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(54) **CLEANING COMPOSITIONS COMPRISING ENZYMES**

(57) A cleaning composition containing an encapsulated lipase and from 5 to 60 wt% surfactant system. The surfactant system contains anionic and nonionic surfactant in a weight ratio from 1:1 to 99:1.

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Description

FIELD OF THE INVENTION

5 **[0001]** The present invention is in the field of cleaning compositions.

BACKGROUND OF THE INVENTION

10 **[0002]** An important purpose of detergents and/or cleaning compositions is to remove soils and stains from fabrics to achieve consumer perceivable cleaning benefit. Enzymes are especially useful cleaning components and particularly lipase enzymes as they are effective at removing oily soils. However they can be difficult to formulate because most liquid detergent compositions comprise protease enzymes. Lipase enzymes are particularly vulnerable to proteases and may be degraded by the presence of other components of the detergent composition so that on storage, the lipase tends to be gradually degraded. Many efforts have been made to alleviate this problem, for example by separating the protease or lipase, however this generally does not solve the problem of formulating with both enzymes.

SUMMARY OF THE INVENTION

20 **[0003]** The present invention relates to a liquid detergent composition comprising a protease enzyme, a lipase enzyme and from 2 to 80 wt%, preferably from 5 to 60 wt% non-soap surfactant system wherein the surfactant system comprises (i) anionic surfactant and (ii) nonionic surfactant wherein the weight ratio of (i) to (ii) is from 1:1 to 99:1, characterized in that in the composition at least 65 wt% of the lipase enzyme is present in an encapsulate, wherein the encapsulate comprises a shell wherein the shell is insoluble in the liquid detergent composition but which dissolves upon dilution of the liquid detergent composition in the wash liquor.

25 **[0004]** Preferably the weight ratio of anionic surfactant (i) to nonionic surfactant (ii) is from 51:49 to 99:1, or preferably 55:45 to 99:1, preferably from 3:2 to 9:1. In the compositions of the invention the surfactant system may comprise alkyl benzene sulphonate surfactant and optionally in addition alkyl sulphate surfactant which is optionally partially or fully ethoxylated with from 1 to 7 ethoxylates. Preferably in addition, in the liquid detergent composition the weight ratio of alkyl benzene sulphonate anionic surfactant to nonionic surfactant is from 1:1 to 99:1.

30 **[0005]** The compositions of the invention preferably additionally comprise an ester-containing laundry ingredient, such as a perfume ester. The ester containing laundry ingredient may comprise a polyester soil release polymer, preferably wherein the polyester soil release polymer comprises a polypropylene terephthalate.

[0006] The compositions of the invention may comprise a structurant, for example preferably wherein the structurant comprises hydrogenated castor oil, citrus pulp or a mixture thereof.

35 **[0007]** The compositions of the invention also include liquid detergent compositions comprising a protease enzyme, a lipase enzyme and from 2 to 80 wt% non-soap surfactant system characterized in that at least 65 wt% of the lipase enzyme is present in an encapsulate, wherein the encapsulate comprises a shell wherein the shell is insoluble in the liquid detergent composition but which dissolves upon dilution of the liquid detergent composition in the wash liquor, and the composition comprises a perfume comprising at least 2 wt% perfume esters based on the total weight of the perfume, preferably comprising at least 5 wt% perfume esters, or at least 10, or at least 15 or at least 20 wt% perfume esters.

40 **[0008]** The compositions of the invention also include liquid compositions comprising a protease enzyme, a lipase enzyme and from 2 to 80 wt% non-soap surfactant system characterized in that at least 65 wt% of the lipase enzyme is present in an encapsulate, wherein the encapsulate comprises a shell wherein the shell is insoluble in the liquid detergent composition but which dissolves upon dilution of the liquid detergent composition in the wash liquor, and the composition comprises a fabric shading dye.

[0009] The compositions of the invention preferably comprise from 0.5% to below 20.0 wt%, preferably from 1% to 13% by weight water.

50 **[0010]** The compositions of the invention preferably comprise an encapsulating shell comprising a polymer, copolymer or derivatives thereof, or mixtures thereof, preferably wherein the shell comprises polyvinyl alcohol, polyvinyl pyrrolidone, polyalkylene oxides, acrylamide, acrylic acid, cellulose, cellulose ethers, cellulose esters, cellulose amides, polyvinyl acetates, polycarboxylic acids and salts, polyaminoacids or peptides, polyamides, polyacrylamide, copolymers of maleic/acrylic acids, polysaccharides, natural gums, polyacrylates, water-soluble acrylate copolymers, methylcellulose, carboxymethylcellulose, dextrin, ethylcellulose, hydroxyethyl cellulose, hydroxypropyl methylcellulose, maltodextrin, polymethacrylates and combinations thereof.

55 **[0011]** The cleaning composition of the present invention can be in any liquid product form. It can be a laundry detergent composition, a hard surface cleaning composition, a hand dishwashing composition, or an automatic dishwashing composition. Preferably, the cleaning composition is in a liquid form and is more preferably in a single phase or multiphase

unit dose form as encapsulated by a single compartment or multi-compartment water-solution pouch. It may further comprise, in addition to the components as described hereinabove, one or more surfactants selected from the group consisting of anionic surfactants, cationic surfactants, nonionic surfactants, amphoteric surfactants, zwitterionic surfactants, and mixtures thereof. Preferably, the surfactants comprise an anionic surfactant selected from the group consisting of alkyl benzene sulfonate, alkoxylated alkyl sulfates, alkyl sulfates, and mixtures thereof.

[0012] The present invention also relates to use of the above-described cleaning composition for treating fabrics to achieve improved cleaning benefit.

[0013] These and other features of the present invention will become apparent to one skilled in the art upon review of the following detailed description when taken in conjunction with the appended claims. Note that preferred embodiments of the present invention include any combination of two or more of those preferred embodiments of the present invention as described hereinbelow.

DETAILED DESCRIPTION OF THE INVENTION

DEFINITIONS

[0014] As used herein, the articles "a" and "an" when used in a claim, are understood to mean one or more of what is claimed or described.

[0015] As used herein, "liquid laundry detergent composition" refers to any laundry treatment composition comprising a fluid capable of wetting and cleaning fabric e.g., clothing, in a domestic washing machine. The composition can include solids or gases in suitably subdivided form, but the overall composition excludes product forms which are nonfluid overall, such as tablets or granules. The compact fluid detergent compositions preferably have densities in the range from 0.9 to 1.3 grams per cubic centimeter, more specifically from 1.00 to 1.10 grams per cubic centimeter, excluding any solid additives but including any bubbles, if present.

[0016] As used herein, the term "external structuring system" refers to a selected compound or mixture of compounds which provide either a sufficient yield stress or low shear viscosity to stabilize the liquid laundry detergent composition independently from, or extrinsic from, any structuring effect of the deterative surfactants of the composition. By "internal structuring" it is meant that the detergent surfactants, which form a major class of laundering ingredients, are relied on for providing the necessary yield stress or low shear viscosity.

[0017] All percentages, ratios and proportions used herein are by weight percent of the composition, unless otherwise specified. All average values are calculated "by weight" of the composition or components thereof, unless otherwise expressly indicated.

[0018] As used herein, the term "substantially free of" or "substantially free from" means that the indicated material is present in an amount of no more than about 5 wt%, preferably no more than about 2%, and more preferably no more than about 1 wt% by weight of the composition.

[0019] As used therein, the term "essentially free of" or "essentially free from" means that the indicated material is present in an amount of no more than about 0.1 wt% by weight of the composition, or preferably not present at an analytically detectable level in such composition. It may include compositions in which the indicated material is present only as an impurity of one or more of the materials deliberately added to such compositions.

[0020] As used herein the phrase "cleaning composition," "detergent composition," or "detergent or cleaning composition" are used interchangeably herein to refer to compositions and formulations designed for cleaning soiled material. Such compositions include but are not limited to, laundry detergent compositions, fabric softening compositions, fabric enhancing compositions, fabric freshening compositions, laundry prewash, laundry pretreat, laundry additives, spray products, dry cleaning agent or composition, laundry rinse additive, wash additive, post-rinse fabric treatment, ironing aid, dish washing compositions, hard surface cleaning compositions, unit dose formulation, delayed delivery formulation, detergent contained on or in a porous substrate or nonwoven sheet, and other suitable forms that may be apparent to one skilled in the art in view of the teachings herein. Such compositions may be used as a precleaning treatment, a post-cleaning treatment, or may be added during the rinse or wash cycle of the cleaning process. The cleaning compositions may have a form selected from liquid, powder, single-phase or multi-phase unit dose or pouch form, tablet, gel, paste, bar, or flake. In a preferred embodiment of the present invention, the cleaning composition of the present invention is a liquid laundry or dish detergent composition, which is in a single phase or multiphase unit dose form as encapsulated by a single compartment or multi-compartment water-soluble pouch, e.g., formed by a water-soluble polymer such as polyvinyl alcohol (PVA) or copolymers thereof. More preferably, the cleaning composition of the present invention is a liquid laundry detergent composition designated for treating fabrics to achieve improved whiteness maintenance benefit.

[0021] As used herein, the term "laundry detergent" means a liquid or solid composition, and includes, unless otherwise indicated, granular or powder-form all-purpose or "heavy-duty" washing agents, especially cleaning detergents as well as cleaning auxiliaries such as bleach additives or pre-treat types. In a preferred embodiment of the present invention, the laundry detergent is a liquid laundry detergent composition.

[0022] As used herein, the term "soiled material" refers non-specifically to any type of flexible material consisting of a network of natural or artificial fibers, including natural, artificial, and synthetic fibers, such as, but not limited to, cotton, linen, wool, polyester, nylon, silk, acrylic, and the like, as well as various blends and combinations. Soiled material may further refer to any type of hard surface, including natural, artificial, or synthetic surfaces, such as, but not limited to, tile, granite, grout, glass, composite, vinyl, hardwood, metal, cooking surfaces, plastic, and the like, as well as blends and combinations.

[0023] As used herein, the term "water hardness" or "hardness" means uncomplexed cations ion (*i.e.*, Ca^{2+} or Mg^{2+}) present in water that have the potential to precipitate under alkaline conditions, and thereby diminishing the surfactancy and cleaning capacity of surfactants. Further, the terms "high water hardness" and "elevated water hardness" can be used interchangeably and are relative terms for the purposes of the present invention, and are intended to include, but not limited to, a hardness level containing at least 12 grams of calcium ion per gallon water (gpg, "American grain hardness" units).

[0024] The encapsulated lipase comprises particles of lipase and/or protease enzymes having a shell and may be produced using any of the known processes, for example spray drying, spray coating, precipitation/coagulation and freeze drying.

[0025] The shell preferably comprises a polymer, copolymer or derivatives thereof, or mixtures thereof, preferably wherein the shell comprises polyvinyl alcohol, polyvinyl pyrrolidone, polyalkylene oxides, acrylamide, acrylic acid, cellulose, cellulose ethers, cellulose esters, cellulose amides, polyvinyl acetates, polycarboxylic acids and salts, polyaminoacids or peptides, polyamides, polyacrylamide, copolymers of maleic/acrylic acids, polysaccharides, natural gums, polyacrylates, water-soluble acrylate copolymers, methylcellulose, carboxymethylcellulose, dextrin, ethylcellulose, hydroxyethyl cellulose, hydroxypropyl methylcellulose, maltodextrin, polymethacrylates and combinations thereof.

[0026] The water-soluble polymers may be copolymers of vinyl alcohol units and sulfonic acid units selected from for example, 2-acrylamido-2-methyl propane sulfonic acid; 2-methacrylamido-2-methyl propane sulfonic acid, and combinations thereof. The copolymers are produced at molecular weights and monomer incorporation levels providing aqueous solubility characteristics in the presence of liquid detergent formulations. Consequently, the copolymers are particularly useful for packaging detergent formulations and encapsulating detergent components such as enzymes. In relation to the present invention the copolymers may be sprayed or misted onto the enzyme particles to provide a polymeric coating encapsulating the particles.

CLEANING COMPOSITIONS

[0027] The present invention provides a cleaning composition, preferably a detergent composition, most preferably a liquid laundry detergent composition, as above and comprising optional additional adjunct ingredients.

[0028] The cleaning composition of the present invention can be in any liquid product form, and it can be a laundry detergent composition, a hard surface cleaning composition, a hand dishwashing composition, and an automatic dishwashing composition. The cleaning composition comprises a liquid, and even more preferably it comprises a single phase or multiphase unit dose form, *i.e.*, the liquid cleaning composition is contained in a single compartment or multi-compartment water-soluble pouch. In a specific embodiment, the cleaning composition is in a single phase or multiphase unit dose form containing either a liquid automatic dishwashing composition or a liquid laundry detergent composition encapsulated in a single compartment or multi-compartment water-soluble unit dose article or pouch, which is formed, for example, by a water-soluble polymer such as polyvinyl alcohol (PVA) and/or polyvinylpyrrolidone (PVP).

[0029] The laundry treatment composition may be any composition suitable for treating or laundering a fabric.

[0030] The liquid detergent composition, preferably laundry detergent of the present invention overall is liquid in nature. That is to say, even though it comprises a solid phase dispersed within a liquid phase, the composition has the nature of a liquid rather than a solid or granular composition. Herein the laundry treatment composition of the present invention, the term "liquid" encompasses forms such as dispersions, gels, pastes and the like. The liquid composition may also include gases in suitably subdivided form. The term "liquid laundry treatment composition" refers to any laundry treatment composition comprising a liquid capable of wetting and treating fabric *e.g.*, cleaning clothing in a domestic washing machine. A dispersion for example is a liquid comprising solid or particulate matter contained therein.

[0031] The laundry treatment composition can be used as a fully formulated consumer product, or may be added to one or more further ingredient to form a fully formulated consumer product. The laundry treatment composition may be a 'pre-treat' composition which is added to a fabric, preferably a fabric stain, ahead of the fabric being added to a wash liquor.

[0032] Preferably, the liquid laundry detergent composition has a viscosity of between 300mPa.s and 700mPa.s, more preferably between 350mPa.s and 600mPa.s at a shear rate of 1000s^{-1} . An exemplary method for measuring viscosity is to use a Rheometer DHR1 from TA instruments using a gap of $1000\mu\text{m}$ at 20°C as according to the manufacturer's instructions.

[0033] The term "liquid laundry detergent composition" refers to any laundry detergent composition comprising a liquid

capable of wetting and treating fabric e.g., cleaning clothing in a domestic washing machine,

[0034] The liquid laundry detergent composition of the present invention comprises a cleaning surfactant system at a level of from 5 wt% to 70 or even 80wt%, preferably from 5 wt% to 65 wt% or 60 wt% or from 10 wt% to 40 wt%, more preferably from 15 wt% to 30 wt%.

Surfactant System

[0035] The cleaning composition of the present invention comprises anionic and nonionic surfactant, which may be present in amounts ranging from about 5 wt% to about 70, 65 or 60 wt%, more preferably from about 5 wt% to 50 wt%, and more preferably from 5 wt% to 30 wt% by total weight of the compositions.

Anionic surfactant

[0036] Useful anionic surfactants can be of several different types. For example, non-soap synthetic anionic surfactants are particularly suitable for use herein, which include the water-soluble salts, preferably the alkali metal, and ammonium salts, of organic sulfuric reaction products having in their molecular structure an alkyl group (included in the term "alkyl" is the alkyl portion of acyl groups) containing from 10 to 20 carbon atoms and a sulfonic acid or sulfuric acid ester group. Examples of this group of synthetic anionic surfactants include, but are not limited to: a) the sodium, potassium and ammonium alkyl sulfates with either linear or branched carbon chains, especially those obtained by sulfating the higher alcohols (C_{10} - C_{20} carbon atoms), such as those produced by reducing the glycerides of tallow or coconut oil; b) the sodium, potassium and ammonium alkylethoxy sulfates with either linear or branched carbon chains, particularly those in which the alkyl group contains from 10 to 20, preferably from 12 to 18 carbon atoms, and wherein the ethoxylated chain has an average degree of ethoxylation ranging from about 0.1 to 9, preferably from 0.3 to 7, and more preferably from 0.5 to 5 or 4 or 3; c) the sodium and potassium alkyl benzene sulfonates in which the alkyl group contains from 10 to 20 carbon atoms in either a linear or a branched carbon chain configuration, preferably a linear carbon chain configuration; d) the sodium, potassium and ammonium alkyl sulphonates in which the alkyl group contains from 10 to 20 carbon atoms in either a linear or a branched configuration; e) the sodium, potassium and ammonium alkyl phosphates or phosphonates in which the alkyl group contains from 10 to 20 carbon atoms in either a linear or a branched configuration, f) the sodium, potassium and ammonium alkyl carboxylates in which the alkyl group contains from 10 to 20 carbon atoms in either a linear or a branched configuration, and combinations thereof; g) the sodium, potassium and ammonium alkyl ester sulfonates, for example of formula $R-CH(SO_3M)-CH_2COOR'$, or the sodium, potassium and ammonium alkyl ester sulfates, for example of formula $R-CH(OSO_3M)-CH_2COOR'$, where R represents a C_{10} - C_{20} and preferably C_{10} - C_{16} linear or branched alkyl radical, R' represents a C_1 - C_6 and preferably C_1 - C_3 alkyl radical, and M represents a sodium, potassium or the ammonium cation. The anionic surfactants may be provided in the cleaning compositions of the present invention at levels ranging from about 4.5% to about 64.5 wt%, more preferably from 5% to 50%, more preferably from 5% to 30%, and most preferably from 10% to 25%, by total weight of the compositions.

