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(71) Applicant: **UNILEVER PLC**
Unilever House Blackfriars
London EC4P 4BQ(GB)

(84) **GB**

Applicant: **UNILEVER NV**
Burgemeester s'Jacobplein 1 P.O. Box 760
NL-3000 DK Rotterdam(NL)

(84) **CH DE ES FR IT LI NL SE**

(72) Inventor: **Hull, Michael**
Windcliffe Alvanley Road
Helsby Warrington WA6 9PS(GB)
Inventor: **Giles, Dennis**
33 Brookhurst Road Bromborough
Wirral Merseyside L63 OEN(GB)
Inventor: **Scowen, Reginald Vear**
113 Brookhurst Road Bromborough
Wirral Merseyside L63 0EH(GB)
Inventor: **Smith, Bryan Cecil**
Mozartlaan 46
NL-3055 KL Rotterdam(NL)

(74) Representative: **Ford, Michael Frederick et al**
MEWBURN ELLIS & CO. 2/3 Cursitor Street
London EC4A 1BQ(GB)

(54) Detergent composition.

(57) A detergent composition for washing fabrics contains a surfactant system in which the major anionic surfactant is an alkyl sulphate of mixed alkyl chain length such that at least 10% by weight of the alkyl chains present in the alkyl sulphate are C_{12} chains, at least 20% by weight of said alkyl chains are C_{18} chains and the ratio of C_{12} alkyl chains to C_{18} alkyl chains is in the range 9:4 to 1:6.

Preferably nonionic surfactant of low HLB value (i.e. less than 10.5) is also present.

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DETERGENT COMPOSITION

This invention relates to a detergent composition, in particular to a detergent composition for washing fabrics.

Fabric washing compositions contain, as an essential ingredient, a surfactant system whose role is to assist in the removal of soil from the fabric and its suspension in the wash liquor. Suitable detergent active materials fall into a number of classes, including anionic, nonionic and cationic materials and marketed products contain materials selected from one or more of these classes.

The most widely used anionic detergent active materials are the alkyl benzene sulphonates and these provide satisfactory results especially at high temperatures. There has been a desire to find alternative anionic surfactants for use in circumstances when alkyl benzene sulphonates are undesirable, but generally speaking the performance of other anionic detergent active materials is unsatisfactory.

Among such alternative anionic surfactants are the primary alcohol sulphates (PAS) otherwise known as alkyl sulphates. The PAS derived from tallow fat has been recommended for use. Thus, GB 1399966 (The Procter & Gamble Company) discloses a detergent composition in which the surfactant system is a mixture of sodium tallow alkyl sulphate and a nonionic detergent active material. However, tallow PAS suffers from the disadvantage that its performance at low temperatures is poor. With the trend towards lower wash temperatures this becomes a serious disadvantage.

Other PAS's have been proposed in the art. Thus, for example, GB 1399966 referred to above, also discloses the possibility of using the PAS derived from coconut oil. We have appreciated that under some circumstances coconut PAS can perform better than tallow PAS at low temperatures, but under such circumstances its performance at higher temperatures is significantly poorer than the tallow derived material. Thus, while the consumer expects a single product to perform satisfactorily both at high and low temperatures, the replacement of tallow PAS by coconut PAS is not an attractive option.

An objective of the present invention is to provide a surfactant system based on PAS and which is able to give a good combination of performance levels at a range of temperatures.

We have found that this can be achieved with a PAS which has a wider spread of alkyl chain lengths than is the case when either tallow alone or coconut alone is the source of the alkyl chains. Use of a PAS derived from a mixture of sources can perform better than tallow PAS at low temperatures and better than coconut PAS at higher temperatures. Under some circumstances there is better performance than with either tallow or coconut PAS. Even though these may give better performance at certain temperatures, use of PAS with a wider spread of alkyl chain lengths can give good performance over a wider temperature range.

The spread of chain lengths may be characterised by the presence of alkyl chains of twelve and eighteen carbon atoms in amounts or a ratio which does not occur when the alkyl chains come from a single natural source.

