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(54) **POLYHEDRON WATER-SOLUBLE PACKAGE WITH LAYERED LIQUID LAUNDRY DETERGENT**

WASSERLÖSLICHER FOLIENBEUTEL IN FORM EINES POLYEDERS MIT SCHICHTFÖRMIG EINGEPACKTEM FLÜSSIGEN WASCHMITTEL

SAC POLYEDRE HYDROSOLUBLE CONTENANT UN DETERGENT LESSIVIEL LIQUIDE EN COUCHES

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EP 1 453 944 B1

Description

FIELD OF THE INVENTION

[0001] A water-soluble single-use polyhedron package comprising liquid detergent with at least two layers in the water-soluble body portion and a process of its preparation.

BACKGROUND OF THE INVENTION

[0002] Detergent compositions are provided in many forms, of which granular and liquid compositions are the most prevalent. More recently, unit dose forms of detergent have been proposed in the form of compressed tablets of detergent powder or water-soluble packages, which are consumed during a single cleaning application. The unit dose forms are preferred by some consumers, in that the dose is premeasured and, consequently, the unit dose form is faster, easier and less messy to use. Water-soluble packages filled with liquid detergent composition are desired especially by consumers who are used to liquid detergents.

[0003] Water-soluble unit dose packages containing liquids are known. See, for instance, Kennedy (US Patent 4,973,416), Dickler et al. (US Patent 6,037,319), Haq (US Patent 4,416,791) and Richardson (US Patent 4,115,292). The packages may contain various amounts, including relatively high, amounts of water. See for instance WO 94/14941, EP 518 689, WO 97/27743, and JP 06/340,899.

[0004] Packages of various shapes are disclosed by Huff, U.S. Patent No. 6,040,286, Buchanan, U.S. Patent No. 5,273,362, Anderson, U.S. Patent No. 4,810,844, Mahler et al., U.S. Patent No. 4,223,029, Wierenga et al., U.S. Patent No. 5,002,681, Smith et al., U.S. Patent No. DES 392,559, Buchanan et al., U.S. Patent No. 5,135,464, and Buchanan et al., U.S. Patent No. 6,120,183. Giessen, U.S. Patent 2,444,987; Schneider et al. US. Patent 3,367,489; Shaw et al., U.S. Patent 3,618,758; Guerry et al., U.S. Patent 4,176,079; Davies et al., U.S. Patent 4,410,441; Ginn, U.S. Patent 4,588,080; Ginn, U.S. Patent 4,680,916; Leigh et al., U.S. Patent 4,706,802; Gouge et al., U.S. Patent 5,224,601; Saam, U.S. Patent 5,927,498.

[0005] It is sometimes desirable to separate various ingredients of the detergent composition. See for instance WO 01/60966 disclosing a multi-compartment water-soluble pouch. It is also desirable to increase the visual appeal of the package and, also, to provide a unique appearance to be associated by consumers with a particular product. In addition, it is desirable to provide a visual signal to a consumer of the presence of special (e.g., benefit) ingredient in the composition.

[0006] EP 116422, EP 175485, GB 1247189, WO 99/47635, and Ginn (US Patent 4,348,292) disclose dual layer liquid cleaning compositions in a bottle or a water insoluble package. The layers are achieved by employing an electrolyte, which when added to an aqueous surfactant solution, forces the separation of the surfactant from the aqueous phase. The phenomenon of separating an organic component from an aqueous layer, by the addition of a salt (electrolyte) is known as "salting out." The salt increases the ionic character of water and drives the organic, less polar, component away.

[0007] Another known technique for separating ingredients in a common container includes encapsulation. Encapsulation technology is well known for different applications. Generally, encapsulation includes a medium that surrounds at least one component and thereby provides a barrier between the "encapsulated" component and other components. The barrier is typically temporary and is designed to break down and release the encapsulated material at a desired time, such as at a particular temperature, upon reaction or dissolution with chemicals, or due to mechanical stress. Methods of encapsulation include coacervation, liposome formation, granulation, coating, emulsification, atomization and spray-cooling.

[0008] See, for instance, the disclosures of enzyme encapsulates and encapsulation processes: Falholt et al. (U.S. Patent 4,906,396, UK 2,186 884, and EP 0 273 775), Tsaur et al. (U.S. Patents 5,434,069 and 5,441,660), Ratuiste et al. (U.S. Patent 5,589,370). See also Mitchnik et al. (U.S. Patent 5,733,531) and Leong (U.S. Patent 5,296,166).

[0009] It is desirable to provide a layered liquid detergent composition in a water-soluble single use package, which provides additional protection to sensitive ingredients.

SUMMARY OF THE INVENTION

[0010] The present invention includes a layered liquid detergent composition in a water-soluble single use package, wherein the package is in the shape of a polyhedron, preferably a tetrahedron. The composition comprises at least two layers, hydrophilic and hydrophobic, with the hydrophobic layer preferably on top. The hydrophobic layer preferably comprises a sensitive benefit ingredient (e.g., enzyme), which is contained predominantly in the hydrophobic layer. By virtue of the shape of the package, the interface between the top layer and the next lower layer is minimized, which in turn leads to a reduced interaction between the two layers, resulting in the increased stability of the ingredient in the top layer.

[0011] The following detailed description and the examples illustrate some of the effects of the inventive compositions.

The invention and the claims, however, are not limited to the following description and examples.

DETAILED DESCRIPTION OF THE INVENTION

[0012] All amounts are by weight of the liquid detergent composition, unless otherwise specified.

[0013] It should be noted that in specifying any range of concentration, any particular upper concentration can be associated with any particular lower concentration.

[0014] For the avoidance of doubt the word "comprising" is intended to mean "including" but not necessarily "consisting of" or "composed of." In other words, the listed steps or options need not be exhaustive.

[0015] "Water-soluble body" as used herein means soluble in cold water, i.e. soluble at 5°C and above.

[0016] "Liquid" as used herein means that a continuous phase or predominant part of the composition is liquid and that a composition is flowable at 20°C. Solids (e.g., suspended or other) may be included.

[0017] "Seal" or "sealing" as used herein includes both heat sealing and water sealing.

[0018] "Transparent" as used herein includes both transparent and translucent and means that an ingredient, or a mixture, or a phase, or a composition, or a package according to the invention preferably has a transmittance of more than 25%, more preferably more than 30%, most preferably more than 40%, optimally more than 50% in the visible part of the spectrum (approx. 410-800 nm). Alternatively, absorbency may be measured as less than 0.6 (approximately equivalent to 25% transmitting) or by having transmittance greater than 25% wherein % transmittance equals: $1/10^{absorbancy}$ x 100%. For purposes of the invention, as long as one wavelength in the visible light range has greater than 25% transmittance, it is considered to be transparent/translucent.

[0019] The term "composition" or "liquid detergent composition" as used herein means the final detergent composition (i.e., the detergent composition itself, but not the water-soluble body), including at least two layers.

WATER-SOLUBLE BODY PORTION

[0020] The package is preferably made of a clear, sealable, cold water soluble film such as polyvinyl alcohol. Thickness could range from 25 to 100 μm, more preferably from 35 to 80 μm, most preferably from 45 to 75 μm. Other materials from which the package can be made include but are not limited to methyl hydroxy propyl cellulose and polyethylene oxide. Polyvinyl alcohol is preferred due to its ready availability and low cost. One supplier of polyvinyl alcohol film is Monosol LLC. European suppliers of suitable films include but are not limited to Monosol supplied by Monosol LLC. or PT supplied by Aicello or K-series supplied by Kurary or Hydrafilm supplied by Rainier Specialty Polymers Ltd, or QSA series by Polymer Films, Inc.

[0021] Preferably the water-soluble film of the base wall is the same material as that used to make the body wall. Both thermoforming and cold forming (e.g., with water) are possible.

[0022] The water-soluble package of the invention is in the shape of the polyhedron having four or more walls wherein each wall is inclined at an angle relative to each other wall.

[0023] Preferably the inclination of each wall is between 30 and 90 degrees, more preferably between 30 and 60 degrees.

