(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 461 871 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
13.11.2024 Bulletin 2024/46

(21) Application number: **23740325.8**

(22) Date of filing: **13.01.2023**

(51) International Patent Classification (IPC):
D06M 15/643 *(2006.01)* ***D06M 13/256*** *(2006.01)*
D06M 101/32 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
D06M 13/165; D06M 13/256; D06M 15/53; D06M 15/643

(86) International application number:
PCT/JP2023/000718

(87) International publication number:
WO 2023/136317 (20.07.2023 Gazette 2023/29)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **17.01.2022 JP 2022005179**

(71) Applicant: **TAKEMOTO OIL & FAT CO., LTD.**
Aichi 443-8611 (JP)

(72) Inventors:
- **KANEKO, Ikki**
  Gamagori-shi, Aichi 443-8611 (JP)
- **OHGAI, Takashige**
  Gamagori-shi, Aichi 443-8611 (JP)

(74) Representative: **Daub, Thomas**
Patent- und Rechtsanwaltskanzlei Daub
Bahnhofstrasse 5
88662 Überlingen (DE)

(54) TREATMENT AGENT FOR POLYESTER SYNTHETIC FIBERS, COMPOSITION CONTAINING TREATMENT AGENT FOR POLYESTER SYNTHETIC FIBERS, AND POLYESTER SYNTHETIC FIBERS

(57) The present invention addresses the problem of improving the antistatic properties and flexibility of fibers to which a treatment agent for synthetic fibers is applied. A treatment agent for polyester synthetic fibers according to the present invention contains a silicone (A), a silicone (B), an anionic component and a silicone (D), while optionally containing a silicone (C). The silicone (A) is a modified silicone that has an amino group in each molecule. The silicone (B) is a silane coupling agent which does not contain an epoxy group but contains at least one functional group that is selected from among a methoxy group, an ethoxy group, an amino group and an isocyanate group in each molecule. The silicone (D) is a silanol-modified silicone that has a number average molecular weight of not less than 20,000 but less than 200,000. The silicone (C) is composed of at least one material that is selected from among a silicone resin, dimethyl silicone and an alkyl-modified silicone (excluding the silicone (A) and the silicone (D)). The content ratio of the silicone (C) in the treatment agent for polyester synthetic fibers is less than 10% by mass.

EP 4 461 871 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a polyester synthetic fiber treatment agent, a composition containing a polyester synthetic fiber treatment agent, and a polyester synthetic fiber.

BACKGROUND ART

[0002] A synthetic fiber treatment agent may be adhered to the surface of synthetic fiber, for example, in a fiber spinning and drawing process and a finishing process of the fibers from standpoints of, for example, friction reduction, antistatic property, and bundling property of the synthetic fibers.

[0003] Synthetic fiber treatment agents disclosed in Patent Documents 1 to 4 are previously known. Patent Document 1 discloses a silicone emulsion composition that contains a silicone with a modified silicone having a functional group such as an amino group as an essential ingredient, a surfactant with a polyalkylene oxide adduct as an essential ingredient, and water. Patent Document 2 discloses a water-repellent composition that contains an amino-modified silicone, a silicone resin, and an alkylpolysiloxane. Patent Document 3 discloses a silicone oil composition that contains a silicone oil having a specific siloxane structure and a specific polyoxyalkylene alkyl or alkenyl ether. Patent Document 4 discloses a silicone emulsion composition that contains a dimethyl silicone and/or an amino-modified silicone, a surfactant that is a specific polyoxyalkylene alkyl ether, and water.

CITATION LIST

PATENT LITERATURE

[0004]

Patent Document 1: Japanese Laid-Open Patent Publication No. 2013-177495
Patent Document 2: International Publication No. WO 2019/131456
Patent Document 3: Japanese Laid-Open Patent Publication No. 2020-59799
Patent Document 4: Japanese Patent No. 4749677

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] With each of the conventional synthetic fiber treatment agents, the respective benefits of improvement of the antistatic property and flexibility of fibers with the synthetic fiber treatment agent applied thereto cannot be realized sufficiently at the same time.