[0037] In one particularly preferred embodiment, the cleaning composition of the present invention is a liquid detergent composition containing from 5 wt% to about 50 wt% of one or more anionic surfactants selected from the group consisting of C_{10} - C_{20} linear alkyl benzene sulphonates, C_{10} - C_{20} linear or branched alkylethoxy sulfates having an average degree of ethoxylation ranging from 1 to 5, C_{10} - C_{20} linear or branched alkyl sulfates, C_{10} - C_{20} linear or branched alkyl ester sulfates, C_{10} - C_{20} linear or branched alkyl sulphonates, C_{10} - C_{20} linear or branched alkyl ester sulphonates, C_{10} - C_{20} linear or branched alkyl phosphates, C_{10} - C_{20} linear or branched alkyl phosphonates, C_{10} - C_{20} linear or branched alkyl carboxylates, and combinations thereof. More preferably, said one or more anionic surfactants are selected from the group consisting of C_{10} - C_{20} linear alkyl benzene sulphonates, C_{10} - C_{20} linear or branched alkylethoxy sulfates having an average degree of ethoxylation ranging from about 1 to about 5, methyl ester sulfonates with a C_{10} - C_{20} linear or branched alkyl group, and mixtures thereof, and are present in an amount ranging from about 5 wt% to about 30 wt% of the liquid laundry or dish detergent composition. Anionic surfactant is typically present in salt form so the weight percentages are therefore typically calculated based on the salt form of the surfactant.

[0038] Preferably the composition comprises alkyl benzene sulphonate surfactant and optionally in addition alkyl sulphate surfactant which is optionally partially or fully ethoxylated with from 1 to 7 ethoxylates. Preferably the weight ratio of alkyl benzene sulphonate anionic surfactant to nonionic surfactant is from 1:1 to 99:1, or from 55:45 to 99:1 or 3:2 to 9:1.

[0039] The surfactant system preferably comprises at least 80% by weight linear alkyl benzene sulphonate surfactant, preferably at least 85 % by weight alkyl benzene sulphonate (LAS), or even at least 87 or at least 90 wt% based on the total weight of surfactant.

[0040] Preferred alkyl benzene sulphonates are linear. Preferred alkyl sulphonates are selected from C_{10} - C_{13} alkyl benzene sulphonates. Suitable alkyl benzene sulphonate (LAS) may be obtained, by sulphonating commercially available linear alkyl benzene (LAB); suitable LAB includes low 2-phenyl LAB, such as those supplied by Sasol under the tradename

Isochem® or those supplied by Petresa under the tradename Petrelab®, other suitable LAB include high 2-phenyl LAB, such as those supplied by Sasol under the tradename Hyblene®. A suitable anionic deterative surfactant is alkyl benzene sulphonate that is obtained by DETAL catalyzed process, although other synthesis routes, such as HF, may also be suitable. In one aspect a magnesium salt of LAS is used.

[0041] The surfactant system may comprise additional surfactants which can be selected from nonionic, non-LAS anionic, cationic, amphoteric, ampholytic, amphiphilic, zwitterionic, semi-polar nonionic surfactants and mixtures thereof. Preferred compositions comprise a mixture of surfactants, however the LAS is preferably present in amounts at least 80 wt% of the surfactant system.

[0042] The anionic surfactants may be neutralized with ammonia, amines, or alkanolamines. Alkanolamines may be preferred. Suitable non-limiting examples including monoethanolamine, diethanolamine, triethanolamine, and other linear or branched alkanolamines known in the art; for example, highly preferred alkanolamines include 2-amino-1-propanol, 1-aminopropanol, monoisopropanolamine, or 1-amino-3-propanol. Amine neutralization may be done to a full or partial extent, e.g. part of the anionic surfactant mix may be neutralized with sodium or potassium and part of the anionic surfactant mix may be neutralized with amines or alkanolamines.

Nonionic Surfactant

[0043] Nonionic surfactants can also be included into the surfactant systems of the present invention, which include those of the formula $R^1(OC_2H_4)_nOH$, wherein R^1 is a C_8 - C_{18} alkyl group or alkyl phenyl group, and n is from about 1 to about 80. Preferred non-ionic deterative surfactants include alkyl alkoxyated alcohols, in one aspect C_8 - C_{18} alkyl alkoxyated alcohol, for example a C_8 - C_{18} alkyl ethoxyated alcohol, the alkyl alkoxyated alcohol may have an average degree of alkoxylation of from 1 to 80, preferably from 1 to 50, most preferably from 1 to 30, from 1 to 20, or from 1 to 10. In one aspect, the alkyl alkoxyated alcohol may be a C_8 - C_{18} alkyl ethoxyated alcohol having an average degree of ethoxylation of from 1 to 10, from 1 to 7, more from 1 to 5 or from 3 to 7, or even below 3 or 2. The alkyl alkoxyated alcohol can be linear or branched, and substituted or un-substituted.

[0044] Suitable nonionic surfactants include those with the tradename Lutensol® (BASF).

[0045] Suitable non-ionic surfactants selected from the group consisting of: C_8 - C_{18} alkyl ethoxylates, include NE-ODOL® non-ionic surfactants from Shell; C_6 - C_{12} alkyl phenol alkoxyates wherein the alkoxyate units may be ethyleneoxy units, propyleneoxy units or a mixture thereof; C_{12} - C_{18} alcohol and C_6 - C_{12} alkyl phenol condensates with ethylene oxide/propylene oxide block polymers such as Pluronic® from BASF; C_{14} - C_{22} mid-chain branched alcohols; C_{14} - C_{22} mid-chain branched alkyl alkoxyates, typically having an average degree of alkoxylation of from 1 to 30; alkylpolysaccharides, in one aspect, alkylpolyglycosides; polyhydroxy fatty acid amides; ether capped poly(oxyalkylated) alcohol surfactants; and mixtures thereof.

[0046] Suitable non-ionic deterative surfactants include alkyl polyglucoside and/or an alkyl alkoxyated alcohol.

[0047] The nonionic surfactants can be provided in the cleaning compositions at levels ranging from about 0.05 wt% to about 20 wt%, preferably from about 0.1 wt% to about 10 wt%, and most preferably from about 1 wt% to about 5 wt%. However, in certain preferred embodiments of the present invention, the cleaning compositions contains nonionic surfactants at a relatively low level, e.g., no more than about 3 wt%, more preferably not more than about 2 wt% or 1 wt%, and most preferably said cleaning composition is essentially free of nonionic surfactants.

Amphoteric/Zwitterionic Surfactant

[0048] The surfactant may be substantially free of optional additional surfactants. However, the surfactant system may comprise additional surfactants such as amphoteric surfactants, zwitterionic surfactants and cationic surfactants. Such surfactants are well known for use in laundry or dish detergents and when present are typically present at levels from about 0.2 wt%, 0.5 wt% or 1 wt% to about 10 wt%, 20 wt% or 30 wt%. In a laundry composition it may be preferred for levels of amphoteric and/or zwitterionic levels to be below 5 or 2 wt% based on the surfactant system. It may be preferred for the surfactant system to be substantially free of these.

[0049] In particular for a liquid dish detergent composition amphoteric and/or zwitterionic surfactants may be present in an amount from about 0.5 wt% to about 20 wt% of one or more. Suitable amphoteric/zwitterionic surfactants include amine oxides and betaines.

[0050] Preferred amphoteric surfactants are selected from the group consisting of amine oxide surfactants, such as, for example, alkyl dimethyl amine oxide or alkyl amido propyl dimethyl amine oxide, more preferably alkyl dimethyl amine oxide and especially coco dimethyl amino oxide. Amine oxide may have a linear or mid-branched alkyl moiety. Typical linear amine oxides are characterized by a formula $R_1-N(R_2)(R_3)-O$, wherein R_1 is a C_8 - C_{18} alkyl, and wherein R_2 and R_3 are independently selected from the group consisting of C_{1-3} alkyls and C_{1-3} hydroxyalkyls, such as methyl, ethyl, propyl, isopropyl, 2-hydroxyethyl, 2-hydroxypropyl and 3-hydroxypropyl. As used herein "mid-branched" means that the amine oxide has one alkyl moiety having n_1 carbon atoms with one alkyl branch on the alkyl moiety having n_2 carbon atoms.

The alkyl branch is located on the α carbon from the nitrogen on the alkyl moiety. This type of branching for the amine oxide is also known in the art as an internal amine oxide. The total sum of n1 and n2 is from about 10 to about 24 carbon atoms, preferably from about 12 to about 20, and more preferably from about 10 to about 16. The number of carbon atoms for the one alkyl moiety (n1) should be approximately the same number of carbon atoms as the one alkyl branch (n2) such that the one alkyl moiety and the one alkyl branch are symmetric. As used herein "symmetric" means that $|n1 - n2|$ is less than or equal to 5, preferably 4, most preferably from 0 to 4 carbon atoms in at least about 50 wt%, more preferably at least about 75 wt% to about 100 wt%, of the mid-branched amine oxides for use herein. Particularly preferred amphoteric surfactants are C₁₀-C₁₄ alkyl dimethyl amine oxides.

[0051] Preferred zwitterionic surfactants are betaine surfactants, such as, for example, alkyl betaines, alkylamido-betaines, amidazoliniumbetaines, sulfobetaines (also referred to as sultaines) as well as phosphobetaines. A particularly preferred betaine is cocoamidopropylbetaine.

Encapsulated enzyme

[0052] At least 65 wt% of the lipase enzyme is present in an encapsulate in the liquid detergent composition. By encapsulated, we herein mean that the enzyme is immobilized within a particle or the like and is not 'free' within the liquid detergent composition.

[0053] The encapsulated enzyme may be of the core-shell type, absorbed onto or into a matrix or a mixture thereof, preferably the encapsulated enzyme is of the core-shell type. A core-shell particle is one comprising an outer shell that surrounds a core, wherein the enzyme is comprised within the core.

[0054] When in encapsulated form the enzymes are typically encapsulated in a polymeric material. Methods of encapsulation of the enzymes are for example, by spray-drying a liquid composition containing the enzyme(s) and the polymer(s), or by drying a liquid composition containing the enzyme and polymer, or by emulsion polymerisation, co-acervation, precipitation or interfacial polymerisation optionally in the presence of the enzyme, optionally followed by drying and/or size reduction processes. Suitable polymers for encapsulating enzymes include: polyvinyl alcohol, polyvinylpyrrolidone, carboxymethylcellulose, guar gum, polycarboxylic acid, methylcellulose, hydroxypropyl methylcellulose, proteins, polybranched polyamines, such as polyethyleneimines (PEI), (hydrophobically modified) polysaccharide modified cellulosic polymers, derivatives or co-polymers thereof and mixtures thereof. Examples of modified cellulosic polymers include hydroxypropyl methylcellulose phthalate, cellulose acetate phthalate. Examples of modified gums include modified guar gum, gum benzoin, gum tragacanth, gum arabic and gum acacia. Examples of modified proteins are modified casein, gelatin and albumin. Examples of modified polymers may be selected from copolymers of at least one hydrophobic vinylic monomer with a least one hydrophilic vinylic monomer. Suitable hydrophilic vinylic monomer is vinylpyrrolidone. Suitable hydrophobic vinylic monomer is C1-C18 alkyl acrylates, C1-C18 alkyl methacrylates, C3-C18 cycloalkyl acrylates, C3-C18 cycloalkyl methacrylates and vinyl C1-C18 alkanoates and mixtures thereof. The polymer may comprise a polymer selected from homo- and copolymers having a C-C-backbone, wherein the C-C-backbone carries carboxyl groups, which may be present in the acidic form or in the neutralized form, and wherein the C-C- backbone comprises at least 20 % by weight, e.g. from 20 to 98 % by weight, based on the total weight of the polymer (i.e. based on the total weight of repeating units in the polymer P), of hydrophobic repeating units. The polymer may comprise branching, for example branched copolymer matrix particles formed from vinyl pyrrolidone and vinyl acetate. The polymer may comprise a copolymers, for example as described in WO2010/003934, based on maleic acid or (meth)acrylic acid. The polymer may be cross-linked. Preferred polymers have a molecular weight from 1000 to 500,000, or 2000 to 200000 Dalton weight average. Typically the weight ratio of enzyme to polymer is from 1:50 to 10:1. The polymer may be selected to be substantially soluble in an aqueous solution having an ionic strength of 0 mol/kg and insoluble in an aqueous solution having an ionic strength of more than 1 mol/kg, for example in which the polymer comprises 35-95% w/w of hydrophilic monomer units, based on the total weight of the polymer.

[0055] Hydrophobically modified polyvinyl alcohol or hydrophobically modified polyvinyl pyrrolidone may be preferred, optionally with high levels of hydrolysis, greater than 60%, or even greater than 80 or 90%. Suitable hydrophobic modifying groups include keto-ester and/or butyryl groups and mixtures thereof and preferably the total degree of substitution (DS) is between about 3% and 20%.

[0056] Preferably, the shell material comprises a polymeric material, preferably selected from polyvinyl alcohol, polyvinylpyrrolidone, carboxymethylcellulose, guar gum, polycarboxylic acid, methylcellulose, hydroxypropyl methylcellulose, proteins, polybranched polyamines, such as polyethyleneimines (PEI), (hydrophobically modified) polysaccharide modified cellulosic polymers, derivatives or co-polymers thereof and mixtures thereof.

[0057] Preferably, the liquid detergent composition comprises between 0.0001% and 0.75%, preferably between 0.0005% and 0.5%, more preferably between 0.001% and 0.5% by weight of the liquid laundry detergent composition of the encapsulated lipase enzyme. Herein we mean that the weight percentage of the enzyme protein only excluding the weight percentage of any other materials such as the shell that may be present in the encapsulate and 'encapsulated enzyme' refers to the enzyme present in the encapsulate as opposed to any other enzyme that may be present in the

liquid detergent composition.

Lipase

[0058] The composition comprises one or more lipases, including "first cycle lipases" such as those described in U.S. Patent 6,939,702 B1 and US PA 2009/0217464. Preferred lipases are first-wash lipases. In one embodiment of the invention the composition comprises a first wash lipase. First wash lipases includes a lipase which is a polypeptide having an amino acid sequence which: (a) has at least 90% identity with the wild-type lipase derived from *Humicola lanuginosa* strain DSM 4109; (b) compared to said wild-type lipase, comprises a substitution of an electrically neutral or negatively charged amino acid at the surface of the three-dimensional structure within 15Å of E1 or Q249 with a positively charged amino acid; and (c) comprises a peptide addition at the C-terminal; and/or (d) comprises a peptide addition at the N-terminal and/or (e) meets the following limitations: i) comprises a negative amino acid in position E210 of said wild-type lipase; ii) comprises a negatively charged amino acid in the region corresponding to positions 90-101 of said wild-type lipase; and iii) comprises a neutral or negative amino acid at a position corresponding to N94 or said wild-type lipase and/or has a negative or neutral net electric charge in the region corresponding to positions 90-101 of said wild-type lipase. Preferred are variants of the wild-type lipase from *Thermomyces lanuginosus* comprising one or more of the T231R and N233R mutations. The wild-type sequence is the 269 amino acids (amino acids 23 - 291) of the Swissprot accession number Swiss-Prot 059952 (derived from *Thermomyces lanuginosus* (*Humicola lanuginosa*)). Preferred lipases would include those sold under the tradenames Lipex® and Lipolex® and Lipoclean®, Lipex Evity®, Calipso®. Other suitable lipases include those described in WO 2016/091870 and WO2016/506611. Preferred lipases may be selected from those as described in WO2016/50661, for example, a lipase variant having at least 60%, or at least 70% or at least 80% or 85% or 90% or at least 95% but less than 100% sequence identity to SEQ ID NO: 1 comprising a substitution at a position corresponding to position 210 which is not a negatively charged amino acid, and position 255 which is not I, and wherein position 256 is not K, of SEQ ID NO: 1, and wherein the variant has lipase activity, preferably having substitution at positions corresponding to position selected from 33, 91, 231, 233 and mixtures thereof, preferably the substitutions may be as follows at: 33 is K or Q; 91 is Q, 210 is A, C, F, G, H, I, K, L, M, N, P, Q, R, S, T, V, W, or Y; 231 is H, K, or R; 233 is H, K, or R; 255 is A, C, D, E, F, G, H, K, L, M, N, P, Q, R, S, T, V, W, or Y; and 256 is A, C, D, E, F, G, H, I, L, M, N, P, Q, R, S, T, V, W, or Y. Particularly preferred lipases may be selected from the group consisting of lipase variants having at least 60%, or at least 70% or at least 80% or 85% or 90% or at least 95% but less than 100% sequence identity to SEQ ID NO: 1 and comprising or consisting of substitutions at two positions corresponding to positions 210+255, three positions corresponding to positions 210+231 +255; 210+233+255; 210+255+256; or 91+210+255; four positions corresponding to positions 33+91 +210+255; 210+231 +233+255, 210+231 +255+256; or 210+233+255+256; or five positions corresponding to positions 210+231 +233+255+256 of SEQ ID NO: 1, particularly preferred lipases may be selected from those comprising or consisting of the set of substitutions selected from:

- a. N33Q +G91 Q +E210Q +I255A; b. D27R +N33K +G38A +F51V +D96E +K98E +D111A +G163K +E210K +D254S +I255G +P256T;
- c. D27R +G38A +F51V +D96E +K98E +D111A +G163K +E210K +D254S +I255G +P256T;
- d. D27R +N33K +G38A +F51V +S54T +E56K +L69R +D96E +K98E +D111A +G163K +E210K +Y220F +D254S +I255G +P256T;
- e. D27R+G38A+F51V+L69R+D96E+K98E+D111A+G163K+E210K+D254S+I255G +P256T;and
- f. Q4V +S58N +V60S +E21 OK +I255F

Protease

[0059] The composition comprises one or more proteases. Suitable proteases include metalloproteases and serine proteases, including neutral or alkaline microbial serine proteases, such as subtilisins (EC 3.4.21.62). Suitable proteases include those of animal, vegetable or microbial origin. In one aspect, such suitable protease may be of microbial origin. The suitable proteases include chemically or genetically modified mutants of the aforementioned suitable proteases. In one aspect, the suitable protease may be a serine protease, such as an alkaline microbial protease or/and a trypsin-type protease. Examples of suitable neutral or alkaline proteases include:

- (a) subtilisins (EC 3.4.21.62), including those derived from *Bacillus*, such as *Bacillus lentus*, *B. alkalophilus*, *B. subtilis*, *B. amyloliquefaciens*, *Bacillus pumilus* and *Bacillus gibsonii*. Examples are described in WO2011/0237487, WO2011/140316 and WO2012/151480.
- (b) trypsin-type or chymotrypsin-type proteases, such as trypsin (e.g., of porcine or bovine origin), including the *Fusarium* protease described in WO 89/06270 and the chymotrypsin proteases derived from *Cellulomonas* described

in WO 05/052161 and WO 05/052146.

