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(54) Titre : COMPOSITIONS D'ADOUCISSANT TEXTILE
(54) Title: FABRIC SOFTENER COMPOSITIONS

(57) Abrégé/Abstract:
A fabric softener composition comprising a quaternary ammonium ester fabric softener compound and an enzyme selected from specific nuclease enzymes, galactanase enzymes and mannanase enzymes. Also, methods of treating a fabric comprising a laundering step, optional rinsing steps and a rinse-treatment step in which the fabric is treated with an aqueous rinse liquor comprising the composition.

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(54) Title: FABRIC SOFTENER COMPOSITIONS

(57) Abstract: A fabric softener composition comprising a quaternary ammonium ester fabric softener compound and an enzyme selected from specific nuclease enzymes, galactanase enzymes and mannanase enzymes. Also, methods of treating a fabric comprising a laundering step, optional rinsing steps and a rinse-treatment step in which the fabric is treated with an aqueous rinse liquor comprising the composition.

FABRIC SOFTENER COMPOSITIONS

FIELD OF INVENTION

This invention relates to softener compositions comprising enzymes.

BACKGROUND OF THE INVENTION

Microorganisms generally live attached to surfaces in many natural environments. Bi-products of bacteria may include extracellular substances including biopolymers and macromolecules which result in a soil which comprises slimy residue, or biofilm soil. Such slimy residues (biofilm soils) are difficult to remove from laundry items an adhesion of other soils such as particulates can be particularly problematic. Further, when very dirty laundry items are washed together with less dirty laundry items the dirt present in the wash liquor may adhere to the slimy residue soil so that some items may even be more "soiled" after washing. Build up of soils over time is undesirable for both coloured and white fabrics but may be particularly noticeable on white or pale-coloured fabrics, for example around collars and cuffs where incomplete cleaning occurs. These soils may exacerbate malodour, which may particularly develop after use of the laundry item and may be particularly problematic for example for sportswear.

International patent applications WO 2011/098579 (University of Newcastle) and WO 2014/087011 (Novozymes A/S) relate to deoxyribonuclease compounds and their uses. WO2016/176282 describes that compositions comprising nuclease enzymes have been found to be especially effective at cleaning fabrics having a fabric care composition deposited thereon.

SUMMARY OF THE INVENTION

This invention relates to a fabric softener composition comprising (i) from 2 to 50 wt% fabric softener compound comprising a quaternary ammonium ester compound having the following formula:

$\{R^2_{(4-m)} - N^+ - [X - Y - R^1]_m\}\ A^-$

wherein:

m is 1, 2 or 3 with proviso that the value of each m is identical;

each R^1 is independently hydrocarbyl, or branched hydrocarbyl group, preferably R^1 is linear, more preferably R^1 is partially unsaturated linear alkyl chain;

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each R^2 is independently a C_1-C_3 alkyl or hydroxyalkyl group, preferably R^2 is selected from methyl, ethyl, propyl, hydroxyethyl, 2-hydroxypropyl, 1-methyl-2-hydroxyethyl, poly(C_{2-3} alkoxy), polyethoxy, benzyl;

each X is independently $(CH_2)n$, CH_2-$CH(CH_3)$- or CH-(CH_3)-CH_2- and

each n is independently 1, 2, 3 or 4, preferably each n is 2;

each Y is independently -O-(O)C- or -C(O)-O-;

A- is independently selected from the group consisting of chloride, methyl sulfate, and ethyl sulfate, preferably A- is selected from the group consisting of chloride and methyl sulfate;

with the proviso that when Y is -O-(O)C-, the number of carbons in each R^1 is from 13 to 21, preferably from 13 to 19; and (ii) a soil-weakening enzyme selected from (a) nuclease enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in any of SEQ ID NOs 1 to 107, (b) galactanase enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in any of SEQ ID NO:108, SEQ ID NO:109 and SEQ ID NO:110, and (b) mannanase enzymes having at least 60% or at least 80%, or at least 90% or at least 95% sequence identity with the amino acid sequence shown in any of SEQ ID NO:111, SEQ ID NO:113, SEQ ID NO:114 and SEQ ID NO:115, and an amino acid sequence having at least 81% sequence identity to SEQ ID NO: 112 and (d) mixtures thereof.

In some embodiments, there is provided a fabric softener composition comprising:

(i) from 2 to 50 wt% fabric softener compound comprising a quaternary ammonium ester compound having the following formula:

$\{R^2_{(4-m)} - N^+ - [X - Y - R^1]_m\}\ A^-$

wherein:

m is 1, 2 or 3 with proviso that the value of each m is identical;

each R^1 is independently a linear hydrocarbyl or branched hydrocarbyl group;

each R^2 is independently a C_1-C_3 alkyl or hydroxyalkyl group;

each X is independently $(CH_2)n$, CH_2-$CH(CH_3)$- or CH-(CH_3)-CH_2-;

each n is independently 1, 2, 3 or 4;

each Y is independently -O-(O)C- or -C(O)-O-; and

A- is independently selected from the group consisting of chloride, methyl sulfate, and ethyl sulfate;

with the proviso that when Y is -O-(O)C-, the number of carbons in each R^1 is from 13 to 21; and

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(ii) a soil-weakening bacterial nuclease enzyme from a *Bacillus* species and selected from nuclease enzymes having at least 60%identity with the amino acid sequence shown in any of SEQ ID NOs 1-6, 8, 9-21, 23, 24, 27-30, 92-96, 98, 101, or 102.

Preferred nucleases are selected from deoxyribonuclease and ribonuclease enzymes.

The fabric softener component is selected from the group consisting of cationic softener components, silicone softener components, paraffins, waxes, dispersible polyolefins and mixtures thereof. Preferred softener components comprise cationic softener components, most preferably quaternary ammonium components, most preferably quaternary ammonium ester softening component. Preferably the fabric softener composition is a liquid.

The present invention also provides a method of treating a fabric, the method comprising the steps of (i) in a laundering step, treating a fabric with an aqueous wash liquor comprising from 0.1g/l to 5g/l of a surfactant, preferably comprising anionic and/or nonionic surfactant; (ii) optionally rinsing the textile one or two or more times with water; and (iii) in a rinse-treatment step, treating the fabric with an aqueous rinse liquor comprising soil-weakening enzyme selected from a soil-weakening enzyme selected from (a) nuclease enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in any of SEQ ID NOs 1 to 107, (b) galactanase enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in any of SEQ ID NO:108, SEQ ID NO:109 and SEQ ID NO:110, and (b) mannanase enzymes having at least 60% or at least 80%, or at least 90% or at least 95% sequence identity with the amino acid sequence shown in any of SEQ ID NO:111, SEQ ID NO:113, SEQ ID NO:114 and SEQ ID NO:115, and an amino acid sequence having at least 81% sequence identity to SEQ ID NO: 112 and (d) mixtures thereof, and fabric softener component; and (iv) drying the fabric. A further additional rinse step may be provided between steps (iii) and (iv) however it may be preferred for the fabric to be dried immediately after step (iii).

DETAILED DESCRIPTION OF THE INVENTION

Definitions

As used herein, the term "alkoxy" is intended to include C1-C8 alkoxy and C1-C8 alkoxy derivatives of polyols having repeating units such as butylene oxide, glycidol oxide, ethylene oxide or propylene oxide.

As used herein, unless otherwise specified, the terms "alkyl" and "alkyl capped" are intended to include C1-C18 alkyl groups, or even C1-C6 alkyl groups.

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As used herein, unless otherwise specified, the term “aryl” is intended to include C3-12 aryl groups.

As used herein, unless otherwise specified, the term “arylalkyl” and “alkaryl” are equivalent and are each intended to include groups comprising an alkyl moiety bound to an aromatic moiety, typically having C1-C18 alkyl groups and, in one aspect, C1-C6 alkyl groups.

The terms “ethylene oxide,” “propylene oxide” and “butylene oxide” may be shown herein by their typical designation of “EO,” “PO” and “BO,” respectively.

As used herein, the term “cleaning and/or treatment composition” includes, unless otherwise indicated, granular, powder, liquid, gel, paste, unit dose, bar form and/or flake type washing agents and/or fabric treatment compositions, including but not limited to products for laundering fabrics, fabric softening compositions, fabric enhancing compositions, fabric freshening compositions, and other products for the care and maintenance of fabrics, and combinations thereof. Such compositions may be pre-treatment compositions for use prior to a washing step or may be rinse added compositions, as well as cleaning auxiliaries, such as bleach additives and/or "stain-stick" or pre-treat compositions or substrate-laden products such as dryer added sheets.

As used herein, “cellulosic substrates” are intended to include any substrate which comprises cellulose, either 100% by weight cellulose or at least 20% by weight, or at least 30 % by weight or at least 40 or at least 50 % by weight or even at least 60 % by weight cellulose. Cellulose may be found in wood, cotton, linen, jute, and hemp. Cellulosic substrates may be in the form of powders, fibers, pulp and articles formed from powders, fibers and pulp. Cellulosic fibers, include, without limitation, cotton, rayon (regenerated cellulose), acetate (cellulose acetate), triacetate (cellulose triacetate), and mixtures thereof. Typically cellulosic substrates comprise cotton. Articles formed from cellulosic fibers include textile articles such as fabrics. Articles formed from pulp include paper.

As used herein, the term “maximum extinction coefficient” is intended to describe the molar extinction coefficient at the wavelength of maximum absorption (also referred to herein as the maximum wavelength), in the range of 400 nanometers to 750 nanometers.

As used herein “average molecular weight” is reported as an average molecular weight, as determined by its molecular weight distribution: as a consequence of their manufacturing process, polymers disclosed herein may contain a distribution of repeating units in their polymeric moiety.

As used herein the term "variant" refers to a polypeptide that contains an amino acid sequence that differs from a wild type or reference sequence. A variant polypeptide can differ from

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the wild type or reference sequence due to a deletion, insertion, or substitution of a nucleotide(s) relative to said reference or wild type nucleotide sequence. The reference or wild type sequence can be a full-length native polypeptide sequence or any other fragment of a full- length polypeptide sequence. A polypeptide variant generally has at least about 60% or at least about 65% or at least about 70% amino acid sequence identity with the reference sequence, but may include 75% amino acid sequence identity within the reference sequence, 80% amino acid sequence identity within the reference sequence, 85% amino acid sequence identity with the reference sequence, 86% amino acid sequence identity with the reference sequence, 87% amino acid sequence identity with the reference sequence, 88% amino acid sequence identity with the reference sequence, 89% amino acid sequence identity with the reference sequence, 90% amino acid sequence identity with the reference sequence, 91% amino acid sequence identity with the reference sequence, 92% amino acid sequence identity with the reference sequence, 93% amino acid sequence identity with the reference sequence, 94% amino acid sequence identity with the reference sequence, 95% amino acid sequence identity with the reference sequence, 96% amino acid sequence identity with the reference sequence, 97% amino acid sequence identity with the reference sequence, 98% amino acid sequence identity with the reference sequence, 98.5% amino acid sequence identity with the reference sequence or 99% amino acid sequence identity with the reference sequence.

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

As used herein, the terms "include/s"and "including" are meant to be non-limiting.

As used herein, the term "solid" includes granular, powder, bar and tablet product forms.

As used herein, the term "fluid" includes liquid, gel, paste and gas product forms.

Unless otherwise noted, all component or composition levels are in reference to the active portion of that component or composition, and are exclusive of impurities, for example, residual solvents or by-products, which may be present in commercially available sources of such components or compositions.

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

The cleaning and/or treatment composition will comprise in addition to the nuclease enzyme, any of the additional adjunct materials from such a cleaning and/or treatment composition, as described below.

Soil-Weakening Enzyme

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The soil-weakening enzyme is selected from a soil-weakening enzyme selected from (a) nuclease enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in any of SEQ ID NOs 1 to 107, (b) galactanase enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in any of SEQ ID NO:108, SEQ ID NO:109 and SEQ ID NO:110, and (b) mannanase enzymes having at least 60% or at least 80%, or at least 90% or at least 95% sequence identity with the amino acid sequence shown in any of SEQ ID NO:111, SEQ ID NO:113, SEQ ID NO:114 and SEQ ID NO:115, and an amino acid sequence having at least 81% sequence identity to SEQ ID NO: 112 and (d) mixtures thereof.

A preferred soil-weakening enzyme comprises a nuclease enzyme.

