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(71) **Applicant** *(for all designated States except AE, AG, AU, BB, BH, BN, BW, BZ, CA, CL, CR, CY, DE, DJ, DM, DO, EC, EG, GB, GD, GH, GM, GT, HN, IE, IL, IN, IR, IT, JO, KE, KH, KN, KR, KW, LA, LC, LK, LS, MA, MD, MT, MW, MY, MZ, NA, NG, NI, NZ, OM, PA, PE, PG, QA, RS, RU, RW, SA, SC, SD, SG, SL, SV, SZ, TH, TN, TR, TT, TZ, UG, US, VC, VN, WS, ZA, ZM, ZW)*: **UNILEVER IP HOLDINGS B.V.** [NL/NL]; Weena 455, 3013 AL Rotterdam (NL).

(71) **Applicant** *(for all designated States except AL, AO, AT, BA, BE, BF, BG, BJ, BR, CF, CG, CH, CI, CM, CN, CO, CU, CZ, DK, DZ, EE, ES, FI, FR, GA, GE, GN, GQ, GR, GW, HR, HU, ID, IS, JP, KM, KP, LR, LT, LU, LV, LY, MC, ME, MG, MK, ML, MN, MR, MX, NE, NL, NO, PH, PL, PT, RO, SE, SI, SK, SM, SN, ST, SY, TD, TG, UA, US, UZ)*: **UNILEVER GLOBAL IP LIMITED** [GB/GB]; Port Sunlight, Wirral Merseyside CH62 4ZD (GB).

(71) **Applicant** *(for US only)*: **CONOPCO, INC., D/B/A UNILEVER** [US/US]; 700 Sylvan Avenue, Englewood Cliffs, New Jersey 07632 (US).

(72) **Inventors: BATCHELOR, Stephen Norman**; Unilever R&D Port Sunlight, Bebington, Wirral Merseyside CH63 3JW (GB). **BENNETT, Julie**; Unilever R&D Port Sunlight, Bebington, Wirral Merseyside CH63 3JW (GB). **DIEDERICHS, Jan**; Clariant Produkte (Deutschland) GmbH, Industrieparkstrasse 1, 84508 Burgkirchen (DE). **GUO, Xiaoqiang**; Clariant Produkte (Deutschland) GmbH, Industriepark Höchst, G860, 65926 Frankfurt am Main (DE). **HÖVELMANN, Felix Florian**; Clariant Produkte (Deutschland) GmbH, Industrieparkstrasse 1, 84508 Burgkirchen (DE). **LEINWEBER, Dirk**; Clariant Produkte (Deutschland) GmbH, Industriepark Höchst, G860, 65926 Frankfurt am Main (DE).

(74) **Agent: MCHUGH, Paul, Edward**; Unilever Patent Group, Bronland 14, 6708 WH Wageningen (NL).

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(54) **Title:** DETERGENT COMPOSITION

(57) **Abstract:** The invention concerns a detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising from 0.5 to 50 wt.% of a fatty alcohol alkoxylate surfactant having C18 content in excess of 30 wt.%, obtainable by reacting at least one fatty alcohol having C18 content in excess of 30 wt.% with ethylene oxide or a mixture of ethylene oxide and propylene oxide, wherein reacting is conducted in the presence of a calcium catalyst.

DETERGENT COMPOSITION

Field of Invention

The present invention concerns a detergent composition, preferably a liquid detergent composition, more preferably a laundry liquid detergent composition.

Background of the Invention

The present invention relates to a detergent composition, preferably a liquid detergent composition, more preferably a laundry liquid detergent composition comprising a fatty alcohol alkoxylate surfactant, obtainable by reacting at least one fatty alcohol with ethylene oxide or a mixture of ethylene oxide and propylene oxide, wherein reacting is conducted in the presence of a calcium catalyst. Furthermore, the present invention refers to a fatty alcohol alkoxylate surfactant comprising at least one fatty alcohol alkoxylate and at least one calcium salt.

Today, surfactant compositions are of interest for a large number of uses. For instance, consumer goods such as, e.g., shampoos, shower gels, toothpastes, laundry formulations, etc., as well as industrial use such as for production processes including emulsion of phases, are of great interest. For many applications, non-ionic surfactants are desired. Often, non-ionic surfactants are less sensitive to water hardness than, for instance, many anionic surfactants. Non-ionic surfactants such as alkoxylates often bear good foaming properties and/or good emulsion properties as desired for many uses. A frequently used class of non-ionic surfactants is the group of alkoxylate surfactants such as, e.g., alcohol ethoxylate surfactants.

Typically, alkoxylate surfactants are obtained by reacting an alcohol with the desired molar ratio of alkylene oxide (often ethylene oxide). This typically requires heating the reagents in the presence of a catalyst.

A common catalyst in this context is a strong inorganic base such as sodium hydroxide. This has several technical drawbacks. In the production process, the operator has to deal with considerable amounts of a harmful strong inorganic base such as sodium hydroxide. Furthermore, the obtained product is basic and has to be neutralized. In the basic environment, undesired saponification may occur when the ester compounds are present.

A severe drawback of the synthetic route of the prior art is that an undesirably broad distribution of the number of alkoxy residues per alcohol group is obtained. In other words, the obtained alkoxylate surfactant has a poor homology. It is a mixture of a large variety of alkoxylate with different properties. This may hamper usability of the surfactant and may even result in undesired phase separation upon storage. The properties as well as the reliability of the alkoxylate surfactants in the art is not as desired.

Antimony pentachloride was described as an alternative catalyst for catalyzing the reaction of an alcohol ethylene oxide as described in GB-A 796,508. Antimony salts are, however, considered as being harmful or even toxic. Thus, the method and alkoxylate surfactants described in GB-A 796,508 have significant drawbacks.

EP-A 0026546 teaches reacting hydroxyl group-containing reactants with epoxides in the presence of a basic salt of an alkaline earth metal. The disclosure of EP-A 0026546 is focused on basic earth alkali metal alkoxides, in particular earth alkali metal alkoxides ethoxides and methoxides prepared by reacting the earth alkali metal with ethanol. For instance, basic calcium ethoxides obtained from reacting calcium metal with ethanol are used as catalyst. Also EP-A 0092256 teaches earth alkali metal alkoxides such as, e.g., calcium alkoxides, usable as catalyst for preparing alkoxides and adds a catalyst promoter selected from a long list of alternatives. Using alkali metal alkoxides such as, e.g., calcium alkoxides, bears the advantage that catalysis is performed rather well. A severe drawback is, however, that alkali metal alkoxides are chemically not well storable and are, thus, typically to be prepared on demand on site. Preparing the catalyst is laborious as it requires constantly removing the ethanol by-product by means of evaporation in a vacuum. This procedure is rather laborious and far from being optimal.

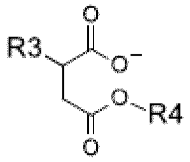
In view of the prior art, there was still an unmet need for alkoxylate surfactants having improved properties such as good solubility, omittance of undesired basic or toxic components, good synthetic accessibility and narrow distribution of the number of alkoxy residues per alcohol group. Further, there was also the desire for effective processes for obtaining such alkoxylate surfactants and the avoidance of non-storable educts and catalysts.

Surprisingly, it was found that a fatty alcohol alkoxylate surfactant having particularly good properties such as narrow distribution of the number of alkoxy residues per alcohol group and good solubility can be obtained by using a calcium catalyst. Using such calcium catalyst allows the avoidance of toxic and basic reagents and the calcium catalyst can optionally partly or completely remain in the fatty alcohol alkoxylate surfactant without disturbing its usability for many applications.

Summary of the Invention

The invention relates to a detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising from 0.5 to 50 wt.%, preferably from 1 to 40 wt.%, more preferably from 1.5 to 30 wt.% of a fatty alcohol alkoxylate surfactant having C18 content in excess of 30 wt.%, obtainable by reacting at least one fatty alcohol having C18 content in excess of 30 wt.% with ethylene oxide or a mixture of ethylene oxide and propylene oxide, wherein reacting is conducted in the presence of a calcium catalyst.

Preferably the calcium catalyst comprises or consist of at least one calcium salt which comprises calcium cations and one or more types of anions selected from the group consisting of branched or linear C_8-C_{12}-alkanoate, preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate, hydrogensulfate, sulfate, an anionic ion of formula (III), and an anionic ion of formula (IV)



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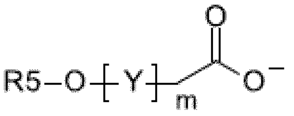


$$\mathrm{R5{-}O{-}[Y]_m{-}CH_2{-}C(=O)O^-}$$

(IV) ,

wherein

R3 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 6 to 18 carbon atoms, in particular a linear or branched alkyl or alkenyl group having 8 to 16 carbon atoms;

R4 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl group having 1 to 16 carbon atoms or a linear or branched alkenyl group having 2 to 16 carbon atoms, in particular a linear or branched alkyl group having 1 to 12 carbon atoms or a linear or branched alkenyl group having 2 to 12 carbon atoms;

R5 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 6 to 20 carbon atoms, in particular a linear or branched alkyl or alkenyl group having 10 to 20 carbon atoms;

Y is selected from ethoxy and mixtures of ethoxy and propoxy, wherein a mixture of ethoxy and propoxy has molar ratio of ethoxy : propoxy of > 1:1, in particular is ethoxy; and

m on a molar average, is from 3 to 100, preferably from 3 to 40, more preferably from 3 to 20, in particular from 3 to 10.

Preferably the fatty alcohol alkoxylate surfactant comprises at least one fatty alcohol alkoxylate described in the following formula (I)

$$R-O-\left[X\right]_{n}-H \qquad (I)$$

,

wherein:
R is a linear or branched alkyl or alkenyl group having 6 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 8 to 20 carbon atoms, more preferably a linear or branched alkyl or alkenyl group having 12 to 20 carbon atoms, even more preferably a linear or branched alkyl or alkenyl group having 16 to 18 carbon atoms, in particular a linear alkyl or alkenyl group having 16 to 18 carbon atoms;

X is selected from ethoxy and mixtures of ethoxy and propoxy, wherein a mixture of ethoxy and propoxy has molar ratio of ethoxy : propoxy of > 1:1, in particular is ethoxy;

n on a molar average, is from 3 to 100, preferably from 3 to 60, more preferably from 3 to 40, even more preferably from 4 to 20, in particular from 4 to 15;
wherein the fatty alcohol alkoxylate surfactant has a C18 content in excess of 30 wt.%, preferably in excess of 35 wt.%, more preferably in in excess of 40 wt.%, even more preferably in excess of 45 wt.%, even more preferably in excess of 50 wt.%, even more preferably in excess of 55 wt.%.

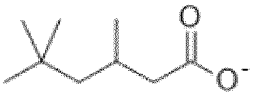
Preferably the at least one fatty alcohol alkoxylate described in the following formula (I) is wherein:

R is a linear alkyl or alkenyl group having 16 to 18 carbon atoms;
X is ethoxy; and
n on a molar average, is from 4 to 20, in particular from 4 to 15, more preferably from 6 to 12, most preferably from 8 to 12,
in particular wherein in more than 70 mol% of the fatty alcohol alkoxylates, n is in the range from 0.5n to 1.5n;
wherein the fatty alcohol alkoxylate surfactant has a C18 content in excess of 30 wt.%, preferably in excess of 35 wt.%, more preferably in in excess of 40 wt.%, even more preferably in excess of 45 wt.%, even more preferably in excess of 50 wt.%, even more preferably in excess of 55 wt.%; and wherein the C18:1 content of the C18 content is from 10 to 100 wt.%, more preferably from 20 to 100 wt.%, even more preferably from 30 to 100 wt.%, even more preferably from 40 to 100 wt.% even more preferably from 50 to 100 wt.%.

Preferably the fatty alcohol alkoxylate surfactant comprises fatty alcohol alkoxylate, preferably the one or more fatty alcohol alkoxylate of formula (I), in an amount from 0.1 to 99.99% by weight, preferably in an amount from 1 to 99.9% by weight, more preferably in an amount from 10 to 99.9% by weight and even more preferably in an amount from 50 to 99.9%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant.

Preferably the at least one calcium salt comprises branched nonanoate and optionally hydrogensulfate and/or sulfate, wherein, on a molar average, the molar ratio branched nonanoate : calcium is at least 1 : 1.

Preferably the at least one calcium salt comprises anions comprising or consisting of branched nonanoate of formula (V):



(V).

Preferably the at least one calcium salt is obtainable by reacting calcium hydroxide with branched or linear C_8-C_{12}-alkanoic acid which is neutralized with sulfuric acid.