(c) metalloproteases, including those derived from *Bacillus amyloliquefaciens* described in WO 07/044993A2.

[0060] Preferred proteases include those derived from *Bacillus gibsonii* or *Bacillus Lentus*.

[0061] Suitable commercially available protease enzymes include those sold under the trade names Alcalase®, Savinase®, Primase®, Durazym®, Polarzyme®, Kannase®, Liquezyme®, Liquezyme Ultra®, Savinase Ultra®, Ovozime®, Neutrase®, Everlase® and Esperase®, Progress Uno® by Novozymes A/S (Denmark), those sold under the tradename Maxatase®, Maxacal®, Maxapem®, Properase®, Purafect®, Purafect Prime®, Purafect Ox®, FN3®, FN4®, Excellase® and Purafect OXP® by Genencor International, those sold under the tradename Opticlean® and Optimase® by Solvay Enzymes, those available from Henkel/ Kemira, namely BLAP (sequence shown in Figure 29 of US 5,352,604 with the following mutations S99D + S101R + S103A + V104I + G159S, hereinafter referred to as BLAP), BLAP R (BLAP with S3T + V4I + V199M + V205I + L217D), BLAP X (BLAP with S3T + V4I + V205I) and BLAP F49 (BLAP with S3T + V4I + A194P + V199M + V205I + L217D) - all from Henkel/Kemira; KAP (*Bacillus alkalophilus subtilisin* with mutations A230V + S256G + S259N) from Kao; and those sold under the tradename Laverge™ 104L from BASF.

[0062] In yet another preferred embodiment of the present invention, the liquid detergent composition further contains from about 0.1 wt% to about 5 wt%, preferably from about 0.5 wt% to about 3 wt%, more preferably from about 1 wt% to about 1.5 wt%, of one or more fatty acids and/or alkali salts thereof. Suitable fatty acids and/or salts that can be used in the present invention include C₁₀-C₂₂ fatty acids or alkali salts thereof. Such alkali salts include monovalent or divalent alkali metal salts like sodium, potassium, lithium and/or magnesium salts as well as the ammonium and/or alkylammonium salts of fatty acids, preferably the sodium salt. However, the cleaning compositions of the present invention preferably contains soaps at a relatively low level, e.g., no more than about 3 wt%, more preferably not more than about 2 wt% or 1 wt%, and most preferably said cleaning composition is essentially free of soaps. In the compositions of the invention the fatty acids function as builders.

[0063] When the cleaning composition is in the form of a liquid laundry detergent composition, it may further comprise one or more organic solvents, which can be present in an amount ranging from about 1 wt% to about 80 wt%, preferably from about 10wt% to about 60 wt%, more preferably from about 15 wt% to about 50 wt%, and most preferably from about 20 wt% to about 45 wt%, by total weight of the composition.

[0064] Because phase separation is a constant challenge for liquid laundry detergent compositions, especially when the salt content in such compositions is high, the solvent system of the present invention is particularly designed to minimize the risk of phase separation. Specifically, the solvent system of the present invention is composed mostly of diols, such as ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, butylene glycol, pentanediols, and combinations thereof. The diols are present in the liquid laundry detergent composition of the present invention in a total amount ranging from about 2 wt% to about 50 wt%. Preferably, the composition contains ethylene, diethylene glycol, and/or propylene glycol in a total amount ranging from about 5 wt% to about 40 wt%. More preferably, the composition contains propylene glycol in the amount ranging from about 15 wt% to about 35 wt%. Other organic solvents may also be present, which include, but are not limited to: methanol, ethanol, glycerin, sodium cumene sulfonate, potassium cumene sulfonate, ammonium cumene sulfonate, sodium toluene sulfonate, potassium toluene sulfonate, sodium xylene sulfonate, potassium xylene sulfonate, ammonium xylene sulfonate, or mixtures thereof. Other lower alcohols, such C₁-C₄ alkanolamines, e.g., monoethanolamine and/or triethanolamine, may also be used. In a particularly preferred embodiment of the present invention, the liquid laundry detergent compositions of the present invention also contain from about 5 wt% to about 20 wt%, preferably from 6 wt% to 18 wt%, more preferably from 8 wt% to 16 wt% of glycerin in addition to the diol(s).

[0065] The liquid laundry detergent composition of the present invention preferably contains water in combination with the above-mentioned organic solvent(s) as carrier(s). In some embodiments, water is present in the liquid laundry detergent compositions of the present invention in the amount ranging from 5 or 10 or from 20 wt% to about 70wt%, preferably from about 25 wt% to 60 wt%, and more preferably from about 30 wt% to about 50 wt%. In other embodiments, water is absent and the composition is anhydrous. Highly preferred compositions afforded by the present invention are clear, isotropic liquids.

[0066] The present compositions may comprise a solvent system for example comprising water alone or mixtures of organic solvents either without or with water. Preferred organic solvents include 1,2-propanediol, ethanol, glycerol, dipropylene glycol, methyl propane diol and mixtures thereof. Other lower alcohols, C₁-C₄ alkanolamines such as monoethanolamine and triethanolamine, can also be used. Solvent systems can be absent, for example from anhydrous solid embodiments of the invention, but more typically are present at levels in the range of from about 0.1% to about 98%, preferably at least about 1% to about 50%, more usually from about 5% to about 25%. Such solvent systems may be particularly useful for pre-mixing with the brightener prior to mixing the brightener with other components in the detergent composition. Alternatively or in addition, surfactant(s) may be pre-mixed with the brightener. In such a preferred embodiment, the surfactant pre-mixed with the brightener comprises at least 25 wt% or at least 50 wt% (based on the total weight of the surfactant) of nonionic surfactant.

Adjunct Ingredients

[0067] The balance of the cleaning composition of the present invention typically contains from about 5 wt% to about 70 wt%, or about 10 wt% to about 60 wt% adjunct ingredients.

[0068] Suitable adjunct ingredients for laundry detergent products for example to assist or enhance cleaning performance, for treatment of the substrate to be cleaned, for example by softening or freshening, or to modify the aesthetics of the detergent composition as is the case with perfumes, colorants, non-fabric-shading dyes or the like, include: builders, chelating agents, dye transfer inhibiting agents, dispersants, rheology modifiers, enzymes, and enzyme stabilizers, catalytic materials, bleach activators, hydrogen peroxide, sources of hydrogen peroxide, preformed peracids, polymeric dispersing agents, clay soil removal/anti-redeposition agents, brighteners, suds suppressors, dyes, photobleaches, structure elasticizing agents, fabric softeners, carriers, hydrotropes, processing aids, solvents, hueing agents, anti-microbial agents, free perfume oils, and/or pigments. The precise nature of these adjunct ingredients and the levels thereof in the liquid laundry detergent composition will depend on factors like the specific type of the composition and the nature of the cleaning operation for which it is to be used.

[0069] Suitable adjunct ingredients for dish detergent products include: builders, chelants, conditioning polymers, cleaning polymers, surface modifying polymers, soil flocculating polymers, structurants, emmollients, humectants, skin rejuvenating actives, enzymes, carboxylic acids, scrubbing particles, bleach and bleach activators, perfumes, malodor control agents, pigments, dyes, opacifiers, beads, pearlescent particles, microcapsules, organic and inorganic cations such as alkaline earth metals such as Ca/Mg-ions and diamines, antibacterial agents, preservatives and pH adjusters and buffering means.

[0070] If the cleaning composition of the present invention comprises composition provided in a powder form, it may also be especially preferred for the powder to comprise low levels, or even be essentially free, of builder. The term "essentially free" means that the composition "comprises no deliberately added" amount of that ingredient. In a preferred embodiment, the cleaning composition of the present invention comprises no builder.

Structurant

[0071] In some embodiments of the invention, the composition is in the form of a structured liquid. Such structured liquids can either be internally structured, whereby the structure is formed by primary ingredients (e.g. surfactant material) and/or externally structured by providing a three dimensional matrix structure using secondary ingredients (e.g. polymers, clay and/or silicate material), for use e.g. as thickeners. The composition may comprise a structurant, preferably from 0.01wt% to 5wt%, from 0.1wt% to 2.0wt% structurant. Examples of suitable structurants are given in US2006/0205631A1, US2005/0203213A1, US7294611, US6855680. The structurant is typically selected from the group consisting of diglycerides and triglycerides, ethylene glycol distearate, microcrystalline cellulose, cellulose-based materials, microfiber cellulose, ally modified alkali-swellable emulsions such as Polygel W30 (3VSigma), biopolymers, xanthan gum, gellan gum, hydrogenated castor oil, derivatives of hydrogenated castor oil such as non-ethoxylated derivatives thereof and mixtures thereof, in particular, those selected from the group of hydrogenated castor oil, derivatives of hydrogenated castor oil, microfibrillar cellulose, hydroxyfunctional crystalline materials, long chain fatty alcohols, 12-hydroxystearic acids, clays and mixtures thereof. A preferred structurant is described in US Patent No. 6,855,680 which defines suitable hydroxyfunctional crystalline materials in detail. Preferred is hydrogenated castor oil. Non-limiting examples of useful structurants include.. Such structurants have a thread-like structuring system having a range of aspect ratios. Other suitable structurants and the processes for making them are described in WO2010/034736.

The liquid detergent composition as described herein above may also contain an external structurant, which may be present in an amount ranging from about 0.001% to about 1.0%, preferably from about 0.05% to about 0.5%, more preferably from about 0.1% to about 0.3% by total weight of the composition. Suitable external structurants include those described, for example, in US2007/169741 and US2005/0203213. A particularly preferred external structurant for the practice of the present invention is hydrogenated castor oil, which is also referred to as trihydroxylstearin and is commercially available under the tradename Thixin®.

Sodium Aluminosilicate

[0072] The level of sodium aluminosilicate present in the aqueous liquor is from 0 to 0.5g/l sodium aluminosilicate (anhydrous basis). More preferably the level of sodium aluminosilicate is from 0 to 0.4g/l, or below 0.3g/l, or below 0.2g/l or below 0.1g/l or below 0.05g/l. The fatty acid decarboxylase enzyme, when present in an additive particle may be the only enzyme in the additive particle or may be present in the additive particle in combination with one or more additional enzymes.

[0073] Particularly preferred additional adjunct materials may be further enzymes.

Enzymes

[0074] Preferably the composition comprises one or more additional enzymes. Preferred enzymes provide cleaning performance and/or fabric care benefits. Examples of suitable enzymes include, but are not limited to, hemicellulases, peroxidases, proteases, cellulases, xylanases, lipases, phospholipases, esterases, cutinases, pectinases, mannanases, pectate lyases, keratinases, reductases, oxidases, phenoloxidases, lipoxygenases, ligninases, pullulanases, tannases, pentosanases, malanases, β -glucanases, arabinosidases, hyaluronidase, chondroitinase, laccase, and amylases, or mixtures thereof. A preferred combination of additional enzymes comprises the protease and the lipase, in conjunction with amylase. When present in the composition, the aforementioned additional enzymes may each be present at levels from about 0.00001% to about 2%, from about 0.0001% to about 1% or even from about 0.001% to about 0.5% enzyme protein by weight of the composition.

Amylases

[0075] Preferably the composition may comprise an amylase. Suitable alpha-amylases include those of bacterial or fungal origin. Chemically or genetically modified mutants (variants) are included. A preferred alkaline alpha-amylase is derived from a strain of *Bacillus*, such as *Bacillus licheniformis*, *Bacillus amyloliquefaciens*, *Bacillus stearothermophilus*, *Bacillus subtilis*, or other *Bacillus* sp., such as *Bacillus* sp. NCIB 12289, NCIB 12512, NCIB 12513, DSM 9375 (USP 7,153,818) DSM 12368, DSMZ no. 12649, KSM AP1378 (WO 97/00324), KSM K36 or KSM K38 (EP 1,022,334). Preferred amylases include:

(a) the variants described in WO 94/02597, WO 94/18314, WO96/23874 and WO 97/43424, especially the variants with substitutions in one or more of the following positions versus the enzyme listed as SEQ ID No. 2 in WO 96/23874: 15, 23, 105, 106, 124, 128, 133, 154, 156, 181, 188, 190, 197, 202, 208, 209, 243, 264, 304, 305, 391, 408, and 444.

(b) the variants described in USP 5,856,164 and WO99/23211, WO 96/23873, WO00/60060 and WO 06/002643, especially the variants with one or more substitutions in the following positions versus the AA560 enzyme listed as SEQ ID No. 12 in WO 06/002643:

26, 30, 33, 82, 37, 106, 118, 128, 133, 149, 150, 160, 178, 182, 186, 193, 203, 214, 231, 256, 257, 258, 269, 270, 272, 283, 295, 296, 298, 299, 303, 304, 305, 311, 314, 315, 318, 319, 339, 345, 361, 378, 383, 419, 421, 437, 441, 444, 445, 446, 447, 450, 461, 471, 482, 484, preferably that also contain the deletions of D183* and G184*.

(c) variants exhibiting at least 90% identity with SEQ ID No. 4 in WO06/002643, the wild-type enzyme from *Bacillus* SP722, especially variants with deletions in the 183 and 184 positions and variants described in WO 00/60060, which is incorporated herein by reference.

(d) variants exhibiting at least 95% identity with the wild-type enzyme from *Bacillus* sp.707 (SEQ ID NO:7 in US 6,093, 562), especially those comprising one or more of the following mutations M202, M208, S255, R172, and/or M261. Preferably said amylase comprises one or more of M202L, M202V, M202S, M202T, M202I, M202Q, M202W, S255N and/or R172Q. Particularly preferred are those comprising the M202L or M202T mutations.

(e) variants described in WO 09/149130, preferably those exhibiting at least 90% identity with SEQ ID NO: 1 or SEQ ID NO:2 in WO 09/149130, the wild-type enzyme from *Geobacillus* *Stearothermophilus* or a truncated version thereof;

(f) variants as described in EP2540825 and EP2357220, EP2534233; (g) variants as described in WO2009100102 and WO2010115028.

[0076] Suitable commercially available alpha-amylases include DURAMYL®, LIQUEZYME®, TERMAMYL®, TERMAMYL ULTRA®, NATALASE®, SUPRAMYL®, STAINZYME®, STAINZYME PLUS®, FUNGAMYL® and BAN® (Novozymes A/S, Bagsvaerd, Denmark), KEMZYM® AT 9000 Biozym Biotech Trading GmbH Wehlstrasse 27b A-1200 Wien Austria, RAPIDASE®, PURASTAR®, ENZYSIZE®, OPTISIZE HT PLUS®, POWERASE® and PURASTAR OX-AM® (Genencor International Inc., Palo Alto, California) and KAM® (Kao, 14-10 Nihonbashi Kayabacho, 1-chome, Chuo-ku Tokyo 103-8210, Japan). In one aspect, suitable amylases include NATALASE®, STAINZYME® and STAINZYME PLUS® and mixtures thereof.

Endoglucanases

[0077] Other preferred enzymes include microbial-derived endoglucanases exhibiting endo-beta-1,4-glucanase activity (E.C. 3.2.1.4), including a bacterial polypeptide endogenous to a member of the genus *Bacillus* which has a

sequence of at least 90%, 94%, 97% and even 99% identity to the amino acid sequence SEQ ID NO:2 in US7,141,403B2) and mixtures thereof. Suitable endoglucanases are sold under the tradenames Celluclean® and Whitezyme® (Novozymes A/S, Bagsvaerd, Denmark).

Pectate Lyases

[0078] Other preferred enzymes include pectate lyases sold under the tradenames Pectawash®, Pectaway®, Xpect® and mannanases sold under the tradenames Mannaway® (all from Novozymes A/S, Bagsvaerd, Denmark), and Purabrite® (Genencor International Inc., Palo Alto, California).

[0079] When the aqueous solution is provided by the addition of a cleaning composition to water, in addition to the nuclease enzyme the cleaning composition will comprise optional cleaning and/or treatment adjunct materials. The nuclease enzyme will preferably be present in the composition in amounts of 0.00001% to about 3% by weight, from about 0.0001% to about 2% by weight or even from about 0.001% to about 1% by weight enzyme protein by weight of the composition.

[0080] Preferably the composition will additionally comprise a β -N-acetylglucosaminidase enzyme from E.C. 3.2.1.52, preferably an enzyme having at least 70%, or at least 75% or at least 80% or at least 85% or at least 90% or at least 95% or at least 96% or at least 97% or at least 98% or at least 99% or at least or 100% identity to SEQ ID NO: 4. When present, the β -N-acetylglucosaminidase enzyme will typically be present in an amount from 0.00001% to about 2%, from about 0.0001% to about 1% or even from about 0.001% to about 0.5% enzyme protein by weight of the composition.

