



(11) **EP 4 372 071 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.05.2024 Bulletin 2024/21

(51) International Patent Classification (IPC):
C11D 1/22 ^(2006.01) **C11D 3/00** ^(2006.01)
C11D 11/00 ^(2006.01)

(21) Application number: **22208400.6**

(52) Cooperative Patent Classification (CPC):
C11D 1/22; C11D 3/0026; C11D 2111/12

(22) Date of filing: **18.11.2022**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

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(54) **DETERGENT COMPOSITION**

(57) A detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition. An aqueous wash liquor comprising water and the detergent composition dissolved or dispersed therein. A method of making the detergent composition comprising the step of incorporating LAS obtained from petroleum feedstock and LAS comprising a component obtained from

waste plastic feedstock. A method of washing a fabric using the detergent composition comprising the steps of (a) treating the fabric in an aqueous liquor comprising the composition and (b) rinsing the fabric. A method of controlling foam in a LAS-containing liquid, using the detergent composition, the method comprising the step of combining the detergent composition with water. Use of the detergent composition to control foaming and/or to reduce water consumption during a fabric washing process.

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Description

[0001] The present invention relates to improved detergent formulations comprising linear alkyl benzene sulphonate (LAS).

[0002] Foaming is a key physical characteristic which affects the sensorial experience of a detergent formulation; however, foam also requires removal from the substrate after cleaning and it greatly affects how much water is used during rinsing. Foam can act as a cue to rinsing. In many countries, clean water is in increasingly shorter supply whereby excessive rinsing is undesirable from an environmental point of view.

[0003] Thus, there is a balance to be struck between generating a good foam and its removal after cleaning.

[0004] Linear alkylbenzene sulphonate (LAS) is an excellent anionic deterative surfactant for providing good stain removal benefits. However, LAS also generates copious foam upon agitation in the washing step after which an appreciable amount of surfactant can remain in the fabric fibers and on the fabric surface. This may be referred to as "carry-over". As a result, significant amounts of foaming occur in the rinse step. This carry-over typically persists over multiple rinses and typically consumes large quantities of clean water to satisfactorily remove the foam, soapy feel, or turbidity in the rinse liquor.

[0005] Thus, there is a need for a cleaning composition which cleans effectively but with control over foaming.

[0006] Rinse aids and anti-foams can reduce the amount of water used during rinsing but all these approaches require additional steps, chemicals and costs and provide no other performance benefit to the composition other than foam suppression.

[0007] Thus, in spite of the many efforts made towards low foaming LAS formulations, there is still a need for a solution that allows good cleaning performance and easily tunable foaming to reduce water usage without excessive reliance on foam suppressing chemicals.

[0008] Accordingly, and in a first aspect of the invention there is provided a detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition.

[0009] In a further aspect, the invention provides a method of making a detergent composition comprising the step of incorporating linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition.

[0010] In a further aspect, the invention provides a method of washing a fabric using a detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition, the method comprising the steps of:

- a. treating the fabric in an aqueous liquor comprising the composition; and
- b. rinsing the fabric.

[0011] In a further aspect, the invention provides a method of controlling foam in a LAS-containing liquid, using a detergent composition according to the first aspect and any optional/preferred features, the method comprising the step of combining the detergent composition with water. The liquid may be a wash liquor in e.g. an automatic washing machine, or it may be any aqueous LAS-containing liquid. The method preferably includes the step of combining a linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition.

[0012] In a further aspect, the invention provides an aqueous wash liquor comprising the detergent composition of the invention dissolved or dispersed in water.

[0013] In a further aspect, the invention provides use of a detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition, to control foaming.

[0014] In a further aspect, the invention provides use of a detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition, to reduce water consumption during a fabric washing process, preferably during rinsing following washing with the detergent composition.

[0015] We have surprisingly found that by inclusion of LAS obtained from waste plastic feedstock, surprising and desirable performance characteristics, specifically foam management in terms of reduced volume and stability over time

as compared with petroleum LAS (or petro-LAS) produced from fossil feedstocks. The plastic-derived LAS provides foam but does not trigger excessive use of water in unnecessary rinsing.

[0016] At the same time we have found that the combination of LAS obtained from waste plastic feedstock together with standard petroleum derived LAS is better versus standard petroleum derived LAS in cleaning ability since the waste-plastic feedstock derived LAS has a higher wetting ability. This means that it is better at accessing stains than standard petroleum derived LAS. Thus, the combination with petroleum derived LAS at the claimed levels means that one gets the benefits of this improved cleaning with the improved foaming control.

[0017] The level of foaming can be tuned by varying the amount of LAS obtained from waste plastic feedstock.

[0018] Preferably, the LAS obtained from waste plastic is present at a level greater than 10%wt, more preferably greater than 20 %wt, even more preferably greater than 30%wt, still more preferably greater than 40%, most preferably greater than 50%wt, based on the total weight of LAS in the composition.

[0019] Preferably, the LAS obtained from waste plastic is present at a level less than 95%wt, more preferably less than 80 %wt, even more preferably less than 70%wt, still more preferably less than 60%, most preferably less than 50%wt, based on the total weight of LAS in the composition.

[0020] In some embodiments, the level of LAS obtained from waste plastic feedstock is in the range 50%wt to 95%wt, preferably 60%wt to 95%wt, more preferably 70%wt to 95%wt based on total weight of LAS present in the composition.

[0021] In some embodiments, the level of the LAS obtained from waste plastic is greater than 20wt% and less than 50%wt, more preferably greater than 20wt% and less than 40%wt based on total weight of LAS present in the composition.

[0022] In methods utilising compositions of the invention, this will usually involve the step of diluting the dose of detergent composition with water to obtain a wash liquor and washing fabrics with the wash liquor so formed.

[0023] Wash liquors may include 5 - 65 litres of water together with 3 to about 20g of deterative surfactant comprising the combination of LAS surfactants of the invention.

[0024] The dose of detergent composition may be adjusted accordingly to give appropriate wash liquor concentrations.

[0025] The wash liquor preferably has a pH of from above 7 to less than 13, preferably from above 7 to less than 10.5.

[0026] A subsequent aqueous rinse step and drying the laundry is preferred.

Foam suppressing agent

[0027] If foam suppressing agents are used preferably a non-soap foam suppressing agent is present at a level from 0.01 wt.% to 15 wt.%, preferably from 0.02 wt.% to 10 wt.%, more preferably from 0.05 wt.% to 5 wt.%, most preferably 0.5wt% to 5wt% of the composition.

[0028] With higher levels of LAS obtained from waste plastic, preferably less than 0.1 %wt., more preferably less than 0.01 %wt and most preferably 0 %wt of foam suppressing agents are used.

[0029] Suitable foam suppressing agent for use herein may comprise essentially any known antifoam compound, including, for example silicone antifoam compounds and 2-alkyl alcanol antifoam compounds. By foam suppressing agent it is meant herein any compound or mixtures of compounds which act such as to depress the foaming or foam produced by a solution of a detergent composition, particularly in the presence of agitation of that solution.

[0030] Particularly preferred foam suppressing agent for use herein are silicone foam suppressing agent defined herein as any antifoam compound including a silicone component. Such silicone antifoam compounds also typically contain a silica component. The term "silicone" as used herein, and in general throughout the industry, encompasses a variety of relatively high molecular weight polymers containing siloxane units and hydrocarbyl group of various types. Preferred silicone antifoam compounds are the siloxanes, particularly the polydimethylsiloxanes having trimethylsilyl end blocking units.

[0031] Preferably the foam suppressing agent is a combination of an antifoam compound and silica. In the combination, preferably the antifoam compound is a silicone antifoam compound most preferably polydimethyl siloxane. In the combination the antifoam compound is present at a level of from 50 wt.% to 99 wt.%, preferably 75 wt.% to 95 wt.% of the foam suppressing agent; and silica is present at a level of from 1 wt.% to 50 wt.%, preferably 5 wt.% to 25 wt.% by weight of the foam suppressing agent. The foam suppressing agent having the combination of silica and antifoam compound is incorporated at a level of from 5 wt.% to 50 wt.%, preferably 10 wt.% to 40 wt.% by weight in the detergent composition. Further the foam suppressing agent preferably includes a dispersant compound, most preferably comprising a silicone glycol rake copolymer with a polyoxyalkylene content of 72-78% and an ethylene oxide to propylene oxide ratio of from 1:0.9 to 1:1.1, at a level of from 0.5% to 10%, preferably 1% to 10% by weight; a particularly preferred silicone glycol rake copolymer of this type is DCO544, commercially available from DOW Coming under the tradename DCO544; Additionally, the foam suppressing agent may include an inert carrier fluid compound, most preferably comprising a C₁₆-C₁₈ ethoxylated alcohol with a degree of ethoxylation of from 5 to 50, preferably 8 to 15, at a level of from 5% to 80%, preferably 10% to 70%, by weight.

[0032] Another preferred foam suppressing agent is described in EP-A-0210731 and includes a combination of silicone antifoam compound and an organic carrier material having a melting point in the range 50°C to 85°C, wherein the organic

carrier material comprises a monoester of glycerol and a fatty acid having a carbon chain containing from 12 to 20 carbon atoms. EP-A-0210721 discloses other preferred particulate foam suppressing systems wherein the organic carrier material is a fatty acid or alcohol having a carbon chain containing from 12 to 20 carbon atoms, or a mixture thereof, with a melting point of from 45°C to 80°C.

[0033] Still further examples of the foam suppressing agents includes silicone based foam suppressing agent, hydrocarbon foam suppressing agent, monostearyl phosphate foam suppressing agent or combinations thereof.