Preferably the one or more calcium catalysts is present in an amount from 0.01 to 10% by weight, preferably in an amount from 0.01 to 5% by weight, more preferably in an amount from 0.05 to 3% by weight and even more preferably in an amount from 0.1 to 2%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant.

Preferably for the fatty alcohol alkoxylate surfactant, the mixture of ethylene oxide and propylene oxide has molar ratio of (ethylene oxide) : (propylene oxide) of > 1:1.

Preferably the surfactant is selected from alcohol ethoxylate, ether sulfate and ether carboxylate.

Preferably the detergent composition comprises 0.1 to 10 wt.% of the composition of cleaning polymer selected from alkoxylate polyethylene imines, polyester soil release polymers, co-polymer of PEG/vinyl acetate, and mixtures thereof.

Preferably the detergent composition comprises one or more enzyme(s).

Preferably the detergent composition comprises sequestrant, and/or benzoate salt, and/or from up to 5 wt.% fatty acid.

Preferably the detergent composition has a viscosity of from 100 to 300 mPa.s.

Detailed Description of the Invention

The indefinite article “a” or “an” and its corresponding definite article “the” as used herein means at least one, or one or more, unless specified otherwise.

wt.% relates to the amount by weight of the ingredient based on the total weight of the composition. For anionic surfactants, wt.% is calculated based on the protonated form of the surfactant.

As used herein, the term “surfactant” may be understood in the broadest sense as generally understood in the art. Typically, it is a surface-active agent that is able to lower the surface tension of aqueous solutions. A surfactant may act as a detergent, wetting agent, emulsifier, foaming agent, and/or dispersant. In a preferred embodiment, a surfactant as used herein is a non-ionic surfactant or an anionic surfactant.

As used herein, the propylene oxide is typically 1,2- propylene oxide.

Alkoxylation

Reacting the at least one fatty alcohol with ethylene oxide may lead to a fatty alcohol residue that is conjugated with one or more ethoxy groups. Reacting the at least one fatty alcohol with propylene oxide may lead to a fatty alcohol residue that is conjugated with one or more propoxy groups. Reacting the at least one fatty alcohol with ethylene oxide and propylene oxide may lead to a fatty alcohol residue that is conjugated with one or more ethoxy groups and one or more propoxy groups.

When a mixture of ethylene oxide and propylene oxide are used, any molar ratio may be used. In a preferred embodiment, the mixture of ethylene oxide and propylene oxide has molar ratio of (ethylene oxide) : (propylene oxide) of > 1:1.

In a preferred embodiment, the mixture of ethylene oxide and propylene oxide has molar ratio of (ethylene oxide) : (propylene oxide) of, > 1.1:1, > 1.2:1, > 1.5:1, > 2:1, > 3:1, or > 5:1.

As used throughout the present invention, the term “ethoxy” may be understood as generally understood in the art. In the context of a residue embedded in a chemical structure, it may have the structure

$$[\#\text{-}CH_2\text{-}CH_2\text{-}O\text{-}\#]_n,$$

wherein each # independently from another is a binding side to another residue of the compound or, at its terminal end, to hydrogen, and n is the number of ethoxy residues.

As used throughout the present invention, the term “propoxy” may be understood as generally understood in the art. In the context of a residue embedded in a chemical structure, preferably has any of the structures:

$$[\#\text{-}CH(CH_3)\text{-}CH_2\text{-}O\text{-}\#]_n, \text{ or}$$
$$[\#\text{-}CH_2\text{-}CH(CH_3)\text{-}O\text{-}\#]_n.$$

wherein each # independently from another is a binding side to another residue of the compound or, at its terminal end, to hydrogen, and n is the number of propoxy residues. In a preferred embodiment, in the context of a residue embedded in a chemical structure, it may have any of the structures $[\#\text{-}CH(CH_3)\text{-}CH_2\text{-}O\text{-}\#]_n$, or $[\#\text{-}CH_2\text{-}CH(CH_3)\text{-}O\text{-}\#]_n$, in particular is $[\#\text{-}CH_2\text{-}CH(CH_3)\text{-}O\text{-}\#]_n$.

A fatty alcohol alkoxylate surfactant as used herein may be understood in the broadest sense as a conjugate of a fatty alcohol group and one or more alkoxy residues. Typically, the bond between the fatty alcohol group and the one or more alkoxy residues is an ether bond (-O-). Also the bond between two or more alkoxy residues is typically each an ether bond.

The term “fatty alcohol” may be understood in the broadest sense as generally understood in the art. Preferably, it is a linear or branched, saturated or unsaturated (e.g. comprising one, two, three or more than three double bonds) alcohol having 4 to 34 carbon atoms, preferably 4 to 26 carbon atoms, more preferably 6 to 22 carbon atoms. For instance, a fatty alcohol may have 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, or 22 carbon atoms. In a preferred embodiment, the fatty alcohol is an alkyl group comprising a single hydroxyl group. In a preferred embodiment, the fatty alcohol is an alkyl group comprising a single hydroxyl group at carbon atom C1, i.e., a terminal carbon atom. In a preferred embodiment, the fatty alcohol has a linear structure.

For instance, a fatty alcohol may be selected from the group consisting of butyl alcohol (e.g., tert-butyl alcohol), tert-amyl alcohol, 3-methyl-3-pentanol, hexanol (e.g., 1-hexanol), heptanol (e.g., 1-heptanol, enanthic alcohol), octanol (e.g., 1-octanol, capryl alcohol), nonanol (e.g. 1-nonanol, pelargonic alcohol), decanol (e.g., 1-decanolm, decyl alcohol, capric alcohol), undecyl alcohol (e.g., 1-undecanol, hendecanol), dodecanol (e.g., 1-dodecanol, lauryl alcohol), tridecyl alcohol (e.g., 1-tridecanol, isotridecanol), tetradecanol (e.g., 1-tetradecanol, myristyl alcohol), pentadecanol, (e.g., 1-pentadecanol, pentadecanol), hexadecanoyl (e.g., 1-hexadecanol, cetyl alcohol), palmitoleyl alcohol (cis-9-hexadecen-1-ol), heptadecanol (e.g., 1-n-heptadecanol, heptadecyl alcohol), octadecanol (e.g., 1-octadecanol, stearyl alcohol), octadecenol (e.g. 1-octadecenol, oleyl alcohol, octadec-9-en-1-ol), nonadecanol (e.g., 1-nonadecanol, nonadecyl alcohol), eicosanol (e.g., 1-eicosanol, arachidyl alcohol), heneicosanol (e.g., 1-heneicosanol, heneicosyl alcohol), docosanol (e.g., 1-docosanol, behenyl alcohol), cis-13-docosen-1-ol (erucyl alcohol), tetracosanol (e.g., 1-tetracosanol (lignoceryl alcohol), hexacosanol (e.g., 1-hexacosanol, ceryl alcohol), octacosanol, nonacosanol, dotriacontanol, and tetratriacontanol.

In a preferred embodiment, a fatty alcohol may be selected from the group consisting of 1-n-hexadecanol, 9-hexadecen-1-ol, 1-n-heptadecanol, 1-n-octadecanol, 1-n-octadecenol (e.g., octadec-9-en-1-ol), 1-n-nonadecanol, and eicosanol (e.g., 1-n-eicosanol). In a preferred embodiment, a fatty alcohol may be octadec-9-en-1-ol.

In a preferred embodiment, a fatty acid residue incorporated in an alkoxylate has the structure

$$R^a\text{-O-\#},$$

wherein

is the binding side to a carbon atom of the one or more alkoxide residues; and
R^a is a linear or branched C_4-C_{34}-alkyl or C_4-C_{34}-alkenyl, preferably a linear or branched C_6-C_{20}-alkyl or C_6-C_{20}-alkenyl, more preferably a linear or branched C_8-C_{20}-alkyl or C_8-C_{20}-alkenyl, even more preferably a C_{12}-C_{20}-alkyl or C_{12}-C_{20}-alkenyl, even more preferably a linear or branched C_{16}-C_{18}-alkyl or C_{16}-C_{18}-alkenyl

In a preferred embodiment, R^a is a linear alkyl or alkenyl residue, in particular a linear C_{16}-C_{18}-alkyl or C_{16}-C_{18}-alkenyl.

As used throughout the present invention, the terms “alkyl” and “alkenyl” may be understood in the broadest sense as generally understood in the art.

An alkyl group is mainly or completely composed of carbon and hydrogen atoms 15 and does not contain a double bond. An alkyl group may be linear (also: unbranched) or branched. It will be understood that a branched alkyl comprises at least three carbon atoms. Thus, for instance, in a branched or linear C_1-C_{20}-alkyl, the person skilled in the art will understand without any burden that a linear alkyl may have from 1 to 20 carbon atoms, while a branched alkyl may have from 3 to 20 carbon atoms.

An alkenyl group is mainly or completely composed of carbon and hydrogen atoms and contains one, two, three or even more than three double bonds. Typically and preferably, a single carbon atom is not involved in two double bonds. An alkenyl group may be linear or branched. It will be understood that a branched alkenyl comprises at least three carbon atoms. Thus, for instance, in a branched or linear C_2-C_{20}-alkenyl, the person skilled in the art will understand without any burden that a linear alkenyl may have from 2 to 20 carbon atoms, while a branched alkenyl may have from 3 to 20 carbon atoms.

Alkyl or alkenyl groups may or may not be substituted by one or more heteroatoms, preferably are not substituted by a heteroatom. As used throughout the present invention, the term “carbon atom” may include any isotope of carbon, including ^{12}C, ^{13}C and ^{14}C, preferably is ^{12}C and/or ^{13}C. As used throughout the present invention, the term “hydrogen” may include any isotope of hydrogen including ^{1}H, ^{2}H (deuterium) and ^{3}H (tritium).

(A) Fatty alcohol alkoxylate

A fatty alcohol alkoxylate used in the present invention may be any fatty alcohol alkoxylate that is obtainable by reacting at least one fatty alcohol with ethylene oxide or a mixture of ethylene oxide and propylene oxide, wherein reacting is conducted in the presence of a calcium catalyst.

In a preferred embodiment, the fatty alcohol surfactant alkoxylate comprises at least one fatty alcohol alkoxylate described in the following formula (I)

$$R{-}O{-}\left[X\right]_{n}{-}H \qquad (I)$$

,

wherein:

R is a linear or branched alkyl or alkenyl group having 6 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 8 to 20 carbon atoms, more preferably a linear or branched alkyl or alkenyl group having 12 to 20 carbon atoms, even more preferably a linear or branched alkyl or alkenyl group having 16 to 18 carbon atoms, in particular a linear alkyl or alkenyl group having 16 to 18 carbon atoms;

X is selected from ethoxy and mixtures of ethoxy and propoxy, wherein a mixture of ethoxy and propoxy has molar ratio of ethoxy : propoxy of > 1:1, in particular is ethoxy;

n on a molar average, is from 3 to 100, preferably from 3 to 60, more preferably from 3 to 40, even more preferably from 4 to 20, in particular from 4 to 15, wherein the fatty alcohol alkoxylate surfactant has a C18 content in excess of 30 wt.%, preferably in excess of 35 wt.%, more preferably in in excess of 40 wt.%, even more preferably in excess of 45 wt.%, even more preferably in excess of 50 wt.%, even more preferably in excess of 55 wt.%.

In a preferred embodiment, R is a linear alkyl or alkenyl group.

In a preferred embodiment, X is ethoxy. In another preferred embodiment, X is a mixture of ethoxy and propoxy having a molar ratio of ethoxy : propoxy of > 1:1, > 1.1:1, > 1.2:1, > 1.5:1, > 2:1, > 3:1, or > 5:1.

In a preferred embodiment, on a molar average, n is from 4 to 15, from 4 to 10, from 5 to 12, from 7 to 15, or from 8 to 12.

In a preferred embodiment, in more than 70 mol% of the fatty alcohol alkoxylates, n is in the range from 0.5n to 1.5n. Thus, the distribution of n (i.e., the ethoxy and optionally propoxy residues) is rather narrow on molar average. In other words, preferably in more than 70 mol% of the fatty alcohol alkoxylates, n is in the range from +/- 0.5n.

In a preferred embodiment, in more than 75 mol% or more than 80 mol% of the fatty alcohol alkoxylates, n is in the range from 0.5n to 1.5n.

In a preferred embodiment, in the at least one fatty alcohol alkoxylate of formula (I):
R is a linear alkyl or alkenyl group having 16 to 18 carbon atoms;
X is ethoxy; and
n on a molar average, is from 4 to 20, in particular from 4 to 15, more preferably from 6 to 12, most preferably from 8 to 12,
in particular wherein in more than 70 mol% of the fatty alcohol alkoxylates, n is in 15 the range from 0.5n to 1.5n;
wherein the fatty alcohol alkoxylate surfactant has a C18 content in excess of 30 wt.%, preferably in excess of 35 wt.%, more preferably in in excess of 40 wt.%, even more preferably in excess of 45 wt.%, even more preferably in excess of 50 wt.%, even more preferably in excess of 55 wt.%; and wherein the C18:1 content of the C18 content is from 10 to 100 wt.%, more preferably from 20 to 100 wt.%, even more preferably from 30 to 100 wt.%, even more preferably from 40 to 100 wt.% even more preferably from 50 to 100 wt.%.

