

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property

Organization

International Bureau

(43) International Publication Date

20 August 2020 (20.08.2020)



(10) International Publication Number

WO 2020/165069 A1

(51) International Patent Classification:

*CII*D 1/83 (2006.01) *CII*D 11/00 (2006.01)

*CII*D 3/00 (2006.01) *CII*D 17/00 (2006.01)

*CII*D 3/37 (2006.01) *CII*D 1/94 (2006.01)

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *of inventorship (Rule 4.17(iv))*

(21) International Application Number:

PCT/EP2020/053257

Published:

- *with international search report (Art. 21(3))*

(22) International Filing Date:

10 February 2020 (10.02.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/805,459 14 February 2019 (14.02.2019) US

19166464.8 01 April 2019 (01.04.2019) EP

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(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: NON-CHLORINATED OPEN PLANT CLEANING COMPOSITION

(57) Abstract: The presently claimed invention relates to a non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14, comprising at least one alkyl ether sulfate of general formula (I), at least one polyethyleneimine of general formula (II), at least one alkyl polyglycoside of general formula (III) and at least one alkyl iminodipropionate of general formula (IV). The presently claimed invention further relates to a method for the removal of protein and fat-based soil from an article having a soiled surface. The presently claimed invention also relates to the use of the non-chlorinated cleaning composition in open plant cleaning.



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Non-chlorinated Open Plant Cleaning Composition

5 The presently claimed invention relates to a non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14, comprising at least one alkyl ether sulfate of general formula (I), at least one polyethyleneimine of general formula (II), at least one alkyl polyglycoside of general formula (III) and at least one alkyl iminodipropionate of general formula (IV). The presently claimed invention further relates to a method for the removal of protein and fat-based soil from an article having a soiled surface. The presently
10 claimed invention also relates to a use of the non-chlorinated aqueous cleaning composition in open plant cleaning.

Background of the Invention

15 The food and beverage market require a high level of consistency in product quality. The manufacturing environment presents significant challenges to food safety as it entails a variety of different processes and equipment which generate a range of soils unique to each application. After the production, the manufacturing equipment and the food contact surfaces all need to be cleaned and sanitized prior to restarting production to ensure an acceptable level of hygiene and cleanliness thereby assuring the
20 final product quality and food safety. Fat and proteins are the two main soils.

Proteins are by far the most difficult to remove. In fact, casein (a major milk protein) is also used because of its adhesive properties in many glues and paints. Food proteins range from simple proteins, which are easier to remove, to more complex proteins, which are very difficult to remove. Heat-denatured proteins can be extremely
25 difficult to remove as they create a protein film which makes the proteins especially difficult for cleaners to reach.

Aqueous cleaning compositions that are formulated for removing fatty and proteinaceous soils from a variety of surfaces have been developed and have been used for many years. Soil removal cannot be considered a spontaneous process because soil removal kinetics require a finite period. The longer the cleaning solution is in contact with the deposited soil, the more soil is removed to a practical limit. Final traces of soil become increasingly difficult to remove. In the last phase of the soil removal process, cleaning involves overcoming the very strong adhesive force between the soil and the substrate
30 surface, rather than the weaker cohesive soil-soil forces. A large variety of different types of formulations have been developed to remove fat and/or protein containing soils from a variety of surfaces. However, it is challenging to clean the vertical walls of the plants as it requires that the cleaning composition should adhere to the walls for some time to enable sufficient contact between the soil on these vertical walls and the
35 cleaning composition. The other challenge is that for open, large facility environments, cleaning does not generally benefit by heating the chemical cleaning solution, as the large surface areas that are to be cleaned will rapidly cool the solution to ambient temperature. In such cleaning operations, chemical residence time on a surface (often in the form of foam or a gel, especially for vertical surfaces) and high temperature
40

rinse water is required to effectively clean a surface. Unfortunately for these types of manual cleaning operations, the rinse water temperature is usually limited at the high end to between 50 °C and 60 °C for employee safety reasons. Without the ability to recirculate the hot water, as is common in automated operations, a much higher amount of water is required to heat up a soiled surface for these environmental areas and the costs of heating cold water to these temperatures can be significant.

EP 2766464 A1 provides a cleaning composition for the removal of proteinaceous and fatty soils in an open plant, comprising a source of chlorine and an alkaline compound. Chlorine degrades protein by oxidative cleavage and hydrolysis of the peptide bond, which breaks apart large protein molecules into smaller peptide chains.

The use of chlorinated cleaning composition in the food process industry is not without problems. The main disadvantage of cleaning composition comprising a source of chlorine is that chlorine leads to corrosion of the metal surface of the article. Such compositions have an unpleasant odour and cause skin irritation. The problems associated with the use and applications of chlorine release agents in the food process industry have been known and tolerated for decades. There is a growing public concern over the health and environmental impacts of chlorine and organochlorines.

Therefore, it is an object of the presently claimed invention to provide a cleaning composition which does not contain chlorine, has a good foam stability, has no or insignificant corrosion effects on metals and can be used for open plant cleaning, preferably at low temperatures such as 15 °C to 20 °C.

Summary of the Invention

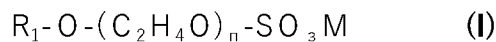
Surprisingly, it was found that combination of a certain alkyl ether sulfate, a polyethyleneimine, an alkyl polyglycoside and an alkyl iminodipropionate provides a cleaning composition for an open plant cleaner which generates a stable foam which clings to the vertical surfaces, thereby allowing an interaction between the soiled surface, which otherwise is not achieved by either of the individual components of the cleaning composition. The non-chlorinated, aqueous cleaning composition of the presently claimed invention is suitable for cleaning the open plant cleaner at both low temperature and high temperature. Temperature herein refers to the temperature at which cleaning with the cleaning composition is affected. Low temperature in the presently claimed invention refers to a temperature range of 15 °C to 20 °C and high temperature refers to a temperature range of 35 °C to 60 °C. Temperature range of 21 °C to 34 °C which lies in between the low temperature and high temperature range can be referred to as medium temperature.

The cleaning compositions comprising a combination of an alkyl ether sulfate, a polyethyleneimine, an alkyl polyglycoside and an alkyl iminodipropionate demonstrates removal of protein and fat-based soil from the surface of an article when the components are combined.

Thus, in an aspect, the presently claimed invention relates to a non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14 comprising

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(a) at least one alkyl ether sulfate of general formula (I)



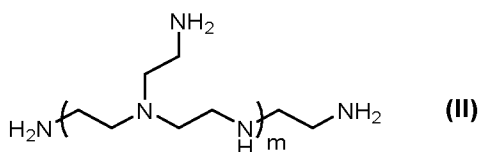
wherein

R_1 denotes linear or branched, unsubstituted C_6-C_{22} alkyl,

5 n is an integer in the range of from 1 to 20, and

M denotes alkali metal or ammonium;

(b) at least one polyethyleneimine of general formula (II)



wherein

10 m is an integer in the range of from 10 to 1000;

(c) at least one alkyl polyglycoside of general formula (III)



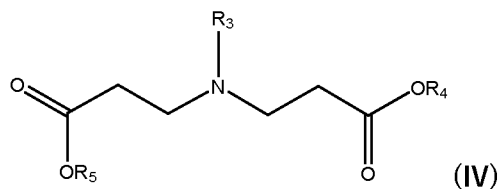
wherein

G_1 is a monosaccharide

15 R_2 denotes linear or branched, unsubstituted C_4-C_{14} alkyl,

x is an integer in the range of from 1 to 10; and

(d) at least one alkyl iminodipropionate of general formula (IV)



wherein

20 R_3 denotes linear or branched, substituted or unsubstituted C_6-C_{16} alkyl

R_4 and R_5 are identical or different and denote H or alkali metal.

25 'Non-chlorinated' herein refers to the cleaning composition, wherein the amount of free chlorine is less than 1 ppm.

30 'Open plant cleaning' refers to 'on-site cleaning operation' and is typically used to clean the exterior surfaces of the processing equipment of any metal type, any part of the processing equipment that is not enclosed, and the walls and floors of the processing plants. It encompasses all parts of the processing plant except the insides of the equipment and pipes.

