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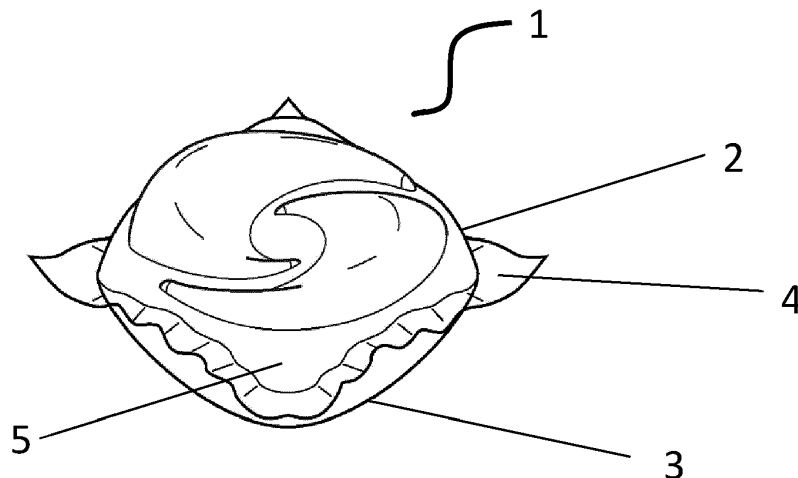
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(54) **WATER-SOLUBLE UNIT DOSE ARTICLE COMPRISING A NUCLEASE ENZYME**

(57) Water-soluble unit dose article comprising a water-soluble film and a detergent composition containing a nuclease enzyme.

FIG. 1



Description

FIELD OF THE INVENTION

5 **[0001]** Water-soluble unit dose article comprising a water-soluble film and a detergent composition containing a surfactant system comprising a non-soap anionic surfactant and a nonionic surfactant, and a nuclease enzyme.

BACKGROUND OF THE INVENTION

10 **[0002]** Water-soluble unit dose articles are liked by consumers as they offer convenience and ease to the laundry process. Without wishing to be bound by theory, the water-soluble unit dose article comprises a water-soluble film and a unitized dose of a laundry treatment composition which may be with one or more compartments within the unit dose article.

15 **[0003]** However, there is an on-going need to improve cleaning efficacy of such water-soluble unit dose articles, especially on reducing fabric malodours. Without wishing to be bound by theory, certain body soils can result in lingering malodours on fabrics, even following the wash process.

20 **[0004]** EP application 15190049.5 discloses that the addition of a nuclease enzyme would (partially) address this problem in which a laundry detergent composition with a protease enzyme and a surfactant system comprising a weight ratio of anionic surfactant to non-ionic surfactant of between 1.5:1 to 1:10 is taught. In other words, it teaches a nuclease enzyme in a high non-ionic surfactant matrix.

25 **[0005]** It was found however that low water detergent compositions rich in non-soap anionic surfactant while low in nonionic surfactant content seem to inhibit nuclease enzyme performance, especially within the lower water and higher total surfactant levels as typically found in water soluble unit dose articles. This impact is even more pronounced as the product ages over time. High anionic low nonionic surfactant-based formulations are desired however due to their high effectiveness on alternative product performance vectors, especially towards grease removal.

[0006] Therefore, there is a need in the art for a water-soluble unit dose article that comprises higher non-soap anionic surfactant to non-ionic surfactant and which also comprises a nuclease enzyme but in which inhibition of the nuclease enzyme activity is minimized, preferably for both freshly made and aged product.

30 **[0007]** It was surprisingly found that a water-soluble unit dose article comprising a nuclease enzyme in combination with a specific weight ratio of linear alkylbenzene sulphonate to ethoxylated alkyl sulphate overcame the above problem.

SUMMARY OF THE INVENTION

35 **[0008]** A water-soluble unit dose article comprising a water-soluble film and a laundry detergent composition, wherein the laundry detergent composition comprises a non-soap surfactant and a nuclease enzyme, wherein the non-soap surfactant comprises an anionic non-soap surfactant and non-ionic surfactant; and wherein, the weight ratio of non-soap anionic surfactant to nonionic surfactant is from 2:1 to 20:1; and wherein the non-soap anionic surfactant comprises linear alkylbenzene sulphonate, alkoxyated alkyl sulphate, or a mixture thereof, wherein the weight ratio of linear alkylbenzene sulphonate to alkoxyated alkyl sulphate is from 1:2 to 9:1; and wherein the laundry detergent composition comprises between 0.01% and 12% by weight of the laundry detergent composition of the non-ionic surfactant.

40 **[0009]** A second aspect of the present invention is a process for washing fabrics comprising the steps of diluting a water-soluble unit dose article according to the invention in water by a factor of between 200 and 3000 fold to create a wash liquor and contacting fabrics to be washed with said wash liquor.

BRIEF DESCRIPTION OF THE DRAWINGS

45 **[0010]** FIG.1 is a water-soluble unit dose article according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

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Water-soluble unit dose article

[0011] The present invention discloses a water-soluble unit dose article comprising a water-soluble film and a laundry detergent composition. The water-soluble film and the laundry detergent composition are described in more detail below.

55 **[0012]** The water-soluble unit dose article comprises the water-soluble film shaped such that the unit-dose article comprises at least one internal compartment surrounded by the water-soluble film. The unit dose article may comprise a first water-soluble film and a second water-soluble film sealed to one another such to define the internal compartment. The water-soluble unit dose article is constructed such that the detergent composition does not leak out of the compart-

ment during storage. However, upon addition of the water-soluble unit dose article to water, the water-soluble film dissolves and releases the contents of the internal compartment into the wash liquor.

[0013] The compartment should be understood as meaning a closed internal space within the unit dose article, which holds the detergent composition. During manufacture, a first water-soluble film may be shaped to comprise an open compartment into which the detergent composition is added. A second water-soluble film is then laid over the first film in such an orientation as to close the opening of the compartment. The first and second films are then sealed together along a seal region.