[0034] Other highly preferred foam suppressing agent comprise polydimethylsiloxane or mixtures of silicone, such as polydimethylsiloxane, aluminosilicate and polycarboxylic polymers, such as copolymers of maleic and acrylic acid and monocarboxylate fatty acid.

LAS from sources other than petrochemicals or plastic waste

[0035] The detergent composition may further comprise LAS from sources other than plastic waste, such as LAS obtained from natural oils, waste oils (from any source) etc.

[0036] Preferably LAS from fossil fuel as a %wt. of total LAS is no more than 75%, more preferably no more than 50 %wt even more preferably no more than 30%wt.

[0037] The detergent composition may further comprise LAS obtained from natural oils. As used herein, "**natural oils**" are those derived from plant or algae matter, and are often referred to as renewable oils. Natural oils are not based on kerosene or other fossil fuels. In certain embodiments, the natural oils include, but are not limited to, one or more of coconut oil, babassu oil, castor oil, algae 1 byproduct, beef tallow oil, borage oil, camelina oil, Canola (R) oil, choice white grease, coffee oil, corn oil, Cuphea Viscosissima oil, evening primrose oil, fish oil, hemp oil, hepar oil, jatropha oil, Lesquerella Fendleri oil, linseed oil, Moringa Oleifera oil, mustard oil, neem oil, palm oil, perilla seed oil, poultry fat, rice bran oil, soybean oil, stillingia oil, sunflower oil, tung oil, yellow grease, cooking oil, and other vegetable, nut, or seed oils. Other natural oils will be known to those having ordinary skill in the art. The natural oils typically include triglycerides, free fatty acids, or a combination of triglycerides and free fatty acids, and other trace compounds. Processes for making LAS using such oils are disclosed in WO13141979A

[0038] The detergent composition may comprise LAS obtained from renewable glyceride feedstock which is preferably rich in triglycerides. This feedstock may be an oil rich in triglycerides with C₁₀ to C₁₄ fatty acids. The oil rich in triglycerides with C₁₀ to C₁₄ fatty acids is preferably selected from the group consisting of: coconut oil; palm kernel oil; laurel oil; babassu oil; microbial oils; and mixtures thereof. Processes for making LAS using such oils are described in US2017029347.

[0039] Virgin or waste oils may be used.

Pyrolysis of waste plastic

[0040] Plastic waste for pyrolysis (or indeed any chemical de-polymerisation action) is preferably pre-treated by any of the steps of washing, drying, shredding and sieving.

[0041] Pyrolysis, as used herein, means the thermal decomposition or de-polymerisation of the waste plastic at elevated temperatures, either catalytically or non-catalytically and via a continuous or a batch process in a controlled atmosphere to form what is termed a what is term "pyrolysate". The atmosphere for pyrolysis preferably has minimal oxygen, more preferably is oxygen free, and may contain inert gases.

[0042] Preferably the pyrolysis is carried out at a temperature between 300 and 900 degrees C.

[0043] The LAS may be obtained from the pyrolysate of fast-pyrolysed waste plastic. Fast pyrolysis may be conducted at high temperature (400 - 900 degrees C).

[0044] Preferably the waste plastic which is pyrolysed comprises any of polyethylene such as high-density polyethylene (HDPE), low-density polyethylene (LDPE); polypropylene (PP). Preferably the waste plastic comprises less than 10 %wt, more preferably less than 5%, even more preferably less than 1% wt of any of polyvinylchloride (PVC) or polystyrene (PS) or polyethylene terephthalate (PET) (based on total weight of plastic).

[0045] Waste plastics may be pyrolysed in any suitable reactor, for example, fluidized bed reactors (Bubbling Fluidised Bed, BFB, Circulated Fluidised Bed, CFB) which are advantageous for temperature control; kilns such as rotary kilns e.g. screw kilns where screw or an auger placed coaxially in a fixed kiln transports the feed through the heated reactor which is advantageous for complex waste; vacuum pyrolysis; melting vessels or stirred-tank reactors (STR) as used in various chemical processes have also been used to pyrolyze plastic; microwaves reactors or any combination thereof.

[0046] Catalysts may be used and may be selected from zeolite (which may be natural (NZ) or and zeolite-based catalysts such as zeolite beta (BEA), ZSM-5, Y-zeolite, FCC, and MCM-41 (Ratnasari, D. K., Nahil, M. A., and Williams, P. T. (2017). Other catalysts include metal-based catalysts such as ZnO.

[0047] Catalysts may be microporous or mesoporous.

[0048] The catalytic reaction during the pyrolysis of plastic waste on solid acid catalysts may include cracking, oli-

gomerization, cyclization, aromatization and isomerization reactions.

[0049] Liquid pyrolysate (or oil) may be obtained. Alternatively or additionally pyrolysate vapours may be condensed to form a liquid and this liquid can (also) be used.

[0050] For pyrolysis vapour, this may be subjected to a quenching process. This involves the rapid cooling and condensation of the products to stop the reaction and to allow further processing.

[0051] Liquid pyrolysate is then preferably refined to a paraffin suitable for use in a LAS manufacturing process.

[0052] The liquid pyrolysis oil is preferably fractionated e.g. in a distillation column to obtain selectively hydrocarbons of the desired boiling point range (i.e. carbon chain length).

[0053] The fractionation process may be a multi-stage process involving multiple fractionation steps. Individual feedstocks may be pre-fractionated prior to combining with other feedstocks and there may be further fractionation steps where the combined feedstocks are co-fractionated.

[0054] For example, the pyrolysate from the waste plastic may be fractionated separately from other feedstocks to produce the required cuts (hydrocarbons of desired carbon chain length, preferably C8 - C16, more preferably C10-C14) which are thus wholly plastic derived.

[0055] Alternatively the pyrolysate liquid may be combined and fractionated together with other feedstocks, but again the desired cuts or desired carbon chain length is preferably C8 - C16, more preferably C10-C14.

Impurities

[0056] The plastic pyrolysate feedstock may comprise impurities and such impurities may be removed or at least reduced by various treatments such as hydrotreatment.

[0057] Hydrotreatment using e.g. a UoP kero-hydrotreater to operate the Unionrefining® process, may be used to reduce the for example, nitrogen, sulfur, oxygen, olefin content, and aromatics. To make the alkyl chain of the LAS from waste plastic and aliphatic feedstock is required so aromatics are preferably removed/reduced for this. Where the phenyl moiety is also obtained from the waste plastic feedstock, the aromatics may be removed and further utilized to provide such benzene. The kero-treater is a catalyst-based apparatus, and various catalysts for denitrification and desulfurization are known to those having ordinary skill in the art.

[0058] Hydroprocessing conditions and reactors are disclosed in for example, U.S. application Ser. Nos. 14/551,797 and 14/101,842 filed Nov. 24, 2014 and Dec. 10, 2013, respectively, and both of which are incorporated herein by reference.

Separation Process

[0059] The plastic pyrolysate liquid may undergo separation alone or in combination with feedstocks to separate the desirable linear paraffins from branched or cyclic compounds that may be included in the stream. A suitable separator for this purpose is a separator that operates using the UOP LLC Molex® process, which is a liquid-state separation of normal paraffins from branched and cyclic components using UOP LLC Sorbex® technology. Other separators known in the art are suitable for use herein as well.

[0060] Such separation processes may take place after the plastic pyrolysate (and any other feedstocks if combined) has been fractionated, e.g. after a pre-fractionation step.

[0061] Processes other than pyrolysis may be used to convert waste plastic feedstock to LAS or LAS components (n-olefins, benzene) e.g., gasification, hydrothermal liquifaction etc..

[0062] The stream of n-paraffins (having selected carbon chain lengths preferably C8 - C16, more preferably C10-C14) obtained from the above treatments may then be used to make P-LAS as described below.

Method of making LAS from refined pyrolysate.

[0063] The LAS obtained from the waste plastic feedstock may utilize known methods. Broadly, this involves taking the n-paraffins obtained from fractionating, separating, the pyrolysate etc as described above, converting said n-paraffins to n-olefins (by de-hydrogenation) e.g. broadly, firstly alkylation of benzene with an n-olefin (typically converted from n-paraffin homologue), followed by sulphonation in the conventional manner. For the present invention, at least the n-olefin is derived from the plastic feedstock.

[0064] LAS from of waste plastic feedstock may be manufactured in solo or in mixed streams with oils from feedstocks.

[0065] So, pyrolysis oil may be processed in a separate stream from say, fossil or natural oil streams up to any point in that process and then combined.

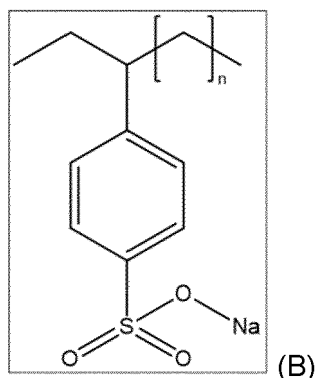
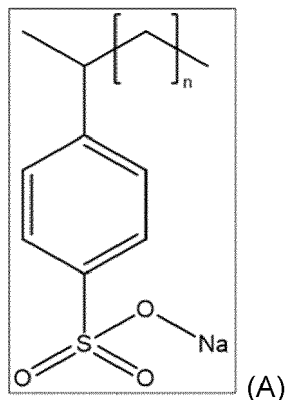
[0066] LAS obtained from waste plastic may be processed entirely in isolation and added to a detergent composition as a separate ingredient to LAS from other sources and/or pre-mixed with LAS from other sources.

[0067] Preferably, the LAS obtained from waste plastic feedstock comprises alkyl chains with an average chain length

from 8 to 14 carbons, more preferably from 10 to 13 and most preferably from 11 to 12.