Antimicrobials

[0081] It may be preferred for the compositions to comprise in addition, one or mixtures of more than one compounds which may give rise to anti-microbial effects. These may be standard ingredients of the treatment compositions that are added for cleaning or malodor benefits such as bleaching agents, but have some anti-microbial effect or they may be added specifically to provide anti-microbial effect. Suitable examples may include but are not limited to aldehydes (formaldehyde, glutaraldehyde, ortho-phthalaldehyde), sulphur dioxide, sulphites, bisulphites, vanillic acid esters), chlorine and oxygen based oxidizing agents (sodium and calcium hypochlorite or hypobromite, chloramine and chloramine-T, chlorine dioxide, hydrogen peroxide, iodine, ozone, peracetic acid, performic acid, potassium permanganate, potassium peroxymonosulfate), phenolics (phenol, o-phenylphenol, chloroxylenol, hexachlorophene, thymol, amylmetacresol, 2,4-dichlorobenzyl alcohol, polycresylen, fenchlor, 4-allylcatechol, p-hydroxybenzoic acid esters including benzylparaben, butylparaben, ethylparaben, methylparaben and propylparaben, butylated hydroxyanisole, butylated hydroxytoluene, capaicin, carvacrol, creosol, eugenol, guaiacol), halogenated (hydroxy)diphenylethers (diclosan, triclosan, hexachlorophene and bromochlorophene, 4-hexylresorcinol, 8-hydroxyquinoline and salts thereof), quaternary ammonium compounds (benzalkonium chloride derivatives, benzethonium chloride derivatives, cetrimonium chloride/bromide, cetylpyridinium, cetrimide, benzoxonium chloride, didecylmethyl ammonium chloride), acridine derivatives (ethacridine lactate, 9-aminoacridine, euflavine), biguanides including polymeric biguanides, and amidines (polyaminopropyl biguanide, dibrompropamidine, chlorhexidine, alexidine, propamidine, hexamidine, polihexanide), nitrofuran derivatives (nitrofurazone), quinoline derivatives (dequalinium, chlorquinaldol, oxyquinoline, clioquinol), iodine products, essential oils (bay, cinnamon, clove, thyme, eucalyptus, peppermint, lemon, tea tree, magnolia extract, menthol, geraniol), cations, Anilides (saclicylanilide, Diphenylureas), salicylic acid esters including menthyl salicylate, methyl salicylate and phenyl salicylate, pyrocatechol, phthalic acid and salts thereof, hexetidine, octenidine, sanguinarine, domiphen bromide, alkylpyridinium chlorides such as cetylpyridinium chloride, tetradecylpyridinium chloride and N-tetradecyl-4-ethylpyridinium chloride, iodine, sulfonamides, piperidino derivatives such as delmopinol and octapinol, and mixtures thereof, miscellaneous preservatives (derivatives of 1,3-dioxane, derivatives of imidazole, Isothiazolones, derivatives of hexamine, triazines, oxazolo-oxazoles, sodium hydroxymethylglycinate, methylene bithiocyanate, captan).

[0082] Preferred antibacterial systems are halogenated benzyl alcohol derivatives such as chloroxylenol (PCMX), halogenated hydroxydiphenylethers preferably diclosan, quaternary ammonium salts preferably alkylbenzalkonium and alkylbenzethonium chloride and derivatives thereof, essential oils, bleach system preferably a peroxide bleach, and mixtures thereof. Most preferred antibacterial systems are benzalkonium chloride, diclosan and PCMX.

Encapsulates

[0083] The composition may comprise an encapsulate, for example an encapsulate comprising a core, a shell having an inner and outer surface, said shell encapsulating said core. The core may comprise any laundry care adjunct, though typically the core may comprise material selected from the group consisting of perfumes; brighteners; dyes; insect repellants; silicones; waxes; flavors; vitamins; fabric softening agents; skin care agents in one aspect, paraffins; enzymes; anti-bacterial agents; bleaches; sensates; and mixtures thereof; and said shell may comprise a material selected from

the group consisting of polyethylenes; polyamides; polyvinylalcohols, optionally containing other co-monomers; polystyrenes; polyisoprenes; polycarbonates; polyesters; polyacrylates; aminoplasts, in one aspect said aminoplast may comprise a polyureas, polyurethane, and/or polyureaurethane, in one aspect said polyurea may comprise polyoxymethyleneurea and/or melamine formaldehyde; polyolefins; polysaccharides, in one aspect said polysaccharide may comprise alginate and/or chitosan; gelatin; shellac; epoxy resins; vinyl polymers; water insoluble inorganics; silicone; and mixtures thereof. Preferred encapsulates comprise perfume. Preferred encapsulates comprise a shell which may comprise melamine formaldehyde and/or cross linked melamine formaldehyde. Preferred encapsulates comprise a core material and a shell, said shell at least partially surrounding said core material, is disclosed. At least 75%, 85% or even 90% of said encapsulates may have a fracture strength of from 0.2 MPa to 10 MPa, and a benefit agent leakage of from 0% to 20%, or even less than 10% or 5% based on total initial encapsulated benefit agent. Preferred are those in which at least 75%, 85% or even 90% of said encapsulates may have (i) a particle size of from 1 microns to 80 microns, 5 microns to 60 microns, from 10 microns to 50 microns, or even from 15 microns to 40 microns, and/or (ii) at least 75%, 85% or even 90% of said encapsulates may have a particle wall thickness of from 30 nm to 250 nm, from 80 nm to 180 nm, or even from 100 nm to 160 nm. Formaldehyde scavengers may be employed with the encapsulates, for example, in a capsule slurry and/or added to a composition before, during or after the encapsulates are added to such composition. Suitable capsules that can be made by following the teaching of USPA 2008/0305982 A1; and/or USPA 2009/0247449 A1. Alternatively, suitable capsules can be purchased from Appleton Papers Inc. of Appleton, Wisconsin USA.

[0084] In a preferred aspect the composition may comprise a deposition aid, preferably in addition to encapsulates. Preferred deposition aids are selected from the group consisting of cationic and nonionic polymers. Suitable polymers include cationic starches, cationic hydroxyethylcellulose, polyvinylformaldehyde, locust bean gum, mannans, xyloglucans, tamarind gum, polyethyleneterephthalate and polymers containing dimethylaminoethyl methacrylate, optionally with one or more monomers selected from the group comprising acrylic acid and acrylamide.

Perfume

[0085] Preferred compositions of the invention comprise perfume. Typically the composition comprises a perfume that comprises one or more perfume raw materials, selected from the group as described in WO08/87497. However, any perfume useful in a detergent may be used. A preferred method of incorporating perfume into the compositions of the invention is via an encapsulated perfume particle comprising either a water-soluble hydroxylic compound or melamine-formaldehyde or modified polyvinyl alcohol. In one aspect the encapsulate comprises (a) an at least partially water-soluble solid matrix comprising one or more water-soluble hydroxylic compounds, preferably starch; and (b) a perfume oil encapsulated by the solid matrix. In a further aspect the perfume may be pre-complexed with a polyamine, preferably a polyethylenimine so as to form a Schiff base.

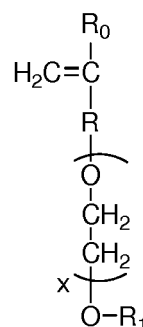
Polymers

[0086] The detergent composition may comprise one or more polymers in addition to the DTI which may be polymeric. Examples are optionally modified carboxymethylcellulose, poly (ethylene glycol), poly(vinyl alcohol), polycarboxylates such as polyacrylates, maleic/acrylic acid copolymers and lauryl methacrylate/acrylic acid co-polymers and carboxylate polymers.

[0087] Suitable carboxylate polymers include maleate/acrylate random copolymer or polyacrylate homopolymer. The carboxylate polymer may be a polyacrylate homopolymer having a molecular weight of from 4,000 Da to 9,000 Da, or from 6,000 Da to 9,000 Da. Other suitable carboxylate polymers are co-polymers of maleic acid and acrylic acid, and may have a molecular weight in the range of from 4,000 Da to 90,000 Da.

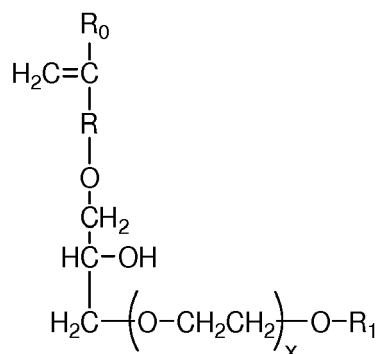
[0088] Other suitable carboxylate polymers are co-polymers comprising: (i) from 50 to less than 98 wt% structural units derived from one or more monomers comprising carboxyl groups; (ii) from 1 to less than 49 wt% structural units derived from one or more monomers comprising sulfonate moieties; and (iii) from 1 to 49 wt% structural units derived from one or more types of monomers selected from ether bond-containing monomers represented by formulas (I) and (II):

formula (I):



wherein in formula (I), R_0 represents a hydrogen atom or CH_3 group, R represents a CH_2 group, CH_2CH_2 group or single bond, X represents a number 0-5 provided X represents a number 1-5 when R is a single bond, and R_1 is a hydrogen atom or C1 to C20 organic group;

formula (II)



in formula (II), R_0 represents a hydrogen atom or CH_3 group, R represents a CH_2 group, CH_2CH_2 group or single bond, X represents a number 0-5, and R_1 is a hydrogen atom or C1 to C20 organic group.

[0089] The composition may comprise one or more amphiphilic cleaning polymers such as the compound having the following general structure: $\text{bis}((C_2H_5O)(C_2H_4O)_n)(CH_3)-N^+-C_xH_{2x}-N^+-(CH_3)-\text{bis}((C_2H_5O)(C_2H_4O)_n)$, wherein n = from 20 to 30, and x = from 3 to 8, or sulphated or sulphonated variants thereof. In one aspect, this polymer is sulphated or sulphonated to provide a zwitterionic soil suspension polymer.

[0090] The composition preferably comprises amphiphilic alkoxyated grease cleaning polymers which have balanced hydrophilic and properties such that they remove grease particles from fabrics and surfaces. Preferred amphiphilic alkoxyated grease cleaning polymers comprise a core structure and a plurality of alkoxyate groups attached to that core structure. These may comprise alkoxyated polyalkylenimines, preferably having an inner polyethylene oxide block and an outer polypropylene oxide block. Typically these may be incorporated into the compositions of the invention in amounts of from 0.005 to 10 wt%, generally from 0.5 to 8 wt%.

[0091] Alkoxyated polycarboxylates such as those prepared from polyacrylates are useful herein to provide additional grease removal performance. Such materials are described in WO 91/08281 and PCT 90/01815. Chemically, these materials comprise polyacrylates having one ethoxy side-chain per every 7-8 acrylate units. The side-chains are of the formula $-(CH_2CH_2O)_m(CH_2)_nCH_3$ wherein m is 2-3 and n is 6-12. The side-chains are ester-linked to the polyacrylate "backbone" to provide a "comb" polymer type structure. The molecular weight can vary, but is typically in the range of about 2000 to about 50,000. Such alkoxyated polycarboxylates can comprise from about 0.05% to about 10%, by weight, of the compositions herein.

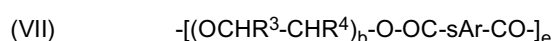
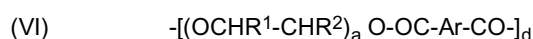
[0092] The composition may comprise polyethylene glycol polymers and these may be particularly preferred in compositions comprising mixed surfactant systems. Suitable polyethylene glycol polymers include random graft co-polymers comprising: (i) hydrophilic backbone comprising polyethylene glycol; and (ii) side chain(s) selected from the group consisting of: C4-C25 alkyl group, polypropylene, polybutylene, vinyl ester of a saturated C1-C6 mono-carboxylic acid, C1-C6 alkyl ester of acrylic or methacrylic acid, and mixtures thereof. Suitable polyethylene glycol polymers have a polyethylene glycol backbone with random grafted polyvinyl acetate side chains. The average molecular weight of the

polyethylene glycol backbone can be in the range of from 2,000 Da to 20,000 Da, or from 4,000 Da to 8,000 Da. The molecular weight ratio of the polyethylene glycol backbone to the polyvinyl acetate side chains can be in the range of from 1:1 to 1:5, or from 1:1.2 to 1:2. The average number of graft sites per ethylene oxide units can be less than 1, or less than 0.8, the average number of graft sites per ethylene oxide units can be in the range of from 0.5 to 0.9, or the average number of graft sites per ethylene oxide units can be in the range of from 0.1 to 0.5, or from 0.2 to 0.4. A suitable polyethylene glycol polymer is Sokalan HP22.

[0093] Typically these are incorporated into the compositions of the invention in amounts from 0.005 to 10 wt%, more usually from 0.05 to 8 wt%.

[0094] Preferably the composition comprises one or more carboxylate polymer, such as a maleate/acrylate random copolymer or polyacrylate homopolymer. In one aspect, the carboxylate polymer is a polyacrylate homopolymer having a molecular weight of from 4,000 Da to 9,000 Da, or from 6,000 Da to 9,000 Da. Typically these are incorporated into the compositions of the invention in amounts from 0.005 to 10 wt%, or from 0.05 to 8 wt%.

[0095] Preferably the composition comprises one or more soil release polymers. Examples include soil release polymers having a structure as defined by one of the following Formulae (VI), (VII) or (VIII):



wherein:

a, b and c are from 1 to 200;

d, e and f are from 1 to 50;

Ar is a 1,4-substituted phenylene;

sAr is 1,3-substituted phenylene substituted in position 5 with SO₃Me;

Me is Li, K, Mg/2, Ca/2, Al/3, ammonium, mono-, di-, tri-, or tetraalkylammonium wherein the alkyl groups are C₁-C₁₈ alkyl or C₂-C₁₀ hydroxyalkyl, or mixtures thereof;

R¹, R², R³, R⁴, R⁵ and R⁶ are independently selected from H or C₁-C₁₈ n- or iso-alkyl; and

R⁷ is a linear or branched C₁-C₁₈ alkyl, or a linear or branched C₂-C₃₀ alkenyl, or a cycloalkyl group with 5 to 9 carbon atoms, or a C₆-C₃₀ aryl group, or a C₆-C₃₀ arylalkyl group.

[0096] Suitable soil release polymers are polyester soil release polymers such as Repel-o-tex polymers, including Repel-o-tex SF, SF-2 and SRP6 supplied by Rhodia. Other suitable soil release polymers include Texcare polymers, including Texcare SRA100, SRA300, SRN100, SRN170, SRN240, SRN300 and SRN325 supplied by Clariant. Other suitable soil release polymers are Marloquest polymers, such as Marloquest SL supplied by Sasol.

[0097] Preferably the composition comprises one or more cellulosic polymer, including those selected from alkyl cellulose, alkyl alkoxyalkyl cellulose, carboxyalkyl cellulose, alkyl carboxyalkyl cellulose. Preferred cellulosic polymers are selected from the group comprising carboxymethyl cellulose, methyl cellulose, methyl hydroxyethyl cellulose, methyl carboxymethyl cellulose, and mixtures thereof. In one aspect, the carboxymethyl cellulose has a degree of carboxymethyl substitution from 0.5 to 0.9 and a molecular weight from 100,000 Da to 300,000 Da.

Bleaching Agents

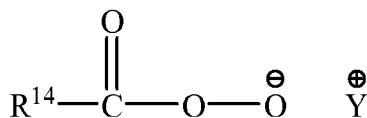
[0098] It may be preferred for the composition to comprise one or more bleaching agents.

Suitable bleaching agents other than bleaching catalysts include photobleaches, bleach activators, hydrogen peroxide, sources of hydrogen peroxide, pre-formed peracids and mixtures thereof. In general, when a bleaching agent is used, the compositions of the present invention may comprise from about 0.1% to about 50% or even from about 0.1% to about 25% bleaching agent or mixtures of bleaching agents by weight of the subject composition. Examples of suitable bleaching agents include:

(1) photobleaches for example sulfonated zinc phthalocyanine sulfonated aluminium phthalocyanines, xanthene dyes and mixtures thereof;

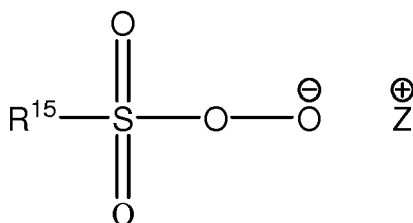
(2) pre-formed peracids: Suitable preformed peracids include, but are not limited to compounds selected from the group consisting of pre-formed peroxyacids or salts thereof typically a percarboxylic acids and salts, percarbonic acids and salts, perimidic acids and salts, peroxymonosulfuric acids and salts, for example, Oxone®, and mixtures thereof. Suitable examples include peroxydicarboxylic acids or salts thereof, or peroxydisulphonic acids or salts thereof.

Typical peroxydicarboxylic acid salts suitable for use herein have a chemical structure corresponding to the following chemical formula:



wherein: R¹⁴ is selected from alkyl, aralkyl, cycloalkyl, aryl or heterocyclic groups; the R¹⁴ group can be linear or branched, substituted or unsubstituted; having, when the peracid is , from 6 to 14 carbon atoms, or from 8 to 12 carbon atoms and, when the peracid is hydrophilic, less than 6 carbon atoms or even less than 4 carbon atoms and Y is any suitable counter-ion that achieves electric charge neutrality, preferably Y is selected from hydrogen, sodium or potassium. Preferably, R¹⁴ is a linear or branched, substituted or unsubstituted C₆₋₉ alkyl. Preferably, the peroxyacid or salt thereof is selected from peroxyhexanoic acid, peroxyheptanoic acid, peroxyoctanoic acid, peroxydecanoic acid, any salt thereof, or any combination thereof. Particularly preferred peroxyacids are phthalimido-peroxy-alkanoic acids, in particular ε-phthalimido peroxy hexanoic acid (PAP). Preferably, the peroxyacid or salt thereof has a melting point in the range of from 30°C to 60°C.

The pre-formed peroxyacid or salt thereof can also be a peroxydisulphonic acid or salt thereof, typically having a chemical structure corresponding to the following chemical formula:



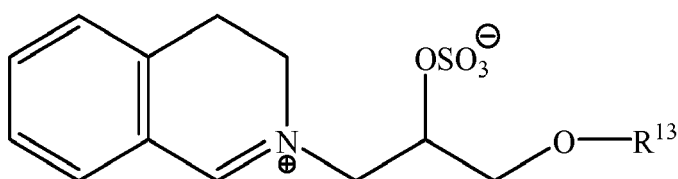
wherein: R¹⁵ is selected from alkyl, aralkyl, cycloalkyl, aryl or heterocyclic groups; the R¹⁵ group can be linear or branched, substituted or unsubstituted; and Z is any suitable counter-ion that achieves electric charge neutrality, preferably Z is selected from hydrogen, sodium or potassium. Preferably R¹⁵ is a linear or branched, substituted or unsubstituted C₄₋₁₄, preferably C₆₋₁₄ alkyl. Preferably such bleach components may be present in the compositions of the invention in an amount from 0.01 to 50%, most preferably from 0.1% to 20%.