[0014] The unit dose article may comprise more than one compartment, even at least two compartments, or even at least three compartments. The compartments may be arranged in superposed orientation, i.e. one positioned on top of the other. In such an orientation the unit dose article will comprise three films, top, middle and bottom. Alternatively, the compartments may be positioned in a side-by-side orientation, i.e. one orientated next to the other. The compartments may even be orientated in a 'tyre and rim' arrangement, i.e. a first compartment is positioned next to a second compartment, but the first compartment at least partially surrounds the second compartment but does not completely enclose the second compartment. Alternatively, one compartment may be completely enclosed within another compartment.

[0015] Wherein the unit dose article comprises at least two compartments, one of the compartments may be smaller than the other compartment. Wherein the unit dose article comprises at least three compartments, two of the compartments may be smaller than the third compartment, and preferably the smaller compartments are superposed on the larger compartment. The superposed compartments preferably are orientated side-by-side.

[0016] In a multi-compartment orientation, the detergent composition according to the present invention may be comprised in at least one of the compartments. It may for example be comprised in just one compartment, or may be comprised in two compartments, or even in three compartments.

[0017] Each compartment may comprise the same or different compositions. The different compositions could all be in the same form, or they may be in different forms.

[0018] The water-soluble unit dose article may comprise at least two internal compartments, wherein the liquid laundry detergent composition is comprised in at least one of the compartments, preferably wherein the unit dose article comprises at least three compartments, wherein the detergent composition is comprised in at least one of the compartments.

[0019] FIG. 1 discloses a water-soluble unit dose article (1) according to the present invention. The water-soluble unit dose article (1) comprises a first water-soluble film (2) and a second water-soluble film (3) which are sealed together at a seal region (4). The liquid laundry detergent composition (5) is comprised within the water-soluble unit dose article (1).

Water-soluble film

[0020] The film of the present invention is soluble or dispersible in water. The water-soluble film preferably has a thickness of from 20 to 150 micron, preferably 35 to 125 micron, even more preferably 50 to 110 micron, most preferably about 76 micron.

[0021] Preferably, the film has a water-solubility of at least 50%, preferably at least 75% or even at least 95%, as measured by the method set out here after using a glass-filter with a maximum pore size of 20 microns:

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

[0022] Preferred film materials are preferably polymeric materials. The film material can, for example, be obtained by casting, blow-moulding, extrusion or blown extrusion of the polymeric material, as known in the art.

[0023] Preferred polymers, copolymers or derivatives thereof suitable for use as pouch material are selected from polyvinyl alcohols, polyvinyl pyrrolidone, polyalkylene oxides, acrylamide, acrylic acid, cellulose, cellulose ethers, cellulose esters, cellulose amides, polyvinyl acetates, polycarboxylic acids and salts, polyaminoacids or peptides, polyamides, polyacrylamide, copolymers of maleic/acrylic acids, polysaccharides including starch and gelatine, natural gums such as xanthum and carragum. More preferred polymers are selected from polyacrylates and water-soluble acrylate copolymers, methylcellulose, carboxymethylcellulose sodium, dextrin, ethylcellulose, hydroxyethyl cellulose, hydroxypropyl methylcellulose, maltodextrin, polymethacrylates, and most preferably selected from polyvinyl alcohols, polyvinyl alcohol copolymers and hydroxypropyl methyl cellulose (HPMC), and combinations thereof. Preferably, the level of polymer in the pouch material, for example a PVA polymer, is at least 60%. The polymer can have any weight average molecular weight, preferably from about 1000 to 1,000,000, more preferably from about 10,000 to 300,000 yet more preferably from about 20,000 to 150,000.

[0024] Preferably, the water-soluble film comprises polyvinyl alcohol polymer or copolymer, preferably a blend of

polyvinylalcohol polymers and/or polyvinylalcohol copolymers, preferably selected from sulphonated and carboxylated anionic polyvinylalcohol copolymers especially carboxylated anionic polyvinylalcohol copolymers, most preferably a blend of a polyvinylalcohol homopolymer and a carboxylated anionic polyvinylalcohol copolymer.

[0025] Preferred films exhibit good dissolution in cold water, meaning unheated distilled water. Preferably such films exhibit good dissolution at temperatures of 24°C, even more preferably at 10°C. By good dissolution it is meant that the film exhibits water-solubility of at least 50%, preferably at least 75% or even at least 95%, as measured by the method set out here after using a glass-filter with a maximum pore size of 20 microns, described above.

[0026] Preferred films are those supplied by Monosol under the trade references M8630, M8900, M8779, M8310.

[0027] The film may be opaque, transparent or translucent. The film may comprise a printed area.

[0028] The area of print may be achieved using standard techniques, such as flexographic printing or inkjet printing.

[0029] The film may comprise an aversive agent, for example a bittering agent. Suitable bittering agents include, but are not limited to, naringin, sucrose octaacetate, quinine hydrochloride, denatonium benzoate, or mixtures thereof. Any suitable level of aversive agent may be used in the film. Suitable levels include, but are not limited to, 1 to 5000ppm, or even 100 to 2500ppm, or even 250 to 2000rpm.

[0030] The water-soluble film or water-soluble unit dose article or both may be coated in a lubricating agent. Preferably, the lubricating agent is selected from talc, zinc oxide, silicas, siloxanes, zeolites, silicic acid, alumina, sodium sulphate, potassium sulphate, calcium carbonate, magnesium carbonate, sodium citrate, sodium tripolyphosphate, potassium citrate, potassium tripolyphosphate, calcium stearate, zinc stearate, magnesium stearate, starch, modified starches, clay, kaolin, gypsum, cyclodextrins or mixtures thereof.

Laundry detergent composition

[0031] The laundry detergent composition may be a powder, a liquid or a mixture thereof, preferably a liquid.

[0032] The term 'liquid laundry detergent composition' refers to any laundry detergent composition comprising a liquid capable of wetting and treating a fabric, and includes, but is not limited to, liquids, gels, pastes, dispersions and the like. The liquid composition can include solids or gases in suitably subdivided form, but the liquid composition excludes forms which are non-fluid overall, such as tablets or granules.