[0068] Preferably, at least 30% wt. of the LAS obtained from waste plastic feedstock comprises alkyl chains with 12 carbons. Preferably, at least 30% wt. of the LAS obtained from waste plastic feedstock comprises alkyl chains with 11 carbons.

[0069] Preferably the waste-plastic feedstock derived LAS is made via an alkylation reaction of benzene with an n-alkyl, then sulphonation. Preferably alkyl chains obtained from the pyrolysis oil and used to make the LAS have a distillation range of 174 to 220°C.



[0070] Preferably, the wt. ratio of (A):(B) is from 2:1 to 1:2, more preferably from 3:2 to 1:2, most preferably 5:4 to 4:5 in the pyrolysis LAS (waste plastic derived). Preferably these two isomers represent from 20 to 70wt% of the pyrolysis LAS, more preferably from 30 to 40wt%.

Phenyl isomer

[0071] The (total) LAS may comprise multiple positional isomers, with regard to the position of the phenyl moiety on the alkyl chain. Such positional isomers may comprise any of 2-phenyl, 3-phenyl, 4-phenyl, 5-phenyl, and the like and any combination.

[0072] Preferably, the linear alkylbenzene has a 2-phenyl isomer content between about 15 percent and 45 percent, based on the weight of the alkylated aryl compound.

[0073] Preferably, the weight ratio of 2-phenyl isomer: 3-phenyl isomer: is from 2:1 to 1:2, more preferably from 3:2 to 1:2, most preferably 5:4 to 4:5. Preferably these two isomers represent from 20 to 70wt% of the LAS obtained from waste plastic, more preferably from 30 to 40wt%.

[0074] Solid alkylation catalysts, such as those used in the Detal™ process, produce products with 2-phenyl isomer content between 25 and 30 percent. HF-catalyzed processes typically yield a 2-phenyl isomer content less than 20 percent, and AlCl_3 typically between 30 and 33 percent. One process for controlling the 2-phenyl isomer content of linear alkylbenzene is disclosed in EP2616176 B. In this process LAB is obtained by alkylating a benzene with an olefin comprising reacting under alkylation reaction conditions a substantially linear olefin with benzene in a process stream comprising water and in the presence of a catalyst and controlling the water concentration in the range from bone dry to 100 ppm, said catalyst comprising a first catalyst component zeolite selected from the group consisting of rare earth-containing faujasite and blends thereof, and a second catalyst component zeolite selected from the group consisting of

Uzm-8, Zeolite MWW, Zeolite BEA, Zeolite OFF, Zeolite MOR, Zeolite LTL, Zeolite MTW, BPH/Uzm-4, and blends thereof.*

Definitions

[0075] As used herein, the following terms are defined:

The articles "a" and "an" when used in a claim, are understood to mean one or more of what is claimed or described; and "include", "includes" and "including" are meant to be nonlimiting.

"Alkyl" means an unsubstituted or substituted saturated hydrocarbon chain having from 1 to 18 carbon atoms. The chain may be linear or branched.

"biodegradable" means the ability of a compound to ultimately be degraded completely into CO₂ and water or biomass by microorganisms and/or natural environmental factors, preferably within 6 months.

"C₁₂" refers to the length of the alkyl chains (12) of the alkyl chain of the LAS obtained from waste plastic. Similarly C₁₁ means the alkyl chain has 11 carbon atoms and so forth.

"detergent composition" in the context of this invention means cleaning compositions, generally containing detergent surfactants, optionally other treatment ingredients, intended for and capable of treating substrates as defined herein. 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.

"detergent surfactant" means a surfactant which provides a detergent (i.e. cleaning) effect to a substrate such as fabric treated as part of a domestic treatment e.g. laundering process or dishwashing process or hard surface washing process.

"low foaming" means a foam height or a foam volume for the cleaning composition according to the present invention which is less than the foam height or foam volume which is achieved in comparable composition containing LAS anionic surfactant. It also includes a decrease in the duration of visible foam in a washing process cleaning soiled articles compared to a composition containing LAS anionic surfactant.

"petro-" or "petroleum derived" LAS means LAS obtained directly from the petroleum supply chain and relates to the industry standard LAS. This therefore excludes LAS which is processed from waste-plastic which involves extracting material from waste products, processing them to form the materials which are fed back into the feedstock to produce LAS. It is acknowledged that literally, waste-plastic feedstock is also ultimately derived from the petroleum supply chain, but has an extra stage in its processing relating its constituent parts being used in different raw materials in a different context, e.g. as packaging materials. It is this extra stage which distinguishes it from what we mean by petroleum derived.

"LAB" means linear alkyl benzene and is the precursor to LAS before sulphonation. The sulphonation step to turn LAB into LAS and occurs at the end is often carried out by the end user. Further, in liquid formulations the LAS is neutralised *in situ* and the weight proportions described herein refer to the protonated form.

"substantially free of" or "substantially free from" refers to either the complete absence of an ingredient or a minimal amount thereof merely as impurity or unintended byproduct of another ingredient. A composition that is "substantially free" of/from a component means that the composition comprises less than 0.5%, 0.25%, 0.1%, 0.05%, or 0.01%, or even 0%, by weight of the composition, of the component.

"Substrate" preferably is any suitable substrate and includes but is not limited to fabric substrates and dishes. Fabric substrates includes clothing, linens and other household textiles etc. In the context of fabrics, wherein the term "linen" is used to describe certain types of laundry items including bed sheets, pillow cases, towels, tablecloths, table napkins and uniforms and the term "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. "Dishes" is meant generically and encompasses essentially any items which may be found in a dishwashing load, including crockery chinaware, glassware, plasticware, hollowware and cutlery, including silverware.

[0076] Substrate may also include any inanimate "household surface". **"household hard surface"**, it is meant herein any kind of surface typically found in and around houses like kitchens, bathrooms, e.g., floors, walls, tiles, windows, cupboards, sinks, showers, shower plastified curtains, wash basins, WCs, fixtures and fittings and the like made of different materials like ceramic, vinyl, no-wax vinyl, linoleum, melamine, glass, Inox®, Formica®, vitroceramic, any plastics, plastified wood, metal or any painted or varnished or sealed surface and the like. Household hard surfaces also include household appliances including, but not limited to refrigerators, freezers, washing machines, automatic dryers, ovens, microwave ovens, dishwashers and so on. Such hard surfaces may be found both in private households as well as in commercial, institutional and industrial environments.

"Treatment" in the context of treating substrates may include cleaning, washing, conditioning, lubricating, care, softening, easy-ironing, anti-wrinkle, fragrancing, de-pilling, rejuvenation including colour rejuvenation, soaking, pretreatment of substrates, bleaching, colour treatments, soil removal, stain removal and any combination thereof.

"total LAS present in the detergent composition" means all the LAS present, regardless of feedstock source.

"Linear alkylbenzene sulphonate obtained from waste plastic feedstock" is distinguished from LAS which is linear alkylbenzene sulphonate from other sources such as petrochemical, natural oils etc. It is obtained from pyrolysis of waste plastic.

[0077] Unless otherwise noted, all component or composition levels are in reference to the active portion of that component or composition, and are exclusive of impurities, for example, residual solvents or by-products, which may be present in commercially available sources of such components or compositions.

[0078] Dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a value disclosed as "50 microns" is intended to mean "about 50 microns."

[0079] All percentages and ratios are calculated by weight unless otherwise indicated. All percentages and ratios are calculated based on the total composition unless otherwise indicated. It should be understood that every maximum numerical limitation given throughout this specification includes every lower numerical limitation, as if such lower numerical limitations were expressly written herein. Every minimum numerical limitation given throughout this specification will include every higher numerical limitation, as if such higher numerical limitations were expressly written herein. Every numerical range given throughout this specification will include every narrower numerical range that falls within such broader numerical range, as if such narrower numerical ranges were all expressly written herein.

Product Form

[0080] The detergent composition may take any suitable form such as a liquid, gel, or a solid composition.

Liquid laundry detergents

[0081] 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.

[0082] 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, and compositions having flowable yet stiffer consistency, known as gels or pastes. The viscosity of the composition may suitably range from about 200 to about 10,000 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 generally have a viscosity of from 200 to 1,500 mPa.s, preferably from 100 to 800 mPa.s.

[0083] A composition according to the invention may suitably have an aqueous continuous phase. By "aqueous continuous phase" is meant a continuous phase which has water as its basis.

[0084] A laundry liquid composition of the invention preferably comprises from 1 to 40%, preferably from 5 to 35%, and more preferably from 7 to 24% (by weight based on the total weight of the composition) of one or more deterative surfactants selected from non-soap anionic surfactants, nonionic surfactants and mixtures thereof.

[0085] Non-soap anionic surfactants for use in the invention are typically salts of organic sulfates and sulfonates having alkyl radicals containing from about 8 to about 22 carbon atoms, the term "alkyl" being used to include the alkyl portion of higher acyl radicals. Examples of such materials include alkyl sulfates, alkyl ether sulfates, alkaryl sulfonates, alpha-

olefin sulfonates and mixtures thereof. The alkyl radicals preferably contain from 10 to 18 carbon atoms and may be unsaturated. The alkyl ether sulfates may contain from one to ten ethylene oxide or propylene oxide units per molecule, and preferably contain one to three ethylene oxide units per molecule. The counterion for anionic surfactants is generally an alkali metal such as sodium or potassium; or an ammoniacal counterion such as monoethanolamine, (MEA) diethanolamine (DEA) or triethanolamine (TEA). Mixtures of such counterions may also be employed.

[0086] Some alkyl sulfate surfactant (PAS) may be used, such as non-ethoxylated primary and secondary alkyl sulphates with an alkyl chain length of from 10 to 18.

[0087] Mixtures of any of the above described materials may also be used.

[0088] In a composition of the invention the total level of anionic surfactant may preferably range from 20 to 90% by weight based on the total weight of the surfactant.