The fatty alcohol alkoxylate surfactant may comprise the fatty alcohol alkoxylate in any content. In a preferred embodiment, the fatty alcohol alkoxylate surfactant of the present invention comprises fatty alcohol alkoxylate, preferably the one or more fatty alcohol alkoxylate of formula (I), in an amount from 0.1 to 99.99% by weight, preferably in an amount from 1 to 99.9% by weight, more preferably in an amount from 10 to 99.9% by weight and even more preferably in an amount from 50 to 99.9%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant.

As noted above, a technical advantage of many preferred embodiment of the present invention is that using a calcium catalyst enables that it may partly or completely remain in the fatty alcohol alkoxylate surfactant without hampering the usability of the fatty alcohol alkoxylate surfactant. Accordingly, the fatty alcohol alkoxylate surfactant may optionally contain calcium catalyst. The fatty alcohol alkoxylate surfactant may comprise the calcium catalyst in any content. In a preferred embodiment, the fatty alcohol alkoxylate surfactant according to the present invention comprises the one or more calcium catalysts in an amount from 0.01 to 10% by weight, preferably in an amount from 0.01 to 5% by weight, more preferably in an amount from 0.05 to 3% by weight and even more preferably in an amount from 0.1 to 2%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant.

In a preferred embodiment, the fatty alcohol alkoxylate surfactant of the present invention comprises:
(A) the one or more fatty alcohol alkoxylates, preferably the one or more fatty alcohol alkoxylate of formula (I), in an amount from 0.1 to 99.99% by weight, preferably in an amount from 1 to 99.9% by weight, more preferably in an amount from 10 to 99.9% by weight and even more preferably in an amount from 50 to 99.9%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant; and

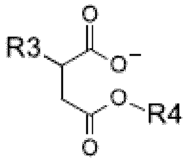
(B) the one or more calcium catalysts in an amount from 0.01 to 10% by weight, preferably in an amount from 0.01 to 5% by weight, more preferably in an amount from 0.05 to 3% by weight and even more preferably in an amount from 0.1 to 2%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant; and
(C) optionally water; and
(D) optionally further ingredients usable in a surfactant composition.

The one or more calcium catalysts and the fatty alcohol alkoxylate may be used in any weight ratio. In a preferred embodiment, the weight ratio of (fatty alcohol alkoxylate) : (one or more calcium catalysts) is from 98.2 : 1.8 to 99.99 : 0.01, more preferably from 98.5 : 1.5 to 99.9 :0.1 and in particular from 99.0 : 1.0 to 99.8 : 0.2.

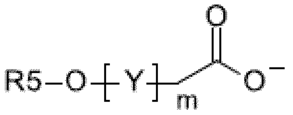
(B) Calcium catalyst
The calcium catalyst may be any catalyst that comprises calcium. In a preferred embodiment, the calcium catalyst comprises or consist of at least one calcium salt, i.e., at least one salt comprising calcium cations (Ca2+) and one or more types of anions as

counterions. It will be understood that, optionally, such calcium salt may also form part of a mixture

In a preferred embodiment, the calcium catalyst comprises or consist of at least one calcium salt which comprises calcium cations and one or more types of anions selected from the group consisting of branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate), hydrogensulfate, sulfate, an anionic ion of formula (III), and an anionic ion of formula (IV)



(III)



(IV) ,

wherein

R3 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 6 to 18 carbon atoms, in particular a linear or branched alkyl or alkenyl group having 8 to 16 carbon atoms;

R4 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl group having 1 to 16 carbon atoms or a linear or branched alkenyl group having 2 to 16 carbon atoms, in particular a linear or branched alkyl group having 1 to 12 carbon atoms or a linear or branched alkenyl group having 2 to 12 carbon atoms;

R5 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 6 to 20 carbon atoms, in particular a linear or branched alkyl or alkenyl group having 10 to 20 carbon atoms;

Y is selected from ethoxy and mixtures of ethoxy and propoxy, wherein a mixture of ethoxy and propoxy has molar ratio of ethoxy : propoxy of > 1:1, in particular is ethoxy; and

m on a molar average, is from 3 to 100, preferably from 3 to 40, more preferably from 3 to 20, in particular from 3 to 10.

In a preferred embodiment, is formulae (III) and/or (IV), the residues are defined as follows:
R3 is a linear or branched alkyl or alkenyl group having 8 to 16 carbon atoms;
R4 is a linear or branched alkenyl group having 2 to 12 carbon atoms;
R5 is a linear or branched alkyl or alkenyl group having 10 to 20 carbon atoms;
Y is selected from ethoxy; and
m on a molar average, is from 3 to 10.

In a preferred embodiment, R3 is a linear alkyl group having 8, 9, 10, 11, 12, 13, 14, 15 or 16 carbon atoms. In another preferred embodiment, R3 is a branched alkyl group having 8, 9, 10, 11, 12, 13, 14, 15 or 16 carbon atoms.

In a preferred embodiment, R4 is a linear alkyl group having 2, 3, 4, 5, 6, 7, 8, 9, 5 10, 11 or 12 carbon atoms. In another preferred embodiment, R4 is a branched alkyl group having 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12 carbon atoms.
In a preferred embodiment, R5 is a linear alkyl group having 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 carbon atoms. In another preferred embodiment, R5 is a branched alkyl group having 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 carbon atoms.

In a preferred embodiment, Y is ethoxy. In another preferred embodiment, Y is a mixture of ethoxy and propoxy having a molar ratio of ethoxy : propoxy of > 1:1, 15 > 1.1:1, > 1.2:1, > 1.5:1, > 2:1, > 3:1, or > 5:1.

In a preferred embodiment, m, on a molar average, is from 3 to 100, preferably from 3 to 40, more preferably from 3 to 20, in particular from 3 to 10. In a preferred embodiment, m, on a molar average, is 3, 4, 5, 6, 7, 8, 9 or 10.

In a preferred embodiment, the calcium catalyst comprises or consist of at least one calcium salt which comprises calcium cations and one or more types of anions selected from the group consisting of branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate), and hydrogensulfate, sulfate.

As used herein, a branched or linear C_8-C_{12}-alkanoate may be any branched or linear alkanoate that has 8, 9, 10, 11 or 12 carbon atoms. An alkanoate is, in the broadest sense, the anion of a carboxylic acid. It, thus, typically has the structure

$$R^b\text{-COO-},$$

wherein R^b is a branched or linear C_7-C_{11}-alkyl group. In a preferred embodiment, the branched or linear C_8-C_{12}-alkanoate is a branched or linear octanoate, a branched or linear nonanoate, a branched or linear decanoate, a branched or linear undecanoate, or a branched or linear dodecanoate.

In a preferred embodiment, the calcium catalyst comprises or consist of at least one calcium salt of a stoichiometry of formula (II)

$$(Ca^{2+})x(R1^{p-})_y(R2^{q-})_z \text{ (II)},$$

wherein

x is 1 or 2;

y is 1 or 2;

z is 1 or 2;

p and q are the charges of ions R1 and R2 which are preferably each independently from another an integer of 0, 1 or 2, in particular 1 or 2, and (yp) + (zq) = (2x); and

R1 and R2 are each independently from another an anion (anionic ion) as defined herein.

In a preferred embodiment, the calcium catalyst comprises or consists of at least one calcium salt of formula (IIa)

$$Ca^{2+}R1\text{-}R2\text{- (IIa)},$$

wherein

R1- and R2- are each independently from another an anion (anionic ion) as defined for R1 and R2 herein and R1- and R2- may optionally also be together a sulfate.

The calcium salt may comprise branched or linear C_8-C_{12}-alkanoate, hydrogensulfate and sulfate in any molar ratio. In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate and the molar ratio branched or linear C_8-C_{12}-alkanoate : calcium is at least 1 : 1. In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate and the molar ratio branched or linear C_8-C_{12}-alkanoate : calcium is at least 1.1 : 1, or is at least 1.5 : 1, or is (approximately) 2 : 1.

In a preferred embodiment, the calcium catalyst comprises or consists of at least one calcium salt which comprises calcium cations and one or more types of anions selected from the group consisting of branched or linear C_8-C_{12}-alkanoate, hydrogensulfate, and sulfate.

In other words, preferably, the at least one calcium salt comprises at least one anion selected from the group consisting of branched or linear C_8-C_{12}-alkanoate, hydrogensulfate and sulfate.

In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate and optionally hydrogensulfate and/or sulfate, wherein, on a molar average, the molar ratio branched or linear C_8-C_{12}-alkanoate : calcium is at least 1 : 1. In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate and optionally hydrogensulfate and/or sulfate, wherein, on a molar average, the molar ratio branched or linear C_8-C_{12}-alkanoate : calcium is at least 1.1 : 1, or is at least 1.5 : 1, or is (approximately) 2 : 1.

In a preferred embodiment, the calcium salt is of formula (II) characterized in that R1 and R2 are each independently an anionic ion selected from the group consisting of branched or linear C_8-C_{12}-alkanoate and sulfate, wherein, on a molar average, at least one of R1 and R2 is branched or linear C_8-C_{12}-alkanoate. In a preferred embodiment, the calcium salt is of formula (IIa) characterized in that R1- and R2- are each independently an anionic ion selected from the group consisting of branched or linear C_8-C_{12}-alkanoate and sulfate, wherein, on a molar average, at least one of R1- and R2- is branched or linear C_8-C_{12}-alkanoate.

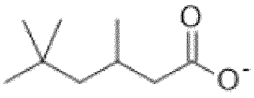
The calcium salt may comprise branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate), hydrogensulfate and sulfate in any molar ratio. The calcium salt may comprise branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate), hydrogensulfate and sulfate in any molar ratio. In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) and the molar ratio branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) : calcium is at least 1 : 1. In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) and the molar ratio branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) : calcium is at least 1.1 : 1, or is at least 1.5 : 1, or is (approximately) 2 : 1.

In a preferred embodiment, the calcium catalyst comprises or consist of at least one calcium salt which comprises calcium cations and one or more types of anions selected from the group consisting of branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate), hydrogensulfate, and sulfate. In other words, preferably, the at least one calcium salt comprises at least one anion selected from the group consisting of branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate), hydrogensulfate and sulfate.

In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) and optionally hydrogensulfate and/or sulfate, wherein, on a molar average, the molar ratio branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) : calcium is at least 1 : 1. In a preferred embodiment, the at least one calcium salt comprises branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) and optionally hydrogensulfate and/or sulfate, wherein, on a molar average, the molar ratio branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) : calcium is at least 1.1 : 1, or is at least 1.5 : 1, or is (approximately) 2 : 1.

In a preferred embodiment, the calcium salt is of formula (II) characterized in that R1 and R2 are each independently an anionic ion selected from the group consisting of branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) and sulfate, wherein, on a molar average, at least one of R1 and R2 is branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate). In a preferred embodiment, the calcium salt is of formula (IIa) characterized in that R1- and R2- are each independently an anionic ion selected from the group consisting of branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) and sulfate, wherein, on a molar average, at least one of R1- and R2- is branched or linear C_8-C_{12}-alkanoate (preferably C_8-C_{12}-alkanoate, in particular branched nonanoate).

As noted above, nonanoate may be branched or linear. In a preferred embodiment, nonanoate is branched. In a preferred embodiment, nonanoate is branched nonanoate. In a preferred embodiment, the at least one calcium salt comprises anions comprising or consisting of branched nonanoate of formula (V):



(V).

In a preferred embodiment, the calcium salt is of formula (II) characterized in that, in the at least one calcium salt of formula (II) R1 and/or R2 is a branched nonanoate residue having the formula (V). In a preferred embodiment, the calcium salt is of formula (II) characterized in that, in the at least one calcium salt of formula (IIa), the one or two branched nonanoate residues have the formula (V).

The at least one calcium salt may be obtained by any means. In a preferred embodiment, the at least one calcium salt is obtainable (or obtained) by reacting calcium hydroxide with branched or linear C_8-C_{12}-alkanoic acid which is neutralized with sulfuric acid. In a preferred embodiment, the at least one calcium salt is obtainable (or obtained) by reacting calcium hydroxide with branched nonanoic acid which is neutralized with sulfuric acid.
In a preferred embodiment, the at least one calcium salt is obtainable (or obtained) by reacting calcium hydroxide with branched nonanoic acid of formula (V) which is neutralized with sulfuric acid.

