

Description

DETERGENT COMPOSITION FOR CLOTHING

Field of the invention

The present invention relates to a detergent composition for clothing, which comprises a clay mineral as a softening base material.

Related arts

Conventionally the incorporation of a softening agent into a detergent has been examined in order that fiber products after washing are prevented from losing softness and feeling stiff due to drop of a fiber treating agent and adhesion of salts. As the softening agent precipitated on fiber surfaces to give softness to the feeling of fiber products, clay minerals such as smectite (see, for example, JP-A 49-85102), cationic surfactants such as dialkyl quaternary ammonium salt (see, for example, "Collection of Known Customary Techniques, Powdery Detergent for Clothing", published by the Japanese Patent Office, March 26, 1998), silicone such as poly(dimethyl siloxane) (see, for example, JP-A 2002-249799), etc. have been conventionally used. However, the detergent composition comprising a detergent integrated with a softening agent did not attain any sufficient detergency or softening effect.

In recent years, a method of enhancing the softening effect of a detergent composition using clay minerals has

further been examined from the viewpoint of easiness in formulation, compatibility with the environment, etc. For example, combined use of bentonite and a pentaerythritol compound (see, for example, JP-A 5-140869), combined use of clay minerals and a flocculant (see, for example, JP-B 2620318), combined use of bentonite and a soluble potassium salt (see, for example, JP-A 8-506843 and "Collection of Known Customary Techniques, Powdery Detergent for Clothing")

Summary of the invention

The present invention relates to a detergent composition for clothing, which contains (a) 1 to 30 wt% of a clay mineral (referred to hereinafter as component (a)), (b) 0.1 to 10 wt% of a polymer having an average molecular weight of 500,000 or more, 60 mol% or more constituent monomers of which have a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof (referred to hereinafter as component (b)), (c) 5 to 40 wt% of a surfactant (referred to hereinafter as component (c)), and (d) 5 to 40 wt% of an alkali (referred to hereinafter as component (d)).

Detailed description of the invention

The effect of conferring sufficient softness while maintaining detergency in a washing step is still not recognized in the methods described in JP-A 5-140869, JP-B 2620318 and JP-A 8-506843.

The present invention provides a detergent composition for clothing using a clay mineral as a softening base material, which can, while washing an article to be washed, such as a fiber product, confer excellent softness on the washed article.

The detergent composition for clothing in the present invention can be used to bring about an effect by which fiber products can be washed and simultaneously endowed with excellent softness. The detergent composition of the present invention can exhibit an effect by which articles to be washed such as fiber products can be washed particularly by hand and simultaneously endowed with excellent softness and prevention of redeposition.

The softness in the present invention refers to smoothness felt upon contacting with clothing, and examples of the fiber products include towels, bath towels, T-shirts, sweatshirts etc.

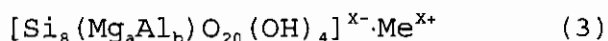
Hereinafter, the detergent composition for clothing in the present invention is described in more detail.

<Component (a)>

The detergent composition for clothing in the present invention comprises a clay mineral as the component (a) in an amount of 1 to 30 wt%. From the viewpoint of softening performance and washing performance, the content of the component (a) in the detergent composition for clothing is preferably 2 to 25 wt%, more preferably 4 to 20 wt%, still more preferably 6 to 18 wt%, further more preferably 8 to 15 wt%.

The component (a) includes talc, pyrophyllite, smectite (saponite, hectorite, sauconite, stevensite, montmorillonite, beidellite, nontronite etc.), vermiculite, mica (phlogopite, biotite, zinnwaldite, commonmica, palagonite, celadonite, glauconite etc.), chlorite (clinochlore, chamosite, nimitite, pennatite, sudoite, donbassite etc.), clintonite (clintonite, margalite etc.), surite, serpentine mineral (antigorite, lizardite, chrysotile, amesite, cronstedtite, berthierine, greenalite, garnierite (nepouite) etc.) and kaolin mineral (kaolinite, dickite, nacrite, halloysite etc.). Among them, from the viewpoint of softening performance, talc, smectite, swollen mica, vermiculite, chrysotile, kaolin mineral etc. are particularly preferable, smectite is more preferable, and montmorillonite is further preferable. These can be used alone or as a suitable mixture of two or more thereof.

From the viewpoint of caking resistance and finish feeling, the component (a) is preferably a clay mineral represented by the following general formula (3):



wherein $0 < a \leq 6$, $0 < b \leq 4$, $x = 12 - 2a - 3b$, and Me is at least one member selected from Na, K, Li, $\text{Ca}^{1/2}$, $\text{Mg}^{1/2}$ and NH_4 .

Examples of the clay mineral represented by the general formula (3) include "Laundrosil DGA212", "Laundrosil PR414" and "Laundrosil DGA Powder" manufactured by SÜD-CHEMIE and "Detersoft G1S", "Detersoft G1B" and "Detersoft G1SW"

manufactured by Laviosa Chimica Mineraria S.p.A.

The component (a) may be either a natural source product or a synthetic product. A mixing method of component (a) is not particularly limited. It is more preferable from the viewpoint of handling on production and resistance to caking to add it in dry-blending, for example, in granulation procedure or after granulation.

<Component (b)>

The detergent composition for clothing in the present invention comprises, as the component (b), 0.1 to 10 wt% polymer having an average molecular weight of 500,000 or more, 60 mol% or more constituent monomers of which have a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof (hereinafter, the polymer is also referred to as the polymer containing a sulfonic acid group and/or a sulfuric acid group). As used herein, the constituent monomers refer to monomer units in the polymer. For example, a constituent monomer of $[\text{CH}_2-\text{CH}(\text{X})]_n$ that is a polymer of vinyl monomer $\text{CH}_2=\text{CH}(\text{X})$ represents a group represented by $-\text{CH}_2-\text{CH}(\text{X})-$ derived from the monomer $\text{CH}_2=\text{CH}(\text{X})$.

The polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention may be a vinyl polymer, may be a condensed polymer or may be a polyether polymer.

When the polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention is a vinyl polymer, the monomer unit that is a vinyl constituent monomer

having a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof includes, for example, groups derived from monomers such as 2-(meth)acryloyloxy ethane sulfonic acid, 2-(meth)acryloyloxy propane sulfonic acid, 2-(meth)acrylamide-2-alkyl (C1 to C4) propane sulfonic acid, vinyl sulfonic acid, allyl sulfonic acid, styrene sulfonic acid, vinylsulfuric acid etc. In particular, groups derived from 2-(meth)acryloyloxy ethane sulfonic acid, 2-(meth)acryloyloxy propane sulfonic acid, 2-(meth)acrylamide-2-alkyl (C1 to C4) propane sulfonic acid, and styrene sulfonic acid are preferable from the viewpoint of high polymerization ability and easy preparation of the polymer, and groups derived from 2-acrylamide-2-methyl propane sulfonic acid and styrene sulfonic acid are more preferable, and a group derived from 2-acrylamide-2-methyl propane sulfonic acid is still more preferable. As used herein, (meth)acryloyl means acryloyl, methacryloyl or a mixture thereof.