(3) sources of hydrogen peroxide, for example, inorganic perhydrate salts, including alkali metal salts such as sodium salts of perborate (usually mono- or tetra-hydrate), percarbonate, persulphate, perphosphate, persilicate salts and mixtures thereof. In one aspect of the invention the inorganic perhydrate salts are selected from the group consisting of sodium salts of perborate, percarbonate and mixtures thereof. When employed, inorganic perhydrate salts are typically present in amounts of from 0.05 to 40 wt%, or 1 to 30 wt% of the overall fabric and home care product and are typically incorporated into such fabric and home care products as a crystalline solid that may be coated. Suitable coatings include, inorganic salts such as alkali metal silicate, carbonate or borate salts or mixtures thereof, or organic materials such as water-soluble or dispersible polymers, waxes, oils or fatty soaps; and

(4) bleach activators having R-(C=O)-L wherein R is an alkyl group, optionally branched, having, when the bleach activator is , from 6 to 14 carbon atoms, or from 8 to 12 carbon atoms and, when the bleach activator is hydrophilic, less than 6 carbon atoms or even less than 4 carbon atoms; and L is leaving group. Examples of suitable leaving groups are benzoic acid and derivatives thereof - especially benzene sulphonate. Suitable bleach activators include dodecanoyl oxybenzene sulphonate, decanoyl oxybenzene sulphonate, decanoyl oxybenzoic acid or salts thereof, 3,5,5-trimethyl hexanoyloxybenzene sulphonate, tetraacetyl ethylene diamine (TAED) and nonanoyloxybenzene sulphonate (NOBS). Suitable bleach activators are also disclosed in WO 98/17767. While any suitable bleach activator may be employed, in one aspect of the invention the subject composition may comprise NOBS, TAED or mixtures thereof.

(5) Bleach Catalysts. The compositions of the present invention may also include one or more bleach catalysts capable of accepting an oxygen atom from a peroxyacid and/or salt thereof, and transferring the oxygen atom to an oxidizable substrate. Suitable bleach catalysts include, but are not limited to: iminium cations and polyions; iminium zwitterions; modified amines; modified amine oxides; N-sulphonyl imines; N-phosphonyl imines; N-acyl imines; thiadiazole dioxides; perfluoroimines; cyclic sugar ketones and alpha amino-ketones and mixtures thereof. Suitable alpha amino ketones are for example as described in WO 2012/000846 A1, WO 2008/015443 A1, and WO 2008/014965 A1. Suitable mixtures are as described in USPA 2007/0173430 A1.

In one aspect, the bleach catalyst has a structure corresponding to general formula below:



wherein R^{13} is selected from the group consisting of 2-ethylhexyl, 2-propylheptyl, 2-butyloctyl, 2-pentylonyl, 2-hexyldecyl, n-dodecyl, n-tetradecyl, n-hexadecyl, n-octadecyl, isononyl, iso-decyl, iso-tridecyl and iso-pentadecyl; (6) The composition may preferably comprise catalytic metal complexes. One preferred type of metal-containing bleach catalyst is a catalyst system comprising a transition metal cation of defined bleach catalytic activity, such as copper, iron, titanium, ruthenium, tungsten, molybdenum, or manganese cations, an auxiliary metal cation having little or no bleach catalytic activity, such as zinc or aluminum cations, and a sequester having defined stability constants for the catalytic and auxiliary metal cations, particularly ethylenediaminetetraacetic acid, ethylenediaminetetra(methylenephosphonic acid) and water-soluble salts thereof. Such catalysts are disclosed in U.S. 4,430,243.

[0099] If desired, the compositions herein can be catalyzed by means of a manganese compound. Such compounds and levels of use are well known in the art and include, for example, the manganese-based catalysts disclosed in U.S. 5,576,282.

Cobalt bleach catalysts useful herein are known, and are described, for example, in U.S. 5,597,936; U.S. 5,595,967. Such cobalt catalysts are readily prepared by known procedures, such as taught for example in U.S. 5,597,936, and U.S. 5,595,967.

[0100] Compositions herein may also suitably include a transition metal complex of ligands such as bispidones (WO 05/042532 A1) and/or macropolycyclic rigid ligands - abbreviated as "MRLs". As a practical matter, and not by way of limitation, the compositions and processes herein can be adjusted to provide on the order of at least one part per hundred million of the active MRL species in the aqueous washing medium, and will typically provide from about 0.005 ppm to about 25 ppm, from about 0.05 ppm to about 10 ppm, or even from about 0.1 ppm to about 5 ppm, of the MRL in the wash liquor.

[0101] Suitable transition-metals in the instant transition-metal bleach catalyst include, for example, manganese, iron and chromium. Suitable MRLs include 5,12-diethyl-1,5,8,12-tetraazabicyclo[6.6.2]hexadecane.

Suitable transition metal MRLs are readily prepared by known procedures, such as taught for example in WO 00/32601, and U.S. 6,225,464.

[0102] When present, the source of hydrogen peroxide/peracid and/or bleach activator is generally present in the composition in an amount of from about 0.1 to about 60 wt%, from about 0.5 to about 40 wt % or even from about 0.6 to about 10 wt% based on the fabric and home care product. One or more peracids or precursors thereof may be used in combination with one or more hydrophilic peracid or precursor thereof.

[0103] Typically hydrogen peroxide source and bleach activator will be incorporated together. The amounts of hydrogen peroxide source and peracid or bleach activator may be selected such that the molar ratio of available oxygen (from the peroxide source) to peracid is from 1:1 to 35:1, or even 2:1 to 10:1.

Builders

[0104] Preferably the composition comprises one or more builders or a builder system. When a builder is used, the composition of the invention will typically comprise at least 1%, or at least 2% to 60% builder. Suitable builders include for example zeolite, phosphate, citrate, etc. It may be preferred that the composition comprises low levels of phosphate salt and/or zeolite, for example from 1 to 10 or 5 wt%. The composition may even be substantially free of strong builder; substantially free of strong builder means "no deliberately added" zeolite and/or phosphate. Typical zeolite builders include zeolite A, zeolite P and zeolite MAP. A typical phosphate builder is sodium tri-polyphosphate.

Chelating Agent

[0105] Preferably the composition comprises chelating agents and/or crystal growth inhibitor. Suitable molecules include copper, iron and/or manganese chelating agents and mixtures thereof. Suitable molecules include aminocarboxylates, aminophosphonates, succinates, salts thereof, and mixtures thereof. Non-limiting examples of suitable chelants for use herein include ethylenediaminetetraacetates, N- (hydroxyethyl)ethylenediaminetriacetates, nitrilotriacetates, ethylenediamine tetrapropionates, triethylenetetraaminehexacetates, diethylenetriamine-pentaacetates, eth-

anoldiglycines, ethylenediaminetetrakis (methylenephosphonates), diethylenetriamine penta(methylene phosphonic acid) (DTPMP), ethylenediamine disuccinate (EDDS), hydroxyethanedimethylenephosphonic acid (HEDP), methylglycinodiacetic acid (MGDA), diethylenetriaminepentaacetic acid (DTPA), salts thereof, and mixtures thereof. Other nonlimiting examples of chelants of use in the present invention are found in U.S. Patent Nos. 7445644, 7585376 and 2009/0176684A1. Other suitable chelating agents for use herein are the commercial DEQUEST series, and chelants from Monsanto, DuPont, and Nalco, Inc.

pH Modifiers

[0106] pH modifiers may be incorporated to generate the desired pH. Any alkali or acid may be added known to those skilled in the art of detergent manufacture, for example, sodium or potassium hydroxide carbonate or silicate, citric acid, or stronger acids such as hydrochloric acid. Those pH modifiers which add buffering capacity may be particularly preferred.

Silicate Salts

[0107] The composition may preferably also contain silicate salts, such as sodium or potassium silicate. The composition may comprise from 0wt% to less than 10wt% silicate salt, to 9wt%, or to 8wt%, or to 7wt%, or to 6wt%, or to 5wt%, or to 4wt%, or to 3wt%, or even to 2wt%, and preferably from above 0wt%, or from 0.5wt%, or even from 1wt% silicate salt. A suitable silicate salt is sodium silicate.

Dispersants

[0108] The composition may preferably also contain dispersants. Suitable water-soluble organic materials include the homo- or co-polymeric acids or their salts, in which the polycarboxylic acid comprises at least two carboxyl radicals separated from each other by not more than two carbon atoms.

Enzyme Stabilisers

[0109] The composition may preferably comprise enzyme stabilizers. Any conventional enzyme stabilizer may be used, for example by the presence of water-soluble sources of calcium and/or magnesium ions in the finished fabric and home care products that provide such ions to the enzymes. In case of aqueous compositions comprising protease, a reversible protease inhibitor, such as a boron compound including borate, or preferably 4-formyl phenylboronic acid, phenylboronic acid and derivatives thereof, or compounds such as calcium formate, sodium formate and 1,2-propane diol, diethylene glycol can be added to further improve stability.

Fabric Shading Dye

[0110] The composition may comprise fabric shading dye. Suitable fabric shading dye (sometimes referred to as hueing, bluing or whitening agents) typically provides a blue or violet shade to fabric. Fabric shading dyes can be used either alone or in combination to create a specific shade of hueing and/or to shade different fabric types. This may be provided for example by mixing a red and green-blue dye to yield a blue or violet shade. The fabric shading dye may be selected from any known chemical class of dye, including but not limited to acridine, anthraquinone (including polycyclic quinones), azine, azo (e.g., monoazo, disazo, trisazo, tetrakisazo, polyazo), including premetallized azo, benzodifurane and benzodifuranone, carotenoid, coumarin, cyanine, diazahemicyanine, diphenylmethane, formazan, hemicyanine, indigoids, methane, naphthalimides, naphthoquinone, nitro and nitroso, oxazine, phthalocyanine, pyrazoles, stilbene, styryl, triarylmethane, triphenylmethane, xanthenes and mixtures thereof.

[0111] Suitable fabric shading dyes include dyes and dye-clay conjugates. Preferred fabric shading dyes are selected from small molecule dyes and polymeric dyes. Suitable small molecule dyes include small molecule dyes selected from the group consisting of dyes falling into the Colour Index (C.I.) classifications of Acid, Direct, Basic, Reactive, Solvent or Disperse dyes for example that are classified as Blue, Violet, Red, Green or Black, and provide the desired shade either alone or in combination with other dyes or in combination with other adjunct ingredients. Dyes described as hydrolysed Reactive dyes, as described in EP-A-1794274 may also be included. In another aspect, suitable small molecule dyes include small molecule dyes selected from the group consisting of Colour Index (Society of Dyers and Colourists, Bradford, UK) numbers Direct Violet dyes such as 5, 7, 9, 11, 31, 35, 48, 51, 66, and 99, Direct Blue dyes such as 1, 71, 80 and 279, Acid Red dyes such as 17, 73, 52, 88 and 150, Acid Violet dyes such as 15, 17, 24, 43, 49 and 50, Acid Blue dyes such as 15, 17, 25, 29, 40, 45, 48, 75, 80, 83, 90 and 113, Acid Black dyes such as 1, Basic Violet dyes such as 1, 3, 4, 10 and 35, Basic Blue dyes such as 3, 16, 22, 47, 66, 75 and 159, Disperse or Solvent dyes such as those described in US 2008/034511 A1 or US 8,268,016 B2, or dyes as disclosed in US 7,208,459 B2, such

as solvent violet 13 and mixtures thereof. In another aspect, suitable small molecule dyes include small molecule dyes selected from the group consisting of C. I. numbers Acid Violet 17, Acid Blue 80, Acid Violet 50, Direct Blue 71, Direct Violet 51, Direct Blue 1, Acid Red 88, Acid Red 150, Acid Blue 29, Acid Blue 113 or mixtures thereof.

[0112] Suitable polymeric dyes include polymeric dyes selected from the group consisting of polymers containing covalently bound (sometimes referred to as conjugated) chromogens, (dye-polymer conjugates), for example polymers with chromogens co-polymerized into the backbone of the polymer and mixtures thereof. Polymeric dyes include those described in WO2011/98355, US 2012/225803 A1, US 2012/090102 A1, WO2012/166768, US 7,686,892 B2, and WO2010/142503.

[0113] Other suitable polymeric dyes include polymeric dyes selected from the group consisting of fabric-substantive colorants sold under the name of Liquitint® (Milliken, Spartanburg, South Carolina, USA), dye-polymer conjugates formed from at least one reactive dye and a polymer selected from the group consisting of polymers comprising a moiety selected from the group consisting of a hydroxyl moiety, a primary amine moiety, a secondary amine moiety, a thiol moiety and mixtures thereof. In still another aspect, suitable polymeric dyes include polymeric dyes selected from the group consisting of Liquitint® Violet CT, carboxymethyl cellulose (CMC) covalently bound to one or more reactive blue, reactive violet or reactive red dye such as CMC conjugated with C.I. Reactive Blue 19, sold by Megazyme, Wicklow, Ireland under the product name AZO-CM-CELLULOSE, product code S-ACMC, alkoxyated triphenyl-methane polymeric colourants, alkoxyated thiophene polymeric colourants, alkoxyated carbocyclic and alkoxyated heterocyclic azo colourants, and mixtures thereof. Preferred polymeric dyes comprise the optionally substituted alkoxyated dyes, such as alkoxyated triphenyl-methane polymeric colourants, alkoxyated thiophene polymeric colourants, alkoxyated carbocyclic and alkoxyated heterocyclic azo colourants, and mixtures thereof, such as the Liquitint dyes.

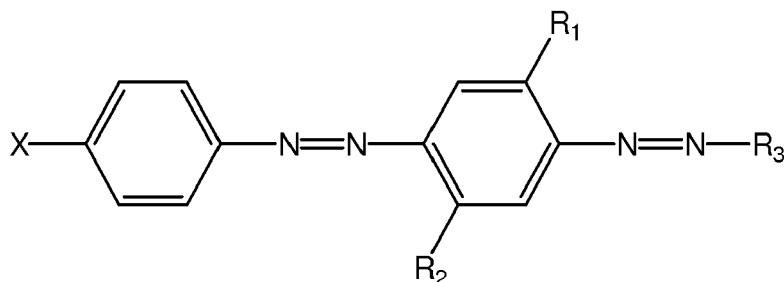
[0114] Preferred hueing dyes include the whitening agents found in WO 08/87497 A1, WO2011/01179 and US 2012/129752 A1. Preferred hueing agents for use in the present invention may be the preferred dyes disclosed in these references, including those selected from Examples 1-42 in Table 5 of WO2011/011799. Other preferred dyes are disclosed in US 8,138,222. Other preferred dyes are disclosed in US 7,909,890 B2.

[0115] Suitable dye clay conjugates include dye clay conjugates selected from the group comprising at least one cationic/basic dye and a smectite clay, and mixtures thereof. In another aspect, suitable dye clay conjugates include dye clay conjugates selected from the group consisting of one cationic/basic dye and a clay selected from the group consisting of Montmorillonite clay, Hectorite clay, Saponite clay and mixtures thereof. Examples of suitable cationic/basic dyes include C.I. Basic Yellow 1 through 108, C.I. Basic Orange 1 through 69, C.I. Basic Red 1 through 118, C.I. Basic Violet 1 through 51, C.I. Basic Blue 1 through 164, C.I. Basic Green 1 through 14, C.I. Basic Brown 1 through 23, C.I. Basic Black 1 through 11, In still another aspect, suitable dye clay conjugates include dye clay conjugates selected from the group consisting of: Montmorillonite Basic Blue B7 C.I. 42595 conjugate, Montmorillonite Basic Blue B9 C.I. 52015 conjugate, Montmorillonite Basic Violet V3 C.I. 42555 conjugate, Montmorillonite Basic Green G1 C.I. 42040 conjugate, Montmorillonite Basic Red R¹ C.I. 45160 conjugate, Montmorillonite C.I. Basic Black 2 conjugate, Hectorite Basic Blue B7 C.I. 42595 conjugate, Hectorite Basic Blue B9 C.I. 52015 conjugate, Hectorite Basic Violet V3 C.I. 42555 conjugate, Hectorite Basic Green G1 C.I. 42040 conjugate, Hectorite Basic Red R¹ C.I. 45160 conjugate, Hectorite C.I. Basic Black 2 conjugate, Saponite Basic Blue B7 C.I. 42595 conjugate, Saponite Basic Blue B9 C.I. 52015 conjugate, Saponite Basic Violet V3 C.I. 42555 conjugate, Saponite Basic Green G1 C.I. 42040 conjugate, Saponite Basic Red R¹ C.I. 45160 conjugate, Saponite C.I. Basic Black 2 conjugate and mixtures thereof.

[0116] The fabric shading dye or indeed other adjuncts made by organic synthesis routes such as pigment, optical brightener, polymer may be incorporated into the detergent composition as part of a reaction mixture which is the result of the organic synthesis for the adjunct with optional purification step(s). Such reaction mixtures generally comprise the adjunct itself and in addition may comprise un-reacted starting materials and/or by-products of the organic synthesis route.

[0117] Suitable polymeric fabric shading dyes are illustrated below. As with all such alkoxyated compounds, the organic synthesis may produce a mixture of molecules having different degrees of alkoxylation. Such mixtures may be used directly to provide the fabric shading dye, or may undergo a purification step.

[0118] The fabric shading dye may have the following structure:



wherein:

R_1 and R_2 are independently selected from the group consisting of: H; alkyl; alkoxy; alkyleneoxy; alkyl capped alkyleneoxy; urea; and amido;

R_3 is a substituted aryl group;

X is a substituted group comprising sulfonamide moiety and optionally an alkyl and/or aryl moiety, and wherein the substituent group comprises at least one alkyleneoxy chain. The hueing dye may be a thiophene dye such as a thiophene azo dye, preferably alkoxyated. Optionally the dye may be substituted with at least one solubilising group selected from sulphonic, carboxylic or quaternary ammonium groups. Preferred dyes are Liquitint Dyes from Milliken Company. Violet DD is particularly preferred.

