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(54) Title: A COMPOSITION COMPRISING A LIPASE AND A BLEACH CATALYST

(57) Abstract: The present invention relates to a composition comprising: (i) a lipase; and (ii) a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate.

A COMPOSITION COMPRISING A LIPASE AND A BLEACH CATALYST

FIELD OF THE INVENTION

5 The present invention relates to a composition comprising a lipase and a bleach catalyst. More specifically, the present invention relates to composition comprising a lipase and a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate. The compositions of the present invention are typically suitable for use as laundry detergent compositions and exhibit a good cleaning performance and a
10 reduced malodor profile, especially on problematic residual dairy soils.

BACKGROUND OF THE INVENTION

Dingy soils such as body soils and other hydrophobic soils, including dairy soils, are extremely difficult to remove from fabric during a laundering process. The appearance of lipase
15 enzymes suitable for detergent applications in the 1980's (e.g. Lipolase and Lipolase Ultra, ex Novo Nordisk – now Novozymes) gave the formulator a new approach to improve grease removal. Lipase enzymes catalyse the hydrolysis of triglycerides which form a major component of many commonly encountered fatty soils such as sebum, animal fats (e.g. lard, ghee, butter) and vegetable oils (e.g. olive oil, sunflower oil, peanut oil). However, these enzymes show
20 limited performance in the first wash cycle (being effective mainly during the drying stage of the laundering process) and give rise to a post-wash malodor. Without wishing to be bound by theory, the malodor arises from fatty acids released by the hydrolysis of fats and is particularly noticeable for dairy soils like milk, cream, butter and yogurt; dairy fats contain triglycerides functionalized with short chain (e.g. C₄) fatty acyl units which release malodorous volatile fatty
25 acids after lipolysis. For a general review of the use of lipases in solid laundry detergents see the following reference: Enzymes in Detergency, ed. J.H. van Ee et al, Vol 69 Marcel Dekker Surfactant Series, Marcel Dekker, New York, 1997, pp 93-132 (ISBN 0-8247-9995-X).

More recently so-called 'first wash' lipases have been commercialised such as LipoprimeTM and LipexTM (ex. Novozymes) which show performance benefits in the initial wash
30 cycle. The LipexTM enzyme is described in more detail in WO 00/60063 and US 6,939,702 B1 (Novozymes). Laundry detergent formulations comprising the LipexTM enzyme are described in more detail in IP.com publication IP 6443D (Novozymes). However in order to better exploit

lipase technology, both the odour profile on residual dairy stains and the cleaning performance on complex soils still needs to be improved.

Detergent manufacturers have also attempted to incorporate bleach catalysts, especially oxaziridium or oxaziridinium-forming bleach catalysts, in their detergent products in an attempt to provide a good bleaching performance. EP 0 728 181, EP 0 728 182, EP 0 728 183, EP 0 775 192, US 4,678,792, US 5,045,223, US 5,047,163, US 5,360,568, US 5,360,569, US 5,370,826, US 5,442,066, US 5,478,357, US 5,482,515, US 5,550,256, US 5,653,910, US 5,710,116, US 5,760, 222, US 5,785,886, US 5,952,282, US 6,042,744, WO95/13351, WO95/13353, WO97/10323, WO98/16614, WO00/42151, WO00/42156, WO01/16110, WO01/16263, WO01/16273, WO01/16274, WO01/16275, WO01/16276, WO01/16277 relate to detergent compositions comprising an oxaziridium and/or an oxaziridinium-forming bleach catalyst.

There is a continuing need for laundry detergent compositions that exhibit a good overall cleaning profile, a good cold water temperature bleaching performance, good greasy soil cleaning performance and a reduced malodor profile on residual fatty soils, especially dairy soils.

The inventors have found that by using lipase in combination with a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate improves the cleaning performance of the detergent composition whilst maintaining a reduced malodor profile on residual fatty soils, especially dairy soils.

In another embodiment of the present invention, the inventors have found that the rubber sump hose compatibility profile is improved when a diacyl and/or a tetraacyl peroxide species is in combination with a lipase.

In an especially preferred embodiment of the present invention, the Inventors have found that using a lipase in combination with (i) a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate and (ii) a diacyl and/or tetraacyl peroxide species, significantly improves the cleaning performance of the composition, reduces the malodor profile of the composition and improves the rubber sump hose compatibility profile of the composition.

SUMMARY OF THE INVENTION

In a first embodiment, the present invention provides a composition comprising: (i) a lipase; and (ii) a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate.

In a second embodiment, the present invention provides a composition comprising: (i) a lipase; and (ii) a diacyl and/or tetraacyl peroxide species.

DETAILED DESCRIPTION OF THE INVENTION

Composition

10 The composition comprises: (i) a lipase; and (ii) a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate. The lipase and the bleach catalyst are described in more detail below.

The composition may be suitable for use as a laundry detergent composition, laundry additive composition, dish-washing composition, or hard surface cleaning composition. The composition is typically a detergent composition. The composition may be a fabric treatment composition. Preferably the composition is a laundry detergent composition.

The composition can be any form such as liquid or solid, although preferably the composition is in solid form. Typically, the composition is in particulate form such as an agglomerate, a spray-dried powder, an extrudate, a flake, a needle, a noodle, a bead, or any combination thereof. The composition may be in compacted particulate form, such as in the form of a tablet or bar. The composition may be in some other unit dose form, such as in the form of a pouch, wherein the composition is typically at least partially, preferably essentially completely, enclosed by a water-soluble film such as polyvinyl alcohol. Preferably, the composition is in free-flowing particulate form; by free-flowing particulate form, it is typically meant that the composition is in the form of separate discrete particles. The composition may be made by any suitable method including agglomeration, spray-drying, extrusion, mixing, dry-mixing, liquid spray-on, roller compaction, spheronisation, tableting or any combination thereof.

The composition typically has a bulk density of from 450g/l to 1,000g/l, preferred low bulk density detergent compositions have a bulk density of from 550g/l to 650g/l and preferred high bulk density detergent compositions have a bulk density of from 750g/l to 900g/l. The composition may also have a bulk density of from 650g/l to 750g/l. During the laundering process, the composition is typically contacted with water to give a wash liquor having a pH of

from above 7 to less than 13, preferably from above 7 to less than 10.5. This is the optimal pH to provide good cleaning whilst also ensuring a good fabric care profile.

Preferably, the composition comprises: (i) from 0% to less than 10%, preferably to 7%, or to 4%, or from 1%, or from 1.5%, by weight of the composition, of tetraacetylenediamine and/or oxybenzene sulphonate bleach activators. Most preferably, the composition is essentially free of tetraacetylenediamine and/or oxybenzene sulphonate bleach activators. By "is essential free of" it is typically meant "comprises no deliberately incorporated". Keeping the levels of these types of bleach activators to a minimum maintains the good dye safety profile of the composition.