SOLUTION TO PROBLEM

[0006] As a result of performing research toward solving the above problem, the inventors of the present application found that a polyester synthetic fiber treatment agent containing a specific silicone and an anionic ingredient is suitable.

[0007] To solve the above problem and in accordance with one aspect of the present invention, a polyester synthetic fiber treatment agent is provided that contains a silicone (A) described below, a silicone (B) described below, an anionic ingredient, a silicone (D) described below, and optionally a silicone (C) described below and is characterized in that the amount of the silicone (C) contained in the treatment agent is less than 10% by mass.

[0008] The silicone (A) is a modified silicone having an amino group in the molecule.

[0009] The silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule.

[0010] The silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000.

[0011] The silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000.

[0012] To solve the above problem and in accordance with another aspect of the present invention, a polyester synthetic

fiber treatment agent is provided that contains a silicone (A) described below, a silicone (B) described below, an anionic ingredient, a nonionic surfactant described below, and optionally a silicone (C) described below and is characterized in that the amount of the silicone (C) contained in the treatment agent is less than 10% by mass.

[0013] The silicone (A) is a modified silicone having an amino group in the molecule.

[0014] The silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule.

[0015] The silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000.

[0016] The nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

[0017] Assuming that the amount of the silicone (A) contained in the polyester synthetic fiber treatment agent is 100 parts by mass, the amount of the silicone (B) contained in the polyester synthetic fiber treatment agent may be not less than 5 parts by mass and not more than 200 parts by mass.

[0018] In the polyester synthetic fiber treatment agent, the anionic ingredient may include at least one selected from the group consisting of organic acids, alkyl sulfonic acids, alkyl phosphoric acid esters, polyoxyalkylene alkyl phosphoric acid esters, and metal salts thereof.

[0019] The polyester synthetic fiber treatment agent may further contain a nonionic surfactant described below.

[0020] The nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

[0021] In the polyester synthetic fiber treatment agent, the silicone (A) may be contained at an amount of not less than 5% by mass and not more than 80% by mass, the silicone (B) may be contained at an amount of not less than 1% by mass and not more than 25% by mass, the silicone (C) may be contained at an amount of not less than 0% by mass but less than 10% by mass, the silicone (D) may be contained at an amount of not less than 5% by mass and not more than 90% by mass, the nonionic surfactant may be contained at an amount of not less than 1% by mass and not more than 25% by mass, and the anionic ingredient may be contained at an amount of not less than 0.1% by mass and not more than 25% by mass.

[0022] To solve the above problem and in accordance with another aspect of the present invention, a composition containing a polyester synthetic fiber treatment agent is characterized by containing the polyester synthetic fiber treatment agent and a solvent.

[0023] To solve the above problem and in accordance with another aspect of the present invention, a polyester synthetic fiber is provided to which the polyester synthetic fiber treatment agent is adhered.

[0024] The polyester synthetic fiber may be applied to wadding.

ADVANTAGEOUS EFFECTS OF INVENTION

[0025] The present invention succeeds in improving the antistatic property and flexibility of fibers with the synthetic fiber treatment agent applied thereto.

DESCRIPTION OF EMBODIMENTS

<First Embodiment>

[0026] A first embodiment that embodies a polyester synthetic fiber treatment agent of the present invention (also referred to hereinafter as treatment agent) will now be described. The treatment agent of the present embodiment contains a silicone (A), a silicone (B), and an anionic ingredient. The treatment agent may optionally further contain a silicone (C). The treatment agent may further contain a nonionic surfactant and/or a silicone (D).

(Silicone (A))

[0027] The silicone (A) used in the treatment agent of the present embodiment is a modified silicone having an amino group in the molecule. It may be a terminal type amino-modified silicone, in which an amino group is introduced to a terminal silicon atom of polydimethylsiloxane that is the main chain, or may be a side-chain type amino-modified silicone, in which an amino group is introduced to a silicon atom other than the terminal of the main chain. As the silicone (A), a

commercial product specified by viscosity and functional group equivalent weight may be used.

