



- (51) **International Patent Classification:**
C11D 1/37 (2006.01)
- (21) **International Application Number:** PCT/EP2015/058969
- (22) **International Filing Date:** 24 April 2015 (24.04.2015)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
14168231.0 14 May 2014 (14.05.2014) EP
- (71) **Applicant** (for all designated States except AE, AG, AU, BB, BH, BN, BW, BZ, CA, CY, EG, GB, GD, GH, GM, IE, IL, IN, KE, KN, LC, LK, LS, MT, MW, MY, NA, NG, NZ, OM, PG, QA, RW, SA, SC, SD, SG, SL, SZ, TT, TZ, UG, US, VC, ZA, ZM, ZW): **UNILEVER N.V.** [NL/NL]; Weena 455, NL-3013 AL Rotterdam (NL).
- (71) **Applicant** (for AE, AG, AU, BB, BH, BN, BW, BZ, CA, CY, EG, GB, GD, GH, GM, IE, IL, IN, KE, KN, LC, LK, LS, MT, MW, MY, NA, NG, NZ, OM, PG, QA, RW, SA, SC, SD, SG, SL, SZ, TT, TZ, UG, VC, ZA, ZM, ZW only): **UNILEVER PLC** [GB/GB]; Unilever House, 100 Victoria Embankment, London EC4Y 0DY (GB).
- (71) **Applicant** (for US only): **CONOPCO, INC., D/B/A UNILEVER** [US/US]; 800 Sylvan Avenue, AG West, S. Wing, Englewood Cliffs, New Jersey 07632 (US).
- (72) **Inventors:** **ASSIGHAOU, Souad**; Unilever R&D Port Sunlight, Quarry Road East, Bebington, Wirral, Merseyside CH63 3JW (GB). **BEST, Jonathan**; Unilever R&D Port Sunlight, Quarry Road East, Bebington, Wirral, Merseyside CH63 3JW (GB). **JOHNSTON, Helena, Marianne**; Unilever R&D Port Sunlight, Quarry Road East, Bebington, Wirral, Merseyside CH63 3JW (GB). **THORLEY, David, Christopher**; Unilever R&D Port Sunlight, Quarry Road East, Bebington, Wirral, Merseyside CH63 3JW (GB).
- (74) **Agent:** **CORSTEN, Michael, A.**; Unilever Patent Group, Olivier van Noortlaan 120, NL-3133 AT Vlaardingen (NL).
- (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, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, 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, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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).
- Declarations under Rule 4.17:**
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
 - as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
 - of inventorship (Rule 4.17(iv))
- Published:**
- without international search report and to be republished upon receipt of that report (Rule 48.2(g))



(54) **Title:** AN AQUEOUS ALKALINE HAND DISHWASH LIQUID DETERGENT FORMULATION

(57) **Abstract:** An aqueous alkaline hand dishwash liquid detergent formulation comprising: i) 9 to 20 wt% of a surfactant system; wherein 2 to 5 wt% of the surfactant system comprises a linear alkyl benzene sulfonate; and 7 to 17 wt% of the surfactant system comprise an alkyl ether sulfate; and wherein less than 1 wt% of the surfactant system comprises non-ionic surfactant; and wherein the weight ratio of linear alkyl benzene sulfonate (as LAS acid) to alkyl ether sulfate is lower than or equal to 1 : 2.2; and ii) wherein the pH of the formulation is in the range 9.1 to 11; iii) wherein the formulation further comprises a pH adjustment, buffering and thickening system which comprises at least 5 wt% of the total formulation, wherein the system comprises one or more components selected from the group consisting of sodium carbonate, sodium hydrogen carbonate, potassium carbonate and potassium hydrogen carbonate; and iv) wherein the formulation has a viscosity in the range of from 1.5 to 6.0 Pa.s when measured at a shear rate of 21 s⁻¹ at 25 °C.

**AN AQUEOUS ALKALINE HAND DISHWASH LIQUID DETERGENT
FORMULATION**

Technical Field of the Invention

5

This present invention relates to an improved aqueous alkaline hand dishwash liquid detergent formulation comprising a surfactant system which includes a linear alkyl benzene sulfonate and an alkyl ether sulfate, and a buffering and thickening system, which provides enhanced cleaning power, particularly against resistant dried-on and

10 burnt-on soil. The aqueous alkaline hand dishwash liquid detergent formulation is also isotropic and is an un-built hand dishwash liquid detergent formulation.