10 Preferably, upon contact with water the composition forms a wash liquor having a pH of from 7 to 10.5. Compositions having this reserve alkalinity profile and pH profile exhibit a good stability profile for lipase.

Preferably, the composition comprises from 0% or from 1%, or from 2%, or from 3%, or from 4%, or from 5%, and to 30%, or to 20%, or to 10%, by weight of the composition, of a source of carbonate anion. The above described levels of a source of carbonate anion ensure that the composition has a good overall cleaning performance and a good bleaching performance.

Preferably, the composition comprises a dye transfer inhibitor. Suitable dye transfer inhibitors are selected from the group consisting of: polyvinylpyrrolidone, preferably having a weight average molecular weight of from 40,000Da to 80,000 Da, preferably from 50,000Da to 70,000Da; polyvinylimidazole, preferably having a weight average molecular weight of from 10,000Da to 40,000 Da, preferably from 15,000Da to 25,000Da; polyvinyl pyridine N-oxide polymer, preferably having a weight average molecular weight of from 30,000Da to 70,000Da, preferably from 40,000Da to 60,000Da; a co-polymer of polyvinylpyrrolidone and vinyl imidazole, preferably having a weight average molecular weight of from 30,000Da to 70,000Da, preferably from 40,000Da to 60,000Da; and any combination thereof. Compositions comprising a dye transfer inhibitor show a further improved dye safety profile.

The composition may comprise from 0% to less than 5%, preferably to 4%, or to 3%, or to 2%, or even to 1%, by weight of the composition, of zeolite-builder. Whilst the composition may comprise zeolite-builder at a level of 5wt% or greater, preferably the composition comprises less than 5wt% zeolite-builder. It may be preferred for the composition to be essentially free of zeolite-builder. By: "essentially free of zeolite -builder", it is typically meant that the composition comprises no deliberately incorporated zeolite-builder. This is especially preferred

when the composition is a solid laundry detergent composition and it is desirable for the composition to be very highly soluble, to minimize the amount of water-insoluble residues (for example, which may deposit on fabric surfaces), and also when it is highly desirable to have transparent wash liquor. Suitable zeolite-builders include zeolite A, zeolite X, zeolite P and
5 zeolite MAP.

The composition may comprise from 0% to less than 10%, or less than 5%, preferably to 4%, or to 3%, or to 2%, or even to 1%, by weight of the composition, of phosphate-builder. Whilst the composition may comprise phosphate-builder at a level of 10wt% or greater, preferably the composition comprises less than 10wt% phosphate-builder. It may even be
10 preferred for the composition to be essentially free of phosphate-builder. By: "essentially free of phosphate-builder", it is typically meant that the composition comprises no deliberately added phosphate-builder. This is especially preferred if it is desirable for the composition to have a very good environmental profile. Suitable phosphate-builders include sodium tripolyphosphate.

The composition may comprise from 0% to less than 5%, or preferably to 4%, or to 3%, or
15 even to 2%, or to 1%, by weight of the composition, of silicate salt. Whilst the composition may comprise silicate salt at a level of 5wt% or greater, preferably the composition comprises less than 5wt% silicate salt. It may even be preferred for the composition to be essentially free of silicate salt. By: "essentially free from silicate salt", it is typically meant that the composition comprises no deliberately added silicate salt. This is especially preferred when the composition is
20 a solid laundry detergent composition and it is desirable to ensure that the composition has very good dispensing and dissolution profiles and to ensure that the composition provides a clear wash liquor upon dissolution in water. The silicate salts include water-insoluble silicate salts. The silicate salts also include amorphous silicate salts and crystalline layered silicate salts (e.g. SKS-6). The silicate salts include sodium silicate.

25 The composition typically comprises adjunct ingredients. These adjunct ingredients include: deterative surfactants such as anionic deterative surfactants, non-ionic deterative surfactants, cationic deterative surfactants, zwitterionic deterative surfactants, amphoteric deterative surfactants; preferred anionic deterative surfactants are alkoxyated anionic deterative surfactants such as linear or branched, substituted or unsubstituted C₁₂₋₁₈ alkyl alkoxyated sulphates having
30 an average degree of alkoxylation of from 1 to 30, preferably from 1 to 10, more preferably a linear or branched, substituted or unsubstituted C₁₂₋₁₈ alkyl ethoxyated sulphates having an average degree of ethoxylation of from 1 to 10, most preferably a linear unsubstituted C₁₂₋₁₈ alkyl

ethoxylated sulphates having an average degree of ethoxylation of from 3 to 7, other preferred anionic deterative surfactants are alkyl sulphates, alkyl sulphonates, alkyl phosphates, alkyl phosphonates, alkyl carboxylates or any mixture thereof, preferred alkyl sulphates include linear or branched, substituted or unsubstituted C₁₀₋₁₈ alkyl sulphates, another preferred anionic
5 deterative surfactant is a C₁₀₋₁₃ linear alkyl benzene sulphonate; preferred non-ionic deterative surfactants are C₈₋₁₈ alkyl alkoxyated alcohols having an average degree of alkoxylation of from 1 to 20, preferably from 3 to 10, most preferred are C₁₂₋₁₈ alkyl ethoxylated alcohols having an average degree of alkoxylation of from 3 to 10; preferred cationic deterative surfactants are mono-
10 C₆₋₁₈ alkyl mono-hydroxyethyl di-methyl quaternary ammonium chlorides, more preferred 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; source of peroxygen such as percarbonate salts and/or perborate salts, preferred is sodium percarbonate, the source of peroxygen is preferably at least partially coated, preferably completely coated, by a coating
15 ingredient such as a carbonate salt, a sulphate salt, a silicate salt, borosilicate, or mixtures, including mixed salts thereof; bleach activators such as tetraacetyl ethylene diamine, oxybenzene sulphonate bleach activators such as nonanoyl oxybenzene sulphonate, caprolactam bleach activators, imide bleach activators such as N-nonanoyl-N-methyl acetamide; enzymes such as amylases, arabinases, xylanases, galactanases, glucanases, carbohydrases, cellulases, laccases,
20 oxidases, peroxidases, proteases, glucanases, pectate lyases and mannanases, especially preferred are proteases; suds suppressing systems such as silicone based suds suppressors; fluorescent whitening agents; photobleach; filler salts such as sulphate salts, preferably sodium sulphate; fabric-softening agents such as clay, silicone and/or quaternary ammonium compounds, especially preferred is montmorillonite clay optionally in combination with a silicone; flocculants
25 such as polyethylene oxide; dye transfer inhibitors such as polyvinylpyrrolidone, poly 4-vinylpyridine N-oxide and/or co-polymer of vinylpyrrolidone and vinylimidazole; fabric integrity components such as hydrophobically modified cellulose and oligomers produced by the condensation of imidazole and epichlorhydrin; soil dispersants and soil anti-redeposition aids such as alkoxyated polyamines and ethoxylated ethyleneimine polymers; anti-redeposition
30 components such as carboxymethyl cellulose and polyesters; perfumes; sulphamic acid or salts thereof; citric acid or salts thereof; carbonate salts, especially preferred is sodium carbonate; and dyes such as orange dye, blue dye, green dye, purple dye, pink dye, or any mixture thereof.