[0028] The silicone (A) has a viscosity at 25°C of preferably not less than 10 mPa·s and not more than 30,000 mPa·s and more preferably not less than 25 mPa·s and not more than 10,000 mPa·s. Any combination of the upper and lower limits may be used. By specifying to be in such range, the handleability of formulation is improved and benefits of the present invention can be exhibited more effectively.

[0029] The silicone (A) has a functional group equivalent weight of preferably not less than 100 g/mol and not more than 20,000 g/mol and more preferably not less than 500 g/mol and not more than 150,00 g/mol. Any combination of the upper and lower limits may be used. By specifying to be in such range, the compatibility with polyester synthetic fibers is improved and the flexibility of fibers with the treatment agent adhered thereto can be exhibited more effectively.

[0030] The silicone (A) may be used either alone or in combination of two or more types as appropriate.

[0031] The lower limit of the silicone (A) content in the treatment agent is preferably not less than 3% by mass and more preferably not less than 5% by mass. When this content is not less than 3% by mass, the flexibility of fibers with the treatment agent adhered thereto can be improved. The upper limit of the silicone (A) content in the treatment agent is preferably not more than 85% by mass and more preferably not more than 80% by mass. When this content is not more than 85% by mass, the bulkiness of fibers with the treatment agent adhered thereto can be improved. Any combination of the upper and lower limits may be used.

(Silicone (B))

[0032] The silicone (B) used in the treatment agent of the present embodiment is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule. The silicone (B) can improve the flexibility of fibers with the treatment agent applied thereto. Specific examples of the silicone (B) include N-2-(aminoethyl)-3-aminopropylmethyldimethoxysilane, 3-aminopropyltriethoxysilane, N-2-(aminoethyl)-3-aminopropyltrimethoxysilane, methyltrimethoxysilane, methyltriethoxysilane, and 3-isocyanatopropyltriethoxysilane.

[0033] The silicone (B) may be used either alone or in combination of two or more types as appropriate.

[0034] The lower limit of the silicone (B) content in the treatment agent is preferably not less than 0.5% by mass and more preferably not less than 1% by mass. When this content is not less than 0.5% by mass, the flexibility of fibers with the treatment agent applied thereto can be improved. The upper limit of the silicone (B) content in the treatment agent is preferably not more than 30% by mass and more preferably not more than 25% by mass. When this content is not more than 30% by mass, the stability of the treatment agent during use, especially the emulsion stability when the treatment agent is put in an emulsion state can be improved. Any combination of the upper and lower limits may be used.

[0035] The lower limit of the silicone (B) content in the treatment agent assuming that the silicone (A) content in the treatment agent is 100 parts by mass is preferably not less than 5 parts by mass and more preferably not less than 6 parts by mass. When this content is not less than 5 parts by mass, the flexibility of fibers with the treatment agent applied thereto can be improved. The upper limit of the silicone (B) content in the treatment agent assuming that the silicone (A) content in the treatment agent is 100 parts by mass is preferably not more than 200 parts by mass and more preferably not more than 150 parts by mass. When this content is not more than 200 parts by mass, the flexibility of fibers with the treatment agent applied thereto can be improved.

(Silicone (C))

[0036] The silicone (C) used in the treatment agent of the present embodiment is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones. The silicone (C) may be contained optionally in the treatment agent.

[0037] Examples of the silicone resins include MQ silicone resins, MDQ silicone resins, T silicone resins, and MTQ silicone resins.

[0038] The M, D, T, and Q that were indicated in relation to the silicone resins will now be described. Using M, D, T, and Q to describe a silicone resin is a common way of describing the components constituting the silicone resin and M is a monofunctional constituent unit $R^1R^2R^3SiO_{1/2}$, D is a difunctional constituent unit $R^4R^5SiO_{2/2}$, T is a trifunctional constituent unit $R^6SiO_{3/2}$, and Q is a tetrafunctional constituent unit $SiO_{4/2}$. R^1 to R^6 are each a hydrocarbon group with 1 to 24 carbon atoms, an organic amino group represented by, for example, $-R^aNHR^bNH_2$ (in the formula, R^a and R^b are each a hydrocarbon group with 2 or 3 carbon atoms) or $-R^cNH_2$ (in the formula, R^c is a hydrocarbon group with 2 or 3 carbon atoms), a vinyl group, or a carbinol group.