These constituent monomers may be used in an acid form or may be used in the form of salt-type groups formed by partially or wholly neutralizing their sulfonic acid group and/or sulfuric acid group.

The counterion forming a group in a salt form of a sulfonic acid group or a sulfuric acid group includes a metal ion, an ammonium ion, an alkyl or alkenyl ammonium ion containing 1 to 22 carbon atoms in total, a C1 to C22 alkyl-

or alkenyl-substituted pyridinium ion, and an alkanol ammonium ion containing 1 to 22 carbon atoms in total, and is preferably an alkali metal ion such as sodium ion or potassium ion, or an ammonium ion, more preferably a sodium ion or potassium ion.

In the polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention, the constituent monomers may be used alone or in combination of two or more thereof, and when two or more kinds of constituent monomers are used, the arrangement of these constituent monomers is not particularly limited, and these monomers may be arranged at random, alternately, or in block.

When the polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention is a vinyl polymer, a method of synthesizing the vinyl polymer is not particularly limited and can be selected from methods known in the art. For example, a vinyl monomer containing a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof may be homo-polymerized or may be co-polymerized with another monomer not containing a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof, at a mole ratio of the former being 60 mol% or more. Alternatively, a sulfonic acid group or a group in a salt form thereof, or a sulfuric acid group or a group in a salt form thereof, may be introduced into an existing arbitrary polymer such that the ratio of the constituent monomers becomes 60 mol% or more.

When the polymer containing a sulfonic acid group and/or

a sulfuric acid group in the present invention is a vinyl polymer, the vinyl polymer can be obtained by homopolymerizing or copolymerizing monomers each containing a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof, and in this case, the polymer can be synthesized through bulk polymerization or precipitation polymerization, preferably through aqueous solution polymerization or reverse phase suspension polymerization from the viewpoint of easy regulation of polymerization.

When the polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention is a vinyl polymer, the vinyl polymer can be synthesized by any polymerization methods such as radical polymerization, anion polymerization, cation polymerization etc.

When the vinyl polymer is obtained as a copolymer wherein a monomer having a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof is copolymerized with other monomer(s), constituent monomers other than the constituent monomer having a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof are not particularly limited insofar as the polymer containing a sulfonic acid group and/or a sulfuric acid group can maintain water solubility.

Examples of such copolymerizable monomers are as follows:

Examples include (meth)acrylic acid ("(meth)acrylic

acid" refers to acrylic acid and/or methacrylic acid) and salts thereof, styrene carboxylic acid and salts thereof, maleic acid monomers (that is, maleic anhydride, maleic acid, maleic acid monoester, maleic acid monoamide, or a mixture of two or more thereof) and salts thereof, and itaconic acid and salts thereof, and at least one member selected from these compounds can be used. Among these compounds, (meth)acrylic acid and salts thereof, styrene carboxylic acid and salts thereof are preferable for easy copolymerization, and (meth)acrylic acid and salts thereof are more preferable. The counterions forming these salts may be any counterions described above.

A vinyl constituent monomer having a phosphoric acid group (or a group in a salt form thereof) or a phosphonic acid group (or a group in a salt form thereof) may also be copolymerized. For example, (meth)acryloyloxy alkyl (C1 to C4) phosphoric acid, vinyl phosphonic acid etc. can be mentioned. The counterions forming the salts may be any counterions described above.

Further, the following monomers may also be copolymerized.

1) (Meth)acrylamides which are unsubstituted or substituted at the nitrogen thereof with a C1 to C4 saturated or unsaturated alkyl or aralkyl group. Preferable examples include (meth)acrylamide, N-methyl (meth)acrylamide, N,N-dimethyl (meth)acrylamide, N-ethyl (meth)acrylamide, N-t-butyl (meth)acrylamide, (meth)acryloyl morpholine, 2-(N,N-dimethylamino) ethyl (meth)acrylamide, 3-(N,N-dimethylamino)

propyl (meth)acrylamide, 2-hydroxyethyl (meth)acrylamide, N-methylol (meth)acrylamide, N-butoxymethyl (meth)acrylamide etc.

2) (Meth)acrylates. Preferable examples include methyl (meth)acrylate, ethyl (meth)acrylate, 2-hydroxyethyl (meth)acrylate, 2-(N,N-dimethylamino)ethyl (meth)acrylate, 2-methoxyethyl (meth)acrylate, polyethylene glycol mono(meth)acrylic acid ester, etc.

The polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention may be a crosslinked product. However, the degree of crosslinkage is preferably in such a degree as not to cause gelling. That is, the amount of a crosslinking agent used in polymerization is preferably 0.001 mol% or less in the constituent monomers.

The crosslinking agent includes, for example, polyhydric alcohol (meth)acrylates such as ethylene glycol di(meth)acrylate, diethylene glycol di(meth)acrylate, polyethylene glycol di(meth)acrylate, propylene glycol di(meth)acrylate, dipropylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, 1,2-butylene glycol di(meth)acrylate, 1,3-butylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate, glycerin di(meth)acrylate, glycerin tri(meth)acrylate, trimethylol propane tri(meth)acrylate, and pentaerythritol tetra(meth)acrylate; acrylamide compounds such as N-methyl allyl acrylamide, N-vinyl acrylamide, N,N'-methylene bis(meth)acrylamide, and bisacrylamide acetate; divinyl compounds such as divinyl

benzene, divinyl ether, and divinyl ethylene urea; polyallyl compounds such as diallyl phthalate, diallyl maleate, diallyl amine, triallyl amine, triallyl ammonium salt, pentaerythritol allyl ether, and allyl ether of sucrose having at least 2 allyl ether units in the molecule; and unsaturated alcohol (meth)acrylates such as vinyl (meth)acrylate, allyl (meth)acrylate, and 2-hydroxy-3-acryloyloxy propyl (meth)acrylate.

Among these crosslinking agents, ethylene glycol di(meth)acrylate, polyethylene glycol di(meth)acrylate, divinyl benzene, pentaerythritol triallyl ether, and pentaerythritol tetraallyl ether are preferable.

In addition to copolymerization with the crosslinking monomers described above, crosslinking may be carried out through a reaction using an epoxy compound such as 1,2-epoxy butane, 1,2-epoxy hexane, 1,2-epoxy octane and 1,2-epoxy decane. Alternatively any crosslinking may be carried out, such as self-crosslinking during polymerization, crosslinking reaction of the polymers with each other, or irradiation of radiation rays; ionic bonding crosslinking via a metal ion or the like; crosslinking via hydrogen bonding; crosslinking by a partial crystalline domain; or crosslinking ascribed to helical structure.

When the polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention is a non-vinyl polymer, the polymer may be a condensed polymer such as polyester, polyamide, polyurethane or polyimide, or may be a

polyether polymer. Alternatively, a sulfonic acid group or a group in a salt form thereof, or a sulfuric acid group or a group in a salt form thereof, may be introduced into an existing arbitrary condensed polymer or polyether polymer such that the ratio of the constituent monomers becomes 60 mol% or more.

