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⑤④ **Liquid detergents containing anionic surfactant, succinate builder and fatty acid.**

⑤⑦ Liquid detergent compositions containing anionic synthetic surfactant, C₁₂-C₁₄ alkyl or alkenyl succinate builder and C₁₂-C₁₄ fatty acid, in a molar ratio of succinate to fatty acid of from about 0.8 to about 2.4, provide a minimum of suds in otherwise high sudsing compositions.

LIQUID DETERGENTS CONTAINING ANIONIC SURFACTANT,
SUCCINATE BUILDER AND FATTY ACID

Stanton L. Boyer

Technical Field

5 The present invention relates to liquid detergent compositions, preferably heavy-duty liquid detergents, containing an anionic synthetic surfactant and a builder system comprising a C_{12} - C_{14} alkyl or alkenyl succinic acid or salt thereof (hereinafter referred to as a "succinate") and a C_{12} - C_{14} fatty acid or salt thereof (hereinafter referred to as a "fatty acid") in a molar ratio
10 (calculated on an acid basis) of succinate to fatty acid of from about 0.8 to about 2.4. Within this range, the succinate and fatty acid mixture surprisingly provides a minimum of sudsing in otherwise high sudsing detergents containing a significant amount
15 of anionic synthetic surfactant.

Background Art

British Patent 1,293,753, Evans et al, published October 25, 1972, discloses dicarboxylate builders, including alkyl and alkenyl succinates. Example 10 is a low-sudsing detergent containing 2%
20 dodecyl benzene sulfonate, 6% of an 80:20 mixture of tallow:coconut soap, and 6% disodium hexadecane-1,2-dicarboxylate. This results in a molar ratio of dicarboxylate to C_{12} - C_{14} fatty acid of about 2.7.

European Patent Application 28,850, van der Griend, published May 20, 1981, discloses liquid detergents containing
25 nonionic surfactant, a small amount of C_{10} - C_{15} alkylbenzene sulfonate, builder and C_7 - C_{12} alkyl or alkenyl succinate as a hydrotrope. Examples D-M contain 0-1% LAS, 5.5-6% nonenyl succinic anhydride and 1.2-3% coconut fatty acid. The lowest
30 ratio of succinate to fatty acid present is about 1.7.

U.S. Patent 3,776,851, Cheng, issued December 4, 1973, discloses detergents containing 5-70% tetrahydroxysuccinic acid builders. Example 4 contains 20% tetrahydroxysuccinic acid and 1.8% 80:20 tallow:coconut soap as a suds suppressor.

35 U.S. Patent 3,707,511, Lamberti et al, issued December 26, 1972, discloses that C_{10} - C_{16} alkyl or alkenyl succinates are useful as suds boosters and stabilizers for detergents, particularly those

containing alkylaryl sulfonates. There are no examples of compositions containing succinate and fatty acid.

Summary of the Invention

The present invention relates to a liquid detergent composition comprising, by weight:

- (a) from about 10% to about 50% of an anionic synthetic surfactant;
- (b) from about 2% to about 25% of a C_{12} - C_{14} alkyl or alkenyl succinic acid, or salt thereof; and
- (c) from about 1% to about 15% of a C_{12} - C_{14} fatty acid, or salt thereof;

the molar ratio of (b) to (c), on an acid basis, being from about 0.8 to about 2.4.

Detailed Description of the Invention

The detergent compositions of the present invention contain anionic synthetic surfactant and succinate and fatty acid builders in a molar ratio (calculated on an acid basis) of succinate to fatty acid of from about 0.8 to about 2.4, preferably from about 0.9 to about 1.8, more preferably from about 1.0 to about 1.4. Within these ratios, the succinate and fatty acid provide a minimum of suds in otherwise high sudsing detergents containing a significant amount (e.g., greater than 10% by weight) of anionic synthetic surfactant. This is particularly surprising given that one would have expected that sudsing would gradually increase with increasing levels of succinate and decrease with increasing levels of fatty acid.