[0033] By powder we herein mean the laundry detergent composition may comprise solid particulates or may be a single homogenous solid. Preferably, the powder laundry detergent composition comprises particles. This means the powder laundry detergent composition comprises individual solid particles as opposed to the solid being a single homogenous solid. The particles may be free-flowing or may be compacted, preferably free-flowing.

[0034] The laundry detergent composition can be used in a fabric hand wash operation or may be used in an automatic machine fabric wash operation, preferably within an automatic machine fabric wash operation.

[0035] The laundry detergent composition comprises a nuclease enzyme. The nuclease enzyme is described in more detail below.

[0036] The laundry detergent composition comprises a non-soap surfactant, wherein the non-soap surfactant comprises an anionic non-soap surfactant and a non-ionic surfactant. Preferably, the laundry detergent composition comprises between 30% and 60%, more preferably between 35% and 50% by weight of the laundry detergent composition of the non-soap surfactant.

[0037] The weight ratio of non-soap anionic surfactant to nonionic surfactant is from 2:1 to 20:1 preferably from 3:1 to 17.5:1, more preferably from 5:1 to 15:1, most preferably from 7.5:1 to 12.5:1.

[0038] The non-soap anionic surfactant comprises linear alkylbenzene sulphonate, alkoxylated alkyl sulphate or a mixture thereof. The weight ratio of linear alkylbenzene sulphonate to alkoxylated alkyl sulphate is from 1:2 to 9:1, preferably from 1:1 to 7:1, more preferably from 1.25:1 to 5:1, most preferably from 1.5:1 to 3:1.

[0039] Exemplary linear alkylbenzene sulphonates are C₁₀-C₁₆ alkyl benzene sulfonic acids, or C₁₁-C₁₄ alkyl benzene sulfonic acids. By 'linear', we herein mean the alkyl group is linear. Alkyl benzene sulfonates are well known in the art.

[0040] The alkoxylated alkyl sulphate anionic surfactant may comprise ethoxylated alkyl sulphate or a mixture of non-ethoxylated and ethoxylated alkyl sulphate.

[0041] The alkoxylated alkyl sulphate anionic surfactant may comprise an ethoxylated alkyl sulphate anionic surfactant, preferably with a mol average degree of ethoxylation from 1 to 5, more preferably from 1 to 4, most preferably from 2 to 4.

[0042] The alkoxylated alkyl sulphate anionic surfactant may comprise a mixture of a non-ethoxylated alkyl sulphate and an ethoxylated alkyl sulphate, wherein the mol average degree of ethoxylation of the alkoxylated alkyl sulphate is from 1 to 5, more preferably from 1 to 4, most preferably from 2 to 4.

[0043] Preferably, the alkyl chain of the alkoxylated alkyl sulphate anionic surfactant is derived from a fatty alcohol, an oxo-synthesised alcohol, or a Guerbet alcohol.

[0044] Preferably, the laundry detergent composition comprises between 20% and 50%, more preferably between 30% and 40% by weight of the laundry detergent composition of the non-soap anionic surfactant.

[0045] Preferably, the non-ionic surfactant is selected from a fatty alcohol alkoxylate, an oxo-synthesised alcohol

alkoxylate, Guerbet alcohol alkoxylates, alkyl phenol alcohol alkoxylates or a mixture thereof.

[0046] The liquid laundry detergent composition comprises between 0.01% and 10%, preferably between 0.01% and 8%, more preferably between 0.1% and 6%, most preferably between 0.15% and 5% by weight of the liquid laundry detergent composition of a non-ionic surfactant.

[0047] Preferably, the detergent composition comprises between 1.5% and 20%, more preferably between 2% and 15%, even more preferably between 3% and 10%, most preferably between 4% and 8% by weight of the laundry detergent composition of soap, preferably a fatty acid salt, more preferably an amine neutralized fatty acid salt, wherein preferably the amine is an alkanolamine more preferably selected from monoethanolamine, diethanolamine, triethanolamine or a mixture thereof, more preferably monoethanolamine. Without wishing to be bound by theory, controlling the soap level within the laundry detergent composition can further contribute to the prevention of the nuclease activity inhibition impact of the overall surfactant system.

[0048] Preferably, the laundry detergent composition is a liquid laundry detergent composition, more preferably the liquid laundry detergent composition comprises less than 15%, more preferably less than 12% by weight of the liquid laundry detergent composition of water.

[0049] Preferably, the laundry detergent composition is a liquid laundry detergent composition comprising a non-aqueous solvent selected from 1,2-propanediol, dipropylene glycol, tripropyleneglycol, glycerol, sorbitol, polyethylene glycol or a mixture thereof. Preferably, the liquid laundry detergent composition comprises between 10% and 40%, preferably between 15% and 30% by weight of the liquid laundry detergent composition of the non-aqueous solvent. Without wishing to be bound by theory, careful selection of the non-aqueous solvent system within the liquid laundry detergent composition can further contribute to the prevention of the nuclease activity inhibition impact of the overall surfactant system.

[0050] Preferably, the laundry detergent composition comprises an adjunct ingredient selected from the group comprising builders including citrate, bleach, bleach catalyst, dye, hueing dye, brightener, cleaning polymers including alkoxylated polyamines and polyethyleneimines, soil release polymer, surfactant, solvent, dye transfer inhibitors, chelant, perfume, encapsulated perfume, polycarboxylates, structurant, pH trimming agents, and mixtures thereof.

[0051] Preferably, the laundry detergent composition comprises a further enzyme selected from the group comprising hemicellulases, peroxidases, proteases, cellulases, xylanases, lipases, phospholipases, esterases, cutinases, pectinases, keratanases, reductases, oxidases, phenoloxidases, lipoxigenases, ligninases, pullulanases, tannases, pentosanases, malanases, β -glucanases, arabinosidases, hyaluronidase, chondroitinase, laccase, xyloglucanases, mannanases and amylases, or mixtures thereof, preferably a further enzyme selected from the group comprising proteases, amylase, cellulase, lipases, xyloglucanases, mannanases, and mixtures thereof. Preferably the further enzyme is a lipase.