Thus, according to a first aspect of this invention there is provided a detergent composition for washing fabrics, the composition containing a surfactant system comprising an anionic surfactant the major ingredient of which is alkyl sulphate of mixed alkyl chain length such that at least 10% by weight of the alkyl chains present in the alkyl sulphate are C_{12} chains, at least 20% by weight of said alkyl chains are C_{18} chains and the weight ratio of C_{12} alkyl chains to C_{18} alkyl chains is in the range 9:4 to 1:6, preferably 2:1 to 1:5.

For comparison in a coconut feedstock the percentages of C_{12} and C_{18} alkyl are typically 53% and 12%, amounting to a ratio over 3:1 (and indeed over 4:1) while in a tallow feedstock the alkyl chains can be 70% C_{18} alkyl with C_{12} almost entirely absent.

In compositions of this invention, preferably at least 15% by weight of the alkyl chains present in the alkyl sulphate are C_{12} while the C_{18} alkyl chains are at least 25% by weight of the alkyl chains in the alkyl sulphate.

As stated, the alkyl sulphate of mixed chain lengths is over 50% of the anionic surfactant present. Of course it may constitute the whole of the anionic surfactant present. Preferred is that the alkyl sulphate is at least 60% or even at least 80% of the anionic surfactant present.

Alkyl sulphates are also known as sulphated fatty alcohol salts. The alkyl sulphates, which are particularly envisaged for this invention, are normally produced from natural alcohols, such as those produced by reducing the glycerides of naturally occurring fats and oils.

Natural alcohols rich in C_{12} alkyl chains include those derived from babassu, coconut, ouri-coury and palm kernel while alcohols rich in C_{18} chains include those derived from beef tallow, kapok, olive, peanut, sesame, tall oil and teaseed.

Natural alcohols may be hardened, in which case unsaturated alkyl chains will be absent. However PAS from unhardened materials, such as unhardened tallow alcohol, may be employed so that unsaturated chains are present. C_{18} unsaturated chains will normally be oleyl but further unsaturation may be present e.g. linoleic chains may be present.

In addition to the C_{12} and C_{18} chains in the PAS materials useful in the present invention, other alkyl and unsaturated chains may be present. These chains will normally have between 8 and 18 carbon atoms. Materials which contain more than a small amount, i.e. more than about 2%, of chains containing more than 18 carbon atoms or less than 8 carbon atoms are less preferred.

From the point of view of ready availability, it is preferred to use a PAS derived from a mixture of tallow and coconut in the weight ratio of from 3:1 to 1:3, most preferably from 2:1 to 1:2.

It is preferred to use the water-soluble salts of these anionic surfactants, specifically the alkali metal (sodium or potassium) salts thereof.

Preferred compositions according to the invention include from 2% to 50%, such as from 4% to 30% by weight of the surfactant system.

The compositions of the invention also preferably contain a nonionic surfactant. We have found it to be of advantage if such a nonionic surfactant has an HLB of less than 10.5, although there is benefit even if the nonionic surfactant has an HLB greater than this.

Suitable nonionic surfactants which may be used are the reaction products of compounds having a hydrophobic group and a reactive hydrogen atom, for example aliphatic alcohols, acids, amides or alkyl phenols with alkylene oxides, especially ethylene oxide either alone or with propylene oxide. Specific nonionic detergent compounds are alkyl (C_6 - C_{22}) phenols-ethylene oxide condensates, the condensation products of aliphatic (C_8 - C_{18}) primary or secondary linear or branched alcohols with ethylene oxide, and products made by condensation of ethylene oxide with the reaction products of propylene oxide and ethylenediamine.

When alkylene oxide adducts of fatty materials are used as the nonionic surfactants, the number of alkylene oxide groups per molecule has a considerable effect upon the HLB of the nonionic surfactant. The chain length and nature of the fatty material is also influential, and thus the preferred number of alkylene oxide groups per molecule depends upon the nature and chain length of the fatty material.