Anionic Synthetic Surfactant

The detergent compositions herein contain from about 10% to about 50%, preferably from about 13% to about 40%, more preferably from about 16% to about 30%, by weight, on an acid basis, of an anionic synthetic surfactant. Anionic synthetic surfactants are disclosed in U.S. Patent 4,285,841, Barrat et al, issued August 25, 1981, and in U.S. Patent 3,919,678, Laughlin et al, issued December 30, 1975, both incorporated herein by reference.

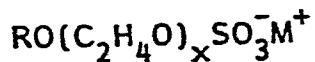
Useful anionic surfactants include the water-soluble salts, particularly the alkali metal, ammonium and alkylammonium (e.g., monoethanolammonium or triethanolammonium) salts, of organic sulfuric reaction products having in their molecular structure an alkyl group containing from about 8 to about 20 carbon atoms and a sulfonic acid or sulfuric acid ester group. (Included in the term "alkyl" is the alkyl portion of aryl groups.) Examples of this group of synthetic surfactants are the alkyl sulfates, especially those obtained by sulfating the higher alcohols (C_8 - C_{18} carbon atoms) such as those produced by reducing the glycerides of tallow or coconut oil; and the alkylbenzene sulfonates in which the alkyl group contains from about 9 to about 15 carbon atoms, in straight chain or branched chain configuration, e.g., those of the type described in United States Patents 2,220,099 and 2,477,383.

Other anionic surfactants herein are the water-soluble salts of: paraffin sulfonates containing from about 8 to about 24 (preferably about 12 to 18) carbon atoms; alkyl glyceryl ether sulfonates, especially those ethers of C_{8-18} alcohols (e.g., those derived from tallow and coconut oil); alkyl phenol ethylene oxide ether sulfates containing from about 1 to about 4 units of ethylene oxide per molecule and from about 8 to about 12 carbon atoms in the alkyl group; and alkyl ethylene oxide ether sulfates containing about 1 to about 4 units of ethylene oxide per molecule and from about 10 to about 20 carbon atoms in the alkyl group.

Other useful anionic surfactants herein include the water-soluble salts of esters of alpha-sulfonated fatty acids containing from about 6 to 20 carbon atoms in the fatty acid group and from about 1 to 10 carbon atoms in the ester group; water-soluble salts of 2-acyloxy-alkane-1-sulfonic acids containing from about 2 to 9 carbon atoms in the acyl group and from about 9 to about 23 carbon atoms in the alkane moiety; water-soluble salts of olefin sulfonates containing from about 12 to 24 carbon atoms; and beta-alkyloxy alkane sulfonates containing from about 1 to 3

carbon atoms in the alkyl group and from about 8 to 20 carbon atoms in the alkane moiety.

Preferred anionic surfactants herein are the alkyl sulfates of the formula



wherein R is an alkyl chain having from about 12 to about 18 carbon atoms, saturated or unsaturated, M is a cation which makes the compound water-soluble, especially an alkali metal, ammonium or substituted ammonium cation, and x is from 0 to about 4. Preferably, R is a C_{12} - C_{16} alkyl or hydroxyalkyl group, especially a C_{12} - C_{15} alkyl, and x is from about 0 to about 3.

Highly preferred anionic surfactants are the linear straight chain alkylbenzene sulfonates in which the average number of carbon atoms in the alkyl group is from about 12 to about 13, and the C_{12-15} alcohol sulfates containing from 0 to about 3 ethylene oxide units, as described above. Also preferred are mixtures of these surfactants in a weight ratio of from about 3:1 to about 1:3, preferably from about 2:1 to about 1:2. These anionics form hardness, preferably magnesium, surfactants that are particularly effective at lowering interfacial tension and removing greasy/oily soils.

Succinate Builder

The detergent compositions herein also contain from about 2% to about 25%, preferably from about 3% to about 20%, more preferably from about 5% to about 15%, by weight of a succinate builder of the general formula $\text{R}-\text{CH}(\text{COOH})\text{CH}_2(\text{COOH})$, wherein R is C_{12} - C_{14} alkyl or alkenyl group.

These succinate builders are preferably used in the form of their water-soluble salts, including the sodium, potassium, ammonium and alkanolammonium salts (e.g., mono-, di-, or tri-ethanolammonium).