A second embodiment of the present invention relates to a composition comprising: (i) a lipase, for example, a first cycle lipase; and (ii) a diacyl peroxide.

Lipase

5 The composition comprises a lipase. The incorporation of lipase into the composition improves the cleaning performance. In addition, the combination of the lipase with the bleach catalyst significantly reduces the malodor profile of the composition.

Typically, the lipase is an Enzyme Classification (EC) number 3.1.1, more especially 3.1.1.3 as defined by EC classification, IUPAC-IUBMB.

10 Preferably the composition comprises lipase in an amount of at least 0.5mg, preferably at least 0.7mg, or at least 1.0mg, or at least 1.5mg, or at least 2.0mg, or even at least 3.0mg, or at least 5.0mg or even at least 10mg of active lipase per 100g of composition. The lipase may comprise a calcium binding site. The lipase may also show improved stability and/or activity, especially activity, in the presence of high levels of free calcium cations that may be present in
15 the wash liquor. This is especially preferred when the composition comprises low levels of zeolite-builder and phosphate-builder.

Typical EC 3.1:1.3 lipases include those described in WO 00/60063, WO 99/42566, WO 97/04078, WO 97/04079, US 5,869,438 and US 6,939,702 B1. Preferred lipases are produced by *Absidia reflexa*, *Absidia corymbifera*, *Rhizomucor miehei*, *Rhizopus delemar*, *Aspergillus niger*,
20 *Aspergillus tubigenensis*, *Fusarium oxysporum*, *Fusarium heterosporum*, *Aspergillus oryzae*, *Penicillium camembertii*, *Aspergillus foetidus*, *Aspergillus niger*, *Thermomyces lanuginosus* (synonym: *Humicola lanuginosa*) and *Landerina penisapora*, particularly *Thermomyces lanuginosus*. Preferred lipases are supplied by Novozymes under the tradenames. Lipolase[®], Lipolase Ultra[®], Lipoprime[®] and Lipex[®] (registered tradenames of Novozymes) and LIPASE P
25 "AMANO[®]" available from Areario Pharmaceutical Co. Ltd., Nagoya, Japan, AMANO-CES[®], commercially available from Toyo Jozo Co., Tagata, Japan; and further *Chromobacter viscosum* lipases from U.S. Biochemical Corp., U.S.A. and Diosynth Co., Netherlands, and other lipases such as *Pseudomonas gladioli*. Other suitable lipases are described in WO 02062973, WO 2004/101759, WO 2004/101760 and WO 2004/101763.

30 Preferably, the lipase 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/or (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 of 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. The peptide sequence of the wild-type lipase is given below (sequence I.D. No. 2).

10 In one embodiment, suitable lipases include the "first cycle lipases" described in WO 00/60063 and U.S. Patent 6,939,702 B1, preferably a variant of SEQ ID No. 2, more preferably a variant of SEQ ID No. 2 having at least 90% homology to SEQ ID No. 2 comprising a substitution of an electrically neutral or negatively charged amino acid with R or K at any of positions 3, 224, 229, 231 and 233, with a most preferred variant comprising T231R and N233R mutations, such most preferred variant being sold under the tradename Lipex®.

15 Other suitable lipases are cutinases and esterases.

Typically, the composition comprises lipase in an amount of from 10 LU/g to 20,000 LU/g, or from 100 LU/g to 10,000 LU/g, or even from 500 LU/g, or from 750 LU/g, and to 3,000 LU/g, or to 1,500 LU/g, or to 1,250 LU/g.

20

Bleach catalyst

The bleach catalyst is 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 mixtures thereof.

Suitable iminium cations and polyions include, but are not limited to, N-methyl-3,4-dihydroisoquinolinium tetrafluoroborate, prepared as described in Tetrahedron (1992), 49(2), 423-38 (see, for example, compound 4, p. 433); N-methyl-3,4-dihydroisoquinolinium p-toluene sulphonate, prepared as described in U.S. Pat. 5,360,569 (see, for example, Column 11, Example 1); and N-octyl-3,4-dihydroisoquinolinium p-toluene sulphonate, prepared as described in U.S. Pat. 5,360,568 (see, for example, Column 10, Example 3).

30

Suitable iminium zwitterions include, but are not limited to, N-(3-sulfopropyl)-3,4-dihydroisoquinolinium, inner salt, prepared as described in U.S. Pat. 5,576,282 (see, for example, Column 31, Example II); N-[2-(sulphooxy)dodecyl]-3,4-dihydroisoquinolinium, inner salt, prepared as described in U.S. Pat. 5,817,614 (see, for example, Column 32, Example V); 2-[3-
5 [(2-ethylhexyl)oxy]-2-(sulphooxy)propyl]-3,4-dihydroisoquinolinium, inner salt, prepared as described in WO05/047264 (see, for example, page 18, Example 8), and 2-[3-[(2-butyloctyl)oxy]-2-(sulphooxy)propyl]-3,4-dihydroisoquinolinium, inner salt.

Suitable modified amine oxygen transfer catalysts include, but are not limited to, 1,2,3,4-tetrahydro-2-methyl-1-isoquinolinol, which can be made according to the procedures described
10 in Tetrahedron Letters (1987), 28(48), 6061-6064. Suitable modified amine oxide oxygen transfer catalysts include, but are not limited to, sodium 1-hydroxy-N-oxy-N-[2-(sulphooxy)decyl]-1,2,3,4-tetrahydroisoquinoline.

Suitable N-sulphonyl imine oxygen transfer catalysts include, but are not limited to, 3-methyl-1,2-benzisothiazole 1,1-dioxide, prepared according to the procedure described in the
15 Journal of Organic Chemistry (1990), 55(4), 1254-61.

Suitable N-phosphonyl imine oxygen transfer catalysts include, but are not limited to, [R-(E)]-N-[(2-chloro-5-nitrophenyl)methylene]-P-phenyl-P-(2,4,6-trimethylphenyl)- phosphinic amide, which can be made according to the procedures described in the Journal of the Chemical Society, Chemical Communications (1994), (22), 2569-70.

Suitable N-acyl imine oxygen transfer catalysts include, but are not limited to, [N(E)]-N-(phenylmethylene)acetamide, which can be made according to the procedures described in Polish
20 Journal of Chemistry (2003), 77(5), 577-590.

Suitable thiadiazole dioxide oxygen transfer catalysts include but are not limited to, 3-methyl-4-phenyl-1,2,5-thiadiazole 1,1-dioxide, which can be made according to the procedures
25 described in U.S. Pat. 5,753,599 (Column 9, Example 2).