We have found it of advantage that the weight ratio between the anionic surfactant and the nonionic surfactant lies between 10:1 and 1:4, most preferably between 4:1 and 1:2.

The surfactant system may include other surfactant materials in addition to the specified alkyl sulphate and the above mentioned nonionic materials. These other surfactant materials may be selected from other anionic detergent active materials, zwitterionic or amphoteric detergent active materials or mixtures thereof.

The level of any such further surfactant materials will not exceed 50% of the composition. It is preferably not more than 40% of the total amount of surfactant in the composition, and may perhaps be not over 5% by weight of the whole composition.

The other anionic detergent active materials which may be present may be the usual water-soluble alkali metal salts of organic sulphonates having alkyl radicals containing from about 8 to about 22 carbon atoms, the term alkyl being used to include the alkyl portion of higher acyl radicals. Examples of suitable synthetic anionic detergent compounds are sodium and potassium alkyl (C_9 - C_{20}) benzene sulphonates, particularly sodium linear secondary alkyl (C_{10} - C_{15}) benzene sulphonates; sodium alkyl glyceryl ether sulphates, especially those ethers of the higher alcohols derived from tallow or coconut oil and synthetic alcohols derived from petroleum; sodium coconut oil fatty monoglyceride sulphates and sulphonates; sodium and potassium salts of sulphuric acid esters of higher (C_8 to C_{18}) fatty alcohol-ethylene oxide reaction products; the reaction products of fatty acids such as coconut fatty acids esterified with isethionic acid and neutralised with sodium hydroxide; sodium and potassium salts of fatty acid amides of methyl taurine; alkane monosulphonates such as those derived by reacting alpha-olefins (C_8-C_{20}) with sodium bisulphite and those derived from reacting paraffins with SO_2 and Cl_2 and then hydrolysing with a base to produce a random sulphate. A further anionic detergent active which may be included is soap, especially soap with a high proportion of unsaturated acyl chains.

The compositions of the invention may contain a detergency builder material, this may be any material capable of reducing the level of free calcium ions in the wash liquor and will preferably provide the compositions with other beneficial properties such as the generation of an alkaline pH and the suspension of soil removed from the fabric. The amount of builder material in a composition of this invention may in particular be from 15% to 60% by weight of the composition.

Examples of phosphorus-containing inorganic detergency builders, when present, include the water-soluble salts, especially alkali metal pyrophosphates, orthophosphates, metaphosphates, polyphosphates and phosphonates. Specific examples of inorganic phosphate builders include sodium and potassium

tripolyphosphates, orthophosphates and hexametaphosphates.

Examples of non-phosphorus-containing inorganic detergency builders, when present, include water-soluble alkali metal carbonates, bicarbonates, silicates and crystalline and amorphous aluminosilicates. Specific examples include sodium carbonate (with or without calcite seeds), potassium carbonate (with or without calcite seeds), sodium and potassium bicarbonates and silicates.

Examples of organic detergency builders, when present, include the alkali metal, ammonium and substituted ammonium polyacetates, carboxylates, polycarboxylates, polyacetyl carboxylates and polyhydroxysulphonates. Specific examples include sodium, potassium, lithium, ammonium and substituted ammonium salts of ethylenediaminetetraacetic acid, nitrilotriacetic acid, oxydisuccinic acid, melitic acid, benzene polycarboxylic acids and citric acid.

It is preferred that the compositions according to the invention be alkaline, that is at the concentration of 1 g/l in distilled water at 25° C the pH should be at least 8, preferably at least 10. To this end the compositions may include a water-soluble alkaline salt. This salt may be a detergency builder or a non-building alkaline material.

Apart from the ingredients already mentioned, a number of optional ingredients may also be present.