The soil-weakening enzyme is preferably present in the fabric softener composition in an amount from 0.0001 to 0.5 wt% based on weight of active protein in the composition, or from 0.001 to 0.3 wt% or from 0.002 to 0.2 wt% based on weight of active protein in the composition. Preferably the soil-wekending enzyme is present in the aqueous rinse liquor in an amount of from 0.01ppm to 1000 ppm based on active protein of the nuclease enzyme, or from 0.05 or from 0.1ppm to 750 or 500ppm. Optionally soil-weakening enzyme may also be present in the aqueous wash liquor, typically in an amount from0.01ppm to 1000 ppm of the enzyme.

Nuclease Enzyme

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 or mixtures 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.

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.

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

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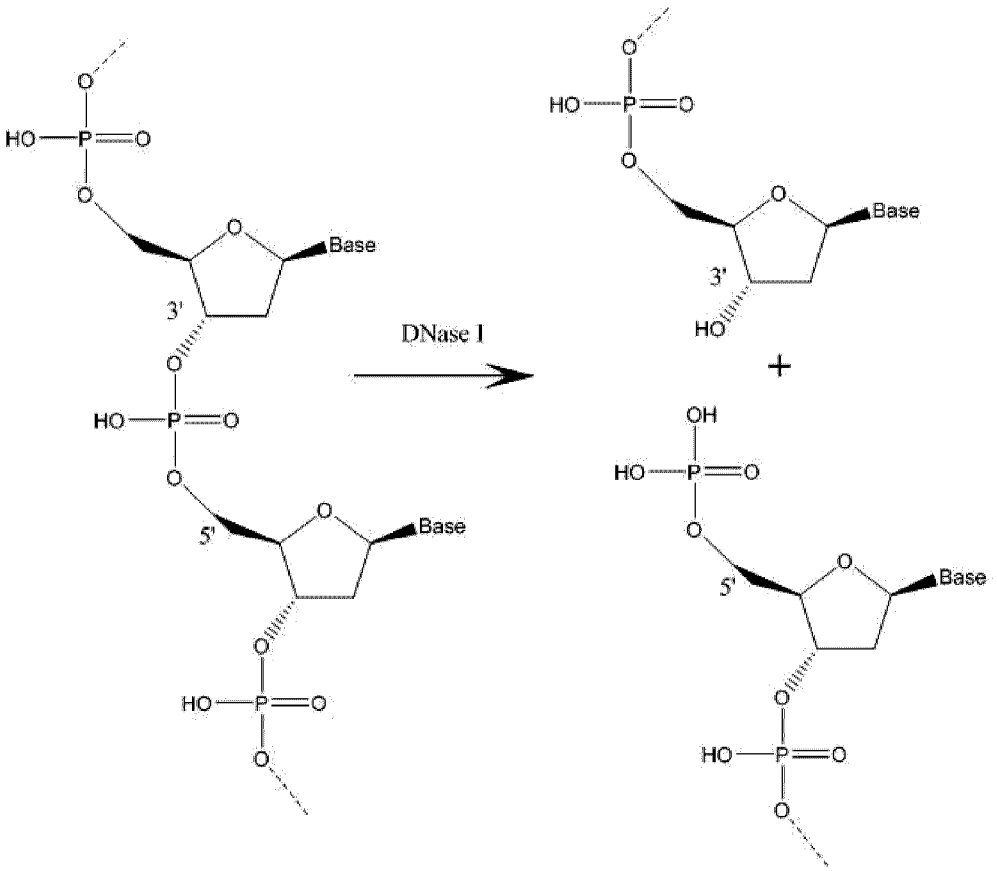

Nuclease enzymes from class E.C. 3.1.21.x and especially where x=1 are particularly preferred.

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. A preferred class of nucleases comprises nucleases from class E.C. 3.1.31.2, for example as described in US2012/0135498A, such as a variant of SEQ ID NO:3 therein. Such enzymes are commercially available as DENARASE® enzyme from c-LECTA. Nuclease enzymes from class E.C. 3.1.31.1 produce 3'phosphomonoesters.

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.

The microbial nuclease is obtainable from *Bacillus, Paenibacillus, Fictibacillus, Streptomyces, Exiguobacterium, Streptococcus, Jeotgalibacillus* bacteria.

Microbial nucleases obtainable from or being variants of *Bacillus* species may be preferred, such as a *Bacillus licheniformis, Bacillus subtilis, Bacillus sp-62451, Bacillus horikoshii, Bacillus sp-62520, Bacillus sp-16840, Bacillus sp-62668, Bacillus sp-13395, Bacillus horneckiae, Bacillus sp-11238, Bacillus cibi, Bacillus sp-18318, Bacillus idriensis, Bacillus algicola, Bacillus vietnamensis, Bacillus hwajinpoensis, Bacillus indicus, Bacillus marisflavi, Bacillus luciferensis, Bacillus sp. SA2-6, Bacillus sp-62738, Bacillus pumilus, Bacillus sp-62490, Bacillus sp-13390, Bacillus sp-62738, Bacillus sp-62599, Bacillus akibai,* bacterial nucleases may be preferred.

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 fioriniae* PJ7, *Colletotrichum sublineola, Trichoderma atroviride* IMI 206040, *Tolypocladium ophioglossoides* CBS 100239, *Beauveria bassiana* ARSEF 2860, *Colletotrichum higginsianum*, *Hirsutella minnesotensis* 3608, *Scedosporium apiospermum, Phaeomoniella 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, Magnaporthiopsis 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, *Torrubiella 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-

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1, *Bipolaris zeicola* 26-R-13, *Setosphaeria turcica* Et28A, *Arthroderma otae* CBS 113480 and *Pyrenophora tritici-repentis* Pt-1C-BFP.

Preferably the nuclease is an isolated nuclease.

Galactanases

The composition of the invention may comprise a β-1,6-galactanase enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in SEQ ID NO:108, SEQ ID NO:109 or SEQ ID NO:110. The term "endo-beta-1,6-galactanase" or "a polypeptide having endo-beta-1,6-galactanase activity" means a endo-beta-1,6-galactanase activity (EC 3.2.1.164) that catalyzes the hydrolytic cleavage of 1,6-3-D-galactooligosaccharides with a degree of polymerization (DP) higher than 3, and their acidic derivatives with 4-O-methylglucosyluronate or glucosyluronate groups at the non-reducing terminals.

For purposes of the present disclosure, endo-beta-1,6-galactanase activity is determined according to the procedure described in WO 2015185689 in Assay I. Suitable examples from class EC 3.2.1.164 are described in WO 2015185689, such as the mature polypeptide SEQ ID NO: 110 described herein. Preferably the galactanase enzyme is selected from Glycoside Hydrolase (GH) Family 30.

Preferably, the endo-beta-1,6-galactanase comprises a microbial enzyme. The endo-beta-1,6-galactanase may be fungal or bacterial in origin. Bacterial endo-beta-1,6-galactanase may be most preferred. Fungal endo-beta-1,6-galactanase may be most preferred.

A bacterial endo-beta-1,6-galactanase is obtainable from *Streptomyces*, for example *Streptomyces davawensis*. A preferred endo-beta-1,6-galactanase is obtainable from *Streptomyces davawensis* JCM 4913 defined in SEQ ID NO: 108 herein, or variant thereof, for example having at least 60% or 70% or 75% or 80% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identiity thereto.

Other bacterial endo-beta-1,6-galactanase include those obtainable from *Streptomyces avermitilis* according to SEQ ID NO:109 herein, or variant thereof, for example having at least 60% or 70% or 75% or 80% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identity thereto.

A fungal endo-beta-1,6-galactanase is obtainable from *Trichoderma*, for example *Trichoderma harzianum*. A preferred endo-beta-1,6-galactanase is obtainable from *Trichoderma harzianum* defined in SEQ ID NO: 110 herein, or variant thereof, for example having at least 60% or 70% or 75% or 80% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identity thereto.

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Other fungal endo-beta-1,6-galactanase include those encoded by the DNA sequences of *Ceratocystis fimbriata f. sp. Platani, Muscodor strobelii WG-2009a, Oculimacula yallundae, Trichoderma viride GD36A, Thermomyces stellatus, Myceliophthora thermophilia.*

Preferably the galactanase is an isolated galactanase.

Mannanases

The compositions of the invention may comprise a mannanase. The mannanase may be obtainable from *Ascobolus stictoideus* for example as defined in SEQ ID NO: 111 herein or a variant thereof, for example having at least 60% or 70% or 75% or 80% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identity thereto. The mannanase may be obtainable from *Chaetomium virescens* for example as defined in SEQ ID NO: 112 herein or a variant thereof, having at least 81% or 82% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identity thereto.

The mannanase may be obtainable from *Preussia aemulans* for example as defined in SEQ ID NO: 113 herein or a variant thereof, having at least 75% or 80% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identity thereto. The mannanase may be obtainable from *Yunnania penicillata* for example as defined in SEQ ID NO: 114 herein or a variant thereof, having at least 65% or 70% or 75% or 80% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identity thereto. The mannanase may be obtainable from *Myrothecium roridum* for example as defined in SEQ ID NO: 115 herein or a variant thereof, having at least 75% or 80% or 85% or 90% or 95%, 96%, 97%, 98%, 99% or 100% identity thereto.

For purposes of the present disclosure, mannanase activity may be determined using the Reducing End Assay as described in the experimental section of WO2015040159. Suitable examples from class EC 3.2.1.78 are described in WO2015040159, such as the mature polypeptide SEQ ID NO: 111 described herein. Preferably the mannanase is an isolated mannanase.

Preferred soil-weakening enzymes are selected from those obtainable from and/or a variant of the polypeptides shown in SEQ ID NOs: 1-115 and mixtures thereof. For example:

1.) a variant of the polypeptide shown in SEQ ID NO: 1

2.) a variant of the polypeptide shown in SEQ ID NO: 2

3.) a variant of the polypeptide shown in SEQ ID NO: 3

4.) a variant of the polypeptide shown in SEQ ID NO: 4

5.) a variant of the polypeptide shown in SEQ ID NO: 5

6.) a variant of the polypeptide shown in SEQ ID NO: 6

7.) a variant of the polypeptide shown in SEQ ID NO: 7

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8.) a variant of the polypeptide shown in SEQ ID NO: 8