[0039] The dimethyl silicones are not particularly limited, but preferably have a viscosity at 25°C of not less than 5 mPa·s and not more than 5,000 mPa·s. A known dimethyl silicone specified by viscosity can be used as appropriate.

[0040] Examples of the alkyl-modified silicones include those obtained by introducing an introduced organic group constituted of $-C_aH_{2a+1}$ to the side chain of a silicone oil that is a straight-chain polymer constituted of siloxane bonds.

[0041] The alkyl-modified silicones are not particularly limited, but preferably have a viscosity at 25°C of not less than 5 mPa·s and not more than 5,000 mPa·s. A known alkyl-modified silicone specified by viscosity can be used as appropriate.

[0042] The silicone (C) may be used alone either or in combination of two or more types as appropriate.

[0043] The silicone (C) content in the treatment agent is less than 10% by mass. When the silicone (C) content is less than 10% by mass, especially the antistatic property of fibers with the treatment agent applied thereto is not impaired.

(Anionic ingredient)

[0044] Examples of the anionic ingredient used in the treatment agent of the present embodiment include an anionic compound, such as an acid and a salt thereof. The anionic ingredient can improve the antistatic property of fibers with the treatment agent applied thereto.

[0045] Examples of the acid include an inorganic acid, organic acid, fatty acid, alkyl sulfonic acid, alkyl sulfuric acid, polyoxyalkylene alkyl sulfuric acid, alkyl phosphoric acid ester, polyoxyalkylene alkyl phosphoric acid ester, sulfuric acid ester of fatty acid, sulfuric acid ester of oil or fat, and a salt of any of the above.

[0046] Specific examples of the inorganic acid or salt thereof include hydrochloric acid, sulfuric acid, phosphoric acid, nitric acid, carbonic acid, sodium hydrogen sulfate, sodium dihydrogen phosphate, disodium hydrogen phosphate, and sodium hydrogen carbonate.

[0047] Specific examples of the organic acid include citric acid, tartaric acid, lactic acid, malic acid, succinic acid, fumaric acid, maleic acid, gluconic acid, glucuronic acid, and benzoic acid.

[0048] As the fatty acid, a known fatty acid can be used as appropriate and it may be a saturated fatty acid or an unsaturated fatty acid. It also may be in a straight chain form or have a branched chain structure. It also may be a monovalent fatty acid or a polyvalent carboxylic acid (polybasic acid).

[0049] Specific examples of the saturated fatty acid include formic acid, acetic acid, propionic acid, butyric acid, valeric acid, hexanoic acid (caproic acid), octylic acid (2-ethylhexanoic acid), octanoic acid (caprylic acid), nonanoic acid, decanoic acid (capric acid), dodecanoic acid (lauric acid), tetradecanoic acid (myristic acid), hexadecanoic acid (palmitic acid), octadecanoic acid (stearic acid), eicosanoic acid (arachidic acid), docosanoic acid (behenic acid), and tetracosanoic acid.

[0050] Specific examples of the unsaturated fatty acid include crotonic acid, myristoleic acid, palmitoleic acid, oleic acid, vaccenic acid, eicosenoic acid, linoleic acid, α-linolenic acid, γ-linolenic acid, and arachidonic acid.

[0051] Specific examples of the polyvalent carboxylic acid (polybasic acid) include (1) dibasic acids, such as succinic acid, fumaric acid, maleic acid, adipic acid, and sebacic acid, (2) tribasic acids, such as aconitic acid, (3) aromatic dicarboxylic acids, such as benzoic acid, terephthalic acid, isophthalic acid, and 2,6-naphthalenedicarboxylic acid, (4) aromatic tricarboxylic acids, such as trimellitic acid, (5) aromatic tetracarboxylic acids, such as pyromellitic acid.

[0052] Among these fatty acids, a fatty acid with not less than 8 and not more than 18 carbon atoms are preferable from a standpoint that fibers with the treatment agent applied thereto are excellent in antistatic property.