[0024] In a preferred embodiment, the package is in the form of a tetrahedron (four-walled polyhedron). The tetrahedron may be regular or irregular i.e. the walls may take the shape of regular or irregular polygons. The tetrahedron shape is advantageous in that it can be a fairly simple structure to manufacture (as compared with other polyhedrons with more walls) and at the same time the inclination of each wall relative to each other walls is optimised.

The package may be formed by any suitable method, but preferably is being formed from a flexible film disposed in folded configuration and sealed with one or more longitudinal seals; and first and second end seals located at opposed ends of the package, wherein the first end seal is substantially orthogonal to the or each longitudinal seal and inclined at an angle to the second end seal.

[0025] With this arrangement, the package may be formed into a polyhedron by adapting existing vertical form fill and seal machinery, thereby reducing the costs of producing packages according to the invention.

[0026] Preferably, the relative inclination of first and second end seals is between 30 and 90 degrees. In a preferred embodiment, the first and second end seals are orientated orthogonal relative to each other. This provides a tetrahedron shaped package.

[0027] The transition between adjacent walls may be slightly curved (e.g. due to the force exerted by the contents of the package, and the flexibility of the package material) while at the same time, distinct walls can still be seen and are still distinguishable from one another.

[0028] The walls may be substantially flat, however, this is not essential, indeed the or each wall may have a slight curvature (e.g. due to the force exerted by the contents of the package, and the flexibility of the package material) so long as the overall shape is still apparent and the general plane of each wall is inclined to the general plane of each of the other walls.

[0029] The edges of the polyhedron may be formed with increased sharpness by, for example, arrangement of one or more seals during formation, so that one or more seals are orientated along respective one or more edge portions of the polyhedron to give more distinct edges.

LAUNDRY COMPOSITION

Layers

[0030] The laundry compositions within the scope of the invention are liquid compositions comprising at least two layers, wherein at least one layer is hydrophilic and at least one layer is hydrophobic. The hydrophobic layer is typically and preferably the top layer.

[0031] The hydrophilic layer employs water, typically in an amount of from 0 to 60%, preferably from 5 to 50%, most preferably from 10 to 40%, by weight of the hydrophilic layer.

[0032] The hydrophobic layer employs a hydrophobic liquid, typically in an amount of from 30 to 100%, preferably from 40 to 80%, most preferably from 50 to 70%, by weight of the hydrophobic layer. The hydrophobic fluid is generally selected from the group consisting of paraffin, wax, oil, petrolatum, a hydrophobic polymer and mixtures thereof. Natural or synthetic hydrocarbon oil or mixtures thereof may be employed. Generally, the hydrocarbon oil may be a paraffinic oil, a naphthenic oil, natural mineral oil or the like. Examples include but are not limited to mineral oil, castor oil, vegetable oil, corn oil, peanut oil, jojoba oil, 2-ethylhexyl oxystearate (and other alkyl oxystearates), acetylated lanolin alcohol, alkyl palmitates such as isopropyl palmitate, 2-ethylhexyl palmitate, glycerol triacetates, disopropyl adipate, dioctyl adipate (and other alkyl adipates), isopropyl myristate, C12 to C15 alcohol benzoates, and the like. Most preferably, the oil is mineral oil, because it is both economic and most easily processable.

[0033] The hydrophobic fluid may be employed in combination with a hydrophobic benefit agent and/or colorant (e.g. oil-soluble colorant), or it may forms a continuous phase which surrounds a discontinuous phase. The discontinuous phase may itself be a benefit agent and/or a colorant or it may contain an additional benefit agent and/or colorant.

[0034] Preferably, at least one layer is transparent/translucent. Preferably, at least one layer is colored. Preferred compositions comprise two layers, with the top layer containing majority, preferably all, of the sensitive benefit ingredient, and the bottom layer containing the majority, preferably all, of the surfactant.

[0035] When shaken, the layers within the composition may coalesce. Yet, they separate into visible layers, with each layer regaining its clarity (if transparent), upon standing for at most 24 hours at 20°C.

[0036] The volume ratio of the two layers in the final composition is generally in the range of from 1:99 to 99:1. In the preferred compositions, the bottom layer is aqueous and is predominant, i.e. the volume ratio of the bottom layer to top layer is at least 60:40, more preferably at least 70:30, most preferably at least 80:20, in order to provide the most pleasing appearance, optimum cleaning benefits and optimum protection for the hydrophobic layer and ingredients contained therein. The resulting layers have the volume ratios in the same ranges as described above (but the layer ratio may not be the same as the starting component ratio).

[0037] It should be noted that in the final composition, the compositions of the resultant layers do not necessarily correspond with the compositions of the respective layers prior to their being combined into a single composition.

[0038] This is because of reaction between ingredients, in particular the acidic ingredients and the basic ingredients (e.g., sodium hydroxide) and also, because of possible migration of material between the two layers, or emulsification of some of the layers within each other.

[0039] Some of the preferred embodiments of laundry products are outlined below:

No.	Hydrophilic (bottom) Layer Ingredients	Range % by weight of the phase	Hydrophobic (top) layer Ingredients	Range % by weight of the phase	Volume ratio of bottom to top layer
1	Water	0-60	Petrolatum	45-80	From 99:1 to 60:40
	Propylene Glycol	0-25	Sodium perborate	5-20	
	Xylene Sulfonate	0-15	Sodium 4-nonanoyloxy Benzene Sulfonate	5-20	
	Alcohol ethoxylate	0-95			
	Sodium Alkylbenzene sulfonate	0-75			
		0-80			
		0-10			

Table continued

No.	Hydrophilic (bottom) Layer Ingredients	Range % by weight of the phase	Hydrophobic (top) layer Ingredients	Range % by weight of the phase	Volume ratio of bottom to top layer
	Sodium Alcohol ethoxylate sulfate Miscellaneous				
2	Water Monoethanolamine Propylene glycol Alcohol ethoxylate Monoethanolamine alkylbenzene sulfonate Protease Miscellaneous	0-60 0-30 0-25 1-95 1-80 0-5 0-10	Mineral oil Kraton G1650M Lipase	40-80 0.5-10 0.5-5	From 99:1 to 60:40
3	Water Ammonium Lauryl Sulfate Cocamide monoethanol amine Ammonium chloride Miscellaneous	0-65 1-20 1-20 0.1-10 1-10	Silicone oil Paraffin wax Cationic surfactant	40-80 5-30 1-10	From 99:1 to 60:40

PREFERRED LAUNDRY COMPOSITION INGREDIENTS

[0040] Surfactant

[0041] The compositions of the invention preferably contain one or more surface active agents (surfactants) selected from the group consisting of anionic, nonionic, cationic, ampholytic and zwitterionic surfactants or mixtures thereof. The preferred surfactant detergents for use in the present invention are mixtures of anionic and nonionic surfactants although it is to be understood that any surfactant may be used alone or in combination with any other surfactant or surfactants. The surfactant should comprise at least 5%, e.g., 5% to 80%, preferably at least 10% to 80%, more preferably 15% to 40%; even more preferably 15% to 35% of the composition. Preferably, the predominant part or all of the surfactant, e.g. at least 80% of all the surfactant in the composition, more preferably at least 90%, is contained in the hydrophilic layer.

Nonionic Surfactant

[0042] Nonionic synthetic organic detergents which can be used with the invention, alone or in combination with other surfactants, are described below. Nonionic surfactants are typically included.

[0043] Preferred nonionic surfactants are nonionic surfactants whch are pourable liquids, gels or pastes at 25°C. Nonionic detergent surfactants normally have molecular weights of from about 300 to about 11,000. Mixtures of different nonionic detergent surfactants may also be used, provided the mixture is a liquid gel or paste at 25°C. Optionally, the composition may comprise one or more nonionic surfactants which are solid at 25°C. These dissolved and/or dispersed in either or both liquid layers.

[0044] As is well known, the nonionic detergents are characterized by the presence of an organic hydrophobic group and an organic hydrophilic group and are typically produced by the condensation of an organic aliphatic or alkyl aromatic

hydrophobic compound with ethylene oxide (hydrophilic in nature). Typical suitable nonionic surfactants are those disclosed in U.S. Pat. Nos. 4,316,812 and 3,630,929 and applicants' published European specification EP-A-225,654.

