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(54) Title: LIQUID HAND DISHWASHING DETERGENT COMPOSITION

(57) Abrégé/Abstract:
Liquid hand dishwashing detergent composition and methods of making said liquid hand dishwashing detergent composition.

ABSTRACT

Liquid hand dishwashing detergent composition and methods of making said liquid hand dishwashing detergent composition.

Date Reçue/Date Received 2020-11-24

LIQUID HAND DISHWASHING DETERGENT COMPOSITION

FIELD OF THE INVENTION

Liquid hand dishwashing detergent composition and methods of making said liquid hand dishwashing detergent composition.

BACKGROUND OF THE INVENTION

Liquid hand dishwashing detergent compositions are commonly used by consumers, and are commercially available under multiple forms, e.g. as a pourable liquid in a bottle, a pumpable liquid in a (foam generating) pump or as a sprayable liquid in a spray container. These liquid hand dishwashing detergent compositions comprise various ingredients. Dioxane and especially 1,4-dioxane may be present as a by-product of the manufacture of some of these ingredients, especially those ingredients that have a polymerization step of ethylene oxide as part of their making process to add an ethoxylation chain to a backbone in order to achieve the targeted molecule. Without wishing to be bound by theory, such ingredients may include ethoxylated surfactants, solvents and polymers. Also, water used as a starting material to make liquid hand dishwashing detergent compositions might already comprise traces of dioxane including 1,4-dioxane. It has been standard practice to reduce dioxane including 1,4-dioxane levels in detergent products and starting materials used to produce these detergent products, however, there is a need to continue to reduce dioxane levels within detergent compositions including liquid hand dishwashing detergent compositions. Without wishing to be bound by theory, formulating liquid hand dishwashing detergent compositions with further reduced dioxane levels are preferred in order to reduce detrimental effects on other formulated detergent actives including enzymes, perfumes, dyes and preservatives, as well as to minimize unpleasant odor generation upon ageing.

BRIEF SUMMARY OF THE INVENTION

A first aspect of the present invention is a liquid hand dishwashing detergent composition comprising between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm,

Date Reçue/Date Received 2020-11-24

even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane.

A second aspect of the present invention is a process of making a liquid hand dishwashing detergent composition according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Cleaning Composition

The cleaning composition is a hand dishwashing cleaning composition in liquid form. The term 'liquid hand dishwashing detergent composition' refers to any hand dishwashing detergent composition comprising a liquid capable of wetting and treating a hard surface, especially dishware, and includes, but is not limited to, liquids, gels, pastes, dispersions and the like. The liquid composition can include solids or gases in suitably subdivided form, but the liquid composition excludes forms which are non-fluid overall, such as tablets or granules. The liquid hand dishwashing detergent composition can be present as a pourable liquid in a detergent bottle, as a pumpable liquid in a (foam generating) pump or as a sprayable liquid in a spray container.

The liquid hand dishwashing detergent composition comprises dioxane. The dioxane may comprise 1,2-dioxane, 1,3-dioxane, 1,4-dioxane, or a mixture thereof, preferably 1,4-dioxane. Without wishing to be bound by theory, most preparations of dioxane comprise a mixture of materials, for example a mixture of 1,2-dioxane, 1,3-dioxane and 1,4-dioxane isomers. Preferably, the dioxane comprises 1,4-dioxane as the dominant isomer. The dioxane may comprise any derivatives of dioxane materials. The term 'dioxane' herein includes 1,2-dioxane, 1,3-dioxane, 1,4-dioxane, derivatives of 1,2-dioxane, 1,3-dioxane or 1,4-dioxane including dimethyl dioxane derivatives of 1,2-dioxane, 1,3-dioxane or 1,4-dioxane, or a mixture thereof.

The liquid hand dishwashing detergent composition according to the invention comprises between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb

Date Reçue/Date Received 2020-11-24

dioxane, most preferably 0ppm dioxane. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within the liquid detergent compositions.

The present invention is to a liquid hand dishwashing detergent composition comprising at least 15%, or from 50% to 85%, preferably from 50% to 75%, by weight of the total composition of water. When formulated as a spray product the liquid hand dishwashing detergent composition comprises from 60% to 95% preferably from 75% to 90% by weight of the composition of water. Preferably, the water used in the liquid hand dishwashing detergent composition comprises between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane prior to addition of the water to the liquid hand dishwashing detergent composition. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level in water.

Preferably, the pH of the liquid hand dishwashing detergent composition is from 6 to 14, preferably from 7 to 12, or more preferably from 7.5 to 10, as measured at 10% dilution in distilled water at 20°C. When formulated as a spray product, preferably the pH of the composition is greater than 8, more preferably from 10 to 12 and most preferably from 10.5 to 11.5, as measured neat at 20°C. As a spray, preferably, the composition has a reserve alkalinity of from 0.1 to 1, more preferably from 0.1 to 0.5. Reserve alkalinity is defined as the grams of NaOH per 100 g of composition required to titrate the test composition at pH 10 to come to the test composition pH. The reserve alkalinity for a solution is determined in the following manner. A pH meter (for example An Orion Model 720A) with a Ag/AgCl electrode (for example an Orion sure flow Electrode model 9172BN) is calibrated using standardized pH 7 and pH 10 buffers. A 100g of a 10% solution in distilled water at 20°C of the composition to be tested is prepared. The pH of the 10% solution is measured and the 100g solution is titrated down to pH 10 using a standardized solution of 0.1 N of HCl. The volume of 0.1N HCl required is recorded in ml. The reserve alkalinity is calculated as follows:

Date Reçue/Date Received 2020-11-24

Reserve Alkalinity = ml 0.1N HCl x 0.1 (equivalent / liter) x Equivalent weight NaOH (g/equivalent) x 10

The pH and reserved alkalinity of the composition can be adjusted using pH and reserved alkalinity modifying ingredients known in the art. This pH and the reserve alkalinity further contribute to the cleaning of tough food soils.

The composition of the present invention can be Newtonian or non-Newtonian, preferably Newtonian. Preferably, the composition has a viscosity of from 10 mPa·s to 10,000 mPa·s, preferably from 100 mPa·s to 5,000 mPa·s, more preferably from 300 mPa·s to 2,000 mPa·s, or most preferably from 500 mPa·s to 1,500 mPa·s, alternatively combinations thereof. The viscosity is measured at 20°C with a Brookfield RT Viscometer using spindle 31 with the RPM of the viscometer adjusted to achieve a torque of between 40% and 60%. When formulated as a spray product, the cleaning product according to the invention can comprise a composition having a Newtonian viscosity, such as from 1 mPa·s to 50 mPa·s, preferably from 1 mPa·s to 20 mPa·s, more preferably from 1 mPa·s to 10 mPa·s, at 20°C. Alternatively the cleaning product according to the invention can comprise a composition having a shear thinning rheology profile, such as having a high shear viscosity of from 1 mPa·s to 50 mPa·s, preferably from 1 mPa·s to 20 mPa·s, more preferably from 5 mPa·s to 15 mPa·s, when measured at a shear rate of at 1000 s^{-1} at 20°C, and a low shear viscosity of from 100 mPa·s to 1,000 mPa·s, preferably from 200 mPa·s to 500 mPa·s, when measured at 0.1 s^{-1} at 20°C. The rheology profile of a spray product is measured using a "TA instruments DHR1" rheometer, using a cone and plate geometry with a flat steel Peltier plate and a 60 mm diameter, 2.026° cone (TA instruments, serial number: SN960912). The viscosity measurement procedure includes a conditioning step and a sweep step at 20 °C. The conditioning step consists of a 10 seconds at zero shear at 20 °C, followed by pre-shearing for 10 seconds at 10 s^{-1} at 20 °C, followed by 30 seconds at zero shear at 20 °C in order for the sample to equilibrate. The sweep step comprises a logarithmical shear rate increase in log steps starting from 0.01 s^{-1} to 3,000 s^{-1} at 20 °C, with a 10 points per decade acquisition rate taken in a sample period of 15 s, after a maximum equilibration time of 200 seconds (determined by the rheometer, based on a set tolerance of 3%). When measuring shear thinning spray product compositions, the high

Date Reçue/Date Received 2020-11-24

shear viscosity is defined at a shear rate of 1,000 s^{-1}, and the low shear viscosity at a shear rate of 0.1 s^{-1}. For Newtonian spray product compositions the shear rate is recorded at 1,000 s^{-1}. Preferably the cleaning composition of use in the invention has a Newtonian viscosity.

Surfactant System

The cleaning composition comprises from 8% to 45%, preferably from 15% to 40%, by weight of the total composition of a surfactant system. When targeting a hand dishwashing spray formulation the cleaning composition comprises from 2% to 15%, preferably from 5% to 15%, more preferably from 7% to 12% by weight of the composition of a surfactant system. Preferably, the dioxane level within each individual surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. If surfactant premixes are generated, the dioxane level in the total surfactant premix composition prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within individual surfactant or surfactant premix compositions.

For improved sudsing, the surfactant system can comprise non-soap anionic surfactant. The surfactant system preferably comprises from 60% to 90% by weight of the surfactant system of the non-soap anionic surfactant. Alkyl sulphated anionic surfactants are preferred, particularly those selected from the group consisting of: alkyl sulphate, alkyl alkoxy sulphate, and mixtures thereof. Preferably, the dioxane level in the alkyl sulphated anionic surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably

Date Reçue/Date Received 2020-11-24

between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane.

For further improvements in sudsing, the surfactant system can comprise less than 30%, preferably less than 15%, more preferably less than 10% of further non-soap anionic surfactant, and most preferably the surfactant system comprises no further non-soap anionic surfactant. If present, preferably, the dioxane level in the further non-soap anionic surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane.

Preferably the liquid hand dishwashing detergent composition comprises between 5% and 35%, preferably between 10% and 32%, more preferably between 15% and 30% by weight of the liquid hand dishwashing detergent composition of the alkyl sulphated anionic surfactant. When formulated as a spray product, the liquid hand dishwashing detergent comprises between 1% and 15%, preferably between 2% and 12%, more preferably between 3% and 10% by weight of the liquid hand dishwashing detergent composition of the alkyl sulphate anionic surfactant.

The alkyl sulphated anionic surfactant preferably has an average alkyl chain length of from 8 to 18, preferably from 10 to 14, more preferably from 12 to 14, most preferably from 12 to 13 carbon atoms. The alkyl sulphated anionic surfactant has an average degree of alkoxylation, of less than 5, preferably less than 3, more preferably from 0.5 to 2.0, most preferably from 0.5 to 0.9. Preferably, the alkyl sulphated anionic surfactant is ethoxylated. That is, the alkyl sulphated anionic surfactant has an average degree of ethoxylation, of less than 5, preferably less than 3, more preferably from 0.5 to 2.0, most preferably from 0.5 to 0.9.

The average degree of alkoxylation is the mol average degree of alkoxylation (i.e., mol average alkoxylation degree) of all the alkyl sulphate anionic surfactant. Hence, when calculating the mol average alkoxylation degree, the mols of non-alkoxylated sulphate anionic surfactant are included:

Date Reçue/Date Received 2020-11-24

Mol average alkoxylation degree = (x1 * alkoxylation degree of surfactant 1 + x2 * alkoxylation degree of surfactant 2 + ...) / (x1 + x2 + ...)

wherein x1, x2, ... are the number of moles of each alkyl (or alkoxy) sulphate anionic surfactant of the mixture and alkoxylation degree is the number of alkoxy groups in each alkyl sulphate anionic surfactant.

If ethoxylated alkyl sulfate is present, without wishing to be bound by theory, through tight control of processing conditions and feedstock material compositions, both during alkoxylation especially ethoxylation and sulfation steps, the amount of 1,4-dioxane by-product within alkoxylated especially ethoxylated alkyl sulfates can be reduced. Based on recent advances in technology, a further reduction of 1,4-dioxane by-product can be achieved by subsequent stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving or catalytic or enzymatic degradation steps. Processes to control 1,4-dioxane content within alkoxylated/ethoxylated alkyl sulfates have been described extensively in the art. Alternatively 1,4-dioxane level control within detergent formulations has also been described in the art through addition of 1,4-dioxane inhibitors to 1,4-dioxane comprising formulations, such as 5,6-dihydro-3-(4-morpholinyl)-1-[4-(2-oxo-1-piperidinyl)-phenyl]-2-(1-H)-pyridone, 3-α-hydroxy-7-oxo stereoisomer-mixtures of cholinic acid, 3-(N- methyl amino)-L-alanine, and mixtures thereof.