Background of the Invention

15

Hand dish-wash liquid detergent formulations suitable for washing dishes are well known. However, it is essential that the formulations are able to deliver excellent grease and soil removal at a competitive price. Unfortunately, changing the components and parameters of hand-dish wash formulations often changes the viscosity of the formulations leading to the requirement of more expensive components to balance the effect. Therefore

20 balancing the components of hand dish wash liquid detergent formulations against cleaning performance poses difficulties for hand dish-wash formulators.

25

For example, in GB833444 there is described both 'built' and 'un-built' foaming detergent compositions. This patent teaches that foaming light-duty detergent compositions may be prepared by formulating an anionic alkyl aryl sulfonate and a non-ionic, surface active polyoxyethylene ether of a multi-branched primary aliphatic alcohol or by formulating an anionic sulfate ester of a polyoxyethylene derivative and an anionic alkyl aryl sulfonate, to create a composition at neutral pH.

30

US 3332877 discloses a neutral synergistic ternary detergent composition for light duty dishwashing liquids containing at least 30 weight % surfactant derived from two anionic surfactants and a zwitterionic surfactant but does not include the use of a linear alkyl benzene sulfonate.

- 2 -

WO 93/14183 discloses stable colourless detergent compositions and is particularly interested in soaps, and shampoos comprising from 9 to 95% anionic or non-ionic surfactant. Whilst this document does also mentions hand dish wash formulations, these formulations are also pH neutral and do not comprise a linear alkyl benzene sulfonate.

5

US 6225272 discloses a pourable, storage-stable manual dishwashing detergent which contains various surfactants, an electrolyte, optionally a solvent, and at least 45% percent sodium bicarbonate with a mean particle diameter of at least 150 micrometers and provides good pouring properties and cleaning performance. However, the formulation does not include a linear alkyl benzene sulfonate.

10

WO 2010/105816 discloses the use of carbamide or a derivative thereof in various detergent compositions such as for example dishwasher detergents, laundry detergents and cleansers. The compositions may contain up to 40% by weight of surfactants and electrolytes. However, only one example of a hand dish wash formulation is included which comprises a pH of 5.4.

15

WO 2013/064356 and WO 2013/064357 disclose structured detergents or cleaning agent compositions with a flow limit and good dispersing properties. The detergent compositions comprise a mixture of anionic and non-ionic surfactants as well as inorganic salts and co-surfactants at a pH slightly above neutral.

20

CN 102492574 discloses a tableware detergent comprising by weight percent: N-fatty acyl glutamate (0.1 to 10), sulfonate anionic surfactant (1 to 25), non-ionic surfactant (1 to 25) and optionally, amphoteric, polyol wetting agents, electrolytes, pH regulators, antimicrobial agents, essence and water to produce a detergent with a neutral pH.

25

However, none of the formulations proposed in the prior art disclose or contemplate high-performance, dermatologically compatible, temperature-stable and storage-stable, pourable hand dishwashing formulations capable of removing obstinate soil and which comprise specific anionic surfactants at high pH. The reason for this may be because the use of, for example, sodium carbonate makes a composition suitably alkaline, but the present inventors have also found that the use of sodium carbonate alone leads to the requirement of other more expensive materials, such as citric acid, at high levels to achieve acceptable formulations. In addition, the use of amino based counter-ions such

35

- 3 -

as, for example, triethanolamine (TEA) with linear alkyl benzene sulfonates (LAS), produces compositions which are unacceptably thin and expensive.

The object of the present invention is therefore to deliver control of cleaning performance, rheology, and appearance in a hand dish wash concentrate composition at an acceptable
5 cost.

To meet these objectives, the inventors have now discovered that an alkaline formulation with a specified range of anionic surfactants in combination with a pH adjustment,
10 buffering and thickening system, is able to meet the demanding performance requirements of hand dish wash formulations if provided with a sufficient buffering capacity to maintain the alkaline pH during the cleaning process.

By pH adjustment, buffering and thickening system is meant a material which is able to
15 maintain the pH of a formulation and generate the required viscosity. A particular example is sodium carbonate.

In addition, a builder is able to sequester calcium and magnesium ions. A buffer may not necessarily be a builder. This depends on whether or not the functional group is able to
20 sequester calcium and/or magnesium ions. For example, carboxylic acid or phosphonate based buffers are also builders whereas amine based buffers are not builders.