9.) a variant of the polypeptide shown in SEQ ID NO: 9

10.) a variant of the polypeptide shown in SEQ ID NO: 10

11.) a variant of the polypeptide shown in SEQ ID NO: 11

12.) a variant of the polypeptide shown in SEQ ID NO: 12

13.) a variant of the polypeptide shown in SEQ ID NO: 13

14.) a variant of the polypeptide shown in SEQ ID NO: 14

15.) a variant of the polypeptide shown in SEQ ID NO: 15

16.) a variant of the polypeptide shown in SEQ ID NO: 16

17.) a variant of the polypeptide shown in SEQ ID NO: 17

18.) a variant of the polypeptide shown in SEQ ID NO: 18

19.) a variant of the polypeptide shown in SEQ ID NO: 19

20.) a variant of the polypeptide shown in SEQ ID NO: 20

21.) a variant of the polypeptide shown in SEQ ID NO: 21

22.) a variant of the polypeptide shown in SEQ ID NO: 22

23.) a variant of the polypeptide shown in SEQ ID NO: 23

24.) a variant of the polypeptide shown in SEQ ID NO: 24

25.) a variant of the polypeptide shown in SEQ ID NO: 25

26.) a variant of the polypeptide shown in SEQ ID NO: 26

27.) a variant of the polypeptide shown in SEQ ID NO: 27

28.) a variant of the polypeptide shown in SEQ ID NO: 28

29.) a variant of the polypeptide shown in SEQ ID NO: 29

30.) a variant of the polypeptide shown in SEQ ID NO: 30

31.) a variant of the polypeptide shown in SEQ ID NO: 31

32.) a variant of the polypeptide shown in SEQ ID NO: 32

33.) a variant of the polypeptide shown in SEQ ID NO: 33

34.) a variant of the polypeptide shown in SEQ ID NO: 34

35.) a variant of the polypeptide shown in SEQ ID NO: 35

36.) a variant of the polypeptide shown in SEQ ID NO: 36

37.) a variant of the polypeptide shown in SEQ ID NO: 37

38.) a variant of the polypeptide shown in SEQ ID NO: 38

39.) a variant of the polypeptide shown in SEQ ID NO: 39

40.) a variant of the polypeptide shown in SEQ ID NO: 40

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41.) a variant of the polypeptide shown in SEQ ID NO: 41
42.) a variant of the polypeptide shown in SEQ ID NO: 42
43.) a variant of the polypeptide shown in SEQ ID NO: 43
44.) a variant of the polypeptide shown in SEQ ID NO: 44
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47.) a variant of the polypeptide shown in SEQ ID NO: 47
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50.) a variant of the polypeptide shown in SEQ ID NO: 50
51.) a variant of the polypeptide shown in SEQ ID NO: 51
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54.) a variant of the polypeptide shown in SEQ ID NO: 54
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67.) a variant of the polypeptide shown in SEQ ID NO: 67
68.) a variant of the polypeptide shown in SEQ ID NO: 68
69.) a variant of the polypeptide shown in SEQ ID NO: 69
70.) a variant of the polypeptide shown in SEQ ID NO: 70
71.) a variant of the polypeptide shown in SEQ ID NO: 71
72.) a variant of the polypeptide shown in SEQ ID NO: 72
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74.) a variant of the polypeptide shown in SEQ ID NO: 74
75.) a variant of the polypeptide shown in SEQ ID NO: 75
76.) a variant of the polypeptide shown in SEQ ID NO: 76
77.) a variant of the polypeptide shown in SEQ ID NO: 77
78.) a variant of the polypeptide shown in SEQ ID NO: 78
79.) a variant of the polypeptide shown in SEQ ID NO: 79
80.) a variant of the polypeptide shown in SEQ ID NO: 80
81.) a variant of the polypeptide shown in SEQ ID NO: 81
82.) a variant of the polypeptide shown in SEQ ID NO: 82
83.) a variant of the polypeptide shown in SEQ ID NO: 83
84.) a variant of the polypeptide shown in SEQ ID NO: 84
85.) a variant of the polypeptide shown in SEQ ID NO: 85
86.) a variant of the polypeptide shown in SEQ ID NO: 86
87.) a variant of the polypeptide shown in SEQ ID NO: 87
88.) a variant of the polypeptide shown in SEQ ID NO: 88
89.) a variant of the polypeptide shown in SEQ ID NO: 89
90.) a variant of the polypeptide shown in SEQ ID NO: 90
91.) a variant of the polypeptide shown in SEQ ID NO: 91
92.) a variant of the polypeptide shown in SEQ ID NO: 92
93.) a variant of the polypeptide shown in SEQ ID NO: 93
94.) a variant of the polypeptide shown in SEQ ID NO: 94
95.) a variant of the polypeptide shown in SEQ ID NO: 95
96.) a variant of the polypeptide shown in SEQ ID NO: 96
97.) a variant of the polypeptide shown in SEQ ID NO: 97
98.) a variant of the polypeptide shown in SEQ ID NO: 98
99.) a variant of the polypeptide shown in SEQ ID NO: 99
100.) a variant of the polypeptide shown in SEQ ID NO: 100
101.) a variant of the polypeptide shown in SEQ ID NO: 101
102.) a variant of the polypeptide shown in SEQ ID NO: 102
103.) a variant of the polypeptide shown in SEQ ID NO: 103
104.) a variant of the polypeptide shown in SEQ ID NO: 104
105.) a variant of the polypeptide shown in SEQ ID NO: 105
106.) a variant of the polypeptide shown in SEQ ID NO: 106

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107.) a variant of the polypeptide shown in SEQ ID NO: 107
108.) a variant of the polypeptide shown in SEQ ID NO: 108
109.) a variant of the polypeptide shown in SEQ ID NO: 109
110.) a variant of the polypeptide shown in SEQ ID NO: 110
111.) a variant of the polypeptide shown in SEQ ID NO: 111
112.) a variant of the polypeptide shown in SEQ ID NO: 112
113.) a variant of the polypeptide shown in SEQ ID NO: 113
114.) a variant of the polypeptide shown in SEQ ID NO: 114
115.) a variant of the polypeptide shown in SEQ ID NO: 115
116.) mixtures thereof.

The soil-weakening enzymes may be present in the composition in microcapsules. The liquid compositions of the invention may comprise an enzyme, which may be a nuclease, galactanase and/or mannanase containing microcapsule, wherein the membrane of the microcapsule is produced by cross-linking of a polybranched polyamine having a molecular weight of more than 1 kDa. Encapsulating of enzymes in a microcapsule with a semipermeable membrane having a water activity inside these capsules (prior to addition to the liquid softener composition) higher than in the liquid softener composition, the capsules will undergo a (partly) collapse when added to the softener composition, thus leaving a more concentrated and more viscous enzyme containing interior in the capsules. The collapse of the membrane may also result in a reduced permeability.

This can be further utilized by addition of stabilizers/polymers, especially ones that are not permeable through the membrane. The collapse and resulting increase in viscosity will reduce/hinder the diffusion of hostile components (e.g., surfactants or sequestrants) into the capsules, and thus increase the storage stability of enzymes such as nucleases in the softener composition. Components in the softener composition that are sensitive to the enzyme (e.g., components that act as substrate for the enzyme) are also protected against degradation by the enzyme. During use the softener composition is diluted by water, thus increasing the water activity. Water will now diffuse into the capsules (osmosis). The capsules will swell and the membrane will either become permeable to the enzyme so they can leave the capsules, or simply burst and in this way releasing the enzyme. The concept is very efficient in stabilizing the enzymes against hostile components in softener compositions, and vice versa also protects enzyme sensitive components in the softener compositions from enzymes.

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Examples of components which are sensitive to, and can be degraded by, enzymes include (relevant enzyme in parenthesis): xanthan gum (xanthanase), polymers with ester bonds (lipase), hydrogenated castor oil (lipase), perfume (lipase), methyl ester sulfonate surfactants (lipase), cellulose and cellulose derivatives (e.g. CMC) (cellulase), and dextrin and cyclodextrin (amylase).

Also, sensitive ingredients can be encapsulated, and thus stabilized, in the microcapsules of the invention. Sensitive ingredients are prone to degradation during storage. Such sensitive ingredients include bleaching compounds, bleach activators, perfumes, polymers, builder, surfactants, etc.

Generally, the microcapsules can be used to separate incompatible components/compounds in detergents.

Addition of the microcapsules to detergents can be used to influence the visual appearance of the detergent product, such as an opacifying effect (small microcapsules) or an effect of distinctly visible particles (large microcapsules). The microcapsules may also be colored.

The microcapsules can be used to reduce the enzyme dust levels during handling and processing of enzyme products.

Microcapsule: The microcapsules are typically produced by forming a water-in-oil emulsion in which the enzymes and any other materials to be encapsulated are present in the aqueous phase, and subsequent formation of the membrane by interfacial polymerization via addition of a cross-linking agent. After eventual curing the capsules can be recovered and further rinsed and formulated by methods known in the art. The capsule formulation is subsequently added to the detergent.

The cross-linking agent(s) is typically subsequently added to the emulsion, either directly or more typically by preparing a solution of the crosslinking agent in a solvent which is soluble in the continuous phase. The emulsion and cross-linking agent or solution hereof can be mixed by conventional methods used in the art, e.g., by simple mixing or by carefully controlling the flows of the emulsion and the cross-linking agent solution through an in-line mixer.

The capsules may be post modified, e.g., by reacting components onto the membrane to hinder or reduce flocculation of the particles in the detergent as described in WO 99/01534.

The produced capsules can be isolated or concentrated by methods known in the art, e.g., by filtration, centrifugation, distillation or decantation of the capsule dispersion.

The resulting capsules can be further formulated, e.g., by addition of surfactants to give the product the desired properties for storage, transport and later handling and addition to the detergent. Other microcapsule formulation agents include rheology modifiers, biocides (e.g.,

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Proxel), acid/base for adjustment of pH (which will also adjust inside the microcapsules), and water for adjustment of water activity.

The capsule forming process may include the following steps:

- Preparation of the initial water and oil phase(s),
- Forming a water-in-oil emulsion,
- Membrane formation by interfacial polymerization,
- Optional post modification,
- Optional isolation and/or formulation,
- Addition to detergent.

The process can be either a batch process or a continuous or semi-continuous process.

A microcapsule may be a small aqueous sphere with a uniform membrane around it. The material inside the microcapsule is referred to as the core, internal phase, or fill, whereas the membrane is sometimes called a shell, coating, or wall. The microcapsules typically have diameters between 0.5 μm and 2 millimeters. Preferably, the mean diameter of the microcapsules is in the range of 1 μm to 1000 μm, more preferably in the range of 5 μm to 500 μm, even more preferably in the range of 10 μm to 500 μm, even more preferably in the range of 50 μm to 500 μm, and most preferably in the range of 50 μm to 200 μm. Alternatively, the diameter of the microcapsules is in the range of 0.5 μm to 30 μm; or in the range of 1 μm to 25 μm. The diameter of the microcapsule is measured in the oil phase after polymerization is complete. The diameter of the capsule may change depending on the water activity of the surrounding chemical environment.

Microencapsulation of enzymes may be carried out by interfacial polymerization, wherein the two reactants in a polymerization reaction meet at an interface and react rapidly. The basis of this method is a reaction of a polyamine with an acid derivative, usually an acid halide, acting as a crosslinking agent. The polyamine is preferably substantially water-soluble (when in free base form). Under the right conditions, thin flexible membranes form rapidly at the interface. One way of carrying out the polymerization is to use an aqueous solution of the enzyme and the polyamine, which are emulsified with a non-aqueous solvent (and an emulsifier), and a solution containing the acid derivative is added. An alkaline agent may be present in the enzyme solution to neutralize the acid formed during the reaction. Polymer (polyamide) membranes form instantly at the interface of the emulsion droplets. The polymer membrane of the microcapsule is typically of a cationic nature, and thus bind/complex with compounds of an anionic nature.

The diameter of the microcapsules is determined by the size of the emulsion droplets, which is controlled, for example by the stirring rate.

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Polyamine: The rigidity/flexibility and permeability of the membrane is mainly influenced by the choice of polyamine. The polyamine according to the invention is a polybranched polyamine. Each branch, preferably ending with a primary amino group serves as a tethering point in the membrane network, thereby giving the favourable properties of the invention. A polybranched polyamine according to the present invention is a polyamine having more than two branching points and more than two reactive amino groups (capable of reacting with the crosslinking agent, i.e., primary and secondary amino groups). The polybranched polyamine is used as starting material when the emulsion is prepared – it is not formed in situ from other starting materials. To obtain the attractive properties, the polybranched structure of the polyamine must be present as starting material.

There is a close relation between number of branching points and number of primary amines, since primary amines will always be positioned at the end of a branch: A linear amine can only contain two primary amines. For each branching point hypothetically introduced in such a linear di-amine will allow one or more primary amine(s) to be introduced at the end of the introduced branch(es). In this context we the primary amino group is understood as part of the branch, i.e., the endpoint of the branch. For example, both tris(2-aminoethyl)amine and 1,2,3-propanetriamine is considered as molecules having one branching point. The polyamine preferably has at least four primary amines. Branching points can be introduced from an aliphatic hydrocarbon chain from unsaturated carbon bonds, such as in, e.g., 3,3'-diaminobenzidine, or from tertiary amino groups, such as in N,N,N',N'-tetrakis-(2-aminoethyl)ethylenediamine.

In addition to the number of branching points, the compactness of the reactive amino groups is of high importance. A substance such as, e.g., N,N,N',N'-tetrakis-(12-aminododecyl)ethylenediamine would not be suitable. Neither would a peptide or protein, such as an enzyme, be suitable for membrane formation. Thus, the polybranched polyamine is not a peptide or protein.

The reactive amino groups preferably constitute at least 15% of the molecular weight of the polybranched polyamine, such as more than 20%, or more than 25%. Preferably, the molecular weight of the polybranched polyamine is at least 1 kDa; more preferably, the molecular weight of the polybranched polyamine is at least 1.3 kDa.

The polybranched polyamine may be a polyethyleneimine (PEI), and modifications thereof, having more than two branching points and more than two reactive amino groups; wherein the reactive amino groups constitute at least 15% of the molecular weight of the PEI, such as more than 20%, or more than 25%. Preferably, the molecular weight of the PEI is at least 1 kDa.

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Combinations of different polybranched polyamines may be used for preparing the microcapsule.

The advantageous properties (e.g., enzyme storage stability, reduced enzyme leakage, reduced in-flux of detergent ingredients) of the microcapsule may be improved by adding one or more small amines with a molecular weight of less than 1 kDa. The small amine is preferably substantially water-soluble (when in free base form) and can be a material such as ethylene diamine, hexamethylene diamine, hexane diamine, diethylene tetramine, ethylene tetramine, diamino benzene, piperazine, tetramethylene pentamine or, preferably, diethylene triamine (DETA). The small amines may be added in an amount of up to 50%, preferably up to 40%, up to 30%, up to 20%, up to 10%, or up to 5%, by weight of the total content of small amine and polybranched polyamine, when preparing the microcapsule.

