

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
9 September 2011 (09.09.2011)

PCT

(10) International Publication Number
WO 2011/109314 A1

(51) International Patent Classification:
C11D 3/386 (2006.01) *C11D 3/39* (2006.01)

(21) International Application Number:
PCT/US2011/026562

(22) International Filing Date:
1 March 2011 (01.03.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

10155096.0	1 March 2010 (01.03.2010)	EP
10155100.0	1 March 2010 (01.03.2010)	EP
10155098.6	1 March 2010 (01.03.2010)	EP
10155094.5	1 March 2010 (01.03.2010)	EP
10160362.9	19 April 2010 (19.04.2010)	EP
10160344.7	19 April 2010 (19.04.2010)	EP
10160338.9	19 April 2010 (19.04.2010)	EP
10160316.5	19 April 2010 (19.04.2010)	EP
10190216.1	5 November 2010 (05.11.2010)	EP

(71) Applicant (for all designated States except US): **THE PROCTER & GAMBLE COMPANY** [US/US]; One Procter & Gamble Plaza, Cincinnati, Ohio 45202 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MEEK, Michelle** [GB/GB]; 4 Summerfield Road, Lowfell, Gateshead Tyne and Wear NE9 5BD (GB). **SOUTER, Phillip, Frank** [GB/GB]; The Nook, The Green, Longhorsley, Morpeth Northumberland NE65 8UP (GB). **LANT, Neil, Joseph** [GB/GB]; 18 Netherwitton Way, Gosforth, Newcastle upon Tyne NE3 5RP (GB). **BROOKER, Alan, Thomas** [GB/GB]; 3 Flaxby Close, Gosforth, Newcastle Upon Tyne NE3 5LP (GB). **SOMERVILLE ROBERTS, Nigel, Patrick** [GB/GB]; 21 Regency Way, Darras Hall, Ponteland, Newcastle upon Tyne NE20 9AU (GB).

(74) Common Representative: **THE PROCTER & GAMBLE COMPANY**; c/o Eileen L. Hughett, Global Patent Services, 299 East Sixth Street, Sycamore Building, 4th Floor, Cincinnati, Ohio 45202 (US).

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

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

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
- with sequence listing part of description (Rule 5.2(a))

(54) Title: COMPOSITION COMPRISING CO-BLEACH PARTICLE AND AMYLASE

(57) Abstract: The present invention relates to a solid particulate laundry detergent composition comprising: (a) co-bleach particle comprising bleach activator, source of hydrogen peroxide and optionally bleach catalyst; (b) amylase with greater than 90% identity to the AA560 alpha amylase endogenous to *Bacillus* sp. DSM 12649 and comprising: (i) mutations at one or more of positions 9, 149, 182, 186, 202, 257, 295, 299, 323, 339 and 345; and (ii) mutations at four or more of positions 118, 183, 184, 195, 320 and 458; and (c) laundry detergent ingredients.



WO 2011/109314 A1

COMPOSITION COMPRISING CO-BLEACH PARTICLE AND AMYLASE

FIELD OF THE INVENTION

The present invention relates to a composition comprising co-bleach particle and amylase enzyme.

BACKGROUND OF THE INVENTION

Consumers of laundry detergent powders continue to desire products with improved cleaning profiles, freshness profiles and dissolution profiles. To meet this consumer demand, laundry detergent powder manufacturers continue to seek optimized laundry detergent powder formulations.

The inventors have found that the whiteness and stain removal profiles of laundry detergent powders are significantly improved by the combination of a specific amylase and specific co-bleach particle. The inventors have also found that the cleaning profile, freshness profile and/or dissolution profile are further improved by the incorporation of specific bleach technologies such as an oxaziridinium-based bleach catalyst, and/or specific polyethylene glycol polymer, and/or specific lipase and/or specific substituted cellulosic polymer into the laundry detergent powder formulation. Further improvements are also observed when some or all of these technologies are incorporated into low-built laundry detergent powder formulations.

SUMMARY OF THE INVENTION

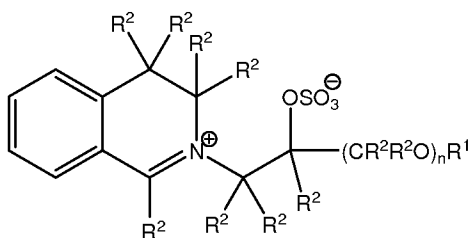
The present invention provides a composition according to claim 1.

DETAILED DESCRIPTION OF THE INVENTION

The solid particulate laundry detergent composition comprises co-bleach particle, amylase and other laundry detergent ingredients. The co-bleach particle, amylase and other laundry detergent ingredients are described in more detail below.

Preferably, the composition comprises: (a) anionic deterative surfactant; (b) from 0wt% to less than 5wt% zeolite builder; (c) from 0wt% to less than 5wt% phosphate builder; and (d) optionally, from 0wt% to 10wt% silicate salt. More preferably, the composition comprises (a) anionic deterative surfactant; (b) from 0wt% to less than 5wt% zeolite builder; (c) from 0wt% to

less than 5wt% phosphate builder; and (d) optionally, from 0wt% to 10wt% silicate salt/ (e) from 5 to 25wt% sodium carbonate; (f) from 1wt% to 10wt% carboxylate polymer; (g) variant of *Thermomyces lanuginosa* lipase having greater than 90% identity with the wild type amino acid and comprising substitution(s) at T231 and/or N233; (h) oxaziridinium-based bleach catalyst having the formula:



wherein R^1 is selected from the group consisting of: 2-propylheptyl, 2-butyloctyl, 2-pentynonyl, 2-hexyldecyl, n-hexyl, n-octyl, n-decyl, n-dodecyl, n-tetradecyl, n-hexadecyl, n-octadecyl, iso-nonyl, iso-decyl, iso-tridecyl and iso-pentadecyl, and wherein R^2 is independently selected from H and methyl groups; and n is an integer from 0 to 1; (i) optionally, substituted cellulosic polymer comprising carboxymethyl substituent groups, and having a degree of substitution (DS) of at least 0.55, and having a degree of blockiness (DB) of at least 0.35, and having a DS+DB in the range of from 1.05 to 2.00; and (j) optionally, polyethylene glycol polymer comprising a polyethylene glycol backbone and polyvinyl acetate side chains, wherein the average molecular weight of the polyethylene glycol backbone is in the range of from 4,000 Da to 8,000 Da, wherein the molecular weight ratio of the polyethylene glycol backbone to the polyvinyl acetate side chains is in the range of from 1:1.2 to 1:2, and wherein the average number of graft sites per ethylene oxide units is preferably in the range of from 0.2 to 0.4.

Amylase: The Amylase typically has greater than 60%, or greater than 70%, or greater than 80%, or greater than 90%, or greater than 95% identity to the AA560 alpha amylase endogenous to *Bacillus sp.* DSM 12649 (shown as SEQ ID NO:1). Preferably, the amylase is a variant of the AA560 alpha amylase endogenous to *Bacillus sp.* Typically, the amylase comprises: (i) mutations at one or more, preferably three or more, or five or more, or seven or more, or ten or more, or even all of positions 9, 149, 182, 186, 202, 257, 295, 299, 323, 339 and 345; and (ii) mutations at four or more, preferably all, of positions 118, 183, 184, 195, 320 and 458. Highly preferably, the amylase comprises all of the mutations: R118K, D183*, G184*, N195F, R320K and R458K.