Therefore in accordance with the present invention there is provided an aqueous alkaline hand dishwash liquid detergent formulation comprising:

25

- i) 9 to 20 wt% of a surfactant system;
wherein 2 to 5 wt% of the surfactant system comprises a linear alkyl benzene sulfonate; and 7 to 17 wt% of the surfactant system comprise an alkyl ether sulfate; and wherein less than 1 wt% of the surfactant system comprises non-
30 ionic surfactant; and wherein the weight ratio of linear alkyl benzene sulfonate to alkyl ether sulfate is lower than or equal to 1 : 2.2; and
- ii) wherein the pH of the formulation is in the range 9.1 to 11;
- iii) wherein the formulation further comprises a pH adjustment, buffering and thickening system which comprises at least 5 wt% of the total formulation,

- 4 -

wherein the system comprises one or more components selected from the group consisting of sodium carbonate, sodium hydrogen carbonate, potassium carbonate and potassium hydrogen carbonate; and

- 5 iv) wherein the formulation has a viscosity in the range of from 1.5 to 6.0 Pa.s when measured at a shear rate of 21^{-s} at 25 °C.

10 It is preferred that in the aqueous alkaline hand dishwash liquid detergent formulation according to the present invention, the linear alkyl benzene sulfonate has between 6 to 20 carbon atoms in its alkyl group. It is also preferred that the linear alkyl benzene sulfonate is sodium linear alkyl benzene sulfonate.

15 It is also preferred that the alkyl ether sulfate has between 8 and 22 carbon atoms in its alkyl group. More preferably the alkyl ether sulfate is sodium alkyl ether sulfate. Even more preferably the sodium alkyl ether sulfate is sodium alkyl ether sulfate (SLES) 1EO.

The pH of the formulation is preferably in the range 9.2 to 10.8. More preferably the pH of the formulation is in the range 9.2 to 10.5. Even more preferably, the pH of the formulation is in the range 9.2 to 9.8.

20 The pH adjustment, buffering and thickening system comprises one or more of the components selected from the group consisting of: sodium carbonate, sodium hydrogen carbonate, potassium carbonate, potassium hydrogen carbonate. Most preferably, the pH adjustment, buffering and thickening system comprises a mixture of sodium carbonate and sodium hydrogen carbonate.

25 It is preferred that the pH adjustment, buffering and thickening system comprises a maximum of 10 wt% of the total formulation. More preferably, however, the buffering and thickening system comprises between 5 and 7 wt% of the total formulation.

30 The formulation preferably comprises at least 65 wt% water. More preferably, the formulation comprises at least 68 wt% water.

- 5 -

The formulation preferably comprises a ratio of linear alkyl benzene sulfonate to alkyl ether sulfate in the range of 1 : 2.2 to 1 : 5.5 by weight. More preferably, the formulation comprises a ratio of linear alkyl benzene sulfonate to alkyl ether sulfate in the range of 1 : 2.2 to 1 : 5.0 by weight. Even more preferably the formulation comprises a ratio of linear alkyl benzene sulfonate to alkyl ether sulfate in the range of 1 : 2.2 to 1 : 1.40 by weight. Most preferably, however, the formulation comprises a ratio of linear alkyl benzene sulfonate to alkyl ether sulfate in the range of 1 : 2.2 to 1 : 3.5 by weight or even 1 : 2.2 to 1 : 3.0 by weight.

10 **Detailed Description of the Invention**

In the present invention, the term 'dish' means a hard surface, as is intended to be cleaned using a hand dish-wash formulation and includes: dishes, glasses, pots, pans, baking dishes and flatware made from any material or a combination of hard surface materials commonly used in the making of articles used for eating and/or cooking.

All amounts are by weight of the total composition, i.e. the aqueous alkaline hand dishwash liquid detergent formulation, unless otherwise specified.

20 **Surfactants**

In the present invention, the surfactant system is comprised of a mixture of a linear alkyl benzene sulfonate and alkyl ether sulfate with less than 1 wt% of the surfactant system comprising non-ionic surfactant.

25

The linear alkyl benzene sulfonate is preferably present in the hand dish wash formulation in an amount of 2 to 5.0 wt%. More preferably the linear alkyl benzene sulfonate is preferably present in the hand dish wash formulation in an amount of from 3 to 5 wt%. More preferably, the linear alkyl benzene sulfonate is preferably present in the hand dish wash formulation is an amount of from 3.25 to 4.95 wt%.

30

It is also preferred that the linear alkyl benzene sulfonate present in the hand dish wash formulation is in the form of a sodium salt. However, it will be appreciated, that other

- 6 -

counter-ions to the linear alkyl benzene sulfonate may be present, such as for example, potassium. The preferred length of the alkyl group is C8 to C18.

5 The alkyl ether sulfate is preferably present in the hand dish wash formulation in an amount of from 6 to 17 wt%. More preferably, the alkyl ether sulfate is present in the hand dish wash formulation in an amount of from 9 to 15 wt%.