[0119] The aforementioned fabric shading dyes can be used in combination (any mixture of fabric hueing agents can be used).

Pigments

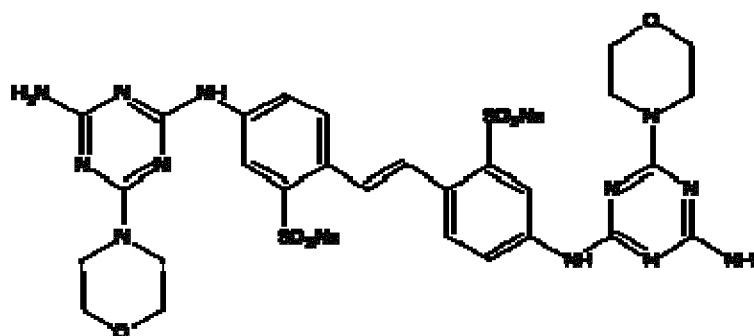
[0120] Suitable pigments include pigments selected from the group consisting of flavanthrone, indanthrone, chlorinated indanthrone containing from 1 to 4 chlorine atoms, pyranthrone, dichloropyranthrone, monobromodichloropyranthrone, dibromodichloropyranthrone, tetrabromopyranthrone, perylene-3,4,9,10-tetracarboxylic acid diimide, wherein the imide groups may be unsubstituted or substituted by C1-C3 -alkyl or a phenyl or heterocyclic radical, and wherein the phenyl and heterocyclic radicals may additionally carry substituents which do not confer solubility in water, anthrapyrimidine-carboxylic acid amides, violanthrone, isoviolanthrone, dioxazine pigments, copper phthalocyanine which may contain up to 2 chlorine atoms per molecule, polychloro-copper phthalocyanine or polybromochloro-copper phthalocyanine containing up to 14 bromine atoms per molecule and mixtures thereof. Other suitable pigments are described in WO2008/090091. In another aspect, suitable pigments include pigments selected from the group consisting of Ultramarine Blue (C.I. Pigment Blue 29), Ultramarine Violet (C.I. Pigment Violet 15), Monostral Blue and mixtures thereof. Particularly preferred are Pigment Blues 15 to 20, especially Pigment Blue 15 and/or 16. Other suitable pigments include those selected from the group consisting of Ultramarine Blue (C.I. Pigment Blue 29), Ultramarine Violet (C.I. Pigment Violet 15), Monostral Blue and mixtures thereof. Suitable hueing agents are described in more detail in US 7,208,459 B2.

[0121] The aforementioned fabric hueing agents can be used in mixtures of hueing agents and/or in mixtures with any pigment.

Optical Brighteners

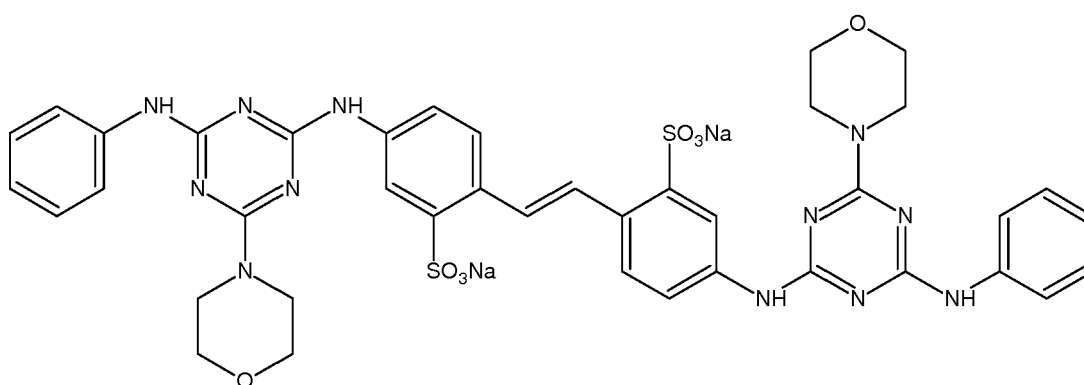
[0122] Suitable examples of optical brighteners are for example stilbene brighteners, coumarinic brighteners, benzoxazole brighteners and mixtures thereof. Diaminostilbene disulphonic acid type brighteners (hereinafter referred to as "DAS") are classified as hydrophilic in WO-A-98/52907. A commercial example of a DAS is Tinopal DMS (ex CIBA). Another type of low ClogP brightener is a distyrylbiphenyl brightener (hereinafter referred to as "DSBP"). A commercial example of this type of brightener is Tinopal CBS-X (also ex CIBA). Commercial optical brighteners which may be useful in the present invention can be classified into subgroups, which include, but are not limited to, derivatives of stilbene, pyrazoline, carboxylic acid, methinecyanines, dibenzothiophene-5,5-dioxide, azoles, 5- and 6-membered-ring heterocycles, and other miscellaneous agents. Particularly preferred brighteners are selected from: sodium 2 (4-styryl-3-sulfophenyl) -2H-naphtho [1, 2-d] triazole, disodium 4,4'-bis[(4-anilino-6-(N-methyl-2-hydroxyethylamino)-1,3,5-triazin-2-yl)amino]stilbene-2,2'-disulfonate, disodium 4,4'-bis[(4-anilino-6-morpholino-1,3,5-triazin-2-yl)amino]stilbene-2,2'-disulfonate, and disodium 4,4'-bis(2-sulfostyryl)biphenyl. Other examples of such brighteners are disclosed in "The Production and Application of Fluorescent Brightening Agents", M. Zahradnik, Published by John Wiley & Sons, New York (1982).

[0123] A preferred brightener has the structure below:



[0124] Suitable levels of brightener are from about 0.01, from about 0.05, from about 0.1 or even from about 0.2 wt % to upper levels of 0.5, of 0.75 or even 1.0 wt %.

[0125] A highly preferred optical brightener comprises C.I. fluorescent brightener 260 (preferably having the following structure:



[0126] A process for making C.I. fluorescent brightener 260 is described in BE680847.

Aesthetic Dyes

[0127] The composition may comprise aesthetic dyes and/or pigments. Suitable dyes include any conventional dye, typically small molecule or polymeric, used for colouring cleaning and/or treatment compositions. These are generally non-fabric shading dyes.

[0128] The composition of the present invention may comprise a high melting point fatty compound. The high melting point fatty compound useful herein has a melting point of 25°C or higher, and is selected from the group consisting of fatty alcohols, fatty acids, fatty alcohol derivatives, fatty acid derivatives, and mixtures thereof. Such compounds of low melting point are not intended to be included in this section. Non-limiting examples of the high melting point compounds are found in International Cosmetic Ingredient Dictionary, Fifth Edition, 1993, and CTFA Cosmetic Ingredient Handbook, Second Edition, 1992. When present, the high melting point fatty compound is preferably included in the composition at a level of from 0.1% to 40%, preferably from 1% to 30%, more preferably from 1.5% to 16% by weight of the composition, from 1.5% to 8% in view of providing improved conditioning benefits such as slippery feel during the application to wet hair, softness and moisturized feel on dry hair.

Cationic Polymer

[0129] The compositions of the present invention may contain a cationic polymer. Concentrations of the cationic polymer in the composition typically range from 0.05% to 3%, in another embodiment from 0.075% to 2.0%, and in yet another embodiment from 0.1% to 1.0%. Suitable cationic polymers will have cationic charge densities of at least 0.5 meq/gm, in another embodiment at least 0.9 meq/gm, in another embodiment at least 1.2 meq/gm, in yet another embodiment at least 1.5 meq/gm, but in one embodiment also less than 7 meq/gm, and in another embodiment less than 5 meq/gm, at the pH of intended use of the composition, which pH will generally range from pH 3 to pH 9, in one embodiment between pH 4 and pH 8. Herein, "cationic charge density" of a polymer refers to the ratio of the number of positive charges on the polymer to the molecular weight of the polymer. The average molecular weight of such suitable

cationic polymers will generally be between 10,000 and 10 million, in one embodiment between 50,000 and 5 million, and in another embodiment between 100,000 and 3 million.

[0130] Suitable cationic polymers for use in the compositions of the present invention contain cationic nitrogen-containing moieties such as quaternary ammonium or cationic protonated amino moieties. Any anionic counterions can be used in association with the cationic polymers so long as the polymers remain soluble in water, in the composition, or in a coacervate phase of the composition, and so long as the counterions are physically and chemically compatible with the essential components of the composition or do not otherwise unduly impair product performance, stability or aesthetics. Nonlimiting examples of such counterions include halides (e.g., chloride, fluoride, bromide, iodide), sulfate and methylsulfate.

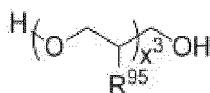
[0131] Nonlimiting examples of such polymers are described in the CTFA Cosmetic Ingredient Dictionary, 3rd edition, edited by Estrin, Crosley, and Haynes, (The Cosmetic, Toiletry, and Fragrance Association, Inc., Washington, D.C. (1982)).

[0132] Other suitable cationic polymers for use in the composition include polysaccharide polymers, cationic guar gum derivatives, quaternary nitrogen-containing cellulose ethers, synthetic polymers, copolymers of etherified cellulose, guar and starch. When used, the cationic polymers herein are either soluble in the composition or are soluble in a complex coacervate phase in the composition formed by the cationic polymer and the anionic, amphoteric and/or zwitterionic surfactant component described hereinbefore. Complex coacervates of the cationic polymer can also be formed with other charged materials in the composition.

[0133] Suitable cationic polymers are described in U.S. Pat. Nos. 3,962,418; 3,958,581; and U.S. Publication No. 2007/0207109A1.

Nonionic Polymer

[0134] The composition of the present invention may include a nonionic polymer as a conditioning agent. Polyalkylene glycols having a molecular weight of more than 1000 are useful herein. Useful are those having the following general formula:



wherein R⁹⁵ is selected from the group consisting of H, methyl, and mixtures thereof. Conditioning agents, and in particular silicones, may be included in the composition. The conditioning agents useful in the compositions of the present invention typically comprise a water insoluble, water dispersible, non-volatile, liquid that forms emulsified, liquid particles. Suitable conditioning agents for use in the composition are those conditioning agents characterized generally as silicones (e.g., silicone oils, cationic silicones, silicone gums, high refractive silicones, and silicone resins), organic conditioning oils (e.g., hydrocarbon oils, polyolefins, and fatty esters) or combinations thereof, or those conditioning agents which otherwise form liquid, dispersed particles in the aqueous surfactant matrix herein. Such conditioning agents should be physically and chemically compatible with the essential components of the composition, and should not otherwise unduly impair product stability, aesthetics or performance.

[0135] The concentration of the conditioning agent in the composition should be sufficient to provide the desired conditioning benefits. Such concentration can vary with the conditioning agent, the conditioning performance desired, the average size of the conditioning agent particles, the type and concentration of other components, and other like factors.

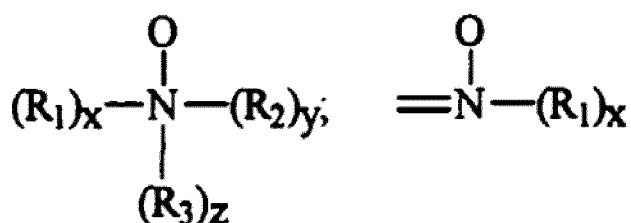
[0136] The concentration of the silicone conditioning agent typically ranges from about 0.01 % to about 10%. Non-limiting examples of suitable silicone conditioning agents, and optional suspending agents for the silicone, are described in U.S. Reissue Pat. No. 34,584, U.S. Pat. Nos. 5,104,646; 5,106,609; 4,152,416; 2,826,551; 3,964,500; 4,364,837; 6,607,717; 6,482,969; 5,807,956; 5,981,681; 6,207,782; 7,465,439; 7,041,767; 7,217,777; US Patent Application Nos. 2007/0286837A1; 2005/0048549A1; 2007/0041929A1; British Pat. No. 849,433; German Patent No. DE 10036533, which are all incorporated herein by reference; Chemistry and Technology of Silicones, New York: Academic Press (1968); General Electric Silicone Rubber Product Data Sheets SE 30, SE 33, SE 54 and SE 76; Silicon Compounds, Petrarch Systems, Inc. (1984); and in Encyclopedia of Polymer Science and Engineering, vol. 15, 2d ed., pp 204-308, John Wiley & Sons, Inc. (1989).

Dye Transfer Inhibitor (DTI)

[0137] The cleaning and/or treatment compositions preferably comprise one or mixtures of more than one dye transfer inhibiting agents. Suitable dye transfer inhibitors are selected from the group consisting of: polyvinylpyrrolidone polymers,

polyamine N-oxide polymers, copolymers of N-vinylpyrrolidone and N-vinylimidazole, polyvinylloxazolidones, polyvinylimidazoles and mixtures thereof. Other suitable DTIs are triazines as described in WO2012/095354, polymerized benzoxazines as described in WO2010/130624, polyvinyl tetrazoles as described in DE 102009001144A, porous polyamide particles as described in WO2009/127587 and insoluble polymer particles as described in WO2009/124908. Other suitable DTIs are described in WO2012/004134, or polymers selected from the group consisting of (a) amphiphilic alkoxylated polyamines, amphiphilic graft co-polymers, zwitterionic soil suspension polymers, manganese phthalocyanines, peroxidases and mixtures thereof. Preferred classes of DTI include but are not limited to polyvinylpyrrolidone polymers, polyamine N-oxide polymers, copolymers of N-vinylpyrrolidone and N-vinylimidazole, polyvinylloxazolidones, polyvinylimidazoles and mixtures thereof. More specifically, the polyamine N-oxide polymers preferred for use herein contain units having the following structural formula: R-AX-P; wherein P is a polymerizable unit to which an N-O group can be attached or the N-O group can form part of the polymerizable unit or the N-O group can be attached to both units; A is one of the following structures: -NC(O)-, -C(O)O-, -S-, -O-, -N=; x is 0 or 1; and R is aliphatic, ethoxylated aliphatics, aromatics, heterocyclic or alicyclic groups or any combination thereof to which the nitrogen of the N-O group can be attached or the N-O group is part of these groups. Preferred polyamine N-oxides are those wherein R is a heterocyclic group such as pyridine, pyrrole, imidazole, pyrrolidine, piperidine and derivatives thereof.

[0138] The N-O group can be represented by the following general structures:



wherein R₁, R₂, R₃ are aliphatic, aromatic, heterocyclic or alicyclic groups or combinations thereof; x, y and z are 0 or 1; and the nitrogen of the N-O group can be attached or form part of any of the aforementioned groups. The amine oxide unit of the polyamine N-oxides has a pK_a < 10, preferably pK_a < 7, more preferred pK_a < 6.

[0139] Any polymer backbone can be used as long as the amine oxide polymer formed is water-soluble and has dye transfer inhibiting properties. Examples of suitable polymeric backbones are polyvinyls, polyalkylenes, polyesters, polyethers, polyamide, polyimides, polyacrylates and mixtures thereof. These polymers include random or block copolymers where one monomer type is an amine N-oxide and the other monomer type is an N-oxide. The amine N-oxide polymers typically have a ratio of amine to the amine N-oxide of 10:1 to 1:1,000,000. However, the number of amine oxide groups present in the polyamine oxide polymer can be varied by appropriate copolymerization or by an appropriate degree of N-oxidation. The polyamine oxides can be obtained in almost any degree of polymerization.

[0140] Typically, the average molecular weight is within the range of 500 to 1,000,000; more preferred 1,000 to 500,000; most preferred 5,000 to 100,000. This preferred class of materials can be referred to as "PVNO".

[0141] The most preferred polyamine N-oxide useful in the detergent compositions herein is poly(4-vinylpyridine-N-oxide) which has an average molecular weight of about 50,000 and an amine to amine N-oxide ratio of about 1:4.

[0142] Copolymers of N-vinylpyrrolidone and N-vinylimidazole polymers (referred to as a class as "PVPVI") are also preferred for use herein. Preferably the PVPVI has an average molecular weight range from 5,000 to 1,000,000, more preferably from 5,000 to 200,000, and most preferably from 10,000 to 20,000. (The average molecular weight range is determined by light scattering as described in Barth, et al.,

[0143] Chemical Analysis, Vol 113. "Modern Methods of Polymer Characterization", the disclosures of which are incorporated herein by reference.) The PVPVI copolymers typically have a molar ratio of N-vinylimidazole to N-vinylpyrrolidone from 1:1 to 0.2:1, more preferably from 0.8:1 to 0.3:1, most preferably from 0.6:1 to 0.4:1.

[0144] These copolymers can be either linear or branched.

[0145] The present invention compositions also may employ a polyvinylpyrrolidone ("PVP") having an average molecular weight of from about 5,000 to about 400,000, preferably from about 5,000 to about 200,000, and more preferably from about 5,000 to about 50,000. PVP's are known to persons skilled in the detergent field; see, for example, EP-A-262,897 and EP-A-256,696, incorporated herein by reference.

[0146] Compositions containing PVP can also contain polyethylene glycol ("PEG") having an average molecular weight from about 500 to about 100,000, preferably from about 1,000 to about 10,000. Preferably, the ratio of PEG to PVP on a ppm basis delivered in wash solutions is from about 2:1 to about 50:1, and more preferably from about 3:1 to about 10:1.

[0147] A mixed polymer system comprising copolymers of (a) N-vinylpyrrolidone and N-vinylimidazole and (b) polyamine N-oxide polymers, particularly poly 4-vinylpyridine N-oxide are a particularly preferred DTI system, particularly preferred in weight ratios of (a):(b) of 5:1 to 1:5. Preferred molecular weights for the DTI essential to the present invention

are from 1000 to 250000 Daltons, more preferably from 2000 to 150000 or even from 8000 to 100000 Daltons.