[0052] The term lipase as used herein, includes enzymes which catalyze the hydrolysis of fats (lipids). Lipases are a sub class of esterases. Lipases suitable in the present invention include phospholipases, acyltransferases or perhydrolases e.g. acyltransferases with homology to *Candida antarctica* lipase A, acyltransferase from *Mycobacterium smegmatis*, perhydrolases from the CE 7 family, and variants of the *M. smegmatis* perhydrolase in particular the S54V variant used in the commercial product Gentle Power Bleach from Huntsman Textile Effects Pte Ltd. Suitable lipases and cutinases include those of bacterial or fungal origin. Chemically modified or protein engineered mutant enzymes are included. Examples include lipase from *Thermomyces*, e.g. from *T. lanuginosus* (previously named *Humicola lanuginosa*), cutinase from *Humicola*, e.g. *H. insolens*, lipase from strains of *Pseudomonas* (some of these now renamed to *Burkholderia*), e.g. *P. alcaligenes* or *P. pseudoalcaligenes*, *P. cepacia*, *P. sp.* strain SD705, *P. wisconsinensis*, GDSL-type *Streptomyces* lipases, cutinase from *Magnaporthe grisea*, cutinase from *Pseudomonas mendocina*, lipase from *Thermobifida fusca*, *Geobacillus stearothermophilus* lipase, lipase from *Bacillus subtilis*, and lipase from *Streptomyces griseus* and *S. pristinae spiralis*. Typically, the lipase enzyme is present in the composition in an amount from 0.001% to 0.03%, preferably from 0.0025% to 0.025% and more preferably from 0.005% to 0.02% by weight of the composition of enzyme active protein. Without wishing to be bound by theory, enzymes are supplied as a preparation comprising the enzyme and other ingredients. Enzymes *per se* are proteins that catalyse reactions. By enzyme active protein we herein mean enzyme that can actively catalyse the relevant reaction.

[0053] Preferably, the laundry detergent composition has a pH between 6 and 10, more preferably between 6.5 and 8.9, most preferably between 7 and 8, wherein the pH of the laundry detergent composition is measured as a 10% product concentration in demineralized water at 20°C.

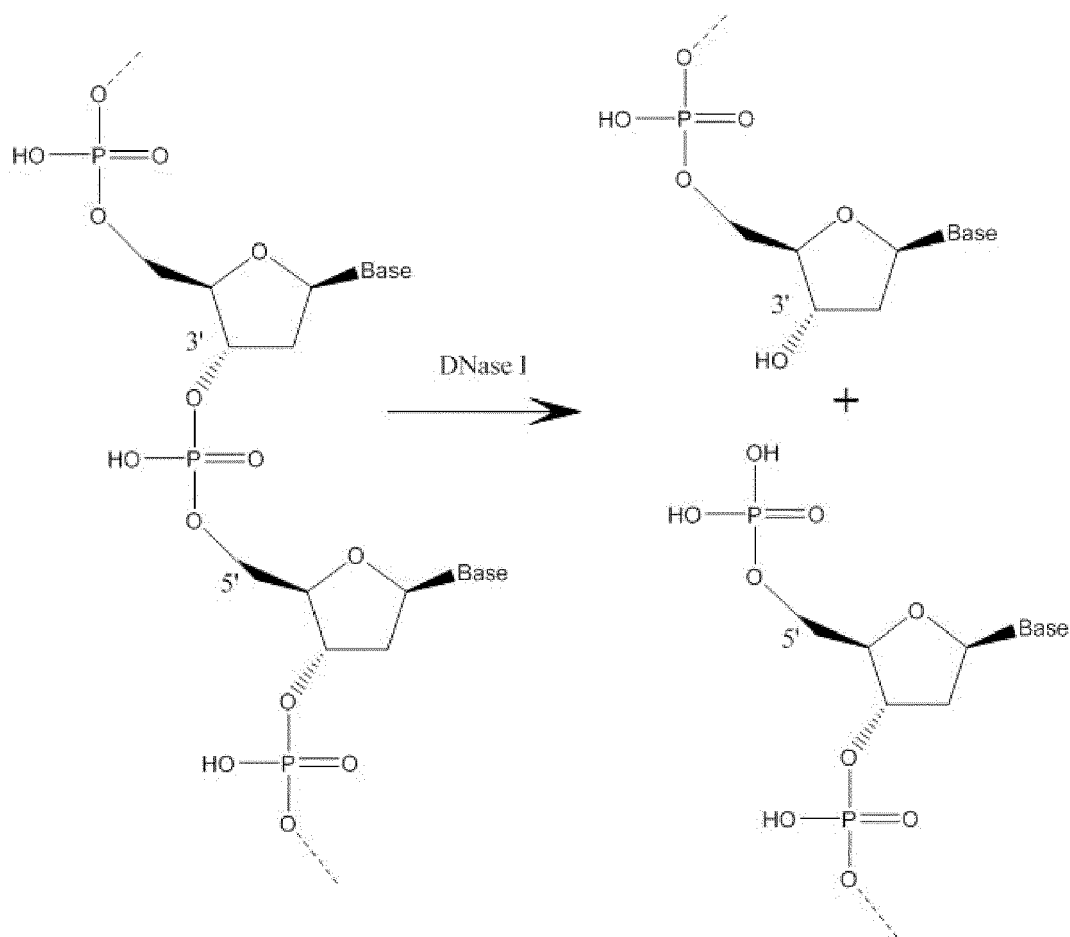
[0054] When liquid, the laundry detergent composition may be Newtonian or non-Newtonian. Preferably, the liquid laundry detergent composition is non-Newtonian. Without wishing to be bound by theory, a non-Newtonian liquid has properties that differ from those of a Newtonian liquid, more specifically, the viscosity of non-Newtonian liquids is dependent on shear rate, while a Newtonian liquid has a constant viscosity independent of the applied shear rate. The decreased viscosity upon shear application for non-Newtonian liquids is thought to further facilitate liquid detergent dissolution. The liquid laundry detergent composition described herein can have any suitable viscosity depending on factors such as formulated ingredients and purpose of the composition.