In consideration of typical staining particles, that is, solid particles of mud and soot treated with the detergent, the polymer containing a sulfonic acid group and/or a sulfuric acid group is considered to be poor in affinity for any staining particles in a washing solution. Accordingly, it is considered that even if any particles of mud and soot are present in a washtub, the polymer in the washing solution is not adsorbed into a plurality of particles, thus causing no aggregation, and accordingly, the polymer serves as a binder of fibers and particles, thus making re-adhesion dirt to clothing difficult. That is, the molar fraction of the sulfonic acid monomer and sulfuric acid monomer is preferably higher in the monomers constituting the polymer as the component (b) in the present invention.

The amount of the constituent monomer containing a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof is preferably 60 mol% or more, more preferably 66 mol% or more, still more preferably 85 mol% or more, further more preferably 95 mol% or more, in the whole constituent monomers.

As the polymer containing a sulfonic acid group and/or

a sulfuric acid group in the present invention, a molecule having an average molecular weight of 500,000 or more determined according to "Definition of Average Molecular Weight" below is used so that softness can also be actually felt upon washing by hand. As the average molecular weight of the molecule is increased, the "smoothness" of clothing can be further improved, and the polymer having an average molecular weight of 500,000 or more can confer sufficient smoothness on clothing during washing by hand. From the viewpoint of realizing sufficient smoothness with the polymer even at a further dilute concentration, the average molecular weight is preferably 1,000,000 or more, more preferably 1,500,000 or more, still more preferably 2,000,000 or more, further more preferably 2,500,000, even more preferably 3,000,000 or more, even more preferably 4,500,000 or more, even more preferably 5,000,000 or more, even more preferably 6,000,000 or more. In the viewpoint of solubility, however, the average molecular weight is preferably 30,000,000 or less, more preferably 20,000,000 or less.

As used herein, "smoothness" refers to a state of clothes in a washing solution or a state of clothes containing a washing solution in which friction generated among clothes or among fibers during washing was reduced. Particularly, upon washing by hand, the friction appears as resistance which a person washing clothes etc. receives (feels) on the hand, and when the smoothness is improved, this resistance is hardly received (felt), and clothes etc. can be very smoothly rubbed against

one another.

Among the physical properties of the polymer containing a sulfonic acid group and/or a sulfuric acid group in the present invention, the physical property suitable for exhibiting "smoothness" is "spinnability". The polymer with improved spinnability may be incorporated in a small amount to exhibit "smoothness". The improved spinnability in the present invention means that an aqueous solution of the polymer at lower concentration and at lower viscosity exhibits a spinnability. A linear polymer having a higher molecular weight with a low degree of crosslinkage has an improved spinnability and is thus a polymer preferable in the invention for exhibiting excellent "smoothness".

A mixing method of component (b) is not particularly limited. It is more preferable from the viewpoint of handling on production to add it in dry-blending, for example in granulation procedure or after granulation.

[Definition of Average Molecular Weight]

The average molecular weight of the component (b) used in the present invention can be determined by gel permeation chromatography (GPC) under measurement conditions described below. As a standard sample, polyethylene oxide (PEO) is used, and PEO-equivalent molecular weight is used as the average molecular weight. In the present invention, the average molecular weight of the component (b) shall be expressed not by number-average molecular weight or weight-average molecular weight, but by the PEO-equivalent value (referred

to hereinafter as "peak-top molecular weight") of a fraction showing the highest density of a GPC elution curve. That is, a "polymer having an average molecular weight of 1,500,000 or more" for example refers to a polymer whose peak-top molecular weight indicates a value of 1,500,000 or more in terms of PEO-equivalent molecular weight.

[Measurement conditions for GPC method]

Columns PW/GMPWXL/GMPWXL (manufactured by Tosoh Corporation) are used with 0.2 M phosphate buffer (KH_2PO_4 , Na_2HPO_4 , pH 7)/ $\text{CH}_3\text{CH} = 9/1$ (mass ratio) as the eluent, wherein the column temperature is 40°C, the flow rate is 1.0 mL/min., and the sample concentration is 1 to 100 $\mu\text{g/mL}$. As the detector, RALLS (90° light scattering analyzer) is used. When the molecular weight cannot be determined by the above measurement method, an approximate average molecular weight can be estimated by using RID (differential refractometer). The GPC analysis using RID is carried out by using, for example, columns GMPWXL+GMPWXL with 0.2 M phosphate buffer/ $\text{CH}_3\text{CH} = 9/1$ (mass ratio) as the eluent, at a column temperature of 40°C, a flow rate of 0.5 mL/min. and a concentration of 0.05 mg/mL.

<Component (c)>

As the surfactant used in the present invention, a conventionally known substance can be used. From the viewpoint of improving detergency, an anionic surfactant or a nonionic surfactant is preferably used as a main surfactant.

Particularly, the anionic surfactant is preferably a surfactant having a C10 to C18 alkyl or alkenyl group.

Preferable examples include alkali metal salts such as a C10 to C18 alkyl chain-containing linear alkyl benzene sulfonate, alkyl sulfate, polyoxyalkylene alkyl ether sulfate, α -sulfofatty acid alkyl ester salt, N-acyl amino acid-type surfactant, alkyl or alkenyl ether carboxylate, amino acid surfactant, alkyl or alkenyl phosphate ester or a salt thereof. They may further be fatty acid salts derived from tallow and coconut oil. In particular, alkyl benzene sulfonate, alkyl sulfate, and polyoxyalkylene alkyl ether sulfate are preferable, and particularly sodium alkyl benzene sulfonate is preferable. The anionic surfactant has an effect of further improving "spinnability" of the organic polymer as the component (b) or "smoothness conferring effect" by the component (b) in the present invention. From this viewpoint, the content of the anionic surfactant in the detergent composition is preferably 5 wt% or more, more preferably 10 wt% or more, still more preferably 12 wt% or more, further more preferably 15 wt% or more, even more preferably 18 wt% or more, even more preferably 20 wt% or more. From the viewpoint of physical properties of powder, the content is preferably 40 wt% or less, more preferably 35 wt% or less, still more preferably 30 wt% or less, further more preferably 26 wt% or less.

The nonionic surfactant is preferably polyoxyalkylene (preferably oxyethylene and/or oxypropylene) alkyl ether. A polyoxyethylene alkyl phenyl ether, higher fatty acid alkanol amide or its alkylene oxide adduct, sucrose fatty acid ester,

alkyl glucoside, and fatty acid glycerin monoester can also be used. The nonionic surfactant is excellent in resistance to hard water and remarkable in detergency for oily stain such as sebum stain. From the viewpoint of foaming properties and rinsing, the nonionic surfactant is used preferably in an amount of 15 wt% or less.

In the case of washing with the detergent composition containing a large amount of the nonionic surfactant, the "creak feeling" of clothes after washing is increased, so when the clay mineral is used as a softening agent, the softening effect of the softening agent even adhering to the clothes may not be achieved to such a level as expected. To allow the clay mineral to be sufficiently adsorbed into the object of washing thereby further improving the softening effect, the ratio of the anionic surfactant to the total surfactant [total component (c)] incorporated into the detergent composition is preferably 50 wt% or more, more preferably 60 wt% or more, still more preferably 70 wt% or more. The ratio of the nonionic surfactant to the total surfactant [total component (c)] is preferably 50 wt% or less, more preferably 40 wt% or less, still more preferably 30 wt% or less.