Alternatively, the alkyl sulphate surfactant has an average degree of alkoxylation preferably ethoxylation, of less than 0.5, preferably less than 0.3, most preferably is free of alkoxylation. It has been found that formulating hand dishwashing compositions comprising alkyl sulfate anionic surfactant with little or no alkoxylated alkyl sulfate surfactant results in less viscosity variation with changes in type of starting alcohol for the alkyl sulfate surfactant, as well as in an improved grease cleaning performance. However, reducing the degree of alkoxylation has also been found to cause low temperature instabilities in the formulation, as well as reduced suds mileage in the presence of emulsified grease.

The alkyl sulphate anionic surfactant can have a weight average degree of branching of more than 10%, preferably more than 20%, more preferably more than 30%, even more preferably between 30% and 60%, most preferably between 30% and 50%. The alkyl sulphate

Date Reçue/Date Received 2020-11-24

anionic surfactant can comprise at least 5%, preferably at least 10%, most preferably at least 25%, by weight of the alkyl sulphate anionic surfactant, of branching on the C2 position (as measured counting carbon atoms from the sulphate group for non-alkoxylated alkyl sulphate anionic surfactants, and the counting from the alkoxy-group furthest from the sulphate group for alkoxylated alkyl sulphate anionic surfactants). More preferably, greater than 75%, even more preferably greater than 90%, by weight of the total branched alkyl content consists of C1-C5 alkyl moiety, preferably C1-C2 alkyl moiety. It has been found that formulating the inventive compositions using alkyl sulphate surfactants having the aforementioned degree of branching results in improved low temperature stability. Such compositions require less solvent in order to achieve good physical stability at low temperatures. As such, the compositions can comprise lower levels of organic solvent, of less than 5.0% by weight of the cleaning composition of organic solvent, while still having improved low temperature stability. Higher surfactant branching also provides faster initial suds generation, but typically less suds mileage. The weight average branching, described herein, has been found to provide improved low temperature stability, initial foam generation and suds longevity.

The weight average degree of branching for an anionic surfactant mixture can be calculated using the following formula:

Weight average degree of branching (%) = [(x1 * wt% branched alcohol 1 in alcohol 1 + x2 * wt% branched alcohol 2 in alcohol 2 + ...) / (x1 + x2 + ...)] * 100

wherein x1, x2, ... are the weight in grams of each alcohol in the total alcohol mixture of the alcohols which were used as starting material before (alkoxylation and) sulphation to produce the alkyl (alkoxy) sulphate anionic surfactant. In the weight average degree of branching calculation, the weight of the alkyl alcohol used to form the alkyl sulphate anionic surfactant which is not branched is included.

The weight average degree of branching and the distribution of branching can typically be obtained from the technical data sheet for the surfactant or constituent alkyl alcohol. Alternatively, the branching can also be determined through analytical methods known in the art, including capillary gas chromatography with flame ionisation detection on

Date Reçue/Date Received 2020-11-24

medium polar capillary column, using hexane as the solvent. The weight average degree of branching and the distribution of branching is based on the starting alcohol used to produce the alkyl sulphate anionic surfactant.

The alkyl chain of the alkyl sulphated anionic surfactant preferably has a mol fraction of C12 and C13 chains of at least 50%, preferably at least 65%, more preferably at least 80%, most preferably at least 90%. Suds mileage is particularly improved, especially in the presence of greasy soils, when the C13/C12 mol ratio of the alkyl chain is at least 50/50, preferably at least 57/43, preferably from 60/40 to 90/10, more preferably from 60/40 to 80/20, most preferably from 60/40 to 70/30, while not compromising suds mileage in the presence of particulate soils.

The alkyl sulphated anionic surfactant can be selected from a primary alkyl sulphated anionic surfactant, a secondary alkyl sulphated anionic surfactant, or a mixture thereof, preferably a primary alkyl sulphated anionic surfactant.

Suitable counterions include alkali metal cation, earth alkali metal cation, alkanolammonium or ammonium or substituted ammonium, but preferably sodium.

Suitable examples of commercially available alkyl sulphate anionic surfactants include, those derived from alcohols sold under the Neodol® brand-name by Shell, or the Lial®, Isalchem®, and Safol® brand-names by Sasol, or some of the natural alcohols produced by The Procter & Gamble Chemicals company. The alcohols can be blended in order to achieve the desired mol fraction of C12 and C13 chains and the desired C13/C12 ratio, based on the relative fractions of C13 and C12 within the starting alcohols, as obtained from the technical data sheets from the suppliers or from analysis using methods known in the art.

Preferably, the liquid hand dishwashing detergent composition comprises a fatty acid, preferably a neutralized fatty acid soap, more preferably, the liquid hand dishwashing detergent composition comprises between 0.1% and 15%, preferably between 0.5% and 5 % by weight of the liquid hand dishwashing detergent composition of fatty acid. Preferably, the fatty acid may be branched or linear, alkoxylated or non-alkoxylated and preferably is selected from palm kernel fatty acid, coconut fatty acid, rapeseed fatty acid, neutralized palm kernel fatty acid, neutralized coconut fatty acid, neutralized rapeseed fatty acid, or mixture

Date Reçue/Date Received 2020-11-24

thereof, most preferably a neutralized palm kernel fatty acid. Preferably, the fatty acid soap is neutralised with an alkali metal, an amine, or a mixture thereof. Preferably, the amine is selected from monoethanolamine, triethanolamine or mixtures thereof and the alkali metal is selected from sodium, potassium, magnesium or a mixture thereof. Most preferably the fatty acid is neutralized with an alkali metal preferably sodium. Preferably, the dioxane level in the fatty acid prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within fatty acid materials. Without wishing to be bound by theory, fatty acid, preferably neutralized fatty acids, provide the benefit of protecting anionic non-soap surfactant from precipitation, as well as contributing to suds formation especially under soft water conditions, as well as towards faster suds collapse especially under rinsing conditions.

In order to improve surfactant packing after dilution and hence improve suds mileage, the surfactant system can comprise an alkyl sulphate anionic surfactant and a co-surfactant. Preferred co-surfactants are selected from the group consisting of an amphoteric surfactant, a zwitterionic surfactant, and mixtures thereof. The co-surfactant is preferably an amphoteric surfactant, more preferably an amine oxide surfactant. The co-surfactant is included as part of the surfactant system. Preferably, the dioxane level in the co-surfactant preferably amphoteric or zwitterionic co-surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. The composition preferably comprises from 0.1% to 20%, more preferably from 0.5% to 15% and especially from 2% to 10% by weight of the cleaning composition of the co-surfactant. The surfactant system of the cleaning composition of the present invention preferably comprises from 10% to 40%, preferably from 15% to 35%, more preferably from 20% to 30%, by weight of the surfactant system of a co-surfactant. The

Date Reçue/Date Received 2020-11-24

alkyl sulphate anionic surfactant to the co-surfactant weight ratio can be from 1:1 to 8:1, preferably from 2:1 to 5:1, more preferably from 2.5:1 to 4:1.

As mentioned earlier, amine oxide surfactants are preferred for use as a co-surfactant. Preferably, the dioxane level in the amine oxide surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. The amine oxide surfactant can be linear or branched, though linear are preferred. Suitable linear amine oxides are typically water-soluble, and characterized by the formula R1 – N(R2)(R3) O wherein R1 is a C8-18 alkyl, and the R2 and R3 moieties are selected from the group consisting of C1-3 alkyl groups, C1-3 hydroxyalkyl groups, and mixtures thereof. For instance, R2 and R3 can be selected from the group consisting of: methyl, ethyl, propyl, isopropyl, 2-hydroxethyl, 2-hydroxypropyl and 3-hydroxypropyl, and mixtures thereof, though methyl is preferred for one or both of R2 and R3. The linear amine oxide surfactants in particular may include linear C10-C18 alkyl dimethyl amine oxides and linear C8-C12 alkoxy ethyl dihydroxy ethyl amine oxides.

Preferably, the amine oxide surfactant is selected from the group consisting of: alkyl dimethyl amine oxide, alkyl amido propyl dimethyl amine oxide, and mixtures thereof. Alkyl dimethyl amine oxides are preferred, such as C8-18 alkyl dimethyl amine oxides, or C10-16 alkyl dimethyl amine oxides (such as coco dimethyl amine oxide). Suitable alkyl dimethyl amine oxides include C10 alkyl dimethyl amine oxide surfactant, C10-12 alkyl dimethyl amine oxide surfactant, C12-C14 alkyl dimethyl amine oxide surfactant, and mixtures thereof. C12-C14 alkyl dimethyl amine oxide are particularly preferred.

Alternative suitable amine oxide surfactants include mid-branched amine oxide surfactants. As used herein, "mid-branched" means that the amine oxide has one alkyl moiety having n1 carbon atoms with one alkyl branch on the alkyl moiety having n2 carbon atoms. The alkyl branch is located on the α carbon from the nitrogen on the alkyl moiety. This type of branching for the amine oxide is also known in the art as an internal amine oxide. The total sum of n1 and n2 can be from 10 to 24 carbon atoms, preferably from 12 to 20, and more

Date Reçue/Date Received 2020-11-24

preferably from 10 to 16. The number of carbon atoms for the one alkyl moiety (n1) is preferably the same or similar to the number of carbon atoms as the one alkyl branch (n2) such that the one alkyl moiety and the one alkyl branch are symmetric. As used herein "symmetric" means that | n1 – n2 | is less than or equal to 5, preferably 4, most preferably from 0 to 4 carbon atoms in at least 50 wt%, more preferably at least 75 wt% to 100 wt% of the mid-branched amine oxides for use herein. The amine oxide further comprises two moieties, independently selected from a C1-3 alkyl, a C1-3 hydroxyalkyl group, or a polyethylene oxide group containing an average of from about 1 to about 3 ethylene oxide groups. Preferably, the two moieties are selected from a C1-3 alkyl, more preferably both are selected as C1 alkyl.

Alternatively, the amine oxide surfactant can be a mixture of amine oxides comprising a mixture of low-cut amine oxide and mid-cut amine oxide. The amine oxide of the composition of the invention can then comprises:

from about 10% to about 45% by weight of the amine oxide of low-cut amine oxide of formula R1R2R3AO wherein R1 and R2 are independently selected from hydrogen, C1-C4 alkyls or mixtures thereof, and R3 is selected from C10 alkyls and mixtures thereof; and

from 55% to 90% by weight of the amine oxide of mid-cut amine oxide of formula R4R5R6AO wherein R4 and R5 are independently selected from hydrogen, C1-C4 alkyls or mixtures thereof, and R6 is selected from C12-C16 alkyls or mixtures thereof

In a preferred low-cut amine oxide for use herein R3 is n-decyl, with preferably both R1 and R2 being methyl. In the mid-cut amine oxide of formula R4R5R6AO, R4 and R5 are preferably both methyl.

Preferably, the amine oxide comprises less than about 5%, more preferably less than 3%, by weight of the amine oxide of an amine oxide of formula R7R8R9AO wherein R7 and R8 are selected from hydrogen, C1-C4 alkyls and mixtures thereof and wherein R9 is selected from C8 alkyls and mixtures thereof. Limiting the amount of amine oxides of formula R7R8R9AO improves both physical stability and suds mileage.

Suitable zwitterionic surfactants include betaine surfactants. Preferably, the dioxane level in the betaine surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more

Date Reçue/Date Received 2020-11-24

preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. Such betaine surfactants includes alkyl betaines, alkylamidobetaine, amidazoliniumbetaine, sulphobetaine (INCI Sultaines) as well as the Phosphobetaine, and preferably meets formula (I):

$$R1\text{-}[CO\text{-}X(CH2)n]x\text{-}N^{+}(R2)(R3)\text{-}(CH2)m\text{-}[CH(OH)\text{-}CH2]y\text{-}Y^{-}$$

wherein in formula (I),

R1 is selected from the group consisting of: a saturated or unsaturated C6-22 alkyl residue, preferably C8-18 alkyl residue, more preferably a saturated C10-16 alkyl residue, most preferably a saturated C12-14 alkyl residue;

X is selected from the group consisting of: NH, NR4 wherein R4 is a C1-4 alkyl residue, O, and S,

n is an integer from 1 to 10, preferably 2 to 5, more preferably 3,

x is 0 or 1, preferably 1,

R2 and R3 are independently selected from the group consisting of: a C1-4 alkyl residue, hydroxy substituted such as a hydroxyethyl, and mixtures thereof, preferably both R2 and R3 are methyl,

m is an integer from 1 to 4, preferably 1, 2 or 3,

y is 0 or 1, and

Y is selected from the group consisting of: COO, SO3, OPO(OR5)O or P(O)(OR5)O, wherein R5 is H or a C1-4 alkyl residue.