Crosslinking agent: The crosslinking agent as used in the present invention is a molecule with at least two groups/sites capable of reacting with amines to form covalent bonds.

The crosslinking agent is preferably oil soluble and can be in the form of an acid anhydride or acid halide, preferably an acid chloride. For example, it can be adipoyl chloride, sebacoyl chloride, dodecanedioc acid chloride, phthaloyl chloride, terephthaloyl chloride, isophthaloyl chloride, or trimesoyl chloride; but preferably, the crosslinking agent is terephthaloyl chloride or trimesoyl chloride.

The microcapsule, as described above, may be added to the softener composition in an amount corresponding to from 0.0001% to 5% (w/w) active enzyme protein (AEP); preferably from 0.001% to 5%, more preferably from 0.005% to 5%, more preferably from 0.005% to 4%, more preferably from 0.005% to 3%, more preferably from 0.005% to 2%, even more preferably from 0.01% to 2%, and most preferably from 0.01% to 1% (w/w) active enzyme protein.

The microcaplsule is further described in WO 2014/177709.

<u>The quaternary ammonium ester compound</u>

The fabric softener composition of the present invention comprises from 2.0 wt% to 50 wt% of a fabric softener compound comprising a quaternary ammonium ester softening active (Fabric Softening Active, "FSA") by weight of the composition. In preferred fabric softener compositions, the quaternary ammonium ester softening active is present at a level from 3.0% to 30%, more preferably from 3.0% to 18 or 20%, even more preferably from 7.0% to 15% by weight of the composition. The level of quaternary ammonium ester softening active may depend on the desired concentration of total softening active in the composition (diluted or concentrated composition) and on the presence or not of other softening active. The risk on dispenser residues

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is especially present with high FSA concentration. On the other hand, at very high FSA levels, the viscosity may no longer be stable over time.

Suitable quaternary ammonium ester softening actives include but are not limited to, materials selected from the group consisting of monoester quats, diester quats, triester quats and mixtures thereof. Preferably, the level of monoester quat is from 2.0% to 40.0%, the level of diester quat is from 40.0% to 98.0%, the level of triester quat is from 0.0% to 25.0% by weight of total quaternary ammonium ester softening active.

Said quaternary ammonium ester softening active may comprise compounds of the following formula:

$$\{R^2_{(4-m)} - N^+ - [X - Y - R^1]_m\}\ A^-$$

wherein:

m is 1, 2 or 3 with proviso that the value of each m is identical;

each R^1 is independently hydrocarbyl, or branched hydrocarbyl group, preferably R^1 is linear, more preferably R^1 is partially unsaturated linear alkyl chain;

each R^2 is independently a C_1-C_3 alkyl or hydroxyalkyl group, preferably R^2 is selected from methyl, ethyl, propyl, hydroxyethyl, 2-hydroxypropyl, 1-methyl-2-hydroxyethyl, poly(C_2-$_3$ alkoxy), polyethoxy, benzyl;

each X is independently (CH_2)n, CH_2-$CH(CH_3)$- or CH-(CH_3)-CH_2- and each n is independently 1, 2, 3 or 4, preferably each n is 2;

each Y is independently -O-(O)C- or -C(O)-O-;

A- is independently selected from the group consisting of chloride, methyl sulfate, and ethyl sulfate, preferably A- is selected from the group consisting of chloride and methyl sulfate;

with the proviso that when Y is -O-(O)C-, the sum of carbons in each R^1 is from 13 to 21, preferably from 13 to 19.

The fabric softener composition herein is preferably a liquid fabric softener composition.

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The liquid fabric softener composition

As used herein, "liquid fabric softener composition" refers to any treatment composition comprising a liquid capable of softening fabrics e.g., clothing in a domestic washing machine. The composition can include solids or gases in suitably subdivided form, but the overall composition excludes product forms which are non-liquid overall, such as tablets or granules. The liquid fabric softener composition preferably has a density in the range from 0.9 to 1.3 $g.cm^{-3}$, excluding any solid additives but including any bubbles, if present.

Aqueous liquid fabric softening compositions are preferred. For such aqueous liquid fabric softener compositions, the water content can be present at a level of from 5% to 97%, preferably from 50% to 96%, more preferably from 70% to 95% by weight of the liquid fabric softener composition.

The pH of the neat fabric softener composition (see Methods) is typically acidic to improve hydrolytic stability of the quaternary ammonium ester softening active and may be from pH 2.0 to 6.0, preferably from pH 2.0 to 4.5, more preferably from 2.0 to 3.5.

To maintain phase stability of the fabric softener composition, the dynamic yield stress (see Methods) at 20°C of the fabric softener composition is from 0.001 Pa to 1.0 Pa, preferably from 0.002 Pa to 0.9 Pa, more preferably from 0.005 Pa to 0.8 Pa, even more preferably from 0.010 Pa to 0.5 Pa. On the one hand, absence of a dynamic yield stress may lead to phase instabilities, especially when the fabric softener composition comprises encapsulated benefit agents or particles. On the other hand, very high dynamic yield stresses may lead to undesired air entrapment during filling of a bottle with the fabric softener composition.

To provide a rich appearance while maintaining pourability of the fabrics softener composition, the viscosity (see Methods) of the fabric softener composition is from 200 mPa.s to 1000 mPa.s, preferably from 250 mPa.s to 900 mPa.s, more preferably from 300 mPa.s to 800 mPa.s, even more preferably from 350 mPa.s to 700 mPa.s at 20°C.

The liquid fabric softener composition may comprise adjunct ingredients suitable for use in the instant compositions and may be desirably incorporated in certain aspects of the invention, for example to improve the aesthetics of the composition as is the case with pigments and dyes. Moreover, liquid fabric softener compositions comprising unsaturated quaternary ammonium ester softening actives are subject to some degree of UV light and/or oxidation which increases the risk on yellowing of the fabric softener composition as well as yellowing of treated fabrics. However, especially in the presence of a dye any dispenser residue becomes more apparent. The

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liquid fabric softener composition may comprise from 0.0001% to 0.1%, preferably from 0.001% to 0.05% of a dye by weight of the composition. Suitable dyes are selected from the list comprising bis-azo dyes, tris-azo dyes, acid dyes, azine dyes, hydrophobic dyes, methane basic dyes, anthraquinone basic dyes, and dye conjugates formed by binding acid or basic dyes to polymers.

In preferred liquid fabric softener compositions, the iodine value of the parent fatty acid from which the quaternary ammonium fabric softening active is formed is from 0 to 100, more preferably from 10 to 60, even more preferably from 15 to 45.

Examples of suitable quaternary ammonium ester softening actives are commercially available from KAO Chemicals under the trade name Tetranyl™ AT-1 and Tetranyl™ AT-7590, from Evonik under the tradename Rewoquat™ WE16 DPG, Rewoquat™ WE18, Rewoquat™ WE20, Rewoquat™ WE28, and Rewoquat™ 38 DPG, from Stepan under the tradename Stepantex™ GA90, Stepantex™ VR90, Stepantex™ VK90, Stepantex™ VA90, Stepantex™ DC90, Stepantex™ VL90A.

These types of agents and general methods of making them are disclosed in U.S.P.N. 4,137,180.

Cellulose fibers:

Optionally the compositions of the invention may comprise cellulose fibers. These may be useful to thicken, and structure the fabric softener composition. They may be useful to help minimize the formation of dispenser residues. Where present, cellulose fibers are typically present in amounts from 0.01% to 5.0 %, more preferably 0.05% to 1.0%, even more preferably from 0.10% to 0.75% of cellulose fibers by weight of the composition.

By cellulose fibers it is meant herein cellulose micro or nano fibrils. The cellulose fibers can be of bacterial or botanical origin, i.e. produced by fermentation or extracted from vegetables, plants, fruits or wood. Cellulose fiber sources may be selected from the group consisting of citrus peels, such as lemons, oranges and/or grapefruit; fruits, such as apples, bananas and/or pear; vegetables such as carrots, peas, potatoes and/or chicory; plants such as bamboo, jute, abaca, flax, cotton and/or sisal, cereals, and different wood sources such as spruces, eucalyptus and/or oak. Preferably, the cellulose fibers source is selected from the group consisting of wood or plants, in particular, spruce, eucalyptus, jute, and sisal.

The content of cellulose in the cellulose fibers will vary depending on the source and treatment applied for the extraction of the fibers, and will typically range from 15% to 100%,

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preferably above 30%, more preferably above 50%, and even more preferably above 80% of cellulose by weight of the cellulose fibers.

Such cellulose fibers may comprise pectin, hemicellulose, proteins, lignin and other impurities inherent to the cellulose based material source such as ash, metals, salts and combinations thereof. The cellulose fibers are preferably non-ionic. Such fibers are commercially available, for instance Citri-Fi™ 100FG from Fiberstar, Herbacel® Classic from Herbafood, and Exilva® from Borregaard.

The cellulose fibers may have an average diameter from 10 nm to 350 nm, preferably from 30 nm to 250 nm, more preferably from 50 nm to 200 nm.

Non-ionic surfactants

It may be preferred for the fabric softener composition to comprise nonionic surfactant, for example from 0.01% to 5%, preferably from 0.1% to 3.0%, more preferably from 0.5% to 2.0% of non-ionic surfactant based on the total fabric softener composition weight. Non-ionic surfactants help to effectively disperse perfume into the fabric softener composition and improve the overall dispersability of the fabric softener composition into water.

In preferred liquid fabric softener compositions the non-ionic surfactant is an alkoxylated non-ionic surfactant, preferably an ethoxylated non-ionic surfactant. Preferably the alkoxylated non-ionic surfactant has an average degree of alkoxylation of at least 3, preferably from 5 to 100, more preferably from 10 to 60.

Preferably ethoxylated non-ionic surfactant, more preferably an ethoxylated non-ionic surfactant having a hydrophobic lipophilic balance value of 8 to 18.

Examples of suitable non-ionic surfactants are commercially available from BASF under the tradename Lutensol™ AT80 (ethoxylated alcohol with an average degree of ethoxylation of 80 from BASF), from Clariant under the tradename Genapol™ T680 (ethoxylated alcohol with an average degree of ethoxylation of 68), from Sigma Aldrich under the tradename Tween™ 20 (polysorbate with an average degree of ethoxylation of 20), from The Dow Chemical Company under the tradename Tergitol™ 15-S-30 (ethoxylated branched alcohol with an average degree of ethoxylation of 30).

Dispersed perfume

The liquid fabric softener composition of the present invention may comprise a dispersed perfume composition to provide a pleasant smell. By dispersed perfume we herein mean a perfume composition that is freely dispersed in the fabric softener composition and is not encapsulated. A perfume composition comprises one or more perfume raw materials. Perfume raw materials are

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the individual chemical compounds that are used to make a perfume composition. The choice of type and number of perfume raw materials is dependent upon the final desired scent. In the context of the present invention, any suitable perfume composition may be used. Those skilled in the art will recognize suitable compatible perfume raw materials for use in the perfume composition, and will know how to select combinations of ingredients to achieve desired scents.

Preferably, the level of dispersed perfume is at a level of from 0.1% to 10.0%, preferably from 0.5% to 7.5%, more preferably from 0.8% to 5.0% by total weight of the composition.

The perfume composition may comprise from 2.5% to 30%, preferably from 5% to 30% by total weight of perfume composition of perfume raw materials characterized by a logP lower than 3.0, and a boiling point lower than 250°C.

The perfume composition may comprise from 5% to 30%, preferably from 7% to 25% by total weight of perfume composition of perfume raw materials characterized by having a logP lower than 3.0 and a boiling point higher than 250°C. The perfume composition may comprise from 35% to 60%, preferably from 40% to 55% by total weight of perfume composition of perfume raw materials characterized by having a logP higher than 3.0 and a boiling point lower than 250°C. The perfume composition may comprise from 10% to 45%, preferably from 12% to 40% by total weight of perfume composition of perfume raw materials characterized by having a logP higher than 3.0 and a boiling point higher than 250°C.