10 It is also preferred that the alkyl ether sulfate present in the hand dish wash formulation is in the form of a sodium salt. However, it will be appreciated, that other counter-ions to the alkyl ether sulfate may be present, such as for example, potassium. The preferred length of the alkyl ether group is C8 to C18 alkyl with 1 to 3 ethoxylate (EO) groups. Most preferably the length of the alkyl ether group is C8 to C18 alkyl with 1 or 2 ethoxylate groups (EO).

15 In addition to the presence of linear alkyl benzene sulfonate and alkyl ether sulfate, additional surfactant may be present in the formulation. Additional surfactants (or detergent actives) may be chosen from, for example, other anionic and/or nonionic detergent actives. The cleaning formulation may further, or alternatively, comprise cationic, amphoteric and zwitterionic surfactants. However, in the formulation of the present invention the surfactant system comprises less than 1 wt% non-ionic surfactant.
20 In addition, in the formulation of the present invention the surfactant system preferably comprises less than 1 wt% cationic surfactants, less than 1 wt% amphoteric surfactants and less than 1 wt% zwitterionic surfactants.

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

30 Examples of such anionic surfactants are (primary) long chain (e.g. 6-22 C-atoms) alcohol sulfates (hereinafter referred to as PAS), especially those obtained by sulphating the fatty alcohols produced by reducing the glycerides of tallow or coconut oil; secondary alkanesulfonates; and mixtures thereof.

- 7 -

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

Nonionic surfactants tend to reduce the foam produced on use of the composition. Consumers frequently associate high foam with powerful cleaning so it is desirable to
10 either avoid the use of nonionic surfactant altogether, or to use less than 1 wt%. For compositions which do include a nonionic surfactant, suitable nonionic surfactants may be broadly described as compounds produced by the condensation of simple alkylene oxides, which are hydrophilic in nature, with an aliphatic or alkyl-aromatic hydrophobic compound having a reactive hydrogen atom. The length of the hydrophilic or
15 polyoxyalkylene chain which is attached to any particular hydrophobic group may be readily adjusted to yield a compound having the desired balance between hydrophilic and hydrophobic elements. This enables the choice of nonionic surfactants with the right 'HLB' value to be selected. The HLB value is a measure of the hydrophilic/lipophilic balance of such a surfactant.

20 Particular examples of preferred nonionic surfactants include: the condensation products of aliphatic alcohols having from 8 to 22 carbon atoms in either straight or branched chain configuration with ethylene oxide, such as a coconut alcohol/ethylene oxide condensates having from 2 to 15 moles of ethylene oxide per mole of coconut alcohol; condensates of
25 alkylphenols having C₆-C₁₅ alkyl groups with 5 to 25 moles of ethylene oxide per mole of alkylphenol; and condensates of the reaction product of ethylene-diamine and propylene oxide with ethylene oxide, the condensates containing from 40 to 80 wt% of ethyleneoxy groups and having a molecular weight of from 5,000 to 11,000.

30 Other classes of nonionic surfactants include for example: tertiary amine oxides of structure R₁R₂R₃N-O, where R₁ is an alkyl group of 8 to 20 carbon atoms and R₂ and R₃ are each alkyl or hydroxyalkyl groups of 1 to 3 carbon atoms, e.g. dimethyldodecylamine oxide; tertiary phosphine oxides of structure R₁R₂R₃P-O, where R₁ is an alkyl group of 8 to 20 carbon atoms and R₂ and R₃ are each alkyl or hydroxyalkyl groups of 1 to 3 carbon

- 8 -

atoms, for instance dimethyl-dodecylphosphine oxide; dialkyl sulphoxides of structure $R_1R_2S=O$, where R_1 is an alkyl group of from 10 to 18 carbon atoms and R_2 is methyl or ethyl, for instance methyl-tetradecyl sulphoxide; fatty acid alkylolamides, such as the ethanol amides; alkylene oxide condensates of fatty acid alkylolamides; and alkyl
5 mercaptans.

If one or more nonionic surfactants are to be employed the amount present in the cleaning compositions of the invention will generally be at least 0.1 wt%. Preferably the amount of nonionic surfactant will be in the region of 0.5 wt%.

10

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

20

Examples of suitable cationic surfactants may be selected from quaternary ammonium salts having one or two alkyl or aralkyl groups of from 8 to 20 carbon atoms and two or three small aliphatic (for example, methyl) groups, for instance cetyltrimethylammonium chloride.