Preferred betaines are the alkyl betaines of formula (IIa), the alkyl amido propyl betaine of formula (IIb), the sulphobetaines of formula (IIc) and the amido sulphobetaine of formula (IId):

$$R1\text{-}N^{+}(CH3)2\text{-}CH2COO^{-} \quad \text{(IIa)}$$

$$R1\text{-}CO\text{-}NH\text{-}(CH2)3\text{-}N^{+}(CH3)2\text{-}CH2COO^{-} \quad \text{(IIb)}$$

$$R1\text{-}N^{+}(CH3)2\text{-}CH2CH(OH)CH2SO3^{-} \quad \text{(IIc)}$$

$$R1\text{-}CO\text{-}NH\text{-}(CH2)3\text{-}N^{+}(CH3)2\text{-}CH2CH(OH)CH2SO3^{-} \quad \text{(IId)}$$

Date Reçue/Date Received 2020-11-24

in which R1 has the same meaning as in formula (I). Particularly preferred are the carbobetaines [i.e. wherein Y-=COO- in formula (I)] of formulae (IIa) and (IIb), more preferred are the alkylamidobetaine of formula (IIb).

Suitable betaines can be selected from the group consisting or [designated in accordance with INCI]: capryl/capramidopropyl betaine, cetyl betaine, cetyl amidopropyl betaine, cocamidoethyl betaine, cocamidopropyl betaine, cocobetaines, decyl betaine, decyl amidopropyl betaine, hydrogenated tallow betaine / amidopropyl betaine, isostearamidopropyl betaine, lauramidopropyl betaine, lauryl betaine, myristyl amidopropyl betaine, myristyl betaine, oleamidopropyl betaine, oleyl betaine, palmamidopropyl betaine, palmitamidopropyl betaine, palm-kernelamidopropyl betaine, stearamidopropyl betaine, stearyl betaine, tallowamidopropyl betaine, tallow betaine, undecylenamidopropyl betaine, undecyl betaine, and mixtures thereof. Preferred betaines are selected from the group consisting of: cocamidopropyl betaine, cocobetaines, lauramidopropyl betaine, lauryl betaine, myristyl amidopropyl betaine, myristyl betaine, and mixtures thereof. Cocamidopropyl betaine is particularly preferred.

Preferably, the surfactant system of the composition of the present invention further comprises from 1% to 25%, preferably from 1.25% to 20%, more preferably from 1.5% to 15%, most preferably from 1.5% to 5%, by weight of the surfactant system, of a non-ionic surfactant. Preferably, the dioxane level in the nonionic surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. Suitable nonionic surfactants can be selected from the group consisting of: alkoxylated non-ionic surfactant, alkyl polyglucoside ("APG") surfactant, and mixtures thereof.

Suitable alkoxylated non-ionic surfactants can be linear or branched, primary or secondary alkyl alkoxylated non-ionic surfactants. Preferably, the dioxane level in the alkyl alkoxylated preferably alkyl ethoxylated nonionic surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between

Date Reçue/Date Received 2020-11-24

0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. Alkyl ethoxylated non-ionic surfactants, especially primary alkyl ethoxylated non-ionic surfactants, are preferred. The ethoxylated non-ionic surfactant can comprise on average from 9 to 15, preferably from 10 to 14 carbon atoms in its alkyl chain and on average from 5 to 12, preferably from 6 to 10, most preferably from 7 to 8, units of ethylene oxide per mole of alcohol. Such alkyl ethoxylated nonionic surfactants can be derived from synthetic alcohols, such as OXO-alcohols, Ziegler alcohols and Fisher Tropsh alcohols, or from naturally derived alcohols, or from mixtures thereof. Suitable examples of commercially available alkyl ethoxylate nonionic surfactants include, those derived from synthetic alcohols sold under the Neodol® brand-name by Shell, or the Lial®, Isalchem®, and Safol® brand-names by Sasol, or some of the natural alcohols produced by The Procter & Gamble Chemicals company. For spray applications the cleaning composition preferably comprises from 1% to 15%, preferably from 1.5% to 10%, more preferably from 2% to 8%, most preferably from 3% to 7% by weight of the composition of a linear or branched low cut alcohol alkoxylate non-ionic surfactant, preferably a low cut alcohol ethoxylate non-ionic surfactant or a mixture thereof, comprising an average alkyl chain length of between 5 and 10, more preferably between 5 and 8, most preferably about 6, and comprising on average from about 3 to about 7 alkoxy preferably ethoxy (EO) groups, more preferably a linear C6 alcohol ethoxylate non-ionic surfactant comprising on average from about 3 to about 7 EO, preferably from about 4 to about 6 EO, more preferably about 5 EO. Suitable examples of such short chain alcohol ethoxylate nonionic surfactants include Emulan HE50 or Lutensol CS6250 from the BASF company. The total surfactant system excluding the low cut alcohol alkoxylate non-ionic surfactant and the low cut alcohol alkoxylate non-ionic surfactant preferably are in a weight ratio of from 5:1 to 1:5, preferably from 5:1 to 1:1, more preferably from 3:1 to 1:1.

The compositions of the present invention can comprise alkyl polyglucoside ("APG") surfactant. Preferably the alkyl polyglucoside surfactant is present between 1 and 15%, preferably between 3 and 10% by weight of the liquid detergent composition. Preferably, the dioxane level in the alkyl polyglucoside surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably

Date Reçue/Date Received 2020-11-24

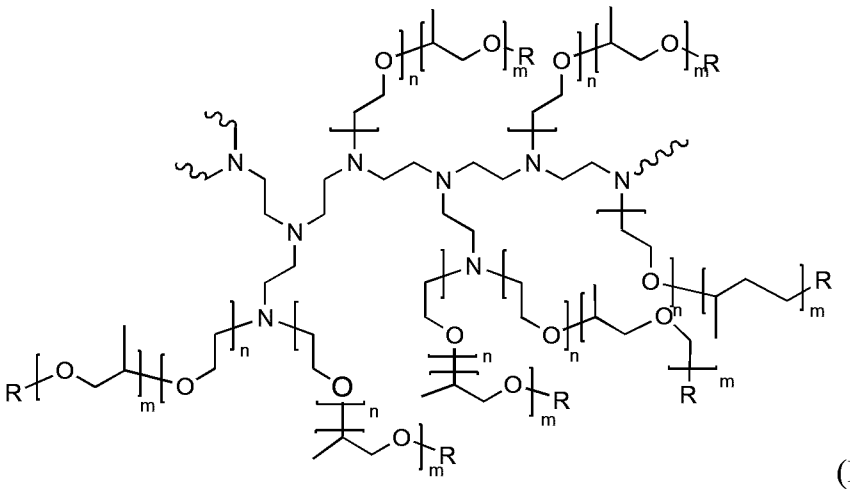
between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane. The addition of alkyl polyglucoside surfactants have been found to improve sudsing beyond that of comparative nonionic surfactants such as alkyl ethoxylated surfactants. Preferably the alkyl polyglucoside surfactant can be selected from C6-C18 alkyl polyglucoside surfactant. The alkyl polyglucoside surfactant can have a number average degree of polymerization of from 0.1 to 3.0, preferably from 1.0 to 2.0, more preferably from 1.2 to 1.6. The alkyl polyglucoside surfactant can comprise a blend of short chain alkyl polyglucoside surfactant having an alkyl chain comprising 10 carbon atoms or less, and mid to long chain alkyl polyglucoside surfactant having an alkyl chain comprising greater than 10 carbon atoms to 18 carbon atoms, preferably from 12 to 14 carbon atoms. Short chain alkyl polyglucoside surfactants have a monomodal chain length distribution between C8-C10, mid to long chain alkyl polyglucoside surfactants have a monomodal chain length distribution between C10-C18, while mid chain alkyl polyglucoside surfactants have a monomodal chain length distribution between C12-C14. In contrast, C8 to C18 alkyl polyglucoside surfactants typically have a monomodal distribution of alkyl chains between C8 and C18, as with C8 to C16 and the like. As such, a combination of short chain alkyl polyglucoside surfactants with mid to long chain or mid chain alkyl polyglucoside surfactants have a broader distribution of chain lengths, or even a bimodal distribution, than non-blended C8 to C18 alkyl polyglucoside surfactants. Preferably, the weight ratio of short chain alkyl polyglucoside surfactant to long chain alkyl polyglucoside surfactant is from 1:1 to 10:1, preferably from 1.5:1 to 5:1, more preferably from 2:1 to 4:1. It has been found that a blend of such short chain alkyl polyglucoside surfactant and long chain alkyl polyglucoside surfactant results in faster dissolution of the detergent solution in water and improved initial sudsing, in combination with improved suds stability. C8-C16 alkyl polyglucosides are commercially available from several suppliers (e.g., Simusol® surfactants from Seppic Corporation; and Glucopon® 600 CSUP, Glucopon® 650 EC, Glucopon® 600 CSUP/MB, and Glucopon® 650 EC/MB, from BASF Corporation).

Date Reçue/Date Received 2020-11-24

Amphiphilic alkoxylated polyalkyleneimine:

The composition of the present invention may further comprise from about 0.05% to about 2%, preferably from about 0.07% to about 1% by weight of the total composition of an amphiphilic polymer. Suitable amphiphilic polymers can be selected from the group consisting of: amphiphilic alkoxylated polyalkyleneimine and mixtures thereof. Preferably, the dioxane level in the amphiphilic polymer preferably the amphiphilic alkoxylated polyethyleneimine polymer prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within such polymeric compositions. The amphiphilic alkoxylated polyalkyleneimine polymer has been found to reduce gel formation on the hard surfaces to be cleaned when the liquid composition is added directly to a cleaning implement (such as a sponge) before cleaning and consequently brought in contact with heavily greased surfaces, especially when the cleaning implement comprises a low amount to nil water such as when light pre-wetted sponges are used.

A preferred amphiphilic alkoxylated polyethyleneimine polymer has the general structure of formula (II):



(II)

Date Reçue/Date Received 2020-11-24

wherein the polyethyleneimine backbone has a weight average molecular weight of about 600, n of formula (II) has an average of about 10, m of formula (II) has an average of about 7 and R of formula (II) is selected from hydrogen, a C1-C4 alkyl and mixtures thereof, preferably hydrogen. The degree of permanent quaternization of formula (II) may be from 0% to about 22% of the polyethyleneimine backbone nitrogen atoms. The molecular weight of this amphiphilic alkoxylated polyethyleneimine polymer preferably is between 10,000 and 15,000 Da.

More preferably, the amphiphilic alkoxylated polyethyleneimine polymer has the general structure of formula (II) but wherein the polyethyleneimine backbone has a weight average molecular weight of about 600 Da, n of Formula (II) has an average of about 24, m of Formula (II) has an average of about 16 and R of Formula (II) is selected from hydrogen, a C1-C4 alkyl and mixtures thereof, preferably hydrogen. The degree of permanent quaternization of Formula (II) may be from 0% to about 22% of the polyethyleneimine backbone nitrogen atoms and is preferably 0%. The molecular weight of this amphiphilic alkoxylated polyethyleneimine polymer preferably is between 25,000 and 30,000, most preferably 28,000 Da.

The amphiphilic alkoxylated polyethyleneimine polymers can be made by the methods described in more detail in PCT Publication No. WO 2007/135645.