[0148] Suitable examples include PVP-K15, PVP-K30, ChromaBond S-400, ChromaBond S-403E and Chromabond S-100 from Ashland Aqualon, and Sokalan® HP165, Sokalan® HP50, Sokalan® HP53, Sokalan® HP59, Sokalan® HP 56K, Sokalan® HP 66 from BASF.

[0149] The inventors have found that the compositions comprising optical brightener and DTI provide significant increase in whiteness and this is surprising because typically DTIs reduce the efficacy of optical brighteners.

[0150] The dye transfer inhibiting agent may be present at levels from about 0.0001% to about 15%, from about 0.01% to about 10%, preferably from about 0.01% to about 5% by weight of the composition.

Organic Conditioning Oil

[0151] The compositions of the present invention may also comprise from about 0.05% to about 3% of at least one organic conditioning oil as the conditioning agent, either alone or in combination with other conditioning agents, such as the silicones (described herein). Suitable conditioning oils include hydrocarbon oils, polyolefins, and fatty esters. Also suitable for use in the compositions herein are the conditioning agents described by the Procter & Gamble Company in U.S. Pat. Nos. 5,674,478, and 5,750,122. Also suitable for use herein are those conditioning agents described in U.S. Pat. Nos. 4,529,586, 4,507,280, 4,663,158, 4,197,865, 4,217, 914, 4,381,919, and 4,422, 853.

Hygiene Agent

[0152] The compositions of the present invention may also comprise components to deliver hygiene and/or malodour benefits such as one or more of zinc ricinoleate, thymol, quaternary ammonium salts such as Bardac®, polyethylenimines (such as Lupasol® from BASF) and zinc complexes thereof, silver and silver compounds, especially those designed to slowly release Ag⁺ or nano-silver dispersions.

Probiotics

[0153] The composition may comprise probiotics, such as those described in WO2009/043709.

Suds Boosters

[0154] The composition may preferably comprise suds boosters if high sudsing is desired. Suitable examples are the C10-C16 alkanolamides or C10-C14 alkyl sulphates, which are preferably incorporated at 1%-10% levels. The C10-C14 monoethanol and diethanol amides illustrate a typical class of such suds boosters. Use of such suds boosters with high sudsing adjunct surfactants such as the amine oxides, betaines and sultaines noted above is also advantageous. If desired, water-soluble magnesium and/or calcium salts such as MgCl₂, MgSO₄, CaCl₂, CaSO₄ and the like, can be added at levels of, typically, 0.1%-2%, to provide additional suds and to enhance grease removal performance.

Suds Suppressor

[0155] Compounds for reducing or suppressing the formation of suds may be incorporated into the compositions of the present invention. Suds suppression can be of particular importance in the so-called "high concentration cleaning process" as described in U.S. Pat. No. 4,489,455 and 4,489,574, and in front-loading -style washing machines. A wide variety of materials may be used as suds suppressors, and suds suppressors are well known to those skilled in the art. See, for example, Kirk Othmer Encyclopedia of Chemical Technology, Third Edition, Volume 7, pages 430-447 (John Wiley & Sons, Inc., 1979). Examples of suds suppressors include monocarboxylic fatty acid and soluble salts therein, high molecular weight hydrocarbons such as paraffin, fatty acid esters (e.g., fatty acid triglycerides), fatty acid esters of monovalent alcohols, aliphatic C18-C40 ketones (e.g., stearone), N-alkylated amino triazines, waxy hydrocarbons preferably having a melting point below about 100 °C, silicone suds suppressors, and secondary alcohols. Suds suppressors are described in U.S. Pat. No. 2,954,347; 4,265,779; 4,265,779; 3,455,839; 3,933,672; 4,652,392; 4,978,471; 4,983,316; 5,288,431; 4,639,489; 4,749,740; and 4,798,679; 4,075,118; European Patent Application No. 89307851.9; EP 150,872; and DOS 2,124,526.

[0156] For any detergent compositions to be used in automatic laundry washing machines, suds should not form to the extent that they overflow the washing machine. Suds suppressors, when utilized, are preferably present in a "suds suppressing amount. By "suds suppressing amount" is meant that the formulator of the composition can select an amount of this suds controlling agent that will sufficiently control the suds to result in a low-sudsing laundry detergent for use in automatic laundry washing machines. The compositions herein will generally comprise from 0% to 10% of suds suppressor. When utilized as suds suppressors, monocarboxylic fatty acids, and salts therein, will be present typically in

amounts up to 5%, by weight, of the detergent composition. Preferably, from 0.5% to 3% of fatty monocarboxylate suds suppressor is utilized. Silicone suds suppressors are typically utilized in amounts up to 2.0%, by weight, of the detergent composition, although higher amounts may be used. Monostearyl phosphate suds suppressors are generally utilized in amounts ranging from 0.1% to 2%, by weight, of the composition. Hydrocarbon suds suppressors are typically utilized in amounts ranging from 0.01% to 5.0%, although higher levels can be used. The alcohol suds suppressors are typically used at 0.2%-3% by weight of the finished compositions.

Pearlescent Agents

[0157] Pearlescent agents as described in WO2011/163457 may be incorporated into the compositions of the invention.

Perfume

[0158] Preferably the composition comprises a perfume, preferably in the range from 0.001 to 3wt%, most preferably from 0.1 to 1 wt%. Many 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. It is usual for a plurality of perfume components to be present in the compositions of the invention, for example four, five, six, seven or more. In perfume mixtures preferably 15 to 25 wt% are top notes. Top notes are defined by Poucher (Journal of the Society of Cosmetic Chemists 6(2):80 [1995]). Preferred top notes include rose oxide, citrus oils, linalyl acetate, lavender, linalool, dihydromyrcenol and cis-3-hexanol.

Process of making liquid laundry detergent compositions:

[0159] The liquid laundry detergent composition can be formulated and prepared by any suitable process. Such process typically involves mixing the essential and optional ingredients in any desired order to a relatively uniform state, with or without heating, cooling, application of vacuum, and the like, thereby providing cleaning compositions containing ingredients in the requisite concentrations.

[0160] Preferably, the external structurant is added, typically as part of a premix, after the incorporation of ingredients that require high shear mixing, in order to minimise damage to the structuring network formed by the external structurant. This is particularly beneficial where the external structurant is a non-polymeric crystalline hydroxyl functional structurant. More preferably, the external structurant is the last ingredient incorporated into the liquid composition. The external structurant is preferably incorporated into the liquid composition using low shear mixing. Preferably, the aqueous structuring premix is incorporated into the liquid composition using average shear rates of less than 1000s^{-1} , preferably less than 500s^{-1} , more preferably less than 200s^{-1} . The residence time of mixing is preferably less than 20s, more preferably less than 5s, more preferably less than 1s. The shear rate and residence time is calculated according to the methods used for the mixing device, and is usually provided by the manufacturer. For instance, for a static mixer, the average shear rate is calculated using the equation:

$$\dot{\gamma} = \frac{v_{\text{pipe}}}{D_{\text{pipe}}} * v_f^{-3/2}$$

where:

v_f is the void fraction of the static mixer (provided by the supplier) D_{pipe} is the internal diameter of the pipe comprising the static mixer elements v_{pipe} is the average velocity of the fluid through a pipe having internal diameter P_{pipe} , calculated from the equation:

$$v_{\text{pipe}} = \frac{4Q}{\pi D_{\text{pipe}}^2}$$

Q is the volume flow rate of the fluid through the static mixer.

For a static mixer, the residence time is calculated using the equation:

$$\text{residence time} = \frac{\pi D_{\text{pipe}}^2 v_f L}{4Q}$$

where:

L is the length of the static mixer.

[0161] The compositions of the invention may be present in the form of a unit dose, for example a tablet or pouch which may comprise liquid and/or solid composition in a water-soluble film.

Water soluble unit dose article

[0162] When in the form of a water-soluble unit dose article, the article comprises at least one water-soluble film shaped such that the unit-dose article comprises at least one internal compartment surrounded by the water-soluble film. The at least one compartment comprises the first particle. The water-soluble film is sealed such that the first particle does not leak out of the compartment during storage. However, upon addition of the water-soluble unit dose article to water, the water-soluble film dissolves and releases the contents of the internal compartment into the wash liquor.

[0163] The compartment should be understood as meaning a closed internal space within the unit dose article, which holds the particle. Preferably, the unit dose article comprises a water-soluble film. The unit dose article is manufactured such that the water-soluble film completely surrounds the particle and in doing so defines the compartment in which the particle resides. The unit dose article may comprise two films. A first film may be shaped to comprise an open compartment into which the particle is added. A second film is then laid over the first film in such an orientation as to close the opening of the compartment. The first and second films are then sealed together along a seal region. The film is described in more detail below.

[0164] The unit dose article may comprise more than one compartment, even at least two compartments, or even at least three compartments. The compartments may be arranged in superposed orientation, i.e. one positioned on top of the other. Alternatively, the compartments may be positioned in a side-by-side orientation, i.e. one orientated next to the other. The compartments may even be orientated in a 'tyre and rim' arrangement, i.e. a first compartment is positioned next to a second compartment, but the first compartment at least partially surrounds the second compartment, but does not completely enclose the second compartment. Alternatively one compartment may be completely enclosed within another compartment.

[0165] Wherein the unit dose article comprises at least two compartments, one of the compartments may be smaller than the other compartment. Wherein the unit dose article comprises at least three compartments, two of the compartments may be smaller than the third compartment, and preferably the smaller compartments are superposed on the larger compartment. The superposed compartments preferably are orientated side-by-side.

[0166] In a multi-compartment orientation, the first particle according to the present invention may be comprised in at least one of the compartments. It may for example be comprised in just one compartment, or may be comprised in two compartments, or even in three compartments.

[0167] Each compartment may comprise the same or different compositions. The different compositions could all be in the same form, or they may be in different forms.

Water-soluble film

[0168] The film is preferably soluble or dispersible in water. The water-soluble film preferably has a thickness of from 20 to 150 micron, preferably 35 to 125 micron, even more preferably 50 to 110 micron, most preferably about 76 micron.

[0169] Preferably, the film has a water-solubility of at least 50%, preferably at least 75% or even at least 95%, as measured by the method set out here after using a glass-filter with a maximum pore size of 20 microns:

5 grams $\pm$ 0.1 gram of film material is added in a pre-weighed 3L beaker and 2L $\pm$ 5ml of distilled water is added. This is stirred vigorously on a magnetic stirrer, Labline model No. 1250 or equivalent and 5 cm magnetic stirrer, set at 600 rpm, for 30 minutes at 30°C. Then, the mixture is filtered through a folded qualitative sintered-glass filter with a pore size as defined above (max. 20 micron). The water is dried off from the collected filtrate by any conventional method, and the weight of the remaining material is determined (which is the dissolved or dispersed fraction). Then, the percentage solubility or dispersability can be calculated.

[0170] Preferred film materials are preferably polymeric materials. The film material can, for example, be obtained by

casting, blow-moulding, extrusion or blown extrusion of the polymeric material, as known in the art.

[0171] Preferred polymers, copolymers or derivatives thereof suitable for use as pouch material are selected from polyvinyl alcohols, polyvinyl pyrrolidone, polyalkylene oxides, acrylamide, acrylic acid, cellulose, cellulose ethers, cellulose esters, cellulose amides, polyvinyl acetates, polycarboxylic acids and salts, polyaminoacids or peptides, polyamides, polyacrylamide, copolymers of maleic/acrylic acids, polysaccharides including starch and gelatine, natural gums such as xanthum and carragum. More preferred polymers are selected from polyacrylates and water-soluble acrylate copolymers, methylcellulose, carboxymethylcellulose sodium, dextrin, ethylcellulose, hydroxyethyl cellulose, hydroxypropyl methylcellulose, maltodextrin, polymethacrylates, and most preferably selected from polyvinyl alcohols, polyvinyl alcohol copolymers and hydroxypropyl methyl cellulose (HPMC), and combinations thereof. Preferably, the level of polymer in the pouch material, for example a PVA polymer, is at least 60%. The polymer can have any weight average molecular weight, preferably from about 1000 to 1,000,000, more preferably from about 10,000 to 300,000 yet more preferably from about 20,000 to 150,000.

[0172] Mixtures of polymers can also be used as the pouch material. This can be beneficial to control the mechanical and/or dissolution properties of the compartments or pouch, depending on the application thereof and the required needs. Suitable mixtures include for example mixtures wherein one polymer has a higher water-solubility than another polymer, and/or one polymer has a higher mechanical strength than another polymer. Also suitable are mixtures of polymers having different weight average molecular weights, for example a mixture of PVA or a copolymer thereof of a weight average molecular weight of about 10,000- 40,000, preferably around 20,000, and of PVA or copolymer thereof, with a weight average molecular weight of about 100,000 to 300,000, preferably around 150,000. Also suitable herein are polymer blend compositions, for example comprising hydrolytically degradable and water-soluble polymer blends such as polylactide and polyvinyl alcohol, obtained by mixing polylactide and polyvinyl alcohol, typically comprising about 1-35% by weight polylactide and about 65% to 99% by weight polyvinyl alcohol. Preferred for use herein are polymers which are from about 60% to about 98% hydrolysed, preferably about 80% to about 90% hydrolysed, to improve the dissolution characteristics of the material.

[0173] Preferred films exhibit good dissolution in cold water, meaning unheated distilled water. Preferably such films exhibit good dissolution at temperatures of 24°C, even more preferably at 10°C. By good dissolution it is meant that the film exhibits water-solubility of at least 50%, preferably at least 75% or even at least 95%, as measured by the method set out here after using a glass-filter with a maximum pore size of 20 microns, described above.

[0174] Preferred films are those supplied by Monosol under the trade references M8630, M8900, M8779, M8310.

[0175] Of the total PVA resin content in the film described herein, the PVA resin can comprise about 30 to about 85 wt% of the first PVA polymer, or about 45 to about 55 wt% of the first PVA polymer. For example, the PVA resin can contain about 50 w.% of each PVA polymer, wherein the viscosity of the first PVA polymer is about 13 cP and the viscosity of the second PVA polymer is about 23 cP.

[0176] Naturally, different film material and/or films of different thickness may be employed in making the compartments of the present invention. A benefit in selecting different films is that the resulting compartments may exhibit different solubility or release characteristics.

[0177] The film material herein can also comprise one or more additive ingredients. For example, it can be beneficial to add plasticisers, for example glycerol, ethylene glycol, diethyleneglycol, propylene glycol, sorbitol and mixtures thereof. Other additives may include water and functional detergent additives, including surfactant, to be delivered to the wash water, for example organic polymeric dispersants, etc.

[0178] The film may be opaque, transparent or translucent. The film may comprise a printed area. The printed area may cover between 10 and 80% of the surface of the film; or between 10 and 80% of the surface of the film that is in contact with the internal space of the compartment; or between 10 and 80% of the surface of the film and between 10 and 80% of the surface of the compartment.

[0179] Alternatively, an ink or pigment may be added during the manufacture of the film such that all or at least part of the film is coloured.

[0180] The film may comprise an aversive agent, for example selected from bittering agents, pungent agents, emetic agents and mixtures thereof. Bittering agents are a preferred component. Suitable bittering agents include, but are not limited to, naringin, sucrose octaacetate, quinine hydrochloride, denatonium benzoate, or mixtures thereof. Any suitable level of aversive agent may be used in the film. Suitable levels include, but are not limited to, 1 to 5000ppm, or even 100 to 2500ppm, or even 250 to 2000rpm.

METHODS:

A) Method of evaluating the phase stability of fluid laundry detergent compositions:

[0181] The phase stability of the composition is evaluated by placing 300ml of the composition in a glass jar for up to a time period of 21 days at 25°C. They are stable to phase splits if, within said time period, (i) they are free from splitting

into two or more layers or, (ii) said composition splits into layers, a major layer comprising at least 90%, preferably 95%, by weight of the composition is present.

B) Method of measuring viscosity:

[0182] The viscosity is measured using an AR 2000 rheometer from TA instruments using a cone and plate geometry with a 40 mm diameter and an angle of 1°. The viscosity at the different shear rates is measured via a logarithmic shear rate sweep from 0.1 s⁻¹ to 1200 s⁻¹ in 3 minutes time at 20°C. Low shear viscosity is measured at a continuous shear rate of 0.05 s⁻¹.

C) Turbidity (NTU):

[0183] The turbidity (measured in NTU: Nephelometric Turbidity Units) is measured using a Hach 2100P turbidity meter calibrated according to the procedure provided by the manufacture. The sample vials are filled with 15ml of representative sample and capped and cleaned according to the operating instructions. If necessary, the samples are degassed to remove any bubbles either by applying a vacuum or using an ultrasonic bath (see operating manual for procedure). The turbidity is measured using the automatic range selection.

D) Percentage of liquid crystalline phase:

[0184] Product is prepared, without the presence of external structurants, and without particulates or other solids which do not dissolve in the product. The product sample is then put in storage in scaled centrifuge tubes for a minimum of 1 day at 5°C and then centrifuged for 1h at 4400rpm. After centrifugation, the % liquid crystalline phase is measured as the height of the liquid crystalline phase with a ruler compared to the total height of the centrifuged sample.

E) Method of measuring pH:

[0185] The pH is measured, at 25°C, using a Santarius PT-10P pH meter with gel-filled probe (such as the Toledo probe, part number 52 000 100), calibrated according to the instructions manual.

METHODS OF USING CLENANING COMPOSITIONS

[0186] The present invention includes methods of using the cleaning compositions described hereinabove for cleaning soiled material. As will be appreciated by one skilled in the art, the cleaning compositions of the present invention are suited for use in laundry pretreatment applications, laundry cleaning applications, and home care applications.

[0187] Such methods include, but are not limited to, the steps of contacting the cleaning compositions in neat form or diluted in wash liquor, with at least a portion of a soiled material and then optionally rinsing the soiled material. The soiled material may be subjected to a washing step prior to the optional rinsing step.