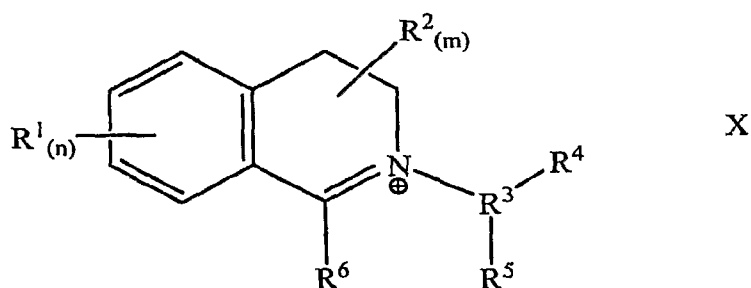
Suitable perfluoroimine oxygen transfer catalysts include, but are not limited to, (Z)-2,2,3,3,4,4,4-heptafluoro-N-(nonafluorobutyl)butanimidoyl fluoride, which can be made according to the procedures described in Tetrahedron Letters (1994), 35(34), 6329-30.

Suitable cyclic sugar ketone oxygen transfer catalysts include, but are not limited to,
30 1,2:4,5-di-O-isopropylidene-D-erythro-2,3-hexodiuro-2,6-pyranose as prepared in U.S. Pat. 6,649,085 (Column 12, Example 1).

Preferably, the bleach catalyst comprises an iminium and/or carbonyl functional group and is typically capable of forming an oxaziridinium and/or dioxirane functional group upon acceptance of an oxygen atom, especially upon acceptance of an oxygen atom from a peroxyacid and/or salt thereof. Preferably, the bleach catalyst comprises an oxaziridinium functional group and/or is capable of forming an oxaziridinium functional group upon acceptance of an oxygen atom, especially upon acceptance of an oxygen atom from a peroxyacid and/or salt thereof.

5 Preferably, the bleach catalyst comprises a cyclic iminium functional group, preferably wherein the cyclic moiety has a ring size of from five to eight atoms (including the nitrogen atom), preferably six atoms. Preferably, the bleach catalyst comprises an aryliminium functional group, preferably a bi-cyclic aryliminium functional group, preferably a 3,4-dihydroisoquinolinium functional group. Typically, the imine functional group is a quaternary imine functional group and is typically capable of forming a quaternary oxaziridinium functional group upon acceptance of an oxygen atom, especially upon acceptance of an oxygen atom from a peroxyacid and/or salt thereof.

15 Preferably, the bleach catalyst has a chemical structure corresponding to the following chemical formula

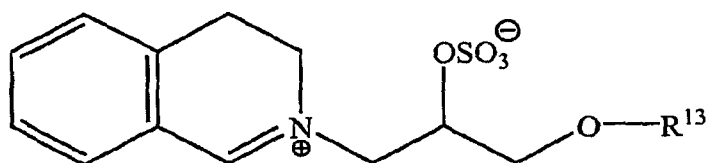


20 wherein: n and m are independently from 0 to 4, preferably n and m are both 0; each R¹ is independently selected from a substituted or unsubstituted radical selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl, fused aryl, heterocyclic ring, fused heterocyclic ring, nitro, halo, cyano, sulphonato, alkoxy, keto, carboxylic, and carboalkoxy radicals; and any two vicinal R¹ substituents may combine to form a fused aryl, fused carbocyclic or fused

25 heterocyclic ring; each R² is independently selected from a substituted or unsubstituted radical independently selected from the group consisting of hydrogen, hydroxy, alkyl, cycloalkyl, alkaryl, aryl, aralkyl, alkylenes, heterocyclic ring, alkoxy, arylcarbonyl groups, carboxyalkyl

groups and amide groups; any R^2 may be joined together with any other of R^2 to form part of a common ring; any geminal R^2 may combine to form a carbonyl; and any two R^2 may combine to form a substituted or unsubstituted fused unsaturated moiety; R^3 is a C_1 to C_{20} substituted or unsubstituted alkyl; R^4 is hydrogen or the moiety Q_t-A , wherein: Q is a branched or unbranched alkylene, $t = 0$ or 1 and A is an anionic group selected from the group consisting of OSO_3^- , SO_3^- , CO_2^- , OCO_2^- , OPO_3^{2-} , OPO_3H^- and OPO_2^- ; R^5 is hydrogen or the moiety $-CR^{11}R^{12}-Y-G_b-Y_c-[(CR^9R^{10})_y-O]_k-R^8$, wherein: each Y is independently selected from the group consisting of O, S, N-H, or N- R^8 ; and each R^8 is independently selected from the group consisting of alkyl, aryl and heteroaryl, said moieties being substituted or unsubstituted, and whether substituted or unsubstituted said moieties having less than 21 carbons; each G is independently selected from the group consisting of CO, SO_2 , SO, PO and PO_2 ; R^9 and R^{10} are independently selected from the group consisting of H and C_1-C_4 alkyl; R^{11} and R^{12} are independently selected from the group consisting of H and alkyl, or when taken together may join to form a carbonyl; $b = 0$ or 1 ; c can = 0 or 1 , but c must = 0 if $b = 0$; y is an integer from 1 to 6; k is an integer from 0 to 20; R^6 is H, or an alkyl, aryl or heteroaryl moiety; said moieties being substituted or unsubstituted; and X, if present, is a suitable charge balancing counterion, preferably X is present when R^4 is hydrogen, suitable X, include but are not limited to: chloride, bromide, sulphate, methosulphate, sulphonate, p-toluenesulphonate, borontetrafluoride and phosphate.

In one embodiment of the present invention, the bleach catalyst has a structure corresponding to general formula below:

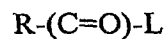


wherein R^{13} is a branched alkyl group containing from three to 24 carbon atoms (including the branching carbon atoms) or a linear alkyl group containing from one to 24 carbon atoms; preferably R^{13} is a branched alkyl group containing from eight to 18 carbon atoms or linear alkyl group containing from eight to eighteen carbon atoms; preferably R^{13} is selected from the group consisting of 2-propylheptyl, 2-butyloctyl, 2-pentylononyl, 2-hexyldecyl, n-dodecyl, n-tetradecyl, n-hexadecyl, n-octadecyl, iso-nonyl, iso-decyl, iso-tridecyl and iso-pentadecyl; preferably R^{13} is

selected from the group consisting of 2-butyloctyl, 2-pentylnonyl, 2-hexyldecyl, iso-tridecyl and iso-pentadecyl.