Ethoxylated polyalkyleneimine :

Preferably, the liquid hand dishwashing detergent composition comprises an ethoxylated polyalkylene preferably polyethyleneimine from about 0.05% to about 2%, preferably from about 0.07% to about 1% by weight of the total composition. The ethoxylated polyethyleneimine has been found to impact the suds bubble size. Preferably, the ethoxylated polyethyleneimine has a polyethyleneimine backbone having a weight average molecular weight of between 100g/mol and 2000g/mol, preferably between 200g/mol and 1500g/mol, more preferably between 300g/mol and 1000g/mol, even more preferably between 400g/mol and 800g/mol, most preferably between 500g/mol and 700g/mol. Preferably, the ethoxylated polyethyleneimine has an average of 5 to 40, preferably 10 to 30, more preferably 15 to 25 or most preferably 18 to 22 ethoxy units per ethoxylation chain.

Date Reçue/Date Received 2020-11-24

Preferably, the ethoxylated polyethyleneimine has a total weight average molecular weight of from about 5000g/mol to about 20000g/mol, preferably from about 7500g/mol to about 17500g/mol, more preferably from about 10000g/mol to about 15000g/mol, most preferably from about 12000g/mol to about 13000g/mol. Preferably, the terminal ethoxy moiety of the ethoxylation modification of the ethoxylated polyethyleneimine is capped with hydrogen, a C_1-C_4 alkyl or mixtures thereof, preferably hydrogen. Preferably, the degree of permanent quaternization of the ethoxylated polyethyleneimine is from about 0% to about 30% of the polyethyleneimine backbone nitrogen atoms, preferably 0%. Preferably, the dioxane level in the ethoxylated polyethyleneimine is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and100ppb dioxane, most preferably 0ppb dioxane. Those skilled in the art will know how to measure dioxane levels within such polymeric materials.

EO-PO-EO triblock co-polymers

Preferably, the liquid hand dishwashing detergent according to any preceding claims comprises an ethyleneoxide (EO) – propyleneoxide (PO) – ethyleneoxide (EO) triblock co-polymer of Formula:

(EO)x-(PO)y-(EO)x

wherein, each x is independently on average between 1 and 80, preferably between 3 and 60, more preferably between 5 and 50, most preferably between 5 and 30; and y is on average between 1 and 60, preferably between 10 and 55, more preferably between 10 and 50, more preferably between 15 and 48. The liquid hand dishwashing detergent composition preferably comprises between 0.1% and 10%, preferably between 0.5% and 7.5%, more preferably between 1% and 5%, by weight of the liquid hand dishwasing detergent composition of the tri-block co-polymer.

Preferably, the triblock co-polymer has an average molecular weight of between 140 and 10500, preferably between 800 and 8500, more preferably between 1000 and 7300, even more preferably between 1300 and 5500, most preferably between 2000 and 4800. Preferably, the triblock co-polymer has a ratio of y to each x of from 1:1 to 3:1, preferably from 1.5:1 to

Date Reçue/Date Received 2020-11-24

2.5:1. Preferably, the triblock co-polymer has an average weight percentage of total EO of between 30% and 50% by weight of the tri-block co-polymer. Preferably, the liquid hand dishwashing detergent composition comprises between 0.1% and 10%, preferably between 0.5% and 7.5%, more preferably between 1% and 5%, by weight of the liquid hand dishwashing detergent composition of the tri-block co-polymer. EO-PO-EO triblock co-polymers are commercially available from BASF such as the Pluronic® PE series, and from the Dow Chemical Company such as Tergitol™ L series. Particularly preferred triblock co-polymer from BASF are sold under the tradenames Pluronic® L44 (MW ca 2200, ca 40wt% EO), Pluronic® PE6400 (MW ca 2900, ca 40wt% EO) and Pluronic® PE 9400 (MW ca 4600, 40 wt% EO). Particularly preferred triblock co-polymer from the Dow Chemical Company is sold under the tradename of Tergitol™ L64 (MW ca 2700, ca 40 wt% EO). Preferably, the dioxane level in the tri-block co-polymer is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and100ppb dioxane, most preferably 0ppb dioxane. Those skilled in the art will know how to measure dioxane levels within such triblock-materials. Without wishing to be bound by theory, such triblock copolymers provide the benefit of improving suds mileage properties of the liquid hand dishwashing detergent composition.

Cyclic Polyamine

The composition can comprise a cyclic polyamine having amine functionalities that helps cleaning. Preferably, the dioxane level in the cyclic polyamine prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within such amine compositions. The composition of the invention preferably comprises from about 0.1% to about 3%, more preferably from about 0.2% to about 2%, and especially from about 0.5% to about 1%, by weight of the composition, of the cyclic polyamine.

Date Reçue/Date Received 2020-11-24

The cyclic polyamine has at least two primary amine functionalities. The primary amines can be in any position in the cyclic amine but it has been found that in terms of grease cleaning, better performance is obtained when the primary amines are in positions 1,3. It has also been found that cyclic amines in which one of the substituents is -CH3 and the rest are H provided for improved grease cleaning performance.

Accordingly, the most preferred cyclic polyamine for use with the cleaning composition of the present invention are cyclic polyamine selected from the group consisting of: 2-methylcyclohexane-1,3-diamine, 4-methylcyclohexane-1,3-diamine and mixtures thereof. These specific cyclic polyamines work to improve suds and grease cleaning profile through-out the dishwashing process when formulated together with the surfactant system of the composition of the present invention.

Additional ingredients:

The composition of the present invention may further comprise at least one active selected from the group consisting of: i) a salt, ii) a hydrotrope, iii) an organic solvent, and mixtures thereof. Preferably, the dioxane level in these additional materials or (aqueous) solutions made thereof prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within such material compositions.

Salt:

The composition of the present invention may comprise from about 0.05% to about 2%, preferably from about 0.1% to about 1.5%, or more preferably from about 0.5% to about 1%, by weight of the total composition of a salt, preferably a monovalent or divalent inorganic salt, or a mixture thereof, more preferably selected from: sodium chloride, sodium sulphate, and mixtures thereof. Sodium chloride is most preferred.

Hydrotrope:

Date Reçue/Date Received 2020-11-24

The composition of the present invention may comprise from about 0.1% to about 10%, or preferably from about 0.5% to about 10%, or more preferably from about 1% to about 10% by weight of the total composition of a hydrotrope or a mixture thereof, preferably sodium cumene sulphonate.

Organic Solvent:

The composition can comprise from about 0.1% to about 10%, or preferably from about 0.5% to about 10%, or more preferably from about 1% to about 10% by weight of the total composition of an organic solvent. Suitable organic solvents include organic solvents selected from the group consisting of: alcohols, glycols, glycol ethers, and mixtures thereof, preferably alcohols, glycols, and mixtures thereof. Ethanol is the preferred alcohol. Polyalkyleneglycols, especially polypropyleneglycol including polypropryleneglycols with an average molecular weight of 1000 or 2000, is the preferred glycol.

Glycol ether solvent :

The composition of the invention can further comprise: a glycol ether solvent. These glycol ether solvents are especially preferred in liquid detergent compositions suitable for spray applications. Preferably, the dioxane level in these glycol ether solvents prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within such glycol ether compositions.

Preferably, the cleaning composition comprises 1% to 8%, preferably from 2% to 7% by weight of the composition of a glycol ether solvent selected from the group consisting of glycol ethers of:

a) Formula (I): R1O(R2O)nR3, wherein R1 is a linear or branched C4, C5 or C6 alkyl or a substituted or unsubstituted phenyl; R2 is ethyl or isopropyl; R3 is hydrogen or methyl; and n is 1, 2 or 3; and mixtures thereof;

Date Reçue/Date Received 2020-11-24

b) Formula (II): R4O(R5O)nR6, wherein: R4 is n-propyl or isopropyl; R5 is isopropyl; R6 is hydrogen or methyl; and n is 1, 2 or 3; and

c) mixtures thereof.

The glycol ether of the product of the invention can boost foaming. Suitable glycol ether solvents according to Formula (I) include ethyleneglycol n-butyl ether, diethyleneglycol n-butyl ether, triethyleneglycol n-butyl ether, propyleneglycol n-butyl ether, dipropyleneglycol n-butyl ether, tripropyleneglycol n-butyl ether, ethyleneglycol n-pentyl ether, diethyleneglycol n-pentyl ether, triethyleneglycol n-pentyl ether, propyleneglycol n-pentyl ether, dipropyleneglycol n-pentyl ether, tripropyleneglycol n-pentyl ether, ethyleneglycol n-hexyl ether, diethyleneglycol n-hexyl ether, triethyleneglycol n-hexyl ether, propyleneglycol n-hexyl ether, dipropyleneglycol n-hexyl ether, tripropyleneglycol n-hexyl ether, ethyleneglycol phenyl ether, diethyleneglycol phenyl ether, triethyleneglycol phenyl ether, propyleneglycol phenyl ether, dipropyleneglycol phenyl ether, tripropyleneglycol phenyl ether, ethyleneglycol benzyl ether, diethyleneglycol benzyl ether, triethyleneglycol benzyl ether, propyleneglycol benzyl ether, dipropyleneglycol benzyl ether, tripropyleneglycol benzyl ether, ethyleneglycol isobutyl ether, diethyleneglycol isobutyl ether, triethyleneglycol isobutyl ether, propyleneglycol isobutyl ether, dipropyleneglycol isobutyl ether, tripropyleneglycol isobutyl ether, ethyleneglycol isopentyl ether, diethyleneglycol isopentyl ether, triethyleneglycol isopentyl ether, propyleneglycol isopentyl ether, dipropyleneglycol isopentyl ether, tripropyleneglycol isopentyl ether, ethyleneglycol isohexyl ether, diethyleneglycol isohexyl ether, triethyleneglycol isohexyl ether, propyleneglycol isohexyl ether, dipropyleneglycol isohexyl ether, tripropyleneglycol isohexyl ether, ethyleneglycol n-butyl methyl ether, diethyleneglycol n-butyl methyl ether triethyleneglycol n-butyl methyl ether, propyleneglycol n-butyl methyl ether, dipropyleneglycol n-butyl methyl ether, tripropyleneglycol n-butyl methyl ether, ethyleneglycol n-pentyl methyl ether, diethyleneglycol n-pentyl methyl ether, triethyleneglycol n-pentyl methyl ether, propyleneglycol n-pentyl methyl ether, dipropyleneglycol n-pentyl methyl ether, tripropyleneglycol n-pentyl methyl ether, ethyleneglycol n-hexyl methyl ether, diethyleneglycol n-hexyl methyl ether, triethyleneglycol n-hexyl methyl ether, propyleneglycol n-hexyl methyl ether, dipropyleneglycol n-hexyl methyl ether, tripropyleneglycol n-hexyl

Date Reçue/Date Received 2020-11-24

methyl ether, ethyleneglycol phenyl methyl ether, diethyleneglycol phenyl methyl ether, triethyleneglycol phenyl methyl ether, propyleneglycol phenyl methyl ether, dipropyleneglycol phenyl methyl ether, tripropyleneglycol phenyl methyl ether, ethyleneglycol benzyl methyl ether, diethyleneglycol benzyl methyl ether, triethyleneglycol benzyl methyl ether, propyleneglycol benzyl methyl ether, dipropyleneglycol benzyl methyl ether, tripropyleneglycol benzyl methyl ether, ethyleneglycol isobutyl methyl ether, diethyleneglycol isobutyl methyl ether, triethyleneglycol isobutyl methyl ether, propyleneglycol isobutyl methyl ether, dipropyleneglycol isobutyl methyl ether, tripropyleneglycol isobutyl methyl ether, ethyleneglycol isopentyl methyl ether, diethyleneglycol isopentyl methyl ether, triethyleneglycol isopentyl methyl ether, propyleneglycol isopentyl methyl ether, dipropyleneglycol isopentyl methyl ether, tripropyleneglycol isopentyl methyl ether, ethyleneglycol isohexyl methyl ether, diethyleneglycol isohexyl methyl ether, triethyleneglycol isohexyl methyl ether, propyleneglycol isohexyl methyl ether, dipropyleneglycol isohexyl methyl ether, tripropyleneglycol isohexyl methyl ether, and mixtures thereof.

Preferred glycol ether solvents according to Formula (I) are ethyleneglycol n-butyl ether, diethyleneglycol n-butyl ether, triethyleneglycol n-butyl ether, propyleneglycol n-butyl ether, dipropyleneglycol n-butyl ether, tripropyleneglycol n-butyl ether, and mixtures thereof.