[0188] For use in laundry pretreatment applications, the method may include contacting the detergent or cleaning compositions described herein with soiled fabric. Following pretreatment, the soiled fabric may be laundered in a washing machine or otherwise rinsed.

[0189] Machine laundry methods may comprise treating soiled laundry with an aqueous wash solution in a washing machine having dissolved or dispensed therein an effective amount of a machine laundry cleaning composition in accord with the invention. An "effective amount" of the cleaning composition means from about 20g to about 300g of product dissolved or dispersed in a wash solution of volume from about 5L to about 65L. The water temperatures may range from about 5°C to about 100°C. The water to soiled material (e.g., fabric) ratio may be from about 1:1 to about 30:1. The compositions may be employed at concentrations of from about 500 ppm to about 15,000 ppm in solution. In the context of a fabric laundry composition, usage levels may also vary depending not only on the type and severity of the soils and stains, but also on the wash water temperature, the volume of wash water, and the type of washing machine (e.g., top-loading, front-loading, top-loading, vertical-axis Japanese-type automatic washing machine).

[0190] The cleaning compositions herein may be used for laundering of fabrics at reduced wash temperatures. These methods of laundering fabric comprise the steps of delivering a laundry detergent composition to water to form a wash liquor and adding a laundering fabric to said wash liquor, wherein the wash liquor has a temperature of from about 0°C to about 20°C, or from about 0°C to about 15°C, or from about 0°C to about 9°C. The fabric may be contacted to the water prior to, or after, or simultaneous with, contacting the laundry detergent composition with water.

[0191] Another method includes contacting a nonwoven substrate impregnated with an embodiment of the detergent or cleaning composition with soiled material. As used herein, "nonwoven substrate" can comprise any conventionally fashioned nonwoven sheet or web having suitable basis weight, caliper (thickness), absorbency, and strength charac-

teristics. Non-limiting examples of suitable commercially available nonwoven substrates include those marketed under the tradenames SONTARA® by DuPont and POLYWEB® by James River Corp.

[0192] Hand washing/soak methods, and combined handwashing with semi-automatic washing machines, are also included.

TEST METHODS

EXAMPLES

[0193] Hereinafter, the present invention is described in more detail based on examples. All percentages are by weight unless otherwise specified.

D. Exemplary Cleaning Compositions

(1). Exemplary Liquid Laundry Detergent Compositions

[0194] The following liquid laundry detergent compositions are prepared by traditional means known to those of ordinary skill in the art by mixing the following ingredients.

TABLE 1

Ingredients (wt%)	1A	1B	1C
AES ¹	2.8	2	6
LAS ²	17	15	15
AE ³	2.3	2.37	3.44
Citric Acid	5	1.98	--
Boric Acid	--	1	3
Amine Oxide	1.2	--	0.5
Trimethyl Lauryl Ammonium Chloride	--	1.5	--
PEI Polymer 1-10 of Example A	0.1-3.5	1	2
S Copolymer 1-11 of Example B	0.1-3.5	1	2
Fatty Acids	1.2	1.2	1.2
Protease (54.5 mg/g) ⁴	7.62	7.98	2.08
Amylase (29.26 Mg/g) ⁵	2.54	2.67	0.69
Encapsulated Lipase	0.35	2.0	0.15
Borax	4.72	4.94	--
Calcium Formate	0.15	0.16	0.16
Amphiphilic polymer ⁷	--	1.5	4.36
Hexamethylene diamine, ethoxylated, quaternized, sulfated ⁸	--	--	1.68
DTPA ⁹ (50% active)	0.28	0.3	0.64
Tiron®	0.84	0.89	--
Optical Brightener ¹⁰	0.34	0.37	0.36
Ethanol	0.97	4.1	2.99
Propylene Glycol	4.9	5.16	8.49
Acid Violet 50/Violet DD	0.001	0.003	0.002
Monoethanolamine (MEA)	1.12	1.17	0.23

(continued)

Ingredients (wt%)	1A	1B	1C
Caustic Soda (NaOH)	3.5	3.74	2.1
Na Formate	0.61	0.64	0.23
Na Cumene Sulfonate	--	--	1
Suds Suppressor	--	--	0.18
Dye	0.01	--	0.02
Perfume	0.85	1.5	1.6
Preservative ¹¹	0.05	0.5	--
Hydrogenated castor oil	--	--	0.27
Water	Q.S.	Q.S.	Q.S.

¹ AES can be AE_{1.5}S, AE₂S, and/or AE₃S, in the amount ranging from 0-20%.
² LAS can be provided in the amount ranging from 0-20%.
³ AE is a C12-14 alcohol ethoxylate, with an average degree of ethoxylation of 7-9, supplied by Huntsman, Salt Lake City, Utah, USA. It can be provided in the amount ranging from 0-10%.
⁴ Proteases may be supplied by Genencor International, Palo Alto, California, USA (e.g., PurafectPrime®, Excellase®) or by Novozymes, Bagsvaerd, Denmark (e.g. Liquease®, Coronase®).
⁵ Available from Novozymes, Bagsvaerd, Denmark (e.g., Natalase®, Mannaway®).
⁶ Available from Novozymes (e.g., Whitezyme®).
⁷ Random graft copolymer is a polyvinyl acetate grafted polyethylene oxide copolymer having a polyethylene oxide backbone and multiple polyvinyl acetate side chains. The molecular weight of the polyethylene oxide backbone is about 6000 and the weight ratio of the polyethylene oxide to polyvinyl acetate is about 40 to 60 and no more than 1 grafting point per 50 ethylene oxide units, available from BASF as Sokalan PG101 ®.
⁸ A compound having the following general structure: bis((C₂H₅O)(C₂H₄O)_n)(CH₃)-N⁺-C_xH_{2x}-N⁺-(CH₃)-bis((C₂H₅O)(C₂H₄O)_n), wherein n = from 20 to 30, and x = from 3 to 8, or sulphated or sulphonated variants thereof, available from BASF as Lutenzit Z 96®.
⁹ DTPA is diethylenetriaminepentaacetic acid supplied by Dow Chemical, Midland, Michigan, USA.
¹⁰ Suitable Fluorescent Whitening Agents are for example, Tinopal® AMS, Tinopal® CBS-X, Sulphonated zinc phthalocyanine Ciba Specialty Chemicals, Basel, Switzerland. It can be provided in the amount ranging from 0-5%.
¹¹ Suitable preservatives include methylisothiazolinone (MIT) or benzisothiazolinone (BIT), which can be provided in the amount ranging from 0-1%.

(2). Exemplary Liquid Detergent Compositions for Use in Unit Dose (UD) Products

[0195] The following liquid detergent compositions are prepared and encapsulated in a multi-compartment pouch formed by a polyvinyl alcohol-film.

TABLE 2

	A	B
Usage (g)	25.36	24.34
Usage (ml)	23.7	22.43
Wash Volume (L)	64	64
Anionic/Nonionic ratio	1.73	9.9
Ingredients (wt%)		
Linear C ₉ -C ₁₅ Alkylbenzene sulfonic acid	18.25	22.46
HC24/25 AE2/3S 90/10 blend	8.73	15.29

(continued)

Ingredients (wt%)		
C ₁₂₋₁₄ alkyl 9-ethoxylate	15.56	3.82
Citric Acid	0.65	1.55
Fatty acid	6.03	6.27
Chelants	1.16	0.62
PEI Polymers 1-10 of Example A	1-6	3
S Copolymers 1-11 of Example B	1-6	3
Enzymes: protease, encapsulated lipase, amylase	0.11	0.12
Brightener 49	0.18	0.19
Structurant	0.1	0.1
Solvent system*	20.31	17.96
Water	10.31	11.66
Perfume	1.63	1.7
Aesthetics	1.48	1.13
Mono-ethanolamine or NaOH (or mixture thereof)	6.69	9.75
Other laundry adjuncts / minors	Q.S.	Q.S.
*May include, but not limited to propanediol, glycerol, ethanol, dipropyleneglycol, polyetheyleneglycol, polypropyleneglycol.		

[0196] All percentages and ratios are calculated by weight unless otherwise indicated. All percentages and ratios are calculated based on the total composition unless otherwise indicated.

It should be understood that every maximum numerical limitation given throughout this specification includes every lower numerical limitation, as if such lower numerical limitations were expressly written herein. Every minimum numerical limitation given throughout this specification will include every higher numerical limitation, as if such higher numerical limitations were expressly written herein. Every numerical range given throughout this specification will include every narrower numerical range that falls within such broader numerical range, as if such narrower numerical ranges were all expressly written herein.

[0197] The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm."

[0198] Every document cited herein, including any cross referenced or related patent or application, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any invention disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

[0199] While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

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SEQUENCE LISTING

<110> THE PROCTER & GAMBLE COMPANY

<120> CLEANING COMPOSITIONS COMPRISING ENZYMES

<130> CM04390FM

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<170> PatentIn version 3.5

<210> 1

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<212> PRT

<213> Thermomyces lanuginosus

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Asn Ile Thr Cys Thr Gly Asn Ala Cys Pro Glu Val Glu Lys Ala Asp
35 40 45

Ala Thr Phe Leu Tyr Ser Phe Glu Asp Ser Gly Val Gly Asp Val Thr
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Gly Phe Leu Ala Leu Asp Asn Thr Asn Lys Leu Ile Val Leu Ser Phe
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Leu Lys Glu Ile Asn Asp Ile Cys Ser Gly Cys Arg Gly His Asp Gly
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Phe Thr Ser Ser Trp Arg Ser Val Ala Asp Thr Leu Arg Gln Lys Val
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His Ser Leu Gly Gly Ala Leu Ala Thr Val Ala Gly Ala Asp Leu Arg
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Leu Tyr Arg Ile Thr His Thr Asn Asp Ile Val Pro Arg Leu Pro Pro
 195 200 205

Arg Glu Phe Gly Tyr Ser His Ser Ser Pro Glu Tyr Trp Ile Lys Ser
 210 215 220

Gly Thr Leu Val Pro Val Arg Arg Arg Asp Ile Val Lys Ile Glu Gly
 225 230 235 240

Ile Asp Ala Thr Gly Gly Asn Asn Gln Pro Asn Ile Pro Asp Ile Pro
 245 250 255

Ala His Leu Trp Tyr Phe Gly Leu Ile Gly Thr Cys Leu
 260 265

Claims

1. A liquid detergent composition comprising a protease enzyme, a lipase enzyme and from 5 to 60 wt% non-soap surfactant system **characterized in that** the surfactant system comprises (i) anionic surfactant and (ii) nonionic surfactant wherein the weight ratio of (i) to (ii) is from 1:1 to 99:1, at least 65 wt% of the lipase enzyme is present in an encapsulate, wherein the encapsulate comprises a shell wherein the shell is insoluble in the liquid detergent composition but which dissolves upon dilution of the liquid detergent composition in the wash liquor.
2. A liquid detergent composition comprising a protease enzyme, a lipase enzyme and from 2 to 80 wt% non-soap surfactant system **characterized in that** at least 65 wt% of the lipase enzyme is present in an encapsulate, wherein the encapsulate comprises a shell wherein the shell is insoluble in the liquid detergent composition but which dissolves upon dilution of the liquid detergent composition in the wash liquor, and the composition comprises a perfume comprising at least 2 wt% perfume esters based on the total weight of the perfume, preferably comprising at least 5 wt% perfume esters, or at least 10, or at least 15 or at least 20 wt% perfume esters.
3. A liquid detergent composition comprising a protease enzyme, a lipase enzyme and from 5 to 60 wt% non-soap surfactant system **characterized in that** at least 65 wt% of the lipase enzyme is present in an encapsulate, wherein the encapsulate comprises a shell wherein the shell is insoluble in the liquid detergent composition but which dissolves upon dilution of the liquid detergent composition in the wash liquor, and the composition comprises a fabric shading dye.
4. A liquid detergent composition according to claim 1 wherein the weight ratio of anionic surfactant (i) to nonionic surfactant (ii) is from 51:49 to 99:1, or preferably 55:45 to 99:1, preferably from 3:2 to 9:1.
5. A liquid detergent composition according to any preceding claim wherein the anionic surfactant comprises alkyl benzene sulphonate surfactant and optionally in addition alkyl sulphate surfactant which is optionally partially or fully ethoxylated with from 1 to 7 ethoxylates.
6. A liquid detergent composition according to any preceding claim wherein the weight ratio of alkyl benzene sulphonate anionic surfactant to nonionic surfactant is from 1:1 to 99:1.
7. A liquid detergent composition according to any preceding claim additionally comprising an ester containing laundry ingredient.

8. A liquid detergent composition according to claim 7 wherein the ester containing laundry ingredient comprises a perfume ester.
9. A liquid detergent composition according to claim 7 or claim 8 wherein the ester containing laundry ingredient comprises a polyester soil release polymer, preferably wherein the polyester soil release polymer comprises a polyethylene or polypropylene terephthalate and mixtures thereof, most preferably polypropylene terephthalate.
10. A liquid detergent composition according to any preceding claim wherein the liquid detergent composition comprises a structurant, preferably wherein the structurant comprises hydrogenated castor oil, citrus pulp, or a mixture thereof.
11. A liquid detergent composition according to any preceding claim comprising from 0.5% to below 20.0 wt%, preferably from 1% to 13% by weight water.
12. A liquid detergent composition according to any preceding claim wherein the shell of the encapsulate comprises a polymer, copolymer or derivatives thereof, or mixtures thereof, preferably wherein the shell comprises polyvinyl alcohol, polyvinyl pyrrolidone, polyalkylene oxides, acrylamide, acrylic acid, cellulose, cellulose ethers, cellulose esters, cellulose amides, polyvinyl acetates, polycarboxylic acids and salts, polyaminoacids or peptides, polyamides, polyacrylamide, copolymers of maleic/acrylic acids, polysaccharides, natural gums, polyacrylates, water-soluble acrylate copolymers, methylcellulose, carboxymethylcellulose, dextrin, ethylcellulose, hydroxyethyl cellulose, hydroxypropyl methylcellulose, maltodextrin, polymethacrylates and mixtures thereof.
13. A liquid detergent composition according to any preceding claim wherein the lipase comprises lipase which is a polypeptide having an amino acid sequence which: (a) has at least 90% identity with the wild-type lipase derived from *Humicola lanuginosa* strain DSM 4109; (b) compared to said wild-type lipase, comprises a substitution of an electrically neutral or negatively charged amino acid at the surface of the three-dimensional structure within 15Å of E1 or Q249 with a positively charged amino acid; and may further comprise: (I) a peptide addition at the C-terminal; and/or (II) comprises a peptide addition at the N-terminal and/or (III) meets the following limitations: i) comprises a negative amino acid in position E210 of said wild-type lipase; ii) comprises a negatively charged amino acid in the region corresponding to positions 90-101 of said wild-type lipase; and iii) comprises a neutral or negative amino acid at a position corresponding to N94 of said wild-type lipase; and/or (iv) has a negative or neutral net electric charge in the region corresponding to positions 90-101 of said wild-type lipase; and (v) mixtures thereof.
14. A liquid detergent composition according to any preceding claim in the form of a water-soluble unit dose article preferably wherein the liquid detergent composition is contained in a water-soluble film pouch, preferably comprising at least two compartments wherein the liquid detergent composition is comprised within at least one compartment and optionally in addition in the second compartment or powder composition is comprised within a second compartment.
15. A method of making a liquid detergent composition comprising encapsulating a lipase enzyme in a shell insoluble in the liquid detergent composition, but which dissolves upon dilution of the liquid detergent composition in a wash liquor and mixing the encapsulated lipase with a non-soap surfactant system wherein the surfactant system comprises (i) anionic surfactant and (ii) nonionic surfactant wherein the weight ratio of (i) to (ii) is from 1:1 to 99:1, and optional additional lipase wherein at least 65 wt%, or at least 70%, preferably at least 80%, more preferably at least 90%, or preferably 100% by weight of the lipase enzyme is encapsulated.



EUROPEAN SEARCH REPORT

 Application Number
 EP 16 20 0365

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	WO 2008/084093 A2 (NOVOZYMES AS [DK]; SIMONSEN OLE [DK]) 17 July 2008 (2008-07-17) * page 2, lines 2-5 * * page 3, lines 20-24 * * page 5, lines 9-10 * * page 12, lines 14-16; example 2 *	1,4-14	
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 January 2017	Examiner Saunders, Thomas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)



Application Number

EP 16 20 0365

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1, 4(completely); 5-14(partially)

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



LACK OF UNITY OF INVENTION
SHEET B

Application Number

EP 16 20 0365

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1, 4(completely); 5-14(partially)

Liquid detergent comprising a protease enzyme, a lipase enzyme and 5-60 wt.% non-soap surfactant system containing anionic and nonionic surfactant in a weight ratio of 1:1 to 99:1. At least 65 wt.% of the lipase is encapsulated in a shell which prevents it from dissolving in the detergent, but allows it to dissolve in the wash liquor obtained by diluting the detergent.

2. claims: 2(completely); 5-14(partially)

Liquid detergent comprising a protease enzyme, a lipase enzyme, 2-80 wt.% non-soap surfactant system and a perfume component. At least 65 wt.% of the lipase is encapsulated in a shell which prevents it from dissolving in the detergent, but allows it to dissolve in the wash liquor obtained by diluting the detergent. At least 2 wt.% of the perfume component comprises fragrant ester compounds.

3. claims: 3(completely); 5-14(partially)

Liquid detergent comprising a protease enzyme, a lipase enzyme, 5-60 wt.% non-soap surfactant system and a fabric shading dye. At least 65 wt.% of the lipase is encapsulated in a shell which prevents it from dissolving in the detergent, but allows it to dissolve in the wash liquor obtained by diluting the detergent.

4. claim: 15

A method of making a liquid detergent composition by mixing an encapsulated lipase with a non-soap surfactant system containing anionic and nonionic surfactant in a weight ratio of 1:1 to 99:1. At least 65 wt.% of the lipase is encapsulated in a shell which prevents it from dissolving in the detergent, but allows it to dissolve in the wash liquor obtained by diluting the detergent.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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