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(54) Title: A FABRIC CARE COMPOSITION COMPRISING HYDROPHOBICALLY MODIFIED POLYALKYLENEIMINE AS DYE FIXATIVE POLYMER

(57) Abstract: The present invention relates to a fabric care composition comprising at least one hydrophobically modified polyalkyleneimine as dye fixative polymer. The present invention further relates to a method for providing an improved color care effect during washing or treatment of colored fabric which comprises use of the hydrophobically modified polyalkyleneimine as dye fixative polymer.



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A Fabric Care Composition Comprising Hydrophobically Modified Polyalkyleneimine as Dye Fixative Polymer

Technical Field

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The invention relates to a hydrophobically modified polyalkyleneimine as dye fixative polymer in fabric care formulation. The present invention also relates to a method for color fixing effect when washing colored fabric by using the dye fixative polymer.

10 Background Art

A known problem in the washing and/or treatment of colored fabrics is color fading in the fabric appearance, which is at least partly due to loss of color shade intensity, fidelity and color definition. Such a problem of color loss is even more acute in laundry
15 treatment after several washing cycles, especially for dark colors, such as blacks, reds, blues and greens.

During the washing process, when the colors of a colored fabric are poorly fixed, i.e. color bleeding, not just rapid fading of the colored fabrics takes place, but there can
20 also, as a result of the relatively high dye concentrations in the wash liquor, additionally be staining of differently colored or white fabrics washed at the same time.

To solve the problem of color bleeding and color fading, several mechanisms have been speculated upon for color loss and various means have been proposed to prevent
25 or reduce the extent of the loss or transfer of color. Dye fixative agent and dye transfer inhibitor are well-known which are designed to improve the appearance of colored fabrics by minimizing the loss and transfer of dyes from fabrics due to washing or treatment. U.S. Patent No. 2010/0017973 discloses a dye transfer inhibitor which may prevent color transferring during laundry processes. However, color bleeding and fading of colored fabric cannot be prevented. U.S Patent No. 2007/0277327 discloses a
30 detergent and cleaning agents containing polyamines/polyimines or their derivatives as dye fixative agents, which can be used in combination with soil release polymers. However, the use of most dye fixative agents in liquid laundry detergent formulation is in practice restricted to the formulations which do not comprise any anionic surfac-
35 tants or comprise very low content of anionic surfactants, due to the lack of compatibility of the anionic surfactants with the dye fixative compounds, which causes flocculation, precipitation or phase separation of the compounds.

In recent times there is still an increasing demand for laundry formulations comprising dye fixative agent which may improve the color fastness and show excellent compatibility with detergents surfactants.

- 5 It is thus the object of the present invention to provide a dye fixative polymer which will help effectively fix dyes through laundry washing and/or treatment processes, while showing better and broader compatibility with laundry formulations.

Summary of Invention

- 10 In one aspect, the present invention is directed to a fabric care composition comprising at least one hydrophobically modified polyalkyleneimine, wherein the hydrophobically modified polyalkyleneimine comprises a polyalkyleneimine backbone having a weight-average molecular weight greater than or equal to 200 g/mol and less than 1000 g/mol, and hydrophobic moieties which are covalently attached to the backbone
15 of polyalkyleneimine.

- Preferably, the unmodified polyalkyleneimine backbone can be polyethyleneimine, polypropyleneimine or polybutyleneimine. Preferably said unmodified polyalkyleneimine has a weight-average molecular weight greater than or equal to 300 g/mol and less
20 than 1000 g/mol, more preferably greater than or equal to 500 g/mol and less than 1000 g/mol.

- In a further aspect, the hydrophobically modified polyalkyleneimines are obtained by a process which comprises the reaction of an unmodified polyalkyleneimine with a hydrophobicizing agent.
25

- In still a further aspect, the present invention provides a fabric care composition comprising the hydrophobically modified polyalkyleneimine and at least one nonionic, anionic and/or cationic surfactant.
30

- In another aspect, the present invention provides a method for providing an improved color care effect during washing and/or treating of colored fabrics, which comprises a step of contacting the colored fabrics with a washing solution which contains the hydrophobically modified polyalkyleneimine.
35

In still another aspect, the present invention relates to use of the fabric care composition comprising the hydrophobically modified polyalkyleneimine for enhancing color care effect during washing and/or treatment of colored fabrics.

Surprisingly and unexpectedly, the application has now discovered that the hydrophobically modified polyalkyleneimine of the present invention, when being formulated in fabric care composition, exhibits satisfactory color fixing effect and excellent compatibility, and thus makes it possible to achieve the objective as outlined above.

Description

Throughout the description, including the claims, the term "comprising one" or "comprising a" should be understood as being synonymous with the term "comprising at least one", unless otherwise specified, and "between" should be understood as being inclusive of the limits.

The terms "a", "an" and "the" are used to refer to one or to more than one (i.e., to at least one) of the grammatical object of the article.

The term "and/or" includes the meanings "and", "or" and also all the other possible combinations of the elements connected to this term.

It should be noted that in specifying any range of concentration, weight ratio or amount, any particular upper concentration, weight ratio or amount can be associated with any particular lower concentration, weight ratio or amount, respectively.

As used herein, the term "fabric care" is the broadest term which refers to the present composition which improves the appearance or wear properties of fabric, especially clothing. For the purposes of the present invention fabric care compositions are divided into several categories, *inter alia*, laundry detergent compositions, fabric appearance, each of which are typically characterized by the presence of an ingredient or the lack thereof. For example, "laundry detergent compositions" are required to comprise one or more deterative surfactants while "fabric softener composition" are required to comprise one or more cationic quaternary ammonium compounds. The term "fabric care" may refer to the laundry detergent compositions as well as the fabric conditioning compositions.

As used herein, the term "hydrophobically modified polyalkyleneimine" refers to polyalkyleneimine with hydrophobic groups chemically attached to unmodified polyalkyleneimine backbone.

As used herein, the term "unmodified or non-modified" refers to a polymer substrate that is not modified or functionalized.

5 As used herein, the term "hydrocarbon radical" refers to any straight, branched, cyclic, acyclic, heterocyclic, saturated or unsaturated chain, which contains a carbon backbone comprising one or more hydrogen atoms, optionally substituted with one or more heteroatoms in or on the carbon backbone.

10 As used herein, the term "hydrophobic moiety" is a moiety which can be saturated or unsaturated, substituted or unsubstituted, straight or branched, cyclic or acyclic hydrocarbon group.

15 As used herein, the term "alkyl" means a saturated hydrocarbon radical, which may be straight, branched or cyclic, such as, for example, methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl, t-butyl, pentyl, n-hexyl, cyclohexyl.

20 As used herein, the term "hydroxyalkyl" means an alkyl radical, more typically an alkyl radical, that is substituted with a hydroxyl groups, such as for example, hydroxymethyl, hydroxyethyl, hydroxypropyl, and hydroxydecyl.

25 As used herein, the term "alkylene" means a bivalent acyclic saturated hydrocarbon radical, including but not limited to methylene, polymethylene, and alkyl substituted polymethylene radicals, such as, for example, dimethylene, tetramethylene, and 2-methyltrimethylene.

As used herein, the term "alkenyl" and "alkadienyl" refer to alkyl groups having, respectively, one or two carbon-carbon double bonds within the chain.