[0045] Usually, the nonionic detergents are polyalkoxylated lipophiles wherein the desired hydrophile-lipophile balance is obtained from addition of a hydrophilic polyalkoxy group to a lipophilic moiety. A preferred class of nonionic detergent is the alkoxylated alkanols wherein the alkanol is of 9 to 18 carbon atoms and wherein the number of moles of alkylene oxide (of 2 or 3 carbon atoms) is from 3 to 12. Of such materials it is preferred to employ those wherein the alkanol is a fatty alcohol of 9 to 11 or 12 to 15 carbon atoms and which contain from 5 to 8 or 5 to 9 alkoxy groups per mole.

[0046] Exemplary of such compounds are those wherein the alkanol is of 12 to 15 carbon atoms and which contain 7 ethylene oxide groups per mole, e.g. Neodol® 25-7 and Neodol® 23®-6.5, which products are made by Shell Chemical Company, Inc. The former is a condensation product of a mixture of higher fatty alcohols averaging about 12 to 15 carbon atoms, with 7 moles of ethylene oxide and the latter is a corresponding mixture wherein the carbon atoms content of the higher fatty alcohol is 12 to 13 and the number of ethylene oxide groups present averages 6.5. The higher alcohols are primary alkanols.

[0047] Other useful nonionics are represented by the commercially well- known class of nonionics sold under the trademark Plurafac®. The Plurafacs® are the reaction products of a higher linear alcohol and a mixture of ethylene and propylene oxides, containing a mixed chain of ethylene oxide and propylene oxide, terminated by a hydroxyl group. Examples include C_{13} -C_{15} fatty alcohol condensed with 6 moles ethylene oxide and 3 moles propylene oxide, C_{13} -C_{15} fatty alcohol condensed with 7 moles propylene oxide and 4 moles ethylene oxide, C_{13} -C_{15} fatty alcohol condensed with 5 moles propylene oxide and 10 moles ethylene oxide, or mixtures of any of the above.

[0048] Another group of liquid nonionics are commercially available from Shell Chemical Company, Inc. under the Dobanol® trademark: Dobanol® 91-5 is an ethoxylated C_9 -C_{11} fatty alcohol with an average of 5 moles ethylene oxide and Dobanol® 23-7 is an ethoxylated C_{12}-C_{13} fatty alcohol with an average of 7 moles ethylene oxide per mole of fatty alcohol.

[0049] In the compositions of this invention, preferred nonionic surfactants include the C_{12} -C_{15} primary fatty alcohols with relatively narrow contents of ethylene oxide in the range of from 7 to 9 moles, and the C_9 to C_{11} fatty alcohols ethoxylated with 5-6 moles ethylene oxide.

[0050] Another class of nonionic surfactants which can be used in accordance with this invention are glycoside surfactants. Glycoside surfactants suitable for use in accordance with the present invention include those of the formula:

$$RO\text{--}R'Oy\text{--}\ (Z)_x$$

wherein R is a monovalent organic radical containing from about 6 to about 30 (preferably from about 8 to about 18) carbon atoms; R' is a divalent hydrocarbon radical containing from about 2 to 4 carbons atoms; 0 is an oxygen atom; y is a number which can have an average value of from 0 to about 12 but which is most preferably zero; Z is a moiety derived from a reducing saccharide containing 5 or 6 carbon atoms; and x is a number having an average value of from 1 to 10 (preferably from 1.5 to 10).

[0051] A particularly preferred group of glycoside surfactants for use in the practice of this invention includes those of the formula above in which R is a monovalent organic radical (linear or branched) containing from about 6 to about 1 8(especially from about 8 to about 18) carbon atoms; y is zero; z is glucose or a moiety derived therefrom; x is a number having an average value of from 1 to about 4 (preferably from about 1 to 4).

[0052] Nonionic surfactants particularly useful for this application include, but are not limited to: alcohol ethoxylates (e.g. Neodol® 25-9 from Shell Chemical Co.), alkyl phenol ethoxylates (e.g. Tergitol® NP-9 from Union Carbide Corp.), alkylpolyglucosides (e.g. Glucapon® 600CS from Henkel Corp.), polyoxyethylenated polyoxypropylene glycols (e.g. Pluronic® L-65 from BASF Corp.), sorbitol esters (e.g. Emsorb® 2515 from Henkel Corp.), polyoxyethylenated sorbitol esters (e.g. Emsorb® 6900 from Henkel Corp.), alkanolamides (e.g. Alkamide® DC212/SE from Rhone-Poulenc Co.), and N-alkypyrrolidones (e.g. Surfadone® LP-100 from ISP Technologies Inc.).

[0053] Mixtures of two or more of the nonionic surfactants can be used.

Anionic Surfactant

[0054] Anionic surface active agents which may be used in the present invention are those surface active compounds which contain a long chain hydrocarbon hydrophobic group in their molecular structure and a hydrophilic group, i.e.; water solubilizing group such as sulfonate, sulfate or carboxylate group. The anionic surface active agents include the alkali metal (e.g. sodium and potassium) water soluble higher alkyl benzene sulfonates, alkyl sulfonates, alkyl sulfates and the alkyl polyether sulfates. They may also include fatty acid or fatty acid soaps. The preferred anionic surface active agents are the alkali metal, ammonium or alkanolamide salts of higher alkyl benzene sulfonates and alkali metal, ammonium or alkanolamide salts of higher alkyl sulfonates.

[0055] Preferred higher alkyl sulfonates are those in which the alkyl groups contain 8 to 26 carbon atoms, preferably

12 to 22 carbon atoms and more preferably 14 to 18 carbon atoms. The alkyl group in the alkyl benzene sulfonate preferably contains 8 to 16 carbon atoms and more preferably 10 to 15 carbon atoms. A particularly preferred alkyl benzene sulfonate is the sodium or potassium dodecyl benzene sulfonate, e.g. sodium linear dodecyl benzene sulfonate.

[0056] The primary and secondary alkyl sulfonates can be made by reacting long chain alpha-olefins with sulfites or bisulfites, e.g. sodium bisulfite. The alkyl sulfonates can also be made by reacting long chain normal paraffin hydrocarbons with sulfur dioxide and oxygen as described in U.S. Pat. Nos. 2,503,280, 2,507,088, 3,372, 188 and 3,260,741 to obtain normal or secondary higher alkyl sulfonates suitable for use as surfactant detergents.

[0057] The alkyl substituent is preferably linear, i.e. normal alkyl, however, branched chain alkyl sulfonates can be employed, although they are not as good with respect to biodegradability. The alkane, i.e. alkyl, substituent may be terminally sulfonated or may be joined, for example, to the carbon atom of the chain, i.e. may be a secondary sulfonate. It is understood in the art that the substituent may be joined to any carbon on the alkyl chain. The higher alkyl sulfonates can be used as the alkali metal salts, such as sodium and potassium. The preferred salts are the sodium salts. The preferred alkyl sulfonates are the C_{10} to C_{18} primary normal alkyl sodium and potassium sulfonates, with the C_{10} to C_{15} primary normal alkyl sulfonate salt being more preferred.

[0058] Mixtures of higher alkyl benzene sulfonates and higher alkyl sulfonates can be used as well as mixtures of higher alkyl benzene sulfonates and higher alkyl polyether sulfates.

[0059] Also normal alkyl and branched chain alkyl sulfates (e.g., primary alkyl sulfates) may be used as the anionic component).

[0060] The higher alkyl polyether sulfates used in accordance with the present invention can be normal or branched chain alkyl and contain lower alkoxy groups which can contain two or three carbon atoms. The normal higher alkyl polyether sulfates are preferred in that they have a higher degree of biodegradability than the branched chain alkyl and the lower poly alkoxy groups are preferably ethoxy groups.