[0089] Also commonly used in laundry liquid compositions are alkyl ether sulfates having a straight or branched chain alkyl group having 10 to 18, more preferably 12 to 14 carbon atoms and containing an average of 1 to 3EO units per molecule. A preferred example is sodium lauryl ether sulfate (SLES) in which the predominantly C12 lauryl alkyl group has been ethoxylated with an average of 3EO units per molecule.

[0090] Preferably, the composition comprises from 20 to 95% wt. non-ionic surfactant based on the total weight of surfactant. Nonionic surfactants for use in the invention are typically polyoxyalkylene compounds, i.e. the reaction product of alkylene oxides (such as ethylene oxide or propylene oxide or mixtures thereof) with starter molecules having a hydrophobic group and a reactive hydrogen atom which is reactive with the alkylene oxide. Such starter molecules include alcohols, acids, amides or alkyl phenols. Where the starter molecule is an alcohol, the reaction product is known as an alcohol alkoxylate. The polyoxyalkylene compounds can have a variety of block and heteric (random) structures. For example, they can comprise a single block of alkylene oxide, or they can be diblock alkoxylates or triblock alkoxylates. Within the block structures, the blocks can be all ethylene oxide or all propylene oxide, or the blocks can contain a heteric mixture of alkylene oxides. Examples of such materials include C₈ to C₂₂ alkyl phenol ethoxylates with an average of from 5 to 25 moles of ethylene oxide per mole of alkyl phenol; and aliphatic alcohol ethoxylates such as C₈ to C₁₈ primary or secondary linear or branched alcohol ethoxylates with an average of from 2 to 40 moles of ethylene oxide per mole of alcohol.

[0091] A preferred class of nonionic surfactant for use in the invention includes aliphatic C₈ to C₁₈, more preferably C₁₂ to C₁₅ primary linear alcohol ethoxylates with an average of from 3 to 20, more preferably from 5 to 10 moles of ethylene oxide per mole of alcohol.

[0092] A further class of surfactants include the alkyl poly glycosides and rhamnolipids.

[0093] Mixtures of any of the above described materials may also be used.

[0094] Preferably, the selection and amount of surfactant is such that the compositions are isotropic in nature.

LAS

[0095] Preferably, the alkyl chain of the LAS derived from waste-plastic feedstock comprises a mixture of chain lengths but has an average of from 8 to 16, more preferably from 10 to 14 and most preferably from 11 to 12. 11.5 to 11.7 is a particularly preferred range. Preferably the LAS contains more than 80wt% of the C10, C11, C12 and C13 alkyl chains. Preferably the weight ratio of C10:C11 is from 1:2 to 1:5. Preferably the weight ratio of C10:C12 is from 1:2 to 1:5. Preferably the weight ratio of C10:C13 is from 1:1 to 1:3.

[0096] Preferably the level of tetralins in the LAS derived from waste-plastic feedstock is less than 8wt%, more preferably less than 0.5wt%.

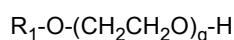
[0097] Preferably the level of isoalkylbenzenes in the LAS derived from waste-plastic feedstock is less than 6wt% more preferably less than 1wt%.

[0098] Preferably, the 2-phenyl isomer content in the LAS derived from waste-plastic feedstock is at least 10% wt. of the total LAS, more preferably at least 15% and most preferably at least 20% wt. of the LAS.

[0099] Preferred surfactants include the C18 based alkyl ether sulphates, the C18 based alcohol ethoxylates and the C₁₈ based methyl ester ethoxylates.

C18 Alcohol Ethoxylate

[0100] The C18 alcohol ethoxylate is of the formula:



where R₁ is selected from saturated, monounsaturated and polyunsaturated linear C18 alkyl chains and where q is from 4 to 20, preferably 5 to 14, more preferably 8 to 12. The mono-unsaturation is preferably in the 9 position of the chain, where the carbons are counted from the ethoxylate bound chain end. The double bond may be in a cis or trans configuration

(oleyl or elaidyl), preferably cis. The cis or trans alcohol ethoxylate $\text{CH}_3(\text{CH}_2)_7\text{-CH=CH-(CH}_2)_8\text{O-(OCH}_2\text{CH}_2)_n\text{OH}$, is described as C18:1(Δ 9) alcohol ethoxylate. This follows the nomenclature CX:Y(Δ Z) where X is the number of carbons in the chain, Y is the number of double bonds and Δ Z the position of the double bond on the chain where the carbons are counted from the OH bound chain end.

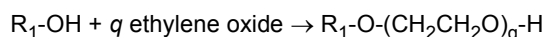
[0101] Preferably, R1 is selected from saturated C18 and monounsaturated C18. As regards the C18 alcohol ethoxylate content, it is preferred that the predominant C18 moiety is C18:1, more preferably C18:1(Δ 9).

[0102] Alcohol ethoxylates are discussed in the Non-ionic Surfactants: Organic Chemistry edited by Nico M. van Os (Marcel Dekker 1998), Surfactant Science Series published by CRC press. Alcohol ethoxylates are commonly referred to as alkyl ethoxylates.

[0103] Linear saturated or mono-unsaturated C20 and C22 alcohol ethoxylate may also be present. Preferably the weight fraction of sum of 'C18 alcohol ethoxylate' / 'C20 and C22 alcohol ethoxylate' is greater than 10.

[0104] Preferably the C18 alcohol ethoxylate contains less than 15wt%, more preferably less than 8wt%, most preferably less than 5wt% of the alcohol ethoxylate polyunsaturated alcohol ethoxylates. A polyunsaturated alcohol ethoxylate contains a hydrocarbon chains with two or more double bonds.

[0105] C18 alcohol ethoxylates may be synthesised by ethoxylation of an alkyl alcohol, via the reaction:



[0106] The alkyl alcohol may be produced by transesterification of the triglyceride to a methyl ester, followed by distillation and hydrogenation to the alcohol. The process is discussed in Journal of the American Oil Chemists' Society. 61 (2): 343-348 by Kreutzer, U. R. Preferred alkyl alcohol for the reaction is oleyl alcohol within an iodine value of 60 to 80, preferably 70 to 75, such alcohols are available from BASF, Cognis, Ecogreen and others.

[0107] Production of the fatty alcohol is further discussed in Sanchez M.A. et al J.Chem.Technol.Biotechnol 2017; 92:27-92 and Ullmann's Encyclopaedie der technischen Chemie, Verlag Chemie, Weinheim, 4th Edition, Vol. 11, pages 436 et seq. Preferably the ethoxylation reactions are base catalysed using NaOH, KOH, or NaOCH₃. Even more preferred are catalyst which provide narrower ethoxy distribution than NaOH, KOH, or NaOCH₃. Preferably these narrower distribution catalysts involve a Group II base such as Ba dodecanoate; Group II metal alkoxides; Group II hydrotalcite as described in WO2007/147866. Lanthanides may also be used. Such narrower distribution alcohol ethoxylates are available from Azo Nobel and Sasol.

[0108] Preferably the narrow ethoxy distribution has greater than 70 wt.%, more preferably greater than 80 wt.% of the alcohol ethoxylate $\text{R-O-(CH}_2\text{CH}_2\text{O)}_q\text{-H}$ in the range $\text{R-O-(CH}_2\text{CH}_2\text{O)}_x\text{-H}$ to $\text{R-O-(CH}_2\text{CH}_2\text{O)}_y\text{-H}$ where q is the mole average degree of ethoxylation and x and y are absolute numbers, where $x = q - q/2$ and $y = q + q/2$. For example when $q=10$, 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.

[0109] However, depending on the source for the alkyl chain, it is preferred that the additional alcohol ethoxylate comprises C16 alcohol ethoxylate. More preferably, the saturated C16 alcohol ethoxylate comprises at least 90% wt. of the total C16 linear alcohol ethoxylate present.

[0110] Preferably, the proportion of monounsaturated C18 alcohol ethoxylate constitutes at least 50% wt. of the total C16 and C18 alcohol ethoxylate surfactant. However, where the level of C16 is above 30% the C18:1 level may be as low as 39%. Preferably, the C16 alcohol ethoxylate surfactant comprises at least 2% wt. and more preferably, from 4% of the total C16 and C18 alcohol ethoxylate surfactant. Preferably, the C16 saturated and C18 monounsaturated together comprise at least 75% wt. of the total alcohol ethoxylate and more preferably from 76 to 85% wt. of the total alcohol ethoxylate.

[0111] Preferably, the proportion of monounsaturated C18 constitutes at least 60% wt., most preferably at least 75% of the total C16 and C18 alcohol ethoxylate surfactant.

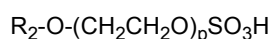
[0112] Preferably, the saturated C18 alcohol ethoxylate surfactant comprises up to 20% wt. and more preferably, up to 11% of the total C16 and C18 alcohol ethoxylate surfactant.

[0113] Preferably the saturated C18 content is at least 2% wt. of the total C16 and C18 alcohol ethoxylate content.

[0114] Preferably the weight fraction of C18 alcohol ethoxylate / C16 alcohol ethoxylate is greater than 1, more preferably from 2 to 100, most preferably 3 to 30. 'C18 alcohol ethoxylate' is the sum of all the C18 fractions in the alcohol ethoxylate and 'C16 alcohol ethoxylate' is the sum of all the C16 fractions in the alcohol ethoxylate.