The detergent composition of the present invention can also be compounded suitably with surfactants such as a betaine-based amphoteric surfactant, a phosphate-based surfactant and a cationic surfactant.

<Component (d)>

A conventionally known alkali is preferably

incorporated as the alkali as the component (d) used in the present invention. Examples of the alkali includes alkali metal carbonates such as sodium carbonate, generally called dense ash and light ash, and alkali metal salts such as amorphous and crystalline alkali metal silicates such as JIS Nos. 1, 2 and 3 sodium silicate. The alkali metal salt has an effect of further improving the "smoothness" attributable to the component (b) in the present invention. From this viewpoint, the content of the alkali metal salt in the detergent composition is preferably 1 wt% or more, more preferably 5 wt% or more, still more preferably 7 wt% or more, further more preferably 10 wt% or more, even more preferably 12 wt% or more, even more preferably 15 wt% or more, even more preferably 20 wt% or more. From the viewpoint of formulation balance, the content is preferably 40 wt% or less, more preferably 30 wt% or less.

<Component (e)>

Preferably, the detergent composition for clothing in the present invention further comprises, as the component (e), 0.5 to 20 wt% compound releasing hydrogen peroxide in water. From the viewpoint of softening performance and washing performance, the content of the component (e) in the detergent composition for clothing is preferably 1.5 to 20 wt%, more preferably 2 to 16 wt%, still more preferably 2.5 to 13 wt%, further more preferably 3 to 10 wt%, even more preferably 3.5 to 8 wt%.

The component (e) includes a carbonate/hydrogen

peroxide adduct, a borate/hydrogen peroxide adduct, a tripolyphosphate/hydrogen peroxide adduct, a pyrophosphate/hydrogen peroxide adduct, and an urea/hydrogen peroxide adduct. Among these compounds, a carbonate/hydrogen peroxide adduct and a borate/hydrogen peroxide adduct are preferable, and a sodium carbonate/hydrogen peroxide adduct and a sodium borate/hydrogen peroxide adduct are more preferable. From the viewpoint of washing performance at high temperatures, a sodium borate/hydrogen peroxide adduct is further preferable, and from the viewpoint of washing performance at low temperatures, a sodium carbonate/hydrogen peroxide adduct is further preferable.

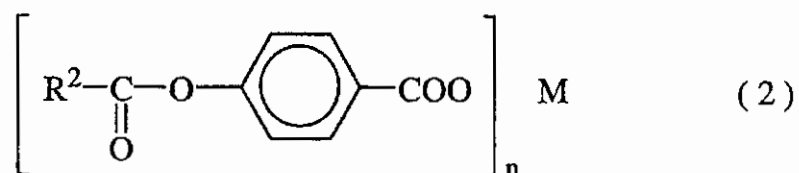
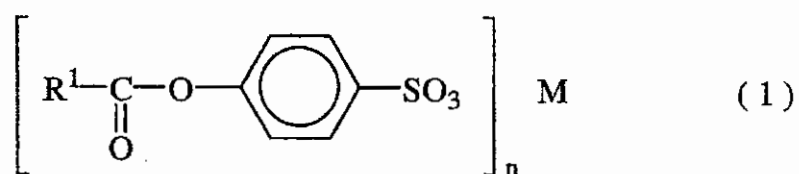
From the viewpoint of storage stability, the compound (e) is preferably coated with an inorganic compound or an organic compound. The inorganic compound includes boric acid, borate, sodium carbonate, sodium sulfate, magnesium sulfate, magnesium silicate, magnesium chloride, magnesium oxide, sodium silicate etc., and the organic compound includes polyethylene glycol, polyvinyl pyrrolidone, hydroxypropyl cellulose etc. The component (e) is coated particularly preferably with at least boric acid or borate. Boric acid includes o-boric acid, m-boric acid and tetraboric acid, and its salt includes alkali metal salts with sodium, potassium etc.

The component (e) can be coated with the inorganic compound or the organic compound by a method described in, for example, JP-A 59-196399. The amount of the component (e) is

preferably 50 to 95 wt%, more preferably 70 to 90 wt%, in particles containing the component (e). When the component (e) is used as particles containing the component (e), the amount of the inorganic compound or the organic compound with which the component (e) is coated is preferably 0.5 to 20 wt%, more preferably 1 to 10 wt%, from the viewpoint of stability and solubility in the particles. A conventionally known stabilizer, solubilizer, chelating agent etc. may be contained in the particles. Among these compounds, chlorides, urea, an anionic surfactant and a nonionic surfactant are preferable in respect of solubility, and the ratio of each of these compounds to the particles is preferably 0.1 to 5 wt%.

<Component (f)>

The detergent composition for clothing according to the present invention preferably comprises, as the component (f), 0.1 to 20 wt% compound represented by formula (1) and/or (2) below. From the viewpoint of softening performance and washing performance, the component (f) in the detergent composition for clothing is preferably 1.5 to 20 wt%, more preferably 2 to 16 wt%, still more preferably 2.5 to 13 wt%, further more preferably 3 to 10 wt%, even more preferably 3.5 to 8 wt%.



wherein R^1 represents a C4 to C13 alkyl group, R^2 represents a C5 to C13 alkyl group, M represents a hydrogen atom, an alkali metal atom, an alkaline earth metal atom, ammonium, or alkanol ammonium, and when M is an alkaline earth metal atom, n is 2, and when M is an alkali metal atom, ammonium or alkanol ammonium, n is 1.

From the viewpoint of washing performance, each of R^1 and R^2 in the formulae (1) and (2) is preferably a C7 to C18, more preferably C10 to C13, alkyl or alkenyl group (more preferably alkyl group). M is preferably an alkali metal atom, more preferably sodium or potassium, particularly preferably sodium.

The component (f) is a compound reacting, in water, with hydrogen peroxide (specifically, hydrogen peroxide released from the component (e)) to generate an organic peracid. The detergent composition for clothing in the present invention is advantageous in that it contains the component (f) thereby improving the softening effect as compared with the case where

the component (a) is used alone. The organic peracid refers to a peroxide generated by reacting the component (f) with hydrogen peroxide derived from the component (e).

The component (f), when incorporated into the detergent composition for clothing, is preferably incorporated as particles containing the component (f), from the viewpoint of stability. The amount of the component (f) in the particles containing the component (f) is preferably 1 to 80 wt%, more preferably 20 to 80 wt%, still more preferably 30 to 75 wt%. In the particles containing the component (f), at least one surfactant selected from polyoxyalkylene alkyl ether, alkyl sulfate, and polyoxyalkylene alkyl ether sulfate is incorporated in an amount of preferably 0 to 50 wt%, more preferably 1 to 45 wt%, still more preferably 2 to 40 wt%, in order to improve the solubility of the component (f) in a washtub.