[0053] Specific examples of the alkyl sulfonic acid include lauryl sulfonic acid (dodecyl sulfonic acid), myristyl sulfonic acid, cetyl sulfonic acid, oleyl sulfonic acid, stearyl sulfonic acid, tetradecane sulfonic acid, dodecyl benzene sulfonic acid, and secondary alkyl sulfonic acids (C13 to C15).

[0054] Specific examples of the alkyl sulfuric acid include lauryl sulfuric acid ester, oleyl sulfuric acid ester, and stearyl sulfuric acid ester.

[0055] Specific examples of the polyoxyalkylene alkyl sulfuric acid include polyoxyethylene lauryl ether sulfuric acid ester, polyoxyalkylene (polyoxyethylene, polyoxypropylene) lauryl ether sulfuric acid esters, polyoxyethylene dodecyl ether sulfuric acid ester, and polyoxyethylene oleyl ether sulfuric acid ester.

[0056] Specific examples of the alkyl phosphoric acid ester include lauryl phosphoric acid ester, cetyl phosphoric acid ester, octyl phosphoric acid ester, oleyl phosphoric acid ester, and stearyl phosphoric acid ester.

[0057] Specific examples of the polyoxyalkylene alkyl phosphoric acid ester include polyoxyethylene lauryl ether phosphoric acid ester, polyoxyethylene oleyl ether phosphoric acid ester, and polyoxyethylene stearyl ether phosphoric acid ester.

[0058] Specific examples of the sulfuric acid ester of fatty acid include castor oil fatty acid sulfuric acid ester, sesame oil fatty acid sulfuric acid ester, tall oil fatty acid sulfuric acid ester, soybean oil fatty acid sulfuric acid ester, rapeseed oil fatty acid sulfuric acid ester, palm oil fatty acid sulfuric acid ester, lard fatty acid sulfuric acid ester, beef tallow fatty acid sulfuric acid ester, and whale oil fatty acid sulfuric acid ester.

[0059] Specific examples of the sulfuric acid ester of oil or fat include sulfuric acid ester of castor oil, sulfuric acid ester of sesame oil, sulfuric acid ester of tall oil, sulfuric acid ester of soybean oil, sulfuric acid ester of rapeseed oil, sulfuric acid ester of palm oil, sulfuric acid ester of lard, sulfuric acid ester of beef tallow, and sulfuric acid ester of whale oil.

[0060] Examples of the salt include an ammonium salt, an amine salt, and a metal salt. Examples of the metal salt include an alkali metal salt and an alkaline earth metal salt. Examples of an alkali metal that constitutes the alkali metal salt include sodium, potassium, and lithium. Examples of an alkaline earth metal that constitutes the alkaline earth metal salt

include a metal corresponding to being a group 2 element, such as, calcium, magnesium, beryllium, strontium, and barium.

[0061] An amine that constitutes the amine salt may be any of primary amines, secondary amines, and tertiary amines. Specific examples of an amine that constitutes the amine salt include (1) aliphatic amines, such as methylamine, dimethylamine, trimethylamine, ethylamine, diethylamine, triethylamine, N-N-diisopropylethylamine, butylamine, dibutylamine, 2-methylbutylamine, tributylamine, octylamine, and dimethyllaurylamine, (2) aromatic amines or heterocyclic amines, such as aniline, N-methylbenzylamine, pyridine, morpholine, piperazine, and derivatives of the above, (3) alkanolamines, such as monoethanolamine, N-methylethanolamine, diethanolamine, triethanolamine, isopropanolamine, diisopropanolamine, triisopropanolamine, dibutylethanolamine, butyldiethanolamine, octyldiethanolamine, and lauryldiethanolamine, (4) aryl amines, such as N-methylbenzylamine, (5) polyoxyalkylene alkyl aminoethers, such as polyoxyethylene lauryl aminoethers and polyoxyethylene stearyl aminoethers, and (6) ammonia.

[0062] Among the anionic ingredients described above, for example, a metal salt of a fatty acid constitutes an anionic surfactant. Therefore, an anionic surfactant may be used as the anionic ingredient.