C18 Alcohol ether sulfates

[0115] Preferably, the composition comprises C18 ether sulfate of the formula:



[0116] Where R_2 is selected from saturated, monounsaturated and polyunsaturated linear C18 alkyl chains and where p is from 3 to 20, preferably 4 to 12, more preferably 5 to 10. The mono-unsaturation is preferably in the 9 position of the chain, where the carbons are counted from the ethoxylate bound chain end. The double bond may be in a cis or trans configuration (oleyl or elaidyl), but is preferably cis. The cis or trans ether sulfate

$CH_3(CH_2)_7-CH=CH-(CH_2)_8O-(CH_2CH_2O)_nSO_3H$, is described as C18:1(Δ 9) ether sulfate. This follows the nomenclature CX:Y(Δ Z) where X is the number of carbons in the chain, Y is the number of double bonds and Δ Z the position of the double bond on the chain where the carbons are counted from the OH bound chain end.

[0117] Preferably, R_2 is selected from saturated C18 and monounsaturated C18. As regards the C18 content, it is preferred that the predominant C18 moiety is C18:1, more preferably C18:1(Δ 9).

[0118] Ether sulfates are discussed in the Anionic Surfactants: Organic Chemistry edited by Helmut W. Stache (Marcel Dekker 1995), Surfactant Science Series published by CRC press.

[0119] Linear saturated or mono-unsaturated C20 and C22 ether sulfate may also be present. Preferably the weight fraction of sum of 'C18 ether sulfate' / 'C20 and C22 ether sulfate' is greater than 10.

[0120] Preferably the C18 ether sulfate contains less than 15 wt.%, more preferably less than 8 wt.%, most preferably less than 4wt% and most preferably less than 2% wt. of the ether sulfate polyunsaturated ether sulfate. A polyunsaturated ether sulfate contains a hydrocarbon chains with two or more double bonds.

[0121] Ether sulfate may be synthesised by the sulphonation of the corresponding alcohol ethoxylate. The alcohol ethoxylate may be produced by ethoxylation of an alkyl alcohol. The alkyl alcohol used to produced the alcohol ethoxylate may be produced by transesterification of the triglyceride to a methyl ester, followed by distillation and hydrogenation to the alcohol. The process is discussed in Journal of the American Oil Chemists' Society. 61 (2): 343-348 by Kreutzer, U. R. Preferred alkyl alcohol for the reaction is oleyl alcohol with an iodine value of 60 to 80, preferably 70 to 75, such alcohol are available from BASF, Cognis, Ecogreen.

[0122] The degree of polyunsaturation in the surfactant may be controlled by hydrogenation of the triglyceride as described in: A Practical Guide to Vegetable Oil Processing (Gupta M.K. Academic Press 2017). Distillation and other purification techniques may be used.

[0123] Ethoxylation reactions are described in Non-Ionic Surfactant Organic Chemistry (N. M. van Os ed), Surfactant Science Series Volume 72, CRC Press.

[0124] Preferably the ethoxylation reactions are base catalysed using NaOH, KOH, or $NaOCH_3$. Even more preferred are catalyst which provide narrower ethoxy distribution than NaOH, KOH, or $NaOCH_3$. Preferably these narrower distribution catalysts involve a Group II base such as Ba dodecanoate; Group II metal alkoxides; Group II hydrotalcite as described in WO2007/147866. Lanthanides may also be used. Such narrower distribution alcohol ethoxylates are available from Azo Nobel and Sasol.

[0125] Preferably the narrow ethoxy distribution has greater than 70 wt.%, more preferably greater than 80 wt.% of the ether sulfate $R_2-O-(CH_2CH_2O)_pSO_3H$ in the range $R_2-O-(CH_2CH_2O)_2SO_3H$ to $R_2-O-(CH_2CH_2O)_wSO_3H$ where q is the mole average degree of ethoxylation and x and y are absolute numbers, where $z = p-p/2$ and $w = p+p/2$. For example when $p=6$, then greater than 70 wt.% of the ether sulfate should consist of ether sulfate with 3, 4, 5, 6, 7, 8, 9 ethoxylate groups.

[0126] The ether sulfate weight is calculated as the protonated form: $R_2-O-(CH_2CH_2O)_pSO_3H$. In the formulation it will be present as the ionic form $R_2-O-(CH_2CH_2O)_pSO_3^-$ with a corresponding counter ion, preferred counter ions are group I and II metals, amines, most preferably sodium.

[0127] The composition may also comprise C16 alkyl ether sulphate. This may be a consequence of active addition of C16 or by way of a component of the sourcing of the C18 raw material.

[0128] More preferably, the saturated C16 comprises at least 90% wt. of the C16 content linear alkyl.

[0129] Preferably, the proportion of monounsaturated C18 constitutes at least 50% wt. of the total C16 and C18 alkyl ether sulphate surfactant. However, where the level of C16 is above 30% the C18:1 level may be as low as 39%. Preferably, the C16 alcohol ether sulphate surfactant comprises at least 2% wt. and more preferably, from 4% of the total C16 and C18 alcohol ether sulphate surfactant. Preferably, the C16 saturated and C18 monounsaturated together comprise at least 75% wt. of the total alcohol ether sulphate and more preferably from 76 to 85% wt. of the total alcohol ether sulphate.

[0130] More preferably, the proportion of monounsaturated C18 constitutes at least 60% wt., most preferably at least 75 of the total C16 and C18 alkyl ether sulphate surfactant.

[0131] Preferably, the C16 alkyl ether sulphate surfactant comprises at least 2% wt. and more preferably, from 4% of the total C16 and C18 alkyl ether sulphate surfactant.

[0132] Preferably, the saturated C18 alkyl ether sulphate surfactant comprises up to 20% wt. and more preferably, up to 11% of the total C16 and C18 alkyl ether sulphate surfactant. Preferably the saturated C18 content is at least 2% wt. of the total C16 and C18 alkyl ether sulphate content.

[0133] Where the composition comprises a mixture of the C16/18 sourced material for the alkyl ether sulphate as well as the more traditional C12 alkyl chain length materials it is preferred that the total C16/18 alkyl ether sulphate content

should comprise at least 10% wt. of the total alkyl ether sulphate, more preferably at least 50%, even more preferably at least 70%, especially preferably at least 90% and most preferably at least 95% of alkyl ether sulphate in the composition.

[0134] Preferably, the weight ratio of total non-ionic surfactant to total 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.

[0135] Preferably, the weight ratio of total C16/18 non-ionic surfactant, to total 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.

[0136] Preferably, the weight ratio of total non-ionic surfactant to total C16/18 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.

[0137] Preferably, the weight ratio of total C18:1 non-ionic surfactant to total C18:1 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.

[0138] Preferably, the weight ratio of total 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.

[0139] Preferably, the weight ratio of total C16/18 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.

Source of alkyl chains

[0140] The alkyl chain of C16/18 surfactant whether an alcohol ethoxylate or an alkyl ether sulphate is preferably obtained from a renewable source, preferably from a triglyceride. A renewable source is one where the material is produced by natural ecological cycle of a living species, preferably by a plant, algae, fungi, yeast or bacteria, more preferably plants, algae or yeasts.

[0141] Preferred plant sources of oils are rapeseed, sunflower, maize, soy, cottonseed, olive oil and trees. The oil from trees is called tall oil. Most preferably Palm and Rapeseed oils are the source.

[0142] Algal oils are discussed in Energies 2019, 12, 1920 Algal Biofuels: Current Status and Key Challenges by Saad M.G. et al. A process for the production of triglycerides from biomass using yeasts is described in Energy Environ. Sci., 2019, 12, 2717 A sustainable, high-performance process for the economic production of waste-free microbial oils that can replace plant-based equivalents by Masri M.A. et al.

[0143] Non edible plant oils may be used and are preferably selected from the fruit and seeds of *Jatropha curcas*, *Calophyllum inophyllum*, *Sterculia feotida*, *Madhuca indica* (mahua), *Pongamia glabra* (koroch seed), Linseed, *Pongamia pinnata* (karanja), *Hevea brasiliensis* (Rubber seed), *Azadirachta indica* (neem), *Camelina sativa*, *Lesquerella fendleri*, *Nicotiana tabacum* (tobacco), Deccan hemp, *Ricinus communis* L. (castor), *Simmondsia chinensis* (Jojoba), *Eruca sativa* L., *Cerbera odollam* (Sea mango), Coriander (*Coriandrum sativum* L.), *Croton megalocarpus*, Pilu, *Crambe*, *syringa*, *Scheleicheria triguga* (kusum), *Stillingia*, *Shorea robusta* (sal), *Terminalia belerica roxb*, *Cuphea*, *Camellia*, *Champaca*, *Simarouba glauca*, *Garcinia indica*, Rice bran, Hingan (balanites), Desert date, Cardoon, *Asclepias syriaca* (Milkweed), *Guizotia abyssinica*, Radish Ethiopian mustard, *Syagrus*, Tung, *Idesia polycarpa* var. *vestita*, Algae, *Argemone mexicana* L. (Mexican prickly poppy, *Putranjiva roxburghii* (Lucky bean tree), *Sapindus mukorossi* (Soapnut), *M. azedarach* (syringe), *Thevetia peruviana* (yellow oleander), *Copaiba*, Milk bush, Laurel, Cumaru, Andiroba, Piqui, *B. napus*, *Zanthoxylum bungeanum*.

COSURFACTANTS

[0144] A composition of the invention may contain one or more cosurfactants (such as amphoteric (zwitterionic) and/or cationic surfactants) in addition to the non-soap anionic and/or nonionic deterative surfactants described above.

[0145] 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).

[0146] Specific amphoteric (zwitterionic) surfactants include alkyl amine oxides, alkyl betaines, alkyl amidopropyl betaines, alkyl sulfobetaines (sultaines), alkyl glycines, alkyl carboxyglycines, alkyl amphotacetates, alkyl amphotpropionates, alkylamphotglycines, 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).

[0147] Mixtures of any of the above described materials may also be used.