The polyoxyalkylene alkyl ether is preferably an ether to which ethylene oxide and propylene oxide were added in block, wherein the average number of ethylene oxide units added is preferably 3 to 20, more preferably 4 to 15, and the average number of propylene oxide units added is preferably 1 to 10, more preferably 2 to 7. The number of carbon atoms in the alkyl group is preferably 10 to 18, more preferably 12 to 16.

The alkyl sulfate is preferably a sodium salt containing 10 to 18 carbon atoms, more preferably sodium lauryl sulfate or sodium myristyl sulfate.

The polyoxyalkylene alkyl ether sulfate is preferably

polyoxyethylene alkyl ether sulfate whose alkyl group contains 10 to 18 carbon atoms, which is preferably a sodium salt. The average polymerization degree of polyoxyethylene group (referred to hereinafter as EOp) is preferably 1 to 10, more preferably 1 to 5, and particularly, sodium polyoxyethylene (EOp = 2 to 5) lauryl ether sulfate and sodium polyoxyethylene (EOp = 2 to 5) myristyl ether sulfate are preferable.

The particles containing the component (f) may be formulated from the above components by using a binder selected from polyethylene glycol and fatty acid.

The polyethylene glycol is the one having an average molecular weight of preferably 2000 to 20000, more preferably 4000 to 15000, still more preferably 4000 to 10000. The fatty acid is the one containing preferably 8 to 20 carbon atoms, more preferably 10 to 18 carbon atoms, still more preferably 12 to 18 carbon atoms, and the fatty acid may be in the form of sodium or potassium soap.

The binder is used in an amount of preferably 0.5 to 30 wt%, more preferably 1 to 20 wt%, still more preferably 5 to 20 wt%, in the particles containing the component (f).

From the viewpoint of storage stability, the composition described above is compounded in the above proportion with the particles containing the component (f).

In the present invention, an acidic substance may be incorporated into the particles containing the component (f) if necessary for the purpose of further improving the stability of the particles containing the component (f). The acidic

substance is preferably an organic carboxylic acid, more preferably at least one member selected from succinic acid, maleic acid, fumaric acid, citric acid, glycolic acid and p-hydroxybenzoic acid. The content of such acidic substance in the particles containing the component (f) is preferably 0 to 20 wt%, more preferably 1 to 15 wt%, still more preferably 1 to 10 wt%.

The particles containing the component (f) can be obtained by mixing the above components by an arbitrary method, preferably by a method wherein the component (f) is mixed with a part or the whole of the above-mentioned surfactant, followed by addition of the remaining surfactant, the binder, the acidic substance etc.

The binder is added preferably after being melted. The binder is added after being melted preferably at 40 to 100°C, more preferably at 50 to 100°C, still more preferably at 50 to 90°C.

The mixture obtained in the manner described above is stirred and mixed uniformly and then formed by a usual granulator into a pharmaceutical preparation.

The granulation method is preferably extrusion granulation to prepare granules having an average particle diameter of preferably 500 to 5000 μm , more preferably 500 to 3000 μm . Another preferable granulation method is preferably a granulation method of forming tablets by a bricketing machine.

<Component (g)>

From the viewpoint of productivity, solubility and caking resistance, the detergent composition for clothing in the present invention preferably comprises, as the component (g), a builder having at least one action selected from metal chelating action, alkali buffering action and solid particle-dispersing action. The content of the component (g) in the composition is preferably 20 to 80 wt%, more preferably 30 to 70 wt%, still more preferably 40 to 60 wt%.

The component (g) includes builders (excluding the component (d)) described on pages 56 to 74 in "Detergent/Washing Dictionary" (in Japanese), First Edition, First Print, November 25, 1990, edited by Haruhiko Okuyama & Motoi Minagawa, published by Asakura Shoten, JP.

Particularly, the inorganic builders are preferably amorphous aluminosilicates, crystalline aluminosilicates (zeolite), tripolyphosphates and pyrophosphates, and the organic builders are preferably aminocarboxylates, hydroxyaminocarboxylates, hydroxycarboxylates, cyclocarboxylates, ether carboxylates and organic carboxylic acid (salt) polymers. Other preferable examples of the inorganic builders include zeolite and sodium tripolyphosphate, and preferable examples of the organic builders include organic carboxylic acid (salt) polymers, carboxymethyl cellulose, soluble starch, saccharides, polyethylene glycol etc., among which the carboxylic acid (salt) polymers are preferable. Among the carboxylic acid (salt) polymers, an acrylic acid/maleic acid copolymer salt

and a polyacrylic acid salt (counter ion: Na, K, NH_4 etc.) are particularly superior in detergency. The molecular weight is preferably 1000 or more, more preferably 5000 or more.

<Water content>

The detergent composition for clothing in the present invention contains water (that is, water by a heating loss method described in JIS K 3362:1998) in an amount of preferably 0.1 to 10 wt%, more preferably 0.2 to 6 wt%, still more preferably 0.5 to 4 wt%, further more preferably 0.5 to 3 wt%, from the viewpoint of storage stability and productivity.

<Other components>

The detergent composition for clothing in the present invention can comprise components known in the field of detergent for clothing, such as a softening agent (other than the component (a)), a fluorescent dye, a foam inhibitor (silicone etc.), an enzyme, an enzyme stabilizer, a coloring agent, a perfume etc.

<Surface modification>

In respect of fluidity and caking resistance, the detergent composition for clothing in the present invention may be surface-modified with a surface modifier. The surface modifier includes, for example, silicate compounds such as aluminosilicates, clay minerals, calcium silicate, silicon dioxide, amorphous silica derivatives and crystalline silicate compounds, fine particles of metal soaps and powdery surfactants, water-soluble polymers such as carboxymethyl cellulose, polyethylene glycol, sodium polyacrylate and

polycarboxylates including an acrylic acid/maleic acid copolymer or salts thereof, and fatty acids. The surface modifier is more preferably aluminosilicates, clay minerals and crystalline silicate compounds, still more preferably aluminosilicates or the clay mineral that is the component (a). From the viewpoint of storage stability, the content of the surface modifier in the detergent composition for clothing in the present invention is preferably 20 wt% or less, more preferably 15 wt% or less, still more preferably 10 wt% or less. From the viewpoint of surface modification, the content of the surface modifier in the detergent composition for clothing in the present invention is preferably 1 wt% or more, more preferably 3 wt% or more, still more preferably 5 wt% or more.

The above-mentioned detergent composition for clothing in the present invention can be produced by mixing the above respective components by a known method.

<Physical properties of the detergent composition for clothing>

In respect of stability, the detergent composition for clothing in the present invention is preferably in a powdery or tablet form, more preferably in a powdery form. In respect of solubility at low temperatures and stability, the average particle diameter determined from particle size measured by a sifting method with a sifting machine described in JIS K 3362:1998 is preferably 200 to 1000 μm , more preferably 250 to 900 μm , still more preferably 300 to 800 μm . In respect of solubility at low temperatures and stability, the apparent

density measured by a method described in JIS K 3362:1998 is preferably 300 to 1200 g/L, more preferably 400 to 1100 g/L, still more preferably 600 to 1000 g/L, further more preferably 700 to 980 g/L.