Particles

The liquid fabric softener composition of the present invention may also comprise particles. The liquid fabric softener composition may comprise, based on the total liquid fabric softener composition weight, from 0.02% to 10%, preferably from 0.1% to 4%, more preferably from 0.25% to 2.5% of particles. Said particles include beads, pearlescent agents, benefit agent encapsulates, and mixtures thereof.

Encapsulated benefit agent:

The liquid fabric softener composition may comprise from 0.05% to 10%, preferably from 0.05% to 3.0%, more preferably from 0.05% to 2.0% by weight of encapsulated benefit agent. The benefit agent is selected from the group consisting of perfume composition, moisturizers, a heating or cooling agent, an insect/moth repellent, germ/mould/mildew control agents, softening agents, antistatic agents, anti-allergenic agents, UV protection agents, sun fade inhibitors, hueing dyes,

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additional enzymes and combinations thereof, color protection agents such as dye transfer inhibitors, bleach agents, and combinations thereof. Perfume compositions are preferred.

The benefit agent is encapsulated, for instance, as part of a core in one or more capsules. Such cores can comprise other materials, such as diluents, solvents and density balancing agents.

The capsules have a wall, which at least partially, preferably fully surrounds the benefit agent comprising core. The capsule wall material may be selected from the group consisting of melamine, polyacrylamide, silicones, silica, polystyrene, polyurea, polyurethanes, polyacrylate based materials, polyacrylate esters based materials, gelatin, styrene malic anhydride, polyamides, aromatic alcohols, polyvinyl alcohol, resorcinol-based materials, poly-isocyanate-based materials, acetals (such as 1,3,5-triol-benzene-gluteraldehyde and 1,3,5-triol-benzene melamine), starch, cellulose acetate phthalate and mixtures thereof.

Preferably, the capsule wall comprises one or more wall material comprising melamine, polyacrylate based material and combinations thereof.

Said melamine wall material may be selected from the group consisting of melamine crosslinked with formaldehyde, melamine-dimethoxyethanol crosslinked with formaldehyde, and combinations thereof.

Said polyacrylate based material may be selected from the group consisting of polyacrylate formed from methylmethacrylate/ dimethylaminomethyl methacrylate, polyacrylate formed from amine acrylate and/or methacrylate and strong acid, polyacrylate formed from carboxylic acid acrylate and/or methacrylate monomer and strong base, polyacrylate formed from an amine acrylate and/or methacrylate monomer and a carboxylic acid acrylate and/or carboxylic acid methacrylate monomer and combinations thereof.

Said polystyrene wall material may be selected from polyestyrene cross-linked with divinylbenzene.

Polyurea capsules can comprise a polyurea wall which is the reaction product of the polymerisation between at least one polyisocyanate comprising at least two isocyanate functional groups and at least one amine, preferably a polyfunctional amine as a cross-linking and a colloidal stabilizer.

Polyurethane capsules can comprise a polyureathane wall which is the reaction product of a polyfunctional isocyanate and a polyfunctional alcohol as a cross-linking agent and a colloidal stabilizer.

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Suitable capsules can be obtained from Encapsys (Appleton, Wisconsin, USA). The fabric softener compositions may comprise combinations of different capsules, for example capsules having different wall materials and/or benefit agents.

As mentioned earlier, perfume compositions are the preferred encapsulated benefit agent. The perfume composition comprises perfume raw materials. The perfume composition can further comprise essential oils, malodour reducing agents, odour controlling agents and combinations thereof.

The perfume raw materials are typically present in an amount of from 10% to 95%, preferably from 20% to 90% by weight of the capsule.

The perfume composition may comprise from 2.5% to 30%, preferably from 5% to 30% by total weight of perfume composition of perfume raw materials characterized by a logP lower than 3.0, and a boiling point lower than 250°C.

The perfume composition may comprise from 5% to 30%, preferably from 7% to 25% by total weight of perfume composition of perfume raw materials characterized by having a logP lower than 3.0 and a boiling point higher than 250°C. The perfume composition may comprise from 35% to 60%, preferably from 40% to 55% by total weight of perfume composition of perfume raw materials characterized by having a logP higher than 3.0 and a boiling point lower than 250°C. The perfume composition may comprise from 10% to 45%, preferably from 12% to 40% by total weight of perfume composition of perfume raw materials characterized by having a logP higher than 3.0 and a boiling point higher than 250°C.

Ratio of encapsulated benefit agent to dispersed perfume oil

The liquid fabric softener composition may comprise a ratio of perfume oil encapsulates to dispersed perfume oil by weight of from 1:1 to 1:40, preferably from 1:2 to 1:20, more preferably from 1:3 to 1:10.

Additional Fabric Softening Active

The liquid fabric softener composition of the present invention may comprise from 0.01% to 10%, preferably from 0.1% to 10%, more preferably from 0.1% to 5% of additional fabric softening active. Suitable fabric softening actives, include, but are not limited to, materials selected from the group consisting of non-ester quaternary ammonium compounds, amines, fatty esters, sucrose esters, silicones, dispersible polyolefins, polysaccharides, fatty acids, softening oils, polymer latexes and combinations thereof.

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Non-ester Quaternary ammonium compounds:

Suitable non-ester quaternary ammonium compounds comprise compounds of the formula:

[R(4-m) - N+ - R1m] X-

wherein each R comprises either hydrogen, a short chain C1-C6, in one aspect a C1-C3 alkyl or hydroxyalkyl group, for example methyl, ethyl, propyl, hydroxyethyl, poly(C2-3 alkoxy), polyethoxy, benzyl, or mixtures thereof; each m is 1, 2 or 3 with the proviso that the value of each m is the same; the sum of carbons in each R1may be C12-C22, with each R1 being a hydrocarbyl, or substituted hydrocarbyl group; and X- may comprise any softener-compatible anion. The softener-compatible anion may comprise chloride, bromide, methylsulfate, ethylsulfate, sulfate, and nitrate. The softener-compatible anion may comprise chloride or methyl sulfate.

Non-limiting examples include dialkylenedimethylammonium salts such as dicanoladimethylammonium chloride, di(hard)tallowdimethylammonium chloride dicanoladimethylammonium methylsulfate, and mixtures thereof. An example of commercially available dialkylenedimethylammonium salts usable in the present invention is dioleyldimethylammonium chloride available from Witco Corporation under the trade name Adogen® 472 and dihardtallow dimethylammonium chloride available from Akzo Nobel Arquad™ 2HT75.

Amines

Suitable amines include but are not limited to, materials selected from the group consisting of amidoesteramines, amidoamines, imidazoline amines, alkyl amines, and combinations thereof. Suitable ester amines include but are not limited to, materials selected from the group consisting of monoester amines, diester amines, triester amines and combinations thereof. Suitable amidoamines include but are not limited to, materials selected from the group consisting of monoamido amines, diamido amines and combinations thereof. Suitable alkyl amines include but are not limited to, materials selected from the group consisting of mono alkylamines, dialkyl amines quats, trialkyl amines, and combinations thereof.

Fatty Acid

The liquid fabric softener composition may comprise a fatty acid, such as a free fatty acid as fabric softening active. The term “fatty acid” is used herein in the broadest sense to include

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unprotonated or protonated forms of a fatty acid. One skilled in the art will readily appreciate that the pH of an aqueous composition will dictate, in part, whether a fatty acid is protonated or unprotonated. The fatty acid may be in its unprotonated, or salt form, together with a counter ion, such as, but not limited to, calcium, magnesium, sodium, potassium, and the like. The term "free fatty acid" means a fatty acid that is not bound to another chemical moiety (covalently or otherwise).

The fatty acid may include those containing from 12 to 25, from 13 to 22, or even from 16 to 20, total carbon atoms, with the fatty moiety containing from 10 to 22, from 12 to 18, or even from 14 (mid-cut) to 18 carbon atoms.

The fatty acids may be derived from (1) an animal fat, and/or a partially hydrogenated animal fat, such as beef tallow, lard, etc.; (2) a vegetable oil, and/or a partially hydrogenated vegetable oil such as canola oil, safflower oil, peanut oil, sunflower oil, sesame seed oil, rapeseed oil, cottonseed oil, corn oil, soybean oil, tall oil, rice bran oil, palm oil, palm kernel oil, coconut oil, other tropical palm oils, linseed oil, tung oil, castor oil, etc. ; (3) processed and/or bodied oils, such as linseed oil or tung oil via thermal, pressure, alkali-isomerization and catalytic treatments; (4) combinations thereof, to yield saturated (e.g. stearic acid), unsaturated (e.g. oleic acid), polyunsaturated (linoleic acid), branched (e.g. isostearic acid) or cyclic (e.g. saturated or unsaturated α-disubstituted cyclopentyl or cyclohexyl derivatives of polyunsaturated acids) fatty acids.

Mixtures of fatty acids from different fat sources can be used.

The cis/trans ratio for the unsaturated fatty acids may be important, with the cis/trans ratio (of the C18:1 material) being from at least 1:1, at least 3:1, from 4:1 or even from 9:1 or higher.

Branched fatty acids such as isostearic acid are also suitable since they may be more stable with respect to oxidation and the resulting degradation of color and odor quality.

The fatty acid may have an iodine value from 0 to 140, from 50 to 120 or even from 85 to 105.

Polysaccharides

The liquid fabric softener composition may comprise a polysaccharide as a fabric softening active, such as cationic starch. Suitable cationic starches for use in the present compositions are commercially-available from Cerestar under the trade name C*BOND® and from National Starch and Chemical Company under the trade name CATO® 2A.

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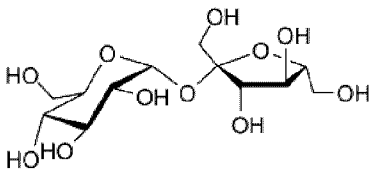
Sucrose esters

The liquid fabric softener composition may comprise a sucrose esters as a fabric softening active. Sucrose esters are typically derived from sucrose and fatty acids. Sucrose ester is composed of a sucrose moiety having one or more of its hydroxyl groups esterified.

Sucrose is a disaccharide having the following formula:



Alternatively, the sucrose molecule can be represented by the formula: $M(OH)_8$, wherein M is the disaccharide backbone and there are total of 8 hydroxyl groups in the molecule.

Thus, sucrose esters can be represented by the following formula:

$$M(OH)_{8-x}(OC(O)R^1)_x$$

wherein x is the number of hydroxyl groups that are esterified, whereas (8-x) is the hydroxyl groups that remain unchanged; x is an integer selected from 1 to 8, alternatively from 2 to 8, alternatively from 3 to 8, or from 4 to 8; and R^1 moieties are independently selected from C_1-C_{22} alkyl or C_1-C_{30} alkoxy, linear or branched, cyclic or acyclic, saturated or unsaturated, substituted or unsubstituted.

The R^1 moieties may comprise linear alkyl or alkoxy moieties having independently selected and varying chain length. For example, R^1 may comprise a mixture of linear alkyl or alkoxy moieties wherein greater than 20% of the linear chains are C_{18}, alternatively greater than 50% of the linear chains are C_{18}, alternatively greater than 80% of the linear chains are C_{18}.

The R^1 moieties may comprise a mixture of saturate and unsaturated alkyl or alkoxy moieties. The iodine value (IV) of the sucrose esters suitable for use herein ranges from 1 to 150, or from 2 to 100, or from 5 to 85. The R^1 moieties may be hydrogenated to reduce the degree of unsaturation. In the case where a higher IV is preferred, such as from 40 to 95, then oleic acid and fatty acids derived from soybean oil and canola oil are suitable starting materials.

The unsaturated R^1 moieties may comprise a mixture of "cis" and "trans" forms the unsaturated sites. The "cis" / "trans" ratios may range from 1:1 to 50:1, or from 2:1 to 40:1, or from 3:1 to 30:1, or from 4:1 to 20:1.

Dispersible Polyolefins and latexes:

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Generally, all dispersible polyolefins that provide fabric softening benefits can be used as fabric softening active in the present invention. The polyolefins can be in the form of waxes, emulsions, dispersions or suspensions.

The polyolefin may be chosen from a polyethylene, polypropylene, or combinations thereof. The polyolefin may be at least partially modified to contain various functional groups, such as carboxyl, alkylamide, sulfonic acid or amide groups. The polyolefin may be at least partially carboxyl modified or, in other words, oxidized.

Non-limiting examples of fabric softening active include dispersible polyethylene and polymer latexes. These agents can be in the form of emulsions, latexes, dispersions, suspensions, and the like. In one aspect, they are in the form of an emulsion or a latex. Dispersible polyethylenes and polymer latexes can have a wide range of particle size diameters (χ_{50}) including but not limited to from 1 nm to 100 μm; alternatively from 10 nm to 10 μm. As such, the particle sizes of dispersible polyethylenes and polymer latexes are generally, but without limitation, smaller than silicones or other fatty oils.