Surfactants for solid particulate compositions

[0148] The particulate composition of the invention comprises from 3 to 80%, preferably from 10 to 60%, and more preferably from 15 to 50% (by weight based on the total weight of the composition) of one or more deterative surfactants selected from non-soap anionic surfactants, nonionic surfactants and mixtures thereof.

[0149] The term "deterative surfactant" in the context of particulate detergent formulations denotes a surfactant which provides a deterative (i.e. cleaning) effect to laundry treated as part of a domestic laundering process.

[0150] In addition to the sulphated ethoxylated C₁₀ Guerbet alcohol surfactant as described above, other non-soap anionic surfactants for use in particulate compositions are typically salts of organic sulfates and sulfonates having alkyl radicals containing from about 8 to about 22 carbon atoms, the term "alkyl" being used to include the alkyl portion of higher acyl radicals. Examples of such materials include alkyl sulfates, alkyl ether sulfates, alkaryl sulfonates, alpha-olefin sulfonates and mixtures thereof. The alkyl radicals preferably contain from 10 to 18 carbon atoms and may be unsaturated. The alkyl ether sulfates may contain from one to ten ethylene oxide or propylene oxide units per molecule, and preferably contain one to three ethylene oxide units per molecule. The counterion for anionic surfactants is generally an alkali metal such as sodium or potassium; or an ammoniacal counterion such as monoethanolamine, (MEA) diethanolamine (DEA) or triethanolamine (TEA). Mixtures of such counterions may also be employed.

[0151] Previously, a preferred class of non-soap anionic surfactant for use in particulate compositions includes alkylbenzene sulfonates, particularly linear alkylbenzene sulfonates (LAS) with an alkyl chain length of from 10 to 18 carbon atoms. Commercial LAS is a mixture of closely related isomers and homologues alkyl chain homologues, each containing an aromatic ring sulfonated at the "para" position and attached to a linear alkyl chain at any position except the terminal carbons. The linear alkyl chain typically has a chain length of from 11 to 15 carbon atoms, with the predominant materials having a chain length of about C₁₂. Each alkyl chain homologue consists of a mixture of all the possible sulfophenyl isomers except for the 1-phenyl isomer. LAS is normally formulated into compositions in acid (i.e. HLAS) form and then at least partially neutralized in-situ.

[0152] Particulate compositions according to the invention may contain some alkyl benzene sulphonate in addition to the sulphated ethoxylated C₁₀ Guerbet alcohol surfactant as described above but it is preferred that the composition comprises less than 5% wt. more preferably less than 1% wt. and most preferably less than 0.1% wt. alkyl benzene sulphonate surfactant.

[0153] Mixtures of any of the above described materials may also be used.

[0154] In a typical particulate composition, the total level of non-soap anionic surfactant may suitably range from 5 to 25% (by weight based on the total weight of the composition).

[0155] Non-ionic surfactants may provide enhanced performance for removing very hydrophobic oily soil and for cleaning hydrophobic polyester and polyester/cotton blend fabrics.

[0156] Nonionic surfactants for use in particulate compositions are typically polyoxyalkylene compounds, i.e. the reaction product of alkylene oxides (such as ethylene oxide or propylene oxide or mixtures thereof) with starter molecules having a hydrophobic group and a reactive hydrogen atom which is reactive with the alkylene oxide. Such starter molecules include alcohols, acids, amides or alkyl phenols. Where the starter molecule is an alcohol, the reaction product is known as an alcohol alkoxylate. The polyoxyalkylene compounds can have a variety of block and heteric (random) structures. For example, they can comprise a single block of alkylene oxide, or they can be diblock alkoxylates or triblock alkoxylates. Within the block structures, the blocks can be all ethylene oxide or all propylene oxide, or the blocks can contain a heteric mixture of alkylene oxides. Examples of such materials include C₈ to C₂₂ alkyl phenol ethoxylates with an average of from 5 to 25 moles of ethylene oxide per mole of alkyl phenol; and aliphatic alcohol ethoxylates such as C₈ to C₁₈ primary or secondary linear or branched alcohol ethoxylates with an average of from 2 to 40 moles of ethylene oxide per mole of alcohol.

[0157] A preferred class of nonionic surfactant for use in particulate compositions includes aliphatic C₈ to C₁₈, more preferably C₁₂ to C₁₅ primary linear alcohol ethoxylates with an average of from 3 to 20, more preferably from 5 to 10 moles of ethylene oxide per mole of alcohol.

[0158] Mixtures of any of the above described materials may also be used.

[0159] In particulate compositions the total level of non-ionic surfactant may suitably range from 1 to 10% (by weight based on the total weight of the composition).

[0160] Examples of suitable mixtures of non-soap anionic and/or nonionic surfactants for use in particulate compositions include mixtures of linear alkylbenzene sulfonate (preferably C₁₁ to C₁₅ linear alkyl benzene sulfonate) if present with sulphated ethoxylated C₁₀ Guerbet alcohol surfactant as described above, with sodium lauryl ether sulfate (preferably C₁₀ to C₁₈ alkyl sulfate ethoxylated with an average of 1 to 3 EO) and/or ethoxylated aliphatic alcohol (preferably C₁₂ to C₁₅ primary linear alcohol ethoxylate with an average of from 5 to 10 moles of ethylene oxide per mole of alcohol).

[0161] A particulate composition may also contain one or more cosurfactants (such as amphoteric (zwitterionic) and/or cationic surfactants) in addition to the non-soap anionic and/or nonionic deterative surfactants described above.

[0162] 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).

[0163] Specific amphoteric (zwitterionic) surfactants include alkyl amine oxides, alkyl betaines, alkyl amidopropyl betaines, alkyl sulphobetaines (sultaines), alkyl glycinate, alkyl carboxyglycinates, alkyl amphotacetates, alkyl amphotpropionates, alkylamphoglycinates, alkyl amidopropyl hydroxysultaines, acyl taurates and acyl glutamates, having alkyl radicals containing from about 8 to about 22 carbon atoms, the term "alkyl" being used to include the alkyl portion of higher acyl radicals. 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).

Fatty Acid

[0164] Preferably, fatty acid is present at from 0.1 to 20% wt. of the composition (as measured with reference to the acid added to the composition), more preferably from 1 to 12% wt. and most preferably 6 to 8% wt.

[0165] 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).

[0166] 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.

[0167] Mixtures of any of the above described materials may also be used.

[0168] 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.

Builders

[0169] Compositions, preferably particulate compositions may also include one or more builders. Builders are principally used to reduce water hardness. This is done either by sequestration or chelation (holding hardness minerals in solution), by precipitation (forming an insoluble substance), or by ion exchange (trading electrically charged particles). Builders can also supply and maintain alkalinity, which assists cleaning, especially of acid soils; help keep removed soil from redepositing during washing; and emulsify oily and greasy soils.

[0170] Builders for use in particulate compositions can be of the organic or inorganic type, or a mixture thereof. Non-phosphate builders are preferred.

[0171] Inorganic, non-phosphate builders for use in particulate compositions include carbonates, silicates, zeolites, and mixtures thereof.

Oxidising Agent

[0172] A particulate composition of the invention may also include an oxidising agent to facilitate removal of tough food stains and other organic stains by chemical oxidation. The oxidising agent may, for example oxidize polyphenolic compounds commonly found in coffee, tea, wine, and fruit stains. Oxidation by the oxidising agent may also aid in bleaching, whitening, and disinfecting fabrics, and may also provide additional washing machine cleanliness and odour prevention. Suitable oxidising agents for use in the invention include peroxy bleach compounds such as sodium perborate monohydrate and tetrahydrate, and sodium percarbonate.

[0173] When included, a particulate composition will preferably comprise from 5 to 35%, preferably from 8 to 20% (by weight based on the total weight of the composition) of one or more oxidising agents such as the peroxy bleach compounds which are described above.

Bleaching Activator

[0174] A bleaching activator such as N,N,N',N'-tetraacetythylenediamine (TAED) or sodium nonanoyloxybenzenesulfonate (NOBS) may be included in conjunction with the one or more oxidising agents to improve bleaching action at low wash temperatures.

[0175] A bleaching catalyst may also be included in addition to or instead of a bleach activator. Typical bleaching catalysts include complexes of heavy metal ions such as cobalt, copper, iron, manganese or combinations thereof; with organic ligands such as 1,4,7-triazacyclononane (TACN), 1,4,7-trimethyl-1,4,7-triazacyclononane (Me₃-TACN), 1,5,9-trimethyl-1,5,9-triazacyclononane, 1,5,9-triazacyclododecane, 1,4,7-triazacycloundecane, tris[2-(salicylideneami-

no)ethyl]amine or combinations thereof.

Sequestrant

[0176] The detergent compositions may also preferably comprise a 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.

Cleaning Polymers

[0177] The detergent composition may further comprise one or more anti-redeposition polymers e.g. alkoxyated polyethyleneimines, preferably an 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.

Soil Release Polymers

[0178] The detergent composition may further comprise one or more soil release polymers.

[0179] 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

[0180] A composition of the invention may incorporate non-aqueous carriers such as hydrotropes, co-solvents and phase stabilizers e.g. C1 to C5 monohydric alcohols (such as ethanol and *n*-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) or mixtures thereof.

[0181] Non-aqueous carriers, are preferably included, may be present in an amount ranging from 1 to 50%, preferably from 10 to 30%, and more preferably from 15 to 25% (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.

External Structurants

[0182] Compositions of the invention 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, microfibrinous 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

[0183] A composition of the invention 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.

Fragrances

[0184] Fragrance components are well known in the art and are preferably incorporated into compositions described herein such that the level of fragrance in totality is from 1 to 5 wt.%. Fragrances may be encapsulated and provided in the form of a microcapsule. Microencapsulates comprise one substance (the 'core' the active ingredient or agent, fill, payload, nucleus, or internal phase) contained within another substance (membrane, shell, wall, coating) such capsules being generally less than one micron to several hundred microns in size.