Preferred variant amylases include those comprising the following sets of mutations:

- (i) M9L + M323T;
- (ii) M9L + M202L/T/V/I + M323T;
- (iii) M9L + N195F + M202L/T/V/I + M323T;
- (iv) M9L + R118K + D183* + G184* + R320K + M323T + R458K;
- (v) M9L + R118K + D183* + G184* + M202L/T/V/I + R320K + M323T + R458K;
- (vi) M9L + G149A + G182T + G186A + M202L + T257I + Y295F + N299Y + M323T + A339S + E345R;
- (vii) M9L + G149A + G182T + G186A + M202I + T257I + Y295F + N299Y + M323T + A339S + E345R;
- (viii) M9L + R118K + G149A + G182T + D183* + G184* + G186A + M202L + T257I + Y295F + N299Y + R320K + M323T + A339S + E345R + R458K;
- (ix) M9L + R118K + G149A + G182T + D183* + G184* + G186A + M202I + T257I + Y295F + N299Y + R320K + M323T + A339S + E345R + R458K;
- (x) M9L + R118K + D183* + D184* + N195F + M202L + R320K + M323T + R458K;
- (xi) M9L + R118K + D183* + D184* + N195F + M202T + R320K + M323T + R458K;
- (xii) M9L + R118K + D183* + D184* + N195F + M202I + R320K + M323T + R458K;
- (xiii) M9L + R118K + D183* + D184* + N195F + M202V + R320K + M323T + R458K;
- (xiv) M9L + R118K + N150H + D183* + D184* + N195F + M202L + V214T + R320K + M323T + R458K;
- (xv) M9L + R118K + D183* + D184* + N195F + M202L + V214T + R320K + M323T + E345N + R458K; or
- (xvi) M9L + R118K + G149A + G182T + D183* + G184* + G186A + N195F + M202L + T257I + Y295F + N299Y + R320K + M323T + A339S + E345R + R458K

A suitable commercially available amylase enzyme includes Stainzyme Plus® (supplied by Novozymes, Bagsvaerd, Denmark).

Co-bleach particle: The composition comprises a co-bleach particle. Highly preferably, the co-bleach particle comprises a bleach activator and a source of peroxide. It is highly preferred for a large amount of bleach activator relative to the source of hydrogen peroxide to be present in the co-bleach particle. Preferably, the weight ratio of bleach activator to source of hydrogen peroxide present in the co-bleach particle is at least 0.3:1, or at least 0.5:1, or at least 0.6:1, or at least 0.7:1, or at least 0.8:1, or at least 0.9:1, or at least 1.0:1.0, or even at least 1.2:1 or higher.

Preferably, the co-bleach particle comprises: (i) bleach activator, preferably TAED; and (ii) a source of hydrogen peroxide, preferably sodium percarbonate. Highly preferably, the bleach activator at least partially, preferably completely, encloses the source of hydrogen peroxide.

The co-bleach particle preferably comprises a binder. Preferred binders are carboxylate polymers such as polyacrylate polymers, and/or surfactants including non-ionic deterative surfactants and/or anionic deterative surfactants such as linear C₁₁-C₁₃ alkyl benzene sulphonate.

The co-bleach particle may comprise bleach catalyst, such as an oxaziridium-based bleach catalyst.

Solid particulate laundry detergent composition: Typically, the composition is a fully formulated laundry detergent composition, not a portion thereof such as a spray-dried or agglomerated particle that only forms part of the laundry detergent composition. However, it is within the scope of the present invention for an additional rinse additive composition (e.g. fabric conditioner or enhancer), or a main wash additive composition (e.g. bleach additive) to also be used in combination with the laundry detergent composition during the method of the present invention. Although, it may be preferred for no bleach additive composition is used in combination with the laundry detergent composition during the method of the present invention.

Typically, the composition comprises a plurality of chemically different particles, such as spray-dried base detergent particles and/or agglomerated base detergent particles and/or extruded base detergent particles, in combination with one or more, typically two or more, or three or more, or four or more, or five or more, or six or more, or even ten or more particles selected from: surfactant particles, including surfactant agglomerates, surfactant extrudates, surfactant needles, surfactant noodles, surfactant flakes; polymer particles such as cellulosic polymer particles, polyester particles, polyamine particles, terephthalate polymer particles, polyethylene glycol polymer particles; builder particles, such as sodium carbonate and sodium silicate co-builder particles, phosphate particles, zeolite particles, silicate salt particles, carbonate salt particles; filler particles such as sulphate salt particles; dye transfer inhibitor particles; dye fixative particles; bleach particles, such as percarbonate particles, especially coated percarbonate particles, such as percarbonate coated with carbonate salt, sulphate salt, silicate salt, borosilicate salt, or any combination thereof, perborate particles, bleach catalyst particles such as transition metal bleach catalyst particles, or oxaziridinium-based bleach catalyst particles, pre-formed peracid particles, especially coated pre-formed peracid particles, and co-bleach particles of bleach activator, source of hydrogen peroxide and optionally bleach catalyst; bleach activator particles such as oxybenzene sulphonate bleach activator particles and tetra acetyl ethylene

diamine bleach activator particles; chelant particles such as chelant agglomerates; hueing dye particles; brightener particles; enzyme particles such as protease prills, lipase prills, cellulase prills, amylase prills, mannanase prills, pectate lyase prills, xyloglucanase prills, bleaching enzyme prills, cutinase prills and co-prills of any of these enzymes; clay particles such as montmorillonite particles or particles of clay and silicone; flocculant particles such as polyethylene oxide particles; wax particles such as wax agglomerates; perfume particles such as perfume microcapsules, especially melamine formaldehyde-based perfume microcapsules, starch encapsulated perfume accord particles, and pro-perfume particles such as Schiff base reaction product particles; aesthetic particles such as coloured noodles or needles or lamellae particles, and soap rings including coloured soap rings; and any combination thereof.

Typically, upon dilution in de-ionized water to a concentration of 1wt% at 20°C, the composition has a pH of above 8.8, or above 8.9, or from 9 to 13, or to 12, or even to 11.

Detergent ingredients: The composition typically comprises detergent ingredients. Suitable detergent ingredients include: deterative surfactants including anionic deterative surfactants, non-ionic deterative surfactants, cationic deterative surfactants, zwitterionic deterative surfactants, amphoteric deterative surfactants, and any combination thereof; polymers including carboxylate polymers, polyethylene glycol polymers, polyester soil release polymers such as terephthalate polymers, amine polymers, cellulosic polymers, dye transfer inhibition polymers, dye lock polymers such as a condensation oligomer produced by condensation of imidazole and epichlorhydrin, optionally in ratio of 1:4:1, hexamethylenediamine derivative polymers, and any combination thereof; builders including zeolites, phosphates, citrate, and any combination thereof; buffers and alkalinity sources including carbonate salts and/or silicate salts; fillers including sulphate salts and bio-filler materials; bleach including bleach activators, sources of available oxygen, pre-formed peracids, bleach catalysts, reducing bleach, and any combination thereof; chelants; photobleach; hueing agents; brighteners; enzymes including proteases, amylases, cellulases, lipases, xyloglucanases, pectate lyases, mannanases, bleaching enzymes, cutinases, and any combination thereof; fabric softeners including clay, silicones, quaternary ammonium fabric-softening agents, and any combination thereof; flocculants such as polyethylene oxide; perfume including starch encapsulated perfume accords, perfume microcapsules, perfume loaded zeolites, schif base reaction products of ketone perfume raw materials and polyamines, blooming perfumes, and any combination thereof; aesthetics including soap rings, lamellar aesthetic particles, gelatin beads, carbonate and/or sulphate salt speckles, coloured clay, and any combination thereof; and any combination thereof.

Deterative surfactant: The composition typically comprises deterative surfactant. Suitable deterative surfactants include anionic deterative surfactants, non-ionic deterative surfactant, cationic deterative surfactants, zwitterionic deterative surfactants, amphoteric deterative surfactants, and any combination thereof.

Anionic deterative surfactant: Suitable anionic deterative surfactants include sulphate and sulphonate deterative surfactants.