Examples of other ingredients which may be present in the composition include fabric softening agents such as fatty amines, fabric softening clay materials, lather boosters such as alkanolamides, particularly the monoethanolamides derived from palm kernel fatty acids and coconut fatty acids, lather depressants, oxygen-releasing bleaching agents such as sodium perborate and sodium percarbonate, peracid bleach precursors, chlorine-releasing bleaching agents such as trichloroisocyanuric acid, inorganic salts such as sodium sulphate, and, usually present in very minor amounts, fluorescent agents, perfumes including deodorant perfumes, enzymes such as proteases, cellulases, amylases and lipase, germicides and colourants.

The detergent compositions according to the invention may be prepared by a number of different methods according to their physical form. In the case of granular products they may be prepared by dry-mixing or coagglomeration. A preferred physical form is a granule incorporating a detergency builder salt and this is most conveniently manufactured by spray-drying at least part of the composition. In this process a slurry is prepared containing the heat-insensitive components of the composition such as the surfactant system, builder material and filler salt. The slurry is spray-dried to form base powder granules with which any solid heat-sensitive ingredients may be mixed, such ingredients including bleaches and enzymes. The specified nonionic surfactants can be liquified by melting or solvent dissolution and sprayed onto the base powder granules, rather than including them in the slurry for spray-drying. The invention will now be described in more detail in the following non-limiting examples.

EXAMPLES 1 TO 6

Wash liquors were prepared in water having a hardness of 25° FH (equivalent to a free calcium ion concentration of 2.5×10^{-3} molar). The wash liquor contained the equivalent of 6 g/l of a composition containing (by weight):

Specified anionic surfactant	9%
Specified nonionic surfactant	4%
Sodium tripolyphosphate	23%
Sodium carbonate	6%
Sodium alkaline silicate	5.5%
Sodium sulphate	30.8%
Sodium chloride	2.93%
Water	balance

The sodium chloride was included as being equivalent in ionic strength to 5% sodium perborate monohydrate which would be present in practice. The bleach is left out of these experiments in order to avoid confusion between detergency and bleaching effect in the interpretation of the results.

The wash liquors were used to wash a fabric load at liquor to cloth ratio of 50:1. The load included a number of polyester monitors to which had previously been applied an amount of C^{14} tagged triolein. Measurement of the level of tagged triolein after washing, using standard radiotracer techniques, gives an

indication of the degree of detergency, i.e. soil removal, obtained.

The wash time was 20 minutes with an agitation of 70 rpm. Washes were isothermal at temperatures as specified below.

The anionic surfactants used were as set out in the following table:

Chain Length Distribution (%)					
Surfactant	$<C_8$	C_{12}	C_{18}	$<C_{18}$	Origin
ELFAN 280[1]	0	53	12	0	Coconut
ELFAN KT550[1]	0	27	38	0	Coco/tallow mix
SULFOPON T55[2]	0	0	70	0	Tallow

1 - ex Akzo
2 - ex Henkel

In Examples 1 to 6 the nonionic surfactant was SYNPERONIC A7 (ex ICI) which is principally C_{13}/C_{15} alcohol ethoxylated with an average of 7 moles of ethylene oxide. This nonionic surfactant has an HLB of 11.7.

The results obtained were as follows:

Example No	Anionic	Wash Temperature	% Soil Removal
1	ELFAN 280	30 °C	24.9
2	ELFAN KT550	30 °C	30.0
3	SULFOPON T55	30 °C	24.9
4	ELFAN 280	60 °C	30.5
5	ELFAN KT550	60 °C	36.3
6	SULFOPON T55	60 °C	46.7

From these results it is apparent that at 60 °C ELFAN KT550 outperforms the coconut only derived PAS, ELFAN 280. At the lower temperature of 30 °C, ELFAN KT550 outperforms both the coconut only and the tallow derived materials.

EXAMPLES 7 TO 12

Examples 1 to 6 were repeated, except that the nonionic surfactant was a mixture of 1 part SYNPERONIC A7 with 3 parts of SYNPERONIC A3, which is a similar material in which the alcohol is ethoxylated with an average of 3 moles ethylene oxide per molecule. This nonionic surfactant mixture has an HLB of approximately 9.0.

