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DETERGENT COMPOSITIONS

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This invention relates to improved detergent compositions comprising synergistic mixtures of salts of long-chain alkyl sulfates and α-sulfonated fatty acids.

Detergents based on long-chain alkyl sulfates, such as sodium dodecyl sulfate, are well known but suffer from several serious handicaps. In the first place, they are expensive to manufacture so that when sold alone or as the sole active component of a detergent, a premium price must be received. Also, compounds of this type containing 16 or more carbon atoms in the molecule are only slightly soluble in water, thus detracting from their usefulness.

Likewise, the α-sulfonated fatty acids have long been recognized to have detergent properties in general, but have not found wide use as detergents because of certain deficiencies, particularly their low detergency and poor solubility.

An object of this invention is to provide improved detergent compositions based on sulfated alcohols and sulfonated fatty acids having 16 to 24 carbon atoms and having high detergency and adequate solubility. A particular object is to provide such compositions that can be manufactured from the fatty acids present in lard, tallow, grease and fish oils.

Most of the detergent compositions of commerce are mixtures of one or more "active components" and a "builder." By "active component" is meant a surface-active compound, as distinguished from a "builder." By the latter term is meant one or more inorganic salts which are added to the active component to increase its effectiveness, to render the composition granular, to decrease hygroscopicity, or merely to dilute the active component and cheapen the composition. Builders typically consist of salts such as sodium phosphate, silicate, carbonate, sulfate, polyphosphates, borates and the like, or mixtures of such salts.

According to the invention, compositions that are outstanding detergents, either with or without the addition of builders, are obtained by mixing the alkali metal, ammonium or substituted ammonium salts of sulfated aliphatic alcohols with similar salts of α-sulfonated fatty acids, the chain length of both the alcohol and the acid being 16 to 24 carbon atoms and each being present to the extent of at least 10% of the composition, exclusive of builder. These compounds may be represented, respectively, by the following formulas:

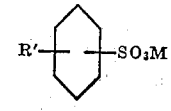
$$RCH_2CH_2OSO_3M$$

and

$$\begin{matrix} RCHCOOM' \\ | \\ SO_3M \end{matrix}$$

wherein R is a straight-chain hydrocarbon radical having 14 to 22 carbon atoms, M is a member selected from the group consisting of alkali metals, ammonium and substituted ammonium radicals, and M′ is a member of the group consisting of M and hydrogen. A preferred embodiment is that in which the long-chain alcohol is the mixed alcohol obtainable from tallow or grease, by sodium reduction or hydrogenolysis, or from hydrogenated tallow or grease; and the fatty acid is the mixture of saturated acids obtainable by the saponification of tallow or grease, or the mixture of acids obtainable by the saponification of hydrogenated tallow or grease. These preferred alcohols and acids consist predominantly of C_{16} and C_{18} compounds, this chain length being the optimum for our detergents. Detergents made from shorter chain compounds tend to be too soluble, less colloidal in character and inferior as detergents. On the other hand, those made from longer chain compounds tend to be only sparingly soluble in cold water. These deficiencies can be largely overcome, however, by blending suitable mixtures of different chain lengths.

A further preferred embodiment is that in which, in addition to the sulfated alcohol and sulfonated fatty acid, a salt of sulfonated dodecylbenzene, having the formula



wherein R′ is a saturated aliphatic hydrocarbon radical having an average of about 12 carbon atoms and M is as above, is present to the extent of at least about 10% of the active components of the detergent mixture. While alone such alkylbenzenesulfonate is relatively ineffective as a detergent, in combination with our sulfated alcohol-sulfonated acid mixture it shows unexpected efficiency.

The relative effectiveness of various detergent compositions was determined in a series of experiments in which 10 swatches of standard soiled cotton cloth were washed for 20 minutes at 60° C. in 1000 ml. of water containing the various detergents. Different lots of standard soiled cotton were used in Table I than in Table II. Detergency was expressed as the increase in reflectance, ΔR, after washing. Results of a typical series of experiments are shown in Tables I and II. For convenience the various detergent components are abbreviated as follows:

X=sodium salt of sulfated hydrogenated tallow alcohol
X′=sodium salt of sulfated tallow alcohol
Y=disodium salt of α-sulfonated hydrogenated tallow acid
Z=sodium dodecylbenzenesulfonate
B=inorganic builder: phosphates, sulfates and silicates

TABLE I

Detergency evaluation

[Hard water of 90 p.p.m. (as $CaCO_3$):]

Example No.	Composition and Concentration of Detergent, Percent	Detergency ΔR
1	0.01% X	3.3
2	0.01% X + 0.04% Y	32.5
3	0.01% X + 0.04% Z	18.9
4	0.04% X	27.7
5	0.04% Y	15.0
6	0.01% X + 0.04% Y + 0.2% B	29.3
7	0.01% X + 0.04% Z + 0.2% B	23.2
8	0.01% X + 0.01% Y + 0.03% Z + 0.2% B	27.5
9	0.025% X + 0.025% Y + 0.2% B	28.6
10	0.025% X + 0.025% Z + 0.2% B	24.2
11	0.025% X′ + 0.025% Y + 0.2% B	28.8
12	0.025% Y + 0.025% Z + 0.2% B	17.6
13	0.05% X + 0.2% B	26.4
14	0.05% Y + 0.2% B	13.2
15	0.05% Z + 0.2% B	13.9
16	0.25% Sodium Dodecyl Sulfate	22.3

TABLE II

Detergency evaluation

[Hard water of 300 p.p.m. (as $CaCO_3$).]