25

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

30

Examples of suitable zwitterionic surfactants may be selected from derivatives of aliphatic quaternary ammonium, sulfonium and phosphonium compounds having an aliphatic group of from 8 to 18 carbon atoms and an aliphatic group substituted by an anionic
water-solubilising group, for instance betaine and betaine derivatives such as alkyl
betaine, in particular C_{12} - C_{16} alkyl betaine, 3-(N,N-dimethyl-N-hexadecylammonium)-
propane 1-sulfonate betaine, 3-(dodecylmethyl-sulfonium)-propane 1-sulfonate betaine,
3-(cetylmethyl-phosphonium)-propane-1-sulfonate betaine and N,N-dimethyl-N-dodecyl-

- 9 -

glycine. Other well known betaines are the alkylamidopropyl betaines for example, those wherein the alkylamido group is derived from coconut oil fatty acids.

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

pH adjustment, buffering and thickening system

The formulation comprises at least 5 wt% of a pH adjustment, buffering and thickening system. Preferably, the pH adjustment, buffering and thickening system preferably
15 comprises no more than 10 wt% of the total formulation. Most preferably the amount of pH adjustment, buffering and thickening system comprises 5 to 7 wt% of the total formulation.

The components of the pH adjustment, buffering and thickening system are selected from
20 the group consisting of sodium carbonate, sodium hydrogen carbonate, potassium carbonate, potassium hydrogen carbonate.

Most preferably, however, the pH adjustment, buffering and thickening system comprises a mixture of sodium carbonate and sodium hydrogen carbonate.

In the present invention the pH adjustment, buffering and thickening system provides a formulation with a viscosity level of between 1.8 and 6.0 Pa.s over the preferred pH range of 9.2 to 11. More preferably, the pH adjustment, buffering and thickening system provides a formulation with the required viscosity level of between 1.85 and 6.0 Pa.s over
30 the preferred pH range of 9.2 to 10.8. Even more preferably, the pH adjustment, buffering and thickening system provides a formulation with the required viscosity level of between 1.85 and 6.0 Pa.s over the preferred pH range of 9.2 to 10.5.

Perfumes

Preferably the formulation comprises a perfume. The perfume is preferably present in the range from 0.001 to 3 wt%, most preferably 0.1 to 1 wt%. Suitable examples of perfumes are provided in the CTFA (Cosmetic, Toiletry and Fragrance Association) 1992 International Buyers Guide, published by CFTA Publications and OPD 1993 Chemicals Buyers Directory 80th Annual Edition, published by Schnell Publishing Co.

Optional Ingredients

The formulation may include optional ingredients, such as, abrasive particles and additional ingredients which aid formulation properties, stability and cleaning performance as well as one or more optional ingredients conventionally included in liquid hand dish wash formulations such as, for example: perfume carriers, fluorescers, colourants, hydrotropes, anti-redeposition agents, polyelectrolytes, enzymes, pearlescers, anti-spotting agents, germicides, fungicides, anti-corrosion agents, anti-static agents, crystal growth inhibitors, anti-oxidants, anti-reducing agents, dyes, and water activity modifiers such as sugars, salts, proteins and water soluble homo- and co-polymers.

The inclusion of a preservative is also desirable in the formulation of the present invention, for example a mixture of biocides CIT and MIT (5-Chloro-2-methyl-4-isothiazolinon-3-one / 2-Methyl-4-isothiazolin-3-one). BIT (1,2-Benzisothiazol-3(2H)-one) may also be used. The level of preservative will vary according to the expected storage temperature and the quality of raw materials. A value of from 0.0001 to 0.1 wt % is typical.

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

The formulation may comprise detergent builders in an amount of from 0.1 to 25 wt%. Suitable inorganic and organic builders are well known to those skilled in the art. For example, citric acid is a preferred buffer/builder and may suitably be included at a level of from 0.01 to 0.5 wt%.

The formulation may also comprise ingredients such as but not limited to: colorants, whiteners, optical brighteners, soil suspending agents, deterative enzymes, compatible bleaching agents (particularly peroxide compounds and active chlorine releasing
5 compounds), solvents, co-solvents, gel-control agents, freeze-thaw stabilisers, bactericides, preservatives, hydrotropes, polymers and perfumes.

Examples of optional enzymes include amylase, lipase, cellulase, protease, mannanase, and pectate lyase.

10

Viscosity

The alkaline hand dishwash aqueous liquid formulation has a viscosity in the range of from 1.5 to 6.0 Pa.s when measured at a shear rate of 21 s^{-1} at $25 \text{ }^\circ\text{C}$. More preferably
15 the formulation has a viscosity in the range of from 1.75 to 5.5 Pa.s when measured at a shear rate of 21 s^{-1} at $25 \text{ }^\circ\text{C}$. Even more preferably the formulation has a viscosity in the range of from 2.0 to 5.5 Pa.s when measured at a shear rate of 21 s^{-1} at $25 \text{ }^\circ\text{C}$. Still even more preferably the formulation has a viscosity in the range of from 2.5 to 4.5 Pa.s, when measured at a shear rate of 21 s^{-1} at $25 \text{ }^\circ\text{C}$.