Suitable sulphonate deterative surfactants include alkyl benzene sulphonate, such as C₁₀₋₁₃ alkyl benzene sulphonate. Suitable alkyl benzene sulphonate (LAS) is obtainable, or even 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®. Another 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.

Suitable sulphate deterative surfactants include alkyl sulphate, such as C₈₋₁₈ alkyl sulphate, or predominantly C₁₂ alkyl sulphate. The alkyl sulphate may be derived from natural sources, such as coco and/or tallow. Alternatively, the alkyl sulphate may be derived from synthetic sources such as C₁₂₋₁₅ alkyl sulphate.

Another suitable sulphate deterative surfactant is alkyl alkoxyated sulphate, such as alkyl ethoxyated sulphate, or a C₈₋₁₈ alkyl alkoxyated sulphate, or a C₈₋₁₈ alkyl ethoxyated sulphate. The alkyl alkoxyated sulphate may have an average degree of alkoxylation of from 0.5 to 20, or from 0.5 to 10. The alkyl alkoxyated sulphate may be a C₈₋₁₈ alkyl ethoxyated sulphate, typically having an average degree of ethoxylation of from 0.5 to 10, or from 0.5 to 7, or from 0.5 to 5 or from 0.5 to 3.

The alkyl sulphate, alkyl alkoxyated sulphate and alkyl benzene sulphonates may be linear or branched, substituted or un-substituted.

The anionic deterative surfactant may be a mid-chain branched anionic deterative surfactant, such as a mid-chain branched alkyl sulphate and/or a mid-chain branched alkyl benzene sulphonate. The mid-chain branches are typically C₁₋₄ alkyl groups, such as methyl and/or ethyl groups.

Another suitable anionic deterative surfactant is alkyl ethoxy carboxylate.

The anionic deterative surfactants are typically present in their salt form, typically being complexed with a suitable cation. Suitable counter-ions include Na⁺ and K⁺, substituted

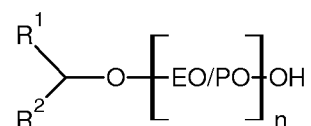
ammonium such as C₁-C₆ alkanolammmonium such as mono-ethanolamine (MEA) tri-ethanolamine (TEA), di-ethanolamine (DEA), and any mixture thereof.

Non-ionic deterative surfactant: Suitable non-ionic deterative surfactants are selected from the group consisting of: C₈-C₁₈ alkyl ethoxylates, such as, NEODOL® non-ionic surfactants from Shell; C₆-C₁₂ alkyl phenol alkoxyates wherein optionally the alkoxyate units are ethyleneoxy units, propyleneoxy units or a mixture thereof; C₁₂-C₁₈ alcohol and C₆-C₁₂ alkyl phenol condensates with ethylene oxide/propylene oxide block polymers such as Pluronic® from BASF; C₁₄-C₂₂ mid-chain branched alcohols; C₁₄-C₂₂ mid-chain branched alkyl alkoxyates, typically having an average degree of alkoxylation of from 1 to 30; alkylpolysaccharides, such as alkylpolyglycosides; polyhydroxy fatty acid amides; ether capped poly(oxyalkylated) alcohol surfactants; and mixtures thereof.

Suitable non-ionic deterative surfactants are alkyl polyglucoside and/or an alkyl alkoxyated alcohol.

Suitable non-ionic deterative surfactants include alkyl alkoxyated alcohols, such as C₈₋₁₈ alkyl alkoxyated alcohol, or a C₈₋₁₈ alkyl ethoxylated alcohol. The alkyl alkoxyated alcohol may have an average degree of alkoxylation of from 0.5 to 50, or from 1 to 30, or from 1 to 20, or from 1 to 10. The alkyl alkoxyated alcohol may be a C₈₋₁₈ alkyl ethoxylated alcohol, typically having an average degree of ethoxylation of from 1 to 10, or from 1 to 7, or from 1 to 5, or from 3 to 7. The alkyl alkoxyated alcohol can be linear or branched, and substituted or un-substituted.

Suitable nonionic deterative surfactants include secondary alcohol-based deterative surfactants having the formula:



wherein R¹ = linear or branched, substituted or unsubstituted, saturated or unsaturated C₂₋₈ alkyl;

wherein R² = linear or branched, substituted or unsubstituted, saturated or unsaturated C₂₋₈ alkyl,

wherein the total number of carbon atoms present in R¹ + R² moieties is in the range of from 7 to 13;

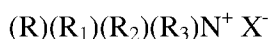
wherein EO/PO are alkoxy moieties selected from ethoxy, propoxy, or mixtures thereof, optionally the EO/PO alkoxy moieties are in random or block configuration;

wherein n is the average degree of alkoxylation and is in the range of from 4 to 10.

Other suitable non-ionic deterative surfactants include EO/PO block co-polymer surfactants, such as the Plurafac[®] series of surfactants available from BASF, and sugar-derived surfactants such as alkyl N-methyl glucose amide.

Cationic deterative surfactant: Suitable cationic deterative surfactants include alkyl pyridinium compounds, alkyl quaternary ammonium compounds, alkyl quaternary phosphonium compounds, alkyl ternary sulphonium compounds, and mixtures thereof.

Suitable cationic deterative surfactants are quaternary ammonium compounds having the general formula:



wherein, R is a linear or branched, substituted or unsubstituted C₆₋₁₈ alkyl or alkenyl moiety, R₁ and R₂ are independently selected from methyl or ethyl moieties, R₃ is a hydroxyl, hydroxymethyl or a hydroxyethyl moiety, X is an anion which provides charge neutrality, suitable anions include: halides, such as chloride; sulphate; and sulphonate. Suitable cationic deterative surfactants are mono-C₆₋₁₈ alkyl mono-hydroxyethyl di-methyl quaternary ammonium chlorides. Suitable cationic deterative surfactants are mono-C₈₋₁₀ alkyl mono-hydroxyethyl di-methyl quaternary ammonium chloride, mono-C₁₀₋₁₂ alkyl mono-hydroxyethyl di-methyl quaternary ammonium chloride and mono-C₁₀ alkyl mono-hydroxyethyl di-methyl quaternary ammonium chloride.

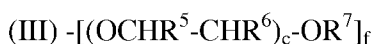
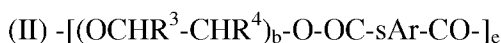
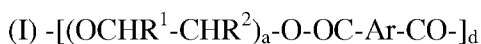
Zwitterionic and/or amphoteric deterative surfactant: Suitable zwitterionic and/or amphoteric deterative surfactants include amine oxide such as dodecyldimethylamine N-oxide, alkanolamine sulphobetaines, coco-amidopropyl betaines, HN⁺-R-CO₂⁻ based surfactants, wherein R can be any bridging group, such as alkyl, alkoxy, aryl or amino acids.

Polymer: Suitable polymers include carboxylate polymers, polyethylene glycol polymers, polyester soil release polymers such as terephthalate polymers, amine polymers, cellulosic polymers, dye transfer inhibition polymers, dye lock polymers such as a condensation oligomer produced by condensation of imidazole and epichlorhydrin, optionally in ratio of 1:4:1, hexamethylenediamine derivative polymers, and any combination thereof.

Carboxylate polymer: 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.

Polyethylene glycol polymer: Suitable polyethylene glycol polymers include random graft co-polymers comprising: (i) hydrophilic backbone comprising polyethylene glycol; and (ii) hydrophobic 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.

Polyester soil release polymers: Suitable polyester soil release polymers have a structure as defined by one of the following structures (I), (II) or (III):



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 any mixture 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 C₈-C₃₀ aryl group, or a C₆-C₃₀ arylalkyl group.

Suitable polyester soil release polymers are terephthalate polymers having the structure of formula (I) or (II) above.

Suitable polyester soil release polymers include the Repel-o-tex series of polymers such as Repel-o-tex SF2 (Rhodia) and/or the Texcare series of polymers such as Texcare SRA300 (Clariant).