30 As used herein, the term "alkenylcarbonyl" refers to a group $-C(=O)R$, wherein R is alkenyl which can be optionally substituted.

35 The present invention is directed to a fabric care composition comprising at least one hydrophobically modified polyalkyleneimine, wherein the hydrophobically modified polyalkyleneimine comprises a polyalkyleneimine backbone having a weight-average molecular weight greater than or equal to 200 g/mol and less than 1000 g/mol, preferably greater than or equal to 300 g/mol and less than 1000 g/mol, more preferably greater than or equal to 500 g/mol and less than 1000 g/mol; and hydrophobic moieties which are covalently attached to the backbone of polyalkyleneimine.

The hydrophobically modified polyalkyleneimines are to be understood as meaning polyalkyleneimines in which the hydrogen atoms of the primary and secondary amino groups are partially or completely replaced by linear or branched aliphatic, saturated or unsaturated hydrocarbon radicals such as alkyl, alkenyl, alkadienyl or hydroxyalkyl radicals. The hydrocarbon radicals generally have 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms.

The hydrophobically modified polyalkyleneimines can be obtained by a process which comprises the reaction of an unmodified polyalkyleneimine with a hydrophobicizing agent. Depending on the hydrophobicizing agent used in each case, the hydrocarbon radicals can be linked to the nitrogen atom of the polyalkyleneimine directly or via a functional group, e.g. via a carbonyl group (*-C(=O)-[#]), via an oxycarbonyl group (*-O-C(=O)-[#]), via an aminocarbonyl group (*-NH-C(=O)-[#]), via a carbonyloxyhydroxypropyl group (*-C(=O)-O-CH₂-CH(OH)-CH₂-[#]), via a 2-oxycarbonylethylenecarbonyl group (*-CH(COOH)-CH₂-CO-[#]), or via a radical of the formula *-CH₂-(C=O)-CH-(C=O)-[#] (in the formulae given above. * represents the linkage to the hydrocarbon radical and [#] represents the linkage to the nitrogen atom of the polyalkyleneimine). The hydrocarbon radical can also form an aldimine or ketimine group with the nitrogen of the polyalkyleneimine or be linked to 2 nitrogen atoms of the polyalkyleneimine via the carbon atom of a cyclic amidine group.

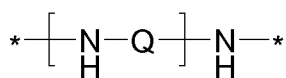
Preferably, the hydrophobically modified polyalkyleneimine has the hydrocarbon radical which is linked to one nitrogen atom of the polyalkyleneimine directly or via a carbonyl group. The latter being particularly preferred. Preferably, the hydrocarbon radicals are linear, more preferably, the hydrocarbon radicals are saturated.

According to any one of the invention embodiments, the hydrocarbon radicals in the preferred hydrophobically modified polyalkyleneimines are present in the form of C₄-C₃₀-alkyl, C₄-C₃₀-alkylcarbonyl, C₄-C₃₀-alkenyl, C₄-C₃₀-alkenylcarbonyl, C₄-C₃₀-alkadieny, C₄-C₃₀-alkadienylcarbonyl and/or hydroxy-C₄-C₃₀-alkyl groups, in particular in the form of C₆-C₁₈-alkyl, C₆-C₁₈-alkylcarbonyl, C₆-C₁₈-alkenyl, C₆-C₁₈-alkenylcarbonyl, C₆-C₁₈-alkadienyl, C₆-C₁₈-alkadienylcarbonyl and/or hydroxy-C₆-C₁₈-alkyl groups, particularly preferably in the form of C₈-C₁₆-alkyl, C₈-C₁₆-alkylcarbonyl, C₈-C₁₆-alkenyl, C₈-C₁₆-alkenylcarbonyl, C₈-C₁₆-alkadienyl, C₈-C₁₆-alkadienylcarbonyl and/or hydroxy-C₈-C₁₆-alkyl groups, where the alkyl, hydroxy-alkyl, alkenyl, alkadienyl radicals of the aforementioned groups are preferably linear.

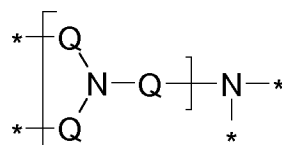
In some preferred embodiment, the hydrocarbon radicals are present in the form of C₄-C₃₀-alkylcarbonyl or C₄-C₃₀-alkenylcarbonyl group, particularly in the form of C₆-C₁₈-alkylcarbonyl or C₆-C₁₈-alkenylcarbonyl group, more particularly, in the form of C₈-C₁₆-alkylcarbonyl or C₈-C₁₆-alkenylcarbonyl group, where the alkyl and alkenyl radicals of the aforementioned groups are preferably linear.

According to any one of the invention embodiments, about from 2 to 25 mol%, in particular 5 to 20 mol%, in more particular from 6 to 15 mol% of the nitrogen atoms of the hydrophobically modified polyalkyleneimine carry a hydrocarbon radical. Correspondingly, the fraction of the hydrocarbon radicals constitutes preferably 5 to 60% by weight, in particular 10 to 50% by weight and specifically 10 to 35% by weight, based on the total weight of the hydrophobically modified polyalkyleneimine.

The hydrophobically modified polyalkyleneimine used according to the present invention can be linear or branched. In particular, the branched polyalkyleneimine branching may occur at its nitrogen fractions. The linear polyalkyleneimines are composed exclusively of repeat units of formula A; the branched polyalkyleneimines have, besides the linear repeat units, tertiary nitrogen atoms according to the formula B:



A



B

20

In which Q is C₂-C₈ alkylene, preferably is ethylene, propylene or butylene.

Preference is given to those branched, hydrophobically modified polyalkyleneimines, in particular branched, hydrophobically modified polyethyleneimines, which, based on the polyalkyleneimine on which they are based, have, on average, per polyalkyleneimine molecule at least one, preferably at least 5 or at least 10, branching points according to formula B. In particular, at least 5%, in particular at least 10% and particularly preferably at least 15%, e.g. 5 to 40% and specifically 15 to 35%, of the nitrogen atoms of the parent polyalkyleneimine are tertiary nitrogen atoms. Particularly, in the case of high degrees of branching, i.e. if at least 10%, in particular 15%, e.g. 10 to 40%, in particular 15 to 35% of the nitrogen atoms of the parent polyalkylimine are tertiary nitrogen atoms, the hydrophobically modified polyalkyleneimines have a structure similar to a core-shell structure, where the polyalkyleneimine moieties form the core and the hydrophobic radicals form the shell.

30

According to any one of the invention embodiments, the hydrophobically modified polyalkyleneimines can be present in uncrosslinked or crosslinked form. Preferably, the hydrophobically modified polyalkyleneimines are uncrosslinked. According to any one of the invention embodiments, the hydrophobically modified polyalkyleneimine has a weight-average molecular weight in the range of from 300 g/mol to 5000 g/mol, preferably from 500 to 3000 g/mol, more preferably from 800 g/mol to 2000 g/mol.

The hydrophobically modified polyalkyleneimines which are used according to the invention are in part known from the prior art or can be prepared analogously to the methods described hereinafter. Accordingly, one embodiment of the present invention relates to the use of a hydrophobically modified polyalkyleneimine obtainable by a process which comprises the reaction of an unmodified polyalkyleneimine, in particular, an unmodified branched polyalkyleneimine, and specifically an unmodified branched polyethyleneimine, with a hydrophobicizing agent.