Most preferred glycol ethers according to Formula (I) are propyleneglycol n-butyl ether, dipropyleneglycol n-butyl ether, and mixtures thereof.

Suitable glycol ether solvents according to Formula (II) include propyleneglycol n-propyl ether, dipropyleneglycol n-propyl ether, tripropyleneglycol n-propyl ether, propyleneglycol isopropyl ether, dipropyleneglycol isopropyl ether, tripropyleneglycol isopropyl ether, propyleneglycol n-propyl methyl ether, dipropyleneglycol n-propyl methyl ether, tripropyleneglycol n-propyl methyl ether, propyleneglycol isopropyl methyl ether, dipropyleneglycol isopropyl methyl ether, tripropyleneglycol isopropyl methyl ether, and mixtures thereof.

Preferred glycol ether solvents according to Formula (II) are propyleneglycol n-propyl ether, dipropyleneglycol n-propyl ether, and mixtures thereof.

Date Reçue/Date Received 2020-11-24

Most preferred glycol ether solvents are propyleneglycol n-butyl ether, dipropyleneglycol n-butyl ether, and mixtures thereof, especially dipropyleneglycol n-butyl ether.

Suitable glycol ether solvents can be purchased from The Dow Chemical Company, more particularly from the E-series (ethylene glycol based) Glycol Ethers and the P-series (propylene glycol based) Glycol Ethers line-ups. Suitable glycol ether solvents include Butyl Carbitol™, Hexyl Carbitol™, Butyl Cellosolve™, Hexyl Cellosolve™, Butoxytriglycol, Dowanol™ Eph, Dowanol™ PnP, Dowanol DPnP™, Dowanol™ PnB, Dowanol™ DPnB, Dowanol™ TPnB, Dowanol™ PPh, and mixtures thereof.

Adjunct Ingredients

The cleaning composition may optionally comprise a number of other adjunct ingredients such as builders (preferably citrate), chelants selected from EDDS, HEDP, GLDA, DTPA, DTPMP, DETA, or mixtures thereof, conditioning polymers, other cleaning polymers, surface modifying polymers, structurants, emollients, humectants, skin rejuvenating actives, enzymes, encapsulated enzymes, carboxylic acids, scrubbing particles, perfumes, encapsulated perfumes, malodor control agents, pigments, dyes, opacifiers, pearlescent particles, inorganic cations such as alkaline earth metals such as Ca/Mg-ions, antibacterial and anti-viral agents including 4.4'-dichloro 2-hydroxydiphenyl ether such as Tinosan HP100 available from the BASF company, PCMX, acids including lactic acid, and quaternary ammonium salts, preservatives, antioxidants including sulfite salts such as potassium sulphite or potassium bisulphite salts and those commercially available under the Ralox brandname, suspended particles, viscosity adjusters (e.g., salt such as NaCl, and other mono-, di- and trivalent salts) and pH adjusters and buffering means (e.g. carboxylic acids such as citric acid, HCl, NaOH, KOH, alkanolamines, carbonates such as sodium carbonates, bicarbonates, sesquicarbonates, and alike). Impurities inherently part of the individual materials are also contemplated by the present description of the individual materials. Preferably, the dioxane level in these adjunct materials or (aqueous) solutions made thereof prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably

Date Reçue/Date Received 2020-11-24

between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within such material compositions.

Material form

Any ingredients described herein may be added to the liquid hand dishwashing detergent composition as an individual material, an aqueous or organic solvent-based solution, or pre-formulated as a premix comprising multiple individual materials. Preferably, each of such materials, solutions or premixed comprises between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and 100ppb, most preferably 0ppb dioxane before they are added to the liquid hand dishwashing detergent composition. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within each of such materials.

Dioxane scavenger

Preferably, the liquid hand dishwashing detergent composition comprises a dioxane scavenger. Preferably, the dioxane scavenger is selected from 5, 6-dihydro-3-(4-morpholinyl) -1-[4-(2-oxo-1-piperidinyl) phenyl]-2 (1 H) -pyridone, 3 a-hydroxy-7-oxo-mixture of cholanic acid , 3 - (N - methyl amino) - L – alanine, and mixtures thereof.

Dioxane control strategy

Preferably, the liquid hand dishwashing detergent composition according to the present invention is made via a process comprising a step of treating the liquid hand dishwashing detergent composition to reduce dioxane, wherein the dioxane is reduced by stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving, catalytic degradation step, enzymatic degradation step or a mixture thereof, most preferably stripping. The dioxane reduction processes can be applied on the final liquid hand dishwashing detergent formulations, any intermediate formulation, or any individual raw

Date Reçue/Date Received 2020-11-24

material used to prepare the liquid detergent formulation. The dioxane can be present within any of the starting materials or intermediates as a by-product of the targeted molecule synthesis, or could have been introduced as an impurity within diluting water or non-aqueous solvent introduction or any other individual material introduced within the targeted raw material.

Process of making

A further aspect of the present invention is a process of making a liquid hand dishwashing detergent composition according to the present invention. Preferably, the process of making the liquid hand dishwashing detergent composition comprises the step of making a surfactant slurry wherein the slurry comprises the alkyl sulphate, alkoxylated alkyl sulphate, or a mixture thereof, and optionally the further co-surfactant, wherein the slurry comprises between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and 100ppb, most preferably 0ppb dioxane. The alkyl sulphate and/or alkoxylated alkyl sulphate can be derived from natural alcohols, synthetic alcohols, or mixtures thereof. Possible alcohol sources are detailed above. Those skilled in the art will be aware of known methods and techniques to determine the dioxane level within such surfactant slurries. Preferably, the slurry comprises at least one adjunct ingredient, wherein the adjunct ingredient is preferably selected from non-aqueous solvents, water or a mixture thereof. Some of the other detergent actives highlighted in the composition section might also have been co-formulated within the surfactant slurry to facilitate further detergent manufacturing. The surfactant slurry might beyond an eventual solvent system also further comprise electrolytes for viscosity control, pH trimming agents and one or more preservatives. Preferably, the alkyl sulphate, alkoxylated alkyl sulphate or a mixture thereof and/or the slurry is pre-/post-treated to reduce dioxane levels, preferably wherein said treatment comprises stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving, catalytic degradation step, enzymatic degradation step, or a mixture thereof, most preferably stripping. Most preferably such treatment includes

Date Reçue/Date Received 2020-11-24

multiple consequent stripping steps, preferably 2 or even 3 stripping steps. Those skilled in the art will be aware of known techniques or methods to achieve this.

A further aspect of the present invention is a process for making a liquid hand dishwashing detergent composition according to the present invention comprising the step of adding the surfactant slurry into an aqueous stream, followed by addition of the further detergent actives highlighted in the composition section. Some detergent actives highlighted in the composition section might also already have been added to the aqueous stream prior to addition of the surfactant slurry. The aqueous stream and further detergent actives comprise between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and 100ppb, most preferably 0ppb dioxane. Preferably, the aqueous stream and/or alternative detergent actives, and/or the final liquid hand dishwashing detergent composition is treated to reduce dioxane levels, preferably wherein said treatment comprises stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving, catalytic degradation step, enzymatic degradation step or a mixture thereof.

Preferably, the process comprises the step of further adding a dioxane scavenger, wherein the dioxane scavenger is preferably selected from 5, 6-dihydro-3-(4-morpholinyl) -1-[4-(2-oxo-1-piperidinyl) phenyl]-2 (1 H) -pyridone, 3 a-hydroxy-7-oxo-mixture of cholanic acid , 3 - (N - methyl amino) - L – alanine, and mixtures thereof.

Preferably, following addition of all ingredients, the final liquid hand dishwashing detergent composition is treated to reduce dioxane levels, preferably wherein said treatment comprises stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving, catalytic degradation step, enzymatic degradation step or a mixture thereof.

The 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 dimension disclosed as “40 mm” is intended to mean “about 40 mm.”

Date Reçue/Date Received 2020-11-24

EXAMPLES

Table 1 exemplifies a liquid hand dishwashing formulation according to the present invention. Such a composition is typically present as a pourable liquid detergent composition in a detergent bottle. Table 2 exemplifies liquid hand dishwashing detergent formulations suitable for use within spray applications. Such detergent composition can be packaged within spray bottles comprising traditional spray triggers or alternatively precompression triggers such those commercially available under the Flairosol tradename from the AFA company. The liquid hand dishwashing detergent compositions exemplified in Tables 1 and 2, as well as their individual starting materials comprise between 0ppm and 1ppm, or even between 0ppm and100ppb dioxane, some starting materials even 0ppm dioxane. Dioxane level in final product has been controlled through applying a dual stripping operation on individual starting materials, especially highly ethoxylated starting materials which are formulated at higher active levels such as alcohol ethoxylated sulphate anionic surfactant and alcohol ethoxylate nonionic surfactants and alkoxylated polymers.

Date Reçue/Date Received 2020-11-24

Table 1 : Liquid hand dishwashing detergent composition

Ingredients (wt% - 100% active)	Composition 1 (wt%)
C12-13AE0.6S (34% branched)	24.0
C12-14 dimethyl amine oxide	8.0
C9-11-EO8 nonionic surfactant	1.0
Polyalkoxylated polyethyleneimine (PEI600EO24PO16)	0.6
GLDA chelant	2.0
Baxxodur ECX210	0.5
NaCl	0.9
PPG (MW2000)	0.2
ethanol	1.3
Sodium citrate	0.5
Sodium cumene sulphonate	2.0
phenoxyethanol	0.3
Water and minors (perfume, dye, preservative)	Balance to 100
pH (as 10% aqueous solution in demineralized water)	9.2

[1] Branched AE0.6S is a C12-C13 alkyl ethoxylate sulfate, with an average degree of ethoxylation of 0.6 and an average degree of branching of 34%.

Date Reçue/Date Received 2020-11-24

Table 2 : Liquid hand dishwashing detergent composition (for spray application)

Ingredients	Composition 2 (wt%)	Composition 3 (wt%)
C12-C14 AE3S [1]	6.5%	-
Glucopon 600[2]	-	6.5%
C12-14 dimethyl amine oxide	2.5%	2.5%
Emulan® HE50 [3]	5%	5%
Glycol ether [4]	5%	5%
monoethanolamine	0.5%	0.5%
GLDA chelant [5]	1%	1%
Citric acid	-	0.1%
ethanol	0.3%	0.3%
PPG 2000 [6]	0.05%	0.05%
Sodium bicarbonate	0.1%	-
Water and minors (preservatives, dyes, perfume)	Balance to 100%	Balance to 100%
pH (neat)	11.2	11.0

[1] linear AE3S is a C12-C14 alkyl ethoxylate sulfate, with an average degree of ethoxylation of 3.

[2] Glucopon 600 is a C12-C14 alkyl polyglucoside and commercially available from BASF

[3] Emulan® HE50 is linear C6 alkyl ethoxylated alcohol (EO5) and commercially available from BASF.

[4] Dowanol DPnB, as commercially available from Dow.

[5] Commercially available under tradename Dissolvine® 47S from Akzo Nobel.

[6] PolyPropylene glycol (molecular weight 2000).

Date Reçue/Date Received 2020-11-24

CLAIMS

What is claimed is:

1. A liquid hand dishwashing detergent composition comprising between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane.

2. The liquid hand dishwashing detergent composition according to claim 1 wherein the dioxane is selected from 1,2-dioxane, 1,3-dioxane, 1,4-dioxane, derivatives of 1,2-dioxane, 1,3-dioxane, 1,4-dioxane including dimethyl dioxane derivatives of 1,2-dioxane, 1,3-dioxane, 1,4-dioxane, or a mixture thereof, preferably 1,4-dioxane.

3. The liquid hand dishwashing detergent composition according to any preceding claims, comprising at least 15%, or from 50% to 85%, preferably from 50% to 75% by weight of the detergent composition of water and wherein the water used in the liquid hand dishwashing detergent composition comprises between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and 100ppb dioxane, most preferably 0ppm dioxane prior to addition to the liquid hand dishwashing detergent composition.

4. The liquid hand dishwashing detergent composition according to claims 1 and 2, comprising from 60% to 95% preferably from 75% to 90% by weight of the detergent composition of water, wherein the liquid hand dishwashing detergent composition is a liquid hand dishwashing detergent spray composition, and wherein the water used in the liquid hand dishwashing detergent composition comprises between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more

Date Reçue/Date Received 2020-11-24

preferably between 0ppm and 100ppb dioxane, most preferably 0ppm dioxane prior to addition to the liquid hand dishwashing detergent composition.