Amine polymer: Suitable amine polymers include polyethylene imine polymers, such as alkoxylated polyalkyleneimines, optionally comprising a polyethylene and/or polypropylene oxide block.

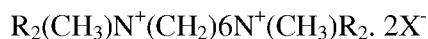
Cellulosic polymer: The composition can comprise cellulosic polymers, such as polymers selected from alkyl cellulose, alkyl alkoxyalkyl cellulose, carboxyalkyl cellulose, alkyl carboxyalkyl, and any combination thereof. Suitable cellulosic polymers are selected from carboxymethyl cellulose, methyl cellulose, methyl hydroxyethyl cellulose, methyl carboxymethyl cellulose, and mixtures thereof. The carboxymethyl cellulose can have a degree of carboxymethyl substitution from 0.5 to 0.9 and a molecular weight from 100,000 Da to 300,000 Da. Another suitable cellulosic polymer is hydrophobically modified carboxymethyl cellulose, such as Finnfix SH-1 (CP Kelco).

Other suitable cellulosic polymers may have a degree of substitution (DS) of from 0.01 to 0.99 and a degree of blockiness (DB) such that either DS+DB is of at least 1.00 or $DB+2DS-DS^2$ is at least 1.20. The substituted cellulosic polymer can have a degree of substitution (DS) of at least 0.55. The substituted cellulosic polymer can have a degree of blockiness (DB) of at least 0.35. The substituted cellulosic polymer can have a DS + DB, of from 1.05 to 2.00. A suitable substituted cellulosic polymer is carboxymethylcellulose.

Another suitable cellulosic polymer is cationically modified hydroxyethyl cellulose.

Dye transfer inhibitor polymer: Suitable dye transfer inhibitor (DTI) polymers include polyvinyl pyrrolidone (PVP), vinyl co-polymers of pyrrolidone and imidazoline (PVPVI), polyvinyl N-oxide (PVNO), and any mixture thereof.

Hexamethylenediamine derivative polymers: Suitable polymers include hexamethylenediamine derivative polymers, typically having the formula:



wherein X^- is a suitable counter-ion, for example chloride, and R is a poly(ethylene glycol) chain having an average degree of ethoxylation of from 20 to 30. Optionally, the poly(ethylene glycol) chains may be independently capped with sulphate and/or sulphonate groups, typically with the charge being balanced by reducing the number of X^- counter-ions, or (in cases where the average

degree of sulphation per molecule is greater than two), introduction of Y^+ counter-ions, for example sodium cations.

Builder: Suitable builders include zeolites, phosphates, citrates, and any combination thereof.

Zeolite builder: The composition typically comprises from 0wt% to 10wt% zeolite builder, or to 8wt%, or to 6wt%, or to 4wt%, or to 3wt%, or to 2wt%, or even to 1wt% zeolite builder. The composition may even be substantially free of zeolite builder; substantially free means “no deliberately added”. Typical zeolite builders include zeolite A, zeolite P, zeolite MAP, zeolite X and zeolite Y.

Phosphate builder: The composition typically comprises from 0wt% to 10wt% phosphate builder, or to 8wt%, or to 6wt%, or to 4wt%, or to 3wt%, or to 2wt%, or even to 1wt% phosphate builder. The composition may even be substantially free of phosphate builder; substantially free means “no deliberately added”. A typical phosphate builder is sodium tri-polyphosphate (STPP).

Citrate: A suitable citrate is sodium citrate. However, citric acid may also be incorporated into the composition, which can form citrate in the wash liquor.

Buffer and alkalinity source: Suitable buffers and alkalinity sources include carbonate salts and/or silicate salts and/or double salts such as burkeite.

Carbonate salt: A suitable carbonate salt is sodium carbonate and/or sodium bicarbonate. The composition may comprise bicarbonate salt. It may be suitable for the composition to comprise low levels of carbonate salt, for example, it may be suitable for the composition to comprise from 0wt% to 10wt% carbonate salt, or to 8wt%, or to 6wt%, or to 4wt%, or to 3wt%, or to 2wt%, or even to 1wt% carbonate salt. The composition may even be substantially free of carbonate salt; substantially free means “no deliberately added”.

The carbonate salt may have a weight average mean particle size of from 100 to 500 micrometers. Alternatively, the carbonate salt may have a weight average mean particle size of from 10 to 25 micrometers.

Silicate salt: The composition may comprise from 0wt% to 20wt% silicate salt, or to 15wt%, or to 10wt%, or to 5wt%, or to 4wt%, or even to 2wt%, and may comprise from above 0wt%, or from 0.5wt%, or even from 1wt% silicate salt. The silicate can be crystalline or amorphous. Suitable crystalline silicates include crystalline layered silicate, such as SKS-6. Other suitable silicates include 1.6R silicate and/or 2.0R silicate. A suitable silicate salt is sodium silicate. Another suitable silicate salt is sodium metasilicate.

Filler: The composition may comprise from 0wt% to 70% filler. Suitable fillers include sulphate salts and/or bio-filler materials.

Sulphate salt: A suitable sulphate salt is sodium sulphate. The sulphate salt may have a weight average mean particle size of from 100 to 500 micrometers, alternatively, the sulphate salt may have a weight average mean particle size of from 10 to 45 micrometers.

Bio-filler material: A suitable bio-filler material is alkali and/or bleach treated agricultural waste.

Bleach: The composition may comprise bleach. Alternatively, the composition may be substantially free of bleach; substantially free means “no deliberately added”. Suitable bleach includes bleach activators, sources of available oxygen, pre-formed peracids, bleach catalysts, reducing bleach, and any combination thereof. If present, the bleach, or any component thereof, for example the pre-formed peracid, may be coated, such as encapsulated, or clathrated, such as with urea or cyclodextrin.

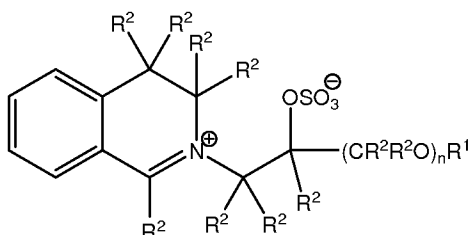
Bleach activator: Suitable bleach activators include: tetraacetylenediamine (TAED); oxybenzene sulphonates such as nonanoyl oxybenzene sulphonate (NOBS), caprylamidononanoyl oxybenzene sulphonate (NACA-OBS), 3,5,5-trimethyl hexanoyloxybenzene sulphonate (Iso-NOBS), dodecyl oxybenzene sulphonate (LOBS), and any mixture thereof; caprolactams; pentaacetate glucose (PAG); nitrile quaternary ammonium; imide bleach activators, such as N-nonanoyl-N-methyl acetamide; and any mixture thereof.

Source of available oxygen: A suitable source of available oxygen (AvOx) is a source of hydrogen peroxide, such as percarbonate salts and/or perborate salts, such as sodium percarbonate. The source of peroxygen may be at least partially coated, or even completely coated, by a coating ingredient such as a carbonate salt, a sulphate salt, a silicate salt, borosilicate, or any mixture thereof, including mixed salts thereof. Suitable percarbonate salts can be prepared by a fluid bed process or by a crystallization process. Suitable perborate salts include sodium perborate mono-hydrate (PB1), sodium perborate tetra-hydrate (PB4), and anhydrous sodium perborate which is also known as fizzing sodium perborate. Other suitable sources of AvOx include persulphate, such as oxone. Another suitable source of AvOx is hydrogen peroxide.

Pre-formed peracid: A suitable pre-formed peracid is N,N-phthaloylamino peroxycaproic acid (PAP).

Bleach catalyst: Suitable bleach catalysts include oxaziridinium-based bleach catalysts, transition metal bleach catalysts and bleaching enzymes.