Nuclease enzyme

[0055] The laundry detergent composition comprises a nuclease enzyme. Typically, the nuclease enzyme is present in the composition in an amount from 0.001% to 0.03%, preferably from 0.0025% to 0.025% and more preferably from 0.005% to 0.02% by weight of the composition of enzyme active protein. Without wishing to be bound by theory, enzymes are supplied as a preparation comprising the enzyme and other ingredients. Enzymes *per se* are proteins that catalyse reactions. By enzyme active protein we herein mean enzyme that can actively catalyse the relevant reaction. The nuclease enzyme is an enzyme capable of cleaving the phosphodiester bonds between the nucleotide sub-units of nucleic acids. The nuclease enzyme herein is preferably a deoxyribonuclease or ribonuclease enzyme or a functional fragment thereof. By functional fragment or part is meant the portion of the nuclease enzyme that catalyzes the cleavage of phosphodiester linkages in the DNA backbone and so is a region of said nuclease protein that retains catalytic activity. Thus, it includes truncated, but functional versions, of the enzyme and/or variants and/or derivatives and/or homologues whose functionality is maintained.

[0056] Preferably the nuclease enzyme is a deoxyribonuclease, preferably selected from any of the classes E.C. 3.1.21.x, where x=1, 2, 3, 4, 5, 6, 7, 8 or 9, E.C. 3.1.22.y where y=1, 2, 4 or 5, E.C. 3.1.30.z where z= 1 or 2, E.C. 3.1.31.1 and mixtures thereof. Preferably, the nuclease enzyme is a microbial nuclease enzyme, preferably a bacterial nuclease enzyme. Preferably, the nuclease enzyme has both RNase and DNase activity, preferably being from E.C. 3.1.30.2.

[0057] Nucleases in class E.C. 3.1.21.x cleave at the 3' hydroxyl to liberate 5' phosphomonoesters as follows:



[0058] Nuclease enzymes from class E.C. 3.1.21.x and especially where x=1 are particularly preferred.

[0059] Nucleases in class E.C. 3.1.22.y cleave at the 5' hydroxyl to liberate 3' phosphomonoesters. Enzymes in class E.C. 3.1.30.z may be preferred as they act on both DNA and RNA and liberate 5'-phosphomonoesters. Such enzymes are commercially available as DENARASE® enzyme from c-LECTA.

[0060] Nuclease enzymes from class E.C. 3.1.31.1 produce 3'phosphomonoesters.

[0061] Preferably, the nuclease enzyme comprises a microbial enzyme. The nuclease enzyme may be fungal or bacterial in origin. Bacterial nucleases may be most preferred. Fungal nucleases may be most preferred.

[0062] Suitable bacterial nucleases are obtainable from/ variants of for example, *Bacillus sp* such as *Bacillus cibi*,

Bacillus subtilis, *Bacillus licheniformis*, *Bacillus bogoriensis*, *Bacillus lentus*, *Bacillus gibsonii*, *Bacillus amyloliquefaciens*, *Bacillus hemiellulosilyticus*; *Paenibacillus* sp such as *Paenibacillus woosongensis*, *Paenibacillus illinoisensis*, *Paenibacillus polymyxa*; or *Cytophaga* sp. The microbial nuclease is preferably obtainable from *Bacillus*, such as a *Bacillus cibi*, *Bacillus licheniformis* or *Bacillus subtilis* bacterial nucleases. A preferred *Bacillus licheniformis*, is strain EI-34-6. Most preferably the deoxyribonuclease is a variant of *Bacillus cibi*. Particularly preferred nuclease enzymes are described in copending application EP19219568 filed 23 December 2019.

[0063] Suitable fungal nucleases are obtainable from/variants of for example, *Humicola* sp. such as *Humicola insolens*; *Thielavia* sp., such as *Thielavia terrestris*; *Thermomyces* sp., such as *Thermomyces lanuginosus*, *Neobulgaria* sp.; *Preussia* sp., such as *Preussia aemulans*; *Yunnania* sp., such as *Yuunnania penicullata*; *Myrothecium* sp., such as *Myrothecium roridum*; *Chaetomium* sp. such as *Chaetomium Brasiliense*, *Chaetomium globosum* or *Chaetomium thermophilum*; *Ascobolus* sp. such as *Ascobolus stictoideus*, A preferred fungal nuclease is obtainable from *Aspergillus*, preferably *Aspergillus oryzae*.

[0064] Another suitable fungal nuclease is obtainable from *Trichoderma*, for example *Trichoderma harzianum*.