Examples of suitable hydrophobicizing agents include but not limit to:

i) long chain, linear or branched carboxylic acids having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms, in the alkyl or alkenyl radical, such as caprylic acid, pelargonic acid, undecanoic acid, lauric acid, tridecanoic acid, myristic acid, pentadecanoic acid, palmitic acid, margaric acid, stearic acid, nonadecanoic acid, arachic acid, behenic acid, palmitoleic acid, oleic acid, linoleic acid, linolenic acid, arachidonic acid and mixtures thereof, preferably lauric acid, stearic acid, palmitic acid and oleic acid, or their amide-forming derivatives, such as acid chlorides, esters or anhydrides of the specified carboxylic acids and mixtures thereof;

ii) natural oils, including plant oils, nut oils, seed oils, animal oils and marine oils, which typically contain triglycerides, free fatty acids, or a combination of triglycerides and free fatty acids. Example of suitable natural plant oils are soybean oil, rapeseed oil, palm oil, corn oil, cottonseed oil, coconut oil, palm kernel oil; Example of suitable animal/marine oils are lard, fish oil, beef tallow oil, seal oil and milk fat, and those obtained by hydrogenation or ester-exchange of these oil, and mixture thereof;

iii) linear or branched alkyl halides having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms, in the linear or branched alkyl radical such as octyl chloride, nonyl chloride, decyl chloride, dodecyl chloride, tetradecyl chloride, hexadecyl chloride, octadecyl chloride and mixtures thereof;

- iv) alkyl epoxides having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms in the linear or branched alkyl radical, such as hexadecenyl oxide, dodecenyl oxide and octadecenyl oxide and mixtures thereof;
- 5 v) alkyl ketene dimers having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, in particular 8 to 16 carbon atoms in the linear or branched alkyl radical, such as lauryl ketene, palmityl ketene, stearyl ketene and oleyl ketene dimers and mixtures thereof;
- 10 vi) cyclic dicarboxylic acid anhydrides, in particular alkyl-substituted succinic anhydrides having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, in particular 8 to 16 carbon atoms, in the linear or branched alkyl radical, such as dodecenylsuccinic anhydride, tetradecylsuccinic anhydride, hexadecylsuccinic anhydride and mixtures thereof;
- 15 vii) alkyl isocyanates having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms in the linear or branched alkyl radical, such as tetradecyl isocyanate, hexadecyl isocyanate, octadecyl isocyanate and mixtures thereof;
- 20 viii) chloroformic acid esters of linear or branched alkanols or alkenols having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms, and dialkyl ketones having in total 4 to 30 carbon atoms, in particular 6 to 18 carbon atoms and mixtures thereof.
- 25 viiii) linear or branched aliphatic aldehydes having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, in particular 8 to 16 carbon atoms, and dialkyl ketones having in total 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, in particular 8 to 16 carbon atoms, in the two alkyl groups and mixtures thereof.
- 30 According to any one of the invention embodiments, the unmodified polyalkyleneimines which form the basis of the hydrophobically modified polyalkyleneimines comprise homopolymers of ethyleneimine (aziridine) and higher homologs thereof, propyleneimine (methylaziridine) and butyleneimine (1,2-dimethylaziridine, 1,1-dimethylaziridine and 1-ethylaziridine), copolymers of ethyleneimine with its higher
- 35 homologs, and the graft polymers of polyamidoamines or polyvinylamines with ethyleneimine and/or its higher homologs. Also suitable are the graft polymers of alkyleneimines described in WO02/095122, such as ethyleneimine onto polyamidoamines or onto polyvinylamines. Such graft polymers generally have a weight fraction of

alkyleneimines of at least 10% by weight, in particular at least 30% by weight, e.g. 10 to 90% by weight in particular 10 to 85% by weight, based on the total weight of the unmodified polyalkyleneimine. In some preferred embodiments, the unmodified polyalkyleneimines are branched polyalkyleneimines, preferably polyethyleneimines, in particular branched polyethyleneimines, in more particular homopolymers of ethyleneimines, in still more particular branched homopolymers of ethyleneimines.

According to any one of the invention embodiments, the unmodified polyalkyleneimine has a weight-average molecular weight M_w of from greater than or equal to 200 g/mol to less than 1000 g/mol. Preferably, the unmodified polyalkyleneimine has a weight-average molecular weight M_w of from greater than or equal to 300 g/mol to less than 1000 g/mol. More preferably, the unmodified polyalkyleneimine has a weight-average molecular weight M_w of from greater than or equal to 500 g/mol to less than 1000 g/mol. The molecular weights given here refer to the molecular weights specified by means of gel permeation chromatography and measured on dilute aqueous solutions at 25°C, which correspond to the weight-average molecular weight.

The present invention also relates to the reaction of the unmodified polyalkyleneimine with at least one hydrophobicizing agent, which can take place according to the processes known in the prior art. The reaction conditions naturally depend on the type and functionality of the polyalkyleneimine and the hydrophobicizing agents. In some embodiments, the reaction may be performed with or without a solvent or diluent. Examples of suitable solvents for the reaction include but not limit to hydrocarbons, in particular aromatic hydrocarbons, e.g. alkylbenzenes such as xylenes, toluene, cumene, tert-butylbenzene and the like. In some embodiments, the reaction may take place as a solvent-free reaction, which at least comprises (a) heating the mixture of polyalkyleneimine and hydrophobicizing agent to melt state; (b) stirring the mixture and reacting the polyalkyleneimine with an amount of hydrophobicizing agent, wherein the amount of the hydrophobicizing agent used is sufficient to derivatize about 2 mol% to 25 mol%, in particular about 5 to 20 mol%, in more particular 6 to 15 mol% of the nitrogen atoms of the polyalkyleneimine. In some preferred embodiment, the reaction taking place between the unmodified polyalkyleneimine and natural oils as the hydrophobicizing agent, comprises (a) heating the mixture of polyalkyleneimine and natural oil to melt state; (b) stirring the mixture and reacting the polyalkyleneimine under nitrogen flow with an amount of natural oil at a temperature of 80 to 120°C, wherein the amount of the hydrophobicizing agent used is sufficient to derivatize about 2 mol% to 25 mol%, in particular about 5 to 20 mol%, in more particular 6 to 15 mol% of the nitrogen atoms of the polyalkyleneimine. In some embodiments, the

hydrophobicizing agent will be used in an amount which corresponds to the desired functionality, it also being possible to use the hydrophobicizing agent in excess.

5 In some embodiments, the reaction may be also performed in the presence of catalysts which improve the reactivity of the hydrophobicizing agent toward the polyalkyleneimine. The type of catalyst depends in a manner known per se on the type and reactivity of the hydrophobicizing agent. The catalysts are usually Lewis acids or Bronsted acids.

10 In some embodiments, the carboxylic acids and carboxylic acid derivatives are used as the hydrophobicizing agent, it has proven advantageous to remove the low molecular weight products, such as water, alcohols or hydrogen chloride which form during the reaction from the reaction mixture. For example, when using carboxylic acids, the water formed will preferably be removed from the reaction mixture via an entrainer or
15 vacuum. Typical entrainers are hydrocarbons, in particular alkyl aromatics such as toluene or xylenes.