Specific examples of succinate builders include: lauryl succinate, myristyl succinate, 2-dodecenyl succinate (preferred) and 2-tetradecenyl succinate.

Fatty Acid

The compositions of the present invention further contain from about 1% to about 15%, preferably from 2% to about 10%, more preferably from about 3% to about 6%, by weight of a C₁₂-C₁₄ fatty acid, or salt thereof.

Suitable fatty acids can be obtained from natural sources such as plant or animal esters (e.g., palm kernel oil, palm oil and coconut oil) or synthetically prepared (e.g., via the oxidation of petroleum or by hydrogenation of carbon monoxide via the Fisher-Tropsch process). Examples of suitable fatty acids for use in the compositions of this invention include lauric, myristic, coconut and palm kernel fatty acid. Preferred are saturated coconut fatty acids, from about 5:1 to 1:1 (preferably about 3:1) weight ratio mixtures of lauric and myristic acid, and palm kernel fatty acid.

The succinate and fatty acid builders herein are calcium-selective builders, which means they preferentially control calcium ion in the wash solution, rather than magnesium or other hardness ions. It is believed that these calcium-selective builders adequately control wash water hardness, preventing excessive interactions with the anionic surfactant herein and with soils, while allowing sufficient free hardness to complex some of the anionic surfactant to produce a hardness surfactant (such as magnesium linear alkylbenzene sulfonate) that is highly effective at removing greasy and oily soils. Such hardness-surfactants pack at the oil/water interface where they lower interfacial tension and enhance removal of greasy/oily soils.

The liquid detergent compositions herein can optionally contain any of the auxiliary ingredients known for use in detergent compositions. These include cosurfactants, cobuilders, neutralizing agents, buffering agents, phase regulants, solvents, hydrotropes, enzymes, enzyme stabilizing agents, polyacids, suds regulants, opacifiers, antioxidants, bactericides, dyes, perfumes, and brighteners, such as those described in U.S.

Patent 4,285,841, Barrat et al, issued August 25, 1981, incorporated herein by reference.

Preferred compositions herein include those described in U.S. Patent 4,561,998, Wertz et al, issued December 31, 1985, and U.S. Patent 4,507,219, Hughes, issued March 26, 1985, both incorporated herein by reference.

The compositions herein preferably contain from about 1% to about 20%, more preferably from about 3% to about 15%, most preferably from about 5% to about 10%, by weight of an ethoxylated nonionic surfactant of the formula $R^1(OC_2H_4)_nOH$, wherein R^1 is a C_{10} - C_{16} alkyl group (preferred) or a C_8 - C_{12} alkyl phenyl group, n is from about 3 to about 9, and said nonionic surfactants has an HLB (hydrophile-lipophile balance) of from about 9 to about 13, preferably from about 10 to about 13. HLB is defined in detail in Nonionic Surfactants, by M.J. Schick, Marcel Dekker, Inc., 1966, pages 607-613, incorporated herein by reference. These ethoxylated nonionic surfactants suspend hardness-surfactants in the wash water solution. They are used at a level high enough to prevent excessive precipitation of hardness-surfactants at the oil/water interface (which makes soil removal more difficult), but low enough to allow for the desired adsorption and packing at the interface.

The compositions herein can be formulated to have a pH of from about 7.5 to about 12, more preferably from about 8 to about 11. Certain preferred compositions herein are alkaline compositions that are particularly useful in combination with peroxyacid bleach compositions, which generally have a pH of from about 2 to about 5 for best bleach stability. Such alkaline compositions have a pH of from about 9 to about 12, preferably from about 9.5 to about 11.5, more preferably from about 10 to about 11. They preferably contain from about 2% to about 15%, more preferably from about 4% to about 10%, by weight of monoethanolamine. The combination of such an alkaline composition and peroxyacid bleach preferably delivers a wash water pH of from about 7.8 to about 9, preferably from about 7.9

to about 8.5, which is desired for good bleaching performance, a minimum of fabric yellowing, and a minimum of bleach decomposition by the monoethanolamine.