[0065] Other fungal nucleases include those encoded by the DNA sequences of *Aspergillus oryzae* RIB40, *Aspergillus oryzae* 3.042, *Aspergillus flavus* NRRL3357, *Aspergillus parasiticus* SU-1, *Aspergillus nomius* NRRL13137, *Trichoderma reesei* QM6a, *Trichoderma virens* Gv29-8, *Oidiodendron maius* Zn, *Metarhizium guizhouense* ARSEF 977, *Metarhizium majus* ARSEF 297, *Metarhizium robertsii* ARSEF 23, *Metarhizium acridum* CQMa 102, *Metarhizium brunneum* ARSEF 3297, *Metarhizium anisopliae*, *Colletotrichum fiorinae* PJ7, *Colletotrichum sublineola*, *Trichoderma atroviride* IMI 206040, *Tolypocladium ophioglossoides* CBS 100239, *Beauveria bassiana* ARSEF 2860, *Colletotrichum higginsianum*, *Hirsutella minnesotensis* 3608, *Scedosporium apiospermum*, *Phaeoconiella chlamydospora*, *Fusarium verticillioides* 7600, *Fusarium oxysporum* f. sp. cubense race 4, *Colletotrichum graminicola* M1.001, *Fusarium oxysporum* FOSC 3-a, *Fusarium avenaceum*, *Fusarium langsethiae*, *Grosmannia clavigera* kw1407, *Claviceps purpurea* 20.1, *Verticillium longisporum*, *Fusarium oxysporum* f. sp. cubense race 1, *Magnaporthe oryzae* 70-15, *Beauveria bassiana* D1-5, *Fusarium pseudograminearum* CS3096, *Neonectria ditissima*, *Magnaportheopsis poae* ATCC 64411, *Cordyceps militaris* CM01, *Marssonina brunnea* f. sp. 'multigermtubi' MB_m1, *Diaporthe ampelina*, *Metarhizium album* ARSEF 1941, *Colletotrichum gloeosporioides* Nara gc5, *Madurella mycetomatis*, *Metarhizium brunneum* ARSEF 3297, *Verticillium alfalfae* VaMs.102, *Gaeumannomyces graminis* var. tritici R3-111a-1, *Nectria haematococca* mpVI 77-13-4, *Verticillium longisporum*, *Verticillium dahliae* VdLs.17, *Torubiella hemipterigena*, *Verticillium longisporum*, *Verticillium dahliae* VdLs. 17, *Botrytis cinerea* B05.10, *Chaetomium globosum* CBS 148.51, *Metarhizium anisopliae*, *Stemphylium lycopersici*, *Sclerotinia borealis* F-4157, *Metarhizium robertsii* ARSEF 23, *Myceliophthora thermophila* ATCC 42464, *Phaeosphaeria nodorum* SN15, *Phialophora attae*, *Ustilaginoidea virens*, *Diplodia seriata*, *Ophiostoma piceae* UAMH 11346, *Pseudogymnoascus pannorum* VKM F-4515 (FW-2607), *Bipolaris oryzae* ATCC 44560, *Metarhizium guizhouense* ARSEF 977, *Chaetomium thermophilum* var. thermophilum DSM 1495, *Pestalotiopsis fici* W106-1, *Bipolaris zeicola* 26-R-13, *Setosphaeria turcica* Et28A, *Arthroderma otae* CBS 113480 and *Pyrenophora tritici-repentis* Pt-1C-BFP.

[0066] Preferably the nuclease is an isolated nuclease.

[0067] The nucleases may also give rise to biofilm-disrupting effects.

Process of washing

[0068] A further aspect of the present invention is a process for washing fabrics comprising the steps of diluting a water-soluble unit dose article according to the invention in water by a factor of between 200 and 3000 fold to create a wash liquor and contacting fabrics to be washed with said wash liquor. Preferably the wash liquor may comprise between 5L and 75L, preferably between 7L and 40L, more preferably between 10L and 20L of water. Preferably, the wash liquor is at a temperature of between 5°C and 90°C, preferably between 10°C and 60°C, more preferably between 12°C and 45°C, most preferably between 15°C and 40°C. Preferably, washing the fabrics in the wash liquor takes between 5 minutes and 50 minutes, preferably between 5 minutes and 40 minutes, more preferably between 5 minutes and 30 minutes, even more preferably between 5 minutes and 20 minutes, most preferably between 6 minutes and 18 minutes to complete. Preferably, the wash liquor comprises between 1kg and 20 kg, preferably between 3kg and 15kg, most preferably between 5 and 10 kg of fabrics. The wash liquor may comprise water of any hardness preferably varying between 0 gpg to 40gpg.

Method of making

[0069] Those skilled in the art will be aware of known methods to make the water-soluble unit dose article according to the present invention. Those skilled in the art will be aware of known methods to make the laundry detergent composition according to the present invention.

[0070] The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited

value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm."

EXAMPLES

[0071] The following is an exemplary low nonionic surfactant formulation having a high non-soap anionic to nonionic surfactant ratio with a linear alkylbenzene sulphonate to alkoxylated alkyl sulphate ratio according to the present invention, and an exemplary comparative composition having a low nonionic surfactant comparative formulation equally having a high non-soap anionic to nonionic surfactant ratio but with a linear alkylbenzene sulphonate to alkoxylated alkyl sulphate ratio outside the scope of the invention.

Table 1

<u>Ingredients</u>	Composition 1 (wt%)	Comparative Composition 1 (wt%)
Fatty alcohol ethoxylate non-ionic surfactant, C ₁₂₋₁₄ average degree of ethoxylation of 7	3.8	3.8
Lutensol XL100	0.5	0.5
Linear C ₁₁₋₁₄ alkylbenzene sulphonate	24.6	33.2
AE3S Ethoxylated alkyl sulphate with an average degree of ethoxylation of 3	12.5	3.3
Citric acid	0.7	0.7
Palm Kernel Fatty acid	5.3	4.8
Nuclease enzyme* (wt% active protein)	0.01	0.01
Protease enzyme (wt% active protein)	0.07	0.07
Amylase enzyme (wt% active protein)	0.005	0.005
Xyloglucanase enzyme (wt% active protein)	0.005	0.005
Mannanase enzyme (wt% active protein)	0.003	0.003
Ethoxylated polyethyleneimine	1.6	1.6
Amphiphilic graft copolymer	2.6	2.6
Zwitterionic polyamine	1.8	1.8
Anionic polyester terephthalate	0.6	0.6
HEDP	2.2	2.2
Brightener 49	0.4	0.4
Silicone anti-foam	0.3	0.3
Hueing dye	0.05	0.05
1,2 PropaneDiol	12.3	12.9
Glycerine	4.7	4.7
DPG (DiPropyleneGlycol)	1.7	1.7
TPG (TriPropyleneGlycol)	0.1	0.1
Sorbitol	0.1	0.1
Monoethanolamine	10.2	10.5
K ₂ SO ₃	0.4	0.4
MgCl ₂	0.3	0.3
water	10.8	11.1

(continued)

<u>Ingredients</u>	Composition 1 (wt%)	Comparative Composition 1 (wt%)
Hydrogenated castor oil	0.1	0.1
Perfume	2.1	2.1
Aesthetic dye & Minors	Balance to 100	Balance to 100
pH (10% product concentration in demineralized water at 20°C)	7.4	7.4
*Nuclease enzyme is as claimed in co-pending European application 19219568.3		

[0072] The following is a multi-compartment water soluble unit dose laundry article comprising a larger bottom compartment while having two smaller compartments in a side by side configuration superposed on top of the bottom compartment, following the Ariel 3-in-1 Pods design, as commercially available in the UK in January 2020. The overall water soluble unit dose article comprises an exemplary low nonionic surfactant formulation having a high non-soap anionic to nonionic surfactant ratio with a linear alkylbenzene sulphonate to alkoxylated alkyl sulphate ratio according to the present invention, together with a nuclease enzyme. The below compositions are enclosed in a polyvinyl alcohol based water soluble film, more specifically a water soluble film comprising a blend of a polyvinylalcohol homopolymer and a carboxylated anionic polyvinylalcohol copolymer.