The hydrophobically modified polyalkyleneimine are generally water-soluble or water-dispersible and can be used in solid and/or liquid fabric care compositions. Said fabric
20 care compositions comprising the hydrophobically modified polyalkyleneimine, can be used for various fabric care products which include but not limit to laundry detergents, after rinse conditioners, pretreatment agents, tumble drier sheet, after-washing sprays etc.

25 The hydrophobically modified polyalkyleneimines of the present invention are characterized in particular by high compatibility with conventional detergent ingredients, in particular with the ingredients of liquid detergent formulation, which comprises anionic surfactant, non-ionic surfactant and optionally a cationic surfactant. The solid/liquid fabric care compositions, which comprise the hydrophobically modified polyalkylene-
30 imine, can be prepared by a method known in the prior art, in which the hydrophobically modified polyalkyleneimine may be used in powder or granule form or in liquid form, preferably being used in liquid form, i.e. dissolved or dispersed form.

In some embodiments, the hydrophobically modified polyalkyleneimines can be used,
35 for example, in those detergent formulations which comprise a deterative surfactant system containing predominantly nonionic surfactants. Preferably the concentration of nonionic surfactants, based on the total amount of surfactants in the fabric care composition, is from 10% to 100% by weight, preferably from 20% to 100% by weight,

more preferably from 30% to 100% by weight. In still some embodiments, the hydrophobically modified polyalkyleneimines come in useful especially in those detergent formulations which may comprise relative high content of anionic surfactants in the deterative surfactant system. Preferably, the concentration of anionic surfactants, based on the total amount of surfactant in the fabric care composition, is from 10 to 100% by weight, preferably from 20% to 100% by weight, more preferably from 30 to 100% by weight.

The solid composition further comprises at least one nonionic, cationic and/or anionic surfactant. The overall concentration of the surfactants in the compositions can be from 0.5% to 60% and preferably 5 to 40% by weight. A typical amount of the hydrophobically modified polyalkyleneimine to be employed in the composition of the invention is from 0.01% to 30% by weight, preferably 0.01% to 15% by weight, more preferably 0.05% to 5% by weight of the composition.

The liquid composition further comprises at least one nonionic, anionic and/or cationic surfactant. The overall concentration of the surfactants in the composition can be from 0.5% to 80% and preferably 5 to 70% by weight. A typical amount of the hydrophobically modified polyalkyleneimine to be employed in the composition of the invention is from 0.01% to 30% by weight, preferably 0.01% to 15% by weight, more preferably 0.05% to 5% by weight of the formulation.

Depending on their intended use, the composition is adapted to the type of textiles to be washed/treated.

The surfactants used may be anionic, nonionic, amphoteric and cationic. It is also possible to use mixtures of said surfactants, Preferred laundry detergent formulations comprise anionic and/or nonionic surfactants and mixtures thereof with other surfactants.

Suitable anionic surfactants are sulfates, sulfonates, carboxylates, phosphates and mixture thereof. Suitable cations here are alkali metals, such as, for example, sodium or potassium or alkaline earth metals, such as, for example, calcium or magnesium, and ammonium, substituted ammonium compounds, including mono-, di- or triethanolammonium cations, and mixtures thereof.

The following types of anionic surfactants are particularly preferred:

Sulfates of (fatty) alcohols having 8 to 22, preferably 10 to 18, carbon atoms, in particular C₉C₁₁-alcohol sulfates, C₁₂-C₁₄-alcohol sulfates, C₁₂-C₁₈-alcohol sulfates, lauryl sulfate, cetyl sulfate, myristyl sulfate, palmityl sulfate, stearyl sulfate and tallow fatty alcohol sulfate; Sulfated alkoxyated C₈-C₂₂-alcohol (alkyl ether sulfates): compounds
5 of this type are prepared, for example, by firstly alkoxyating a C₈-C₂₂-, preferably a C₁₀-C₁₈-alcohol, e.g. a fatty alcohol, and then sulfating the alkoxylation product. For the alkoxylation, ethylene oxide is preferably used; linear C₈-C₂₀ alkylbenzenesulfonates (LAS), preferably linear C₉-C₁₃-alkylbenzenesulfonates and alkyltoluenesulfonates; alkanesulfonates, in particular C₈-C₂₄-, preferably C₁₀-C₁₈-alkanesulfonates;
10 olefinsulfonates; fatty acid and fatty acid ester sulfonates; soaps, such as the Na and K salts of C₈-C₂₄-carboxylic acids, and mixtures thereof.

The anionic surfactants are preferably added to the laundry formulation in the form of salts. Suitable salts here are, for example, alkali metal salts, such as sodium, potassium
15 and lithium salts, and ammonium salts, such as hydroxyethylammonium, di(hydroxyethyl)ammonium and tri(hydroxyethyl)ammonium salts.

Examples of suitable nonionic surfactants are the following compounds:

Alkoxyated C₈-C₂₂-alcohols, such as fatty alcohol alkoxyates, oxo alcohol alkoxyates
20 and Guerbet alcohol ethoxyates, the alkoxylation can take place with ethylene oxide, propylene oxide and/or butylene oxide. Block copolymers of random copolymers may be present. Per mole of alcohol, they usually comprise 2 to 50 mol, preferably 3 to 20 mol, of at least one alkylene oxide. A preferred alkylene oxide is ethylene oxide. The alcohols preferably have 10 to 18 carbon atoms; alkylphenol alkoxyates, in particular
25 alkylphenol ethoxyates, which comprise C₆-C₁₄-alkyl chains and 5 to 30 mol of alkylene oxide; alkyl polyglucosides which comprise C₈-C₂₂-, preferably C₁₀-C₁₈-alkyl chains and as a rule 1 to 20, preferably 1.1 to 5, glucoside units; N-alkylglucamides, fatty acid amide alkoxyates, fatty acid alkanolamide alkoxyates, long-chain amine oxides, polyhydroxy(alkoxy) fatty acid amides, gemini surfactants, and block copoly-
30 mers of ethylene oxide, propylene oxide and /or butylene oxide; and their mixtures.

Examples of suitable cationic surfactants are the following compounds:

Substituted or unsubstituted, straight-chain or branched, quaternary ammonium salts
35 of the R₁N(CH₃)₃⁺X⁻, R₁R₂N(CH₃)⁺X⁻, R₁R₂R₃N(CH₃)⁺X⁻ or R₁R₂R₃R₄N⁺X⁻ type. The R₁, R₂, R₃ and R₄ radicals are each independently preferably unsubstituted alkyl having a chain length of from 8 to 24 carbon atoms, in particular from 10 to 18 carbon atoms, hydroxy-alkyl having from about 1 to 4 carbon atoms, phenyl, C₂-C₁₈-alkyl, C₇-C₂₄-

aralkyl, $(C_2H_4O)_xH$ where x is an integer from 1 to 3, alkyl radicals comprising one or more ester groups, or cyclic quaternary ammonium salts. X is a suitable anion.