[0063] The anionic ingredient may be used either alone or in combination of two or more types as appropriate.

[0064] Among the above, organic acids, alkyl sulfonic acids, alkyl phosphoric acid esters, polyoxyalkylene alkyl phosphoric acid esters, and metal salts thereof are preferable. By using such a compound, the stability of the treatment agent, especially the emulsion stability when the treatment agent is put in an emulsion state can be improved.

[0065] The lower limit of the anionic ingredient content in the treatment agent is preferably not less than 0.1% by mass and more preferably not less than 1% by mass. When this content is not less than 0.1% by mass, especially the antistatic property of fibers with the treatment agent applied thereto can be improved. The upper limit of the anionic ingredient content in the treatment agent is preferably not more than 80% by mass, more preferably not more than 30% by mass, and especially preferably not more than 25% by mass. When this content is not more than 80% by mass, the flexibility of fibers with the treatment agent applied thereto can be improved. Any combination of the upper and lower limits may be used.

(Silicone (D))

[0066] The treatment agent of the present embodiment may further contain the silicone (D). By the treatment agent containing the silicone (D), the antistatic property of fibers with the treatment agent applied thereto can be improved.

[0067] The silicone (D) used in the treatment agent of the present embodiment is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000. As the silanol-modified silicone, a dimethylsiloxane compound in which a hydroxy group that is also expressed as a silanol group is directly bonded to a terminal silicon atom of the main chain can be used.

[0068] The lower limit of the number average molecular weight of the silanol-modified silicone is not less than 20,000 and preferably not less than 100,000. The upper limit of the number average molecular weight of the silanol-modified silicone is less than 200,000 and preferably not more than 150,000. By specifying the number average molecular weight of the silanol-modified silicone to be in such range, the effects of the present invention can be improved. Any combination of the upper and lower limits may be used. The number average molecular weight of the silanol-modified silicone can be measured using gel permeation chromatography (GPC). The silicone (D) may be used either alone or in combination of two or more types as appropriate.

[0069] The lower limit of the silicone (D) content in the treatment agent is preferably not less than 2% by mass and more preferably not less than 5% by mass. When this content is not less than 2% by mass, the bulkiness of fibers with the treatment agent applied thereto can be improved. The upper limit of the silicone (D) content in the treatment agent is preferably not more than 92% by mass and more preferably not more than 90% by mass. When this content is not more than 92% by mass, the stability of the treatment agent, especially the emulsion stability when the treatment agent is put in an emulsion state can be improved. Any combination of the upper and lower limits may be used.

(Nonionic Surfactant)

[0070] The treatment agent of the present embodiment may further contain the nonionic surfactant. By the treatment agent containing the nonionic surfactant, the stability of the treatment agent, especially the emulsion stability when the treatment agent is put in an emulsion state can be improved.

[0071] Examples of the nonionic surfactant used in the treatment agent of the present embodiment include at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

[0072] Specific examples of a monohydric alcohol used as a raw material of the nonionic surfactant include (1) straight-chain alkyl alcohols, such as ethanol, propanol, butanol, pentanol, hexanol, octanol, nonanol, decanol, undecanol, dodecanol, tridecanol, tetradecanol, pentadecanol, hexadecanol, heptadecanol, and octadecanol, (2) branched alkyl

alcohols, such as isopropanol, isobutanol, isohexanol, 2-ethylhexanol, isononanol, isodecanol, isododecanol, isotridecanol, isotetradecanol, isotriacontanol, isohexadecanol, isoheptadecanol, and isooctadecanol, (3) straight-chain alkenyl alcohols, such as tetradecenol, hexadecenol, heptadecenol, and octadecenol, (4) branched alkenyl alcohols, such as isohexadecenol and isooctadecenol, (5) cyclic alkyl alcohols, such as cyclopentanol and cyclohexanol, and (6) aromatic alcohols, such as phenol, nonylphenol, benzyl alcohol, and monostyrenated phenol.