In respect of washing performance, softening performance and damage, the pH of 0.05 wt% aqueous solution of the detergent composition for clothing, determined at 20°C as described in JIS K3362:1998, is preferably 8 to 12, more preferably 9 to 11.5, still more preferably 9.5 to 11, further more preferably 10 to 11.

In respect of washing performance and softening performance, the amount of calcium captured in the detergent composition for clothing, as determined for the detergent composition for clothing by a measurement method below, is preferably 20 to 300 CaCO₃ mg/g, more preferably 50 to 200 CaCO₃ mg/g, still more preferably 100 to 150 CaCO₃ mg/g.

(Method of measuring the amount of calcium captured)

The amount of calcium captured is determined by a method described in line 6 in lower right column on page 3 to line 6 in upper left column on page 4 of JP-A 3-277696 (provided that the anionic surfactant is read as the detergent composition for clothing).

<Method of washing fiber products>

The method of washing fiber products in the present invention has a step of washing an object with the detergent composition for clothing. The object to be washed includes fiber products made of natural fibers such as cotton, hemp,

hair etc., regenerated fibers such as rayon, cuprammonium rayon etc., semi-synthetic fibers such as acetate, and synthetic fibers such as nylon, polyester, acryl etc.

The method of washing with the composition of the invention having an enhanced softening effect may be any known method used in washing of usual fiber products, and the washing conditions such as temperature, washing device etc. are not particularly limited.

The detergent composition for clothing in the present invention is preferable for use in washing by hand. When the composition of the present invention is used in washing of clothes by hand, the clothes during the treatment are also conferred with soft feeling.

Examples

<Powdery detergent composition for clothing>

Table 1 shows detergents A to F used in the Examples and Comparative Examples below and detergent G preferable as the composition of the present invention. In Table 1, 0.05 wt% aqueous solutions of all detergents A to G, as determined at 20°C as described in JIS K3362:1998, showed that the pH value was in the range of 10 to 11, the amount of calcium captured was in the range of 50 to 200 CaCO₃ mg/g, the average particle diameter was in the range of 300 to 800 μm, and the apparent density was in the range of 700 to 980 g/L.

Table 1

			Detergent						
			A	B	C	D	E	F	G
Compounding component (wt. %)	(c)	LAS-Na	30	14	11	30		10	11
		Non-ion		6	9		15	10	9
		Soap		2	1				1
		AS-Na		4					
	(g)	Zeolite	14	28	27	20	20	20	26
		Sodium tripolyphosphate	15			10	10	10	
	(d)	Soda ash	10	24	23	25	25	25	22
		Sodium bicarbonate	6						
		No.1 silicate	10	10					
		Crystalline silicate			1				1
		Glauber's salt	4	2	13	13	28	23	13
		Sodium sulfite		1	0.4				0.4
		Sodium chloride			4				4
		PEG13000	1	2	1	1	1	1	1
		AA/MA copolymer	0.5	3		1	1	1	
		AA polymer			6				6
	(f)	Granulated product of sodium lauroxy benzene sulfonate							1
		CMC	0.5						
	(e)	Sodium percarbonate	2						1
		Fluorescent dye	0.1	0.1					
		Enzyme (protease)	0.1	0.4	0.2				0.2
		Enzyme (cellulase)	0.1	0.3	0.2				0.2
		Perfume	0.3	0.2	0.2				0.2
		Water	6.4	3	3				3
		Total	100	100	100	100	100	100	100

The ingredients in Table 1 are as follows:

- LAS-Na: Sodium linear-alkyl benzene sulfonate (the number of carbon atoms in the alkyl group: 12 to 14)
- Non-ion or nonionic compound: C10 to C14 primary alcohol to which 10 moles on average of EO was added
- Soap: Sodium fatty acid salt (the number of carbon atoms in the alkyl group: 14 to 18)
- AS-Na: Sodium alkyl sulfate (the number of carbon atoms in the alkyl group: 12 to 16)
- Zeolite: manufactured by PQ Chemicals Ltd., Thailand
- Sodium tripolyphosphate: manufactured by Jiangyin Chengxing Household Chemicals Co., Ltd.
- Sodium bicarbonate: Sodium hydrogen carbonate manufactured by Tosoh Corporation
- No 1 silicate: manufactured by TOKUYAMA SIAM SILICA CO., LTD.
- Crystalline silicate: "PURIFEED GRANULE" manufactured by Tokuyama Siltech Corporation
- Glauber's salt: Sodium sulfate manufactured by Shikoku Kasei Kogyo Co., Ltd.
- Sodium sulfite: manufactured by Mitsui Chemicals, Inc.
- Sodium chloride: manufactured by Nippon Salt Manufacturing Co., Ltd.
- PEG13000: Polyethylene glycol "PEG13000" manufactured by Mitsui Chemicals, Inc.
- AA/MA copolymer: an acrylic acid/maleic acid copolymer "ACUSOL479N" manufactured by Rohm & Haas, Taiwan

- AA polymer: polyacrylic acid (peak-top average molecular weight 10,000, polyethylene glycol-equivalent molecular weight determined by GPC)
- CMC: carboxymethyl cellulose "Sun Rose B (B2B)" manufactured by Nippon Seishi Chemical Co., Ltd.
- Sodium percarbonate: manufactured by Nippon Peroxide Co., Ltd.
- Granulated product of sodium lauroxyloxy benzene sulfonate: bleaching particles described in column 0018 in JP-A 2000-256699
- Fluorescent dye: "Tinoparl CBS-X" manufactured by Ciba Geigy
- Enzyme (protease): "Cannase 24TK" manufactured by Novozymes
- Enzyme (cellulase): "Cellulase K" described in JP-A 63-264699

Examples 1 to 3 and Comparative Examples 1 to 3

Powdery detergent compositions for clothing in Table 2 were prepared from detergent A, B or C in Table 1 and the ingredients in Table 2 and then examined for prevention of redeposition according to the following method.

(Method of evaluating the prevention of redeposition)

0.25 g carbon black (Asahi standard carbon for washing, average particle diameter of 150 nm, manufactured by Asahi Carbon Co., Ltd.) was introduced into a 1-L beaker and then mixed with a detergent solution prepared by dissolving the detergent composition for clothing in Table 2 (the concentration used is shown in Table 2). For efficiently

dispersing the carbon black, the sample is dispersed for 10 minutes by a sonicator (U0600PB-Y manufactured by Kokusai Denki Kasei Co., Ltd.). Separately, cotton 2003 (No. 3 cotton cloth manufactured by Senshoku Shizai Co., Ltd.) was washed 5 times (in an automatic washing machine, National NA-F70AP2, standard mode) with a standard detergent for detergency judgment JIS K 3362 (not compounded with a fluorescent dye) (referred to hereinafter as JIS standard detergent) and then cut into 8 cm×8 cm pieces to prepare 8 cotton test clothes. These cotton test clothes were introduced into the above detergent solution and washed in a mixing type detergency tester (Terg-O-Tometer; rotational speed:100±5 rpm) at 25°C for 10 minutes. After washing, the test clothes are dehydrated, then ironed and measured for the redeposition-preventing ratio according to the following equation.

$$\text{Redeposition Preventing Ratio (\%)} = 100 - \left[\frac{(\text{reflectance of the original cloth}) - (\text{reflectance of the test cloth after washing})}{(\text{reflectance of the original cloth})} \times 100 \right]$$

The reflectance was measured at a wavelength of 550 nm. The redeposition-preventing ratio is shown in Table 2.