Generally, any surfactant suitable for making polymer emulsions or emulsion polymerizations of polymer latexes can be used as emulsifiers for polymer emulsions and latexes used as fabric softeners active in the present invention. Suitable surfactants include anionic, cationic, and nonionic surfactants, and combinations thereof. In one aspect, such surfactants are nonionic and/or anionic surfactants. In one aspect, the ratio of surfactant to polymer in the fabric softening active is 1:5, respectively.

Silicone:

The liquid fabric softener composition may comprise a silicone as fabric softening active. Useful silicones can be any silicone comprising compound. The silicone polymer may be selected from the group consisting of cyclic silicones, polydimethylsiloxanes, aminosilicones, cationic silicones, silicone polyethers, silicone resins, silicone urethanes, and combinations thereof. The silicone may be a polydialkylsilicone, alternatively a polydimethyl silicone (polydimethyl siloxane or "PDMS"), or a derivative thereof. The silicone may be chosen from an aminofunctional silicone, amino-polyether silicone, alkyloxylated silicone, cationic silicone, ethoxylated silicone, propoxylated silicone, ethoxylated/propoxylated silicone, quaternary silicone, or combinations thereof.

Further Perfume Delivery Technologies

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The liquid fabric softener composition may comprise one or more perfume delivery technologies that stabilize and enhance the deposition and release of perfume ingredients from treated substrate. Such perfume delivery technologies can be used to increase the longevity of perfume release from the treated substrate. Perfume delivery technologies, methods of making certain perfume delivery technologies and the uses of such perfume delivery technologies are disclosed in US 2007/0275866 A1.

The liquid fabric softener composition may comprise from 0.001% to 20%, or from 0.01% to 10%, or from 0.05% to 5%, or even from 0.1% to 0.5% by weight of the perfume delivery technology. Said perfume delivery technologies may be selected from the group consisting of: pro-perfumes, cyclodextrins, starch encapsulated accord, zeolite and inorganic carrier, and combinations thereof.

Amine Reaction Product (ARP): For purposes of the present application, ARP is a subclass or species of pro-perfumes. One may also use "reactive" polymeric amines in which the amine functionality is pre-reacted with one or more PRMs to form an amine reaction product (ARP). Typically the reactive amines are primary and/or secondary amines, and may be part of a polymer or a monomer (non-polymer). Such ARPs may also be mixed with additional PRMs to provide benefits of polymer-assisted delivery and/or amine-assisted delivery. Nonlimiting examples of polymeric amines include polymers based on polyalkylimines, such as polyethyleneimine (PEI), or polyvinylamine (PVAm). Nonlimiting examples of monomeric (non-polymeric) amines include hydroxyl amines, such as 2-aminoethanol and its alkyl substituted derivatives, and aromatic amines such as anthranilates. The ARPs may be premixed with perfume or added separately in leave-on or rinse-off applications. A material that contains a heteroatom other than nitrogen, for example oxygen, sulfur, phosphorus or selenium, may be used as an alternative to amine compounds. The aforementioned alternative compounds can be used in combinations with amine compounds. A single molecule may comprise an amine moiety and one or more of the alternative heteroatom moieties, for example, thiols, and phosphines. The benefit may include improved delivery of perfume as well as controlled perfume release.

Deposition Aid

The liquid fabric softener composition may comprise, based on the total liquid fabric softener composition weight, from 0.0001% to 3%, preferably from 0.0005% to 2%, more preferably from 0.001% to 1% of a deposition aid. The deposition aid may be a cationic or amphoteric polymer. The cationic polymer may comprise a cationic acrylate. Cationic polymers

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in general and their method of manufacture are known in the literature. Deposition aids can be added concomitantly with particles or directly in the liquid fabric softener composition. Preferably, the deposition aid is selected from the group consisting of polyvinylformamide, partially hydroxylated polyvinylformamide, polyvinylamine, polyethylene imine, ethoxylated polyethylene imine, polyvinylalcohol, polyacrylates, and combinations thereof.

The weight-average molecular weight of the polymer may be from 500 to 5000000 or from 1000 to 2000000 or from 2500 to 1500000 Dalton, as determined by size exclusion chromatography relative to polyethyleneoxide standards using Refractive Index (RI) detection. In one aspect, the weight-average molecular weight of the cationic polymer may be from 500 to 37500 Dalton.

Method

The present invention also provides a method of treating a fabric, the method comprising the steps of (i) in a laundering step, treating a fabric with an aqueous wash liquor comprising from 0.1g/l to 5g/l of a surfactant, preferably comprising anionic and/or nonionic surfactant; (ii) optionally rinsing the fabric one or two or more times with water; and (iii) in a rinse-treatment step, treating the fabric with an aqueous rinse liquor comprising soil-weakening enzyme selected from (i) nuclease enzymes, (ii) galactanase enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in SEQ ID NO:111, SEQ ID NO:112 or SEQ ID NO:113, and (iii) mannanase enzymes having at least 60% sequence identity to SEQ ID NO:114, or having at least 81% sequence identity to SEQ ID NO: 115, and (iv) mixtures thereof, and fabric softener component; and (iv) drying the fabric. A further additional rinse step may be provided between steps (iii) and (iv) however it may be preferred for the fabric to be dried immediately after step (iii).

The laundering step may be any conventional fabric washing step. A detergent composition can be used to form the aqueous wash liquor for use in the laundering. The detergent composition will comprise a surfactant and optional additional adjuncts.

Surfactant System

The surfactant system comprises an anionic surfactant and/or a nonionic surfactant wherein the weight ratio of anionic to non-ionic surfactant is from 1.5:1 to 1:10, preferably from 1.2:1 to 1:5, more preferably from 1:1 to 1:4.

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The total surfactant level in the cleaning composition is preferably from 5 to 80 % by weight, or from 10 to 50% by weight, more preferably from 15 to 45 % by weight.

Anionic Surfactant

The anionic surfactant may comprise one surfactant or typically mixtures of more than one surfactant. Preferred anionic detersive surfactants are alkyl benzene sulfonates, alkoxylated anionic surfactant, or a combination thereof. Suitable anionic detersive surfactants include sulphate and sulphonate detersive surfactants.

Particularly preferred alkyl benzene sulphonates are linear alkylbenzene sulphonates, particularly those having a carbon chain length of C8-15, or C10-13 alkyl benzene sulphonate. Suitable alkyl benzene sulphonate (LAS) is obtainable, or even obtained, by sulphonating commercially available linear alkyl benzene (LAB); suitable LAB includes low 2-phenyl LAB, such as those supplied by Sasol under the tradename Isochem® or those supplied by Petresa under the tradename Petrelab®, other suitable LAB include high 2-phenyl LAB, such as those supplied by Sasol under the tradename Hyblene®. Another suitable anionic detersive surfactant is alkyl benzene sulphonate that is obtained by DETAL catalyzed process, preferably having 8 to 15 carbon atoms. Other synthesis routes, such as HF, may also be suitable.

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

It may be preferred for the surfactant composition to comprise as additional anionic surfactant, in addition an alkyl alkoxylated sulphate, such as alkyl ethoxylated sulphate, or a C8-18 alkyl alkoxylated sulphate, or a C8-18 alkyl ethoxylated sulphate. Preferably the alkyl chain length may be from 12 to 16 carbon atoms. The alkyl alkoxylated sulphate may have an average degree of alkoxylation of from 0.5 to 20, or from 0.5 to 10, or from 0.5 to 7, or from 0.5 to 5 or from 0.5 to 3. Examples include predominantly C12 sodium lauryl ether sulphate ethoxylated with an average of 3 moles of ethylene oxide per mole.

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

The anionic detersive surfactant may be a mid-chain branched anionic detersive surfactant, such as a mid-chain branched alkyl sulphate and/or a mid-chain branched alkyl benzene

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sulphonate. The mid-chain branches are typically C1-4 alkyl groups, such as methyl and/or ethyl groups.

Another suitable anionic detersive surfactant is alkyl ethoxy carboxylate.

The anionic surfactants are typically present in their salt form, typically being complexed with a suitable cation. Suitable counter-ions include Na+ and K+, substituted ammonium such as C1-C6 alkanolammnonium such as mono-ethanolamine (MEA) tri-ethanolamine (TEA), di-ethanolamine (DEA), and any mixture thereof.

In the cleaning compositions, when alky (optionally ethoxylated) sulphates are present preferably the weight ratio of linear alkyl benzene sulphonate to alkyl sulphate and/or alkyl alkoxylated sulphate is from 20:1 to 1:2, more preferably from 5:1 to 1:1. Typically the anionic surfactant is present in the cleaning composition in an amount from 5 to 30 wt% anionic surfactant, or from at least 8 or at least 10 % by weight anionic surfactant.

Herein, fatty acid is not considered as a surfactant.

Nonionic Surfactant

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

Suitable non-ionic detersive surfactants include alkyl polyglucoside and/or an alkyl alkoxylated alcohol.

When alkyl alkoxylated alcohols are present, preferably they are selected from C_{8-18} alkyl alkoxylated alcohol, for example a C_{8-18} alkyl ethoxylated alcohol. Preferably the alkyl alkoxylated alcohol has an average degree of alkoxylation of from 1 to 80, preferably from 1 to 50, most preferably from 1 to 30, from 1 to 20, or from 1 to 10. Preferred nonionic surfactants may be C_{8-18} alkyl alkoxylated, preferably ethoxylated alcohols having an average degree of alkoxylation, preferably ethoxylation of from 1 to 10, from 1 to 7, more from 1 to 5 or from 3 to

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7, or even below 3 or 2. The alkyl alkoxylated alcohol can be linear or branched, and substituted or un-substituted.

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

Typically the nonionic surfactant is present in the cleaning composition in an amount from 4 to 40 wt% anionic surfactant, or from at least from 8 or at least from 10 % by weight, or from 12 10 % by weight nonionic surfactant.

Detergent compositions may be in any suitable form, for example, solid such as powder detergent or liquid or in unit dose form. It may be preferred for a liquids to be an externally structured aqueous isotropic liquid laundry detergent composition.

The wash liquor comprises from 0.1g/l to 5g/l of the surfactant system.

Detergent Composition Adjunct Materials

Further suitable adjuncts may be, for example to assist or enhance cleaning performance, or to modify the aesthetics of the detergent composition as is the case with perfumes, colorants, non-fabric-shading dyes or the like. Suitable adjunct materials include, but are not limited to, surfactants, builders, chelating agents, dispersants, enzymes, and enzyme stabilizers, catalytic materials, bleach activators, hydrogen peroxide, sources of hydrogen peroxide, preformed peracids, polymeric dispersing agents, clay soil removal/anti-redeposition agents, additional brighteners, suds suppressors, dyes, hueing dyes, perfumes, perfume delivery systems, structure elasticizing agents, fabric softeners, carriers, hydrotropes, processing aids, solvents, additional dyes and/or pigments, some of which are discussed in more detail below. In addition to the disclosure below, suitable examples of such other adjuncts and levels of use are found in U.S. Patent Nos. 5,576,282, 6,306,812 B1 and 6,326,348 B1.

Generally, an effective amount of such a composition is added to water, for example in a conventional fabric automatic washing machine, to form the aqueous wash liquor. The aqueous wash liquor so formed is then contacted, typically under agitation, with the fabrics to be laundered. An effective amount of the detergent composition added to water to form aqueous laundering solutions can comprise amounts sufficient to form from about 500 to 25,000 ppm, or from 500 to 15,000 ppm of composition in aqueous washing solution, or from about 1,000 to 3,000 ppm of the detergent compositions herein will be provided in aqueous washing solution.

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

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even to 1.5g/l. The method of laundering fabric or textile may be carried out in a top-loading or front-loading automatic washing machine, or can be used in a hand-wash laundry application. In these applications, the wash liquor formed and concentration of laundry detergent composition in the wash liquor is that of the main wash cycle. Any input of water during any optional rinsing step(s) is not included when determining the volume of the wash liquor.