Oxaziridinium-based bleach catalyst: A suitable oxaziridinium-based bleach catalyst has the formula:



wherein: R^1 is selected from the group consisting of: H, a branched alkyl group containing from 3 to 24 carbons, and a linear alkyl group containing from 1 to 24 carbons; R^1 can be a branched alkyl group comprising from 6 to 18 carbons, or a linear alkyl group comprising from 5 to 18 carbons, R^1 can be selected from the group consisting of: 2-propylheptyl, 2-butyloctyl, 2-pentylononyl, 2-hexyldecyl, n-hexyl, n-octyl, n-decyl, n-dodecyl, n-tetradecyl, n-hexadecyl, n-octadecyl, iso-nonyl, iso-decyl, iso-tridecyl and iso-pentadecyl; R^2 is independently selected from the group consisting of: H, a branched alkyl group comprising from 3 to 12 carbons, and a linear alkyl group comprising from 1 to 12 carbons; optionally R^2 is independently selected from H and methyl groups; and n is an integer from 0 to 1.

Transition metal bleach catalyst: The composition may include transition metal bleach catalyst, typically comprising copper, iron, titanium, ruthenium, tungsten, molybdenum, and/or manganese cations. Suitable transition metal bleach catalysts are manganese-based transition metal bleach catalysts.

Reducing bleach: The composition may comprise a reducing bleach. However, the composition may be substantially free of reducing bleach; substantially free means “no deliberately added”. Suitable reducing bleach include sodium sulphite and/or thiourea dioxide (TDO).

Co-bleach particle: The composition may comprise a co-bleach particle. Typically, the co-bleach particle comprises a bleach activator and a source of peroxide. It may be highly suitable for a large amount of bleach activator relative to the source of hydrogen peroxide to be present in the co-bleach particle. The weight ratio of bleach activator to source of hydrogen peroxide present in the co-bleach particle can be at least 0.3:1, or at least 0.6:1, or at least 0.7:1, or at least 0.8:1, or at least 0.9:1, or at least 1.0:1.0, or even at least 1.2:1 or higher.

The co-bleach particle can comprise: (i) bleach activator, such as TAED; and (ii) a source of hydrogen peroxide, such as sodium percarbonate. The bleach activator may at least partially, or even completely, enclose the source of hydrogen peroxide.

The co-bleach particle may comprise a binder. Suitable binders are carboxylate polymers such as polyacrylate polymers, and/or surfactants including non-ionic deterative surfactants and/or anionic deterative surfactants such as linear C₁₁-C₁₃ alkyl benzene sulphonate.

The co-bleach particle may comprise bleach catalyst, such as an oxaziridium-based bleach catalyst.

Chelant: Suitable chelants are selected from: diethylene triamine pentaacetate, diethylene triamine penta(methyl phosphonic acid), ethylene diamine-N'N'-disuccinic acid, ethylene diamine tetraacetate, ethylene diamine tetra(methylene phosphonic acid), hydroxyethane di(methylene phosphonic acid), and any combination thereof. A suitable chelant is ethylene diamine-N'N'-disuccinic acid (EDDS) and/or hydroxyethane diphosphonic acid (HEDP). The laundry detergent composition may comprise ethylene diamine-N'N'-disuccinic acid or salt thereof. The ethylene diamine-N'N'-disuccinic acid may be in S,S enantiomeric form. The composition may comprise 4,5-dihydroxy-m-benzenedisulfonic acid disodium salt. Suitable chelants may also be calcium crystal growth inhibitors.

Calcium carbonate crystal growth inhibitor: The composition may comprise a calcium carbonate crystal growth inhibitor, such as one selected from the group consisting of: 1-hydroxyethanediphosphonic acid (HEDP) and salts thereof; N,N-dicarboxymethyl-2-aminopentane-1,5-dioic acid and salts thereof; 2-phosphonobutane-1,2,4-tricarboxylic acid and salts thereof; and any combination thereof.

Photobleach: Suitable photobleaches are zinc and/or aluminium sulphonated phthalocyanines.

Hueing agent: The hueing agent (also defined herein as hueing dye) is typically formulated to deposit onto fabrics from the wash liquor so as to improve fabric whiteness perception. The hueing agent is typically blue or violet. It may be suitable that the hueing dye(s) have a peak absorption wavelength of from 550nm to 650nm, or from 570nm to 630nm. The hueing agent may be a combination of dyes which together have the visual effect on the human eye as a single dye having a peak absorption wavelength on polyester of from 550nm to 650nm, or from 570nm to 630nm. This may be provided for example by mixing a red and green-blue dye to yield a blue or violet shade.

Dyes are typically coloured organic molecules which are soluble in aqueous media that contain surfactants. Dyes may be selected from the classes of basic, acid, hydrophobic, direct and polymeric dyes, and dye-conjugates. Suitable polymeric hueing dyes are commercially available, for example from Milliken, Spartanburg, South Carolina, USA.

Examples of suitable dyes are violet DD, direct violet 7, direct violet 9, direct violet 11, direct violet 26, direct violet 31, direct violet 35, direct violet 40, direct violet 41, direct violet 51, direct violet 66, direct violet 99, acid violet 50, acid blue 9, acid violet 17, acid black 1, acid red 17, acid blue 29, solvent violet 13, disperse violet 27, disperse violet 26, disperse violet 28, disperse violet 63 and disperse violet 77, basic blue 16, basic blue 65, basic blue 66, basic blue 67, basic blue 71, basic blue 159, basic violet 19, basic violet 35, basic violet 38, basic violet 48; basic blue 3, basic blue 75, basic blue 95, basic blue 122, basic blue 124, basic blue 141, thiazolium dyes, reactive blue 19, reactive blue 163, reactive blue 182, reactive blue 96, Liquitint® Violet CT (Milliken, Spartanburg, USA) and Azo-CM-Cellulose (Megazyme, Bray, Republic of Ireland). Other suitable hueing agents are hueing dye-photobleach conjugates, such as the conjugate of sulphonated zinc phthalocyanine with direct violet 99. A particularly suitable hueing agent is a combination of acid red 52 and acid blue 80, or the combination of direct violet 9 and solvent violet 13.

Brightener: Suitable brighteners are stilbenes, such as brightener 15. Other suitable brighteners are hydrophobic brighteners, and brightener 49. The brightener may be in micronized particulate form, having a weight average particle size in the range of from 3 to 30 micrometers, or from 3 micrometers to 20 micrometers, or from 3 to 10 micrometers. The brightener can be alpha or beta crystalline form.

Enzyme: Suitable enzymes include proteases, amylases, cellulases, lipases, xyloglucanases, pectate lyases, mannanases, bleaching enzymes, cutinases, and mixtures thereof.

For the enzymes, accession numbers and IDs shown in parentheses refer to the entry numbers in the databases Genbank, EMBL and/or Swiss-Prot. For any mutations, standard 1-letter amino acid codes are used with a * representing a deletion. Accession numbers prefixed with DSM refer to micro-organisms deposited at Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH, Mascheroder Weg 1b, 38124 Brunswick (DSMZ).

Protease. The composition may comprise a protease. Suitable proteases include metalloproteases and/or 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*, *Bacillus alkalophilus* (P27963, ELYA_BACAO), *Bacillus subtilis*, *Bacillus amyloliquefaciens* (P00782, SUBT_BACAM), *Bacillus pumilus* (P07518) and *Bacillus gibsonii* (DSM14391).

(b) trypsin-type or chymotrypsin-type proteases, such as trypsin (e.g. of porcine or bovine origin), including the Fusarium protease and the chymotrypsin proteases derived from *Cellulomonas* (A2RQE2).

(c) metalloproteases, including those derived from *Bacillus amyloliquefaciens* (P06832, NPPE_BACAM).