'Stable foam' herein indicates that the foam retains a foam height of at least 50 mm for a period of at least 10 minutes. A stable foam has a lower rate of water drainage.

In another aspect, the presently claimed invention relates to a method for the removal of protein and fat-based soil from an article having a soiled surface, comprising the steps of (i) contacting the said article with the non-chlorinated aqueous cleaning composition as described herein above, at a temperature in the range of 20 °C to 60 °C; and (ii) rinsing the article with water.

In another aspect, the presently claimed invention relates to a use of the non-chlorinated composition, as described herein above, in open plant cleaning.

10 Detailed description of the Invention

Before the present compositions and formulations of the invention are described, it is to be understood that this invention is not limited to particular compositions and formulations described, since such compositions and formulation may, of course, vary. It is also to be understood that the terminology used herein is not intended to be limiting, since the scope of the presently claimed invention will be limited only by the appended claims.

If hereinafter a group is defined to comprise at least a certain number of embodiments, this is meant to also encompass a group which preferably consists of these embodiments only. Furthermore, the terms "first", "second", "third" or "(a)", "(b)", "(c)", "(d)" etc. and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein. In case the terms "first", "second", "third" or "(A)", "(B)" and "(C)" or "(a)", "(b)", "(c)", "(d)", "i", "ii" etc. relate to steps of a method or use or assay there is no time or time interval coherence between the steps, that is, the steps may be carried out simultaneously or there may be time intervals of seconds, minutes, hours, days, weeks, months or even years between such steps, unless otherwise indicated in the application as set forth herein above or below.

In the following passages, different aspects of the invention are defined in more detail. Each aspect so defined may be combined with any other aspect or aspects unless clearly indicated to the contrary. In particular, any feature indicated as being preferred or advantageous may be combined with any other feature or features indicated as being preferred or advantageous.

Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the presently claimed invention. Thus, appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment but may do so. Furthermore, the particular features, structures or characteristics may be combined in any suitable manner, as would be apparent to a person skilled in the art from this disclosure, in one or more embodiments. Further-more, while some embodiments described herein include some, but not other features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the

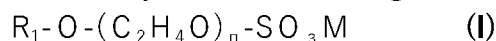
invention, and form different embodiments, as would be understood by those in the art. For example, in the appended claims, any of the claimed embodiments can be used in any combination.

Furthermore, the ranges defined throughout the specification include the end values as well, i.e. a range of 1 to 10 implies that both 1 and 10 are included in the range. For the avoidance of doubt, the applicant shall be entitled to any equivalents according to the applicable law.

In one aspect, the presently claimed invention relates to a non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14 comprising

10

(a) at least one alkyl ether sulfate of general formula (I)



wherein

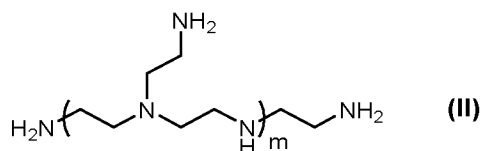
R_1 denotes linear or branched, unsubstituted C_6-C_{22} alkyl,

15

n is an integer in the range of from 1 to 20, and

M denotes alkali metal or ammonium;

(b) at least one polyethyleneimine of general formula (II)



wherein

20

m is an integer in the range of from 10 to 1000;

(c) at least one alkyl polyglycoside of general formula (III)



wherein

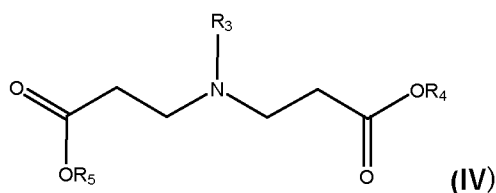
G_1 is a monosaccharide

25

R_2 denotes linear or branched, unsubstituted C_4-C_{14} alkyl,

x is an integer in the range of from 1 to 10; and

(d) at least one alkyl iminodipropionate of general formula (IV)



wherein

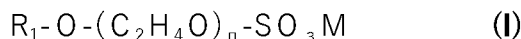
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R_3 denotes linear or branched, substituted or unsubstituted C_6-C_{16} alkyl

R_4 and R_5 are identical or different and denote H or alkali metal.

Alkyl ether sulfate of general formula (I)

- 5 The at least one alkyl ether sulfate of the presently claimed invention is the compound of the general formula (I)



wherein

- 10 R_1 denotes linear or branched, unsubstituted C_6 - C_{22} alkyl,
 n is an integer in the range of from 1 to 20, and
 M denotes alkali metal or ammonium.

15 For the purposes of the presently claimed invention, the term " C_6 - C_{22} -alkyl" covers acyclic saturated hydrocarbon residues, which may be linear or branched and unsubstituted having 6 to 22 carbon atoms.

As used herein, "branched" denotes a chain of atoms with one or more side chains attached to it. Branching occurs by the replacement of a substituent, e.g., a hydrogen atom, with a covalently bonded aliphatic moiety.

- 20 Representative examples of linear and branched C_6 - C_{22} alkyl include, but are not limited to, *n*-hexyl, *n*-heptyl, *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, *n*-pentadecyl, *n*-hexadecyl, *n*-heptadecyl, *n*-octadecyl, *n*-nonadecyl, *n*-eicosyl, *n*-heneicosyl, *n*-docosyl, 2-ethylhexyl, 2-propyl heptyl, 2-butyl-1-octyl, 2-pentyl-1-nonyl, isohexyl, isoheptyl, isooctyl, isodecyl, isoundecyl, isododecyl, isotridecyl, isotetradecyl,
 25 isopentadecyl, isohexadecyl, isoheptadecyl, isooctadecyl, isononadecyl, isoeicosyl, isoheneicosyl and isodocosyl.

In an embodiment, R_1 is selected from *n*-hexyl, *n*-heptyl, *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, *n*-pentadecyl and *n*-hexadecyl.

30 In another embodiment, R_1 is selected from *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, *n*-pentadecyl and *n*-hexadecyl.

In still another embodiment, R_1 is selected from *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl and *n*-tetradecyl.

35 In an embodiment, n is an integer in the range from 1 to 15, more preferably from 1 to 10, and most preferably from 1 to 5.

40 In an embodiment, the cation M is selected from sodium, potassium and ammonium cation.

The at least one alkyl ether sulfate of general formula (I) is produced by the ethoxylation of a fatty alcohol followed by neutralization with alkali hydroxide. The at least one alkyl ether sulfate also contains reaction by-products such as free salts (for example sodium

chloride is the free salt by product, when neutralization agent is sodium hydroxide), free fatty alcohols, salts of fatty alcohols and non-ethoxylated alkyl sulfates. Therefore, the solid content of the alkyl ether sulfate will be different from the active content. Active content denotes 'the amount of alkyl ether sulfate' present in the composition whereas the solid content denotes 'a total of alkyl ether sulfate, fatty alcohol, salt of fatty alcohol, non-ethoxylated alkyl sulfate and the free salt' in the composition. 'Free' herein denotes that the salt is not bound to the fatty alcohol/ alkyl ether sulfate by any kind of chemical bonding.

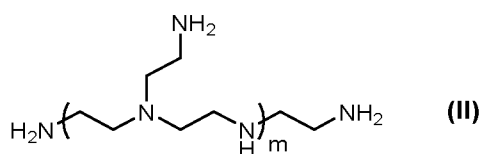
In an embodiment, the at least one alkyl ether sulfate of general formula (I) is present in an amount from 3.0 % to 10.0 %, based on the total weight of the composition.

In an embodiment, the at least one alkyl ether sulfate has a weight average molecular weight (Mw) in the range from 200 to 2000 g/mol, more preferably from 200 to 1500 g/mol and most preferably from 200 to 1200 g/mol.

Weight average molecular weight "Mw" is determined according to DIN 55672-1 and refers a polystyrene calibration standard.

Polyethyleneimine of general formula (II)

The at least one polyethyleneimine of the presently claimed invention is the compound of the general formula (II)



wherein

m is an integer in the range of from 10 to 1000.

