed. It is evident, therefore, that the admixture of ordinary soap with even relatively small quantities of an acidic material in an effort to reduce its natural alkalinity will only result in rapid deterioration and eventually in complete loss of detergency of the soap.

My present invention is based on the discovery that mildly acidic materials such as boric acid, tartaric acid, sodium or potassium acid tartrate, sodium acid phosphate and the like can be added to soap in quantities sufficient to reduce the alkalinity of the soap to a pH value of about 7.2–8.0 without destroying the wetting and detergent properties of the composition, providing certain quantities of surface-active agent containing a single long aliphatic chain of 8 or more carbon atoms are added to the composition. This discovery provides a soap composition which is only mildly alkaline and therefore has no deleterious action on the skin, but which has

wetting, sudsing and detergent properties equal and in some cases better than those of ordinary soap.

I have discovered that certain surface-active agents characterized by the presence of a single long aliphatic chain of 8–20 or more carbon atoms in the hydrophobic portion thereof are extremely effective dispersing agents in soap compositions containing acidifying agents. It is well known that surface-active or wetting agents are organic compounds containing hydrophobic or oil-solubilizing groups together with hydrophilic or water-solubilizing groups, these two groups being balanced in such a manner that the molecules of the compound possess the property of orienting themselves at an oil-water interface. I have found that those compounds of this class which contain one (but not more than one) relatively long aliphatic radical of at least 8 carbon atoms possess the important property of dispersing or solubilizing free soap-forming fatty acids, and that they will cause soap to maintain its detergent power within the pH range of 7.2–8.0 when added thereto in the proper quantities.

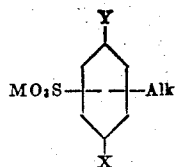
The range of surface-active or wetting agents used in practicing the invention is not limited by the type or types of hydrophilic groups that may be present. In the great majority of commercial wetting agents the hydrophilic portion of the molecule consists of or contains a sulfuric acid derivative such as a sulfonic acid or sulfuric ester group, preferably neutralized with sodium, potassium or other salt-forming base which forms a soluble salt therewith. However, wetting agents are also known which contain phosphoric acid radicals, and certain organic solubilizing groups such as aliphatic hydroxy, ether and amino groups will also impart water-solubilizing properties. The surface-active agents used as soap dispersants in the compositions of the present invention may therefore be defined by the formula $R-alk$, in which R is the hydrophilic portion of the molecule, characterized by the presence of a sulfuric ester, sulfonic acid or other water-solubilizing group, and alk is the hydrophobic portion which contains or consists of a long aliphatic radical of 8–20 or more carbon atoms.

I believe that the efficiency of the above-described class of surface-active agents in maintaining the detergency of soap at the relatively low pH values of 7.2–8.0 is due principally to the long alkyl chains which they contain. It is a well-recognized fact that the detergency of soap is due to the formation of micelles, or

minute bundles of parallel rod-like soap molecules orientated at the interface between the water and the object to be washed, which possess the property of carrying grease, soot and other similar water-insoluble materials into solution. These micelles are ordinarily destroyed when the soap is even partially acidified. I believe, however, that dispersing agents containing a long alkyl chain have a natural affinity for free fatty acids and will function to retain these micelles intact under acid conditions.

That this property is a function of a single long alkyl radical and is not inherent in wetting agents generally is shown by the fact that a wide variety of well-known wetting agents have little or no dispersing action on soap in the pH range of 7.2-8.0 and will not prevent its loss of detergency in this range. Thus, for example, sodium isopropyl and butyl naphthalene sulfonates, which possess only short alkyl groups, and such highly active wetting agents as sodium dioctyl sulfosuccinate (sold commercially as "Aerosol OT"), tri(2-ethyl butyl) sodium sulfotricarballylate (sold as "Nekal NS") and higher secondary alcohol sulfates (sold as "Tergitol"), which contain two relatively long alkyl groups, are ineffective for the purposes of the present invention. On the other hand the following classes of compounds, all of which contain a single long alkyl chain, are very effective for this purpose:

I. Water-soluble salts of mononuclear aromatic sulfonic acids containing a single long alkyl substituent of 8-20 or more carbon atoms. These compounds are defined generally by the following structural formula



wherein M is a salt-forming base which forms a water-soluble sulfonic acid salt, such as alkali metal, ammonium and the like, Y is hydrogen or hydroxyl, X is hydrogen or a phenyl group and Alk is an alkyl radical of 8-20 carbon atoms. This alkyl radical may be connected with the phenyl radical directly by a carbon to carbon bond or by means of an ether group, at any suitable point. Representative compounds of this type are available commercially under the trade names "Nocconol NR," "Keminol," "Santomer," "Triton NE" and "Ultrawet." "Nacconol NR" is the sodium salt of an alkylated benzene sulfonic acid obtained by condensing a chlorinated kerosene with benzene and sulfuric acid followed by neutralization with caustic soda. "Keminol" is a compound of the same general type in which phenol is substituted for the benzene. "Santomer" is an alkylated diphenyl sulfonic acid wherein X in the above structural formula represents the phenyl group C₆H₅ and the alkyl group contains about 8-10 carbon atoms. "Triton NE" is an alkyl-aryl ether sulfonate in which the sulfonic acid radical is attached to the aryl nucleus and the alkyl group contains about 12 carbon atoms. These solutions are sold commercially as a 40% product, the remainder usually consisting of sodium sulfate or other water-soluble inorganic salt. "Ultrawet" is also a monosodium benzene sulfonate containing an alkyl radical of 10-12 car-

bon atoms, but this material is sold as a 100% product and therefore contains no added salt.