The results were as follows:

Example No	Anionic	Wash Temperature	% Soil Removal
7	ELFAN 280	30 °C	39.0
8	ELFAN KT550	30 °C	38.7
9	SULFOPON T55	30 °C	30.4
10	ELFAN 280	60 °C	44.6
11	ELFAN KT550	60 °C	49.8
12	SULFOPON T55	60 °C	54.4

From these results it is apparent, as with Examples 1 to 6, that at 60 °C ELFAN KT550 outperforms the coconut only derived PAS, ELFAN 280. At the lower temperature, ELFAN KT550 outperforms the tallow only derived PAS, SULFOPON T55, while not being significantly different in performance to the coconut

only derived material.

A comparison of the results in Examples 7 to 12 with those in Examples 1 to 6 demonstrates the preference for utilising a nonionic surfactant with a lower HLB.

EXAMPLES 13 TO 24

Examples 1 to 3 were repeated but the levels and proportions of the surfactants were varied. The variations in composition and the results are set out in the list below in which "A3" and "A7" denote SYNPERONIC A3 and SYNPERONIC A7. The wash temperature was 30 °C in each instance, as with Examples 1 to 3.

Example No	Anionic	Nonionic	% Soil Removal
13	12% ELFAN 280	1.33% A7 + 4% A3	42.9
14	12% ELFAN KT550	1.33% A7 + 4% A3	43.7
15	12% SULFOPON T55	1.33% A7 + 4% A3	34.5
16	9% ELFAN 280	2% A7 + 3% A3	37.3
17	9% ELFAN KT550	2% A7 + 3% A3	36.8
18	9% SULFOPON T55	2% A7 + 3% A3	32.3
19	9% ELFAN 280	3% A7 + 3% A3	35.2
20	9% ELFAN KT550	3% A7 + 3% A3	37.2
21	9% SULFOPON T55	3% A7 + 3% A3	33.0
22	9% ELFAN 280	4% A7 + 3% A3	34.3
23	9% ELFAN KT550	4% A7 + 3% A3	36.1
24	9% SULFOPON T55	4% A7 + 3% A3	33.2

It will be seen that in every case, the ELFAN KT550 outperformed the all tallow SULFOPON T55 and came close to or surpassed the all coconut ELFAN 280. In every case, this amounts to a soil removal which is better than the average of the figures for the all coconut and all tallow derived materials.

EXAMPLES 25 TO 31

Wash liquors were prepared in water of 30 °FH (equivalent to a free calcium ion concentration of 3.0 x 10^{-3} molar). The wash liquor contained the equivalent of 6g/l of a composition containing (by weight):

Specified surfactant	13%
Zeolite	24%
Polyacrylate	4%
Sodium sulphate	20.6%
Sodium carbonate	12%
Water	balance

Each wash liquor composition was employed to launder several test cloths in a Tergotometer, in a heat-up cycle to 60 °C. After laundering the increase in reflectance of the test cloths was measured.

The test cloths employed had various stains as follows:

EMPA-104 : Stain of Indian ink and olive oil.

WFK-10C : Stain predominantly wool fat, with minor amounts of kaolin, carbon black and iron oxide.

PC-9 : Stain of ground nut oil, Indian ink and iron oxide.

The specified surfactant(s) consisted of some or all of hardened tallow alcohol sulphate (TAS) and/or coconut alcohol sulphate (CAS) and mixtures with nonionic surfactant (NI) which was SYNPERONIC A3, i.e. C_{13}/C_{15} fatty alcohol ethoxylated with an average of 3 moles of ethylene oxide per molecule.

Results were as follows:

Example No	Surfactant(s)			Increase in Reflectance		
				WFK-10C	PC-9	EMPA-104
25		100% TAS	0% CAS	17.1	18.9	21.5
26		60% TAS	40% CAS	21.8	19.3	24.3
27		40% TAS	60% CAS	23.7	19.7	22.2
28		0% TAS	100% CAS	18.4	17.9	20.6
29	20% NI	80% TAS	0% CAS	20.0	19.8	17.9
30	20% NI	40% TAS	40% CAS	24.6	21.0	20.3
31	20% NI	0% TAS	80% CAS	19.2	18.9	16.9

It will be seen that in each case the mixture of hardened tallow based and coconut based surfactants gave better detergency than either of them used alone.