In an embodiment, the at least one polyethyleneimine has a weight average molecular weight (Mw) in the range from 400 to 15,000 g/mol, more preferably in the range from 500 to 10,000 g/mol and most preferably in the range from 700 to 5000 g/mol.

In an embodiment m is from 10 to 500, more preferably m is from 15 to 250, still more preferably m is from 15 to 100 and most preferably m is from 15 to 70.

The ratio of primary amine groups to secondary amine groups and tertiary amine groups is preferably 2:2:1.

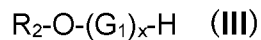
The at least one polyethyleneimine is prepared according to the conventional methods known in the art. For example, aziridine is cationically polymerized to form polyethyleneimines in the presence of an acidic catalyst.

In an embodiment, the at least one polyethyleneimine is present in an amount from 0.1 % to 4.0 %, based on the total weight of the composition.

Alkyl polyglycoside of general formula (III)

The at least one alkyl polyglycoside of the presently claimed invention is the compound of the general formula (III).

5



wherein

- 10 G_1 is selected from xylose, arabinose, glucose, and mixtures thereof
 R_2 denotes linear or branched, unsubstituted C_4 - C_{14} alkyl,
 x is in an integer in the range of from 1 to 10; and

15 According to an embodiment, G_1 is selected from monosaccharides with 5 or 6 carbon atoms, referred to as pentoses and hexoses, respectively. Representative examples of pentoses include, but are not limited to, ribulose, xylulose, ribose, arabinose, xylose and lyxose. Representative examples of hexoses include, but are not limited to galactose, manose, rhamnose and glucose. Monosaccharides may be synthetic or derived or isolated from natural products. In an embodiment, the monosaccharide is obtained from a fer-

20 mentive process of a biomass source. The biomass source is selected from pine wood, beech wood, wheat straw, corn straw, switchgrass, flax, barley husk, oat husk, bagasse, miscanthus and mixtures thereof.

In an embodiment, G_1 is selected from glucose, xylose, arabinose, rhamnose and mixtures thereof.

25 Representative examples of linear and branched C_4 - C_{14} alkyl include, but are not limited to, *n*-butyl, *n*-pentyl, *n*-hexyl, *n*-heptyl, *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, 2-ethylhexyl, 2-propyl heptyl, 2-butyl-1-octyl, 2-pentyl-1-nonyl, iso-butyl, isopentyl, isohexyl, isoheptyl, isooctyl, isodecyl, isoundecyl, isododecyl, isotridecyl and isotetradecyl.

30

In an embodiment, R_2 is selected from *n*-hexyl, *n*-heptyl, *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl and *n*-tetradecyl.

35 In another embodiment, R_2 is selected from *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl and *n*-tetradecyl.

In still another embodiment, R_2 is selected from *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl and *n*-dodecyl.

40 In an embodiment, x which is also known as degree of polymerization (DP) is in the range of from 1 to 5, preferably in the range of 1 to 2.5, and more preferably in the range of from 1.1 to 1.8. In the context of the presently claimed invention, x refers to average values, and is not necessarily a whole number.

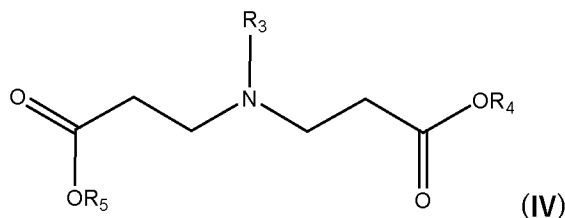
The degree of polymerization, x , is determined by high temperature gas chromatography (HTGC), in accordance with K. Hill et. Al., Alkyl Polyglucosides, VCH Weinheim, page 28 ff.

5

The amount of the at least one alkyl polyglycoside of general formula (III) is in the range of from 3.0 % to 10.0 % by weight, based on the total weight of the composition.

10 Alkyl iminodipropionate of general formula (IV)

The at least one alkyl iminodipropionate of the presently claimed invention is the compound of the general formula (IV)



15

wherein

R_3 denotes linear or branched, substituted or unsubstituted C_6 - C_{16} alkyl
 R_4 and R_5 are identical or different and denote H or alkali metal.

20 Representative examples of linear and branched C_6 - C_{16} alkyl include, but are not limited to, *n*-hexyl, *n*-heptyl, *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, *n*-pentadecyl, *n*-hexadecyl, 2-ethylhexyl, 2-propyl heptyl, 2-butyl-1-octyl, 2-pentyl-1-nonyl, isooctyl, isodecyl, isoundecyl, isododecyl, isotridecyl, isotetradecyl, isopentadecyl and isohexadecyl.

25

In an embodiment, R_4 and R_5 are different and selected from H and alkali metal.
 The alkali metal is selected from sodium and potassium.

30 Examples of alkyliminodipropionate compounds include, but are not limited to, lauryl beta-iminodipropionate, monosodium lauryl beta-iminodipropionate, monopotassium lauryl beta-iminodipropionate, disodium lauryl beta-imino dipropionate and dipotassium lauryl beta-iminodipropionate.

In an embodiment, the amount of the at least one alkyliminodipropionate of general formula (IV) is in the range of from 5.0 % to 20.0 % by weight, based on the total weight of
 35 the composition.

Alkaline agent

In an embodiment of the presently claimed invention, the non-chlorinated aqueous cleaning composition has a pH value from 10 to 14.

5 The pH of the non-chlorinated aqueous cleaning composition is adjusted by adding at least one alkaline agent.

The at least one alkaline agent is selected from alkali metal hydroxides, alkaline earth metal hydroxides, alkylamines, ethanolamine, alkali metal carbonates, alkali metal bicarbonates and alkali metal silicates.

10 In an embodiment, the at least one alkaline agent is an alkali metal hydroxide.

In an embodiment, the alkali metal hydroxide is selected from sodium hydroxide, potassium hydroxide and mixtures thereof. The alkali metal hydroxide is employed as an aqueous solution such as a 50 % aqueous solution of sodium hydroxide and a 45 % aqueous solution of potassium hydroxide. The amounts set out herein are percentages of the active compound.

15 The at least one alkaline agent is present in an amount in the range of from 5.0 % to 16.0 % by weight, based on the total weight of the composition.

Chelating agent

20 In an embodiment, the at least one chelating agent is selected from aminopolycarboxylate and polycarboxylic acid. In general, a chelating agent is a molecule capable of coordinating (i.e. binding) the metal ions commonly found in natural water to prevent the metal ions from interfering with the action of the other detergent ingredients of a cleaning composition.

25 In an embodiment, the aminopolycarboxylate is selected from ethylene diamine tetraacetic acid (EDTA), tetrasodium ethylene diamine tetraacetate (disodium EDTA), diammonium ethylene diamine tetraacetate (diammonium EDTA), trisodium hydroxyethylethylene diamine triacetate (HEDTA, sodium salt), diethylene triamine pentaacetic acid (DTPA), methyl glycine diacetic acid (MGDA), methyl glycine diacetic acid trisodium salt, glutamic acid diacetic acid (GLDA), glutamic acid diacetic acid tetrasodium salt and nitrilotriacetic acid (NTA).

30 In an embodiment, the aminocarboxylate is selected from tetrasodium ethylene diamine tetraacetate (disodium EDTA), methyl glycine diacetic acid (MGDA) and methyl glycine diacetic acid trisodium salt

35 In another embodiment, the polycarboxylic acid is citric acid.

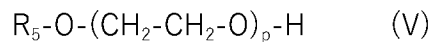
Suitable chelating agents are known and available commercially, e.g. Trilon[®] M, Trilon[®] B, Trilon[®] A, Trilon[®] C, Trilon[®] D, Trilon[®] BAD, Trilon[®] BAQ, Trilon[®] BX from BASF SE, Ludwigshafen, Germany.

40 The at least one chelating agent is present in an amount in the range of from 2.0 % to 10.0 % by weight, based on the total weight of the composition.

Ethoxylated surfactant of general formula (V)

The non-chlorinated aqueous cleaning composition of the presently claimed invention further comprises at least one ethoxylated surfactant of general formula (V)

5



wherein

R_5 denotes linear or branched, unsubstituted C_6 - C_{18} alkyl; and

p is an integer in the range of from 1 to 15.