Table 2

<u>Ingredients</u>	Full article Composition (wt%)	Bottom compartment Composition (wt%)	Top compartment Composition 1 (wt%)	Top compartment Composition 2 (wt%)
Volume	25.5ml	22.3ml	1.6ml	1.6ml
Fatty alcohol ethoxylate non-ionic surfactant, C12-14 average degree of ethoxylation of 7	3.5	3.7	2.6	1.6
Lutensol XL100	0.4	0.5	-	-
Linear C ₁₁₋₁₄ alkylbenzene sulphonate	24.2	24.9	18.9	19.4
AE3S Ethoxylated alkyl sulphate with an average degree of ethoxylation of 3	12.3	12.6	9.7	9.7
Citric acid	0.7	0.7	0.5	0.5
Palm Kernel Fatty acid	5.2	5.4	4.1	4.1
Nuclease enzyme* (wt% active protein)	0.009	0.011	-	-
Protease enzyme (wt% active protein)	0.05	0.06	-	-
Amylase enzyme (wt% active protein)	0.004	0.005	-	-
Xyloglucanase enzyme (wt% active protein)	0.005	-	0.073	-
Mannanase enzyme (wt% active protein)	0.003	0.003	-	-
Lipase enzyme (wt% active protein)	0.012	-	0.187	-

(continued)

Ingredients	Full article Composition (wt%)	Bottom compartment Composition (wt%)	Top compartment Composition 1 (wt%)	Top compartment Composition 2 (wt%)
Ethoxylated polyethyleneimine	1.5	1.6	1.2	1.2
Amphiphilic graft copolymer	2.0	2.3	-	-
Zwitterionic polyamine	1.8	1.9	1.4	1.4
Anionic polyester terephthalate	0.4	-	-	5.8
HEDP	2.2	2.2	1.7	1.7
Brightener 49	0.3	0.4	0.01	0.01
Silicone anti-foam	0.3	0.3	-	-
Hueing dye	0.04	-	0.69	-
1,2 PropaneDiol	13.6	12.8	11.3	26.4
Glycerine	6.0	5.0	17.3	8.3
DPG (DiPropyleneGlycol)	0.8	0.8	0.6	0.6
TPG (TriPropyleneGlycol)	0.06	0.06	-	-
Sorbitol	0.6	0.05	8.8	-
Monoethanolamine	10.0	10.4	7.9	8.0
K ₂ SO ₃	0.4	0.4	0.04	0.4
MgCl ₂	0.3	0.3	0.2	0.2
water	10.9	10.9	11.8	9.9
Hydrogenated castor oil	0.1	0.1	-	0.1
Perfume	1.6	1.9	-	-
Aesthetic dye & Minors (incl. preservative)	Balance to 100	Balance to 100	Balance to 100	Balance to 100
pH (10% product concentration in demineralized water at 20°C)	7.4	7.4	7.4	7.4
*Nuclease enzyme is as claimed in co-pending European application 19219568.3				

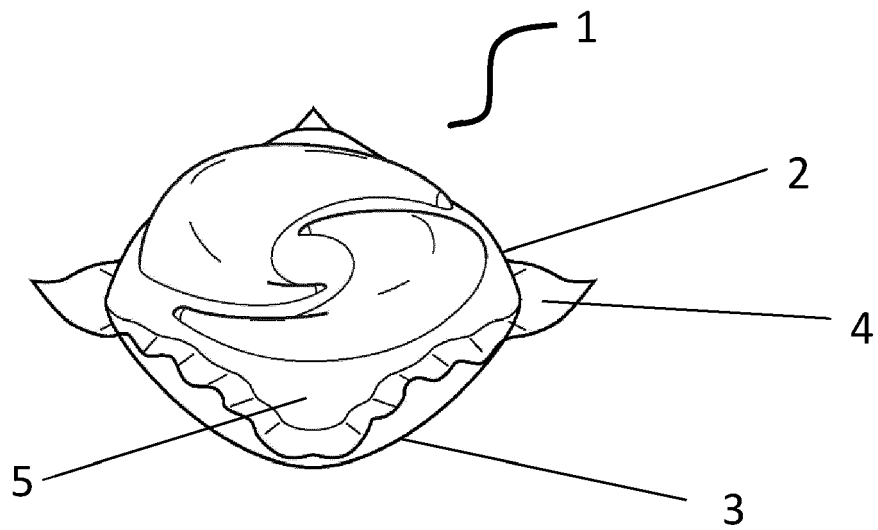
Claims

1. A water-soluble unit dose article comprising a water-soluble film and a laundry detergent composition, wherein the laundry detergent composition comprises a non-soap surfactant and a nuclease enzyme, wherein the non-soap surfactant comprises an anionic non-soap surfactant and a non-ionic surfactant; and wherein, the weight ratio of non-soap anionic surfactant to nonionic surfactant is from 2:1 to 20:1; and wherein the non-soap anionic surfactant comprises linear alkylbenzene sulphonate and alkoxylated alkyl sulphate, wherein the weight ratio of linear alkylbenzene sulphonate to alkoxylated alkyl sulphate is from 1:2 to 9:1; and wherein the laundry detergent composition comprises between 0.01% and 12% by weight of the laundry detergent composition of the non-ionic surfactant.
2. The water-soluble unit dose article according to claim 1, wherein the nuclease enzyme is selected from a deoxyribonuclease, a ribonuclease or a mixture thereof, preferably wherein the nuclease enzyme is selected from any of E.C. classes E.C. 3.1.21.x (where x=1, 2, 3, 4, 5, 6, 7, 8, 9), 3.1.22.y (where y=1, 2, 4, 5), E.C. 3.1.30.z (where z=1, 2) or E.C. 3.1.31.1, or mixtures thereof, preferably from E.C. 3.1.21, preferably E.C. 3.1.21.1.