Oxybenzene sulphonate and/or oxybenzoic bleach activators

5 The composition preferably comprises (i) oxybenzene sulphonate bleach activators and/or oxybenzoic bleach activators and (ii) a source of peroxygen. Typically, the oxybenzoic acid bleach activator is in its salt form. Preferred oxybenzene sulphonate bleach activators include bleach activators having the general formula:



10 wherein R is an alkyl group, optionally branched, having, when the bleach activator is hydrophobic, from 6 to 14 carbon atoms, or from 8 to 12 carbon atoms and L is leaving group. Examples of suitable leaving groups are benzoic acid and derivatives thereof, especially salts thereof. Another especially preferred leaving group is oxybenzene sulphonate. Suitable bleach activators include dodecanoyl oxybenzene sulphonate, decanoyl oxybenzene sulphonate, a salt of
15 decanoyl oxybenzoic acid, 3,5,5-trimethyl hexanoyloxybenzene sulphonate, nonanoylamidocaproxybenzene sulphonate, and nonanoyloxybenzene sulphonate (NOBS). Suitable bleach activators are also disclosed in WO 98/17767. The incorporation of these bleach activators into the composition is especially preferred when the composition comprises low levels of zeolite builder and phosphate builder. The inventors have found that combining these
20 bleach activators with a source of peroxygen and a bleach catalyst as described in more detail above and a lipase, especially in an under-built detergent composition (such as a detergent composition comprising low levels of zeolite-builder and phosphate-builder), improves the overall cleaning performance, improves the rubber sump hose compatibility profile, and reduces the malodor profile of the composition.

25

Diacyl peroxide

In another embodiment the composition comprises: (i) a lipase; and (ii) a diacyl and/or tetraacyl peroxide species. The Inventors have found that these composition exhibit excellent rubber hose compatibility. Diacyl peroxides and also tetraacyl peroxides are known to attack
30 rubber, such as the rubber sump hoses of automatic washing machines, and over multiple washing cycles this can lead to failure of the rubber sump hose. The Inventors have found that

combining the diacyl peroxides and/or tetraacyl peroxides with lipase overcomes this problem of rubber sump hose incompatibility.

The diacyl peroxide bleaching species is preferably selected from diacyl peroxides of the general formula:

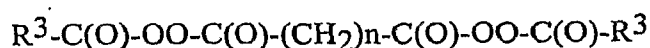
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in which R^1 represents a C_6-C_{18} alkyl, preferably C_6-C_{12} alkyl group containing a linear chain of at least 5 carbon atoms and optionally containing one or more substituents (e.g. $-N^+$ $(CH_3)_3$, $-COOH$ or $-CN$) and/or one or more interrupting moieties (e.g. $-CONH-$ or $-CH=CH-$)
 10 interpolated between adjacent carbon atoms of the alkyl radical, and R^2 represents an aliphatic group compatible with a peroxide moiety, such that R^1 and R^2 together contain a total of 8 to 30 carbon atoms. In one preferred aspect R^1 and R^2 are linear unsubstituted C_6-C_{12} alkyl chains. Most preferably R^1 and R^2 are identical. Diacyl peroxides, in which both R^1 and R^2
 15 are C_6-C_{12} alkyl groups, are particularly preferred. Preferably, at least one of, most preferably only one of, the R groups (R_1 or R_2), does not contain branching or pendant rings in the alpha position, or preferably neither in the alpha nor beta positions or most preferably in none of the alpha or beta or gamma positions. In one further preferred embodiment the DAP may be asymmetric, such that preferably the hydrolysis of R_1 acyl group is rapid to generate peracid,
 20 but the hydrolysis of R_2 acyl group is slow.

The tetraacyl peroxide bleaching species is preferably selected from tetraacyl peroxides of the general formula:

25



in which R^3 represents a C_1-C_9 alkyl, preferably $C_3 - C_7$, group and n represents an integer from 2 to 12, preferably 4 to 10 inclusive.

Preferably, the diacyl and/or tetraacyl peroxide bleaching species is present in an amount sufficient to provide at least 0.5 ppm, more preferably at least 10 ppm, and even more
 30 preferably at least 50 ppm by weight of the wash liquor. In a preferred embodiment, the

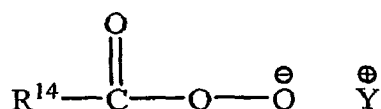
bleaching species is present in an amount sufficient to provide from about 0.5 to about 300 ppm, more preferably from about 30 to about 150 ppm by weight of the wash liquor.

Pre-formed peroxyacid

5 The pre-formed peroxyacid or salt thereof is typically either a peroxydicarboxylic acid or salt thereof, or a peroxysulphonic acid or salt thereof.

The pre-formed peroxyacid or salt thereof is preferably a peroxydicarboxylic acid or salt thereof, typically having a chemical structure corresponding to the following chemical formula:

10

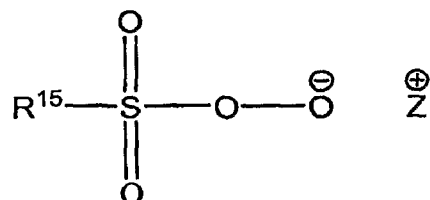


15

wherein: R¹⁴ is selected from alkyl, aralkyl, cycloalkyl, aryl or heterocyclic groups; the R¹⁴ group can be linear or branched, substituted or unsubstituted; 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, peroxynonanoic acid, peroxydecanoic acid, any salt thereof, or any combination thereof. Preferably, the peroxyacid or salt thereof has a melting point in the range of from 30°C to 60°C.

20

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



25

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 C₆₋₉ alkyl.

EXAMPLES

Example 1: Preparation of Sulphuric acid mono-[2-(3,4-dihydro-isoquinolin-2-yl)-1-(2-ethylhexyloxymethyl)-ethyl] ester, internal salt

5 Preparation of 2-ethylhexyl glycidyl ether: To a flame dried, 500 mL round bottomed flask equipped with an addition funnel charged with epichlorohydrin (15.62 g, 0.17 moles), is added 2-ethylhexanol (16.5 g, 0.127 moles) and stannic chloride (0.20 g, 0.001 moles). The reaction is kept under an argon atmosphere and warmed to 90°C using an oil bath. Epichlorohydrin is dripped into the stirring solution over 60 minutes followed by stirring at 90°C for 18 hours. The
10 reaction is fitted with a vacuum distillation head and 1-chloro-3-(2-ethyl-hexyloxy)-propan-2-ol is distilled under 0.2mm Hg. The 1-chloro-3-(2-ethyl-hexyloxy)-propan-2-ol (4.46 g, 0.020 moles) is dissolved in tetrahydrofuran (50 mL) and stirred at room temperature under an argon atmosphere. To the stirring solution is added potassium tert-butoxide (2.52 g, 0.022 moles) and the suspension is stirred at room temperature for 18 hours. The reaction is then evaporated to
15 dryness, residue dissolved in hexanes and washed with water (100 mL). The hexanes phase is separated, dried with Na₂SO₄, filtered and evaporated to dryness to yield the crude 2-ethylhexyl glycidyl ether, which can be further purified by vacuum distillation.

Preparation of Sulphuric acid mono-[2-(3,4-dihydro-isoquinolin-2-yl)-1-(2-ethylhexyloxymethyl)-ethyl] ester, internal salt: To a flame dried 250 mL three neck round
20 bottomed flask, equipped with a condenser, dry argon inlet, magnetic stir bar, thermometer, and heating bath is added 3,4-dihydroisoquinoline (0.40 mol.; prepared as described in Example I of U.S. 5,576,282), 2-ethylhexyl glycidyl ether (0.38 mol, prepared as described above), SO₃-DMF complex (0.38 mol), and acetonitrile (500 mL). The reaction is warmed to 80°C and stirred at temperature for 72 hours. The reaction is cooled to room temperature, evaporated to dryness and
25 the residue recrystallized from ethyl acetate and/or ethanol to yield the desired product. The solvent acetonitrile may be replaced with other solvents, including but not limited to, 1,2-dichloroethane.