10

Representative examples of linear and branched C_6 - C_{18} alkyl include, but are not limited to, *n*-hexyl, *n*-heptyl, *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, *n*-pentadecyl, *n*-hexadecyl, *n*-heptadecyl, *n*-octadecyl, 2-ethylhexyl, 2-propyl heptyl, 2-butyl-1-octyl, 2-pentyl-1-nonyl, isohexyl, isoheptyl, isooctyl, isodecyl, isoundecyl, isododecyl, isotridecyl, isotetradecyl, isopentadecyl, isohexadecyl, isoheptadecyl and iso-octadecyl.

15

20

In an embodiment, R_5 is selected from *n*-octyl, *n*-nonyl, *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, *n*-pentadecyl, *n*-hexadecyl, isooctyl, isodecyl, isoundecyl, isododecyl, isotridecyl, isotetradecyl, isopentadecyl and isohexadecyl.

In an embodiment, R_5 is selected from *n*-decyl, *n*-undecyl, *n*-dodecyl, *n*-tridecyl, *n*-tetradecyl, isodecyl, isoundecyl, isododecyl, isotridecyl and isotetradecyl.

25

In an embodiment, R_5 is selected from *n*-tridecyl and isotridecyl.

In an embodiment, p is an integer in the range from 2 to 14, more preferably in the range from 3 to 12 and most preferably in the range from 3 to 10.

30

The weight average molecular weight of the at least one ethoxylated surfactant of general formula (V) is in the range from 200 g/mol to 2000 g/mol, preferably from 200 g/mol to 1500 g/mol, more preferably from 250 g/mol to 1200 g/mol and most preferably from 300 g/mol to 1000 g/mol.

In an embodiment, the amount of the at least one ethoxylated surfactant of general formula (V) is in the range of from 0 to 5.0 % by weight, preferably in the range from 1.0 to 5.0 % by weight, based on the total weight of the composition

35

Additives

In an embodiment, the presently claimed invention further comprises at least one additive.

40

The at least one additive is selected from solvents, amine oxides, curing agents, dyes, fragrances, antimicrobial agents, thickening agents, anti-redeposition agents and fatty alcohols.

In an embodiment, the amount of the at least one additive is in the range of 0 to 30.0 % by weight, more preferably in the range of 0.1 to 25.0 %, and most preferably in the range

from 0.5 to 25.0 % by weight, in each case related to the overall based on the total weight of the composition.

Solvents

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The non-chlorinated aqueous cleaning composition according to the presently claimed invention may contain solvents. The solvents that may be used in the non-chlorinated aqueous cleaning composition can be selected from monovalent or polyvalent alcohols, alkanolamines and glycol ethers. The solvents are selected from ethanol, *n*-propanol, iso-
10 propanol, ethylene glycol, butanediol, glycerol, diethylene glycol, butyl diglycol, hexylene glycol, ethylene glycol methyl ether, ethylene glycol ethyl ether, ethylene glycol propyl ether, ethylene glycol mono-*n*-butyl ether, diethylene glycol methyl ether, diethylene glycol ethyl ether, propylene glycol methyl ether, propylene glycol ethyl ether or propylene glycol propyl ether, dipropylene glycol monomethyl ether, dipropylene glycolethyl ether, diisopro-
15 pylene glycol monomethyl ether, diisopropylene glycol monoethyl ether, methoxytriglycol, ethoxytriglycol, butoxytriglycol, 1-butoxyethoxy-2-propanol, 3-methyl-3-methoxybutanol, propylene glycol tert-butyl ether and mixtures thereof.

Amine oxides

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The non-chlorinated aqueous cleaning composition of the presently claimed invention may also comprise amine oxides. Amine oxides are tertiary amine oxides. In an embodiment, the amine oxides are selected from the coconut or tallow alkyl di-(lower alkyl) amine ox-
25 ides, specific examples of which are dodecyldimethylamine oxide, tridecyldimethylamine oxide, tetradecyldimethylamine oxide, pentadecyldimethylamine oxide, hexadecyldime-
thylamine oxide, heptadecyldimethylamine oxide, octadecyldimethylamine oxide, dodecyldi-
propylamine oxide, tetradecyldipropylamine oxide, hexadecyldipropylamine oxide, tetradecyldibutylamine oxide, octadecyldibutylamine oxide, bis(2-hydroxyethyl)dodecyla-
30 mine oxide, bis(2-hydroxyethyl)-3-dodecoxy-1-hydroxypropylamine oxide, dimethyl-(2-
hydroxydodecyl)amine oxide and 3,6,9-trioctadecyldimethylamine oxide and 3-dodecoxy-
2-hydroxypropyl-di-(2-hydroxyethyl)amine oxide.

Curing agents

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The non-chlorinated aqueous cleaning composition of the presently claimed invention may also comprise curing agents. In an embodiment, the curing agents are selected from polyether amines, cycloaliphatic amines and nitriles. Curing agents are known and commercially available, such as Baxxodur® EC 280, Baxxodur® EC 301, Baxxodur® EC 311, Baxx-
40 odur® EC 130, Baxxodur® EC 302, Baxxodur® EC 303 and Baxxodur® EC 310.

Dyes

The non-chlorinated aqueous cleaning composition of the presently claimed invention may

optionally comprise one or more dyes. The dye is used to colour the non-chlorinated aqueous cleaning composition. This might render the product more attractive to the consumer. Dyes that can be used in the cleaning composition include, but are not limited to, Nylosan[®] yellow N-7GL, Sanolin[®] brilliant flavine 8GZ, Sanolin[®] yellow BG, Vitasyn[®] quinoline yellow 70, Vitasyn[®] tartrazine X90, Puricolor[®] yellow AYE23, Basacid yellow 232, Vibracolor[®] yellow AYE17, Simacid[®] Eosine Y, Puricolor[®] red ARE27, Puricolor[®] red ARE14, Vibracolor[®] red ARE18, Vibracolor[®] red ARE52, Vibracolor[®] red SRE3, Basacid[®] red 316, Ponceau[®] SX, Iragon[®] blue DBL86, Sanolin[®] blue EHRL, Sanolin[®] turquoise blue FBL, Basacid[®] blue 750, Iragon[®] blue ABL80, Vitasyn[®] blue AE90, Basacid[®] blue755, Vitasyn[®] patentblue V 8501 and Vibracolor[®] green AGR25.

Fragrances

The non-chlorinated aqueous cleaning composition of the presently claimed invention may optionally comprise one or more fragrances. Suitable fragrances are those derived from natural sources or are synthetic aromatic substances. Natural aromatic substances are, for example, extracts from blossom (lilies, lavender, roses, jasmine, neroli, ylang-ylang), from stems and leaves (geranium, patchouli, petitgrain), from fruit (aniseed, coriander, caraway, juniper), from fruit peel (bergamot, lemons, oranges), from roots (mace, angelica, celery, cardamom, costus, iris, calamus), from wood (pinewood, sandalwood, guaiacum wood, cedarwood, rose-wood), from herbs and grasses (tarragon, lemon grass, sage, thyme), from needles and twigs (spruce, pine, scots pine, mountain pine), from resins and balsams (galbanum, elemi, benzoin, myrrh, olibanum, opopanax). Typical synthetic aromatic substances are, for example, products of the ester, ether, aldehyde, ketone, alcohol or hydrocarbon type. Aromatic substance compounds of the ester type are, for example, benzyl acetate, phenoxyethyl isobutyrate, p-tert-butyl cyclohexyl acetate, linalyl acetate, dimethylbenzylcarbiny acetate, phenylethyl acetate, linalyl benzoate, benzyl formate, ethylmethylphenyl glycinate, allylcyclohexyl propionate, styrallyl propionate and benzyl salicylate. The ethers include, for example, benzyl ethyl ether; the aldehydes include, for example, the linear alkanals having from 8 to 18 hydrocarbon atoms, citral, citronellal, citronellyl oxyacetaldehyde, cyclamen aldehyde, hydroxy citronellal, lilial and bourgeonal; the ketones include, for example, the ionones, isomethylionone and methyl cedryl ketone; the alcohols include, for example, anethol, citronellol, eugenol, isoeugenol, geraniol, linalool, phenyl ethyl alcohol and terpinol; and the hydrocarbons include mainly the terpenes and balsams. Ethereal oils of relatively low volatility, which are chiefly used as aroma components, are also suitable for fragrance, e.g. sage oil, camomile oil, clove oil, melissa oil, oil of cinnamon leaves, lime blossom oil, juniper berry oil, vetiver oil, olibanum oil, galbanum oil, labolanum oil and lavandin oil.