3. The water-soluble unit dose article according to any preceding claims, wherein the nuclease enzyme is a microbial nuclease enzyme, preferably a bacterial nuclease enzyme, preferably wherein the nuclease enzyme has both RNase and DNase activity, more preferably being from E.C. 3.1.30.2.
- 5 4. The water-soluble unit dose article according to any preceding claims, wherein the nuclease enzyme is present in the laundry detergent composition in an amount from 0.001% to 0.03%, preferably from 0.0025% to 0.025% and more preferably from 0.005% to 0.02% by weight of the composition of enzyme active protein, wherein 'enzyme active protein' herein means enzyme that can actively catalyse the relevant reaction.
- 10 5. The water-soluble unit dose article according to any preceding claims wherein the laundry detergent composition comprises between 30% and 60%, more preferably between 35% and 50% by weight of the laundry detergent composition of the non-soap surfactant.
- 15 6. The water-soluble unit dose article according to any preceding claims, wherein the weight ratio of linear alkylbenzene sulphonate to alkoxylated alkyl sulphate is from 1:1 to 7:1, more preferably from 1.25:1 to 5:1, most preferably from 1.5:1 to 3:1.
- 20 7. The water-soluble unit dose article according to any preceding claims, wherein the laundry detergent composition comprises between 20% and 50%, more preferably between 30% and 40% by weight of the liquid laundry detergent composition of the non-soap anionic surfactant.
- 25 8. The water-soluble unit dose article according to any preceding claims, wherein the liquid laundry detergent composition comprises between 0.01% and 8%, more preferably between 0.1% and 6%, most preferably between 0.15% and 5% by weight of the liquid laundry detergent composition of the non-ionic surfactant, and preferably wherein the non-ionic surfactant is selected from a fatty alcohol alkoxyate, an oxo-synthesised alcohol alkoxyate, Guerbet alcohol alkoxyates, alkyl phenol alcohol alkoxyates or a mixture thereof, preferably wherein the alkoxyate is ethoxyate.
- 30 9. The water-soluble unit dose article according to any preceding claims, wherein, the weight ratio of non-soap anionic surfactant to nonionic surfactant is from 3:1 to 17.5:1, more preferably from 5:1 to 15:1, most preferably from 7.5:1 to 12.5:1.
- 35 10. The water-soluble unit according to any preceding claims wherein the laundry detergent composition is selected from liquid laundry detergents, powder laundry detergents or a mixture thereof, preferably wherein the laundry detergent composition is a liquid laundry detergent composition, more preferably wherein the liquid laundry detergent composition comprises less than 15%, more preferably less than 12% by weight of the liquid laundry detergent composition of water.
- 40 11. The water-soluble unit dose article according to claim 10, wherein the laundry detergent composition is a liquid laundry detergent composition comprising a non-aqueous solvent selected from 1,2-propanediol, dipropylene glycol, tripropyleneglycol, glycerol, sorbitol, polyethyleneglycol, or a mixture thereof, preferably wherein the liquid laundry detergent composition comprises between 10% and 40%, preferably between 15% and 30% by weight of the liquid laundry detergent composition of the non-aqueous solvent.
- 45 12. The water-soluble unit dose article according to any preceding claims wherein the laundry detergent composition comprises a further enzyme selected from the group comprising hemicellulases, peroxidases, proteases, cellulases, xylanases, lipases, phospholipases, esterases, cutinases, pectinases, keratanases, reductases, oxidases, phenoloxidases, lipoxigenases, ligninases, pullulanases, tannases, pentosanases, malanases, β -glucanases, arabinosidases, hyaluronidase, chondroitinase, laccase, xyloglucanases, mannanases and amylases, or mixtures thereof, preferably a further enzyme selected from the group comprising proteases, amylase, cellulase, lipases, xyloglucanases, mannanases, and mixtures thereof, most preferably the further enzyme is lipase.
- 50 13. The water-soluble unit dose article according to any preceding claims wherein the laundry detergent composition comprises an adjunct ingredient selected from the group comprising builders including citrate, bleach, bleach catalyst, dye, hueing dye, brightener, cleaning polymers including alkoxylated polyamines and polyethyleneimines, soil release polymer, surfactant, solvent, dye transfer inhibitors, chelant, perfume, encapsulated perfume, polycarboxylates, structurant and mixtures thereof.
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14. The water-soluble unit dose article according to any preceding claims wherein the water-soluble film comprises polyvinyl alcohol, preferably wherein the water-soluble film comprises polyvinyl alcohol polymer or copolymer, preferably a blend of polyvinylalcohol polymers and/or polyvinylalcohol copolymers, more preferably selected from sulphonated and carboxylated anionic polyvinylalcohol copolymers especially carboxylated anionic polyvinylalcohol copolymers, most preferably a blend of a polyvinylalcohol homopolymer and a carboxylated anionic polyvinylalcohol copolymer.
15. The water-soluble unit dose article according to any preceding claims wherein the water-soluble unit dose article comprises at least one internal compartment, wherein the laundry detergent composition is comprised within said compartment, preferably, wherein the water-soluble unit dose article comprises at least two internal compartments, more preferably at least three internal compartments.
16. A process for washing fabrics comprising the steps of diluting a water-soluble unit dose article according to any preceding claims in water by a factor of between 200 and 3000 fold to create a wash liquor and contacting fabrics to be washed with said wash liquor.

FIG. 1





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