A calcium catalyst may be obtainable (or obtained) from any means in the art. In a preferred embodiment, the calcium catalyst may be obtainable (or obtained) from reacting one or more types of branched or linear C_8-C_{12}-alkanoic acid or a branched or linear C_8-C_{12}-alkanoic salt with a basic calcium salt (e.g., calcium hydroxide, $Ca(OH)_2$) and subsequently addition of sulfuric acid.

In a preferred embodiment, the calcium catalyst may be obtainable (or obtained) from a method comprising the following steps:
(i) dissolving one or more types of branched or linear C_8-C_{12}-alkanoic acid or a branched or linear C_8-C_{12}-alkanoic salt in a solvent (e.g., water), an alcohol (e.g., propanol) or a mixture thereof;
(ii) adding a basic calcium salt (e.g., calcium hydroxide, $Ca(OH)_2$) to the mixture of step (i) and, optionally, mixing (e.g., by stirring or shaking);
(iii) adding sulfuric acid to the product of step (ii) and optionally, mixing (e.g., by stirring or shaking).

In a preferred embodiment, the calcium catalyst may be obtainable (or obtained) from a method comprising the following steps:
(i) dissolving one or more types of branched or linear C_8-C_{12}-alkanoate (preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate) in a solvent (e.g., water, an alcohol (e.g., propanol), or a mixture thereof;
(ii) adding calcium hydroxide to the mixture of step (i) and, optionally, mixing;
(iii) adding sulfuric acid to the product of step (ii).

As laid out above, the present invention includes a fatty alcohol alkoxylate surfactant as defined herein. The fatty alcohol alkoxylate surfactant, is obtainable (or obtained) by reacting at least one fatty alcohol with ethylene oxide or a mixture of ethylene oxide and propylene oxide, wherein reacting is conducted in the presence of a calcium catalyst. Preferred embodiments and definitions are laid out above.
It was surprisingly found that fatty alcohol alkoxylate surfactants that comprise at least one fatty alcohol alkoxylate and at least one calcium catalyst bear unexpectedly beneficial technical properties independent on the route of preparation.

A preferred fatty alcohol alkoxylate surfactant comprises:
(A) at least one fatty alcohol alkoxylate as component A; and
(B) at least one calcium catalyst, preferably a calcium salt as defined herein as component B,
preferably wherein the fatty alcohol alkoxylate surfactant is defined as herein, and preferably wherein the weight ratio A : B is from 98.2 : 1.8 to 99.99 : 0.01, more preferably from 98.5 : 1.5 to 99.9 :0.1 and in particular from 99.0 : 1.0 to 99.8 : 0.2.

It will be understood that all embodiments and definitions as laid out above, also *mutatis mutandis* apply to this aspect.

In a preferred embodiment, the at least one fatty alcohol alkoxylate is defined as above. In a preferred embodiment, the at least one calcium catalyst is defined as above. In a preferred embodiment, the at least one fatty alcohol alkoxylate and the at least one calcium catalyst are both defined as above.

A fatty alcohol alkoxylate surfactant of the present invention is exemplified in the example section below. A fatty alcohol alkoxylate surfactant of the present invention may be stored at various conditions. It may be stored at ambient temperature (typically ranging from 15 to 35°C, preferably from 18 to 22°C, in particular is approximately 20°C). Alternatively, it may also be stored under cooled condition such as, e.g., at temperatures ranging below -80°C, from -80°C to -20°C, from -25°C to 0°C, from 0°C to 4°C, or from 4°C to 15°C. A fatty alcohol alkoxylate surfactant of the present invention may be stored under conditions allowing it being in contact with light (e.g., sunlight and/or artificial light) or may be stored in the dark.

A fatty alcohol alkoxylate surfactant of the present invention is used as a detergent. It may be used in a consumer good such as, e.g., shampoo, shower gel, toothpaste, laundry formulation, etc.

(D) Means of preparing a fatty alcohol alkoxylate surfactant

The fatty alcohol alkoxylate surfactant included in the present invention may be prepared by any means. Preferably, it comprises reacting the at least one fatty alcohol with ethylene oxide or a mixture of ethylene oxide and propylene oxide, wherein the reaction is catalyzed by a calcium catalyst. It was surprisingly found that such method bears unexpectedly beneficial technical benefits.

A method for preparing the fatty alcohol alkoxylate surfactant, comprises the steps of:

(i) providing:
  (a) at least one fatty alcohol,
  (b) ethylene oxide or a mixture of ethylene oxide and propylene oxide, and
  (c) at least one calcium catalyst, preferably comprising or consisting of at least one calcium salt as defined herein; and
(ii) reacting the at least one fatty alcohol with the ethylene oxide or a mixture of ethylene oxide and propylene oxide in the presence of the at least one calcium catalyst,

preferably wherein the fatty alcohol alkoxylate surfactant is defined as above.

It will be understood that all embodiments and definitions as laid out above in the context of the fatty alcohol alkoxylate surfactant of the present invention also *mutatis mutandis* apply to the method for preparing such.

As indicated above, the provision of at least one calcium catalyst of step (i) may optionally include the procedural step of reacting one or more types of branched or linear C_8-C_{12}-alkanoic acid or a branched or linear C_8-C_{12}-alkanoic salt with a basic calcium salt (e.g., calcium hydroxide, $Ca(OH)_2$) and subsequently addition of sulfuric acid. Preferred embodiments in this context are provided above.

Step (ii) may be performed by any means. In a preferred embodiment, step (ii) is conducted by means of procedural steps comprising the following steps:
(ii-a) mixing the at least one fatty alcohol and the at least one calcium catalyst may be mixed (e.g., in an autoclave reactor);
(ii-b) heating the mixture of step (ii-a) to a suitable reaction temperature; and
(ii-c) adding ethylene oxide or a mixture of ethylene oxide and propylene oxide to the heated mixture of step (ii-b).

This allows obtaining the fatty alcohol alkoxylate surfactant as a liquid under the reaction condition. Optionally, the obtained fatty alcohol alkoxylate surfactant may be further purified.

The at least one fatty alcohol and the at least one calcium catalyst may be used at any content range. In a preferred embodiment, the weight ratio of (at least one fatty alcohol) : (at least one calcium catalyst) is from 90:10 to 99.999 : 0.001, from 95:5 to 99.995 : 0.005, from 98:2 to 99.99 : 0.01, from 98.2 : 1.8 to 99.99 : 0.01, more preferably from 98.5 : 1.5 to 99.9 :0.1 and in particular from 99.0 : 1.0 to 99.8 : 0.2.

Preferably, step (ii-c) of adding ethylene oxide or a mixture of ethylene oxide and propylene oxide is dosing the ethylene oxide or a mixture of ethylene oxide and propylene oxide slowly and/or stepwise to the heated mixture of step (ii-b).

Step (ii) may be conducted at any temperature. In a preferred embodiment, step (ii) is conducted at a temperature of from 100 to 200°C, preferably of from 150 to 200°C.

A method for preparing fatty alcohol alkoxylate surfactant is exemplified in the example section below.

As indicated above, the method of the present invention allows obtaining fatty alcohol alkoxylate surfactant that has a narrow distribution of the number n of ethoxy, and optionally propoxy, on the molar average, in the obtained fatty alcohol alkoxylate, in particular wherein in more than 70 mol% of the obtained fatty alcohol alkoxylates, n is in the range from 0.5n to 1.5n.

Surfactant production from the fatty alcohol

The fatty alcohol is a useful intermediate in the production of various surfactants. Examples of fatty alcohol based surfactants follow.

Surfactant

The fatty alcohol is converted to surfactants by chemically linking a water-soluble head group to the OH group, preferably selected from ethoxylate, ether sulfate, ether carboxylate.

Anionic surfactants are discussed in Anionic Surfactants Organic Chemistry edited by Helmut W. Stache (Marcel Dekker 1996)

The integers ‘w’ ‘m’ and ‘n’ are mole average values.

Alcohol ethoxylate

Alcohol ethoxylates may be synthesised by ethoxylation of the alkyl alcohol, R_1-OH, via the reaction:

$$R_1\text{-OH} + w \text{ ethylene oxide} \rightarrow R_1\text{-O-}(CH_2CH_2O)_w\text{-H}$$

The alcohol ethoxylate preferably has w is from 4 to 20, more preferably 5 to 14, most preferably 8, 9, 10, 11, 12.

R_1 is preferably C_{16} and C_{18}.

Ethoxylation reactions are described in Non-Ionic Surfactant Organic Chemistry (N. M. van Os ed), Surfactant Science Series Volume 72, CRC Press.

Preferably the narrow ethoxy distribution has greater than 70 wt.%, more preferably greater than 80 wt.% of the alcohol ethoxylate R-O-$(CH_2CH_2O)_w$-H wherein w is in the range from 0.5w to 1.5w. For example, when w = 10, then greater than 70 wt.% of the alcohol ethoxylate should consist of ethoxylate with 5, 6, 7, 8, 9 10, 11, 12, 13, 14 and 15 ethoxylate groups.

Ether sulfate

The ether sulfate is preferably of the form:

$$R_1\text{-O-}(CH_2CH_2O)_w\text{-}SO_3H$$

R_1 is preferably C_{16} and C_{18}.

Where w is preferably from 3 to 20, preferably 4 to 12, more preferably 5, 6, 7, 8.

Preferably the narrow ethoxy distribution has greater than 70 wt.%, more preferably greater than 80 wt.% of the alcohol ethoxylate $R\text{-O-}(CH_2CH_2O)_w\text{-}H$ wherein w is in the range from 0.5w to 1.5w. For example, when w = 10, then greater than 70 wt.% of the alcohol ethoxylate should consist of ethoxylate with 5, 6, 7, 8, 9 10, 11, 12, 13, 14 and 15 ethoxylate groups.

Ether sulfates are discussed in the Anionic Surfactants: Organic Chemistry edited by Helmut W. Stache (Marcel Dekker 1996), Surfactant Science Series published by CRC press. Ether sulfate may be synthesised by the sulphonation of the corresponding alcohol ethoxylate.

Ether carboxylate

The ether carboxylate is preferably of the form

$$R_1\text{-O-}(CH_2CH_2O)_w\text{-}CH_2COOH$$

R_1 is preferably C_{16} and C_{18}.

Preferably w is from 5 to 20, more preferably from 6 to 14, most preferably from 8, 9, 10, 11, 12.

Preferably the narrow ethoxy distribution has greater than 70 wt.%, more preferably greater than 80 wt.% of the alcohol ethoxylate $R\text{-O-}(CH_2CH_2O)_w\text{-}H$ wherein w is in the range from 0.5w to 1.5w. For example, when w = 10, then greater than 70 wt.% of the alcohol ethoxylate should consist of ethoxylate with 5, 6, 7, 8, 9 10, 11, 12, 13, 14 and 15 ethoxylate groups.

Alkyl ether carboxylic acids synthesis is discussed in Anionic Surfactants Organic Chemistry edited by Helmut W. Stache (Marcel Dekker 1996). They may be synthesised via the reaction of the corresponding alcohol ethoxylate with chloroacetic acid or monochloro sodium acetate in the presence of NaOH.

Liquid laundry detergents

The invention takes the form of a detergent composition, preferably a liquid detergent composition, most preferably a liquid laundry detergent composition. Such compositions are explained in greater detail in the following paragraphs.

The term “laundry detergent” in the context of this invention denotes formulated compositions intended for and capable of wetting and cleaning domestic laundry such as clothing, linens and other household textiles. The aim is to provide a composition which on dilution is capable of forming a liquid laundry detergent composition and in the manner now described.

The term “linen” is often used to describe certain types of laundry items including bed sheets, pillow cases, towels, tablecloths, table napkins and uniforms. Textiles can include woven fabrics, non-woven fabrics, and knitted fabrics; and can include natural or synthetic fibres such as silk fibres, linen fibres, cotton fibres, polyester fibres, polyamide fibres such as nylon, acrylic fibres, acetate fibres, and blends thereof including cotton and polyester blends.

Examples of liquid laundry detergents include heavy-duty liquid laundry detergents for use in the wash cycle of automatic washing machines, as well as liquid fine wash and liquid colour care detergents such as those suitable for washing delicate garments (e.g. those made of silk or wool) either by hand or in the wash cycle of automatic washing machines.