5. The liquid hand dishwashing detergent composition according to claims 1 to 3, wherein the pH of the liquid hand dishwashing detergent composition is from 6 to 14, preferably from 7 to 12, or more preferably from 7.5 to 10, as measured at 10% dilution in distilled water at 20°C.

6. The liquid hand dishwashing detergent composition according to claim 4, wherein the pH of the composition is greater than 8, more preferably from 10 to 12 and most preferably from 10.5 to 11.5, as measured neat at 20°C.

7. The liquid hand dishwashing detergent composition according to claim 6, wherein the composition has a reserve alkalinity of from 0.1 to 1, more preferably from 0.1 to 0.5, defined as the grams of NaOH per 100 g of composition required to titrate the test composition at pH 10 to come to the test composition pH.

8. The liquid hand dishwashing detergent composition according to claims 1 to 3 and 5, wherein the composition has a Newtonian viscosity of from 10 mPa·s to 10,000 mPa·s, preferably from 100 mPa·s to 5,000 mPa·s, more preferably from 300 mPa·s to 2,000 mPa·s, or most preferably from 500 mPa·s to 1,500 mPa·s, alternatively combinations thereof. The viscosity is measured at 20°C with a Brookfield RT Viscometer using spindle 31 with the RPM of the viscometer adjusted to achieve a torque of between 40% and 60%.

9. The liquid hand dishwashing detergent composition according to claims 4, 6 and 7, wherein the composition has a Newtonian viscosity of from 1 mPa·s to 50 mPa·s, preferably from 1 mPa·s to 20 mPa·s, more preferably from 1 mPa·s to 10 mPa·s, at 20°C, measured at a shear rate is recorded at 1,000 s^{-1} following the viscosity test method for spray products described herein.

Date Reçue/Date Received 2020-11-24

10. The liquid hand dishwashing detergent composition according to claims 4, 6 and 7, wherein the composition has a shear thinning rheology profile having a high shear viscosity of from 1 mPa·s to 50 mPa·s, preferably from 1 mPa·s to 20 mPa·s, more preferably from 5 mPa·s to 15 mPa·s, when measured at a shear rate of at 1000 s^{-1} at 20°C, and a low shear viscosity of from 100 mPa·s to 1,000 mPa·s, preferably from 200 mPa·s to 500 mPa·s, when measured at 0.1 s^{-1} at 20°C following the viscosity test method for spray products described herein.

11. The liquid hand dishwashing detergent composition according to any preceding claims comprising a surfactant system, wherein the surfactant system comprises anionic surfactant, non-ionic surfactant, cationic surfactant, amphoteric surfactant, zwitterionic surfactant or a mixture thereof.

12. The liquid hand dishwashing detergent composition according to claim 11 wherein the liquid detergent composition comprises from 8% to 45%, preferably from 15% to 40%, by weight of the total composition of a surfactant system.

13. The liquid hand dishwashing detergent composition according to claim 11 wherein the liquid detergent composition comprises from 2% to 15%, preferably from 5% to 15%, more preferably from 7% to 12% by weight of the composition of a surfactant system, and wherein the liquid hand dishwashing detergent composition is a liquid hand dishwashing spray composition.

14. The liquid hand dishwashing detergent composition according to claim 11 wherein the surfactant system comprises one or more surfactant materials, wherein each individual surfactant material prior to addition to the liquid hand dishwashing detergent composition comprises between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more

Date Reçue/Date Received 2020-11-24

preferably between 0ppm and100ppb dioxane, most preferably comprises 0ppm dioxane.

15. The liquid hand dishwashing detergent composition according to claim 14 wherein the surfactant system comprises a surfactant premix, wherein the surfactant premix prior to addition to the liquid hand dishwashing detergent composition comprises between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably comprises 0ppm dioxane.

16. The liquid hand dishwashing detergent composition according to claim 11 wherein the surfactant system comprises a non-soap anionic surfactant, preferably wherein the surfactant system comprises from 60% to 90% by weight of the surfactant system of the non-soap anionic surfactant.

17. The liquid hand dishwashing detergent composition according to claim 16 wherein the non-soap anionic surfactant comprises, prior to addition to the liquid hand dishwashing detergent composition, between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably comprises 0ppm dioxane.

18. The liquid hand dishwashing detergent composition according to claims 16 and 17 wherein the non-soap anionic surfactant comprises alkyl sulphated anionic surfactants, preferably selected from the group consisting of: alkyl sulphate, alkyl alkoxy sulphate, and mixtures thereof.

19. The liquid hand dishwashing detergent composition according to claim 18 wherein the alkyl sulphated anionic surfactant comprises, prior to addition to the liquid hand

Date Reçue/Date Received 2020-11-24

dishwashing detergent composition, between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably comprises 0ppm dioxane.

20. The liquid hand dishwashing detergent composition according to claims 16 to 19 wherein the non-soap anionic surfactant comprises less than 30%, preferably less than 15%, more preferably less than 10% of further non-soap anionic surfactant, and most preferably the surfactant system comprises no further non-soap anionic surfactant.

21. The liquid hand dishwashing detergent composition according to claim 20 wherein the further non-soap anionic surfactant, if present, comprises, prior to addition to the liquid hand dishwashing detergent composition, between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably comprises 0ppm dioxane.

22. The liquid hand dishwashing detergent composition according to claims 18 to 21, wherein the alkyl sulphated anionic surfactant has an average alkyl chain length of from 8 to 18, preferably from 10 to 14, more preferably from 12 to 14, most preferably from 12 to 13 carbon atoms.

23. The liquid hand dishwashing detergent composition according to claims 18 to 22, wherein the alkyl sulphated anionic surfactant has an average degree of alkoxylation preferably ethoxylation, of less than 5, preferably less than 3, more preferably from 0.5 to 2.0, most preferably from 0.5 to 0.9.

24. The liquid hand dishwashing detergent composition according to claims 18 to 22, wherein the alkyl sulphated anionic surfactant has an average degree of alkoxylation

Date Reçue/Date Received 2020-11-24

preferably ethoxylation, of less than 0.5, preferably less than 0.3, most preferably is free of alkoxylation.

25. The liquid hand dishwashing detergent composition according to claims 18 to 24, wherein the alkyl sulphated anionic surfactant has a weight average degree of branching of more than 10%, preferably more than 20%, more preferably more than 30%, even more preferably between 30% and 60%, most preferably between 30% and 50%.

26. The liquid hand dishwashing detergent composition according to claim 25, wherein the alkyl sulphated anionic surfactant comprises at least 5%, preferably at least 10%, most preferably at least 25%, by weight of the alkyl sulphate anionic surfactant, of branching on the C2 position (as measured counting carbon atoms from the sulphate group for non-alkoxylated alkyl sulphate anionic surfactants, and the counting from the alkoxy-group furthest from the sulphate group for alkoxylated alkyl sulphate anionic surfactants).

27. The liquid hand dishwashing detergent composition according to claims 25 or 26, wherein the alkyl sulphated anionic surfactant comprises greater than 75%, even more preferably greater than 90%, by weight of the total branched alkyl content consists of C1-C5 alkyl moiety, preferably C1-C2 alkyl moiety.

28. The liquid hand dishwashing detergent composition according to claims 18 to 27, wherein the alkyl sulphated anionic surfactant has a mol fraction of C12 and C13 chains of at least 50%, preferably at least 65%, more preferably at least 80%, most preferably at least 90%.

29. The liquid hand dishwashing detergent composition according to claim 28, wherein the alkyl sulphated anionic surfactant has a C13/C12 mol ratio of the alkyl chain is at least 50/50, preferably at least 57/43, preferably from 60/40 to 90/10, more preferably from 60/40 to 80/20, most preferably from 60/40 to 70/30.

Date Reçue/Date Received 2020-11-24

30. The liquid hand dishwashing detergent composition according to claims 18 to 29, wherein the alkyl sulphated anionic surfactant is a primary alkyl sulphated anionic surfactant, a secondary alkyl sulphated anionic surfactant, or a mixture thereof, preferably a primary alkyl sulphated anionic surfactant.

31. The liquid hand dishwashing detergent composition according to claims 18 to 30, wherein the alkyl chain of the alkyl sulphated anionic surfactant is selected from naturally derived material, synthetically derived material or mixtures thereof.

32. The liquid hand dishwashing detergent composition according to claim 31, wherein the synthetically derived material comprises oxo-synthesized material, Ziegler-synthesized material, Guerbet-synthesized material, Fischer-Tropsch – synthesized material, iso-alkyl synthesized material, or mixtures thereof, preferably oxo-synthesised material.

33. The liquid hand dishwashing detergent composition according to claims 18 to 32, wherein the alkyl sulphated anionic surfactant has a counterion selected from alkali metal cation, earth alkali metal cation, alkanolammonium or ammonium or substituted ammonium, preferably sodium.

34. The liquid hand dishwashing detergent composition according to claims 18 to 33 comprising between 5% and 35%, preferably between 10% and 32%, more preferably between 15% and 30% by weight of the liquid hand dishwashing detergent composition of the alkyl sulphated anionic surfactant.

35. The liquid hand dishwashing detergent composition according to claims 18 to 33, wherein the liquid hand dishwashing detergent composition is a liquid hand dishwashing spray detergent composition comprising between 1% and 15%, preferably between 2% and 12%, more preferably between 3% and 10% by weight of

Date Reçue/Date Received 2020-11-24

the liquid hand dishwashing detergent composition of the alkyl sulphated anionic surfactant.

36. The liquid hand dishwashing detergent composition according to claims 11 to 35 wherein the surfactant system comprises a fatty acid, preferably a neutralised fatty acid soap, more preferably, wherein the liquid hand dishwashing detergent composition comprises between 0.1% and 15% preferably between 0.5% and 5% by weight of the liquid detergent composition of fatty acid.

37. The liquid hand dishwashing detergent composition according to claim 36, wherein the fatty acid may be branched or linear, alkoxylated or non-alkoxylated and preferably is selected from palm kernel fatty acid, coconut fatty acid, rapeseed fatty acid, neutralized palm kernel fatty acid, neutralized coconut fatty acid, neutralized rapeseed fatty acid, or mixture thereof, most preferably neutralized palm kernel fatty acid.

38. The liquid hand dishwashing detergent composition according to claims 36 and 37 wherein the fatty acid soap is neutralised with an alkali metal, an amine, or a mixture thereof, preferably the amine is selected from monoethanolamine, triethanolamine or mixtures thereof and the alkali metal is selected from sodium, potassium, magnesium or a mixture thereof, more preferably the fatty acid is neutralized with an alkali metal most preferably sodium.

39. The liquid hand dishwashing detergent composition according to claims 36 to 38 wherein the dioxane level in the fatty acid prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane.

Date Reçue/Date Received 2020-11-24

40. The liquid hand dishwashing detergent composition according to claims 11 to 39, wherein the surfactant system comprises a co-surfactant selected from amphoteric surfactants, zwitterionic surfactants or mixtures thereof.

41. The liquid hand dishwashing detergent composition according to claim 40 wherein the dioxane level in the co-surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane.

42. The liquid hand dishwashing detergent composition according to claims 40 to 41, wherein the co-surfactant is an amphoteric surfactant or mixtures thereof, preferably an amine oxide surfactant, more preferably an alkyl dimethyl amine oxide, even more preferably a C12-C14 dimethyl amine oxide, most preferably a linear C12-14 dimethyl amine oxide.

43. The liquid hand dishwashing detergent composition according to claim 42 wherein the dioxane level in the amine oxide co-surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane.

44. The liquid hand dishwashing detergent composition according to claims 40 to 41, wherein the co-surfactant is a zwitterionic surfactant or mixtures thereof, preferably a betaine surfactant, more preferably an alkyl amidoalkyl betaine surfactant, most preferably cocoamidopropylbetaine.

45. The liquid hand dishwashing detergent composition according to claim 44 wherein the dioxane level in the betaine co-surfactant prior to addition to the liquid hand

Date Reçue/Date Received 2020-11-24

dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane.