Further preferred cationic surfactants can be C₇-C₂₅-alkylamines; N, N-dimethyl-N-
5 (hydroxy-C₇-C₂₅-alkyl)ammonium salts; mono- and di(C₇-C₂₅-
alkyl)dimethylammonium compounds quaternized with alkylating agents; ester quaternary ammonium salts, in particular quaternary esterified mono-, di- and trialkanolamines which have been esterified with C₈-C₂₂-carboxylic acids; imidazoline quaternary ammonium and its derivatives.

10 Typical examples of amphoteric or zwitterionic surfactants are alkylbetaines, alkylamidobetaines, aminopropionates, aminoglycinates or amphoteric imidazolium compounds. Preferred amphoteric surfactants thereof are cocoamphocarboxypropionate, cocoamidocarboxypropionic acid, cocoamphocarboxyglycinate (also referred to as co-
15 coamphodiacetate) and cocoamphoacetate. Further preferred amphoteric surfactants are alkyldimethylbetaines and alkyldipolyethoxybetaines with an alkyl radical having about 8 to about 22 carbon atoms, which may be linear or branched, preferably having about 12 to about 18 carbon atoms.

20 Further laundry ingredients which may be used in the present invention include inorganic and/or organic builders in order to reduce the degree of hardness of the water.

These builders may be present in the fabric care formulations in proportions by weight of from about 5% to about 80%. Inorganic builders include, for example, alkali metal,
25 ammonium and alkanolammonium salts of polyphosphates, pyrophosphates and glasslike polymeric metaphosphates, phosphonates, silicates, carbonates including bicarbonates and sesquicarbonates, sulfates and aluminosilicates. Examples of aluminosilicate builders are crystalline and amorphous aluminosilicates with ion-exchanging properties, such as in particular zeolites, various types of zeolites are suitable, in particular
30 the zeolites A, X, B, P, MAP and HS in their Na form or in forms in which Na is partially replaced by other cations such as Li, K, Ca, Mg or ammonium; Examples of silicate builders are the alkali metal silicates, in particular those with an SiO₂:Na₂O ratio between 1.6:1 and 3.2:1, and phyllosilicates, amorphous silicates, such as sodium metasilicate and amorphous disilicate. Examples of carbonate and hydrogencarbonate
35 builders are those can be used in the form of their alkali metal, alkaline earth metal or ammonium salts. Preferred example of polyphosphate builder is pentasodium triphosphate. Organic builders include, for example, low molecular weight carboxylic acids, such as citric acid, hydrophobically modified citric acid, e.g. agaric acid, malic acid,

tartaric acid, gluconic acid, glutaric acid, succinic acid, imidodisuccinic acid, oxydisuccinic acid, propanetricarboxylic acid, butanetetra-carboxylic acid, cyclopentanetetra-carboxylic acid, alkyl- and alkenylsuccinic acids and aminopolycarboxylic acids, e.g. nitrilotriacetic acid, α -alaninediacetic acid, ethylenediaminetetraacetic acid, serinediacetic acid, isoserinediacetic acid, N-(2-hydroxyethyl)iminoacetic acid, ethylenediaminedisuccinic acid and methyl- and ethylglycinediacetic acid or alkali metal salts thereof; oligomeric and polymeric carboxylic acids, such as homopolymers of acrylic acid and aspartic acid, oligomaleic acids, copolymers of maleic acid with acrylic acid, methacrylic acid or C₂-C₂₂-olefins, e.g. isobutene or long-chain α -olefins, vinyl C₁-C₈-alkyl ethers, vinyl acetate, vinyl propionate, (meth)acrylic acid esters of C₁-C₈-alcohols and styrene; phosphonic acids, such as, for example, 1-hydroxyethylene(1,1-diphosphonic acid), aminotri(methylenephosphonic acid), ethylenediaminetetra(methylenephosphonic acid) and diethylenetriaminepenta(methylenephosphonic acid) and alkali metal salts thereof.

15 The fabric care composition according to the present invention may further comprise customary auxiliaries or other materials which enhance the cleaning action, serve to treat or care for the textile material to be washed or change the performance properties of the fabric care formulation.

20 Examples of suitable auxiliaries include the substances given in U.S. Pat. No. 3,936,537, for example enzymes, in particular proteases, lipases, cellulases and amylases, mannanases; graying inhibitors, in particular carboxymethylcellulose and graft polymers of vinyl acetate onto polyethyleneglycol; bleaches, in particular adducts of hydrogen peroxide onto inorganic salts, such as sodium perboratemonohydrate, sodium perboratetetrahydrate and sodium carbonate perhydrate and percarboxylic acids such as phthalimidopercaproic acid; bleach activators, in particular N,N,N', N'-tetraacetylenediamine, sodium p-nonanoyloxybenzenesulfonate and N-methylmorpholinium acetonitrile methyl sulfate.

30 Other suitable auxiliaries are in particular, enzyme stabilizers, foam boosters, foam limiters, antitarnish and/or anticorrosion agents, suspension agents, dyes, fillers, optical brighteners, disinfectants, alkalis, hydrotropic compounds, antioxidants, perfumes, solvents, solubilizers, anti-redeposition agents, dispersants, processing auxiliaries, softeners, antistatic auxiliaries and soil release polymers.

The fabric care composition according to the present invention may further comprise dye transfer inhibitor. Examples of these dye transfer inhibitor are polyamine N-

oxides, such as, for example, poly-(4-vinylpyridine N-oxide), copolymers of N-vinylpyrrolidone with N-vinylimidazole and optionally other monomers, homopolymers and copolymers of 4-vinylpyridine reacted with chloroacetic acid. A significant disadvantage of the dye transfer inhibitors is that they not only bind the dye detached from the textiles and present in the wash liquor, but additionally can also remove dyes from the textiles and thus promote fading of the washed colored fabric.

Detergent ingredients are otherwise generally known. Detailed descriptions can be found, for example, in Wo-A-99/06524 and 99/04313; in Liquid Detergents, Editor: Kuo-Yann Lai, Surfactant Sci. Ser., Vol. 67, Marcel Decker, New York, 1997, p. 272-304.

The present invention also relates to a method of preparing a fabric care composition having improved color care properties, which comprises a step of adding the hydrophobically modified polyalkyleneimine in the composition. Particularly, the present invention relates to a method for providing an improved color care effect during cleaning and/or treating colored fabrics, which comprises contacting the colored fabrics with a washing solution which contains the hydrophobically modified polyalkyleneimine. More particularly, the improved color care effect is due to color fixing effect.

Materials

Polyethyleneimine (Lupasol® FG sold by BASF)

Palm kernel oil sold from Shanghai Jinyang Co., Ltd

EMPA 130: C.I. Direct Red 83.1 on cotton (Commercially available from Swissatest, Swissatest Testmaterialien AG, Switzerland)

EMPA 133: C.I. Direct Blue 71 on cotton (commercially available from Swissatest, Swissatest Testmaterialien AG, Switzerland)

Stained fabrics:

JB 01: Mineral oil with carbon black on cotton, Chinese standard for detergency tests

JB 03: Sebum with pigment on cotton, Chinese standard for detergency tests

Test white fabrics:

WFK 10A: Standard cotton (commercially available from wfk testgewebe GmbH, Germany);

WFK 20A: Polyester/cotton (65%/35%) (commercially available from wfk testgewebe GmbH, Germany)

WFK 80A: Knitted cotton (commercially available from wfk testgewebe GmbH, Germany)

WFK clay-oil: prepared using 20% WFK Clay (code 05203, commercially available from wfk testgewebe GmbH, Germany) with 1.25% mineral oil and 3.75% peanut oil in water.