[0185] Microencapsulates may comprise at least one generally spherical continuous shell surrounding the core being

a fragrance formulation with solvents, carriers etc.

[0186] 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. 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.

[0187] 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.

[0188] Polymeric microparticles suitable for use in the invention may be provided with a deposition aid at the outer surface of the microparticle. Desired substrates include cellulosics (including cotton) and polyesters (including those employed in the manufacture of polyester fabrics).

[0189] 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 β 1-4 linked, such as a glucan backbone (consisting of β 1-4 linked glucose residues), a mannan backbone (consisting of β 1-4 linked mannose residues) or a xylan backbone (consisting of β 1-4 linked xylose residues). Examples of such β 1-4 linked polysaccharides include xyloglucans, glucomannans, mannans, galactomannans, β (1-3),(1-4) glucan and the xylan family incorporating glucurono-, arabino- and glucuronoarabinoxylans. Preferred β 1-4 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 β 1-4 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 locust bean gum (LBG) (which has a mannan backbone of β 1-4 linked mannose residues, with single unit galactose side chains linked α 1-6 to the backbone).

[0190] 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.

[0191] 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.

[0192] Mixtures of any of the above described materials may also be suitable.

[0193] 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.

[0194] 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 β 1-4 linked polysaccharides, and in particular the xyloglucans of plant origin, as are further described above.

Solid detergent compositions

[0195] Solid detergent compositions can take a variety of physical solid forms including forms such as powder or particulate. The term "particulate laundry detergent" in the context of this invention denotes free-flowing or compacted solid forms such as powders, granules, pellets, flakes, bars, briquettes or tablets and which are intended for and capable of wetting and cleaning domestic laundry such as clothing, linens and other household textiles. 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.

[0196] One preferred form for the composition according to the invention is a free-flowing powdered solid, with a loose (unpacked) bulk density generally ranging from about 200g/l to about 1,300 g/l, preferably from about 400 g/l to about 1,000 g/l, more preferably from about 500g/l to about 900 g/l.

[0197] The solid detergent composition may be in the form of a unit dose formulation or contained on or in a porous substrate or nonwoven sheet, and other suitable forms.

[0198] Solid unit dose composition includes compositions enclosed within a water-soluble film.

[0199] Where the product is a liquid it may be a dilutable composition or an auto-dose composition. An auto-dose composition is one which is contained within a cartridge or such like and dispensed from within the washing machine when required.

[0200] Where the product is a dilutable it means that the consumer can purchase a concentrated product and take the concentrate home where it can be diluted to form a regular home care product. The dilution may require anything from 1 to 10 parts water to one part concentrate. A composition of the invention may contain further optional ingredients to enhance performance and/or consumer acceptability. Examples of such ingredients include fatty acids, 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, preservative. 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.

Packaging and dosing

[0201] A composition of the invention may be packaged as unit doses in polymeric film soluble in the wash water. Alternatively, a composition of the invention may be supplied in multidose plastics packs with a top or bottom closure. A dosing measure may be supplied with the pack either as a part of the cap or as an integrated system.

Dishwash compositions

[0202] Dish means a hard surface as is intended to be cleaned using a hand dish-wash composition and includes dishes, glasses, pots, pans, baking dishes and flatware made from any material or combination of hard surface materials commonly used in the making of articles used for eating and/or cooking.

Surfactants for dishwasher compositions

[0203] Surfactant (detergent active) is generally chosen from anionic and non-ionic detergent actives. The cleaning composition may further or alternatively comprise cationic, amphoteric and zwitterionic surfactants.

[0204] Suitable synthetic (non-soap) anionic surfactants are water-soluble salts of organic sulphuric acid mono-esters and sulphonic acids which have in the molecular structure a branched or straight chain alkyl group containing from 6 to 22 carbon atoms in the alkyl part.

[0205] Examples of such anionic surfactants are water soluble salts of alkyl benzene sulfonates, such as those in which the alkyl group contains from 6 to 20 carbon atoms; (primary) long chain (e.g. 6-22 C-atoms) alcohol sulphates (hereinafter referred to as PAS), especially those obtained by sulphating the fatty alcohols produced by reducing the glycerides of tallow or coconut oil; secondary alkanesulfonates; and mixtures thereof.

[0206] Also suitable are the salts of alkylglyceryl ether sulphates, especially of the ethers of fatty alcohols derived from tallow and coconut oil; fatty acid monoglyceride sulphates; sulphates of ethoxylated aliphatic alcohols containing 1-12 ethylenoxy groups; alkylphenol ethylenoxy-ether sulphates with from 1 to 8 ethylenoxy units per molecule and in which the alkyl groups contain from 4 to 14 carbon atoms; the reaction product of fatty acids esterified with isethionic acid and neutralised with alkali, and mixtures thereof.

[0207] Previously, the preferred water-soluble synthetic anionic surfactants are the alkali metal (such as sodium and potassium) and alkaline earth metal (such as calcium and magnesium) salts of alkyl-benzenesulfonates and mixtures with olefinsulfonates and alkyl sulfates, and the fatty acid mono-glyceride sulfates.

[0208] Non-ionic surfactants tend to reduce the foam produced on use of the composition. Consumers frequently associate high foam with powerful cleaning so it may be desirable to avoid the use of non-ionic surfactant altogether. For compositions where this is not an issue a suitable class of non-ionic surfactants can be broadly described as compounds produced by the condensation of simple alkylene oxides, which are hydrophilic in nature, with an aliphatic or alkyl-aromatic hydrophobic compound having a reactive hydrogen atom. The length of the hydrophilic or polyoxy-alkylene chain which is attached to any particular hydrophobic group can be readily adjusted to yield a compound having

the desired balance between hydrophilic and hydrophobic elements. This enables the choice of non-ionic surfactants with the right HLB. Particular examples include: the condensation products of aliphatic alcohols having from 8 to 22 carbon atoms in either straight or branched chain configuration with ethylene oxide, such as a coconut alcohol/ethylene oxide condensates having from 2 to 15 moles of ethylene oxide per mole of coconut alcohol; condensates of alkylphenols having C6-C15 alkyl groups with 5 to 25 moles of ethylene oxide per mole of alkylphenol; and condensates of the reaction product of ethylene-diamine and propylene oxide with ethylene oxide, the condensates containing from 40 to 80 percent of ethyleneoxy groups by weight and having a molecular weight of from 5,000 to 11,000.

[0209] Other classes of non-ionic surfactants are: tertiary amine oxides of structure $R_1 R_2 R_3 N-O$, where R_1 is an alkyl group of 8 to 20 carbon atoms and R_2 and R_3 are each alkyl or hydroxyalkyl groups of 1 to 3 carbon atoms, e.g. dimethyldodecylamine oxide; tertiary phosphine oxides of structure $R_1 R_2 R_3 P-O$, where R_1 is an alkyl group of 8 to 20 carbon atoms and R_2 and R_3 are each alkyl or hydroxyalkyl groups of 1 to 3 carbon atoms, for instance dimethyldodecylphosphine oxide; dialkyl sulphoxides of structure $R_1 R_2 S=O$, where R_1 is an alkyl group of from 10 to 18 carbon atoms and R_2 is methyl or ethyl, for instance methyl-tetradecyl sulphoxide; fatty acid alkylolamides, such as the ethanol amides; alkylene oxide condensates of fatty acid alkylolamides; and alkyl mercaptans.

If non-ionic surfactant is to be employed the amount present in the cleaning compositions of the invention will generally be at least 0.1 wt. percent, preferably at least 0.5 wt. percent, more preferably at least 1.0 wt. percent, but not more than 20 wt. percent, preferably at most 10 wt. percent and more preferably not more than 5 wt. percent.

[0210] It is also possible optionally to include amphoteric, cationic or zwitterionic surfactants in the compositions.

[0211] Suitable amphoteric surfactants are derivatives of aliphatic secondary and tertiary amines containing an alkyl group of 8 to 20 carbon atoms and an aliphatic group substituted by an anionic water-solubilising group, for instance sodium 3-dodecylamino-propionate, sodium 3-dodecylaminopropane-sulfonate and sodium N 2-hydroxy-dodecyl-N-methyltaurate.

[0212] Examples of suitable cationic surfactants can be found among quaternary ammonium salts having one or two alkyl or aralkyl groups of from 8 to 20 carbon atoms and two or three small aliphatic (e.g. methyl) groups, for instance cetyltrimethylammonium chloride.

[0213] A specific group of surfactants are the tertiary amines obtained by condensation of ethylene and/or propylene oxide with long chain aliphatic amines. The compounds behave like non-ionic surfactants in alkaline medium and like cationic surfactants in acid medium.

[0214] Examples of suitable zwitterionic surfactants can be found among derivatives of aliphatic quaternary ammonium, sulfonium and phosphonium compounds having an aliphatic group of from 8 to 18 carbon atoms and an aliphatic group substituted by an anionic water-solubilising group, for instance betaine and betaine derivatives such as alkyl betaine, in particular C12-C16 alkyl betaine, 3-(N,N-dimethyl-N-hexadecylammonium)-propane 1-sulfonate betaine, 3-(dodecylmethyl-sulfonium)-propane 1-sulfonate betaine, 3-(cetylmethyl-phosphonium)-propane-1-sulfonate betaine and N,N-dimethyl-N-dodecyl-glycine. Other well known betaines are the alkylamidopropyl betaines e.g. those wherein the alkylamido group is derived from coconut oil fatty acids.