Example 2: Preparation of Sulphuric acid mono-[2-(3,4-dihydro-isoquinolin-2-yl)-1-(2-butyl-octyloxymethyl)-ethyl] ester, internal salt

30 The desired product is prepared according to Example 1 but substituting 2-butyloctanol for 2-hexyloctanol.

Example 3: Laundry detergent compositions

The following laundry detergent compositions A, B, C and D are suitable for use in the present invention. Typically, these compositions are dosed into water at a concentration of from 5 80g/l to 120g/l during the laundering process.

Ingredient	A	B	C	D
Bleach catalyst made according to example 1 or 2	0.1wt%	0.05wt%	0.03wt%	0.05wt%
Lipase (9mg/g active)	0.15wt%	0.2wt%	0.3wt%	0.2wt%
Sodium linear C ₁₂₋₁₃ alkyl benzenesulphonate (LAS)	9.0wt%	8wt%	7.5wt%	7.0wt%
Tallow alkyl sulphate (TAS)	1.0wt%	1.0wt%		
C ₁₄₋₁₅ alkyl ethoxylated alcohol having an average degree of ethoxylation of 7 (AE7)	2.5wt%			
C ₁₄₋₁₅ alkyl ethoxylated alcohol sulphate having an average degree of ethoxylation of 3 (AE ₃ S)		4wt%	3.0wt%	2.5wt%
Mono-C ₁₂₋₁₄ alkyl mono-hydroxyethyl di-methyl quaternary ammonium chloride	1.5wt%	1.0wt%		
Zeolite 4A	15wt%	12.5wt%		
Citric Acid	3.0wt%	2.0wt%	3.0wt%	3.0wt%
Sodium Percarbonate	20wt%	15wt%	17.5wt%	14wt%
TAED (tetraacetylenediamine)	2.5wt%	3wt%	2.3wt%	1.6wt%
NOBS (nonanoyloxybenzene sulphonate)	0.0%	1.0wt%	0.0wt%	1.5wt%
Sodium carbonate	20wt%	25wt%	20wt%	25wt%
Polymeric carboxylate	2.0wt%	1.5wt%	3.0wt%	2.5wt%

A compound having the following general structure: bis((C ₂ H ₅ O)(C ₂ H ₄ O) _n)(CH ₃)-N ⁺ - C _x H _{2x} -N ⁺ -(CH ₃)- bis((C ₂ H ₅ O)(C ₂ H ₄ O) _n), wherein n = from 20 to 30, and x = from 3 to 8, or sulphated or sulphonated variants thereof	1.0wt%	0.5wt%	0.75wt%	1.0wt%
Carboxymethyl cellulose			1.5wt%	1.0wt%
Other enzymes	1.0wt%	0.5wt%	0.75wt%	0.5wt%
Ethylene diamine disuccinic acid	0.5wt%	0.1wt%	0.2wt%	0.25wt%
Magnesium sulphate	0.75wt%	0.5wt%	1.0wt%	0.5wt%
Hydroxyethane di(methylene phosphonic acid)	0.5wt%	0.25wt%	0.2wt%	0.4wt%
Fluorescent whitening agent	0.2wt%	0.1wt%	0.15wt%	0.25wt%
Silicone suds suppressing agent	0.1wt%	0.05wt%	0.1wt%	0.1wt%
Soap	0.5wt%	0.25wt%	0.0wt%	0.3wt%
Photobleach	0.01wt%	0.0001wt %	0.0005wt %	0.0015wt %
Perfume	1.0wt%	0.5wt%	0.75wt%	0.5wt%
Sodium sulphate	13wt%	15wt%	30wt%	30wt%
Water and miscellaneous	to 100wt%	to 100wt%	to 100wt%	to 100wt%

The following laundry detergent compositions E, F, G and H are suitable for use in the present invention. Typically, these compositions are dosed into water at a concentration of from 80g/l to 120g/l during the laundering process.

5

Ingredient	E	F	G	H
Bleach catalyst made according to example 1 or 2			0.01wt%	0.05wt%
Diacyl peroxide	2 wt%	1wt%	0.5wt%	1wt%

Lipase (9mg/g active enzyme)	0.5wt%	0.3wt%	0.2wt%	0.1wt%
Sodium linear C ₁₂₋₁₃ alkyl benzenesulphonate (LAS)	8.0wt%	5.0wt%	7.5wt%	7.0wt%
C ₁₄₋₁₅ alkyl ethoxylated alcohol sulphate having an average degree of ethoxylation of 3 (AE ₃ S)	5.0wt%	2.5wt%	3.5wt%	6.0wt%
Citric Acid	3.0wt%	2.0wt%	5.0wt%	2.5wt%
Sodium carbonate	20wt%	25wt%	22.5wt%	25wt%
Polymeric carboxylate	2.0wt%	3.5wt%	3.5wt%	2.5wt%
A compound having the following general structure: bis((C ₂ H ₅ O)(C ₂ H ₄ O) _n)(CH ₃)-N ⁺ -C _x H _{2x} -N ⁺ -(CH ₃)-bis((C ₂ H ₅ O)(C ₂ H ₄ O) _n), wherein n = from 20 to 30, and x = from 3 to 8, or sulphated or sulphonated variants thereof	1.0wt%	0.5wt%	0.75wt%	1.0wt%
Sodium Percarbonate	0wt%	15wt%	17.5wt%	14wt%
TAED (tetraacetylenediamine)	0wt%	3wt%	2.3wt%	1.6wt%
Carboxymethyl cellulose	0.5wt%	1.0wt%	1.5wt%	1.0wt%
Other Enzymes	1.0wt%	0.5wt%	0.2wt%	0.5wt%
Ethylene diamine disuccinic acid	0.05wt%	0.1wt%	0.2wt%	0.15wt%
Magnesium sulphate	0.35wt%	0.1wt%	1.0wt%	0.25wt%
Hydroxyethane di(methylene phosphonic acid)	0.1wt%	0.25wt%	0.2wt%	0.5wt%
Fluorescent whitening agent	0.2wt%	0.1wt%	0.15wt%	0.25wt%
Silicone suds suppressing agent	0.1wt%	0.05wt%	0.1wt%	0.2wt%
Soap	0.5wt%	0.25wt%	1.0wt%	0.5wt%
Photobleach	0.01wt%	0.0001wt %	0.0005wt %	0.0015wt %

Perfume	1.0wt%	0.5wt%	0.75wt%	0.5wt%
Sodium sulphate	45wt%	30wt%	20wt%	22wt%
Water and miscellaneous	to 100wt%	to 100wt%	to 100wt%	to 100wt%

The following laundry detergent compositions I, J, K and L are suitable for use in the present invention. Typically, these compositions are dosed into water at a concentration of from 20g/l to 60g/l during the laundering process.