Suitable proteases include those derived from *Bacillus gibsonii* or *Bacillus Lentus* such as subtilisin 309 (P29600) and/or DSM 5483 (P29599).

Suitable commercially available protease enzymes include: those sold under the trade names Alcalase®, Savinase®, Primase®, Durazym®, Polarzyme®, Kannase®, Liquanase®, Liquanase Ultra®, Savinase Ultra®, Ovozyme®, Neutrase®, Everlase® and Esperase® 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 (P29599 having the following mutations S99D + S101 R + S103A + V104I + G159S), and variants thereof including 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; and KAP (*Bacillus alkalophilus* subtilisin with mutations A230V + S256G + S259N) from Kao.

Other Amylase: Suitable other amylases are alpha-amylases, including those of bacterial or fungal origin. Chemically or genetically modified mutants (variants) are included. A suitable 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, sp 707, DSM 9375, DSM 12368, DSMZ no. 12649, KSM AP1378, KSM K36 or KSM K38. Suitable amylases include:

(a) alpha-amylase derived from *Bacillus licheniformis* (P06278, AMY_BACLI), and variants thereof, especially the variants with substitutions in one or more of the following positions: 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) AA560 amylase (CBU30457, HD066534) and variants thereof, especially the variants with one or more substitutions in the following positions: 26, 30, 33, 82, 37, 106, 118, 128, 133, 150, 160, 178, 193, 203, 214, 231, 256, 258, 269, 270, 272, 283, 296, 298, 299, 303, 304, 305, 311, 314, 315, 318, 319, 361, 378, 383, 419, 421, 437, 441, 444, 445, 446, 447, 450, 461, 471, 482, 484, optionally that also contain the deletions of D183* and G184*.

(c) variants exhibiting at least 90% identity with the wild-type enzyme from *Bacillus SP722* (CBU30453, HD066526), especially variants with deletions in the 183 and 184 positions.

Suitable commercially available alpha-amylases are Duramyl®, Liquezyme® Termamyl®, Termamyl Ultra®, Natalase®, Supramyl®, Stainzyme®, Stainzyme Plus®, Fungamyl® and BAN® (Novozymes A/S), Bioamylase® and variants thereof (Biocon India Ltd.), Kemzym® AT 9000 (Biozym Ges. m.b.H, Austria), Rapidase®, Purastar®, Optimize HT Plus®, EnzySize®, Powerase® and Purastar Oxam®, Maxamyl® (Genencor International Inc.) and KAM® (KAO, Japan). Suitable amylases are Natalase® and Stainzyme®.

Cellulase: The composition may comprise a cellulase. Suitable cellulases include those of bacterial or fungal origin. Chemically modified or protein engineered mutants are included. Suitable cellulases include cellulases from the genera *Bacillus*, *Pseudomonas*, *Humicola*, *Fusarium*, *Thielavia*, *Acremonium*, e.g., the fungal cellulases produced from *Humicola insolens*, *Myceliophthora thermophila* and *Fusarium oxysporum*.

Commercially available cellulases include Celluzyme®, and Carezyme® (Novozymes A/S), Clazinase®, and Puradax HA® (Genencor International Inc.), and KAC-500(B)® (Kao Corporation).

The cellulase can 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 sp. AA349* and mixtures thereof. Suitable endoglucanases are sold under the tradenames Celluclean® and Whitezyme® (Novozymes A/S, Bagsvaerd, Denmark).

The composition may comprise a cleaning cellulase belonging to Glycosyl Hydrolase family 45 having a molecular weight of from 17kDa to 30 kDa, for example the endoglucanases sold under the tradename Biotouch® NCD, DCC and DCL (AB Enzymes, Darmstadt, Germany).

Suitable cellulases may also exhibit xyloglucanase activity, such as Whitezyme®.

Lipase. The composition may comprise a lipase. Suitable lipases include those of bacterial or fungal origin. Chemically modified or protein engineered mutants are included. Examples of useful lipases include lipases from *Humicola* (synonym *Thermomyces*), e.g., from *H. lanuginosa* (*T. lanuginosus*), or from *H. insolens*, a *Pseudomonas* lipase, e.g., from *P. alcaligenes* or *P. pseudoalcaligenes*, *P. cepacia*, *P. stutzeri*, *P. fluorescens*, *Pseudomonas* sp. strain SD 705, *P. wisconsinensis*, a *Bacillus* lipase, e.g., from *B. subtilis*, *B. stearothermophilus* or *B. pumilus*.

The lipase may be a “first cycle lipase”, optionally a variant of the wild-type lipase from *Thermomyces lanuginosus* comprising T231R and N233R mutations. The wild-type sequence is the 269 amino acids (amino acids 23 – 291) of the Swissprot accession number Swiss-Prot O59952 (derived from *Thermomyces lanuginosus* (*Humicola lanuginosa*)). Suitable lipases would include those sold under the tradenames Lipex®, Lipolex® and Lipoclean® by Novozymes, Bagsvaerd, Denmark.

The composition may comprise a variant of *Thermomyces lanuginosa* (O59952) lipase having >90% identity with the wild type amino acid and comprising substitution(s) at T231 and/or N233, optionally T231R and/or N233R.

Xyloglucanase: Suitable xyloglucanase enzymes may have enzymatic activity towards both xyloglucan and amorphous cellulose substrates. The enzyme may be a glycosyl hydrolase (GH) selected from GH families 5, 12, 44 or 74. The glycosyl hydrolase selected from GH family 44 is particularly suitable. Suitable glycosyl hydrolases from GH family 44 are the XYG1006 glycosyl hydrolase from *Paenibacillus polyxyma* (ATCC 832) and variants thereof.

Pectate lyase: Suitable pectate lyases are either wild-types or variants of *Bacillus*-derived pectate lyases (CAF05441, AAU25568) sold under the tradenames Pectawash®, Pectaway® and X-Pect® (from Novozymes A/S, Bagsvaerd, Denmark).

Mannanase: Suitable mannanases are sold under the tradenames Mannaway® (from Novozymes A/S, Bagsvaerd, Denmark), and Purabrite® (Genencor International Inc., Palo Alto, California).

Bleaching enzyme: Suitable bleach enzymes include oxidoreductases, for example oxidases such as glucose, choline or carbohydrate oxidases, oxygenases, catalases, peroxidases, like halo-, chloro-, bromo-, lignin-, glucose- or manganese-peroxidases, dioxygenases or laccases (phenoloxidases, polyphenoloxidases). Suitable commercial products are sold under the Guardzyme® and Denilite® ranges from Novozymes. It may be advantageous for additional organic compounds, especially aromatic compounds, to be incorporated with the bleaching enzyme; these compounds interact with the bleaching enzyme to enhance the activity of the

oxidoreductase (enhancer) or to facilitate the electron flow (mediator) between the oxidizing enzyme and the stain typically over strongly different redox potentials.

Other suitable bleaching enzymes include perhydrolases, which catalyse the formation of peracids from an ester substrate and peroxygen source. Suitable perhydrolases include variants of the *Mycobacterium smegmatis* perhydrolase, variants of so-called CE-7 perhydrolases, and variants of wild-type subtilisin Carlsberg possessing perhydrolase activity.

Cutinase: Suitable cutinases are defined by E.C. Class 3.1.1.73, optionally displaying at least 90%, or 95%, or most optionally at least 98% identity with a wild-type derived from one of *Fusarium solani*, *Pseudomonas Mendocina* or *Humicola Insolens*.

Identity. The relativity between two amino acid sequences is described by the parameter “identity”. For purposes of the present invention, the alignment of two amino acid sequences is determined by using the Needle program from the EMBOSS package (<http://emboss.org>) version 2.8.0. The Needle program implements the global alignment algorithm described in Needleman, S. B. and Wunsch, C. D. (1970) J. Mol. Biol. 48, 443-453. The substitution matrix used is BLOSUM62, gap opening penalty is 10, and gap extension penalty is 0.5.