46. The liquid hand dishwashing detergent composition according to claims 40 to 45, wherein the liquid hand dishwashing detergent composition comprises from 0.1% to 20%, more preferably from 0.5% to 15% and especially from 2% to 10% by weight of the cleaning composition of the co-surfactant.

47. The liquid hand dishwashing detergent composition according to claims 40 to 46, wherein the liquid hand dishwashing detergent composition comprises from 10% to 40%, preferably from 15% to 35%, more preferably from 20% to 30%, by weight of the surfactant system of a co-surfactant.

48. The liquid hand dishwashing detergent composition according to claims 40 to 47, wherein the liquid hand dishwashing detergent composition comprises the alkyl sulphate anionic surfactant and the co-surfactant in a weight ratio of from 1:1 to 8:1, preferably from 2:1 to 5:1, more preferably from 2.5:1 to 4:1

49. The liquid hand dishwashing detergent composition according to claims 11 to 48 wherein the surfactant system comprises a non-ionic surfactant, wherein the non-ionic surfactant preferably comprises an alkoxylated alcohol, wherein the alkoxylated alcohol is derived from a synthetical alcohol, a natural alcohol or a mixture thereof, an alkyl polyglucoside surfactant, or a mixture thereof.

50. The liquid hand dishwashing detergent composition according to claim 49, wherein the alkoxylated alcohol comprises ethoxylated alcohol, propoxylated alcohol, a mixed ethoxylated/propoxylated alcohol, or a mixture thereof, more preferably an ethoxylated alcohol.

Date Reçue/Date Received 2020-11-24

51. The liquid hand dishwashing detergent composition according to claim 50, wherein the ethoxylated alcohol has an average degree of ethoxylation of between 0.1 to 20, preferably between 5 and 15, most preferably between 6 and 10.

52. The liquid hand dishwashing detergent composition according to claim 50, wherein the ethoxylated alcohol has an average degree of ethoxylation of between 3 to 7, preferably between 4 and 6, most preferably about 5, wherein the liquid hand dishwashing detergent composition is a liquid hand dishwashing spray composition.

53. The liquid hand dishwashing detergent composition according to claims 49-51, wherein the ethoxylated alcohol has an average alkyl chain length of between 8 and 18, more preferably between 10 and 16, most preferably 12 and 15.

54. The liquid hand dishwashing detergent composition according to claims 49, 50 and 52, wherein the ethoxylated alcohol has an average alkyl chain length of between 5 and 10, more preferably between 5 and 8, most preferably about 6, wherein the liquid hand dishwashing detergent composition is a liquid hand dishwashing spray composition.

55. The liquid hand dishwashing detergent composition according to claims 49-54, wherein the alkyl chain of the alkoxylated alcohol is linear, branched or a mixture thereof, wherein the branched alkyloxylated alcohol is a branched primary alkoxylated alcohol, a branched secondary alkoxylated alcohol or a mixture thereof, preferably a branched primary alkoxylated alcohol.

56. The liquid hand dishwashing detergent composition according to claim 55 wherein the weight average degree of branching of the alkoxylated alcohol is from 0% to 100% preferably from 0% to 95%, more preferably 0% to 60%, most preferably from 0% to 20%.

Date Reçue/Date Received 2020-11-24

57. The liquid hand dishwashing detergent composition according to claims 49 to 56, wherein the synthetically derived alkyl chain comprises oxo-synthesized material, Ziegler-synthesized material, Guerbet-synthesized material, Fischer-Tropsch – synthesized material, iso-alkyl synthesized material, or mixtures thereof, preferably oxo-synthesised material.

58. The liquid hand dishwashing detergent composition according to claims 49 to 51, 53 and 55 till 57, comprising from 1% to 25%, preferably from 1.25% to 20%, more preferably from 1.5% to 15%, most preferably from 1.5% to 5%, by weight of the surfactant system, of a non-ionic surfactant, preferably wherein the nonionic surfactant consists of the alkoxylated alcohol.

59. The liquid hand dishwashing detergent composition according to claims 49, 50, 52 and 54 till 57, comprising from 1% to 15%, preferably from 1.5% to 10%, more preferably from 2% to 8%, most preferably from 3% to 7% by weight of the composition of a linear or branched low cut alcohol alkoxylate non-ionic surfactant, preferably a low cut alcohol ethoxylate non-ionic surfactant or a mixture thereof, comprising an average alkyl chain length of between 5 and 10, more preferably between 5 and 8, most preferably about 6, and comprising on average from about 3 to about 7 alkoxy preferably ethoxy (EO) groups, more preferably a linear C6 alcohol ethoxylate non-ionic surfactant comprising on average from about 3 to about 7 EO, preferably from about 4 to about 6 EO, more preferably about 5 EO, wherein the liquid hand dishwashing detergent composition is a liquid hand dishwashing spray detergent composition.

60. The liquid hand dishwashing detergent composition according to claims 49 to 59 wherein the dioxane level in the alkoxylated alcohol nonionic surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between

Date Reçue/Date Received 2020-11-24

0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably 0ppm dioxane.

61. The liquid hand dishwashing detergent composition according to claim 49, wherein the alkyl polyglucoside surfactant is selected from C6-C18 alkyl polyglucoside surfactant, having a number average degree of polymerization of from 0.1 to 3.0, preferably from 1.0 to 2.0, more preferably from 1.2 to 1.6.

62. The liquid hand dishwashing detergent composition according to claims 49 and 61, wherein the alkyl polyglucoside surfactant comprises a blend of short chain alkyl polyglucoside surfactant having an alkyl chain comprising 10 carbon atoms or less, and mid to long chain alkyl polyglucoside surfactant having an alkyl chain comprising greater than 10 carbon atoms to 18 carbon atoms, preferably from 12 to 14 carbon atoms.

63. The liquid hand dishwashing detergent composition according to claim 62, wherein in the alkyl polyglucoside surfactant blend the weight ratio of short chain alkyl polyglucoside surfactant to long chain alkyl polyglucoside surfactant is from 1:1 to 10:1, preferably from 1.5:1 to 5:1, more preferably from 2:1 to 4:1.

64. The liquid hand dishwashing detergent composition according to claim 49 and claims 61 to 63 wherein the liquid detergent compositions comprises between 1 and 15%, preferably between 3 and 10% by weight of the liquid detergent composition of the alkyl polyglucoside surfactant

65. The liquid hand dishwashing detergent composition according to claim 49 and claims 61 to 64 wherein the alkyl polyglucoside surfactant prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppm and100ppb dioxane, most preferably is 0ppm dioxane.

Date Reçue/Date Received 2020-11-24

66. The liquid hand dishwashing detergent composition according to any preceding claims comprising an ethoxylated polyethyleneimine.

67. The liquid hand dishwashing detergent composition according to claim 66 wherein the ethoxylated polyethyleneimine has a polyethyleneimine backbone having a weight average molecular weight of between 100g/mol and 2000g/mol, preferably between 200g/mol and 1500g/mol, more preferably between 300g/mol and 1000g/mol, even more preferably between 400g/mol and 800g/mol, most preferably between 500g/mol and 700g/mol.

68. The liquid hand dishwashing detergent composition according to claims 66 and 67 wherein the ethoxylated polyethyleneimine has an average of 5 to 40, preferably 10 to 30, more preferably 15 to 25 or most preferably 18 to 22 ethoxy units per ethoxylation chain.

69. The liquid hand dishwashing detergent composition according to claims 66 to 68 wherein the ethoxylated polyethyleneimine has a total weight average molecular weight of from about 5000g/mol to about 20000g/mol, preferably from about 7500g/mol to about 17500g/mol, more preferably from about 10000g/mol to about 15000g/mol, most preferably from about 12000g/mol to about 13000g/mol.

70. The liquid hand dishwashing detergent composition according to claims 66 to 69 wherein the terminal ethoxy moiety of the ethoxylation modification of the ethoxylated polyethyleneimine is capped with hydrogen, a C_1-C_4 alkyl or mixtures thereof, preferably hydrogen.

71. The liquid hand dishwashing detergent composition according to claims 66 to 70 wherein the degree of permanent quaternization of the ethoxylated polyethyleneimine is from about 0% to about 30% of the polyethyleneimine backbone nitrogen atoms, preferably 0%.

Date Reçue/Date Received 2020-11-24

72. The liquid hand dishwashing detergent composition according to claims 66 to 71 wherein the liquid hand dishwashing detergent composition comprises between 0.05% and 2%, preferably between 0.07% and 1% by weight of the liquid hand dishwashing detergent composition of the ethoxylated polyethyleneimine.

73. The liquid hand dishwashing detergent composition according to claims 66 to 72 wherein the dioxane level in the ethoxylated polyethyleneimine, prior to addition to the liquid hand dishwashing detergent composition, is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and100ppb dioxane, most preferably 0ppb dioxane.

74. The liquid hand dishwashing detergent composition according to any preceding claims comprising an amphiphilic alkoxylated polyalkyleneimine, preferably wherein the amphiphilic alkoxylated polyalkyleneimine is an alkoxylated polyethyleneimine polymer comprising a polyethyleneimine backbone having a weight average molecular weight range of from 100 to 5,000, preferably from 400 to 2,000, more preferably from 400 to 1,000 Daltons.

75. The liquid hand dishwahsing detergent composition according to claim 74, wherein the polyethyleneimine backbone comprises the following modifications:

(i) one or two alkoxylation modifications per nitrogen atom, dependent on whether the modification occurs at an internal nitrogen atom or at an terminal nitrogen atom, in the polyethyleneimine backbone, the alkoxylation modification consisting of the replacement of a hydrogen atom on by a polyalkoxylene chain having an average of about 1 to about 50 alkoxy moieties per modification, wherein the terminal alkoxy moiety of the alkoxylation modification is capped with hydrogen, a C1-C4 alkyl or mixtures thereof;

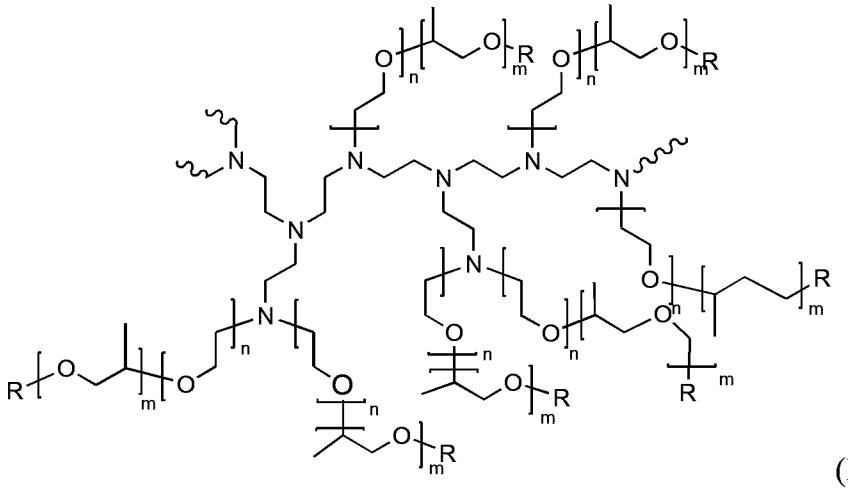
Date Reçue/Date Received 2020-11-24

(ii) a substitution of one C1-C4 alkyl moiety and one or two alkoxylation modifications per nitrogen atom, dependent on whether the substitution occurs at a internal nitrogen atom or at an terminal nitrogen atom, in the polyethyleneimine backbone, the alkoxylation modification consisting of the replacement of a hydrogen atom by a polyalkoxylene chain having an average of about 1 to about 50 alkoxy moieties per modification wherein the terminal alkoxy moiety is capped with hydrogen, a C1-C4 alkyl or mixtures thereof; or

(iii) a combination thereof.

76. The liquid hand dishwashing detergent composition according to claims 74 to 75, wherein the ethoxy/propoxy block moieties have a relative ethoxy to propoxy unit ratio between 3 to 1 and 1 to 1, preferably between 2 to 1 and 1 to 1, most preferably the polyalkoxylene chain is the ethoxy/propoxy block moieties wherein the propoxy moiety block is the terminal alkoxy moiety block.