5 Molecular weight Determination

The weight-average molecular weight can be measured by gel permeation chromatography (GPC) using TSKgel GMPW_{XL} columns, aqueous solution containing 1.8% acetic acid and 0.3 mol/L sodium acetate as eluent and polyethylene glycol salt as standards.

10 Value outside this elution range are extrapolated.

Examples

15 Preparation of inventive hydrophobically modified polyethyleneimine (unmodified polyethyleneimine has a $M_w = 800$ g/mol)

Polymer 1: 120 g of polyethyleneimine ($M_w = 800$ g/mol) and 20.3 g of hexanoic acid were mixed and purged with nitrogen flow. The mixture was heated to 150°C and stirred. The reaction was performed for 6h and the product was obtained as a yellow liquid. The fraction of hydrocarbon radicals is 14.4% based on the weight of polyethyleneimine.

25 Polymer 2: 120 g of polyethyleneimine ($M_w = 800$ g/mol) and 25.1 g of octanoic acid were mixed and purged with nitrogen flow. The mixture was heated to 150°C and stirred. The reaction was performed for 6h and the product was obtained as a yellow liquid. The fraction of hydrocarbon radicals is 18.5% based on the weight of polyethyleneimine.

30 Polymer 3: 60 g of polyethyleneimine ($M_w = 800$ g/mol) and 17.5 g of lauric acid were mixed and purged with nitrogen flow. The mixture was heated to 150°C and stirred. The reaction was performed for 6h and the product was obtained as a yellow liquid. The fraction of hydrocarbon radicals is 26.6% based on the weight of polyethyleneimine.

35 Polymer 4: 900 g of polyethyleneimine ($M_w = 800$ g/mol) and 297 g of palm kernel oil were mixed and purged with nitrogen flow. The mixture was heated to 90°C and stirred. The reaction was performed for 6h and the product was obtained as a yellow

liquid. The fraction of hydrocarbon radicals is 28.7% based on the weight of polyethyleneimine.

5 Polymer 5: 90 g of polyethyleneimine ($M_w=800$ g/mol) and 29.9 g of myristic acid were mixed and purged with nitrogen flow. The mixture was heated to 150°C and stirred. The reaction was performed for 6h and the product was obtained as a yellow liquid. The fraction of hydrocarbon radicals is 30.7% based on the weight of polyethyleneimine.

10 Polymer 6: 90 g of polyethyleneimine ($M_w=800$ g/mol) and 33.5 g of palmitic acid were mixed and purged with nitrogen flow. The mixture was heated to 150°C and stirred. The reaction was performed for 6h and the product was obtained as a yellow paste. The fraction of hydrocarbon radicals is 34.8% based on the weight of polyethyleneimine.

15 Polymer 7: 80 g of polyethyleneimine ($M_w=800$ g/mol) and 33.1 g of stearic acid were mixed and purged with nitrogen flow. The mixture was heated to 150°C and stirred. The reaction was performed for 6h and the product was obtained as a yellowish paste. The fraction of hydrocarbon radicals is 38.9% based on the weight of polyethylene-
20 imine.

Preparation of comparative hydrophobically modified polyethyleneimine (unmodified polyethyleneimine has a M_w from 1300 to 5000 g/mol)

25 Comparative polymer 1 was obtained by the reaction of polyethyleneimine ($M_w = 2000$ g/mol) and lauric acid under the condition described in U.S. Pat No. 2010/0017973. The fraction of hydrocarbon radicals is 25.6% based on the weight of polyethyleneimine.

30 Comparative polymer 2 was obtained by the reaction of polyethyleneimine ($M_w = 1300$ g/mol) and lauric acid under the condition described in U.S. Pat No. 2010/0017973. The fraction of hydrocarbon radicals is 25.6% based on the weight of polyethyleneimine.

35 Comparative polymer 3 was obtained by the reaction of polyethyleneimine ($M_w = 5000$ g/mol) and lauric acid under the condition described in U.S. Pat No. 2010/0017973. The fraction of hydrocarbon radicals is 28.0% based on the weight of polyethyleneimine.

Comparative polymer 4 was obtained by the reaction of polyethyleneimine ($M_w = 5000$ g/mol) and palmitic acid under the condition described in U.S. Pat No. 2010/0017973. The fraction of hydrocarbon radicals is 36.5% based on the weight of polyethyleneimine.

Comparative polymer 5 was obtained by the reaction of polyethyleneimine ($M_w = 5000$ g/mol) and palmitic acid under the condition described in U.S. Pat No. 2010/0017973. The fraction of hydrocarbon radicals is 115.8% based on the weight of polyethyleneimine.

Test of color fixing performance

Selected colored fabrics (EMPA 130 and EMPA 133) were washed in the presence of white test fabric made of cotton using a liquid detergent composition (the detergent formulation was prepared at a pH between 7.0 to 9.0 and the composition is shown in Table 2) at 40°C and 60°C with the addition of the inventive dye fixative polymer. After the washing cycle, the fabrics were rinsed, spun and dried. In order to determine the color care effect, the fabrics were instrumentally assessed with a Datacolor reflection spectrometer Model Type ELREPHO before and after washing. From the reflection data reading L^* , a^* , b^* , Y were derived and further expressed in ΔE and ΔY value.

For color fixing effect, ΔY is adopted for characterization, which is calculated from Y value for lightness according to CIE 1931 XYZ color space in accordance with following equation:

$$\Delta Y = Y_{\text{washed}} - Y_{\text{initial}}$$

For dye transfer inhibiting effect, ΔE is adopted as conventionally used in the art. ΔE is calculated as CIE 1976 color difference according to DIN EN ISO 11664-4 (June 2012) in accordance with following equation:

$$\Delta E = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})^{1/2}$$

in which

$$\Delta L^* = L^*_{\text{washed}} - L^*_{\text{initial}};$$

$\Delta a^* = a^*_{\text{washed}} - a^*_{\text{initial}};$ and

$$\Delta b^* = b^*_{\text{washed}} - b^*_{\text{initial}}$$

The values L^*_{initial} , a^*_{initial} , and b^*_{initial} were measured on the test white fabric before washing. The values L^*_{washed} , a^*_{washed} , and b^*_{washed} were measured on the test white fabric after washing. Standard colorimetric measurement was used to obtain L^* , a^* , and b^* values.

5

The higher absolute values of ΔY are observed for the color bleeding fabrics in comparison to the initial lightness before the test, the higher color bleeding and lower color fixing is found.

10 The higher values of ΔE are observed for the test white fabric in comparison to the initial whiteness before the test, the higher dye transfer is found.

Any of the well-known methods of preparing detergent composition can be employed to make the detergent composition of this invention. The washing conditions are given in Table 1. The detergent composition used is given in Table 2. The test results for color fixing effect and dye inhibiting effect are listed in Table 3 & Table 4.