[0073] Specific examples of a dihydric or higher and tetrahydric or lower polyhydric alcohol used as a raw material of the nonionic surfactant include ethylene glycol, propylene glycol, 1,3-propanediol, 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 2-methyl-1,2-propanediol, 1,5-pentanediol, 1,6-hexanediol, 2,5-hexanediol, 2-methyl-2,4-pentanediol, 2,3-dimethyl-2,3-butanediol, glycerin, 2-methyl-2-hydroxymethyl-1,3-propanediol, trimethylolpropane, sorbitan, and pentaerythritol.

[0074] Examples of an alkylene oxide used as a raw material for forming the (poly)oxyalkylene structure of the nonionic surfactant include an alkylene oxide with not less than 2 and not more than 3 carbon atoms. Specific examples of the alkylene oxide include ethylene oxide and propylene oxide. The number of moles of alkylene oxide added is set as appropriate and is preferably not less than 3 moles and not more than 50 moles, more preferably not less than 5 moles and not more than 40 moles. Any combination of the upper and lower limits may be used. The number of moles of alkylene oxide added represents the number of moles of the alkylene oxide with respect to 1 mole of the alcohol in the charged raw materials. The alkylene oxide may be used either alone or in combination of two or more types as appropriate. If two or more types of alkylene oxides are used in combination, the form of addition thereof may be any of block addition, random addition, and combination of block addition and random addition and is not particularly limited.

[0075] The block copolymers of a polyoxyethylene chain and a polyoxypropylene chain are not restricted in particular as long as they have a polyoxypropylene chain of low hydrophilicity and a polyoxyethylene chain of high hydrophilicity and have a surfactant action. The numbers of the polyoxyethylene chain and the polyoxypropylene chain in the molecule are not restricted in particular, and the block copolymer may, for example, be constituted of a single polyoxypropylene chain and a single polyoxyethylene chain or may be a poloxamer surfactant constituted of a polyoxypropylene chain and two polyoxyethylene chains that sandwich it.

[0076] The number of moles of ethylene oxide added that form the polyoxyethylene chain is not restricted in particular and may be, for example, not less than 5 moles and not more than 50 moles. The number of moles of propylene oxide added that form the polypropylene chain is not restricted in particular and may be, for example, not less than 5 moles and not more than 50 moles.

[0077] Specific examples of the nonionic surfactant include polyoxyethylene (6 moles: represents the number of moles of alkylene oxide added (the same applies hereinafter)) polyoxypropylene (2) dodecyl ether, polyoxyethylene (10) C12-13 branched alkyl ethers, and polyoxyethylene (25) polyoxypropylene (15) block ether.

[0078] The nonionic surfactants may be used either alone or in combination of two or more types as appropriate.

[0079] The lower limit of the nonionic surfactant content in the treatment agent is preferably not less than 1% by mass and more preferably not less than 3% by mass. When this content is not less than 1% by mass, the stability of the treatment agent during use, especially the emulsion stability when the treatment agent is put in an emulsion state can be improved. The upper limit of the nonionic surfactant content in the treatment agent is preferably not more than 30% by mass and more preferably not more than 25% by mass. When this content is not more than 30% by mass, the flexibility of fibers with the treatment agent applied thereto can be improved. Any combination of the upper and lower limits may be used.

[0080] In the treatment agent, the silicone (A) is preferably contained at an amount of not less than 5% by mass and not more than 80% by mass, the silicone (B) is preferably contained at an amount of not less than 1% by mass and not more than 25% by mass, the silicone (C) is preferably contained at an amount of not less than 0% by mass but less than 10% by mass, the silicone (D) is preferably contained at an amount of not less than 5% by mass and not more than 90% by mass, the nonionic surfactant is preferably contained at an amount of not less than 1% by mass and not more than 25% by mass, and the anionic ingredient is preferably contained at an amount of not less than 0.1% by mass and not more than 25% by mass. By specifying to be in such ranges, the effects of the present invention can be improved.

(Form of preservation)

[0081] From a standpoint of improving the formulation stability, the treatment agent may be arranged as a two-component treatment agent or a three-component treatment agent such as described below.