The wash liquor may comprise 40 litres or less of water, or 30 litres or less, or 20 litres or less, or 10 litres or less, or 8 litres or less, or even 6 litres or less of water. The wash liquor may comprise from above 0 to 15 litres, or from 2 litres, and to 12 litres, or even to 8 litres of water. Typically from 0.01kg to 2kg of fabric per litre of wash liquor is dosed into said wash liquor. Typically from 0.01kg, or from 0.05kg, or from 0.07kg, or from 0.10kg, or from 0.15kg, or from 0.20kg, or from 0.25kg fabric per litre of wash liquor is dosed into said wash liquor. Optionally, 50g or less, or 45g or less, or 40g or less, or 35g or less, or 30g or less, or 25g or less, or 20g or less, or even 15g or less, or even 10g or less of the composition is contacted to water to form the wash liquor. Such compositions are typically employed at concentrations of from about 500 ppm to about 15,000 ppm in solution. When the wash solvent is water, the water temperature typically ranges from about 5 °C to about 90 °C and, when the situs comprises a fabric, the water to fabric ratio is typically from about 1:1 to about 30:1. Typically the wash liquor comprising the detergent of the invention has a pH of from 3 to 11.5.

The laundering step may be followed by one or more optional rinsing steps. In the subsequent rinse-treatment step (iii), the fabric is treated with an aqueous rinse liquor comprising soil-weakening enzyme selected from (i) nuclease enzymes, (ii) galactanase enzymes having at least 60%, or at least 80%, or at least 90% or at least 95% identity with the amino acid sequence shown in SEQ ID NO:108, SEQ ID NO:109 or SEQ ID NO:110, and (iii) mannanase enzymes having at least 60% sequence identity to SEQ ID NO:114, or having at least 81% sequence identity to SEQ ID NO: 115, and (iv) mixtures thereof, and fabric softener component. This can be achieved by adding the softener composition described herein into the rinse water, either in a hand washing processing or in a laundry washing machine rinse step. This step is preferably the final rinse step, immediately before drying the fabric. If desired a rinse step may take place between the rinse-treatment step and dyring the fabric.

Drying of the fabric may be by any conventional means either in domestic or industrial settings: machine drying or open-air drying. The fabric may comprise any fabric capable of being laundered in normal consumer or institutional use conditions, and the invention is particularly suitable for synthetic textiles such as polyester and nylon and especially for treatment of mixed

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fabrics and/or fibres comprising synthetic and cellulosic fabrics and/or fibres. As examples of synthetic fabrics are polyester, nylon, these may be present in mixtures with cellulosic fibres, for example, polycotton fabrics. The water temperatures typically range from about 5 ºC to about 90 ºC, though lower water temperatures up to 60 or 40 or 30 ºC are useful. The water to fabric ratio is typically from about 1:1 to about 30:1.

METHODS

For each method applied to a fabric softener composition, a visually homogeneous sample is used. In case the fabric softener composition is visually not homogeneous, the entire fabric softener composition is homogenized in a way to avoid air entrapment, prior to sampling to ensure representative sampling.

Method for determining viscosity and dynamic yield stress

Viscosity and dynamic yield stress are measured using a controlled stress rheometer (such as an HAAKE MARS™ from Thermo Scientific, or equivalent), using a 60 mm parallel plate and a gap size of 500 microns at 20°C. The viscosity and dynamic yield stress are obtained by measuring quasi steady state shear stress as a function of shear rate in the range starting from 10 s^{-1} to 10^{-4} s^{-1}, taking 25 points logarithmically distributed over the shear rate range. Quasi-steady state is defined as the shear stress value once variation of shear stress over time is less than 3%, after at least 30 seconds and a maximum of 60 seconds at a given shear rate. Variation of shear stress over time is continuously evaluated by comparison of the average shear stress measured over periods of 3 seconds. If after 60 seconds measurement at a certain shear rate, the shear stress value varies more than 3%, the final shear stress measurement is defined as the quasi state value for calculation purposes. The viscosity of the fabric softener composition is defined as the measured shear stress divided by the applied shear rate of 10 s^{-1}.

Shear stress data is then fitted using least squares method in logarithmic space as a function of shear rate following a Herschel – Bulkley model:

$$\tau = \tau_0 + k\dot{\gamma}^n$$

wherein τ is the measured equilibrium quasi steady state shear stress at each applied shear rate $\dot{\gamma}$, τ_0 is the fitted dynamic yield stress. k and n are fitting parameters.

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Method of determining pH of a fabric softener composition

The pH is measured on the neat fabric softener composition, using a Sartorius™ PT-10P pH meter with gel-filled probe (such as the Toledo probe, part number 52 000 100), calibrated according to the instructions manual.

Method for determining fabric softener active by CatSO3 titration

The fabric softener activity is determined by cationic $CatSO_3$ titration as described in ISO2871.

Specifically, to a sample containing cationic fabric softener active, a mixed indicator composed of a cationic and an anionic dye is added under stirring in a water-chloroform system. The cationic fabric softener active - anionic dye complex is blue and chloroform soluble, whereas the red cationic dye remains dissolved in the aqueous phase. Upon titration with anionic surfactant (standardized sodium dodecyl sulfate, "NaLS"), the blue dye-surfactant complex in the chloroform breaks and a colorless cationic fabric softening active – anionic titrant complex is formed while the liberated blue dye migrates back into the aqueous phase. A color change from blue to grey in the chloroform layer indicates the endpoint. Excess anionic surfactant forms a complex with the red cationic dye, giving a pink to red color to the chloroform layer.

Calculation:

% Cationic SO3 equivalent = $[(V * N)]*0.080 *100/W$

Where:

V = mL NaLS Standard Solution

N = Normality of NaLS Standard Solution

0.080 = Milliequivalent Weight of SO3

W = Sample weight in g

Method for determining dispenser residue:

Following setup is used to simulate the final rinse cycle in the dispenser of the washing machine.

The dispenser drawer PP-T40 corresponding to a Miele Novotronic™ W986 washing machine is fixed in horizontal position. Then, 25 grams of the fabric softener composition is added into the fabric softener composition compartment of the dispenser drawer.

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A total flow of 3.47 kg of water of 2.5 mmol/L hardness is flushed through the dispenser in 80 seconds at 20°C by using a "cylindrical nozzle" located horizontally 2.5 cm above and parallel to the dispenser compartment. Such cylindrical nozzle having a diameter of 4 cm and a length of 12.8 cm with 3 orifices of 0.5 cm diameter located corresponding to the orifices of the fabric care composition compartment of the dispenser drawer.

Rinse water containing the fabric care composition is collected in a bucket containing 5 kg of 2.5 mmol/L hardness water and homogenized with an IKA EURO-ST P VC with an R 2302 4-bladed Propeller stirrer at 450 rpm for 1 minute after water flow has finished. The total rinse water mass obtained at the end of the dispenser residue test is 8.47 kg.

The fabric softener activity, measured using CatSO3 titration, is measured of the fabric softener composition added into the dispenser and of the rinse water.

Dispensing residue expressed in % is calculated as:

$$\frac{0.025 \cdot CatSO3_{(fabric\ softener\ composition)} - 8.47 \cdot CatSO3_{(rinse\ water)}}{0.025 \cdot CatSO3_{(fabric\ softener\ composition)}}$$

wherein

$CatSO3_{(fabric\ softener\ composition)}$ is the % Cationic SO3 Equivalent determined by CatSO3 titration of the fabric softener composition;

$CatSO3_{(rinse\ water)}$ is the % Cationic SO3 Equivalent determined by CatSO3 titration of the rinse water collected at the end of the dispenser residue test.

EXAMPLES

Table 1: Liquid fabric softener compositions examples 1 through 8.

	Weight %			
	Ex. 1	Ex. 2	Ex. 3	Ex. 4
deionized water	Balance	Balance	Balance	Balance
NaHEDP	0.007	0.007	0.007	0.007
Formic acid	0.044	0.044	0.044	0.044
HCl	0.009	0.009	0.009	0.009
Preservative[a]	0.022	0.022	0.022	0.022
FSA[b]	7.6	7.6	7.6	7.6
Antifoam[c]	0.1	0.1	0.1	0.1

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coconut oil	0.3	0.3	0.3	0.3
isopropanol	0.78	0.78	0.77	0.77
Encapsulated perfume[d]	0.15	0.15	0.15	0.15
dye	0.015	0.015	0.015	0.015
Cationic polymeric thickener[e]	0.15	0.20	0.28	0.35
Nuclease enzyme[g]	0.005	0.005	-	-
Galactanase enzyme[h]	0.002	-	0.01	-
Mannanase enzyme[i]	-		-	0.005
Perfume	1.0	1.0	1.0	1.0
Dynamic yield stress	0.000 Pa	0.090 Pa	0.380 Pa	0.380 Pa
Viscosity at 10 s^{-1}	172 mPa.s	284 mPa.s	474 mPa.s	662 mPa.s
Dispenser residue	11%	14%	34%	39%

Table 1 continued

	Weight %			
	Ex. 5	Ex. 6	Ex. 7	Ex. 8
deionized water	Balance	Balance	Balance	Balance
NaHEDP	0.007	0.007	0.007	0.007
Formic acid	0.043	0.043	0.043	0.043
HCl	0.009	0.009	0.009	0.009
Preservative[a]	0.022	0.021	0.021	0.021
FSA[b]	7.4	7.4	7.3	7.3
Nuclease enzyme	0.004	0.008	0.03	0.02
Antifoam[c]	0.1	0.1	0.1	0.1
coconut oil	0.3	0.3	0.3	0.2
isopropanol	0.76	0.76	0.75	0.75
Encapsulated perfume[d]	0.15	0.15	0.15	0.15
dye	0.015	0.015	0.015	0.015
Cationic polymeric thickener[e]	0.22	-	-	-
Microfibrous cellulose[f]		0.27	0.34	0.36
Nuclease enzyme[g]	0.01	0.005	-	0.008

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Galactanase enzyme [h]	-	-	-	-
Mannanase enzyme[i]	-	0.005	0.01	-
Perfume	1.0	1.0	1.0	1.0
Dynamic yield stress	0.060 Pa	0.110 Pa	0.200 Pa	0.230 Pa
Viscosity at 10 s^{-1}	208 mPa.s	230 mPa.s	367 mPa.s	600 mPa.s
Dispenser residue	12%	12%	6%	5%

[a] Proxel™ GXL, 20% aqueous dipropylene glycol solution of 1,2-benzisothiazolin-3-one, supplied by Lonza.

[b] N,N-bis(hydroxyethyl)-N,N-dimethyl ammonium chloride fatty acid ester. The iodine value of the parent fatty acid of this material is between 18 and 22. The material as obtained from Evonik contains impurities in the form of free fatty acid, the monoester form of N,N-bis(hydroxyethyl)-N,N-dimethyl ammonium chloride fatty acid ester, and fatty acid esters of N,N-bis(hydroxyethyl)-N-methylamine.

[c] MP10®, supplied by Dow Corning, 8% activity

[d] as described in US 8,765,659, expressed as 100% encapsulated perfume oil

[e] Rheovis® CDE, cationic polymeric thickener supplied by BASF

[f] Exilva®, microfibrous cellulose, expressed as 100% dry matter, supplied as 10% aqueous dispersion by Borregaard

[g]Nuclease enzyme variant of any of SEQ ID NOs:1-107

[h]Galactanase enzyme variant of any of SEQ ID NOs: 108-110

[i]Mannanase enzyme variant of any of SEQ ID NOs:111-115

	(%wt)					
	9	10	11	12	13	14
FSA [a]	9.2	7	-	-	-	-
FSA [b]	-	-	-	9.3	12.5	-
FSA [c]	-	-	-	-	-	-
FSA [n]	-	-	5	-	-	8.5
Coco oil	0.735	0.1	0.51	0.3	0.6	0.8
Low MW Alcohol [d]	0.58	0.11	0.58	0.95	0.95	0.95
Perfume	1.65	3.5	1.65	1.00	1.60	1.00

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Perfume encapsulate [e]	0.26	1.33	0.26	0.25	0.25	0.25
Calcium Chloride	0.12	0.05	-	0.12	0.16	0.07
Chelant [f]	0.01	0.01	0.01	0.01	0.01	0.01
Preservative [g]	0.001	-	0.001	-	-	-
Acidulent (Formic Acid)	-	0.06	-	0.06	0.06	0.06
Antifoam [h]	-	0.02	-	-	-	-
Polymer 1 [i]	0.03	0.25	0.01	0.12	0.12	0.12
Polymer 2 [i]	0.04	0.18	0.02	0.12	0.12	0.12
Water soluble dialkyl quat [j]	0.29	0.29	0.29	0.11	0.11	0.11
Dispersant [k]	-	-	0.15	-	-	0.10
Stabilizing Surfactant [l]	-	-	0.45	0.50	0.1	0.10
Stabilizing Surfactant [p]	-	-	0.10	-	0.25	-
Floc preventing agent [o]	0.40	-	-	-	-	0.12
PDMS emulsion [m]	1.12	-	0.85	-	-	-
Amino-functional Organosiloxane Polymer	-	3.1	0.95	-	-	-
Dye	0.03	0.03	-	0.03	0.03	0.03
Hydrochloric Acid	0.03	0.03	0.03	0.03	0.03	0.03
Nuclease enzyme[s]	0.01	0.005	-	0.008	0..1	0.009
Galactanase enzyme [t]	-	-	-	-	-	-
Mannanase enzyme[u]	-	0.005	0.01	-	-	-
Deionized Water	Balance	Balance	Balance	Balance	Balance	Balance