The term “liquid” in the context of this invention denotes that a continuous phase or predominant part of the composition is liquid and that the composition is flowable at 15°C and above. Accordingly, the term “liquid” may encompass emulsions, suspensions, but not compositions having flowable yet stiffer consistency, known as gels or pastes. The viscosity of the composition is preferably from 100 to about 1,000 mPa.s at 25°C at a shear rate of 21 sec^{-1}. This shear rate is the shear rate that is usually exerted on the liquid when poured from a bottle. Pourable liquid detergent compositions preferably have a viscosity of from 200 to 500 mPa.s, preferably from 200 to 300 mPa.s.

Preferably, the liquid laundry detergent composition comprises from 50% water, more preferably from 70% wt. water and most preferably from 75% water. Preferably the water used has a french hardness of less than 5 degrees french hard, most preferably it is demineralised. Preferably the water is treated with a disinfectant, preferably selected from a chlorine based disinfectant, ozone or UV treatment, to sterilize the water.

A liquid laundry detergent composition may suitably have an aqueous continuous phase. By “aqueous continuous phase” is meant a continuous phase which has water as its basis. Preferably the formulation has a pH of 5 to 10, more preferably 6 to 8, most preferably 6.1 to 7.0

A liquid laundry detergent composition suitably comprises from 5 to 60% and preferably from 10 to 40% (by weight based on the total weight of the composition) of one or more detersive surfactants. Preferably greater than 50 wt.%, more preferably greater than 80 wt.%, most preferably great than 95 wt.% of the detersive surfactant are selected from oleyl based surfactants, more preferably oleyl ethoxylate, oleyl ether sulfate, oleyl ether carboxylate, most preferably oleyl ethoxylate and oleyl ether sulfate.

The term “detersive surfactant” in the context of this invention denotes a surfactant which provides a detersive (i.e. cleaning) effect to laundry treated as part of a domestic laundering process.

Preferably, the selection and amount of surfactant is such that the composition and the diluted mixture are isotropic in nature.

Preferably, the weight ratio of non-ionic surfactant to alkyl ether sulphate surfactant (wt. non-ionic / wt. alkyl ether sulphate) is from 0.5 to 2, preferably from 0.7 to 1.5, most preferably 0.9 to 1.1.

Preferably, the weight ratio of non-ionic surfactant to linear alkyl benzene sulphonate, where present, (wt. non-ionic/ wt. linear alkyl benzene sulphonate) is from 0.1 to 2, preferably 0.3 to 1, most preferably 0.45 to 0.85.

ANTI-FOAM

The composition may also comprise an anti-foam. Anti-foam materials are well known in the art and include silicones and fatty acid.

Preferably, fatty acid soap is present at from 0 to 3.0% wt. of the composition, more preferably from 0 to 0.5% wt. and most preferably zero.

Suitable fatty acids in the context of this invention include aliphatic carboxylic acids of formula RCOOH, where R is a linear or branched alkyl or alkenyl chain containing from 6 to 24, more preferably 10 to 22, most preferably from 12 to 18 carbon atoms and 0 or 1 double bond. Preferred examples of such materials include saturated C12-18 fatty acids such as lauric acid, myristic acid, palmitic acid or stearic acid; and fatty acid mixtures in which 50 to 100% (by weight based on the total weight of the mixture) consists of saturated C12-18 fatty acids. Such mixtures may typically be derived from natural fats and/or optionally hydrogenated natural oils (such as coconut oil, palm kernel oil or tallow).

The fatty acids may be present in the form of their sodium, potassium or ammonium salts and/or in the form of soluble salts of organic bases, such as mono-, di- or triethanolamine.

Mixtures of any of the above described materials may also be used.
For formula accounting purposes, in the formulation, fatty acids and/or their salts (as defined above) are not included in the level of surfactant or in the level of builder.

POLYMERIC CLEANING BOOSTERS

Anti-redeposition polymers stabilise the soil in the wash solution thus preventing redeposition of the soil. Suitable soil release polymers for use in the invention include alkoxylated polyethyleneimines. Polyethyleneimines are materials composed of ethylene imine units $-CH_2CH_2NH-$ and, where branched, the hydrogen on the nitrogen is replaced by another chain of ethylene imine units. Preferred alkoxylated polyethyleneimines for use in the invention have a polyethyleneimine backbone of about 300 to about 10000 weight average molecular weight (M_w). The polyethyleneimine backbone may be linear or branched. It may be branched to the extent that it is a dendrimer. The alkoxylation may typically be ethoxylation or propoxylation, or a mixture of both. Where a nitrogen atom is alkoxylated, a preferred average degree of alkoxylation is from 10 to 30, preferably from 15 to 25 alkoxy groups per modification. A preferred material is ethoxylated polyethyleneimine, with an average degree of ethoxylation being from 10 to 30, preferably from 15 to 25 ethoxy groups per ethoxylated nitrogen atom in the polyethyleneimine backbone.

Mixtures of any of the above described materials may also be used.

A liquid laundry detergent composition will preferably comprise from 0.025 to 8% wt. of one or more anti-redeposition polymers such as, for example, the alkoxylated polyethyleneimines which are described above.

SOIL RELEASE POLYMERS

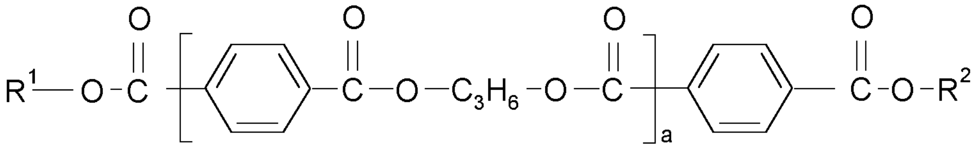
Soil release polymers help to improve the detachment of soils from fabric by modifying the fabric surface during washing. The adsorption of a SRP over the fabric surface is promoted by an affinity between the chemical structure of the SRP and the target fibre.

SRPs for use in the invention may include a variety of charged (e.g. anionic) as well as non-charged monomer units and structures may be linear, branched or star-shaped. The SRP structure may also include capping groups to control molecular weight or to alter polymer properties such as surface activity. The weight average molecular weight (M_w) of the SRP may suitably range from about 1000 to about 20,000 and preferably ranges from about 1500 to about 10,000.

SRPs for use in the invention may suitably be selected from copolyesters of dicarboxylic acids (for example adipic acid, phthalic acid or terephthalic acid), diols (for example ethylene glycol or propylene glycol) and polydiols (for example polyethylene glycol or polypropylene glycol). The copolyester may also include monomeric units substituted with anionic groups, such as for example sulfonated isophthaloyl units. Examples of such materials include oligomeric esters produced by transesterification/oligomerization of poly(ethyleneglycol) methyl ether, dimethyl terephthalate ("DMT"), propylene glycol ("PG") and poly(ethyleneglycol) ("PEG"); partly- and fully-anionic-end-capped oligomeric esters such as oligomers from ethylene glycol ("EG"), PG, DMT and Na-3,6-dioxa-8-hydroxyoctanesulfonate; nonionic-capped block polyester oligomeric compounds such as those produced from DMT, Me-capped PEG and EG and/or PG, or a combination of DMT, EG and/or PG, Me-capped PEG and Na-dimethyl-5-sulfoisophthalate, and copolymeric blocks of ethylene terephthalate or propylene terephthalate with polyethylene oxide or polypropylene oxide terephthalate.

Other types of SRP for use in the invention include cellulosic derivatives such as hydroxyether cellulosic polymers, C_1-C_4 alkylcelluloses and C_4 hydroxyalkyl celluloses; polymers with poly(vinyl ester) hydrophobic segments such as graft copolymers of poly(vinyl ester), for example C_1-C_6 vinyl esters (such as poly(vinyl acetate)) grafted onto polyalkylene oxide backbones; poly(vinyl caprolactam) and related co-polymers with monomers such as vinyl pyrrolidone and/or dimethylaminoethyl methacrylate; and polyester-polyamide polymers prepared by condensing adipic acid, caprolactam, and polyethylene glycol.

Preferred SRPs for use in the invention include copolyesters formed by condensation of terephthalic acid ester and diol, preferably 1,2 propanediol, and further comprising an end cap formed from repeat units of alkylene oxide capped with an alkyl group. Examples of such materials have a structure corresponding to general formula (I):



(I)

in which R^1 and R^2 independently of one another are $X\text{-}(OC_2H_4)_n\text{-}(OC_3H_6)_m$;
in which X is $C_{1\text{-}4}$ alkyl and preferably methyl;
n is a number from 12 to 120, preferably from 40 to 50;
m is a number from 1 to 10, preferably from 1 to 7; and
a is a number from 4 to 9.

Because they are averages, m, n and a are not necessarily whole numbers for the polymer in bulk.

Mixtures of any of the above described materials may also be used.

The overall level of SRP, when included, may range from 0.1 to 10%, depending on the level of polymer intended for use in the final diluted composition and which is desirably from 0.3 to 7%, more preferably from 0.5 to 5% (by weight based on the total weight of the diluted composition).

Suitable soil release polymers are described in greater detail in U. S. Patent Nos. 5,574,179; 4,956,447; 4,861,512; 4,702,857, WO 2007/079850 and WO2016/005271. If employed, soil release polymers will typically be incorporated into the liquid laundry detergent compositions herein in concentrations ranging from 0.01 percent to 10 percent, more preferably from 0.1 percent to 5 percent, by weight of the composition.

HYDROTROPES

A liquid laundry detergent composition may incorporate non-aqueous carriers such as hydrotropes, co-solvents and phase stabilizers. Such materials are typically low molecular weight, water-soluble or water-miscible organic liquids such as C1 to C5 monohydric alcohols (such as ethanol and n- or i-propanol); C2 to C6 diols (such as monopropylene glycol and dipropylene glycol); C3 to C9 triols (such as glycerol); polyethylene glycols having a weight average molecular weight (M_w) ranging from about 200 to 600; C1 to C3 alkanolamines such as mono-, di- and triethanolamines; and alkyl aryl sulfonates having up to 3 carbon atoms in the lower alkyl group (such as the sodium and potassium xylene, toluene, ethylbenzene and isopropyl benzene (cumene) sulfonates).

Mixtures of any of the above described materials may also be used.

Non-aqueous carriers, when included, may be present in an amount ranging from 0.1 to 20%, preferably from 2 to 15%, and more preferably from 10 to 14% (by weight based on the total weight of the composition). The level of hydrotrope used is linked to the level of surfactant and it is desirable to use hydrotrope level to manage the viscosity in such compositions. The preferred hydrotropes are monopropylene glycol and glycerol.

COSURFACTANTS

A liquid laundry detergent composition may contain one or more cosurfactants (such as amphoteric (zwitterionic) and/or cationic surfactants) in addition to the non-soap anionic and/or nonionic detersive surfactants described above.

Specific cationic surfactants include C8 to C18 alkyl dimethyl ammonium halides and derivatives thereof in which one or two hydroxyethyl groups replace one or two of the methyl groups, and mixtures thereof. Cationic surfactant, when included, may be present in an amount ranging from 0.1 to 5% (by weight based on the total weight of the composition).

Specific amphoteric (zwitterionic) surfactants include alkyl amine oxides, alkyl betaines, alkyl amidopropyl betaines, alkyl sulfobetaines (sultaines), alkyl glycinates, alkyl carboxyglycinates, alkyl amphoacetates, alkyl amphopropionates, alkylamphoglycinates, alkyl amidopropyl hydroxysultaines, acyl taurates and acyl glutamates, having alkyl radicals containing from about 8 to about 22 carbon atoms preferably selected from C12, C14, C16 ,C18 and C18:1, the term “alkyl” being used to include the alkyl portion of higher acyl radicals. Amphoteric (zwitterionic) surfactant, when included, may be present in an amount ranging from 0.1 to 5% (by weight based on the total weight of the composition).

Mixtures of any of the above described materials may also be used.

BUILDERS AND SEQUESTRANTS

The detergent compositions may also optionally contain relatively low levels of organic detergent builder or sequestrant material. Examples include the alkali metal, citrates, succinates, malonates, carboxymethyl succinates, carboxylates, polycarboxylates and polyacetyl carboxylates. Specific examples include sodium, potassium and lithium salts of oxydisuccinic acid, mellitic acid, benzene polycarboxylic acids, and citric acid. Other examples are DEQUEST™, organic phosphonate type sequestering agents sold by Monsanto and alkanehydroxy phosphonates.

Other suitable organic builders include the higher molecular weight polymers and copolymers known to have builder properties. For example, such materials include appropriate polyacrylic acid, polymaleic acid, and polyacrylic/polymaleic acid copolymers and their salts, for example those sold by BASF under the name SOKALAN™. If utilized, the organic builder materials may comprise from about 0.5 percent to 20 wt percent, preferably from 1 wt percent to 10 wt percent, of the composition. The preferred builder level is less than 10 wt percent and preferably less than 5 wt percent of the composition. More preferably the liquid laundry detergent formulation is a non-phosphate built laundry detergent formulation, i.e., contains less than 2 wt.%, preferably less than 1% wt. of phosphate. Most preferably the laundry detergent formulation is not built i.e. contain less than 1 wt.% of builder. A preferred sequestrant is HEDP (1 -Hydroxyethylidene -1,1,-diphosphonic acid), for example sold as Dequest 2010. Also suitable but less preferred as it gives inferior cleaning results is Dequest(R) 2066 (Diethylenetriamine penta(methylene phosphonic acid or Heptasodium DTPMP).