Table 2

		Comparative example			Example		
		1	2	3	1	2	3
Formulation composition (parts by weight)	Detergent A	90			90		
	Detergent B		90			90	
	Detergent C			90			90
	Synthetic polymer				1	1	1
	Bentonite	10	10	10	10	10	10
Used concentration* (g/30L)		100	100	100	100	100	100
Prevention of redeposition(%)		56	53	55	55	54	53

* The used concentration is the total concentration of the detergent and bentonite used (this applies hereinafter).

The ingredients in Table 2 are as follows:

- Bentonite: "Laundrosil DGA212" (bentonite, manufactured by SÜD-CHEMIE)
- Synthetic polymer: a copolymer of sodium 2-acrylamide-2-methyl propane sulfonate/sodium acrylate = 95 : 5 (molar ratio), synthesized in the following Synthesis Example.
(Synthesis Example)

6.00 g sugar ester (S-770, Mitsubishi-Kagaku Foods Corporation) was dissolved in 800 g n-hexane and refluxed in

a nitrogen atmosphere, and a solution of 600 g 2-acrylamide-2-methyl propane sulfonic acid, 160 g sodium hydroxide, 10 g acrylic acid, and 0.80 g 2,2'-azobis(2-methylpropionamidine) dihydrochloride (V-50, manufactured by Wako Pure Chemical Industries, Ltd.) in 510 g deionized water was added dropwise thereto over 1 hour a temperature kept at 10°C or less, and the mixture was further stirred for 30 minutes. Only the aqueous phase was separated from the resulting azeotropic refluxed fluid, and when the water content was reduced to 30 wt%, the aqueous phase was left and cooled, and the resulting solid granular product was dried under reduced pressure to give 674 g colorless granular polymer (99.7%). As a result of measurement of the resulting polymer by GPC, the peak-top molecular weight was 7,800,000. The average particle diameter was 220 μm .

As can be seen from the results in Table 2, the prevention of redeposition is not reduced even if the synthetic polymer is added.

Examples 4 to 7 and Comparative Examples 4 to 7

The ingredients shown in Table 3 (the same ingredients as in Examples 1 to 3) were used in the detergent A, D, E or F in Table 1 and the resulting detergent compositions were evaluated for their softening property in the following method.

(Method of evaluating the softening property)

(1) Preparation of towels for evaluation

Commercially available 20 new cotton towels (size 30

cm×80 cm, 100% cotton) were pretreated by washing them 5 times with the JIS standard detergent at a detergent concentration of 25 g/30 L in an automatic washing machine (National NA-F70AP2, standard mode), to prepare towels for evaluation (pretreated towels). The water used in the pretreatment had a hardness of 4.9°DH and a water temperature of 26°C. Underclothes (YG, L size, manufactured by Gunze, 100% cotton) were also pretreated in the same manner.

(2) Evaluation

To 40 L water having a hardness of 5°DH at 25°C in an automatic washing machine (National NA-F70AP2; water-volume mode, small volume) is added 33.3 g (25 g/30 L) of a mixture of detergent A, D, E or F and bentonite in a ratio shown in Table 3, and in Example 4, 1.67 g synthetic polymer is added thereto, while in Examples 5 to 7, 0.5 g synthetic polymer is added thereto. After stirring for 1 minute, about 2.5 kg of 20 treated underclothes and 5 treated towels for evaluation are introduced in this order into the washing machine, to initiate washing. In this water-volume mode, the washing is finished in about 35 minutes. After washing, the towels for evaluation and the underclothes are removed, and the same towels for evaluation and the same underclothes are subjected to washing in the same manner as above. This washing is repeated 5 times, and thereafter, only the towels for evaluation are dried at 25°C at 40% RH for 1 day.

A pair of the towel for evaluation washed with the detergent composition to which the synthetic polymer was added

and the towel for evaluation washed with the composition to which the synthetic polymer was not added were sensorially evaluated for their softness to the touch in blind by 4 examiners. This evaluation was carried out by selecting one towel at random (so that the examiners could not see which one was selected) from the towels washed with the composition to which the synthetic polymer was added and the towels for evaluation washed with the composition to which the synthetic polymer was not added, respectively, and a pair of the towels were compared with each other in blind. When the towel washed with the composition to which the synthetic polymer was added was softer than the towel with the composition to which the synthetic polymer was not added, +1 point was given; when there was not difference therebetween, 0 point was given; and when the towel washed with the composition to which the synthetic polymer was not added was softer, -1 point was given, and the total point of the 4 examiners was shown.

Table 3

		Comparative example 4	Example 4	Comparative example 5	Example 5	Comparative example 6	Example 6	Comparative example 7	Example 7
Formulation composition (parts by weight)	Detergent A	90	90						
	Detergent D			90	90				
	Detergent E					90	90		
	Detergent F							90	90
	Synthetic polymer		5		1.5		1.5		1.5
	Bentonite	10	10	10	10	10	10	10	10
Used concentration (g/30L)		25	25	25	25	25	25	25	25
Softness		0 based on softness in Example 4	+2	0 based on softness in Example 5	+1	0 based on softness in Example 6	+2	0 based on softness in Example 7	+1

Example 8 and Comparative Example 8

The ingredients shown in Table 4 (the same ingredients as in Examples 1 to 3) were used in the detergent A in Table 1, and the resulting composition was evaluated for softening property and prevention of redeposition by the following method.

(Method of evaluating the softening property)

Three towels and two underclothes pretreated in the same manner as in Examples 4 to 7 were used. Two artificially

stained clothes were sewed on each of two towels out of the three towels. The artificially stained clothes were prepared in the following manner. A knit cloth (manufactured by Tanigashira Shoten) was cut into 1 m×10 cm rectangular strips and silently dipped in a muddy dispersion (Kashima mud 30 μ m pass product, 100 g/L uniform dispersion in chloroform). This procedure was repeated 3 times and the artificially stained specimens were dried with air. Thereafter, an excess of the mud was removed with a brush, and the artificially stained specimens were cut into 10 cm×10 cm pieces to give the above artificially stained clothes.

A powdery detergent (Comparative Example 8) comprising 22.5 g detergent A and 2.5 g bentonite sufficiently mixed with each other and a powdery detergent (Example 8) comprising 22.5 g detergent A, 2.5 g bentonite and 0.375 g synthetic polymer sufficiently mixed with one another were prepared.

Water at 25°C having a hardness of 5°DH was introduced into a washtub (inner diameter 45 cm, depth 15 cm), and the prepared detergent was dissolved well therein (stirred for 30 seconds with the hand), and first the towels each having the artificially stained clothes sewed thereon were washed respectively for 1 minute with the hand. Each specimen (each of the towels and underclothes) was washed with such strength that the detergent solution was not scattered. The 5 specimens were washed successively (5 minutes in total), followed by rinsing with running water (26°C, 4°DH, 4 L/min. running water) by the hand in a bath having the same size as the above washtub.