20

A preferred formulation with a ratio of linear alkyl benzene sulfonate (LAS) to sodium dodecyl benzene sulfonate (SLES) of 1: 2.2 to 1 : 3.5, preferably has a viscosity in the range of from 2.5 to 6.0 Pa.s over the pH range of 9.2 to 10.5, when measured at a shear rate of 21 s^{-1} at $25 \text{ }^\circ\text{C}$.

25

For the purpose of the present invention the viscosity is measured using an Anton Paar Physica – DSR 301 measuring head Automated Sample Changer (ASC), geometry – CC27, DIN concentric cylinder.

30 Packaging

The formulation may be packaged in any suitable form of container. Preferably the formulation is packaged in a plastic bottle with a detachable closure or pouring spout. The bottle may be rigid or deformable and may optionally comprise a dosing device to

- 12 -

deliver set amounts of liquids when in use. A deformable bottle offers the advantage that it allows the bottle to be squeezed to aid dispensing of the liquid formulation. If clear bottles are used, they may be formed from Polyethylene terephthalate (PET).

Polyethylene or clarified polypropylene may also be used. Preferably the container is clear enough so that the liquid formulation with any visual cues therein, is visible from the outside. The bottle may also be provided with one or more labels. In addition, the bottle may be provided with a shrink wrap sleeve which is desirably at least partially transparent, for example, at least 50% of the area of the sleeve is transparent. The adhesive used to secure any transparent label to the bottle should preferably not adversely affect the transparency of the bottle.

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

15 Abbreviations

The abbreviated names used in these examples have the following meanings:

	Water	is Demineralised water.
	NaOH	is sodium hydroxide base.
20	LAS acid	is linear alkyl benzene sulfonic acid (anionic surfactant).
	NaHCO ₃	is sodium hydrogen carbonate (also called sodium bicarbonate)
	Na ₂ CO ₃	is sodium carbonate
	SLES (1EO)	is sodium dodecyl benzene sulfonate (SLES) 1EO (anionic surfactant), (Texapon®, N701, ex BASF).
25	DMDMH	preservative, Glydant™ ex Lonza
	Preservative	antimicrobial preservative, solution of chloromethylisothiazolin-3-one (CMIT) and methylisothiazolin-3-one (MIT) in water ex Dow chemical and ex Arch Chemicals
	EDTA	ethylene diamine tetra acetic acid, sequestrant
30	Perfume	is free oil perfume, lime juice, green lime
	Lutensol	is non-ionic surfactant ex BASF

Unless otherwise specified, the amounts and proportions used in the methods and formulations are by weight.

Example 1

5

Aqueous alkaline hand dishwash liquid detergent formulations were prepared using the components listed in Table 1 over a range of pH concentrations by mixing the ingredients listed therein. The components were diluted further with demineralised water to give the concentration levels indicated in Table1.

10

Table 1

<u>COMPONENTS IN LIQUID DETERGENT FORMULATION</u>	<u>WEIGHT %</u>	<u>WEIGHT %</u>	<u>WEIGHT %</u>	<u>WEIGHT %</u>	<u>WEIGHT %</u>
pH of Formulation	7.0	8.4	9.2	9.5	10.5
Demineralised Water	82.12	78.59	77.59	76.99	78.09
LAS Acid (Detal)	3.94	3.94	3.94	3.94	3.94
NaOH	1.37	-	-	-	-
Sodium hydrogen carbonate (NaHCO ₃)	-	4.50	4.50	4.50	-
Sodium Carbonate (Na ₂ CO ₃)	-	0.40	1.40	2.00	5.40
SLES 1EO (Texapon N701)	11.80	11.80	11.80	11.80	11.80
CIT:MIT low salt: Microcare IT	0.00090	0.00090	0.00090	0.00090	0.00090
DMDMH (Glydant)	0.22	0.22	0.22	0.22	0.22
4Na-EDTA	0.10	0.10	0.10	0.10	0.10
Lime Juice	0.01	0.01	0.01	0.01	0.01
Blue colorant	0.000625	0.000625	0.000625	0.000625	0.000625
Yellow colorant	0.0013	0.0013	0.0013	0.0013	0.0013
Green Lime	0.28	0.28	0.28	0.28	0.28
Lutensol xp40	0.16	0.16	0.16	0.16	0.16
Citric acid	0.40	-	-	-	-

15 The components in the aqueous alkaline hand dishwash liquid detergent formulations were added in the order set out in Table 1 in which the amounts given define the amount of reagent required in the final formulation based on 100% reagent supplied.