5

Ingredient	I	J	K	L
Bleach catalyst made according to example 1 or 2	0.15wt%	0.10wt%	0.1wt%	0.15wt%
Diacyl peroxide			1wt%	0.5wt%
Lipase	0.5wt%	0.3wt%	0.1wt%	0.2wt%
Sodium linear C ₁₂₋₁₃ alkyl benzenesulphonate (LAS)	15wt%	17.5wt%	20wt%	10.0wt%
C ₁₄₋₁₅ alkyl ethoxylated alcohol sulphate having an average degree of ethoxylation of 3 (AE ₃ S)	7.0wt%	7.5wt%	5.0wt%	5.0wt%
Citric Acid	7.0wt%	5.0wt%	7.5wt%	3.0wt%
Sodium Percarbonate	20wt%	15wt%	0wt%	14wt%
TAED (tetraacetylenediamine)	2.5wt%	3wt%	0wt%	1.6wt%
NOBS (nonanoyloxybenzene sulphate)	0.0wt%	2.0wt%	0.0wt%	0wt%
Sodium carbonate	22.5wt%	25wt%	20wt%	10wt%
Polymeric carboxylate	7.0wt%	7.5wt%	5.0wt%	3.0wt%
A compound having the following general structure: bis((C ₂ H ₅ O)(C ₂ H ₄ O) _n)(CH ₃)-N ⁺ - C _x H _{2x} -N ⁺ -(CH ₃)- bis((C ₂ H ₅ O)(C ₂ H ₄ O) _n), wherein n	2.5wt%	1.5wt%	3.0wt%	1.0wt%

= from 20 to 30, and x = from 3 to 8, or sulphated or sulphonated variants thereof				
Carboxymethyl cellulose	2.5wt%	3.0wt%	1.5wt%	1.0wt%
Other Enzymes	2.5wt%	1.5wt%	3.0wt%	0.75wt%
Ethylene diamine disuccinic acid	0.25wt%	0.1wt%	0.5wt%	0.15wt%
Hydroxyethane di(methylene phosphonic acid)	0.5wt%	0.75wt%	0.25wt%	0.2wt%
Fluorescent whitening agent	0.5wt%	0.75wt%	0.25wt%	0.15wt%
Silicone suds suppressing agent	0.05wt%	0.10wt%	0.02wt%	0.02wt%
Photobleach	0.025wt%	0.050wt%	0.02wt%	0.0015wt %
Water, filler (including sodium sulphate) and miscellaneous	to 100wt%	to 100wt%	to 100wt%	to 100wt%

Bleaching detergent compositions having the form of granular laundry detergents are exemplified by the following formulations. Any of the below compositions is used to launder fabrics at a concentration of 600 - 10000 ppm in water, with typical median conditions of 5 2500ppm, 25°C, and a 25:1 water:cloth ratio. The typical pH is about 10 but can be can be adjusted by altering the proportion of acid to Na- salt form of alkylbenzenesulfonate.

	M	N	O	P	Q	R
Linear alkylbenzenesulfonate	20	22	20	15	20	20
C ₁₂ Dimethylhydroxyethyl ammonium chloride	0.7	1	0.0	0.6	0.0	0.7
AE3S	0.9	0.0	0.9	0.0	0.0	0.9
AE7	0.0	0.5	0.0	1	3	1
sodium tripolyphosphate	23	30	23	17	12	23
Zeolite A	0.0	0.0	0.0	0.0	10	0.0
1.6R Silicate	7	7	7	7	7	7

Sodium Carbonate	15	14	15	18	15	15
Polyacrylate MW 4500	1	0.0	1	1	1.5	1
Carboxy Methyl Cellulose	1	1	1	1	1	1
Savinase 32.89mg/g	0.1	0.07	0.1	0.1	0.1	0.1
Natalase 8.65mg/g	0.1	0.1	0.1	0.0	0.1	0.1
Lipase 18mg/g*	0.03	0.07	0.3	0.1	0.07	0.1
Tinopal AMS (ex. Ciba)	0.06	0.0	0.06	0.18	0.06	0.06
Tinopal CBS-X (ex. Ciba)	0.1	0.06	0.1	0.0	0.1	0.1
Diethylenetriamine pentacetic acid	0.6	0.3	0.6	0.25	0.6	0.6
MgSO ₄	1	1	1	0.5	1	1
Sodium Percarbonate	0.0	5.2	0.1	0.0	0.0	0.0
Photobleach	0.0030	0.0015	0.0015	0.0020	0.0045	0.0010
Sodium Perborate Monohydrate	4.4	0.0	3.85	2.09	0.78	3.63
NOBS	1.9	0.0	1.66	0.0	0.33	0.75
TAED	0.58	1.2	0.51	0.0	0.015	0.28
Organic Catalyst **	0.0185	0.0185	0.0162	0	0.0111	0.0074
Diacyl peroxide ***		0.5		1		
Sulfate/Moisture	Balance to 100%	Balance to 100%	Balance to 100%	Balance to 100%	Balance to 100%	Balance to 100%

* Lipase is preferably Lipex®.

** Organic catalyst prepared according to Examples 1 or 2 or mixtures thereof.

*** Diacyl peroxide is preferably dinonanoylperoxide.

5 Sequence I.D No. 2

Glu Val Ser Gln Asp Leu Phe Asn Gln Phe Asn Leu Phe Ala Gln Tyr
1 5 10 15

Ser Ala Ala Ala Tyr Cys Gly Lys Asn Asn Asp Ala Pro Ala Gly Thr
20 25 30

22

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
 50 55 60

Gly Phe Leu Ala Leu Asp Asn Thr Asn Lys Leu Ile Val Leu Ser Phe
 65 70 75 80

Arg Gly Ser Arg Ser Ile Glu Asn Trp Ile Gly Asn Leu Asn Phe Asp
 85 90 95

Leu Lys Glu Ile Asn Asp Ile Cys Ser Gly Cys Arg Gly His Asp Gly
 100 105 110

Phe Thr Ser Ser Trp Arg Ser Val Ala Asp Thr Leu Arg Gln Lys Val
 115 120 125

Glu Asp Ala Val Arg Glu His Pro Asp Tyr Arg Val Val Phe Thr Gly
 130 135 140

His Ser Leu Gly Gly Ala Leu Ala Thr Val Ala Gly Ala Asp Leu Arg
 145 150 155 160

Gly Asn Gly Tyr Asp Ile Asp Val Phe Ser Tyr Gly Ala Pro Arg Val
 165 170 175

Gly Asn Arg Ala Phe Ala Glu Phe Leu Thr Val Gln Thr Gly Gly Thr
 180 185 190

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 Thr Arg Asn 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

All documents cited in the Detailed Description of the Invention are, in relevant part, incorporated herein by reference; the citation of any document is not to be construed as an admission that it is prior art with respect to the present invention. 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.