When foam disappeared, the towels and underclothes were dehydrated for 1 minute in a dehydrating chamber in a 2-chamber washing machine, and then the towels for evaluation and the underclothes were dried at 25°C in 40% RH for 1 day.

A pair of the towel for evaluation washed with the detergent composition for clothing to which the synthetic polymer was added and the towel for evaluation washed with the composition to which the synthetic polymer was not added were sensorially evaluated once for their softness to the touch in blind by 3 examiners. It was visually evaluated whether or not the redeposition of the towels/underclothes with mud had occurred. The softness was evaluated in the same manner as described above; that is, when the towel washed with the composition to which the synthetic polymer was added was softer than the towel washed with the composition to which the synthetic polymer was not added, +1 point was given; when there was not difference therebetween, 0 point was given; and when the towel washed with the composition to which the synthetic polymer was not added was softer, -1 point was given, and the total point was shown. With respect to the redeposition with mud, O was given when the specimen was similar to the standard (Comparative Example 8), Δ was given when a re-contaminated part could be seen by careful watching, × was given when the specimen was evidently re-contaminated, and ×× was given when several re-contaminated parts were further observed.

Table 4

		Comparative example 8	Example 8
Formulation composition (parts by weight)	Detergent A	90	90
	Synthetic polymer		1.5
	Bentonite	10	10
Used concentration (g/30L)		150	150
Softness		Standard	+1
Prevention of redeposition		Standard	○

Example 9 and Comparative Example 9

The ingredients shown in Table 5 (the same ingredients as in Examples 1 to 3) were used in the detergent A in Table 1, and the resulting compositions were evaluated for their softening property by the following method.

Five towels pretreated in the same manner as in Examples 4 to 7 were used. 22.5 g detergent A in Table 1 and 2.5 g bentonite (Comparative Example 9) and 22.5 g detergent A, 2.5 g bentonite and 0.375 g synthetic polymer (Example 9) were prepared. All the ingredients were preliminarily dissolved in deionized water. 5 L water at 25°C having a hardness of 5°DH was introduced into a washtub (inner diameter 45 cm, depth

15 cm), and aqueous solutions of the respective ingredients were introduced into the washtub (in the order of the aqueous solution of the detergent A → aqueous solution of bentonite → aqueous solution of the synthetic polymer), and the pretreated towels were washed one after another by the hand for 1 minute per towel. The towels were washed with such strength that the detergent solution was not scattered. The 5 towels were washed successively (5 minutes in total), followed by rinsing with running water (26°C, 4°DH, 4 L/min. running water) by the hand in a bath having the same size as the above washtub. When foam disappeared, the towels were dehydrated for 1 minute in a dehydrating chamber in a 2-chamber washing machine, and then the towels for evaluation and underclothes were dried at 25°C in 40% RH for 1 day.

A pair of the towel for evaluation washed with the detergent composition for clothing to which the synthetic polymer was added and the towel for evaluation washed with the composition to which the synthetic polymer was not added were sensorially evaluated for their softness to the touch in blind by 5 examiners. This evaluation was carried out by selecting one towel at random (so that the examiners could not see which one was selected) from the towels washed with the composition to which the synthetic polymer was added and the towels for evaluation washed with the composition to which the synthetic polymer was not added, respectively, and a pair of the towels were compared with each other in blind. The softness was evaluated in the same manner as described above; that is, when

the towel washed with the composition to which the synthetic polymer was added was softer than the towel with the composition to which the synthetic polymer was not added, +1 point was given; when there was not difference therebetween, 0 point was given; and when the towel washed with the composition to which the synthetic polymer was not added was softer, -1 point was given, and the total point was shown.

Table 5

		Comparative example 9	Example 9
Formulation composition (parts by weight)	Detergent A	90	90
	Synthetic polymer		1.5
	Bentonite	10	10
Used concentration (g/30L)		150	150
Softness		Standard	+1

As can be seen from the results in Tables 3 to 5, detergent compositions with an enhanced softening effect can be obtained by incorporating the components (a), (b), (c) and (d) into detergent compositions for clothing.

The detergent composition for clothing in the present

invention can be used as a softening detergent for fiber products such as clothes represented by cotton towels, bath towels, T-shirts and sweatshirts.

CLAIMS

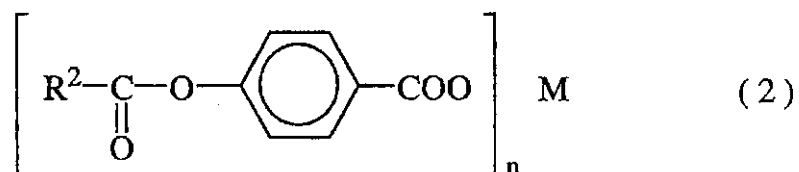
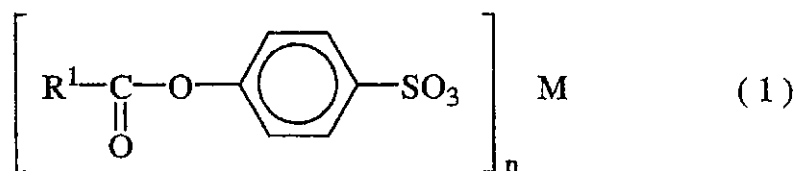
1. A detergent composition for clothing, which comprises (a) 1 to 30 wt% of a clay mineral, (b) 0.1 to 10 wt% of a polymer having an average molecular weight of 500,000 or more, 60 mol% or more constituent monomers of which have a sulfonic acid group or a group in a salt form thereof or a sulfuric acid group or a group in a salt form thereof, (c) 5 to 40 wt% of a surfactant, and (d) 5 to 40 wt% of an alkali.

2. The detergent composition for clothing according to claim 1, wherein the constituent monomers of the component (b) are one or more monomers selected from the group consisting of 2-(meth)acrylamide-2-alkyl (C1 to C4) propanesulfonic acid, a salt thereof, styrenesulfonic acid, and a salt thereof.

3. The detergent composition for clothing according to claim 1 or 2, wherein the proportion of a nonionic surfactant in the whole of the component (c) is 50 wt% or more.

4. The detergent composition for clothing according to any one of claims 1 to 3, which further comprises (e) 0.5 to 20 wt% of a compound releasing hydrogen peroxide in water.

5. The detergent composition for clothing according to any one of claims 1 to 4, which further comprises (f) 0.1 to 20 wt% of a compound represented by the following formula (1) and/or (2):



wherein R¹ represents a C4 to C13 alkyl group, R² represents a C5 to C13 alkyl group, M represents a hydrogen atom, an alkali metal atom, an alkaline earth metal atom, ammonium, or alkanol ammonium, and when M is an alkaline earth metal atom, n is 2, and when M is an alkali metal atom, ammonium or alkanol ammonium, n is 1.

6. The detergent composition for clothing according to any one of claims 1 to 5, which is a detergent composition for washing by hand.