[0061] The preferred higher alkyl poly ethoxy sulfates used in accordance with the present invention are represented by the formula:

$$R'\text{--}O(CH_2\ CH_2\ O)p\ \text{--}SO_3\ M,$$

where R' is C_8 to C_{20} alkyl, preferably C_{10} to C_{18} and more preferably C_{12} to C_{15}; p is 2 to 8, preferably 2 to 6, and more preferably 2 to 4;and M is an alkali metal, such as sodium and potassium, or an ammonium cation. The sodium and potassium salts are preferred.

[0062] A preferred higher alkyl poly ethoxylated sulfate is the sodium salt of a triethoxy C_{12} to C_{15} alcohol sulfate having the formula:

$$C_{12\text{-}15}\ \text{--}O\text{--}(CH_2\ CH_2\ O)_3\ \text{--}SO_3\ Na$$

[0063] Examples of suitable alkyl ethoxy sulfates that can be used in accordance with the present invention are $C_{12\text{-}15}$ normal or primary alkyl triethoxy sulfate, sodium salt; n-decyl diethoxy sulfate, sodium salt; C_{12} primary alkyl diethoxy sulfate, ammonium salt; C_{12} primary alkyl triethoxy sulfate, sodium salt: C_{15} primary alkyl tetraethoxy sulfate, sodium salt, mixed $C_{14\text{-}15}$ normal primary alkyl mixed tri- and tetraethoxy sulfate, sodium salt; stearyl pentaethoxy sulfate, sodium salt; and mixed $C_{10\text{-}18}$ normal primary alkyl triethoxy sulfate, potassium salt.

[0064] The normal alkyl ethoxy sulfates are readily biodegradable and are preferred. The alkyl poly-lower alkoxy sulfates can be used in mixtures with each other and/or in mixtures with the above discussed higher alkyl benzene, alkyl sulfonates, or alkyl sulfates.

[0065] The alkali metal higher alkyl poly ethoxy sulfate can be used with the alkylbenzene sulfonate and/or with an alkyl sulfonate or sulfonate, in an amount of 0 to 70%, preferably 10 to 50% and more preferably 10 to 20% by weight of entire composition.

[0066] Anionic surfactants particularly useful for this application include, but are not limited to: linear alkyl benzene sulfonates (e.g. Vista® C-500 from Vista Chemical Co.), alkyl sulfates (e.g. Polystep® B-5 from Stepan Co.), polyoxyethylenated alkyl sulfates (e.g. Standapol® ES-3 from Stepan Co.), alpha olefin sulfonates (e.g. Witconate® AOS from Witco Corp.), alpha sulfo methyl esters (e.g. Alpha-Step® MC-48 from Stepan Co.), alkyl ether sulfates and isethionates (e.g. Jordapon® CI from PPG Industries Inc.).

[0067] Anionic surfactants may be added pre-neutralized or, preferably, may be formed in situ, by neutralizing a precursor acid (fatty acid in the case of soaps). Further, the anionic precursor or fatty acid should be over-neutralised (i.e. there should be an excess of the alkaline material used to form the counter-ion). Inorganic salt, preferably, sodium or potassium salt of the anionic precursor acid is preferred to improve detergency, but organic salt results in improved transparency.

Cationic Surfactants

[0068] Many cationic surfactants are known in the art, and almost any cationic surfactant having at least one long chain alkyl group of about 10 to 24 carbon atoms is suitable in the present invention. Such compounds are described in "Cationic Surfactants", Jungermann, 1970, incorporated by reference.

[0069] Specific cationic surfactants which can be used as surfactants in the subject invention are described in detail in U.S. Pat. No. 4,497,718, hereby incorporated by reference.

[0070] As with the nonionic and anionic surfactants, the compositions of the invention may use cationic surfactants alone or in combination with any of the other surfactants known in the art. Of course, the compositions may contain no cationic surfactants at all.

Amphoteric Surfactants

[0071] Ampholytic synthetic detergents can be broadly described as derivatives of aliphatic or aliphatic derivatives of heterocyclic secondary and tertiary amines in which the aliphatic radical may be a straight chain or a branched and wherein one of the aliphatic substituents contains from 8 to 18 carbon atoms and at least one contains an anionic water-solubilizing group, e.g. carboxylate, sulfonate, sulfate. Examples of compounds falling within this definition are sodium 3(dodecylamino)propionate, sodium 3-(dodecylamino)propane-1-sulfonate, sodium 2-(dodecylamino)ethyl sulfate, sodium 2-(dimethylamino)octadecanoate, disodium 3-(N-carboxymethyldodecylamino)propane 1-sulfonate, disodium octadecyl- imminodiacetate, sodium 1-carboxymethyl-2-undecylimidazole, and sodium N, N-bis(2-hydroxyethyl)-2-sulfato-3-dodecoxypropylamine. Sodium 3-(dodecylamino)propane-1-sulfonate is preferred.

[0072] Zwitterionic surfactants can be broadly described as derivatives of secondary and tertiary amines, derivatives of heterocyclic secondary and tertiary amines, or derivatives of quaternary ammonium, quaternary phosphonium or tertiary sulfonium compounds. The cationic atom in the quaternary compound can be part of a heterocyclic ring. In all of these compounds there is at least one aliphatic group, straight chain or branched, containing from about 3 to 18 carbon atoms and at least one aliphatic substituent containing an anionic water solubilizing group, e. g., carboxy, sulfonate, sulfate, phosphate, or phosphonate.

[0073] Specific examples of zwitterionic surfactants which may be used are set forth in U.S. Pat. No. 4,062,647, hereby incorporated by reference.

[0074] Preferably, the surfactant in the laundry compositions of the invention is anionic and/or nonionic, especially linear alkylbenzene sulfonate, alkyl ether sulfate, alcohol ethoxylates and mixtures thereof.

[0075] For higher foaming formulations (top-loading washing machines), mixtures of anionic and nonionic surfactants are especially preferred, for optimum greasy stain and particulate soil removal. When mixtures are used, the most effective mixtures employ anionic to nonionic ratio of from 10: 1 to 1:10, preferably from 5:1 to 1:5, most preferably from 3:1 to 1:3.

[0076] When low foaming formulations are desired, e.g., for front-loading machines, nonionic surfactants are employed, in the absence of, or lower levels of, anionic surfactants, alone or in combination with cationic surfactants and/or antifoams.

Optional Third Layer

[0077] The laundry compositions may include a third layer. A surfactant layer may contain polar and non-polar components and thus may separate into two layers. Generally, however, the third layer may be created, by adding an electrolyte to the aqueous layer, which contains the predominant amount of the surfactant. The electrolyte may also be added in order to increase the water content of the laundry compositions, without compromising the integrity of he water soluble package.

Electrolyte

[0078] The electrolyte which may be included into the inventive compositions is selected from the group of organic electrolytes, inorganic electrolytes and mixtures thereof.

[0079] Preferably, the electrolytes suitable for use in the present invention meet both of the following criteria:

(1) they have a high salting out ability;
(2) they are able to lower water activity.

[0080] "Colored Inorganic electrolyte" contains a transition metal cation, such that the electrolytes (salts) containing such cations will produce a colored aqueous solution. Suitable cations include, but are not limited to cobalt, copper (cuprous and cupric), chrome, nickel, iron (ferric and ferrous), zinc, zinc, manganese, vandium (vanadyl), palladium and

cadmium.

[0081] Suitable anions include but are not limited to sulphate, nitrate, fluoride, chloride, bromide, iodide, acetate, tartrate, ammonium tartrate, benzenesulphonate, benzoate, bicarbonate, carbonate, bisulphate, bisulphite, sulphate, sulphite, borate, borotartrate, bromate, butyrate, chlorate, camphorate, chlorite, cinnamate, citrate, disilicate, dithionate, ethylsulphate, ferricyanide, ferrocyanide, fluorosilicate, formate, glycerophosphate, hydrogenphosphate, hydroxostannate, hypochlorite, hyponitrite, hypophosphite, iodate, isobutyrate, lactate, laurate, metaborate, metasilicate, methionate, methylsulphate, nitrite, oleate, orthophosphate, orthophosphite, orthosilicate, oxalate, perborate, perchlorate, phosphate, polyfluoride, polychloride, polyiodide, polybromide, polysulphide, polysulphate, polysulphite, salicylate, silicate, sorbate, stannate, stearate, succinate or valerate, dichromate, chromate, nitrate, throyonate, permanganate, bromide, chloride, fluoride, gluconate, phenolsulfate, selenate.