POLYMERIC THICKENERS

A liquid laundry detergent composition may comprise one or more polymeric thickeners. Suitable polymeric thickeners for use in the invention include hydrophobically modified alkali swellable emulsion (HASE) copolymers. Exemplary HASE copolymers for use in the invention include linear or crosslinked copolymers that are prepared by the addition polymerization of a monomer mixture including at least one acidic vinyl monomer, such as (meth)acrylic acid (i.e. methacrylic acid and/or acrylic acid); and at least one associative monomer. The term “associative monomer” in the context of this invention denotes a monomer having an ethylenically unsaturated section (for addition polymerization with the other monomers in the mixture) and a hydrophobic section. A preferred type of associative monomer includes a polyoxyalkylene section between the ethylenically unsaturated section and the hydrophobic section. Preferred HASE copolymers for use in the invention include linear or crosslinked copolymers that are prepared by the addition polymerization of (meth)acrylic acid with (i) at least one associative monomer selected from linear or branched C_8-C_{40} alkyl (preferably linear C_{12}-C_{22} alkyl) polyethoxylated (meth)acrylates; and (ii) at least one further monomer selected from C_1-C_4 alkyl (meth) acrylates, polyacidic vinyl monomers (such as maleic acid, maleic anhydride and/or salts thereof) and mixtures thereof. The polyethoxylated portion of the associative monomer (i) generally comprises about 5 to about 100, preferably about 10 to about 80, and more preferably about 15 to about 60 oxyethylene repeating units.

Mixtures of any of the above described materials may also be used.

When included, a liquid laundry detergent composition will preferably comprise from 0.01 to 5% wt. of the composition but depending on the amount intended for use in the final diluted product and which is desirably from 0.1 to 3% wt. by weight based on the total weight of the diluted composition.

FLUORESCENT AGENTS

It may be advantageous to include fluorescer in the compositions. Usually, these fluorescent agents are supplied and used in the form of their alkali metal salts, for example, the sodium salts. The total amount of the fluorescent agent or agents used in the composition is generally from 0.005 to 2 wt %, more preferably 0.01 to 0.5 wt % the composition.

Preferred classes of fluorescer are: Di-styryl biphenyl compounds, e.g. Tinopal (Trade Mark) CBS-X, Di-amine stilbene di-sulphonic acid compounds, e.g. Tinopal DMS pure Xtra, Tinopal 5BMGX, and Blankophor (Trade Mark) HRH, and Pyrazoline compounds, e.g. Blankophor SN.

Preferred fluorescers are: sodium 2 (4-styryl-3-sulfophenyl)-2H-napthol[1,2-d]triazole, disodium 4,4'-bis{[(4-anilino-6-(N methyl-N-2 hydroxyethyl) amino 1,3,5-triazin-2-

yl)]amino}stilbene-2-2' disulfonate, disodium 4,4'-bis{[(4-anilino-6-morpholino-1,3,5-triazin-2-yl)]amino} stilbene-2-2' disulfonate, and disodium 4,4'-bis(2-sulfoslyryl)biphenyl.

Most preferably the fluoescer is a Di-styryl biphenyl compound, preferably Sodium 2,2'-([1,1'-biphenyl]-4,4'-diylbis(ethene-2,1-diyl))dibenzenesulfonate (CAS-No 27344-41-8).

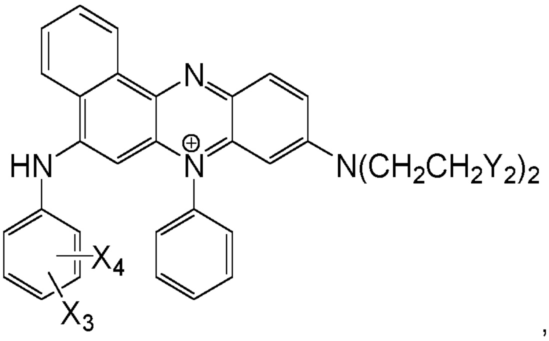
SHADING DYES

Shading dye can be used to improve the performance of the compositions. Preferred dyes are violet or blue. It is believed that the deposition on fabrics of a low level of a dye of these shades, masks yellowing of fabrics. A further advantage of shading dyes is that they can be used to mask any yellow tint in the composition itself.

Shading dyes are well known in the art of laundry liquid formulation.

Suitable and preferred classes of dyes include direct dyes, acid dyes, hydrophobic dyes, basic dyes, reactive dyes and dye conjugates.

Preferred examples are Disperse Violet 28, Acid Violet 50, anthraquinone dyes covalently bound to ethoxylate or propoxylated polyethylene imine as described in WO2011/047987 and WO 2012/119859 alkoxylated mono-azo thiophenes, dye with CAS-No 72749-80-5, acid blue 59, and the phenazine dye selected from:



,

wherein:

X_3 is selected from: -H; -F; -CH_3; -C_2H_5; -OCH_3; and, –OC_2H_5;

X_4 is selected from: -H; -CH_3; -C_2H_5; -OCH_3; and, –OC_2H_5;

Y_2 is selected from: –OH; -OCH_2CH_2OH; -CH(OH)CH_2OH; -OC(O)CH_3; and, C(O)OCH_3.

Alkoxylated thiophene dyes are discussed in WO2013/142495 and WO2008/087497.

The shading dye is preferably present is present in the composition in range from 0.0001 to 0.1wt %. Depending upon the nature of the shading dye there are preferred ranges depending upon the efficacy of the shading dye which is dependent on class and particular efficacy within any particular class.

EXTERNAL STRUCTURANTS

Liquid laundry detergent compositions may have their rheology further modified by use of one or more external structurants which form a structuring network within the composition. Examples of such materials include hydrogenated castor oil, microfibrous cellulose and citrus pulp fibre. The presence of an external structurant may provide shear thinning rheology and may also enable materials such as encapsulates and visual cues to be suspended stably in the liquid.

ENZYMES

A liquid laundry detergent composition may comprise an effective amount of one or more enzyme selected from the group comprising, pectate lyase, protease, amylase, cellulase, lipase, mannanase and mixtures thereof. The enzymes are preferably present with corresponding enzyme stabilizers.

PRESERVATIVES

The composition preferably comprises a preservative.

Preferably, the composition comprises a preservative to inhibit microbial growth. For example, preservatives may optionally be included in various embodiments as a way to further boost microbial protection for gross bacteria, virus and/or fungi contamination introduced e.g., by a consumer, through a contaminated ingredient, contaminated storage container, equipment, processing step or other source. Any conventional preservative known in the art may be used. Some illustrative preservatives include: potassium sorbate, sodium benzoate, benzoic acid, phenoxyethanol, benzyl alcohol, dehydoxyacetic acid, sodium borate, boric acid, usinic acid, phenols, quaternary ammonia compounds, glycols, isothiazolinones (methyl, benzyl, chloro), DMDM hydantoin, hexidine, ethanol, IPBC, polyaminopropyl biguanide, phenylphenol, imidazolidinyl urea, parabens, formaldehyde, salicylic acid or salts, caprylyl glycol, D-glucono-1,5 lactone, sodium erythorbate, sodium hydroxymethylglycinate, peroxides, sodium sulphite, bisulphite, glucose oxidase, lacto peroxidase, and other preservatives compatible with the cleaning ingredients. Some other natural materials might also be considered like cinnamon, fruit acids, essential oils like thyme and rosemary, willow bark, aspen bark, tocopherol, curry, citrus extracts, honeysuckle, and amino acid based preservatives. Especially preferred are preservatives that do not compete with the cleaning ingredients and do not have reported health or environmental issues. Some of the more preferred preservatives are: phenoxyethanol, benzoic acid/potassium sorbate, enzymes, borates, isothiazolinones such as MIT, BIT and CIT, and the natural solutions above. In one embodiment, the preservative is present in an amount less than about 5 wt. percent based on the total weight of the cleaning composition. In another embodiment, the preservative is present in an amount from about 0.01 to about 2 wt. percent. In another embodiment, the fragrant agent is present in an amount from about 0.01 to about 1 wt. percent.

More preferably the composition comprises BIT and/or MIT at a combined level of not more than 550 ppm and more preferably at from 300 to 450 ppm. Preferably, the level of MIT does not exceed 95 ppm. Preferably, the level of BIT does not exceed 450 ppm.

Most preferably, the composition comprises benzoate salt as preservative. Preferably the benzoate salt is present at from 0.01 to 3% wt., more preferably from 0.1 to 2% wt. and most preferably from 0.5 to 1.5% wt. of the composition.

FRAGRANCES

Fragrances are well known in the art and may be incorporated into compositions described herein.

MICROCAPSULES

One type of microparticle suitable for use in the invention is a microcapsule. Microencapsulation may be defined as the process of surrounding or enveloping one substance within another substance on a very small scale, yielding capsules ranging from less than one micron to several hundred microns in size. The material that is encapsulated may be called the core, the active ingredient or agent, fill, payload, nucleus, or internal phase. The material encapsulating the core may be referred to as the coating, membrane, shell, or wall material.

Microcapsules typically have at least one generally spherical continuous shell surrounding the core. The shell may contain pores, vacancies or interstitial openings depending on the materials and encapsulation techniques employed. Multiple shells may be made of the same or different encapsulating materials, and may be arranged in strata of varying thicknesses around the core. Alternatively, the microcapsules may be asymmetrically and variably shaped with a quantity of smaller droplets of core material embedded throughout the microcapsule.

The shell may have a barrier function protecting the core material from the environment external to the microcapsule, but it may also act as a means of modulating the release of core materials such as fragrance. Thus, a shell may be water soluble or water swellable and fragrance release may be actuated in response to exposure of the microcapsules to a moist environment. Similarly, if a shell is temperature sensitive, a microcapsule might release fragrance in response to elevated temperatures. Microcapsules may also release fragrance in response to shear forces applied to the surface of the microcapsules.

A preferred type of polymeric microparticle suitable for use in the invention is a polymeric core-shell microcapsule in which at least one generally spherical continuous shell of polymeric material surrounds a core containing the fragrance formulation (f2). The shell will typically comprise at most 20% by weight based on the total weight of the microcapsule. The fragrance formulation (f2) will typically comprise from about 10 to about 60% and preferably from about 20 to about 40% by weight based on the total weight of the microcapsule. The amount of fragrance (f2) may be measured by taking a slurry of the microcapsules, extracting into ethanol and measuring by liquid chromatography.

Polymeric core-shell microcapsules for use in the invention may be prepared using methods known to those skilled in the art such as coacervation, interfacial polymerization, and polycondensation.

The process of coacervation typically involves encapsulation of a generally water-insoluble core material by the precipitation of colloidal material(s) onto the surface of droplets of the material. Coacervation may be simple e.g. using one colloid such as gelatin, or complex where two or possibly more colloids of opposite charge, such as gelatin and gum arabic or gelatin and carboxymethyl cellulose, are used under carefully controlled conditions of pH, temperature and concentration.

Interfacial polymerisation typically proceeds with the formation of a fine dispersion of oil droplets (the oil droplets containing the core material) in an aqueous continuous phase. The dispersed droplets form the core of the future microcapsule and the dimensions of the dispersed droplets directly determine the size of the subsequent microcapsules. Microcapsule shell-forming materials (monomers or oligomers) are contained in both the dispersed phase (oil droplets) and the aqueous continuous phase and they react together at the phase interface to build a polymeric wall around the oil droplets thereby to encapsulate the droplets and form core-shell microcapsules. An example of a core-shell microcapsule produced by this method is a polyurea microcapsule with a shell formed by reaction of diisocyanates or polyisocyanates with diamines or polyamines.

Polycondensation involves forming a dispersion or emulsion of the core material in an aqueous solution of precondensate of polymeric materials under appropriate conditions of agitation to produce capsules of a desired size, and adjusting the reaction conditions to cause condensation of the precondensate by acid catalysis, resulting in the condensate separating from solution and surrounding the dispersed core material to produce a coherent film and the desired microcapsules. An example of a core-shell microcapsule produced by this method is an aminoplast microcapsule with a shell formed from the polycondensation product of melamine (2,4,6-triamino-1,3,5-triazine) or urea with formaldehyde. Suitable cross-linking agents (e.g. toluene diisocyanate, divinyl benzene, butanediol diacrylate) may also be used and secondary wall polymers may also be used as appropriate, e.g. anhydrides and their derivatives, particularly polymers and co-polymers of maleic anhydride.