EXAMPLES 32 AND 33

Wash liquors were prepared in water having a hardness of 25° FH. The wash liquors contained the equivalent of 6 g/l of a composition containing (by weight):

Ingredient	% by weight
Specified anionic	9
SYNPERONIC A7	1
SYNPERONIC A3	3
Zeolite	26.6
Sodium sulphate	19.5
Sodium carbonate	14.0
Sodium silicate	1.3
Sodium chloride	3.0
Moisture	balance to 100%

For Example 32 the anionic surfactant was ELFAN KT550. For Example 33 the anionic surfactant was PAS derived from myristyl alcohol (i.e. C_{14} alcohol). The wash liquors were tested as in Examples 1 to 6, although a different grade of polyester was used for the test cloths.

Soil removal results were:

Example 32 (ELFAN KT550)	28.1%
Example 33 (C_{14} PAS)	26.0%

EXAMPLE 34

The following formulation was prepared by spray drying a slurry of some of the ingredients to form a base powder and then subsequently spraying on some of the nonionic surfactant and post dosing the remaining ingredients.

Ingredients	Parts by weight	
Base powder		
Anionic (see below)	9.0	
SYNPERONIC A7	1.0	
Zeolite	26.6	
Sodium sulphate	19.5	
Sodium carbonate	2.0	
Moisture and miscellaneous	13.7	71.8
Spray-on		
SYNPERONIC A3	1.0	1.0
Post-dose		
Sodium silicate	1.3	
Sodium perborate monohydrate	8.0	
SYNPERONIC A3	2.0	
TAED granules	2.8	
Antifoam	3.0	
Enzyme	0.6	
Perfume	0.3	
Sodium carbonate	12.0	30.0
Total		102.8

This composition was used to wash a variety of stained fabrics under a variety of conditions, results being assessed by measuring the reflectance of treated monitors. The anionic surfactants used were tallow PAS, coconut PAS and a 50/50 mixture of the two.

The benefits observed in previous Examples were again observed in this case also. Thus the 50/50 mixture generally gave better performance than the coconut PAS alone, while on a number of stains (notably dirty motor oil, and make-up on white cotton) the mixture out-performed both alternatives.

Claims

1. A detergent composition for washing fabrics, the composition containing a surfactant system comprising an anionic surfactant the major ingredient of which is an alkyl sulphate of mixed alkyl chain length such that at least 10% by weight of the alkyl chains present in the alkyl sulphate are C_{12} chains, at least 20% by weight of said alkyl chains are C_{18} chains and the ratio of C_{12} alkyl chains to C_{18} alkyl chains is in the range 9:4 to 1:6.

2. A composition according to claim 1 wherein the said weight ratio is in the range 2:1 to 1:5.

3. A composition according to claim 1 or claim 2 wherein the alkyl sulphate of mixed chain length is at least 60% of the anionic surfactant.

4. A composition according to claim 1 or claim 2 wherein the alkyl sulphate of mixed chain length is at least 80% of the anionic surfactant.

5. A composition according to any one of the preceding claims wherein at least 15% by weight of the alkyl chains are C_{12} chains while at least 25% are C_{18} chains.

6. A detergent composition according to claim 1 or claim 3 in which the alkyl sulphate is a mixture of tallow alkyl sulphate and coconut alkyl sulphate in a weight ratio of 3:1 to 1:3 preferably from 2:1 to 1:2.

7. A detergent composition according to any one of the preceding claims which additionally contains a nonionic surfactant.

8. A detergent composition according to claim 7 in which the nonionic surfactant has an HLB of less than 10.5.

9. A detergent composition according to claim 7 or claim 8 in which the weight ratio of alkyl sulphate to nonionic surfactant is in the range 10:1 to 1:4.