5 The following examples illustrate the compositions of the present invention.

All parts, percentages and ratios used herein are by weight unless otherwise specified.

EXAMPLE I

10 The following composition was prepared by adding the components to a mixing tank in the order listed with continuous mixing.

		%	Wt. %	Wt. %
	<u>Components</u>	<u>Assay</u>	<u>Product</u>	<u>Stock</u>
15	Sodium C ₁₄₋₁₅ alkyl polyethoxylate (2.25) sulfate	48.8	11.3	23.2 ¹
	C ₁₃ linear alkylbenzene sulfonic acid	96.0	8.0	8.33
	Sodium diethylenetriamine pentaacetate	41.0	0.35	0.7
20	Propylene glycol	100.0	10.5	10.5
	Monoethanolamine	100.0	5.0	3.0
	Brightener mix	100.0	-	6.21 ²
	C ₁₂₋₁₃ alcohol polyethoxylate (6.5)*	100.0	9.0	7.0
25	Ethanol	92.0	10.48	7.3
	Potassium hydroxide	45.0	2.48	5.51
	Sodium hydroxide	50.0	2.94	5.88
	Boric acid	100.0	1.25	1.25
	Water	-	-	5.65
30	Sodium 2-dodecenyl succinate	80.0	5.53	6.9
	C ₁₂₋₁₄ fatty acid	100.0	3.5	3.5
	Citric acid	50.0	4.0	8.0
	Calcium formate	10.0	0.12	1.2
	TEPA-E ₁₅₋₁₈ **	80.0	3.0	3.75
35	pH trim to 10.5	-	-	-

	Protease enzyme (2.0 AU/g)	100.0	1.16	1.16
	Amylase enzyme (375 AM. U/g)	100.0	0.16	0.16
	Perfume	100.0	0.25	0.25
	Dye	100.0	0.08	0.08
5	Water	-	to 100%	3.25

¹Paste also contains 16.2% ethanol and 35% water

²Contains 32.2% monoethanolamine, 32.2% water, 32.2% C₁₂₋₁₃ alcohol polyethoxylate (6.5)*, and 3.36% of brightener.

* Alcohol and monoethoxylated alcohol removed.

10 ** Tetraethylene pentamine ethoylated with 15-18 moles (avg.) of ethylene oxide at each hydrogen site.

The above composition is preferably used in combination with the following liquid diperoxyacid bleach composition. The liquid bleach composition was prepared by high shear mixing of the components in an Eppenbach mixer while in an ice bath. The DPDA and water were added to the mixer before turning the mixer on. The suds suppressor was added to minimize foaming while mixing and to minimize air entrapment in the finished composition. The other components were added in the order listed at the indicated times after turning on the mixer.

		<u>Grams</u>	<u>Wt. %</u>	<u>Time</u>
-	1,12-Diperoxydodecanedioic acid (DPDA) (26.68% active slurry*)	10,821.6	18.0	0
25	Water (additional)	1896	11.8	0
	Suds suppressor	12.8	0.08	1 min.
	C ₁₃ linear alkylbenze sulfonic acid (96% active*)	417.8	2.5	3 min.
30	Sodium cumene sulfonate (50% active*)	463.4	1.45	3 min.
	Dipicolinic acid	1.6	0.01	3 min.
	Sodium sulfate	641.6	4.0	1 hr.25 min.
	Magnesium sulfate	1684.2	10.5	2 hr.10 min.
35	Sodium hydroxide (50% active*)	104	0.32	3 hr.10 min.

* Balance primarily water.

After 3 hr. 30 min., the pH of the composition was determined to be 3.20 at 20°C. After 4 hr. 10 min., the pH was again determined to be 3.20 at 20°C and the mixer was turned off. The composition was a stable suspension of the ingredients and had a viscosity of about 350 cps at about 20°C. The DPDA had an average particle size of about 2-5 microns.

The above describes the preferred process for making the composition since high shear mixing of the components in an ice bath, their order of addition and the approximate times of addition have all been found to be important to obtain the desired physical stability.