40 Anti-microbial agents

The non-chlorinated aqueous cleaning composition of the presently claimed invention may optionally comprise one or more anti-microbial agents. Generally, these materials fall in

specific classes including phenolics, halogen compounds, quaternary ammonium compounds, metal derivatives, amines, alkanol amines, nitro derivatives, anilides, organosulfur and sulfur-nitrogen compounds and miscellaneous compounds. The given antimicrobial agent depending on chemical composition and concentration may simply limit further proliferation of numbers of the microbe or may destroy all or a substantial proportion of the microbial population. The terms "microbes" and "microorganisms" typically refer primarily to bacteria and fungus microorganisms. Common antimicrobial agents that may be used include phenolic antimicrobials such as pentachlorophenol, orthophenylphenol; halogen containing antibacterial agents that may be used include sodium trichloroisocyanurate, sodium dichloroisocyanurate (anhydrous or dihydrate), iodine-poly(vinylpyrrolidin-onen) complexes, bromine compounds such as 2-bromo-2-nitropropane-1,3-diol; quaternary antimicrobial agents such as benzalkonium chloride, cetylpyridiniumchloride; amines and nitro containing antimicrobial compositions such as hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine, dithiocarbamates such as sodium dimethyldithiocarbamate, and a variety of other materials known in the art for their microbial properties. When an antimicrobial agent is incorporated into the composition, the composition of an antimicrobial agent can be present in the range of approximately 0-10000 ppm in cleaning solutions at use concentrations.

20 **Thickening agents**

The non-chlorinated aqueous cleaning compositions of the presently claimed invention may also comprise viscosity modifiers or thickeners for obtaining a desired viscosity of the laundry detergent composition. Suitable viscosity modifiers are polysaccharides, for e.g. xanthan gum, carboxymethylcellulose, organic clays (organically modified or unmodified), polycarboxylates and silicates. Some examples of additional thickeners include soluble organic or inorganic thickener material. Some examples of inorganic thickeners include clays, silicates and other well-known inorganic thickeners. Some examples of organic thickeners include thixotropic and non-thixotropic thickeners. In some embodiments, the thickeners have some substantial proportion of water solubility to promote easy removability. Examples of soluble organic thickeners are, but not limited to, carboxylated vinyl polymers such as polyacrylic acids and sodium salts thereof, ethoxylated cellulose, polyacrylamide thickeners, xanthan thickeners, guar gum, sodium alginate and algin by-products, hydroxy propyl cellulose, hydroxy ethyl cellulose and other similar aqueous thickeners that have some substantial proportion of water solubility.

Anti-redeposition agents

Antiredeposition agents are useful in the presently claimed invention to assist in reducing redepositing of the removed soil onto the surface being cleaned. Anti-redeposition agent(s) can provide their effect by becoming adsorbed irreversibly or reversibly to the soil particles or to the article surface, thereby the soil becomes better dispersed in the non-chlorinated aqueous cleaning compositions or the article is occupied with anti-redeposition agent(s) on those places the soil could redeposit. Examples of the anti-redeposition

agent(s) that are known to be used in the cleaning compositions include, but are not limited to, carboxymethyl cellulose, polyester-PEG co-polymer and polyvinyl pyrrolidone based polymers.

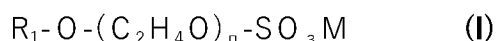
5 Fatty alcohol

The non-chlorinated aqueous cleaning compositions of the presently claimed invention may also comprise at least one fatty alcohol. The at least one fatty alcohol is derived from vegetable oil. Preferred fatty alcohol have a carbon chain length in the range of 10 to 24.

10 Tallows produce a fairly narrow range of alcohols, predominantly C₁₆-C₁₈. Higher alcohols (C₂₀-C₂₂) can be obtained from rapeseed oil or mustard seed oil. Midcut alcohols are obtained from coconut oil (C₁₂-C₁₄) or palm kernel oil (C₁₆-C₁₈). A preferred fatty alcohol is C₁₂-C₁₆ fatty alcohol.

15 In another embodiment, the presently claimed invention relates to a non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14 comprising

(a) at least one alkyl ether sulfate of general formula (I)



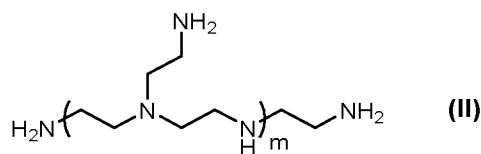
wherein

R₁ denotes linear or branched, unsubstituted C₆-C₂₂ alkyl,

20 n is an integer in the range of from 1 to 20, and

M denotes alkali metal or ammonium;

(b) at least one polyethyleneimine of general formula (II)



wherein

25 m is an integer in the range of from 10 to 1000;

(c) at least one alkyl polyglycoside of general formula (III)



wherein

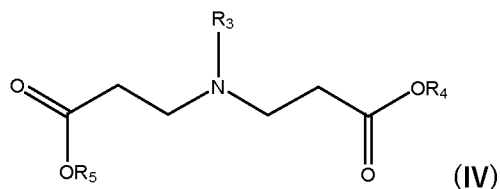
G₁ is a monosaccharide

30 R₂ denotes linear or branched, unsubstituted C₄-C₁₄ alkyl,

x is an integer in the range of from 1 to 10;

(d) at least one alkyl iminodipropionate of general formula (IV)

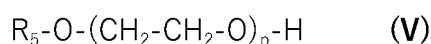
16



wherein

R₃ denotes linear or branched, substituted or unsubstituted C₆-C₁₆ alkyl

- 5 R₄ and R₅ are identical or different and denote H or alkali metal; and
 (e) at least one ethoxylated surfactant of general formula (V)

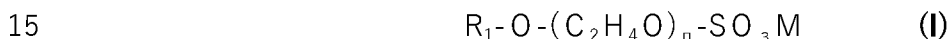


wherein

- 10 R₅ denotes linear or branched, unsubstituted C₆-C₁₈ alkyl; and
 p is an integer in the range of from 1 to 15.

In another embodiment, the presently claimed invention relates to a non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14 comprising

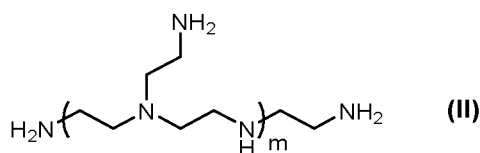
- (a) at least one alkyl ether sulfate of general formula (I)



wherein

R₁ denotes linear or branched, unsubstituted C₆-C₂₂ alkyl,
 n is an integer in the range of from 1 to 20, and
 M denotes alkali metal or ammonium;

- 20 (b) at least one polyethyleneimine of general formula (II)



wherein

m is an integer in the range of from 10 to 1000;

- 25 (c) at least one alkyl polyglycoside of general formula (III)

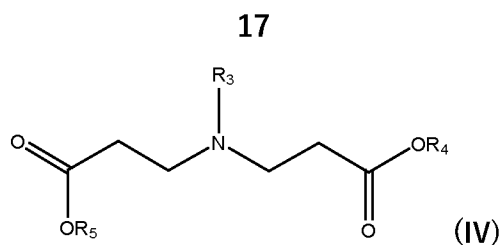


wherein

G₁ is a monosaccharide

- 30 R₂ denotes linear or branched, unsubstituted C₄-C₁₄ alkyl,
 x is an integer in the range of from 1 to 10;

- (d) at least one alkyl iminodipropionate of general formula (IV)



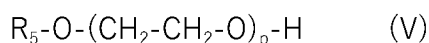
wherein

R_3 denotes linear or branched, substituted or unsubstituted C_6-C_{16} alkyl

5 R_4 and R_5 are identical or different and denote H or alkali metal; and

(e) at least one ethoxylated surfactant of general formula (V)

(f)



wherein

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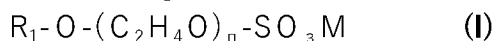
R_5 denotes linear or branched, unsubstituted C_6-C_{18} alkyl;

p is an integer in the range of from 1 to 15; and

(g) at least one additive.