[0082] The use of the colored inorganic electrolyte results in formulations which contain a colored electrolyte layer, with the color not leaking into the surfactant layer.

[0083] Furthermore, it is possible to have stable multi-colored formulations, with the colored inorganic electrolyte in the electrolyte layer, and an organic dye in the surfactant layer.

[0084] Suitable colored electrolytes include but are not limited to the following:

Compound	Color
Nickel Sulfate	Green
Cupric Sulfate	Blue
Potassium Dichromate	Orange-red
Ammonium Chromate	Yellow
Ammonium Chromic Sulfate	Purple-red
Tetraamminecopper Sulfate	Blue
Ammonium Ferric Sulfate	Pale violet
Chromic Potassium Sulfate	Purple-red
Ferric Sulfate	Light yellow
Ferrous Sulfate	Brown-green
Cobaltous Sulfate	Red-pink
Cobaltous Potassium Sulfate	Purple
Manganese Sulfate	Red-pink
Vanadyl Sulfate	Blue
Manganese Nitrate	Pink-ish
Ammonium Ferric Citrate	Green-brown
Ferric Nitrate	Purple-white
Ferric Sulfate	Yellowish
Cobaltous Throyonate	Blue-green
Merbromin	Red
Zinc Permanganate	Violet-brown
Ammonium Nickel Sulfate	Blue-green
Nickel Acetate	Green
Nickel Bromide	Yellow-green
Nickel Chloride	Green
Nickel Fluoride	Yellow-green
Potassium Tetracyanonickelate	Orange
Ammonium Cupric Chloride	Yellow
Cupric Acetate	Green
Cupric Chloride	Blue-green
Cupric Formate	Pale blue
Cupric Gluconate	Light blue
Cupric Glycinate	Light blue
Cupric Nitrate	Pale green
Cupric Perchlorite	Pale green
Cupric Phenolsulfate	Blue-green
Cupric Salicylate	Blue-green

Table continued

Compound	Color
Cupric Selenate	Green-blue
Cupric Tatrate	Dark green
Cuproxoline	Brown
Palladium Chloride	Brown
Cadmium Sulfide	Yellow-orange

[0085] Mixtures of electrolytes may be employed.

[0086] Electrolyte may be pre-formed or formed in situ.

[0087] Preferred electrolytes are selected from the group consisting of nickel, cupric and cobaltous salts of sulfate and chloride, because these result in the most pleasing colors for a laundry detergent.

[0088] "Organic electrolyte" as used herein means an electrolyte containing an organic cation. "Organic cation," in turn, means a non-metal, positively charged ionic entity. Suitable organic cations include but are not limited to ammonium, ammonium hydroxide, amines, more preferably alkanolamines (e.g., monoethanolamine, diethanolamine, triethanolamine, isopropylamine). Preferred organic electrolytes are selected from the group consisting of monoethanolamine, triethanolamine, and ammonium oxide salts of citrate, carbonate, bicarbonate, borate and sulfate. Monoethanolamine salt is the most effective. Monoethanolamine citrate, monoethanolamine carbonate and monoethanolamine borate are the most preferred, due to their ability to also function as builders and/or buffering agents in the detergent composition. Monoethanolamine citrate is optimum, due to its optimum ability to salt out a surfactant and/or reduce the water activity.

[0089] "Inorganic electrolyte" as used herein means an electrolyte containing an alkali or alkaline earth metal cation. Suitable additional inorganic electrolytes include but are not limited to sodium, potassium, lithium, magnesium, and calcium salts. Preferred electrolytes are selected from the group consisting of sodium and potassium salts of citrate, carbonate, bicarbonate, borate and sulfate. Sodium salt is the most cost-effective. Sodium citrate, sodium carbonate and sodium borate are the most preferred, due to their ability to also function as builders and/or buffering agents in the detergent composition. Sodium citrate is optimum, due to its optimum ability to salt out a surfactant and/or reduce the water activity.

[0090] Suitable anions for the inorganic electrolyte and the organic electrolyte are selected from the list above.

[0091] When the third layer is desired, the liquid detergent composition of the invention preferably includes from 1 to 50%, more preferably from 5 to 40%, most preferably from 5 to 35%, and optimally from 10 to 30% of the electrolyte, in order to attain a stable three-layered composition, at optimum cost. When mixtures of the colored inorganic electrolyte are employed with additional inorganic or organic electrolytes, the amount of the colored inorganic electrolyte is in the range of from 0.001 to 10%, preferably from 0.01 to 5%, more preferably from 0.05 to 5%, optimally from 0.5 to 3%. The concentration of electrolyte to create a three-layered composition depends on the surfactant concentration, the water amount and the identity of the electrolyte. The concentration needed may be predicted by calculating the ionic strength of the electrolyte at a particular concentration. It has been found as part of the present invention that the preferred electrolytes and preferred concentrations are those that have a calculated ionic strength of at least 4.2 preferably at least, 4.4, most preferably at least 5.

[0092] Ionic strength represents interactions of ions with water molecules and other ions in the solution. Ionic strength may be calculated as follows:

$$I = \tfrac{1}{2} \Sigma z_i^2 m_i$$

Σ=a sum for i number of ions
I = ionic strength
z = valence factor
m = molal concentration of the ith ion concentration

Hydrotrope

[0093] A particularly preferred optional ingredient is a hydrotrope, which prevents liquid crystal formation. The addition of the hydrotrope thus aids the clarity/transparency of the composition. The hydrotrope is typically included in the surfactant layer. Suitable hydrotropes include but are not limited to propylene glycol, ethanol, urea, salts of benzene sulphonate, toluene sulphonate, xylene sulphonate or cumene sulphonate. Suitable salts include but are not limited to

sodium, potassium, ammonium, monoethanolamine, triethanolamine. Preferably, the hydrotrope is selected from the group consisting of propylene glycol, xylene sulfonate, ethanol, and urea to provide optimum performance. The amount of the hydrotrope is generally in the range of from 0 to 30%, preferably from 0.5 to 20%, most preferably from 1 to 15%.

Protected Ingredient in the Top Layer

[0094] The top layer is preferably hydrophobic. The desired ingredient to be protected (e.g., benefit ingredient or a colorant) may form a continuous phase with the hydrophobic ingredient (it can then be co-melted with the hydrophobic material) or it may form a discontinuous (hydrophilic or incompatible hydrophobe) phase. In the latter case, the hydrophobic material forms a continuous phase, which surrounds a discontinuous phase. A hybrid of the two cases is also possible, i.e. both the continuous and discontinuous phases contain benefit ingredient(s) and/ or colorant(s).

[0095] If present, the discontinuous phase of the hydrophobic layer is itself and/or comprises a benefit agent and/or a colorant. In some embodiments of the invention, the discontinuous phase is itself a benefit agent, e.g. a vegetable oil, such as sunflower seed oil, in personal care compositions. In other embodiments, the discontinuous phase is itself a colorant (e.g. a solid pigment). Still in other embodiments the discontinuous phase serves as a vehicle for a benefit agent and/or colorant. And still in other embodiments of the invention the discontinuous phase may itself be a benefit agent and/or colorant and also further include an additional benefit agent and/or colorant. According to the present invention, the discontinuous phase is immiscible with the continuous phase, to prevent the exposure of the continuous phase to the environment outside the capsule. The discontinuous phase may be a solution (aqueous or oil), an oil, an emulsion, a dispersion, or a solid. The preferred form of the discontinuous phase is an oil or a solution (oil or aqueous solution), due to the relative ease of incorporation of the oil or the solution into the continuous phase. The layer may include more than one discontinuous phase.

[0096] If the additional benefit agent/colorant is oil-soluble, than an oil is chosen to carry the benefit agent/colorant in the discontinuous phase; if the benefit agent/colorant is water-soluble, than the discontinuous phase is an aqueous solution. Of course, as mentioned above, solids may be employed, without making a solution.