	(%wt)					
	15	16	17	18	19	20
FSA [r]	4.3	7	9	11	14.7	18
Coco oil	-	0.5	-	-	-	-
Low MW Alcohol [d]	-	-	-	-	-	0.5
Perfume	0.7	2.2	2.2	3.3	1.60	1.2
Perfume encapsulate [e]	-	1.33	0.26	0.25	0.25	0.25
Calcium Chloride	-	0.03	0.045	0.12	0.15	0.2

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Chelant [f]	0.01	0.01	0.01	0.01	0.01	0.01
Preservative [g]	0.001	-	0.001	-	-	-
Acidulent (Formic Acid)	-	0.06	-	0.06	0.06	0.06
Antifoam [h]	-	0.02	-	-	-	-
Polymer 1 [i]	0.03	0.2	0.01	0.12	0.12	0.12
Polymer 2 [i]	0.04	0.1	0.02	0.12	0.12	0.12
Water soluble dialkyl quat [j]	-	-	0.2	0.4	-	-
Dispersant [k]	-	-	0.15	-	-	0.10
Stabilizing Surfactant [l]	-	-	0.1	0.156	-	-
Stabilizing Surfactant [p]	-	-	0.10	-	-	-
Floc preventing agent [o]	0.40	0.4	0.4	-	-	-
Amino-functional Organosiloxane Polymer	-	3.1	0.95	-	-	-
Dye	0.03	0.03	-	0.03	0.03	0.03
Hydrochloric Acid	0.02	0.03	0.03	0.03	0.035	0.035
Nuclease enzyme[s]	0.01	0.005	-	0.2	0.005	0.008
Galactanase enzyme [t]	-	-	-	-	-	0.001
Mannanase enzyme[u]	-	0.005	0.01	-	0.005	
Deionized Water	Balance	Balance	Balance	Balance	Balance	Balance

[a] reaction product of Methyl-diethanolamine with fatty acids, in molar ratio ranging from 1:1.5 to 1:2, fully or partially quaternized with methylchloride. The fatty acid has a chain length distribution comprising about 35-55% saturated C18 chains, 10-25% mono-unsaturated C18 chains, and has an iodine value of about 20. Material available from Evonik.

[b] reaction product of Tri-ethanolamine with fatty acids in molar ratio ranging from 1:1.5 to 1:2, fully or partially quaternized with dimethylsulphate. The fatty acid has a chain length distribution of about 35-55% saturated C18 chains, 15-25% mono-unsaturated C18 chains, and an iodine value of about 40. Material available from Stepan.

[c] reaction product of Methyl-diethanolamine with fatty acids, in molar ratio ranging from 1:1.5 to 1:2, fully or partially quaternized with methylchloride. The fatty acid has a chain length distribution comprising about 35-55% saturated C18 chains, 10-25% mono-unsaturated C18 chains, and an iodine value of about 56. Material available from Evonik.

[d] Low molecular weight alcohol such as ethanol or isopropanol.

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[e] Perfume microcapsules available ex Appleton Papers, Inc.

[f] Diethylenetriaminepentaacetic acid or hydroxyl ethylidene-1,1-diphosphonic acid.

[g] 1,2-Benzisothiazolin-3-ONE (BIT) under the trade name Proxel™ available from Lonza.

[h] Silicone antifoam agent available from Dow Corning® under the trade name DC2310.

[i] Polymer 1 are chosen from Table 1 and Polymer 2 are chosen from Table 2.

[j] Didecyl dimethyl ammonium chloride under the trade name Bardac® 2280 or Hydrogenated tallowalkyl(2-ethylhexyl)dimethyl ammonium methylsulfate from AkzoNobel under the trade name Arquad® HTL8-MS.

[k] Non-ionic surfactant from BASF under the trade name Lutensol® XL-70.

[l] Non-ionic surfactant, such as TWEEN 20™, Lutensol™ AT25 (ethoxylated alcohol with an average degree of ethoxylation of 25 from BASF).

[m] Polydimethylsiloxane emulsion from Dow Corning under the trade name DC346®.

[n] reaction product of Methyl-diisopropanolamine with fatty acids, mixed in a molar ratio ranging from 1:1.5 to 1:2, fully or partially quaternized with dimethylsulphate. The fatty acid has a chain length distribution comprising less than 10% saturated C18 chains, about 20-30% mono-unsaturated C18 chains, about 50-70% C16 chains, and an iodine of about 35. Material available from Evonik.

[o] Nonionic surfactant such as Lutensol™ AT80 (ethoxylated alcohol with an average degree of ethoxylation of 80 from BASF) or Genapol™ T680 (ethoxylated alcohol with an average degree of ethoxylation of 68 from Clariant).

[p] ethoxylated cationic surfactant such as Berol™ R648 (average degree of ethoxylation of 15 from Akzo Nobel) or Variquat™ K1215 (average degree of ethoxylation of 15 from Evonik).

[q] Rheovis™ CDE® commercially available from BASF.

[r] reaction product of Methyl-diisopropanolamine with fatty acids, mixed in a molar ratio ranging from 1:1.5 to 1:2, fully or partially quaternized with dimethylsulphate. The fatty acid has a chain length distribution comprising about 35-55% saturated C18 chains, 10-25% mono-unsaturated C18 chains, and has an iodine value of about 20. Material available from Evonik.

[s] Nuclease enzyme variant of any of SEQ ID NOs:1-107

[t] Galactanase enzyme variant of any of SEQ ID NOs: 108-110

[u] Mannanase enzyme variant of any of SEQ ID NOs:111-115

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”.

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CLAIMS

What is claimed is:

1. A fabric softener composition comprising:

   (i) from 2 to 50 wt% fabric softener compound comprising a quaternary ammonium ester compound having the following formula:

   $$\{R^2_{(4-m)} - N^+ - [X - Y - R^1]_m\}\ A^-$$

   wherein:

   m is 1, 2 or 3 with proviso that the value of each m is identical;

   each R^1 is independently a linear hydrocarbyl or branched hydrocarbyl group;

   each R^2 is independently a C_1-C_3 alkyl or hydroxyalkyl group;

   each X is independently $(CH_2)n$, CH_2-$CH(CH_3)$- or CH-(CH_3)-CH_2-;

   each n is independently 1, 2, 3 or 4;

   each Y is independently -O-(O)C- or -C(O)-O-; and

   A- is independently selected from the group consisting of chloride, methyl sulfate, and ethyl sulfate;

   with the proviso that when Y is -O-(O)C-, the number of carbons in each R^1 is from 13 to 21; and

   (ii) a soil-weakening bacterial nuclease enzyme from a *Bacillus* species and selected from nuclease enzymes having at least 60% identity with the amino acid sequence shown in any of SEQ ID NOs 1-6, 8, 9-21, 23, 24, 27-30, 92-96, 98, 101, or 102.

2. The fabric softener composition according to claim 1, wherein R^1 is a linear hydrocarbyl.
3. The fabric softener composition according to claim 2, wherein R^1 is a partially unsaturated linear alkyl chain.
4. The fabric softener composition according to any one of claims 1 to 3, wherein R^2 is selected from the group consisting of methyl, ethyl, propyl, hydroxyethyl, 2-hydroxypropyl, 1-methyl-2-hydroxyethyl, poly(C_{2-3} alkoxy), polyethoxy, and benzyl.
5. The fabric softener composition according to any one of claims 1 to 4, wherein each n is 2.
6. The fabric softener composition according to any one of claims 1 to 5, wherein A- is selected from the group consisting of chloride and methyl sulfate.
7. The fabric softener composition according to any one of claims 1 to 6, wherein when Y is -O-(O)C-, the number of carbons in each R^1 is from 13 to 19.

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8. The fabric softener composition according to any one of claims 1 to 7, wherein the soil-weakening bacterial nuclease enzyme from a *Bacillus* species is selected from nuclease enzymes having at least 80% identity with the amino acid sequence shown in any of SEQ ID NOs 1-6, 8, 9-21, 23, 24, 27-30, 92-96, 98, 101, or 102.
9. The fabric softener composition according to claim 8, wherein the soil-weakening bacterial nuclease enzyme from a *Bacillus* species is selected from nuclease enzymes having at least 90% identity with the amino acid sequence shown in any of SEQ ID NOs 1-6, 8, 9-21, 23, 24, 27-30, 92-96, 98, 101, or 102.
10. The fabric softener composition according to claim 9, wherein the soil-weakening bacterial nuclease enzyme from a *Bacillus* species is selected from nuclease enzymes having at least 95% identity with the amino acid sequence shown in any of SEQ ID NOs 1-6, 8, 9-21, 23, 24, 27-30, 92-96, 98, 101, or 102.
11. The fabric softener composition according to any one of claims 1 to 10, wherein the *Bacillus species,* is *Bacillus licheniformis, Bacillus subtilis, Bacillus sp-62451, Bacillus horikoshii, Bacillus sp-62520, Bacillus sp-16840, Bacillus sp-62668, Bacillus sp-13395, Bacillus horneckiae, Bacillus sp-11238, Bacillus cibi, Bacillus sp-18318, Bacillus idriensis, Bacillus algicola, Bacillus vietnamensis, Bacillus hwajinpoensis, Bacillus indicus, Bacillus marisflavi, Bacillus luciferensis, Bacillus sp. SA2-6, Bacillus sp-62738, Bacillus pumilus, Bacillus sp-62490, Bacillus sp-13390, Bacillus sp-62738, Bacillus sp-62599,* or *Bacillus akibai.*
12. The fabric softener composition according to any one of claims 1 to 11, further comprising a galactanase enzyme having at least 60% identity with the amino acid sequence shown in SEQ ID NO:108, SEQ ID NO:109 or SEQ ID NO:110.
13. The fabric softener composition according to claim 12, wherein the galactanase enzyme has at least 80% identity with the amino acid sequence shown in SEQ ID NO:108, SEQ ID NO:109 or SEQ ID NO:110.
14. The fabric softener composition according to claim 13, wherein the galactanase enzyme has at least 90% identity with the amino acid sequence shown in SEQ ID NO:108, SEQ ID NO:109 or SEQ ID NO:110.
15. The fabric softener composition according to claim 14, wherein the galactanase enzyme has at least 95% identity with the amino acid sequence shown in SEQ ID NO:108, SEQ ID NO:109 or SEQ ID NO:110.

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16. The fabric softener composition according to any one of claims 1 to 15, further comprising a mannanase enzyme having at least 60% sequence identity to SEQ ID NO:111 or SEQ ID NO:113 or SEQ ID NO:114 or SEQ ID NO:115.
17. The fabric softener composition according to any one of claims 1 to 16, further comprising a mannanase enzyme having at least 81% sequence identity to SEQ ID NO: 112.
18. A method of treating a fabric, the method comprising the steps of (i) in a laundering step, treating a fabric with an aqueous wash liquor comprising from 0.1g/l to 5g/l of a surfactant; (ii) in a rinse-treatment step, treating the fabric with an aqueous rinse liquor comprising biofilm soil-weakening enzyme and a quaternary ammonium ester fabric softener compound, wherein the aqueous rinse liquor is formed by the addition of the fabric softener composition according to any one of claims 1 to 17 to water; and (iii) drying the fabric.
19. The method of claim 18, wherein the method additionally comprises a step of rinsing the fabric one or two or more times with water between steps (i) and (ii).
20. The method of claim 18 or 19, wherein the surfactant comprises anionic and/or nonionic surfactant.
21. The method according to any one of claims 18 to 20, wherein the fabric from rinse-treatment step (ii) is dried after step (ii) with no rinse step between steps (ii) and (iii).
22. The method according to any one of claims 18, 20 or 21, wherein there is no rinse step between steps (i) and (ii).

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