Cleaning test experiments

The efficiency and cleaning power of the five aqueous alkaline hand dishwash liquid detergent formulations listed in Table 1 was investigated.

5

A 25% solution by weight of each aqueous alkaline hand dishwash liquid detergent formulation listed in Table 1 was prepared using a 3 : 1 weight ratio of water : detergent.

10 Soiled brushed stainless steel tiles were prepared by coating the tiles with a three way soil monitor, that is a mixture of fat, protein, and starch and then baked at 100 ° C for 1 hour. A number of tiles were then soaked in each of the five aqueous alkaline hand dishwash liquid detergent formulations before cleaning.

15 Cleaning was carried out using a custom Martindale Abrasion rig called a WIRA. A piece of ballerina cloth was affixed to the cleaning head which was placed in contact with a tile specially designed to simulate a dish surface and to give highly repeatable cleaning results. Cleaning was achieved by moving the cleaning head in a lissajous motion. The soak time prior to the cleaning process was measured using a count-down timer before starting the abrasion rig. Cleaned tiles were rinsed with demineralised water and left to
20 dry overnight before investigating the results of the cleaning process.

Gravimetric measurements were recorded by weighing the tiles with and without soil before and after washing to determine the cleaning efficiency of the different aqueous alkaline hand dishwash liquid detergent formulations in Table 1.

25

Multiple repeat tiles were cleaned per aqueous alkaline hand dishwash liquid detergent formulation. In Table 2 the average % soil removal values for each formulation are reported. The entire test was carried out at a temperature of approximately 21 °C. The clean stainless steel tiles used in Experiment 1 were supplied by Mersey Metals and
30 possess low in-batch variability. The results of the cleaning test experiments are provided in Table 2.

Table 2

<u>Aqueous alkaline hand dishwash liquid detergent formulation pH.</u>	<u>Percentage of soil removed.</u>	<u>Viscosity of liquid hand wash formulation measured at a shear rate of 21 s⁻¹. (Pa.s).</u>
7	35.00	0.008
8.4	41.50	12.500
9.2	48.00	5.740
9.5	47.50	3.120
10.5	53.25	2.660

It can be seen from Table 2 that increasing the pH using a pH adjustment, buffering and thickening system (for example a mixture of sodium carbonate and sodium hydrogen carbonate) in the aqueous alkaline hand dishwash liquid detergent formulation provides an increase in the cleaning performance of the formulation moving from neutral to alkaline pH. For each pH a minimum of four experiments were performed.

In addition, the increase in pH of the aqueous alkaline hand dishwash liquid detergent formulation created by introducing a mixture of carbonate and hydrogen carbonate enabled a formulation to be achieved with a pH above 9, sufficient for un-built hand dish wash formulations. For hand dish wash formulations a viscosity of at least 1.5 Pa.s is preferred.

These compositions therefore provide an aqueous alkaline hand dishwash liquid detergent formulation which is able to meet the cleaning requirements of obstinate soiling and which still provides the required rheology parameters required of hand dish wash formulations using pH adjustment, buffering and thickening system in the form of a combination of sodium carbonate and sodium hydrogen carbonate.

Example 2

Aqueous alkaline hand dishwash liquid detergent formulations were prepared using the components listed in Table 3 over a range of ratios of linear alkyl benzene sulfonate (LAS Acid) to sodium dodecyl benzene sulfonate, at pH 9.5, by mixing the ingredients listed

- 16 -

therein. The components were diluted further with demineralised water to give the concentration levels indicated in Table 3.

Table 3

5

COMPONENTS IN LIQUID DETERGENT FORMULATION	WEIGH T %	WEIGH T %	WEIGH T %	WEIGH T %	WEIGH T %	WEIGH T %	WEIGH T %
pH of Formulation	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Demineralised Water	71.86	70.82	70.69	70.52	70.29	70.12	69.98
LAS Acid (Detal)	7.87	5.25	4.92	4.50	3.94	3.50	3.15
Sodium hydrogen carbonate (NaHCO ₃)	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Sodium Carbonate (Na ₂ CO ₃)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
SLES 1EO (Texapon N701)	7.87	10.49	10.82	11.24	11.81	12.24	12.59
CIT:MIT low salt: Microcare IT	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
DMDMH (Glydant)	0.22	0.22	0.22	0.22	0.22	0.22	0.22
4Na-EDTA	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Lime Juice	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Blue colorant	0.00062 5	0.00062 5	0.00062 5	0.00062 5	0.00062 5	0.00062 5	0.00062 5
Yellow colorant	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013
Green Lime	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Lutensol xp40	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Ratio of LAS Acid to SLES 1EO (Texapon N701)	1:1	1:2	1:2.2	1:2.5	1:3	1:3.5	1:4

The viscosity of each of the formulations was measured and the values are recorded in Table 4.