The compositions are preferably used in a volume ratio of detergent composition to liquid bleach of about 5.5:1. The detergent composition is designed for a usage level of about 0.55 cups in a typical U.S. laundering process. This delivers a concentration of product in the wash water of about 0.22% by weight. Usage of about 0.1 cups (i.e., about 25 ml) of the liquid bleach delivers about 10 ppm of available oxygen to the wash water. The detergent composition and liquid bleach are preferably simultaneously codispersed from a dual compartment bottle at a volume ratio of detergent to bleach of about 5.5:1.

The mixture of the succinate and fatty acid builders in the above detergent composition is preferred because it causes less fabric yellowing and measuring cup residue than an all fatty acid formula when used with the above liquid bleach.

EXAMPLE II

Other compositions of the invention, which can be prepared by adding the components to a mixing tank in the order listed with continuous mixing, are as follows.

<u>Components</u>	<u>A</u>	<u>B</u>
Sodium C ₁₄₋₁₅ alkyl poly-ethoxylate (2.25) sulfate	12.7	8.1
Sodium C ₁₃ linear alkylbenzene sulfonate	8.5	3.9

	Sodium diethylenetriamine		
	pentaacetate	0.3	-
	Propylene glycol	8.5	-
	Monoethanolamine	2.0	5.4
	C ₁₂₋₁₃ alcohol polyethoxy-		
	late (6.5)*	5.0	-
	C ₁₂ -C ₁₆ alkyldimethylamine oxide		6.6
	Ethanol	4.0	
	Sodium toluene sulfonate		8.0
0	Sodium 2-dodecenyl succinate	11.0	15.0
	C ₁₂₋₁₄ fatty acid	7.0	7.0
	Citric acid	4.0	2.0
	Calcium formate	0.12	-
	Sodium formate	0.87	-
5	TEPA-E ₁₅₋₁₈ **	2.0	2.0
	Protease enzyme (2.0 AU/g)	0.75	-
	Amylase enzyme (375 AM. U/g)	0.16	-
	Water and minors		Balance to 100%

CLAIMS

1. A liquid detergent composition comprising, by weight:

- (a) from about 10% to about 50% of an anionic synthetic surfactant;
- (b) from about 2% to about 25% of a C_{12} - C_{14} alkyl or alkenyl succinic acid, or salt thereof; and
- (c) from about 1% to about 15% of a C_{12} - C_{14} fatty acid, or salt thereof;

the molar ratio of (b) to (c), on an acid basis, being from about 0.8 to about 2.4.

2. The composition of Claim 1 wherein the molar ratio of (b) to (c), on an acid basis, is from about 1.0 to about 1.4.

3. The composition of Claim 1 wherein the anionic surfactant comprises a C_{12} - C_{13} linear alkylbenzene sulfonate, a C_{12} - C_{15} alcohol sulfate containing from 0 to about 3 ethylene oxide units, or mixtures thereof.

4. The composition of Claim 1 wherein (b) is sodium 2-dodecenyl succinate.

5. The composition of Claim 1 comprising from about 16% to about 30% of anionic synthetic surfactant, which comprises a C_{12} - C_{13} linear alkylbenzene sulfonate, a C_{12} - C_{15} alcohol sulfate containing from 0 to about 3 ethylene oxide units, or mixtures thereof.

6. The composition of Claim 5 comprising from about 5% to about 15% of sodium 2-dodecenyl succinate and from about 3% to about 6% of C_{12} - C_{14} fatty acid.

7. The composition of Claim 6 wherein the molar ratio of (b) to (c) is from about 1.0 to about 1.4.

8. The composition of Claim 1 having a pH of from about 9.5 to about 11.5.

9. The composition of Claim 7 having a pH of from about 10 to about 11.

10. The composition of Claim 9 comprising from about 4% to about 10% of monoethanolamine.

11. The composition of Claim 10 further comprising from about 5% to about 10% of an ethoxylated nonionic surfactant of the formula $R^1(OC_2H_4)_nOH$, wherein R^1 is a C_{10} - C_{16} alkyl group, and n is from about 3 to about 9, said surfactant having an HLB of from about 9 to about 13.

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