15

Table 1

Washing conditions	
Machine	Laundry-o-meter 12 containers
Detergent dosing	3 g/L
Water hardness	250 ppm
Fabric/liquor ratio	1/20
Wash temperature	40°C, 60°C
Wash time	30 mins
Polymer dosing	0.2 %
Colored fabric	EMPA 130, EMPA 133
Test fabric	WFK 10 A, WFK 20 A

20

Table 2

Composition of liquid detergent	
Ingredients	[% by weight]
LAS	6
AEO	24

Sodium Citrate	0.5
Ethanol	1.5
Propylene glycol	5.0
Deionized water	Add to 100

LAS: Linear alkylbenzene sulfonate Disponil LDBS

AEO: C12/C14 fatty alcohol (7EO) Lutensol A7N

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Table 3: Color fixing Test Results

No.	EMPA 130		EMPA 133	
	ΔY of color bleeding (at 40°C)	ΔY of color bleeding (at 60°C)	ΔY of color bleeding (at 40°C)	ΔY of color bleeding (at 60°C)
Blank	0.30	0.31	0.03	0.30
P1	-0.10	0.15	-0.05	0.16
P2	-0.07	0.24	-0.03	0.13
P3	0.09	0.24	-0.01	0.18
P4	0.19	0.18	0.04	0.21
P5	0.07	0.18	0.03	0.04
P6	0.36	0.15	0.00	0.21
P7	0.24	0.20	0.06	0.14
CP1	0.49	0.60	0.13	0.35

CP2	0.61	0.55	0.06	0.30
CP3	0.33	0.61	0.15	0.36
CP4	0.38	0.75	nd	nd
CP5	nd	0.86	0.15	0.33

Blank sample: the liquid detergent composition prepared without any dye fixative polymer.

P1-P7: Inventive Polymers 1-7

CP1-CP5: Comparative polymers 1-5

Nd: not determined

5

As expressly demonstrated in Table 3, it has been found unexpectedly that the formulations comprising the inventive polymers show improved color fixing and lower color bleeding effect with lower absolute values of ΔY in comparison with the formulations comprising comparative polymers (M_w higher than 1000 g/mol).

10

Table 4: Dye transfer inhibiting test results

No.	EMPA 130				EMPA 133			
	ΔE of WFK 10 (at 40°C)	ΔE of WFK 20 (at 40°C)	ΔE of WFK 10 (at 60°C)	ΔE of WFK 20 (at 60°C)	ΔE of WFK 10 (at 40°C)	ΔE of WFK 20 (at 40°C)	ΔE of WFK 10 (at 60°C)	ΔE of WFK 20 (at 60°C)
Blank	4.48	3.13	25.77	21.17	20.33	16.06	31.8	25.84
P1	2.46	2.23	11.63	9.78	6.76	4.44	24.77	20.05
P2	2.46	1.98	12.31	9.52	6.55	3.97	26.40	21.41
P3	2.34	1.82	11.59	8.74	8.50	5.80	28.38	22.04
P4	2.33	1.64	11.81	9.06	9.97	6.88	26.97	19.91
P5	2.40	2.02	12.07	9.09	7.77	5.24	28.35	21.33
P6	2.67	2.27	11.92	8.92	10.12	6.94	29.36	23.23
P7	2.92	2.25	11.22	8.85	9.09	6.12	28.65	22.69

Blank sample: the liquid detergent composition prepared without any dye fixative polymer.

15 P1-P7: Inventive Polymers 1-7

As demonstrated in Table 4, it has been found that the formulations comprising the inventive polymers make it possible to obtain good dye inhibiting effect with lower values of ΔE in comparison with the formulations without dye fixative polymer.

20

The liquid detergent formulations were prepared according to the composition of Table 2 by varying the concentration of the inventive polymer 4. The color fixing effect and dye inhibiting effect of the formulations were tested under the same washing condition listed in Table 2. The results are given in Table 5.

5

Table 5

Concentrations of Polymer 4	EMPA 130			EMPA 133		
	ΔY of color bleeding	ΔE of WFK 10	ΔE of WFK 20	ΔY of color bleeding	ΔE of WFK 10	ΔE of WFK 20
Blank	0.65	25.81	21.03	0.17	34.07	26.13
0.1 wt.%	0.34	15.33	11.03	0.10	32.35	25.22
0.2 wt.%	0.37	9.84	7.39	0.04	29.90	23.26
0.5 wt.%	0.51	14.35	11.34	-0.02	24.21	18.68

Blank sample: the liquid detergent composition prepared without any dye fixative polymer.

- 10 The results in Table 5 clearly show that all the formulations comprising the inventive polymer 4 with varying concentrations can bring about satisfactory color fixing and dye transfer inhibiting effects.

Formulation Compatibility Test

- 15 0.2 % by weight of the inventive polymer 4 and comparative polymer 5 were added respectively in each aqueous surfactant solution or each formulation during the conventional formulation process. Each formulation comprises the overall surfactant concentration of 30% by weight but with different ratios of anionic/nonionic surfactants. Each sample with the polymer was kept for 1 week and its appearance was visually
20 checked. The results are listed in Table 6.

25

Table 6

Ingredient	Formulation A		Formulation B		Formulation C	
AEO	9 wt. %		15 wt. %		6 wt. %	
AES	13.5 wt. %		6 wt. %		12 wt. %	
LAS	7.5 wt. %		9 wt. %		12 wt. %	
1,2-propanediol	5 wt. %		5 wt. %		5 wt. %	
Sodium Citrate	1 wt. %		1 wt. %		1 wt. %	
Water	63.8 wt. %		63.8 wt. %		63.8 wt. %	
Polymer 4	0.2 wt. %	-	0.2 wt. %	-	0.2 wt. %	-
Comparative polymer 5	-	0.2 wt. %	-	0.2 wt. %	-	0.2 wt. %
Stability & Optical appearance	Stable & Transparent	Unstable & turbid	Stable & Transparent	Unstable & turbid	Stable & Transparent	Unstable & turbid

AEO: C12/C14 fatty alcohol (7EO) Lutensol A7N

AES: Alcohol Ethoxysulfate Texapon N 70

LAS: Linear alkylbenzene sulfonate Disponil LDBS

5

The compatibility tests were performed with the formulations containing varied surfactants, particularly with the formulation A and formulation C which comprise anionic surfactants as dominant components in the surfactant blends.

- 10 As demonstrated in Table 6, it has been found unexpectedly that the formulations comprising the inventive polymer 4 of the present invention make it possible to obtain the stable and transparent solutions with improved compatibilities in comparison with the formulations comprising the comparative polymer 5 ($M_w > 1000$ g/mol).

15 Detergency test

The detergency test was also tested with the detergent formulations comprising the inventive polymers 3 and 4. The washing conditions are listed in Table 7. The detergent formulations were prepared according the compositions listed in Table 8.

20

Whiteness test method

The degree of whiteness of the test fabric was used to determine the degree of soiling. The difference of whiteness was determined by photometric measurement of the reflectance using an Elrepho 2000 photometer (Datacolor) at a wavelength of 457 nm.

5

The higher values of whiteness decrease are observed for the white test fabrics in comparison to the initial lightness before the test, the higher re-deposition of soil onto fabric is found.

The whiteness test results are given in Table 9.