[0097] The discontinuous phase may be present in an amount of from 0.01 to 45%, more preferably from 5 to 45%, most preferably from 10 to 40%, and optimally from 20 to 35%, (% by volume of the hydrophobic layer) in order to deliver sufficient benefit agent/colorant, provide an adequate protection for the benefit agent/colorant and to maintain the ease of processing.

[0098] For a hydrophobic layer which contains a discontinuous phase, the continuous phase may sometimes be referred to hereinafter as a "shell" or "shell material".

[0099] For simplicity, the material entrapped within the shell, either directly, or as a discontinuous phase, will be referred to as an "enzyme". However, it is within the scope of the present disclosure that materials other than enzymes can be encapsulated by the techniques disclosed herein. The choice of the benefit agent depends largely on whether the final consumer composition is a detergent composition or a personal care composition. As mentioned above, the continuous or discontinuous phase itself may represent a benefit agent, so it is not necessary that an additional benefit agent be present. Thus, an additional benefit agent may be present in an amount of from 0 to 100%, preferably 0.01 to 50%, more preferably 0.1 to 20%, by weight of the discontinuous phase.

[0100] Typical benefit agents include, but are not limited to a bleach, a bleach precursor, a surfactant, an enzyme, a whitening agent, a fabric softener, an anti-wrinkle compound, a dye fixative, dye transfer inhibitors, anti-redeposition polymers, soil release polymers, an anti-foam agent, a perfume, a silicone oil, a vegetable oil, a and mixtures thereof.

Enzymes

[0101] Enzymes which may be used in the subject invention are described in greater detail below. Enzyme is typically included in an amount from 0.05 to 5%, preferably 0.05 to 3%. The enzyme is preferably contained predominantly in the top layer, which is preferably hydrophobic, with the volume ratio of bottom to top layer of at least 90:10, preferably 95:5. Thus, generally, at least 90%, preferably at least 90% of the enzyme is in the top layer.

[0102] If a lipase is used, the lipolytic enzyme may be either a fungal lipase producible by Humicola lanuginosa and Thermomyces lanuginosus, or a bacterial lipase which show a positive immunological cross-reaction with the antibody of the lipase produced by the microorganism Chromobacter viscosum var. lipolyticum NRRL B-3673. This microorganism has been described in Dutch patent specification 154,269 of Toyo Jozo Kabushiki Kaisha and has been deposited with the Fermentation Research Institute, Agency of Industrial Science and Technology, Ministry of International Trade and Industry, Tokyo, Japan, and added to the permanent collection under nr. KO Hatsu Ken Kin Ki 137 and is available to the public at the United States Department of Agriculture, Agricultural Research Service, Northern Utilization and Development Division at Peoria, Ill., USA, under the nr. NRRL B-3673. The lipase produced by this microorganism is commercially available from Toyo Jozo Co., Tagata, Japan, hereafter referred to as "TJ lipase". These bacterial lipases should show a positive immunological cross-reaction with the TJ lipase antibody, using the standard and well-known

immune diffusion procedure according to Ouchterlony (Acta. Med. Scan., 133. pages 76-79 (1930).

[0103] The preparation of the antiserum is carried out as follows:

[0104] Equal volumes of 0.1 mg/ml antigen and of Freund's adjuvant (complete or incomplete) are mixed until an emulsion is obtained. Two female rabbits are injected 45 with 2 ml samples of the emulsion according to the following scheme:

day 0:antigen in complete Freund's adjuvant

day 4:antigen in complete Freund's adjuvant

day 32:antigen in incomplete Freund's adjuvant

day 64:booster of antigen in incomplete Freund's adjuvant.

[0105] The serum containing the required antibody is prepared by centrifugation of clotted blood, taken on day 67.

[0106] The titre of the anti-TJ-lipase antiserum is determined by the inspection of precipitation of serial dilutions of antigen and antiserum according to the Ouchteriony procedure. A dilution of antiserum was the dilution that still gave a visible precipitation with an antigen concentration of 0.1 mg/ml.

[0107] All bacterial lipases showing a positive immunological cross reaction with the TJ-lipase antibody as hereabove described are lipases suitable in this embodiment of the invention. Typical examples thereof are the lipase ex Pseudomonas fluorescens IAM 1057 (available from Amano Pharmaceutical Co., Nagoya, Japan, under the trade-name Amano-P lipase), the lipase ex Pseudomonas fragi PERM P 1339 (available under the trade- name Amano B), the lipase ex Pseudomonas nitroreducens var. lipolyticum FERM P1338, the lipase ex Pseudomonas sp. (available under the trade- name Amano CES), the lipase ex Pseudomonas cepacia, lipases ex Chromobacter viscosum, e.g. Chromobacter viscosum var. lipolyticum NRRL B-3673, commercially available from Toyo Jozo Co., Tagata, Japan; and further Chromobacter viscosum lipases from U.S. Biochemical Corp. USA and Diosynth Co., The Netherlands, and lipases ex Pseudomonas gladioli.

[0108] An example of a fungal lipase as defined above is the lipase ex Humicola lanuginosa available from Amano under the tradename Amano CE; the lipase ex Humicola lanuginosa as described in the aforesaid European Patent Application 0,258,068 (NOVO), as well as the lipase obtained by cloning the gene from Humicola lanuginosa and expressing this gene in Aspergillus oryzae, commercially available from NOVO industri A/S under the tradename "Lipolase". This lipolase is a preferred lipase for use in the present invention.

[0109] While various specific lipase enzymes have been described above, it is to be understood that any lipase which can confer the desired lipolytic activity to the composition may be used and the invention is not intended to be limited in any way by specific choice of lipase enzyme.

[0110] The lipases of this embodiment of the invention are included in the liquid detergent composition in such an amount that the final composition has a lipolytic enzyme activity of from 100 to 0.005 LU/ml in the wash cycle, preferably 25 to 0.05 LU/ml when the formulation is dosed at a level of about 0.1-10, more preferably 0.5-7, most preferably 1-2 g/liter.

[0111] A Lipase Unit (LU) is that amount of lipase which produces 1/mmol of titratable fatty acid per minute in a pH state under the following conditions: temperature 30°C.; pH=9.0;substrate is an emulsion of 3.3 wt. % of olive oil and 3,3% gum arabic, in the presence of 13 mmol/l Ca^{2+} and 20 mmol/l NaCl in 5 mmol/l Trisbuffer.

[0112] Naturally, mixtures of the above lipases can be used. The lipases can be used in their non-purified form or in a purified form, e.g. purified with the aid of well-known absorption methods, such as phenyl sepharose absorption techniques.

[0113] If a protease is used, the proteolytic enzyme can be of vegetable, animal or microorganism origin. Preferably, it is of the latter origin, which includes yeasts, fungi, molds and bacteria.

[0114] Particularly preferred are bacterial subtilisin type proteases, obtained from e.g. particular strains of B. subtilis and B licheniformis. Examples of suitable commercially available proteases are Alcalase, Savinase, Esperase, all of NOVO Industri A/S; Maxatase and Maxacal of Gist-Brocades; Kazusase of Showa Denko; BPN and BPN' proteases and so on. The amount of proteolytic enzyme, included in the composition, ranges from 0.05-50,000 GU/mg. preferably 0.1 to 50 GU/mg, based on the final composition. Naturally, mixtures of different proteolytic enzymes may be used.

[0115] While various specific enzymes have been described above, it is to be understood that any protease which can confer the desired proteolytic activity to the composition may be used and this embodiment of the invention is not limited in any way be specific choice of proteolytic enzyme.

[0116] In addition to lipases or proteases, it is to be understood that other enzymes such as cellulases, oxidases, amylases, peroxidases and the like which are well known in the art may also be used with the composition of the invention. The enzymes may be used together with cofactors required to promote enzyme activity, i.e., they may be used in enzyme systems, if required. It should also be understood that enzymes having mutations at various positions (e.g., enzymes

engineered for performance and/or stability enhancement) are also contemplated by the invention. One example of an engineered commercially available enzyme is Durazym from Novo.