10

Table 4

<u>Range of linear alkyl benzene sulfonate (LAS Acid) to SLES for aqueous alkaline hand dishwash liquid detergent formulation at pH 9.5</u>	<u>Viscosity of liquid hand wash formulation measured at a sheer rate of 21 s⁻¹. (Pa.s).</u>
1 : 1.0	0.52
1 : 2.0	1.69
1 : 2.2	1.85
1 : 2.5	2.70
1 : 3.0	3.99
1 : 3.5	4.15
1 : 4.0	5.15

Therefore it can be seen that as the ratio of linear alkyl benzene sulfonate (LAS Acid) to SLES increases, the viscosity of the formulation increases with a preferred level of viscosity for the hand dish wash formulation being obtained with a ratio of 1: 2.2.

CLAIMS

1. An aqueous alkaline hand dishwash liquid detergent formulation comprising:
 - 5 i) 9 to 20 wt% of a surfactant system;
wherein 2 to 5 wt% of the surfactant system comprises a linear alkyl benzene sulfonate; and 7 to 17 wt% of the surfactant system comprise an alkyl ether sulfate; and wherein less than 1 wt% of the surfactant system comprises non-ionic surfactant; and wherein the weight ratio of linear alkyl benzene sulfonate
10 (as LAS acid) to alkyl ether sulfate is lower than or equal to 1 : 2.2; and
 - ii) wherein the pH of the formulation is in the range 9.1 to 11;
 - iii) wherein the formulation further comprises a pH adjustment, buffering and thickening system which comprises at least 5 wt% of the total formulation,
15 wherein the system comprises one or more components selected from the group consisting of sodium carbonate, sodium hydrogen carbonate, potassium carbonate and potassium hydrogen carbonate; and
 - iv) wherein the formulation has a viscosity in the range of from 1.5 to 6.0 Pa.s when measured at a shear rate of 21 s⁻¹ at 25 °C.
- 20 2. An aqueous alkaline hand dishwash liquid detergent formulation according to claim 1 wherein the linear alkyl benzene sulfonate has between 6 to 20 carbon atoms in its alkyl group.
3. An aqueous alkaline hand dishwash liquid detergent formulation according to claim
25 1 or 2 wherein the linear alkyl benzene sulfonate is sodium linear alkyl benzene sulfonate.
4. An aqueous alkaline hand dishwash liquid detergent formulation according to any
30 one of claims 1 to 3 wherein the alkyl ether sulfate has between 8 and 22 carbon atoms in its alkyl group.
5. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 4 wherein the alkyl ether sulfate is sodium alkyl ether sulfate, most preferably, SLES 1EO.

6. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 5 wherein the pH is in the range 9.2 to 10.8.
- 5 7. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 6 wherein the pH of the formulation is in the range 9.2 to 9.8.
8. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 7 wherein the pH adjustment, buffering and thickening system
10 consists of a mixture of sodium carbonate and sodium hydrogen carbonate.
9. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 8 wherein the pH adjustment, buffering and thickening system comprises a maximum of 10 wt% of the total formulation.
- 15 10. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 8 wherein the pH adjustment buffering and thickening system comprises between 5 and 7 wt% of the total formulation.
- 20 11. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 10 wherein the formulation comprises at least 65 wt% water.
12. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 11 wherein the formulation has a weight ratio of linear alkyl
25 benzene sulfonate to alkyl ether sulfate in the range of 1 : 2.2 to 1 : 5.0.
13. An aqueous alkaline hand dishwash liquid detergent formulation according to any of claims 1 to 12 wherein the formulation has a weight ratio of linear alkyl benzene sulfonate to alkyl ether sulfate in the range of 1 : 2.2 to 1 : 4.0, more preferably the
30 formulation comprises a weight ratio of linear alkyl benzene sulfonate to alkyl ether sulfate in the range of 1 : 22 to 1 : 3.5.

- 20 -

14. An aqueous alkaline hand dishwash liquid detergent formulation according to any one of claims 1 to 13 wherein the formulation has a viscosity in the range of from 1.75 to 5.5 Pa.s, preferably from 2.0 to 5.5 Pa.s and more preferably from 2.5 to 4.5 Pa.s.

5