10

Table 7

Washing conditions	
Machine	Launder-o-meter 12 containers
Detergent dosing	2 g/L
Water hardness	250 ppm
Fabric/liquor ratio	1/25
Wash temperature	30°C
Wash time	20 mins/3 cycles
Polymer dosing	0.1%, 0.2 %, 0.5 %
Stain fabric	WFK clay-oil
White Test fabric	WFK 10 A, WFK 20 A

Table 8

	Formulation D	Formulation E
Ingredients	[% by weight]	
LAS	5	6
AES	10	0
AEO	5	24
Sodium Citrate	0.5	0.5
Ethanol	1.5	1.5

Propylene glycol	0	5.0
Inventive polymer	0.1/0.2/0.5	
Deionized water	Add to 100	

AEO: C12/C14 fatty alcohol (7EO) Lutensol A7

AES: Alcohol Ethoxysulfate Texapon N 70

LAS: Linear alkylbenzene sulfonate Disponil LDBS

5

Table 9

10

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25

	Polymer amount % by weight	Whiteness decrease WFK 80A	Whiteness decrease WFK 10A
Formulation D comprising polymer 3	0	16.46	9.44
	0.1	13.98	7.85
	0.2	13.31	7.71
	0.5	13.20	7.47
Formulation E comprising polymer 3	0	16.25	9.73
	0.1	16.14	9.59
	0.2	14.87	8.71
	0.5	14.41	8.46
Formulation D comprising polymer 4	0	27.80	17.64
	0.1	25.89	17.61
	0.2	25.31	16.61
	0.5	24.93	14.64
Formulation E comprising polymer 4	0	29.14	20.50
	0.1	28.66	19.80
	0.2	27.94	18.36
	0.5	24.96	17.18

30

According to the results shown in Table 9, it has been also found unexpectedly that, the hydrophobically modified polyalkyleneimine as dye fixative polymer in the detergent formulations, can prevent re-deposition of dirt which is removed from fabric by a laundry detergent from redepositing onto cleaned/washed fabric during the wash cycle. An especially favorably interaction between deterative surfactant and the inventive

hydrophobically modified polyethyleneimine has been observed, giving reduced re-deposition of soil such as clay and oil onto the fabrics.

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Claims

1. A fabric care composition comprising at least one hydrophobically modified polyalkyleneimine, wherein the hydrophobically modified polyalkyleneimine comprises a polyalkyleneimine backbone having a weight-average molecular weight greater than or equal to 200 g/mol and less than 1000 g/mol, preferably greater than or equal to 300 g/mol and less than 1000 g/mol, more preferably greater than or equal to 500 g/mol and less than 1000 g/mol; and hydrophobic moieties which are covalently attached to the backbone of polyalkyleneimine.
2. The fabric care composition according to claim 1, wherein from 2 to 25 mol %, preferably from 5 to 20 mol% of the nitrogen atoms of the polyalkyleneimine carry an aliphatic, saturated or unsaturated hydrophobic moiety.
3. The fabric care composition according to claim 2 or 3, wherein the fraction of hydrophobic moieties, based on the total weight of the hydrophobically modified polyalkyleneimine, constitutes 5 to 60 %, preferably 10 to 50%, more preferably 10 to 30% by weight.
4. The fabric care composition according to any one of claims 1 to 3, wherein the hydrophobic moieties are present in the form of C₄-C₃₀ alkyl, C₄-C₃₀ alkyl carbonyl, C₄-C₃₀ alkenyl, C₄-C₃₀ alkenyl carbonyl, C₄-C₃₀ alkadienyl, C₄-C₃₀ alkadienyl carbonyl and/or hydroxy-C₄-C₃₀ alkyl groups, preferably in the form of C₆-C₁₈ alkyl, C₆-C₁₈ alkyl carbonyl, C₆-C₁₈ alkenyl, C₆-C₁₈ alkenyl carbonyl, C₆-C₁₈ alkadienyl, C₆-C₁₈ alkadienyl carbonyl and/or hydroxy-C₆-C₁₈ alkyl groups, more preferably in the form of C₈-C₁₆ alkyl, C₈-C₁₆ alkyl carbonyl, C₈-C₁₆ alkenyl, C₈-C₁₆ alkenyl carbonyl, C₈-C₁₆ alkadienyl, C₈-C₁₆ alkadienyl carbonyl and/or hydroxy-C₈-C₁₆ alkyl groups
5. The fabric care composition according to any one of claims 1 to 4, wherein the hydrophobically modified polyalkyleneimine has a weight-average molecular weight in the range of from 300 to 5000 g/mol, preferably 500 to 3000 g/mol, more preferably 800 to 2000 g/mol.
6. The fabric care composition according to any one of claims 1 to 5, wherein the hydrophobically modified polyalkyleneimine in the polyalkyleneimine backbone is branched.
7. The fabric care composition according to any one of claims 1 to 6, wherein the

hydrophobically modified polyalkyleneimines are obtained by a process which comprises the reaction of an unmodified polyalkyleneimine with a hydrophobicizing agent.

8. The fabric care composition according to claim 7, wherein the hydrophobicizing agent is selected from the group consisting of linear or branched carboxylic acids having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms; natural oils, linear or branched alkyl halides having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms; alkyl epoxides having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms; alkyl ketene dimers having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms; cyclic dicarboxylic acid anhydrides having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms; alkyl isocyanates having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms; chloroformic acid esters of linear or branched alkanols or alkenols having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms; and linear or branched aliphatic aldehydes having 4 to 30 carbon atoms, preferably 6 to 18 carbon atoms, more preferably 8 to 16 carbon atoms.
9. The fabric care composition according to any one of claims 1 to 8, wherein the polyalkyleneimine backbone is branched.
10. The fabric care composition according to any one of claims 1 to 9, wherein the hydrophobically modified polyalkyleneimine is hydrophobically modified polyethyleneimine, hydrophobically modified polypropyleneimine or hydrophobically modified polybutyleneimine.
11. The fabric care composition according to any one of claims 1 to 10, further comprises at least one nonionic, anionic and/or cationic surfactant.
12. The fabric care composition according to any one of claims 1 to 11, wherein the hydrophobically modified polyalkyleneimine is used in a concentration of from 0.01 to 30 % by weight of the composition.
13. The fabric care composition according to claim 11 or 12, wherein the surfactant, based on the total weight of the composition, is from 0.5 to 80 % by weight.
14. A method for providing an improved color care effect during washing and/or

treatment of colored fabrics, which comprises a step of contacting the colored fabric with a washing solution which contains the fabric care composition according to any one of claims 1 to 13.

- 5 15. Use of the fabric care composition according to any one of claims 1 to 13 for enhancing color care effect during washing and/or treatment of colored fabrics.
16. Use of the fabric care composition according to any one of claims 1 to 13 for preparing laundry detergents, fabric conditioners, pretreatment agents, tumble drier
10 sheet and after-washing sprays products.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/073252

A. CLASSIFICATION OF SUBJECT MATTER
INV. C11D3/00 C11D3/37
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
C11D
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/017973 A1 (DETERING JUERGEN [DE] ET AL) 28 January 2010 (2010-01-28) cited in the application paragraphs [0024], [0123] - [0136]; claims; tables 1-3	1-16
X	US 2013/161239 A1 (GANE PATRICK A C [CH] ET AL) 27 June 2013 (2013-06-27) paragraphs [0048] - [0066], [0090] - [0097]; claims; examples	1-10,12
A		11,13-16

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search 7 November 2019	Date of mailing of the international search report 20/11/2019
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Péntek, Eric

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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