77. The liquid hand dishwashing detergent composition according to claims 74 to 76, wherein the amphiphilic alkoxylated polyethyleneimine polymer has the general structure of formula (II):



(II)

wherein the polyethyleneimine backbone has a weight average molecular weight of about 600, n of formula (II) has an average of about 10, m of formula (II) has an

Date Reçue/Date Received 2020-11-24

average of about 7 and R of formula (II) is selected from hydrogen, a C_1-C_4 alkyl and mixtures thereof, preferably hydrogen. The degree of permanent quaternization of formula (II) may be from 0% to about 22% of the polyethyleneimine backbone nitrogen atoms and the molecular weight preferably is between 10,000 and 15,000 Da.

78. The liquid hand dishwashing detergent composition according to claims 74 to 77 wherein the liquid hand dishwashing detergent composition comprises between 0.05% and 2%, preferably between 0.07% and 1% by weight of the liquid hand dishwashing detergent composition of the amphiphilic alkoxylated polyethyleneimine.

79. The liquid hand dishwashing detergent composition according to claims 74 to 78 wherein the dioxane level in the amphiphilic alkoxylated polyethyleneimine is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and100ppb dioxane, most preferably 0ppb dioxane.

80. The liquid hand dishwashing detergent composition according to any preceding claims wherein the liquid hand dishwashing detergent composition comprises an ethyleneoxide (EO) – propyleneoxide (PO) – ethyleneoxide (EO) triblock co-polymer of Formula:

$$(EO)x\text{-}(PO)y\text{-}(EO)x$$

wherein:

each x is independently on average between 1 and 80, preferably between 3 and 60, more preferably between 5 and 50, most preferably between 5 and 30; and y is on average between 1 and 60, preferably between 10 and 55, more preferably between 10 and 50, more preferably between 15 and 48.

Date Reçue/Date Received 2020-11-24

81. The liquid hand dishwashing detergent composition according to claim 80 wherein the triblock co-polymer has an average molecular weight of between 140 and 10500, preferably between 800 and 8500, more preferably between 1000 and 7300, even more preferably between 1300 and 5500, most preferably between 2000 and 4800.

82. The liquid hand dishwashing detergent composition according to claims 80 to 81 wherein the triblock co-polymer has a ratio of y to each x of from 1:1 to 3:1, preferably from 1.5:1 to 2.5:1.

83. The liquid hand dishwashing detergent composition according to claims 80 to 82 wherein the triblock co-polymer has an average weight percentage of total EO of between 30% and 50% by weight of the tri-block co-polymer.

84. The liquid hand dishwashing detergent composition according to claims 80 to 83 comprising between 0.1% and 10%, preferably between 0.5% and 7.5%, more preferably between 1% and 5%, by weight of the liquid hand dishwashing detergent composition of the tri-block co-polymer.

85. The liquid hand dishwashing detergent composition according to claims 80 to 84 wherein the dioxane level in the tri-block co-polymer is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and100ppb dioxane, most preferably 0ppb dioxane.

86. The liquid hand dishwashing detergent composition according to any preceding claims wherein the liquid hand dishwashing detergent composition comprises a cyclic polyamine.

Date Reçue/Date Received 2020-11-24

87. The liquid hand dishwashing detergent composition according to claim 86, wherein said cyclic polyamine polyamine has at least two primary amine functionalities, preferably wherein the primary amines are in positions 1,3, more preferably wherein in the cyclic polyamine one of the substituents is -CH3 and the rest are H.

88. The liquid hand dishwashing detergent composition according to claim 87, wherein said cyclic polyamine is selected from the group consisting of: 2-methylcyclohexane-1,3-diamine, 4-methylcyclohexane-1,3-diamine and mixtures thereof.

89. The liquid hand dishwashing detergent composition according to claims 86 to 88 comprising between 0.1% and 3%, more preferably between 0.2% and 2%, and especially between 0.5% and 1%, by weight of the liquid hand dishwashing detergent composition of the ctclic polyamine.

90. The liquid hand dishwashing detergent composition according to claims 86 to 89 wherein the dioxane level in the cyclic polyamine prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and100ppb dioxane, most preferably 0ppb dioxane.

91. The liquid hand dishwashing detergent composition according to any preceding claims wherein the liquid hand dishwashing detergent composition comprises one or more perfume raw materials.

92. The liquid hand dishwashing detergent composition according to claim 91 wherein the dioxane level in the perfume raw material prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably

Date Reçue/Date Received 2020-11-24

between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and 100ppb, most preferably 0ppb dioxane.

93. The liquid hand dishwashing detergent composition according to any preceding claims wherein the liquid hand dishwashing detergent composition comprises one or more active ingredients, wherein the one or more active ingredient is selected from the group consisting of: i) a salt, ii) a hydrotrope, iii) an organic solvent, and mixtures thereof, preferably wherein the dioxane level in these one or more active ingredients or (aqueous) solutions made thereof prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb.

94. The liquid hand dishwashing detergent composition according to claim 93, wherein the liquid hand dishwashing detergent composition comprises the salt between 0.05% and 2%, preferably between 0.1% and 1.5%, or more preferably between 0.5% and 1%, by weight of the liquid composition, preferably the salt is a monovalent or divalent inorganic salt, or a mixture thereof, more preferably selected from: sodium chloride, sodium sulphate, and mixtures thereof, most preferably sodium chloride.

95. The liquid hand dishwashing detergent composition according to claim 93, wherein the liquid hand dishwashing detergent composition comprises the hydrotrope or a mixture thereof between 0.1% and 10%, preferably between 0.5% and 10%, more preferably between 1% and 10% by weight of the liquid composition, preferably wherein the hydrotrope is sodium cumene sulphonate.

96. The liquid hand dishwashing detergent composition according to claim 93, wherein the liquid hand dishwashing detergent composition comprises the organic solvent or a mixture thereof between 0.1% and 10%, preferably between 0.5% and 10%, more preferably between 1% and 10% by weight of the liquid composition, preferably

Date Reçue/Date Received 2020-11-24

wherein the organic solvent is selected from the group of alcohols, glycols, glycol ethers, and mixtures thereof, preferably alcohols, glycols, and mixtures thereof, more preferably wherein the alcohol is ethanol and wherein the glycol is polypropyleneglycol preferably polypropyleneglycol with an average molecular weight of 1000 or 2000.

97. The liquid hand dishwashing detergent composition according to claim 96, wherein the glycol ether solvent is selected from the group consisting of glycol ethers of:
    d) Formula (I): R1O(R2O)nR3, wherein R1 is a linear or branched C4, C5 or C6 alkyl or a substituted or unsubstituted phenyl; R2 is ethyl or isopropyl; R3 is hydrogen or methyl; and n is 1, 2 or 3; and mixtures thereof;
    e) Formula (II): R4O(R5O)nR6, wherein: R4 is n-propyl or isopropyl; R5 is isopropyl; R6 is hydrogen or methyl; and n is 1, 2 or 3; and
    f) mixtures thereof.

98. The liquid hand dishwashing detergent composition according to claim 96, wherein the glycol ether solvent is selected from propyleneglycol n-butyl ether, dipropyleneglycol n-butyl ether, and mixtures thereof, most preferably dipropyleneglycol n-butyl ether.

99. The liquid hand dishwashing detergent composition according to any preceding claims wherein the liquid hand dishwashing detergent composition comprises one or more adjunct ingredients selected from the group of builders preferably citrate, chelants preferably selected from EDDS, HEDP, GLDA, DTPA, DTPMP, DETA, or mixtures thereof, conditioning polymers, other cleaning polymers, surface modifying polymers, structurants, emollients, humectants, skin rejuvenating actives, enzymes, encapsulated enzymes, carboxylic acids, scrubbing particles, encapsulated perfumes, malodor control agents, pigments, dyes, opacifiers, pearlescent particles, inorganic cations such as alkaline earth metals such as Ca/Mg-ions, antibacterial and anti-viral agents preferably selected from 4.4'-dichloro 2-hydroxydiphenyl ether, PCMX, acids preferably lactic acid, and quaternary ammonium salts, preservatives, antioxidants

Date Reçue/Date Received 2020-11-24

including sulfite salts such as potassium sulphite or potassium bisulphite salts and those commercially available under the Ralox brandname, suspended particles, viscosity adjusters preferably salts such as NaCl, and other mono-, di- and trivalent salts, and pH adjusters and buffering means preferably selected from carboxylic acids such as citric acid, HCl, NaOH, KOH, alkanolamines, carbonates preferably selected from sodium carbonates, bicarbonates, sesquicarbonates, and mixtures thereof.

100. The liquid hand dishwashing detergent composition according to claim 99 wherein the dioxane level in these one or more adjunct ingredients or (aqueous) solutions made thereof prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb.

101. The liquid hand dishwashing detergent composition according to any preceding claims comprising a dioxane scavenger.

102. The liquid hand dishwashing detergent composition according to claim 101 wherein the dioxane scavenger is selected from 5, 6-dihydro-3-(4-morpholinyl) -1-[4-(2-oxo-1-piperidinyl) phenyl]-2 (1 H) -pyridone, 3 a-hydroxy-7-oxo-mixture of cholanic acid , 3 - (N - methyl amino) - L – alanine, and mixtures thereof

103. The liquid hand dishwashing detergent composition according to claims 101 and 102 wherein the dioxane level in the dioxane scavenger prior to addition to the liquid hand dishwashing detergent composition is between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, more preferably between 0ppb and 100ppb dioxane, most preferably 0ppb.

Date Reçue/Date Received 2020-11-24

104. A process of making the liquid hand dishwashing detergent composition according to any preceding claims, comprising a step of treating the liquid hand dishwashing detergent composition to reduce dioxane, wherein the dioxane is reduced by stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving, catalytic degradation step, enzymatic degradation step or a mixture thereof, more preferably stripping, even more preferably multiple stripping, most preferably 2 or 3 stripping.

105. A process of making a liquid hand dishwashing detergent composition according to any of claims 1 to 103, comprising the step of making a surfactant slurry wherein the slurry comprises the alkyl sulphate, alkoxylated alkyl sulphate or a mixture thereof, and optionally a further ingredient selected from a further co-surfactant, a non-aqueous solvent, water, an electrolyte, a pH trimming agent, a preservative or any other detergent active, wherein the slurry comprises between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and 100ppb, most preferably 0ppb dioxane.

106. The process according to claim 105, wherein the surfactant slurry is treated to reduce dioxane levels, preferably wherein said treatment comprises stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving, catalytic degradation step, enzymatic degradation step or a mixture thereof, more preferably stripping, most preferably a multiple stripping step.

107. A process for making a liquid hand dishwashing detergent composition according to claims 1 to 103, comprising the step of adding individual surfactants or the surfactant slurry from claims 105 to 106 into an aqueous stream, followed by addition of further liquid hand dishwashing detergent actives.

Date Reçue/Date Received 2020-11-24

108. A process for making a liquid hand dishwashing detergent composition according to claim 107 wherein some detergent actives of the liquid hand dishwashing detergent composition have been added to the aqueous stream prior to addition of the individual surfactants or the surfactant slurry.

109. A process for making a liquid hand dishwashing detergent composition according to claims 107 or 108 wherein the aqueous stream and further detergent actives comprise prior to combining them between 0ppm and 20ppm, preferably between 0ppm and 15ppm, more preferably between 0ppm and 10ppm, even more preferably between 0ppm and 5ppm, even more preferably between 0ppm and 1ppm, even more preferably between 0ppb and 100ppb, most preferably 0ppb dioxane.

110. A process for making a liquid hand dishwashing detergent composition according to claims 107 to 109 wherein the aqueous stream and/or alternative detergent actives, and/or the final liquid hand dishwashing detergent composition is treated to reduce dioxane levels, preferably wherein said treatment comprises stripping, distillation, evaporation, centrifugation, microwave irradiation, molecular sieving, catalytic degradation step, enzymatic degradation step or a mixture thereof.

111. A process for making a liquid hand dishwashing detergent composition according to claims 107 to 110 wherein the process comprises the step of further adding a dioxane scavenger, wherein the dioxane scavenger is preferably selected from 5, 6-dihydro-3-(4-morpholinyl) -1-[4-(2-oxo-1-piperidinyl) phenyl]-2 (1 H) - pyridone, 3 a-hydroxy-7-oxo-mixture of cholanic acid , 3 - (N - methyl amino) - L – alanine, and mixtures thereof.

Date Reçue/Date Received 2020-11-24