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.

CLAIMS

What is claimed is:

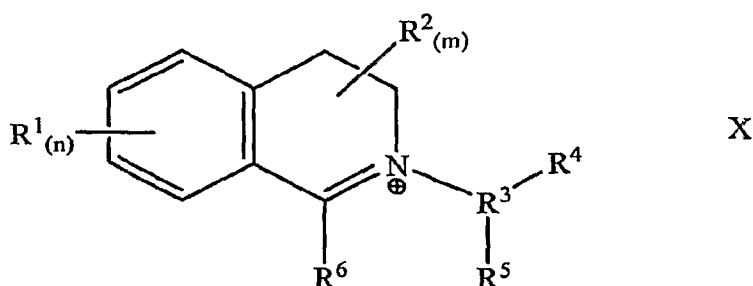
1. A composition comprising:

- (a) a lipase; and
- (b) a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate.

2. A composition according to Claim 1, wherein the bleach catalyst comprises an iminium and/or a carbonyl functional group.

3. A composition according to Claim 1, wherein the bleach catalyst comprises an oxaziridinium and/or a dioxirane functional group, and/or is capable of forming an oxaziridinium and/or a dioxirane functional group upon acceptance of an oxygen atom.

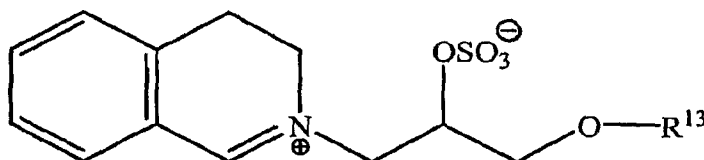
4. A composition according to Claim 1, wherein the bleach catalyst has a chemical structure corresponding to the chemical formula:



wherein: n and m are independently from 0 to 4; each R^1 is independently selected from a substituted or unsubstituted radical selected from the group consisting of hydrogen, alkyl, cycloalkyl, aryl, fused aryl, heterocyclic ring, fused heterocyclic ring, nitro, halo, cyano, sulphonato, alkoxy, keto, carboxylic, and carboalkoxy radicals, and any two vicinal R^1 substituents may combine to form a fused aryl, fused carbocyclic or fused heterocyclic ring; each R^2 is independently selected from a substituted or unsubstituted radical independently selected from the group consisting of hydrogen, hydroxy, alkyl, cycloalkyl, alkaryl, aryl, aralkyl,

alkylenes, heterocyclic ring, alkoxy, arylcarbonyl groups, carboxyalkyl groups and amide groups; any R^2 may be joined together with any other of R^2 to form part of a common ring; any geminal R^2 may combine to form a carbonyl; and wherein any two R^2 may combine to form a substituted or unsubstituted fused unsaturated moiety; R^3 is a C_1 to C_{20} substituted or unsubstituted alkyl; R^4 is hydrogen or the moiety Q_t-A , wherein: Q is a branched or unbranched alkylene, $t = 0$ or 1 , and A is an anionic group selected from the group consisting of OSO_3^- , SO_3^- , CO_2^- , OCO_2^- , OPO_3^{2-} , OPO_3H^- and OPO_2^- ; R^5 is hydrogen or the moiety $-CR^{11}R^{12}-Y-G_b-Y_c-[(CR^9R^{10})_y-O]_k-R^8$, wherein: each Y is independently selected from the group consisting of O , S , $N-H$, or $N-R^8$; and each R^8 is independently selected from the group consisting of alkyl, aryl and heteroaryl, said moieties being substituted or unsubstituted, and whether substituted or unsubstituted said moieties having less than 21 carbons; each G is independently selected from the group consisting of CO , SO_2 , SO , PO and PO_2 ; R^9 and R^{10} are independently selected from the group consisting of hydrogen and C_1-C_4 alkyl; R^{11} and R^{12} are independently selected from the group consisting of hydrogen and alkyl, or when taken together may join to form a carbonyl; $b = 0$ or 1 ; c can = 0 or 1 , but c must = 0 if $b = 0$; y is an integer of from 1 to 6 ; k is an integer of from 0 to 20 ; R^6 is H , or an alkyl, aryl or heteroaryl moiety; said moieties being substituted or unsubstituted; and X , if present, is a suitable charge balancing counterion.

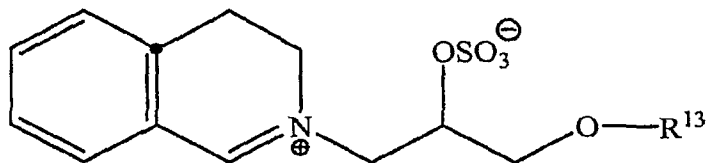
5. A composition according to Claim 1, wherein the bleach catalyst has a chemical structure corresponding to the chemical formula:



wherein R^{13} is a branched alkyl group containing from 3 to 24 carbons, or a linear alkyl group containing from 1 to 24 carbons.

6. A composition according to Claim 1, wherein the bleach catalyst has a chemical structure corresponding to the chemical formula:

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wherein R^{13} is selected from the group consisting of 2-butyloctyl, 2-pentylnonyl, 2-hexyldecyl, iso-tridecyl and iso-pentadecyl.

7. A composition according to Claim 1, wherein the lipase 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/or
- (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 of 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.

8. A composition according to Claim 7, wherein the lipase is a variant of the *Humicola lanuginosa* lipase with the mutations T231R and N233R.

9. A composition according to Claim 1, wherein the composition comprises less than 5%, by weight of the composition, of a source of peroxygen.

10. A composition according to Claim 1, wherein the composition comprises from 5% to 10%, by weight of the composition, of a source of carbonate anion.

11. A composition according to Claim 1, wherein the composition comprises a dye transfer inhibitor.
12. A composition according to Claim 1, wherein the composition comprises:
 - (a) less than 5%, by weight of the composition, of zeolite builder;
 - (b) optionally, less than 5%, by weight of the composition, of phosphate builder; and
 - (c) optionally, less than 5%, by weight of the composition, of silicate salt.
13. A composition according to Claim 1, wherein the composition comprises a diacyl and/or a tetraacyl peroxide species.
14. A composition according to Claim 1, wherein the composition comprises an oxybenzene sulphonate bleach activator and a source of peroxygen.
15. A composition according to Claim 1, wherein the composition comprises a pre-formed peroxyacid.
16. A composition comprising:
 - (a) a first cycle lipase; and
 - (b) a diacyl and/or tetraacyl peroxide species.
17. A composition according to Claim 16, wherein the composition comprises a bleach catalyst that is capable of accepting an oxygen atom from a peroxyacid and transferring the oxygen atom to an oxidizable substrate.
18. A composition according to Claim 16, wherein the lipase 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/or

- (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 of 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.
19. A composition according to Claim 18, wherein the lipase is a variant of the *Humicola lanuginosa* lipase with the mutations T231R and N233R.