[0117] In the case of an enzyme, the discontinuous phase is an aqueous solution of the enzyme. The aqueous enzyme solution may optionally contain a low HLB surfactant, in order to further enhance the formation of the emulsion. The level of the surfactant can be reduced or even eliminated, particularly if suitable agitation is used. Furthermore, the need for surfactant is entirely eliminated if the shell material is a mixture of thermoplastic polymer with oil, rather than a wax/oil mixture.

Colorant

[0118] The colorant may be a dye or a pigment. Dyes are preferable, since they are water-soluble and thus are more easily incorporated into the layer emulsion, compared to pigments which are typically not water-soluble. Most preferably, a water-soluble dye is entrapped, alone or in the mixture with a benefit agent, within a transparent, uncolored continuous phase.

[0119] Most preferably, the layer is an emulsion or dispersion containing both the benefit agent and the colorant, within a transparent continuous phase, to provide a visual signal to the consumer that a composition contains an additional beneficial ingredient.

[0120] The emulsion/dispersion may be prepared by any known method, but preferably the emulsion or dispersion is prepared by mixing the continuous and discontinuous phases, the latter being or containing the ingredient to be encapsulated, e.g. bleach solution or a vegetable oil. In the preferred embodiment, the co-polymer is melted, mixed with oil, then the discontinuous phase is added, with stirring (agitation), to ensure uniform mixing of the ingredients. The resulting emulsion/dispersion is preferably kept at a temperature in the range from 40°C to 95°C. Most preferably, the use of direct heat is avoided. A most preferred temperature range is from 60°C to 75°C.

POSITION OF THE LAYERS

[0121] Position of the hydrophobic layer is defined by the relative densities of the layers. Most liquid detergents have a density of 1 or slightly below or above, i.e. in the range of from 0.9-1.1 g/L. Enzyme emulsions typically have a lower density than a liquid detergent composition. In this case, the density of the enzyme capsule/emulsion is less than 1, as a result of the density of the hydrophobic ingredient ranging from 0.8 to 0.9 g/L. Thus, the hydrophobic layer will typically float to the top, as is preferred according to the present invention, to minimize the interface area between the ingredient to be protected in the hydrophobic layer and the aqueous layer.

[0122] The preferred laundry composition may further include one or more well-known laundry ingredients, such as builders (from 0.1 to 20%), anti-redeposition agents, fluorescent dyes, perfumes, soil-release polymers, colorant, enzymes, buffering agents, antifoam agents, UV-absorber, etc.

[0123] Examples of suitable inorganic alkaline detergency builders which may be used are water-soluble alkali metal phosphates, polyphosphates, borates, silicates and also carbonates. Specific examples of such salts are sodium and potassium triphosphates, pyrophosphates, orthophosphates, hexametaphosphates, tetraborates, silicates, and carbonates.

[0124] Examples of suitable organic alkaline detergency builder salts are: (1) water-soluble amino polycarboxylates, e.g., sodium and potassium ethylenediaminetetraacetates, nitrilotriacetates and N-(2 hydroxyethyl)-nitrilodiacetates; (2) water-soluble salts of phytic acid, e.g., sodium and potassium phytates (see U.S. Pat. No. 2,379,942); (3) water-soluble polyphosphonates, including specifically, sodium, potassium and lithium salts of ethane-1-hydroxy-1,1-diphosphonic acid; sodium, potassium and lithium salts of ethylene diphosphonic acid; sodium, potassium and lithium salts of ethylene diphosphonic acid; and sodium, potassium and lithium salts of ethane-1,1,2-triphosphonic acid. Other examples include the alkali metal salts of ethane-2-carboxy-1,1-diphosphonic acid hydroxymethanediphosphonic acid, carboxyldiphosphonic acid, ethane-1-hydroxy-1,1,2-triphosphonic acid, ethane-2-hydroxy-1,1,2- triphosphonic acid, propane-1,1,3,3-tetraphosphonic acid, propane-1,1,2, 3-tetraphosphonic acid, and propane-1,2,2,3-tetra-phosphonic acid; (4) water-soluble salts of polycarboxylates polymers and copolymers as described in U.S. Pat. No. 3,308,067.

[0125] In addition, polycarboxylate builders can be used satisfactorily, including water-soluble salts of mellitic acid, citric acid, and carboxymethyloxysuccinic acid, salts of polymers of itaconic acid and maleic acid, tartrate monosuccinate, tartrate disuccinate and mixtures thereof (TMS/TPS).

[0126] Certain zeolites or aluminosilicates can be used. One such aluminosilicate which is useful in the compositions of the invention is an amorphous water-insoluble hydrated compound of the formula $Na\ [(AlO_2)\ .y.SiO_2)$, wherein x is a number from 1.0 to 1.2 and y is 1, said amorphous material being further characterized by a Mg++ exchange capacity of from about 50 mg eq. $CaCO_3$ /g. and a particle diameter of from about 0.01 mm to about 5 mm. This ion exchange builder is more fully described in British Patent No. 1,470,250.

[0127] A second water-insoluble synthetic aluminosilicate ion exchange material useful herein is crystalline in nature

and has the formula $Na_z [(AlO_2)_y (SiO_2)]_x H_2 O$, wherein z and y are integers of at least 6; the molar ratio of z to y is in the range from 1.0 to about 0.5, and x is an integer from about 15 to about 264; said aluminosilicate ion exchange material having a particle size diameter from about 0.1 mm to about 100 mm; a calcium ion exchange capacity on an anhydrous basis of at test about 200 milligrams equivalent of $CaCO_3$ hardness per gram; and a calcium exchange rate on an anhydrous basis of at least about 2 grains/gallon/minute/gram. These synthetic aluminosilicates are more fully described in British Patent No. 1,429,143.

[0128] Optical brighteners for cotton, polyamide and polyester fabrics can be used. Suitable optical brighteners include Tinopal, stilbene, triazole and benzidine sulfone compositions, especially sulfonated substituted triazinyl stilbene, sulfonated naphthotriazole stilbene, benzidene sulfone, etc., most preferred are stilbene and triazole combinations. A preferred brightener is Stilbene Brightener N4 which is a dimorpholine dianilino stilbene sulfonate.

[0129] Anti-foam agents, e.g. silicone compounds, such as Silicane L 7604, can also be added in small effective amounts.

[0130] Bactericides, e.g. tetrachlorosalicylanilide and hexachlorophene, fungicides, dyes, pigments (water dispersible), preservatives, e.g. formalin, ultraviolet absorbers, anti-yellowing agents, such as sodium carboxymethyl cellulose, pH modifiers and pH buffers, color safe bleaches, perfume and dyes and bluing agents such as Iragon Blue L2D, Detergent Blue 472/372 and ultramarine blue can be used.

[0131] Also, soil release polymers and cationic softening agents may be used.

[0132] The list of optional ingredients above is not intended to be exhaustive and other optional ingredients which may not be listed, but are well known in the art, may also be included in the composition.

[0133] The pH of the inventive compositions is generally in the range of from 2.5 to 12.5, preferably in the range of from 4 to 10, most preferably from 6 to 9, in order to attain optimum laundry cleaning.

[0134] Preferably, the detergent composition is a transparent/translucent two-colored composition packaged in the transparent/translucent body.

[0135] The packages of the invention may be filled in any suitable way. Preferably, the liquid detergent composition is premixed (both components) and filled in the same manner as a single phase composition would be. The composition may also be filled component by component.

[0136] In use, the package is mixed with water (e.g., inside a laundry machine or a dishwasher), in order to dissolve the body and to release the contents of the package.

[0137] The following specific examples further illustrate the invention, but the invention is not limited thereto.