15 In an embodiment, the presently claimed invention relates to a non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14 consisting of

(a) at least one alkyl ether sulfate of general formula (I)



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wherein

R_1 denotes linear or branched, unsubstituted C_6-C_{22} alkyl,

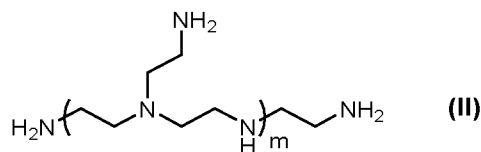
n is an integer in the range of from 1 to 20, and

M denotes alkali metal or ammonium;

(b) at least one polyethyleneimine of general formula (II)

25

(c)



wherein

m is an integer in the range of from 10 to 1000;

(d) at least one alkyl polyglycoside of general formula (III)

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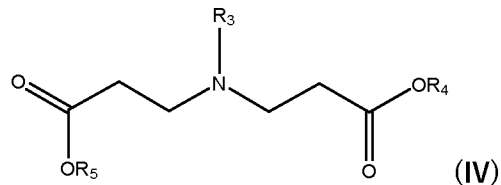
wherein

G_1 is a monosaccharide

R_2 denotes linear or branched, unsubstituted C_4 - C_{14} alkyl,

x is an integer in the range of from 1 to 10; and

- 5 (e) at least one alkyl iminodipropionate of general formula (IV)



wherein

R_3 denotes linear or branched, substituted or unsubstituted C_6 - C_{16} alkyl

- 10 R_4 and R_5 are identical or different and denote H or alkali metal.

In another aspect, the presently claimed invention relates to a method for the removal of protein and fat-based soil from an article having a soiled surface, said method comprising the steps of

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- (i) contacting the said article with the non-chlorinated aqueous cleaning composition as described herein above, at a temperature in the range of 20 °C to 60 °C; and
 (ii) rinsing the article with water.

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'Contacting' herein refers to contacting the surface of the article with the non-chlorinated aqueous cleaning composition either by applying it manually, i.e. by hand on the soiled surface or by means of a spraying device, preferably a pressure spraying device. The pressure spraying device aerates the non-chlorinated aqueous cleaning composition such that the cleaning formulation is ejected from the spray nozzle as foam. The foam provides a greater surface residence time for the cleaning composition, thereby improving cleaning performance.

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In an embodiment, the step (ii) of rinsing the article is carried out by spraying water at high pressure. The pressurized water can be applied by high pressure units and special spraying lances. In an embodiment, the pressure of the pressurized water is between 30-70 bar.

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These surfaces can include equipment surfaces not cleaned by automated clean-in-place systems, external surfaces of equipment of any metal type, any part of the processing equipment that is not enclosed and the walls and floors of the processing plants. It encompasses all parts of the plant except the insides of the equipment and pipes.

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In an embodiment, the presently claimed invention relates to the method for the removal of protein and fat-based soil from an article having a soiled surface, said method comprising the steps of

- 5 (i) contacting the said article with the non-chlorinated aqueous cleaning composition as described herein above, at a temperature in the range of 20 °C to 60 °C for a contact time in the range of 5 minutes to 30 minutes; and
(ii) rinsing the article with water.

10 In an embodiment, the presently claimed invention relates to the method for the removal of protein and fat-based soil from an article having a soiled surface, said method comprising the steps of

- 15 (i) contacting the said article with the non-chlorinated aqueous cleaning composition as described herein above, at a temperature in the range of 20 °C to 60 °C;
(ii) rinsing the article with water, and
(iii) drying the article.

20 In an embodiment, the presently claimed invention relates to the method for the removal of protein and fat-based soil from an article having a soiled surface, said method comprising the steps of

- 25 (i) contacting the said article with the non-chlorinated aqueous cleaning composition as described herein above, at a temperature in the range of 20 °C to 60 °C for a contact time in the range of 5 minutes to 30 minutes;
(ii) rinsing the article with water, and
(iii) drying the article.

In an embodiment, for step (ii) of rinsing the article, potable water is used. Potable water is the water which is fit for human consumption.

30 Step (ii), of rinsing the article, can be performed once or repeated several times to remove the soil. An optional drying step may be applied, if required.

In another aspect, the presently claimed invention relates to the use of the non-chlorinated composition as described herein above in open plant cleaning.

35 Said compositions are used in cleaning food soiled surfaces. The composition of the presently claimed invention may be manufactured and/or supplied as 'ready to use' formulations or as concentrates for dilution. Said products being enclosed in metal, plastic, composite, laminate, paper, paperboard, or water-soluble protective packaging. Said products being designed for open plant cleaning (OPC) regimens in food process industries such as dairy farm; fluid milk and processed milk by-product, red meat, poultry,
40 fish, and respective processed by-products, soft drink, juice, and fermented beverages, egg, dressings, condiments, and other fluid food processing, and, fresh, frozen, canned or ready-to-serve processed foodstuffs.

The cleaning composition is pumped with air to form a foam lather that remains on the vertical surfaces of the equipment, allowing chemical interaction with the soils in question.

The non-chlorinated aqueous cleaning composition is applied on the articles having a metallic surface such as stainless steel, aluminum and other surfaces including, but not limited to, glass, rubber and plastic. The composition of the presently claimed invention do not corrode the metal surface.

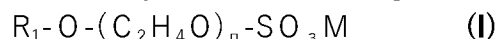
Advantages

1. The cleaning composition of the presently claimed invention is free of chlorine.
2. The cleaning composition of the presently claimed invention has limited corrosion effects on metals.
3. The cleaning composition of the presently claimed invention show a better effect in terms of removal of protein and fat-based soils as the cleaning composition generates a good clinging foam which adheres to the vertical surfaces for a time sufficient for effective cleaning.

Embodiments

1. A non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14, comprising

- (a) at least one alkyl ether sulfate of general formula (I)



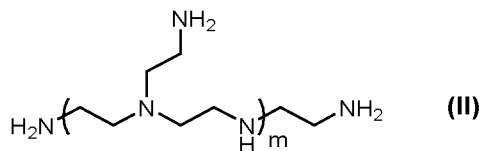
wherein

R_1 denotes linear or branched, unsubstituted C_6 - C_{22} alkyl,

n is an integer in the range of from 1 to 20, and

M denotes alkali metal or ammonium;

- (b) at least one polyethyleneimine of general formula (II)



wherein

m is an integer in the range of from 10 to 1000;

- (c) at least one alkyl polyglycoside of general formula (III)



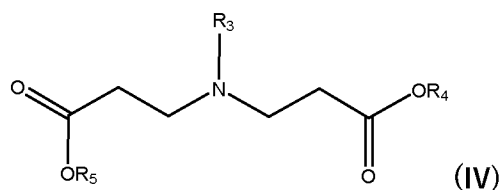
wherein

G_1 is a monosaccharide

R_2 denotes linear or branched, unsubstituted C_4 - C_{14} alkyl,

x is an integer in the range of from 1 to 10; and

- (d) at least one alkyl iminodipropionate of general formula (IV)



wherein

R_3 denotes linear or branched, substituted or unsubstituted C₆-C₁₆ alkyl

R_4 and R_5 are identical or different and denote H or alkali metal.