Fabric-softener: Suitable fabric-softening agents include clay, silicone and/or quaternary ammonium compounds. Suitable clays include montmorillonite clay, hectorite clay and/or laponite clay. A suitable clay is montmorillonite clay. Suitable silicones include amino-silicones and/or polydimethylsiloxane (PDMS). A suitable fabric softener is a particle comprising clay and silicone, such as a particle comprising montmorillonite clay and PDMS.

Flocculant: Suitable flocculants include polyethylene oxide; for example having an average molecular weight of from 300,000 Da to 900,000 Da.

Suds suppressor: Suitable suds suppressors include silicone and/or fatty acid such as stearic acid.

Perfume: Suitable perfumes include perfume microcapsules, polymer assisted perfume delivery systems including Schiff base perfume/polymer complexes, starch-encapsulated perfume accords, perfume-loaded zeolites, blooming perfume accords, and any combination thereof. A suitable perfume microcapsule is melamine formaldehyde based, typically comprising perfume that is encapsulated by a shell comprising melamine formaldehyde. It may be highly suitable for such perfume microcapsules to comprise cationic and/or cationic precursor material in the shell, such as polyvinyl formamide (PVF) and/or cationically modified hydroxyethyl cellulose (catHEC).

Aesthetic: Suitable aesthetic particles include soap rings, lamellar aesthetic particles, gelatin beads, carbonate and/or sulphate salt speckles, coloured clay particles, and any combination thereof.

Method of laundering fabric: The method of laundering fabric typically comprises the step of contacting the composition to water to form a wash liquor, and laundering fabric in said wash liquor, wherein typically the wash liquor has a temperature of above 0°C to 90°C, or to 60°C, or to 40°C, or to 30°C, or to 20°C, or to 10°C, or even to 8°C. The fabric may be contacted to the water prior to, or after, or simultaneous with, contacting the laundry detergent composition with water. The composition can be used in pre-treatment applications.

Typically, the wash liquor is formed by contacting the laundry detergent to water in such an amount so that the concentration of laundry detergent composition in the wash liquor is from above 0g/l to 5g/l, or from 1g/l, and to 4.5g/l, or to 4.0g/l, or to 3.5g/l, or to 3.0g/l, or to 2.5g/l, or even to 2.0g/l, or even to 1.5g/l.

The method of laundering fabric may be carried out in a top-loading or front-loading automatic washing machine, or can be used in a hand-wash laundry application. In these applications, the wash liquor formed and concentration of laundry detergent composition in the wash liquor is that of the main wash cycle. Any input of water during any optional rinsing step(s) is not included when determining the volume of the wash liquor.

The wash liquor may comprise 40 litres or less of water, or 30 litres or less, or 20 litres or less, or 10 litres or less, or 8 litres or less, or even 6 litres or less of water. The wash liquor may comprise from above 0 to 15 litres, or from 2 litres, and to 12 litres, or even to 8 litres of water.

Typically from 0.01kg to 2kg of fabric per litre of wash liquor is dosed into said wash liquor. Typically from 0.01kg, or from 0.05kg, or from 0.07kg, or from 0.10kg, or from 0.15kg, or from 0.20kg, or from 0.25kg fabric per litre of wash liquor is dosed into said wash liquor.

Optionally, 50g or less, or 45g or less, or 40g or less, or 35g or less, or 30g or less, or 25g or less, or 20g or less, or even 15g or less, or even 10g or less of the composition is contacted to water to form the wash liquor.

EXAMPLES

Ingredient	Amount
Co-bleach particle (comprising 60wt% sodium percarbonate, 30wt% bleach activator, 10wt% mixture of deterative surfactant and cellulosic polymer)	from 10wt% to 20wt%
Amylase (Stainzyme Plus, having an enzyme activity of 14mg active enzyme/g)	from 0.1wt% to 0.5wt%
Anionic deterative surfactant (such as alkyl benzene sulphonate, alkyl ethoxylated sulphate and mixtures thereof)	from 8wt% to 15wt%
Non-ionic deterative surfactant (such as alkyl ethoxylated alcohol)	from 0.5wt% to 4wt%
Cationic deterative surfactant (such as quaternary ammonium compounds)	from 0 to 4wt%
Other deterative surfactant (such as zwiterionic deterative surfactants, amphoteric surfactants and mixtures thereof)	from 0wt% to 4wt%
Carboxylate polymer (such as co-polymers of maleic acid and acrylic acid)	from 1wt% to 4wt%
Polyethylene glycol polymer (such as a polyethylene glycol polymer comprising poly vinyl acetate side chains)	from 0wt% to 4wt%
Polyester soil release polymer (such as Repel-o-tex and/or Texcare polymers)	from 0.1 to 2wt%
Cellulosic polymer (such as carboxymethyl cellulose, methyl cellulose and combinations thereof)	from 0.5wt% to 2wt%
Other polymer (such as amine polymers, dye transfer inhibitor polymers, hexamethylenediamine derivative polymers, and mixtures thereof)	from 0wt% to 4wt%
Zeolite builder and phosphate builder (such as zeolite 4A and/or sodium tripolyphosphate)	from 0wt% to 4wt%
Other builder (such as sodium citrate and/or citric acid)	from 0wt% to 3wt%
Carbonate salt (such as sodium carbonate and/or sodium bicarbonate)	from 15wt% to 30wt%
Silicate salt (such as sodium silicate)	from 0wt% to 10wt%

Filler (such as sodium sulphate and/or bio-fillers)	from 10wt% to 40wt%
Source of available oxygen (such as sodium percarbonate)	from 10wt% to 20wt%
Bleach activator (such as tetraacetyethylene diamine (TAED) and/or nonanoyloxybenzenesulphonate (NOBS))	from 2wt% to 8wt%
Bleach catalyst (such as oxaziridinium-based bleach catalyst and/or transition metal bleach catalyst)	from 0wt% to 0.1wt%
Other bleach (such as reducing bleach and/or pre-formed peracid)	from 0wt% to 10wt%
Chelant (such as ethylenediamine-N'N'-disuccinic acid (EDDS) and/or hydroxyethane diphosphonic acid (HEDP))	from 0.2wt% to 1wt%
Photobleach (such as zinc and/or aluminium sulphonated phthalocyanine)	from 0wt% to 0.1wt%
Hueing agent (such as direct violet 99, acid red 52, acid blue 80, direct violet 9, solvent violet 13 and any combination thereof)	from 0wt% to 0.5wt%
Brightener (such as brightener 15 and/or brightener 49)	from 0.1wt% to 0.4wt%
Protease (such as Savinase, Polarzyme, Purafect, FN3, FN4 and any combination thereof), typically having an enzyme activity of from 20 to 100mg active enzyme/g	from 0.1wt% to 1.5wt%
Amylase (such as Termamyl, Termamyl Ultra, Natalase, Optisize HT Plus, Powerase, Stainzyme and any combination thereof), typically having an enzyme activity of from 10 to 50mg active enzyme/g	from 0.05wt% to 0.2wt%
Cellulase (such as Carezyme, Celluzyme and/or Celluclean), typically having an enzyme activity of from 10 to 50mg active enzyme/g	from 0.05wt% to 0.5wt%
Lipase (such as Lipex, Lipolex, Lipoclean and any combination thereof), typically having an enzyme activity of from 10 to 50mg active enzyme/g	from 0.2 to 1wt%
Other enzyme (such as xyloglucanase (e.g. Whitezyme), cutinase, pectate lyase, mannanase, bleaching enzyme), typically having an enzyme activity of from 10 to 50mg active enzyme/g	from 0wt% to 2wt%
Fabric softener (such as montmorillonite clay and/or polydimethylsiloxane (PDMS))	from 0wt% to 15wt%

Flocculant (such as polyethylene oxide)	from 0wt% to 1wt%
Suds suppressor (such as silicone and/or fatty acid)	from 0wt% to 0.1wt%
Perfume (such as perfume microcapsule, spray-on perfume, starch encapsulated perfume accords, perfume loaded zeolite, and any combination thereof)	from 0.1wt% to 1wt%
Aesthetics (such as coloured soap rings and/or coloured speckles/noodles)	from 0wt% to 1wt%
Miscellaneous	Balance

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”.