EXAMPLE 1

[0138]

Ingredient	Supplier	% of each layer
Top layer (10% of the whole composition)		
Mineral oil	Witco	65
Paraffin wax	Penreco	15
Silicon oil	Dow Corning	10
Antifoam agent	Dow Corning	10
Bottom layer (90% of the whole composition)		
Water		6
Propylene glycol	Eastman Chemical	20
Alcohol ethoxylate nonionic surfactant, Neodol® 25-9	Shell Chemical	25
MEA-LAS (monoethanolamine linear alkylbenzene sulfonate)	Stepan	40
Miscellaneous		9

[0139] The top layer was prepared by melting paraffin wax at 60°C with mineral oil, followed by emulsifying silicon oil and antifoam agent in the mixture. At 20°C, the top layer was a thick emulsion. The bottom layer was prepared by following the order listed in the above formulation. MEA-LAS was neutralized in-situ by reacting monoethanolamine with

LAS acid. First, a PVA pouch was prepared by heat-sealed the longitudinal edges to form a tube followed by heat-sealed the bottom by using a Mono-Sol M4045 PVA film. Forty-five grams of bottom layer and five grams of the top layer were filled in the prepared PVA pouch. The pouch then heat-sealed orthogonal to the bottom sealed. The top layer floated to the top and formed a visible layer.

EXAMPLE 2

[0140]

Ingredient	Supplier	% by weight of layer
Top Layer (3% of the whole composition)		
Mineral oil	Witco	61
Paraffin wax	Penreco	19
Properase® 1600L	Genencor	20
Middle layer (47% of the whole composition)		
Water		9.0
Xylene Sulfonate, 25%	Stepan	10.5
Propylene Glycol	Eastman Chemical	10.0
Alcohol Ethoxylate Nonionic Surfactant, Neodol® 25-9	Shell Chemical	16.8
Sodium LAS	Stepan	16.8
Sodium alcohol ethoxylate sulfate, 59.39%	Stepan	27.6
Miscellaneous		9.3
Bottom layer (50% of the *whole formulation)*		
Water		40
MEA-Citrate (monoethanolamine citrate)	Haarman and Reimer	50
Monoethanolamine	Dow Chemical	10

[0141] The top layer was prepared by melting paraffin wax at 45°C with mineral oil, followed by emulsifying Properase® 1600L in the mixture. After the emulsification, the emulsion was cooled to 20°C to prevent the excess loss of enzyme. The top layer was a thick emulsion. The other two layers were prepared by following the order listed in the above table. MEA-citrate was neutralized in-situ by reacting monoethanolamine with citric acid. First, a PVA (polyvinyl alcohol) pouch was prepared by heat-sealed the longitudinal edges to form a tube followed by heat-sealed the bottom by using a Mono-Sol M4045 PVA film. Twenty-five grams of bottom layer, 23.5 grams of middle layer and 15 grams of the top layer were filled in the prepared PVA pouch. The pouch then heat-sealed orthogonal to the bottom sealed. The top layer floated to the top and minimized the interface between the top and the middle layers. Three visible layers were formed.

Claims

1. A laundry detergent package for use in a single laundry application, the package comprising:

(a) a water - soluble body in the form of a polyhedron having four or more walls wherein each wall is inclined at an angle relative to each other wall;
(b) a liquid laundry detergent composition contained within the polyhedron water-soluble body for release upon the dissolution of the water-soluble body, the composition comprising at least two layers:

(b1) a hydrophilic layer; and
(b2) a hydrophobic layer.

2. The package of claim 1 wherein the hydrophobic layer is on top.

3. The package of claim 1 or claim 2, wherein the hydrophobic layer comprises an enzyme.

4. The package of any preceding claim wherein the volume ratio of the hydrophilic layer to the hydrophobic layer is at least about 60:40.

5. The package of any preceding claim, wherein the at least two layers comprise in total:

i) from about 5 to about 90% of a detergent surfactant; by weight of the composition;
ii) from about 0.05 to about 5% of an enzyme.

6. The package of any preceding claim, wherein the composition further comprises a hydrotrope.

7. The package of any preceding claim, wherein the composition further comprises a colorant.

8. The package of any preceding claim, wherein the water-soluble body is transparent.

9. The package of any preceding claim, wherein the composition is transparent.

10. The package of any preceding claim, further comprising a third layer.

11. The package of any preceding claim wherein the water-soluble body is in the form of tetrahedron.

Revendications

1. Emballage de détergent lessiviel à utiliser dans une seule application lessivielle, l'emballage comprenant :

(a) un corps soluble dans l'eau sous la forme d'un polyèdre comportant quatre parois ou plus où chaque paroi est inclinée selon un angle par rapport à chaque autre paroi ;
(b) une composition de détergent lessiviel liquide contenue au sein du corps soluble dans l'eau polyédrique pour une libération lors de la dissolution du corps soluble dans l'eau, la composition comprenant au moins deux couches :

(b1) une couche hydrophile ; et
(b2) une couche hydrophobe.

2. Emballage selon la revendication 1, dans lequel la couche hydrophobe est au sommet.

3. Emballage selon la revendication 1 ou la revendication 2, dans lequel la couche hydrophobe comprend une enzyme.

4. Emballage selon l'une quelconque des revendications précédentes, dans lequel le rapport en volume de la couche hydrophile sur la couche hydrophobe est d'au moins environ 60:40.

5. Emballage selon l'une quelconque des revendications précédentes, dans lequel les deux couches comprennent au total :

i) d'environ 5 à environ 90 % d'un agent tensioactif détergent ; par rapport au poids de la composition ;
ii) d'environ 0,05 à environ 5 % d'une enzyme.

6. Emballage selon l'une quelconque des revendications précédentes, dans lequel la composition comprend en outre un hydrotrope.

7. Emballage selon l'une quelconque des revendications précédentes, dans lequel la composition comprend en outre

un colorant.

8. Emballage selon l'une quelconque des revendications précédentes, dans lequel le corps soluble dans l'eau est transparent.

9. Emballage selon l'une quelconque des revendications précédentes, dans lequel la composition est transparente.

10. Emballage selon l'une quelconque des revendications précédentes, comprenant en outre une troisième couche.

11. Emballage selon l'une quelconque des revendications précédentes, dans lequel le corps soluble dans l'eau est sous la forme d'un tétraèdre.

Patentansprüche

1. Wäschewaschmittelverpackung zur Verwendung bei einer einzelnen Wäscheanwendung, wobei die Verpackung umfasst:

   (a) einen in Wasser löslichen Körper in Form eines Polyeders mit vier oder mehreren Wänden, worin jede Wand in einem Winkel, bezogen auf jede andere Wand, geneigt ist;
   (b) eine flüssige Wäschewaschmittelzusammensetzung, die in dem in Wasser löslichen Polyeder-Körper zur Abgabe nach Auflösung des in Wasser löslichen Körpers enthalten ist, wobei die Zusammensetzung mindestens zwei Schichten umfasst:

      (b1) eine hydrophile Schicht und
      (b2) eine hydrophobe Schicht.

2. Verpackung nach Anspruch 1, wobei die hydrophobe Schicht oben ist.

3. Verpackung nach Anspruch 1 oder Anspruch 2, wobei die hydrophobe Schicht ein Enzym umfasst.

4. Verpackung nach einem vorangehenden Anspruch, wobei das Volumenverhältnis der hydrophilen Schicht zu der hydrophoben Schicht mindestens etwa 60:40 ist.

5. Verpackung nach einem vorangehenden Anspruch, wobei die mindestens zwei Schichten insgesamt umfassen:

   i) etwa 5 bis etwa 90% eines Waschmitteltensids, auf das Gewicht der Zusammensetzung;
   ii) etwa 0,05 bis etwa 5% eines Enzyms.

6. Verpackung nach einem vorangehenden Anspruch, wobei die Zusammensetzung weiterhin einen hydrotropen Stoff umfasst.

7. Verpackung nach einem vorangehenden Anspruch, wobei die Zusammensetzung weiterhin ein Färbemittel umfasst.

8. Verpackung nach einem vorangehenden Anspruch, wobei der in Wasser lösliche Körper transparent ist.

9. Verpackung nach einem vorangehenden Anspruch, wobei die Zusammensetzung transparent ist.

10. Verpackung nach einem vorangehenden Anspruch, weiterhin umfassend eine dritte Schicht.

11. Verpackung nach einem vorangehenden Anspruch, wobei der in Wasser lösliche Körper in Form eines Tetraeders vorliegt.