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2. The non-chlorinated aqueous cleaning composition according to embodiment 1, wherein the amount of the at least one alkyl ether sulfate of general formula (I) is in the range of from 3.0 % to 10.0 % by weight, based on the total weight of the composition.
3. The non-chlorinated aqueous cleaning composition according to embodiment 1, wherein the amount of the at least one polyethyleneimine of general formula (II) is in the range of from 0.1 % to 4.0 % by weight, based on the total weight of the composition.
4. The non-chlorinated aqueous composition according to embodiment 1, wherein the amount of the at least one alkyl polyglycoside of general formula (III) is in the range of from 3.0 % to 10.0 % by weight, based on the total weight of the composition.
5. The non-chlorinated aqueous composition according to embodiment 1, wherein the amount of at least one alkyl iminodipropionate of general formula (IV) is in the range of from 5.0 % to 20.0 % by weight, based on the total weight of the composition.
6. The non-chlorinated aqueous cleaning composition according to embodiment 1, wherein the pH is adjusted by adding at least one alkaline agent.
7. The non-chlorinated aqueous cleaning composition according to embodiment 6, wherein the at least one alkaline agent is selected from alkali metal hydroxide, alkaline earth metal hydroxide, alkylamine, ethanolamine, alkali metal carbonate or bicarbonate and silicate.
8. The non-chlorinated aqueous cleaning composition according to embodiment 6, wherein the at least one alkaline agent is present in an amount in the range of from 5.0 % to 16.0 % by weight, based on the total weight of the composition.

9. The non-chlorinated aqueous cleaning composition according to embodiment 1, further comprising at least one chelating agent.
10. The non-chlorinated aqueous cleaning composition according to embodiment 9, wherein the at least one chelating agent is selected from aminopolycarboxylate and polycarboxylic acid.
11. The non-chlorinated aqueous cleaning composition according to embodiment 10, wherein the aminopolycarboxylate is selected from ethylene diamine tetraacetic acid, tetrasodium ethylene diamine tetraacetate, diammonium ethylene diamine tetraacetate, trisodium hydroxyethylethylene diamine triacetate, methyl glycine diacetic acid, glutamic acid diacetic acid, glutamic acid diacetic acid tetrasodium salt and nitrilotriacetic acid.
12. The non-chlorinated aqueous cleaning composition according to embodiment 10, wherein the polycarboxylic acid is citric acid.
13. The non-chlorinated aqueous cleaning composition according to one or more of embodiments 9 to 12, wherein the at least one chelating agent is present in an amount in the range of from 2.0 % to 10.0 % by weight, based on the total weight of the composition.
14. The non-chlorinated aqueous cleaning composition according to embodiment 1, further comprising at least one ethoxylated surfactant of general formula (V)
- $$R_5-O-(CH_2-CH_2-O)_p-H \quad (V)$$
- wherein
 R_5 denotes linear or branched, unsubstituted C_6-C_{18} alkyl; and
 p is an integer in the range of from 1 to 15.
15. The non-chlorinated aqueous cleaning composition according to embodiment 14, wherein the amount of the at least one ethoxylated surfactant of general formula (V) is in the range of from 0 to 5.0 % by weight, based on the total weight of the composition.
16. The non-chlorinated aqueous cleaning composition according to embodiment 1 further comprising at least one additive.
17. The non-chlorinated aqueous cleaning composition according to embodiment 16, wherein the at least one additive is selected from solvents, amine oxides, curing agents, dyes, fragrances, antimicrobial agents, thickening agents, anti-redeposition agents and fatty alcohols.

18. The non-chlorinated aqueous cleaning composition according to embodiment 16 or 17, wherein the amount of the at least one additive is in the range of 0 to 30.0 % by weight, based on the total weight of the composition.
- 5
19. The non-chlorinated aqueous cleaning composition according to one or more of embodiments 1 to 18, wherein the amount of free chlorine is less than 1.0 ppm.
20. A method for the removal of protein and fat-based soil from an article having a soiled surface, comprising the steps of
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- (i) contacting the said article with the non-chlorinated aqueous cleaning composition according to one or more of embodiments 1 to 19, at a temperature in the range of 20 °C to 60 °C; and
- (ii) rinsing the article with water.
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21. The method according to embodiment 18, wherein in step (i) the contact time is in the range of 5 minutes to 30 minutes.
22. The method according to embodiment 18, further comprising step (iii) drying the
- 20
- article.
23. Use of the non-chlorinated aqueous cleaning composition according to one or more of embodiments 1 to 19 in open plant cleaning.

Experimental Section

Compounds

5 Compound A: Compound of general formula (I): Sodium laureth sulfate, 2 EO)

Compound B: Compound of general formula (II): polyethyleneimine, average molecular weight of 2000 g/mol as determined by Gel permeation chromatography.

10 Compound C: Compound of general formula (III): C₈-C₁₀ glucoside

Compound D: Compound of general formula (IV): N-lauryl-β-iminodipropionate

15 Compound E: Compound of general formula (V): Tridecyl alcohol ethoxylate (9EO), weight average molecular weight 590 g/mol

Trilon® M (trisodium salt of methylglycinediacetic acid)

Baxxodur® EC 280 (curing agent)

Baxxodur® EC 301 (curing agent)

20 C₁₂-C₁₆ fatty alcohol

are available from BASF SE, Ludwigshafen, Germany.

Test Methods

25 The degree of polymerization, x was determined by high temperature gas chromatography (HTGC), in accordance with K. Hill et. Al., Alkyl Polyglucosides, VCH Weinheim, page 28 ff.

Weight average molecular weight "Mw" was determined according to DIN 55672-1 and referred to a polystyrene calibration standard.

30

Examples

The non-chlorinated aqueous cleaning compositions of examples 1 to 5 were prepared as per the details provided in Table-1

Table-1: Non-chlorinated aqueous cleaning composition

Product	Example 1	Example 2	Example 3	Example 4	Example 5
Compound A	4.29	4.29	4.29	4.29	4.29
Compound C	4.29	4.29	4.29	4.29	4.29
Lauramine oxide	10	0	0	10	10
Compound D	10	10	10	10	10
Compound E	2	2	2	2	2
Compound B	1	1	1	1	1
Fatty Alcohol (C ₁₂ -C ₁₆)	0.5	0.5	0.5	0	0.5
Butyldiglycol (BDG)	3	3	3	0	3
KOH (45%)	8.33	8.33	8.33	8.33	8.33
NaOH (50%)	7	7	7	7	7
Trilon® M	8.75	8.75	8.75	8.75	0
Baxxodur® EC 280	0	2	0	0	0
Baxxodur® EC 301	0	0	2	0	0
Sodium citrate	0	0	0	0	3.5
Water	40.84	48.84	48.84	44.34	46.09

Cleaning test

5 Procedure:

Aluminium-5052 panels of 3" x6" were soiled with a blend of lard and egg and heated for 15 minutes at 50 ° C in an oven. A dilute solution of composition of example-1 was prepared by adding 47 ml of example-1 in 1 L water and this was then added to the holding tank of the spray box. This was then sprayed on the panels at a pressure of 60 psi for 20 seconds. The cling time on the aluminum panel was measured. The aluminum panel was rinsed off with water and allowed to dry overnight. The panel was weighed before and

after cleaning to calculate the percent clean gravimetrically. The procedure was conducted at two different temperatures: 23 °C and 40 °C. The same procedure was repeated for cleaning composition of example-2.

5 Table-2: Cleaning results at temperature 23 °C

Cleaning composition	% clean
Example-1	68
Example-2	30
Example-3	24
Example-4	-
Example-5	23

Table 3: Cleaning results at temperature 40 °C

Cleaning composition	% clean
Example-1	91
Example-2	90
Example-3	83
Example-4	81
Example-5	83

As presented in tables 2 and 3 above, the compositions of the present invention provide the cleaning flexibility desired in open plant cleaning at low and high temperatures.

10

Foam test

Foam test was performed on Dynamic Foam analyzer (DFA) 100, Krüss

15 Procedure:

Dynamic Foam analyzer (DFA) 100, Krüss, measures the foamability of liquids and the foam stability based on precise measurements of the foam height. It also measures the liquid content of the foam and analyses the foam structure regarding bubble size and distribution.

20 1000 ppm each of solution of example-1, 2, 3 and 4 was prepared. Sparging at 8000 rpm was done. Foam was generated for 30 seconds and foam stability data over 10 minutes was generated.