II. Esters of sulfonated carboxylic acids with a single higher aliphatic alcohol and esters of a single higher fatty acid with short-chain sulfonated alcohols. Typical examples and their tradenames are the following:

Disodium monolauryl sulfosuccinate, "Aerosol NAL"

Disodium monooleyl sulfosuccinate, "Aerosol NAO"

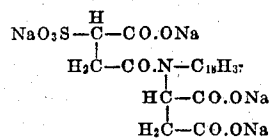
Sodium lauryl sulfoacetate, "Nocconol LAL"

Sodium stearyl sulfopropionate, "Igepon AP"

Trisodium monostearyl sulfotricarballylate

III. Sulfonated higher primary aliphatic alcohols of 8-20 carbon atoms and sulfonated higher aliphatic hydrocarbons of 8-20 or more carbon atoms containing the sulfonate group near the end of the chain, e. g. "Gardinol" and "Duponol MP 189."

IV. Sulfonated amides of higher fatty acids containing at least 8 carbon atoms and the corresponding higher alkyl amides of sulfonated carboxylic acids containing at least 8 carbon atoms in the amide radical, such as the stearic acid amide of taurine ("Igepon T"), N-octadecyl disodium sulfosuccinamate, and N-octadecyl (N-1,2-dicarboxyethyl) tetrasodium sulfosuccinamate of the formula



V. Unsulfonated amides and esters of higher fatty acids with polyamines and polyhydroxy polyamines, e. g. "Ninol 737," which is a mixed fatty acid alkylol amine condensation product wherein the fatty acid contains 12 carbon atoms.

In preparing the detergent compositions of the invention I add to ordinary soap a sufficient quantity of a mild acidifying agent to reduce the alkalinity of the soap to the desired pH of 7.2-8.0. About 18-20% of boric acid, based on the weight of the soap, or equivalent quantities of monosodium dihydrogen phosphate, citric acid, monosodium citrate or sodium acid tartrate may be used for this purpose. The proper quantities of dispersing agent may be incorporated into the composition either before or after the acid is added in amounts dependent upon the activity of the particular dispersing agent used. Thus, for example, most of the higher alkyl-aryl sulfonates of group I are used in amounts of 4-20% of the active dispersing agent, based on the weight of the soap and irrespective of additional quantities of sodium sulfate or other water-soluble salts that may have been included when the commercial product is used. However, I prefer to employ up to 50% of the product "Ultrawet" since this is a less powerful dispersing agent. About 4-20% or more of the alkyl sulfonates and alcohol sulfates of group III should be employed while 5-30% of the sulfo acid esters of group II and of the sulfonated amides of group IV represent the proper quantities. In all cases the best results are obtained when quantities approaching the upper limits are employed. The compound "Igepon T" is sold commercially as a 40% material, and 15-100% by weight of this material should be used, based on the weight of the soap, to obtain the best results. The sulfosuccinamates, on the other hand, are extremely active dispersing agents

and may be employed in quantities of 5-30%. The unsulfonated compounds of group V are preferably used in quantities of 3-30% on their 100% basis.

In addition to a major proportion of soap and the quantities of acidifying agent and dispersing agents outlined above, the compositions of my invention may also contain other auxiliary materials. Thus, for example, quantities of a sudsing agent such as di(methyl amyl) sulfo-succinate on the order of 5-10%, based on the entire weight of the composition, may be employed. Perfumes, plasticizers and other similar ingredients may also be added if desired. The soap, acidifying agent, dispersant and auxiliary material are preferably blended by mixing with a small amount of water, or by melting the soap and mixing in the other ingredients, after which the product may be molded into cakes in the usual manner. In this form it is well suited for general use as a toilet soap, particularly for those persons whose skins are sensitive to alkali. When larger quantities of water are added the product is an excellent shaving cream of the type ordinarily sold in tubes.

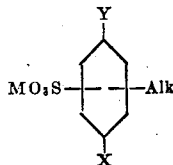
What I claim is:

1. A detergent composition comprising a major proportion of soap consisting essentially of alkali metal salts of fat acids, together with a quantity of an acidifying agent sufficient to reduce the alkalinity of the soap to a pH of 7.2-8 and about 3-30%, based on the weight of the soap, of a surface-active agent containing a hydrophobic portion together with a hydrophilic portion, said hydrophobic portion containing a single long aliphatic radical of at least 8 carbon atoms.

2. A detergent composition comprising a major proportion of soap consisting essentially of alkali metal salts of fat acids together with a quantity of an acidifying agent sufficient to reduce the

alkalinity of the soap to a pH of 7.2-8 and 3-30%, based on the weight of the soap, of a surface-active agent selected from the group consisting of sulfonated amides of fatty acids containing at least 8 carbon atoms and monoamides of sulfonated carboxylic acids containing at least 8 carbons in the amide radical.

3. A detergent composition comprising a major proportion of soap consisting essentially of alkali metal salts of fat acids together with a quantity of an acidifying agent sufficient to reduce the alkalinity of the soap to a pH of 7.2-8 and 3-30%, based on the weight of the soap, of a surface-active agent of the formula



wherein M is a salt-forming base which forms a water-soluble sulfonic acid salt, Y is hydrogen or hydroxyl, X is hydrogen or phenyl, and Alk is an aliphatic radical containing at least 8 carbon atoms.

4. A detergent composition comprising a major proportion of soap consisting essentially of alkali metal salts of fat acids together with a quantity of an acidifying agent sufficient to reduce the alkalinity of the soap to a pH of 7.2-8 and 3-30%, based on the weight of the soap, of a surface-active agent of the formula $MO_3S.R$, wherein M is a salt-forming base which forms water-soluble sulfuric ester and sulfonic acid salts and R is a member of the group consisting of alkyl and oxyalkyl radicals containing at least 8 carbon atoms attached to sulfur near the end thereof.

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