One example of a preferred polymeric core-shell microcapsule for use in the invention is an aminoplast microcapsule with an aminoplast shell surrounding a core containing the fragrance formulation (f2). More preferably such an aminoplast shell is formed from the polycondensation product of melamine with formaldehyde.

Polymeric microparticles suitable for use in the invention will generally have an average particle size between 100 nanometers and 50 microns. Particles larger than this are entering the visible range. Examples of particles in the sub-micron range include latexes and mini-emulsions with a typical size range of 100 to 600 nanometers. The preferred particle size range is in the micron range. Examples of particles in the micron range include polymeric core-shell microcapsules (such as those further described above) with a typical size range of 1 to 50 microns, preferably 5 to 30 microns. The average particle size can be determined by light scattering using a Malvern Mastersizer with the average particle size being taken as the median particle size D (0.5) value. The particle size distribution can be narrow, broad or multimodal. If necessary, the microcapsules as initially produced may be filtered or screened to produce a product of greater size uniformity.

Polymeric microparticles suitable for use in the invention may be provided with a deposition aid at the outer surface of the microparticle. Deposition aids serve to modify the properties of the exterior of the microparticle, for example to make the microparticle more substantive to a desired substrate. Desired substrates include cellulosics (including cotton) and polyesters (including those employed in the manufacture of polyester fabrics).

The deposition aid may suitably be provided at the outer surface of the microparticle by means of covalent bonding, entanglement or strong adsorption. Examples include polymeric core-shell microcapsules (such as those further described above) in which a deposition aid is attached to the outside of the shell, preferably by means of covalent bonding. While it is preferred that the deposition aid is attached directly to the outside of the shell, it may also be attached via a linking species.

Deposition aids for use in the invention may suitably be selected from polysaccharides having an affinity for cellulose. Such polysaccharides may be naturally occurring or synthetic and may have an intrinsic affinity for cellulose or may have been derivatised or otherwise modified to have an affinity for cellulose. Suitable polysaccharides have a 1-4 linked β glycan (generalised sugar) backbone structure with at least 4, and preferably at least 10 backbone residues which are β1-4 linked, such as a glucan backbone (consisting of β1-4 linked glucose residues), a mannan backbone (consisting of β1-4 linked mannose residues) or a xylan backbone (consisting of β1-4 linked xylose residues). Examples of such β1-4 linked polysaccharides include xyloglucans, glucomannans, mannans, galactomannans, β(1-3),(1-4) glucan and the xylan family incorporating glucurono-, arabino- and glucuronoarabinoxylans. Preferred β1-4 linked polysaccharides for use in the invention may be selected from xyloglucans of plant origin, such as pea xyloglucan and tamarind seed xyloglucan (TXG) (which has a β1-4 linked glucan backbone with side chains of α-D xylopyranose and β-D-galactopyranosyl-(1-2)-α-D-xylo-pyranose, both 1-6 linked to the backbone); and galactomannans of plant origin such as loc ust bean gum (LBG) (which has a mannan backbone of β1-4 linked mannose residues, with single unit galactose side chains linked α1-6 to the backbone).

Also suitable are polysaccharides which may gain an affinity for cellulose upon hydrolysis, such as cellulose mono-acetate; or modified polysaccharides with an affinity for cellulose such as hydroxypropyl cellulose, hydroxypropyl methylcellulose, hydroxyethyl methylcellulose, hydroxypropyl guar, hydroxyethyl ethylcellulose and methylcellulose.

Deposition aids for use in the invention may also be selected from phthalate containing polymers having an affinity for polyester. Such phthalate containing polymers may have one or more nonionic hydrophilic segments comprising oxyalkylene groups (such as oxyethylene, polyoxyethylene, oxypropylene or polyoxypropylene groups), and one or more hydrophobic segments comprising terephthalate groups. Typically, the oxyalkylene groups will have a degree of polymerization of from 1 to about 400, preferably from 100 to about 350, more preferably from 200 to about 300. A suitable example of a phthalate containing polymer of this type is a copolymer having random blocks of ethylene terephthalate and polyethylene oxide terephthalate.

Mixtures of any of the above described materials may also be suitable.
Deposition aids for use in the invention will generally have a weight average molecular weight (M_w) in the range of from about 5 kDa to about 500 kDa, preferably from about 10 kDa to about 500 kDa and more preferably from about 20 kDa to about 300 kDa.

One example of a particularly preferred polymeric core-shell microcapsule for use in the invention is an aminoplast microcapsule with a shell formed by the polycondensation of melamine with formaldehyde; surrounding a core containing the fragrance formulation (f2); in which a deposition aid is attached to the outside of the shell by means of covalent bonding. The preferred deposition aid is selected from β1-4 linked polysaccharides, and in particular the xyloglucans of plant origin, as are further described above.

The present inventors have surprisingly observed that it is possible to reduce the total level of fragrance included in the liquid laundry detergent composition without sacrificing the overall fragrance experience delivered to the consumer at key stages in the laundry process. A reduction in the total level of fragrance is advantageous for cost and environmental reasons.

Accordingly, the total amount of fragrance formulation (f1) and fragrance formulation (f2) in the liquid laundry detergent composition suitably ranges from 0.5 to 1.4%, preferably from

0.5 to 1.2%, more preferably from 0.5 to 1% and most preferably from 0.6 to 0.9% (by weight based on the total weight of the composition).

The weight ratio of fragrance formulation (f1) to fragrance formulation (f2) in the liquid laundry detergent composition preferably ranges from 60:40 to 45:55. Particularly good results have been obtained at a weight ratio of fragrance formulation (f1) to fragrance formulation (f2) of around 50:50.

The fragrance (f1) and fragrance (f2) are typically incorporated at different stages of formation of the liquid laundry detergent composition. Typically, the discrete polymeric microparticles (e.g. microcapsules) entrapping fragrance formulation (f2) are added in the form of a slurry to a warmed base formulation comprising other components of the composition (such as surfactants and solvents). Fragrance (f1) is typically post-dosed later after the base formulation has cooled.

FURTHER OPTIONAL INGREDIENTS

A liquid laundry detergent composition may contain further optional ingredients to enhance performance and/or consumer acceptability. Examples of such ingredients include foam boosting agents, preservatives (e.g. bactericides), polyelectrolytes, anti-shrinking agents, anti-wrinkle agents, anti-oxidants, sunscreens, anti-corrosion agents, drape imparting agents, anti-static agents, ironing aids, colorants, pearlisers and/or opacifiers, and shading dye. Each of these ingredients will be present in an amount effective to accomplish its purpose. Generally, these optional ingredients are included individually at an amount of up to 5% (by weight based on the total weight of the diluted composition) and so adjusted depending on the dilution ratio with water.

Preferably the composition comprises less than 1% alcohol and more preferably less than 0.1% alcohol.

Many of the ingredients used in embodiments of the invention may be obtained from so called black carbon sources or a more sustainable green source. The following provides a list of alternative sources for several of these ingredients and how they can be made into raw materials described herein.

Alkyl ether sulphates

SLES and other such alkali metal alkyl ether sulphate anionic surfactants are typically obtainable by sulphating alcohol ethoxylates. These alcohol ethoxylates are typically obtainable by ethoxylating linear alcohols. Similarly, primary alkyl sulphate surfactants (PAS) can be obtained from linear alcohols directly by sulphating the linear alcohol. Accordingly, forming the linear alcohol is a central step in obtaining both PAS and alkali-metal alkyl ether sulphate surfactants.

The linear alcohols which are suitable as an intermediate step in the manufacture of alcohol ethoxylates and therefore anionic surfactants such as sodium lauryl ether sulphate ca be obtained from many different sustainable sources. These include:

Primary sugars

Primary sugars are obtained from cane sugar or sugar beet, etc., and may be fermented to form bioethanol. The bioethanol is then dehydrated to form bio-ethylene which then undergoes olefin methathesis to form alkenes. These alkenes are then processed into linear alcohols either by hydroformylation or oxidation.

An alternative process also using primary sugars to form linear alcohols can be used and where the primary sugar undergoes microbial conversion by algae to form triglycerides. These triglycerides are then hydrolysed to linear fatty acids and which are then reduced to form the linear alcohols.

Biomass

Biomass, for example forestry products, rice husks and straw to name a few may be processed into syngas by gasification. Through a *Fischer Tropsch* reaction these are processed into alkanes, which in turn are dehydrogenated to form olefins. These olefins may be processed in the same manner as the alkenes described above [primary sugars].

An alternative process turns the same biomass into polysaccharides by steam explosion which may be enzymatically degraded into secondary sugars. These secondary sugars are then fermented to form bioethanol which in turn is dehydrated to form bio-ethylene. This bio-ethylene is then processed into linear alcohols as described above [primary sugars].

Waste Plastics

Waste plastic is pyrolyzed to form pyrolysed oils. This is then fractioned to form linear alkanes which are dehydrogenated to form alkenes. These alkenes are processed as described above [primary sugars].

Alternatively, the pyrolyzed oils are cracked to form ethylene which is then processed to form the required alkenes by olefin metathesis. These are then processed into linear alcohols as described above [primary sugars].

Municipal Solid Waste

MSW is turned into syngas by gasification. From syngas it may be processed as described above [primary sugars] or it may be turned into ethanol by enzymatic processes before being dehydrogenated into ethylene. The ethylene may then be turned into linear alcohols by the *Ziegler Process*.

The MSW may also be turned into pyrolysis oil by gasification and then fractioned to form alkanes. These alkanes are then dehydrogenated to form olefins and then linear alcohols.

Marine Carbon

There are various carbon sources from marine flora such as seaweed and kelp. From such marine flora the triglycerides can be separated from the source and which is then hydrolysed to form the fatty acids which are reduced to linear alcohols in the usual manner.

Alternatively, the raw material can be separated into polysaccharides which are enzymatically degraded to form secondary sugars. These may be fermented to form bio-ethanol and then processed as described above [Primary Sugars].

Waste Oils

Waste oils such as used cooking oil can be physically separated into the triglycerides which are split to form linear fatty acids and then linear alcohols as described above.
Alternatively, the used cooking oil may be subjected to the Neste Process whereby the oil is catalytically cracked to form bio-ethylene. This is then processed as described above.

Methane Capture

Methane capture methods capture methane from landfill sites or from fossil fuel production. The methane may be formed into syngas by gasification. The syngas may be processed as described above whereby the syngas is turned into methanol (*Fischer Tropsch* reaction) and then olefins before being turned into linear alcohols by hydroformylation oxidation.

Alternatively, the syngas may be turned into alkanes and then olefins by *Fischer Tropsch* and then dehydrogenation.

Carbon Capture

Carbon dioxide may be captured by any of a variety of processes which are all well known. The carbon dioxide may be turned into carbon monoxide by a reverse water gas shift reaction and which in turn may be turned into syngas using hydrogen gas in an electrolytic reaction. The syngas is then processed as described above and is either turned into methanol and/or alkanes before being reacted to form olefins.

Alternatively, the captured carbon dioxide is mixed with hydrogen gas before being enzymatically processed to form ethanol. This is a process which has been developed by Lanzatech. From here the ethanol is turned into ethylene and then processed into olefins and then linear alcohols as described above.

The above processes may also be used to obtain the C16/18 chains of the C16/18 alcohol ethoxylate and/or the C16/18 ether sulfates.

LAS

One of the other main surfactants commonly used in cleaning compositions, in particular laundry compositions is LAS (linear alkyl benzene sulphonate).

The key intermediate compound in the manufacture of LAS is the relevant alkene. These alkenes (olefins) may be produced by any of the methods described above and may be formed from primary sugars, biomass, waste plastic, MSW, carbon capture, methane capture, marine carbon to name a few.

Whereas in the processed described above the olefin is processed to form linear alcohols by hydroformylation and oxidation instead, the olefin is reacted with benzene and then sulphonate to form the LAS.

The invention will be further described with the following non-limiting examples.

Examples

Example 1

Preparation of calcium branched nonanoate catalyst

Branched nonanoic acid (141 g) was dissolved in water (33 g) and isopropanol (430 g). Calcium hydroxide (74 g) was then added into the mixture and homogenized for 5 min. Sulfuric acid (13 g) was added slowly into the mixture. The mixture was then homogenised again for 5 min.

Example 2

Synthesis of narrow range oleyl alcohol ethoxylate comprising six ethoxylate residues (EO) on molar average (6EO)

Oleyl alcohol (C16/18-fatty alcohol containing unsaturated C18-fatty alcohol; 1700 g) and calcium branched nonanoate catalyst (as obtained from Example 1; 14 g) were added together into an autoclave reactor. The mixture was heated to 160 °C and then ethylene oxide (1900 g) was dosed slowly into the mixture. The narrow range oleyl alcohol ethoxylate comprising six ethoxylate residues (EO) on molar average (6EO) was obtained as a liquid.