Table 4: Foam stability data

Example no.	Foam height (mm)		Foam stability (%) over 10 minutes
	30 sec	10 minutes	
Example 1	119	72	60
Example 2	113	59	50
Example 3	115	61	51
Example 4	120	81	65

As observed from the data of Table 4, the decay of foam is very slow over 10 minutes period, indicating that the foam generated by the compositions of the presently claimed invention is stable. This indicates that the foam has the capacity to cling to the surface of the article to be cleaned for a longer time, offering a greater time for interaction with the soil for its effective removal.

Corrosion test:

10 Corrosion test was performed on two grades of aluminium, Al-5052 and Al-6063 and two grades of stainless steel, SS-304 and SS-316,

Procedure:

15 47 ml of composition of each of example 1 and example 2 was diluted with 1 L water and the dilution was added to four glass vials, each containing a strip of metal. These glass vials were placed at 50 ° C for 7 days. The corrosion rate was calculated (in mm/y) using the following equation:

$$\text{mm/y} = 87.6 * (W/DAT)$$

20 where,

W=weight loss in mg

D=metal density in g/cm³

A=area of sample in cm²

T=exposure time in hours

25

Table 5: Corrosion rate

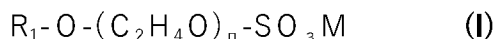
Example no.	Corrosion rate (mm/y)			
	Aluminum		Stainless steel	
	Al-5052	Al-6063	SS-304	SS-316
Example 1	0.63	1.04	0.00013	0.00065
Example 2	0.57	0.59	0.0009	0.00013

A lower value of corrosion rate indicates low corrosive effect on the metal surface. This indicates that the non-chlorinated aqueous cleaning composition of the presently claimed invention have insignificant corrosive effect on the metal surface of equipment.

Claims:

1. A non-chlorinated aqueous cleaning composition having a pH in the range of 10 to 14, comprising

5 (a) at least one alkyl ether sulfate of general formula (I)



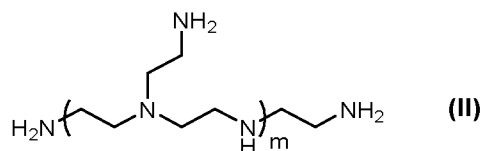
wherein

R_1 denotes linear or branched, unsubstituted C_6-C_{22} alkyl,

n is an integer in the range of from 1 to 20, and

10 M denotes alkali metal or ammonium;

(b) at least one polyethyleneimine of general formula (II)



wherein

m is an integer in the range of from 10 to 1000;

15 (c) at least one alkyl polyglycoside of general formula (III)



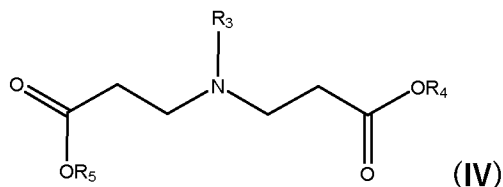
wherein

G_1 is a monosaccharide

R_2 denotes linear or branched, unsubstituted C_4-C_{14} alkyl,

20 x is an integer in the range of from 1 to 10; and

(d) at least one alkyl iminodipropionate of general formula (IV)



wherein

25 R_3 denotes linear or branched, substituted or unsubstituted C_6-C_{16} alkyl

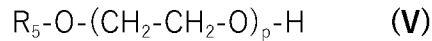
R_4 and R_5 are identical or different and denote H or alkali metal.

30 2. The non-chlorinated aqueous cleaning composition according to claim 1, wherein the amount of the at least one alkyl ether sulfate of general formula (I) is in the range of from 3.0 % to 10.0 % by weight, based on the total weight of the composition.

3. The non-chlorinated aqueous cleaning composition according to claim 1, wherein the amount of the at least one polyethyleneimine of general formula (II) is in the range of from 0.1 % to 4.0 % by weight, based on the total weight of the composition.
- 5
4. The non-chlorinated aqueous composition according to claim 1, wherein the amount of the at least one alkyl polyglycoside of general formula (III) is in the range of from 3.0 % to 10.0 % by weight, based on the total weight of the composition.
- 10
5. The non-chlorinated aqueous composition according to claim 1, wherein the amount of at least one alkyl iminodipropionate of general formula (IV) is in the range of from 5.0 % to 20.0 % by weight, based on the total weight of the composition.
- 15
6. The non-chlorinated aqueous cleaning composition according to claim 1, wherein the pH is adjusted by adding at least one alkaline agent.
- 20
7. The non-chlorinated aqueous cleaning composition according to claim 6, wherein the at least one alkaline agent is selected from alkali metal hydroxide, alkaline earth metal hydroxide, alkylamine, ethanolamine, alkali metal carbonate or bicarbonate and silicate.
- 25
8. The non-chlorinated aqueous composition according to claim 6, wherein the at least one alkaline agent is present in an amount in the range of from 5.0 % to 16.0 % by weight, based on the total weight of the composition.
- 30
9. The non-chlorinated aqueous cleaning composition according to claim 1, further comprising at least one chelating agent.
- 35
10. The non-chlorinated aqueous cleaning composition according to claim 9, wherein the at least one chelating agent is selected from aminopolycarboxylate and polycarboxylic acid.
- 40
11. The non-chlorinated aqueous cleaning composition according to claim 10, wherein the aminopolycarboxylate is selected from ethylene diamine tetraacetic acid, tetrasodium ethylene diamine tetraacetate, diammonium ethylene diamine tetraacetate, trisodium hydroxyethylethylene diamine triacetate, methyl glycine diacetic acid, glutamic acid diacetic acid, glutamic acid diacetic acid tetrasodium salt and nitrilotriacetic acid.
12. The non-chlorinated aqueous cleaning composition according to claim 10, wherein the polycarboxylic acid is citric acid.

13. The non-chlorinated aqueous composition according to one or more of claims 9 to 12, wherein the at least one chelating agent is present in an amount in the range of from 2.0 % to 10.0 % by weight, based on the total weight of the composition.

5 14. The non-chlorinated aqueous cleaning composition according to claim 1, further comprising at least one ethoxylated surfactant of general formula (V)



wherein

10 R_5 denotes linear or branched, unsubstituted C_6-C_{18} alkyl; and
 p is an integer in the range of from 1 to 15.

15 15. The non-chlorinated aqueous composition according to claim 14, wherein the amount of the at least one ethoxylated surfactant of general formula (V) is in the range of from 0 to 5.0 % by weight, based on the total weight of the composition.

16. The non-chlorinated aqueous cleaning composition according to claim 1 further comprising at least one additive.

20 17. The non-chlorinated aqueous cleaning composition according to claim 16, wherein the at least one additive is selected from solvents, amine oxides, curing agents, dyes, fragrances, antimicrobial agents, thickening agents, anti-redeposition agents and fatty alcohols.

25 18. The non-chlorinated aqueous cleaning composition according to claim 16 or 17, wherein the amount of the at least one additive is in the range of 0 to 30.0 % by weight, based on the total weight of the composition.

30 19. The non-chlorinated aqueous cleaning composition according to one or more of claims 1 to 18, wherein the amount of free chlorine is less than 1 ppm.

20. A method for the removal of protein and fat-based soil from an article having a soiled surface, comprising the steps of

35 (i) contacting the article with the non-chlorinated aqueous cleaning composition according to one or more of claims 1 to 19, at a temperature in the range of 20 °C to 60 °C; and
 (ii) rinsing the article with water.

40 21. The method according to claim 20, wherein in step (i) the contact time is in the range of 5 minutes to 30 minutes.

22. The method according to claim 20, further comprising step (iii) drying the article.

23. Use of the non-chlorinated aqueous composition according to one or more of claims 1 to 19 in open plant cleaning.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/053257

A. CLASSIFICATION OF SUBJECT MATTER
 INV. C11D1/83 C11D3/00 C11D3/37 C11D11/00 C11D17/00
 C11D1/94
 ADD.
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
 C11D

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 2014/148374 A1 (MAN VICTOR FUK-PONG [US] ET AL) 29 May 2014 (2014-05-29) example 3 paragraph [0196] the whole document	1-23

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "&" document member of the same patent family

Date of the actual completion of the international search 3 April 2020	Date of mailing of the international search report 15/04/2020
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Yildirim, Zeynep
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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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