[0215] Further examples of suitable surfactants are compounds commonly used as surface-active agents given in the well-known textbooks: 'Surface Active Agents' Vol.1, by Schwartz and Perry, Interscience 1949; 'Surface Active Agents' Vol.2 by Schwartz, Perry and Berch, Interscience 1958; the current edition of 'McCutcheon's Emulsifiers and Detergents' published by Manufacturing Confectioners Company; 'Tenside-Taschenbuch', H. Stache, 2nd Edn., Carl Hauser Verlag, 1981.

[0216] The total level of surfactant is preferably from 3 to 40% wt. of the composition and typically along with the sulphated Guerbet surfactant the ratio between the LAS and SLES is from 80:20 to 30:70. The preferred ratio between the SLES and the CAPB is from 4:1 to 7:1 and the ratio between the PAS and the SLES is from 1:1 to 2:1.

Optional ingredients for dishwash compositions

[0217] The composition may include optional ingredients, such as abrasive particles and additional ingredients which aid formulation properties, stability and cleaning performance.

[0218] Magnesium and/or sodium sulphate are desirably included from 0.5 to 5 wt. percent in order to ensure the desired rheological properties are achieved.

[0219] A preservative system is also desirable, for example a mixture of CIT and MIT. BIT may also be used. The level of preservative will vary according to the expected storage temperature and the quality of raw materials. From 0.0001 to 0.1 wt percent is typical.

[0220] Sodium EDTA chelant is advantageously included in the compositions at a level of 0.01 to 0.5 wt percent. DMDMH (glydant) may also be included into the compositions at level of from 0.005 to 1 wt percent.

[0221] When the composition contains one or more anionic surfactants, the composition may preferably comprise detergent builders in an amount of more preferably from 0.1 to 25 weight percent. Suitable inorganic and organic builders are well known to those skilled in the art. Citric acid is a preferred buffer/ builder and may suitably be included at a level

of from 0.01 to 0.5 wt percent.

[0222] The composition may also comprise ingredients such as colorants, whiteners, optical brighteners, soil suspending agents, detergent enzymes, compatible bleaching agents (particularly peroxide compounds and active chlorine releasing compounds), solvents, co-solvents, gel-control agents, freeze-thaw stabilisers, bactericides, preservatives, hydrotropes, polymers and perfumes.

[0223] Examples of optional enzymes include lipase, cellulase, protease, mannanase, and pectate lyase.

Viscosity for dishwash compositions

[0224] Liquid dishwash compositions according to the invention preferably have a viscosity from 100 to 10,000 mPa.s, more preferably from 200 to 8,000 mPa.s, even more preferably from 400 to 6,500 mPa.s, and still even more preferably from 800 to 5,000 mPa.s, as measured at a shear rate of 20 s^{-1} and at a temperature of 25 degrees Celsius.

EXAMPLES

[0225] Below is a laundry liquid formulation which comprises LAS obtained from plastic feedstock comprising 50% wt. of the total LAS present. The remainder being directly derived from petroleum feedstocks.

Table 1

Ingredient	Weight%
Linear alkyl benzene sulfonate acid	8.2
Alcohol ethoxylate	6.2
Sodium lauryl ether sulfate with 3 moles of EO	6.2
Monoethanolamine	3.5
Citric acid	2
Sodium benzoate	1.0
Potassium sulfite	0.2
Ethoxylate polyethylene imine	1.2
Polyester soil release polymer	0.4
Dequest 2010	0.5
perfume	1.3
fluorescer	0.2
remainder	water

[0226] Below are two unit dose laundry liquid formulations which comprises LAS obtained from plastic feedstock comprising 50% wt. of the total LAS present. The remainder being directly derived from petroleum feedstocks.

Table 2

Ingredient	Weight %	
Alcohol ethoxylate	20.0	26.9
Glycerol	14.2	16.3
Fatty Acid	13.9	6.9
LAS	13.8	13.8
Mono propylene glycol	11.6	11.6
Monoethanolamine	6.9	4.9
enzymes	5.2	5.2
perfume	4.4	4.4

(continued)

Ingredient	Weight %	
Polyester cleaning polymer	4.3	4.3
Dequest 2066	2.8	2.8
cleaning polymer	2.0	2.0
potassium sulphite	0.4	0.4
TinoPal CBS-CL	0.3	0.3
water	0.2	0.2

[0227] In table 2 below are provided 2 different spray-dried solid laundry detergent composition (Ex 1 and Ex 2) according to the present invention were prepared having LAS obtained from plastic waste feedstock at an amount which constituted 50 wt.% of the total LAS present. The remainder being directly derived from petroleum feedstocks.

Table 3: Spray-dried solid laundry composition

	Ex 1	Ex 2
Na LAS	15	19
PAS	0	0
SLES	0	1
Sodium carbonate	13	14
Sodium silicate	7.0	10
Layering agent (calcite)	6.5	4.5
Visual cues	0.5	0.5
Moisture	2.19	2.5
Perfume	0.36	0.4
Carboxylate polymer	0.50	0.5
Antiredeposition agent	0	0.2
Antifoam	2	2
Shading dye	0	1.1
Optical brightener (Tinopal)	0.2	0
Enzyme (protease, amylase, lipase, mannanase)	0.2	0.5
NDOM	0.5	0.5
Water	2.0	2.6
Sodium sulphate	Upto 100	Upto 100

[0228] The data in Table 4 shows that LAS obtained directly from petroleum sources (C) produces more foam and which lasts for longer. In comparison, LAS obtained from waste-plastic feedstock (A and B) produces a much lower foam and which does not last as long.

[0229] Thus LAS (A and B) can be used to tune foaming by mixing with from petroleum sources (C)

Table 4

	Foam volume (ml) with time (min)							
	0	30	60	90	120	150	180	210
C	210	210	210	210	210	210	210	210

(continued)

	Foam volume (ml) with time (min)							
	0	30	60	90	120	150	180	210
A	30	30	30	28	28	22	20	20
B	30	28	22	20	18	10	10	10

[0230] The data in Table 5 compares the surface tension between LAS obtained from waste plastic feedstock (A and B) with LAS obtained from regular petroleum sources (C and D).

[0231] The data shows that LAS obtained from waste plastic feedstock has a much lower surface tension at lower concentrations. This means that the surface tension changes during the wash cycle more for petroleum derived LAS than for waste-plastic feedstock LAS. This means that waste-plastic feedstock LAS performs better than petroleum-derived LAS during the wash

Table 5

A		B		C		D	
Conc [mg/l]	Avg. SFT [mN/m]	Conc [mg/l]	Avg. SFT [mN/m]	Conc [mg/l]	Avg. SFT [mN/m]	Conc [mg/l]	Avg. SFT [mN/m]
2500.00	33.05	2500.00	30.45	1500.00	33.20	1500.00	33.22
2244.47	33.25	2244.47	30.50	1344.45	33.71	1400.01	33.39
1988.89	33.41	1988.89	30.87	1188.88	33.96	1300.00	33.73
1733.32	33.50	1733.32	31.10	1033.34	34.12	1200.01	34.11
1477.77	33.68	1477.77	31.41	877.78	34.30	1099.99	34.32
1222.23	33.95	1222.23	32.03	722.23	34.48	999.99	34.52
966.67	34.35	966.67	32.73	566.66	35.60	900.00	34.69
711.11	35.16	711.11	33.65	411.11	37.69	800.00	34.98
455.56	36.24	455.56	34.65	255.55	40.81	700.01	35.31
200.00	36.99	200.00	35.37	100.00	43.62	600.00	36.30
						500.00	38.03
						400.00	39.94
						300.00	42.11
						200.00	44.18
						100.00	46.02

Claims

1. A detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition.
2. A detergent composition according to claim 1 wherein LAS obtained from waste plastic feedstock is present at a level greater than 30%wt. of the total LAS in the composition.
3. A detergent composition according any preceding claim wherein LAS obtained from waste plastic feedstock is present at a level greater than 40%wt. of the total LAS in the composition.
4. A detergent composition according to any preceding claim comprising AES and/or AE.

5. A detergent composition according to any preceding claim wherein the LAS obtained from waste plastic feedstock comprises alkyl chains with an average chain length from 8 to 14 carbons.
- 5 6. A detergent composition according to any preceding claim wherein the LAS obtained from waste plastic feedstock comprises a phenyl moiety which is obtained from waste plastic.
7. A detergent composition according to any preceding wherein from 1 to 30% wt. of the LAS obtained from waste plastic feedstock comprises 2-phenyl isomer.
- 10 8. A detergent composition according to any preceding claim which is a liquid detergent composition, a liquid dishwash composition or a powder laundry detergent composition.
9. A detergent composition according to any preceding claim in the form of a unit dose.
- 15 10. An aqueous wash liquor comprising water and dissolved or dispersed therein, a detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition.
- 20 11. A method of making a detergent composition comprising the step of incorporating linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition.
- 25 12. A method of washing a fabric using a detergent composition according to any of the claims 1 -9, the method comprising the steps of:
 - a. treating the fabric in an aqueous liquor comprising the composition; and
 - b. rinsing the fabric.
- 30 13. A method of controlling foam in a LAS-containing liquid, using a detergent composition according to any of the claims 1 -9, the method comprising the step of combining the detergent composition with water.
- 35 14. Use of a detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present at a level greater than 8%wt based on the total weight of LAS in the composition, to control foaming.
- 40 15. Use of a detergent composition comprising linear alkyl benzene sulphonate (LAS) obtained from petroleum feedstock and LAS comprising a component obtained from waste plastic feedstock wherein LAS obtained from waste plastic feedstock is present from at a level greater than 8%wt based on the total weight of LAS in the composition, to reduce water consumption during a fabric washing process.



EUROPEAN SEARCH REPORT

Application Number

EP 22 20 8400

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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