It was surprisingly found that using calcium catalyst, exemplified as calcium branched nonanoate catalyst, leads to high yields of alkoxylate surfactant.

Example 3 (Comparative Example)

Synthesis of broad range oleyl alcohol ethoxylate comprising six ethoxylate residues (EO) on molar average (6EO)

Oleyl alcohol (C16/18-unsaturated C18-fatty alcohol; 1700 g) and sodium hydroxide catalyst (7.7 g) were added together into an autoclave reactor. The mixture was heated to 160 °C and then ethylene oxide (1900 g) was dosed slowly into the mixture. The broad range oleyl alcohol ethoxylate comprising six ethoxylate residues (EO) on molar average (6EO) was obtained as a liquid.

Example 4

Characterization of the molar distribution of ethoxylate residues (EO)

The molar distribution of ethoxylate residues (EO) was determined by means of mass spectrometry (MS). A full integration of the MS spectrum was performed and considered as 1. Then, the individual compound peaks were integrated separately. In the present case, the MS spectrum included less than 1% by weight of impurities. The percentage molar content of ethoxylate residues (EO) was determined.

Table 1. Determined distribution of ethoxylate residues (EO) in narrow range oleyl alcohol ethoxylate and broad range oleyl alcohol ethoxylate (comparative), wherein both are 6 EO in average

Number of EO per oleyl alcohol	**Narrow range according to Example 2 (inventive) (in mol%)**	**Broad range according to Example 3 (comparison) (in mol%)**
0 (only fatty alcohol)	3.3	9.9
1	1.9	7.2
2	3.0	8
3	6.1	9.1
4	11.5	9.6
5	17.9	9.1
6	20.7	9.1
7	17.4	8.5
8	10.6	7.7
9	4.7	7.6
10	1.6	4.1
11	0.4	3.8
12	0.1	2.6
13	0	1.6
14	0	0.7
15	0	0.3
16	0	0.1

It was surprisingly found that using calcium catalyst, exemplified as calcium branched nonanoate catalyst, leads to unexpectedly beneficial technical results with respect to narrow distribution of number of the number of alkoxylate residues. Thus, a calcium catalyst leads to a higher homogeneity of the obtained fatty acid alkoxylate surfactant.

Example 5

Liquid detergent formulation

A liquid detergent formulation, comprising:

(A) 88 % by weight, referred to the liquid detergent formulation, of water; and

(B) 12 % by weight, referred to the liquid detergent formulation, of a surfactant mixture containing oleyl alcohol ethoxylate (with 6EO as obtained from Example 2 or

Example 3, respectively) and oleyl ether sulfate, (made by Sulfonation of the oleyl alcohol ethoxylate of example 2 or example 3 respectively),

was prepared. The surfactant mixture was thoroughly mixed with the water. The pH value was adjusted to pH 7. Then, the liquid stored to equilibrate for 24 hours at 5 room temperature of approximately 20 °C. the obtained liquid detergent formulation is considered as a potential basis for a liquid aqueous laundry detergent formulation.

Subsequently, the phase behaviour observed. The results are summarized in Table 2 below.

Table 2. Comparison of liquid detergent formulation. The weight percentages (% by weight) refer to the surfactant mixture containing oleyl alcohol ethoxylate and oleyl ether sulfate

Formulation No.	**Ether sulfate (% by weight)**	**Alcohol ethoxylate (% by weight)**	**Type of alcohol ethoxylate and ether sulfate**	**Narrow range according to Example 2 (inventive) (in mol%)**
F1	80	20	Narrow range according to Example 2 (inventive)	Liquid
F2	60	40	Narrow range according to Example 2 (inventive)	Liquid
F3	50	20	Narrow range according to Example 2 (inventive)	Liquid
F4	40	60	Narrow range according to Example 2 (inventive)	Liquid
C1	80	20	Broad range according to Example 3 (comparative)	Liquid
C2	60	40	Broad range according to Example 3 (comparative)	Two phase liquid
C3	50	20	Broad range according to Example 3 (comparative)	Two phase liquid
C4	40	60	Broad range according to Example 3 (comparative)	Two phase liquid

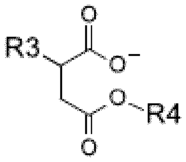
It was surprisingly found that all liquid detergent formulations F1 to F4 containing a narrow range alcohol ethoxylate and ether sulfate according to Example 2 according to the present invention were liquid and showed as single phase as desirable. In contrast, higher concentrations of broad range alcohol ethoxylate according to Example 3 (comparative), as found for comparative formulations C2 to C4, showed undesirable two phase separation.

Thus, the fatty alcohol alkoxylate surfactant of the present invention is surprisingly beneficial for preparing detergent formulations, in particular liquid detergent formulations, in particular liquid laundry detergent formulations.

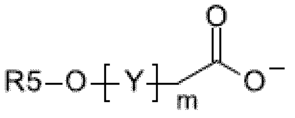
CLAIMS

1. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising from 0.5 to 50 wt.%, preferably from 1 to 40 wt.%, more preferably from 1.5 to 30 wt.% of a fatty alcohol alkoxylate surfactant having C18 content in excess of 30 wt.%, obtainable by reacting at least one fatty alcohol having C18 content in excess of 30 wt.% with ethylene oxide or a mixture of ethylene oxide and propylene oxide, wherein reacting is conducted in the presence of a calcium catalyst.

2. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to claim 1, wherein the calcium catalyst comprises or consist of at least one calcium salt which comprises calcium cations and one or more types of anions selected from the group consisting of branched or linear C_8-C_{12}-alkanoate, preferably branched C_8-C_{12}-alkanoate, in particular branched nonanoate, hydrogensulfate, sulfate, an anionic ion of formula (III), and an anionic ion of formula (IV)



(III)



(IV)

,

wherein

R3 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 6 to 18 carbon atoms, in particular a linear or branched alkyl or alkenyl group having 8 to 16 carbon atoms;

R4 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched alkyl group having 1 to 16 carbon atoms or a linear or branched alkenyl group having 2 to 16 carbon atoms, in particular a linear or branched alkyl group having 1 to 12 carbon atoms or a linear or branched alkenyl group having 2 to 12 carbon atoms;

R5 is a linear or branched alkyl group having 1 to 20 carbon atoms or a linear or branched alkenyl group having 2 to 20 carbon atoms, preferably a linear or branched

alkyl or alkenyl group having 6 to 20 carbon atoms, in particular a linear or branched alkyl or alkenyl group having 10 to 20 carbon atoms;
Y is selected from ethoxy and mixtures of ethoxy and propoxy, wherein a mixture of ethoxy and propoxy has molar ratio of ethoxy : propoxy of > 1:1, in particular is ethoxy; and

m on a molar average, is from 3 to 100, preferably from 3 to 40, more preferably from 3 to 20, in particular from 3 to 10.

3. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to claim 1 or claim 2, wherein the fatty alcohol alkoxylate surfactant comprises at least one fatty alcohol alkoxylate described in the following formula (I)

$$R{-}O{-}\left[X\right]_n{-}H \qquad (I)$$
,

wherein:
R is a linear or branched alkyl or alkenyl group having 6 to 20 carbon atoms, preferably a linear or branched alkyl or alkenyl group having 8 to 20 carbon atoms, more preferably a linear or branched alkyl or alkenyl group having 12 to 20 carbon atoms, even more preferably a linear or branched alkyl or alkenyl group having 16 to 18 carbon atoms, in particular a linear alkyl or alkenyl group having 16 to 18 carbon atoms;
X is selected from ethoxy and mixtures of ethoxy and propoxy, wherein a mixture of ethoxy and propoxy has molar ratio of ethoxy : propoxy of > 1:1, in particular is ethoxy;
n on a molar average, is from 3 to 100, preferably from 3 to 60, more preferably from 3 to 40, even more preferably from 4 to 20, in particular from 4 to 15, wherein the fatty alcohol alkoxylate surfactant has a C18 content in excess of 30 wt.%, preferably in excess of 35 wt.%, more preferably in in excess of 40 wt.%, even more preferably in excess of 45 wt.%, even more preferably in excess of 50 wt.%, even more preferably in excess of 55 wt.%.

4. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant

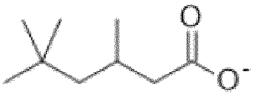
according to claim 3, wherein the at least one fatty alcohol alkoxylate described in the following formula (I) is wherein:
R is a linear alkyl or alkenyl group having 16 to 18 carbon atoms;
X is ethoxy; and
n on a molar average, is from 4 to 20, in particular from 4 to 15, more preferably from 6 to 12, most preferably from 8 to 12,
in particular wherein in more than 70 mol% of the fatty alcohol alkoxylates, n is in the range from 0.5n to 1.5n;
wherein the fatty alcohol alkoxylate surfactant has a C18 content in excess of 30 wt.%, preferably in excess of 35 wt.%, more preferably in in excess of 40 wt.%, even more preferably in excess of 45 wt.%, even more preferably in excess of 50 wt.%, even more preferably in excess of 55 wt.%; and wherein the C18:1 content of the C18 content is from 10 to 100 wt.%, more preferably from 20 to 100 wt.%, even more preferably from 30 to 100 wt.%, even more preferably from 40 to 100 wt.% even more preferably from 50 to 100 wt.%.

5. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any one of claims 1 to 4, wherein the fatty alcohol alkoxylate surfactant comprises fatty alcohol alkoxylate, preferably the one or more fatty alcohol alkoxylate of formula (I), in an amount from 0.1 to 99.99% by weight, preferably in an amount from 1 to 99.9% by weight, more preferably in an amount from 10 to 99.9% by weight and even more preferably in an amount from 50 to 99.9%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant.

6. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any one of claims 2 to 5, characterized in that the at least one calcium salt comprises branched nonanoate and optionally hydrogensulfate and/or sulfate, wherein, on a molar average, the molar ratio branched nonanoate : calcium is at least 1 : 1.

7. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any one of claims 2 to 6, characterized in that, the at least one calcium

salt comprises anions comprising or consisting of branched nonanoate of formula (V):


(V).

8. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any one of claims 2 to 7, characterized in that the at least one calcium salt is obtainable by reacting calcium hydroxide with branched or linear C_8-C_{12}-alkanoic acid which is neutralized with sulfuric acid.

9. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any one of claims 1 to 8, characterized in that it comprises the one or more calcium catalysts in an amount from 0.01 to 10% by weight, preferably in an amount from 0.01 to 5% by weight, more preferably in an amount from 0.05 to 3% by weight and even more preferably in an amount from 0.1 to 2%, in each case based on the total weight of the fatty alcohol alkoxylate surfactant.

10. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any one of claims 1 to 9, wherein the mixture of ethylene oxide and propylene oxide has molar ratio of (ethylene oxide) : (propylene oxide) of > 1:1.

11. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any preceding claim, wherein the surfactant is selected from alcohol ethoxylate, ether sulfate and ether carboxylate.

12. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any preceding claim, wherein the detergent composition comprises 0.1 to 10 wt.% of the composition of cleaning polymer selected from alkoxylate

polyethylene imines, polyester soil release polymers, co-polymer of PEG/vinyl acetate, and mixtures thereof.

13. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any preceding claim, wherein the detergent composition comprises one or more enzyme(s).

14. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any preceding claim, wherein the detergent composition comprises sequestrant, and/or benzoate salt, and/or from up to 5 wt.% fatty acid.

15. A detergent composition, preferably a liquid detergent composition, more preferably a liquid laundry detergent composition, comprising a fatty alcohol alkoxylate surfactant according to any preceding claim, wherein the detergent composition has a viscosity of from 100 to 300 mPa.s.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/086260

A. CLASSIFICATION OF SUBJECT MATTER
INV. C07C41/03 C11D1/06 C11D1/29 C11D1/72 C11D1/722
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C07C C11D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/240064 A1 (WEERASOORIYA UPALI P [US] ET AL) 27 October 2005 (2005-10-27) abstract claims 1-53 examples 1,2 table 2 paragraph [0011] - paragraph [0013] paragraphs [0006], [0036] - [0039] -----	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 30 March 2022	Date of mailing of the international search report 11/04/2022
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Delanghe, Patrick

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2021/086260

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005240064 A1	27-10-2005	CN 1976887 A	06-06-2007
		EP 1747183 A2	31-01-2007
		PL 1747183 T3	30-11-2018
		US 2005240064 A1	27-10-2005
		WO 2005104774 A2	10-11-2005