Example No.	Composition and Concentration of Detergent, Percent	Detergency ΔR
17	0.01% X + 0.04% Y + 0.2% B	38.0
18	0.01% X + 0.04% Y + 0.01% Z + 0.22% B	36.6
19	0.03% X + 0.01% Y + 0.01% Z + 0.2% B	37.1
20	0.04% X + 0.01% Y + 0.2% B	38.0
21	0.05% X + 0.2% B	33.6
22	0.05% Y + 0.2% B	15.2
23	0.05% Z + 0.2% B	19.1

The examples in Tables I and II and other similar experiments show that sodium alkyl sulfates, such as X, are excellent detergents in both hard and soft water while the salts of both α-sulfonated fatty acids and sulfonated dodecylbenzene are relatively poor in both. In the absence of builder (Table I), a combination of X and Y is an excellent detergent, better than that to be expected from a combination of a relatively poor detergent (0.04% Y) and a low concentration of X (0.01% X). In the presence of builder, at 20% total active ingredient content, combinations of X and Y, or X' and Y, or X, Y and Z are synergistic and better detergents than built 0.05% X. Table II shows synergistic combinations of X and Y, and of X, Y and Z in very hard water.

Various conventional builders were tested and found to differ only slightly in effectiveness. Likewise, replacement of X with X' or with the sodium salt of other sulfated straight-chain aliphatic alcohols having 16 to 24 carbon atoms had no substantial effect on the detergency of the composition. Similarly other α-sulfonated fatty acids having 16 to 24 carbon atoms could be used instead of the hydrogenated tallow acids used in the preparation of Y without greatly affecting the detergency of the XY or the XYZ combinations.

The use of potassium, ammonium, mono-, di- or triethanolammonium, or mono-, di- or trialylammonium salts instead of the sodium salts of the detergents used in the above examples gave substantially similar results, the principal difference being that they were in general more soluble than were the corresponding sodium salts. The ammonium and substituted ammonium salts are particularly useful in detergent compositions containing no builders, such as in liquid detergents, shampoos and the like.

While our detergent compositions are useful in the form of liquid, flakes, granules or powders, they are particularly advantageous in the formulation of bars.

The requirements for bar detergents are more stringent than for detergents in other physical form because, in addition to the requirements of effective detergency, suitable solubility, effectiveness in hard water, etc., a bar detergent composition must have the proper physical consistency, lathering properties, cohesiveness, plasticity, affinity for water and mutual compatibility with other constituents to permit ready formation into bars having proper characteristics. The detergent compositions of this invention, described above, have all these desirable characteristics and the unexpected synergistic detergency of the compositions is retained in the bar form. Formulation of these compositions for use in bars is facilitated by the wide range of physical properties attainable by varying the chain length and proportions of the constituents within the specified limits and by appropriate use of the

detergent compounds in the form of the various salts specified as operable.

Among the compositions found particularly suitable for use in detergent bars are the following:

(1) 15 to 30% of salts of sulfated hydrogenated tallow alcohols, 15 to 30% of sodium dodecylbenzenesulfonate and 40 to 70% of salts of α-sulfonated hydrogenated tallow acids.

(2) 35 to 45% of salts of sulfated tallow alcohols and 55 to 65% of salts of α-sulfonated saturated tallow acids.

Excellent bars were also made from mixtures containing 20 to 40% of triethanolammonium salt and 60 to 80% of sodium salt of α-sulfonated saturated tallow acid, though there was no synergism in detergency.

All the above bar compositions require the use of a small amount of water, about 8 to 16%, for proper plasticity and cohesion.

We claim:

1. A detergent composition comprising at least about 10% each of (1) a compound having the formula

$$RCH_2CH_2OSO_3M$$

and (2) a compound having the formula

$$\begin{array}{l} RCHCOOM' \\ | \\ SO_3M \end{array}$$

wherein R is a straight-chain aliphatic hydrocarbon radical having 14 to 22 carbon atoms, M is a member selected from the group consisting of alkali metals, ammonium and substituted ammonium radicals, and M' is a member of the group consisting of M and hydrogen.

2. A detergent composition as in claim 1 wherein M and M' are sodium.

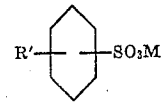
3. A detergent composition comprising at least about 10% each of (1) a compound having the formula

$$RCH_2CH_2OSO_3M,$$

(2) a compound having the formula

$$\begin{array}{l} RCHCOOM' \\ | \\ SO_3M \end{array}$$

and (3) a compound having the formula



wherein R is a straight-chain aliphatic hydrocarbon radical having 14 to 22 carbon atoms, R' is a saturated aliphatic hydrocarbon radical having an average of about 12 carbon atoms, M is a member selected from the group consisting of alkali metals, ammonium and substituted ammonium radicals, and M' is a member selected from the group consisting of M and hydrogen.

4. A detergent composition as in claim 3 wherein M and M' are sodium.

References Cited in the file of this patent

UNITED STATES PATENTS

1,909,295	Luther	May 16, 1933
2,247,741	Beller	July 1, 1941
2,477,383	Lewis	July 26, 1949

FOREIGN PATENTS

353,475	Great Britain	July 24, 1931
494,113	Great Britain	Oct. 20, 1938