CLAIMS

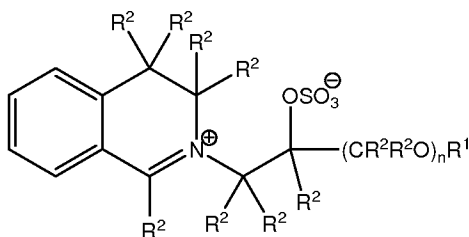
1. A solid particulate laundry detergent composition comprising:
 - (a) co-bleach particle comprising bleach activator, source of hydrogen peroxide and optionally bleach catalyst;
 - (b) amylase with greater than 90% identity to the AA560 alpha amylase endogenous to *Bacillus* sp. DSM 12649 and comprising:
 - (i) mutations at one or more of positions 9, 149, 182, 186, 202, 257, 295, 299, 323, 339 and 345; and
 - (ii) mutations at four or more of positions 118, 183, 184, 195, 320 and 458; and
 - (c) laundry detergent ingredients.
2. A composition according to claim 1, wherein upon dilution in de-ionized water to a concentration of 1wt% at 20°C, the composition has a pH of from 9 to 13.
3. A composition according to any preceding claim, wherein the amylase comprises all of the mutations: R118K, D183*, G184*, N195F, R320K and R458K.
4. A composition according to any preceding claim, wherein the weight ratio of bleach activator to source of hydrogen peroxide present in the co-bleach particle is at least 1.2:1 or higher.
5. A composition according to any preceding claim, wherein the co-bleach particle comprises tetraacetyl ethylene diamine (TAED) and sodium percarbonate.
6. A composition according to any preceding claim, wherein the co-bleach particle comprises a layer of bleach activator that surrounds a core of source of hydrogen peroxide.
7. A composition according to any preceding claim, wherein the co-bleach particle comprises a binder selected from cellulosic polymer and/or surfactant.
8. A composition according to any preceding claim, wherein the composition comprises:
 - (a) anionic deterative surfactant;
 - (b) from 0wt% to less than 5wt% zeolite builder;

- (c) from 0wt% to less than 5wt% phosphate builder; and
- (d) optionally, from 0wt% to 10wt% silicate salt.

9. A composition according to any preceding claim, wherein the composition comprises XYG1006 glycosyl hydrolase from *Paenibacillus polyxyma* and variants thereof.

10. A composition according to any preceding claim, wherein the composition comprises substituted cellulosic polymer comprising carboxymethyl substituent groups, and having a degree of substitution (DS) of at least 0.55, and having a degree of blockiness (DB) of at least 0.35, and having a DS+DB is in the range of from 1.05 to 2.00.

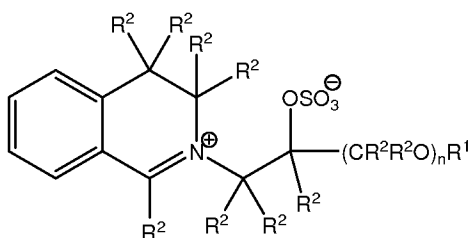
11. A composition according to any preceding claim, wherein the composition comprises oxaziridinium-based bleach catalyst having the formula:



wherein R^1 is selected from the group consisting of: 2-propylheptyl, 2-butyloctyl, 2-pentylononyl, 2-hexyldecyl, n-hexyl, n-octyl, n-decyl, n-dodecyl, n-tetradecyl, n-hexadecyl, n-octadecyl, isononyl, iso-decyl, iso-tridecyl and iso-pentadecyl, and wherein R^2 is independently selected from H and methyl groups; and n is an integer from 0 to 1.

12. A composition according to any preceding claim, wherein the composition comprises a polyethylene glycol polymer comprising a polyethylene glycol backbone and polyvinyl acetate side chains, wherein the average molecular weight of the polyethylene glycol backbone is in the range of from 4,000 Da to 8,000 Da, wherein the molecular weight ratio of the polyethylene glycol backbone to the polyvinyl acetate side chains is in the range of from 1:1.2 to 1:2, and wherein the average number of graft sites per ethylene oxide units is preferably in the range of from 0.2 to 0.4.

13. A composition according to any preceding claim, wherein the composition comprises a variant of *Thermomyces lanuginosa* lipase having greater than 90% identity with the wild type amino acid and comprising substitution(s) at T231 and/or N233.
14. A composition according to any preceding claim, wherein the composition comprises:
- (a) hueing agent; and/or
 - (b) perfume microcapsule, wherein the perfume is encapsulated by a shell comprising melamine formaldehyde.
15. A composition according to any preceding claim, wherein the composition comprises:
- (a) anionic deterative surfactant;
 - (b) from 0wt% to less than 5wt% zeolite builder;
 - (c) from 0wt% to less than 5wt% phosphate builder; and
 - (d) optionally, from 0wt% to 10wt% silicate salt;
 - (e) from 5 to 25wt% sodium carbonate;
 - (f) from 1wt% to 10wt% carboxylate polymer;
 - (g) variant of *Thermomyces lanuginosa* lipase having greater than 90% identity with the wild type amino acid and comprising substitution(s) at T231 and/or N233;
 - (h) oxaziridinium-based bleach catalyst having the formula:



wherein R^1 is selected from the group consisting of: 2-propylheptyl, 2-butyloctyl, 2-pentylonyl, 2-hexyldecyl, n-hexyl, n-octyl, n-decyl, n-dodecyl, n-tetradecyl, n-hexadecyl, n-octadecyl, iso-nonyl, iso-decyl, iso-tridecyl and iso-pentadecyl, and wherein R^2 is independently selected from H and methyl groups; and n is an integer from 0 to 1;

(i) optionally, substituted cellulosic polymer comprising carboxymethyl substituent groups, and having a degree of substitution (DS) of at least 0.55, and having a degree of blockiness (DB) of at least 0.35, and having a DS+DB is in the range of from 1.05 to 2.00; and

(j) optionally, polyethylene glycol polymer comprising a polyethylene glycol backbone and polyvinyl acetate side chains, wherein the average molecular weight of the polyethylene glycol backbone is in the range of from 4,000 Da to 8,000 Da, wherein the molecular weight ratio of the polyethylene glycol backbone to the polyvinyl acetate side chains is in the range of from 1:1.2 to 1:2, and wherein the average number of graft sites per ethylene oxide units is preferably in the range of from 0.2 to 0.4.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2011/026562

A. CLASSIFICATION OF SUBJECT MATTER

INV. C11D3/386 C11D3/39
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C11D

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/209447 A1 (MEEK MICHELLE [GB] ET AL) 20 August 2009 (2009-08-20) paragraphs [0006], [0147] - [0164] -----	1-15
Y	US 5 458 801 A (OYASHIKI TOMONORI [JP] ET AL) 17 October 1995 (1995-10-17) claims examples 11,13,15,17,19 -----	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

2 August 2011

Date of mailing of the international search report

08/08/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Culmann, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2011/026562

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009209447	A1	20-08-2009	CA 2715580 A1 20-08-2009
			CN 101945988 A 12-01-2011
			EP 2252682 A1 24-11-2010
			JP 2011511879 A 14-04-2011
			WO 2009102854 A1 20-08-2009
US 5458801	A	17-10-1995	DE 4232494 A1 01-04-1993