[0082] The two-component treatment agent is arranged as a set that includes a first component of the two-component polyester synthetic fiber treatment agent (referred to hereinafter as "first-of-two-component treatment agent") containing the silicone (A), the anionic ingredient, and optionally the silicone (C) and a second component of the two-component polyester synthetic fiber treatment agent (referred to hereinafter as "second-of-two-component treatment agent") containing the silicone (B). The first-of-two-component treatment agent contains the silicone (C) such that its content in a mixture of the first-of-two-component treatment agent and the second-of-two-component treatment agent is less than 10% by mass. The first-of-two-component treatment agent may also further contain the silicone (D) and/or the nonionic

surfactant. The two-component treatment agent is constituted of the first-of-two-component treatment agent and the second-of-two-component treatment agent that are separate from each other before use, for example, during preservation or during distribution. In use, the first-of-two-component treatment agent and the second-of-two-component treatment agent are mixed with each other to prepare the two-component treatment agent.

[0083] The three-component treatment agent is arranged as a set that includes a first component of the three-component polyester synthetic fiber treatment agent (referred to hereinafter as "first-of-three-component treatment agent") containing the silicone (A), the anionic ingredient, and optionally the silicone (C), a second component of the three-component polyester synthetic fiber treatment agent (referred to hereinafter as "second-of-three-component treatment agent") containing the silicone (D), and a third component of the three-component polyester synthetic fiber treatment agent (referred to hereinafter as "third-of-three-component treatment agent") containing the silicone (B).

[0084] The first-of-three-component treatment agent contains the silicone (C) such that its content in a mixture of the first-of-three-component treatment agent, the second-of-three-component treatment agent, and the third-of-three-component treatment agent is less than 10% by mass. One of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent may contain the nonionic surfactant. The anionic ingredient may also be contained in the second-of-three-component treatment agent.

[0085] The three-component treatment agent is constituted of the first-of-three-component treatment agent, the second-of-three-component treatment agent, and the third-of-three-component treatment agent that are separate from one another before use, for example, during preservation or during distribution. In use, the first-of-three-component treatment agent, the second-of-three-component treatment agent, and the third-of-three-component treatment agent are mixed with one another to prepare the three-component type treatment agent.

(Solvent)

[0086] The treatment agent of the present embodiment may be mixed as necessary with a solvent to prepare a composition containing a polyester synthetic fiber treatment agent (hereinafter referred to as "treatment agent-containing composition") and be preserved or distributed in the form of the treatment agent-containing composition.

[0087] The solvent is a solvent having a boiling point at atmospheric pressure of not more than 105°C. Examples of the solvent include water and an organic solvent. Specific examples of the organic solvent include lower alcohols, such as ethanol and propanol, and low polarity solvents, such as hexane. The solvent may be used either alone or in combination of two or more types as appropriate. Among these, a polar solvent, such as water or a lower alcohol, is preferable from a standpoint of being excellent in terms of the dispersibility and solubility of the respective ingredients and water is more preferable from a standpoint of being excellent in handleability.

[0088] Assuming that the sum of the amounts of the treatment agent and the solvent contained in the treatment agent-containing composition is 100 parts by mass, the amount of the treatment agent contained in the treatment agent-containing composition is not less than 10 parts by mass and not more than 80 parts by mass.

[0089] Effects of the treatment agent of the first embodiment will now be described.

(1-1) The treatment agent of the first embodiment contains the specific silicones and the anionic ingredient described above. Therefore, the antistatic property and the flexibility of fibers with the treatment agent applied thereto can be improved. Also, the stability of the treatment agent, especially the emulsion stability when the treatment agent is put in an emulsion state can be improved. Also, the bulkiness of fibers with the treatment agent applied thereto can be improved.

(1-2) The treatment agent of the first embodiment may be arranged as a set that includes the first-of-two-component treatment agent containing the silicone (A), the anionic ingredient, and optionally the silicone (C) and the second-of-two-component treatment agent containing the silicone (B). By such an arrangement, the formulation stability and especially the preservation stability of the treatment agent can be improved.

(1-3) If the treatment agent of the first embodiment contains the silicone (D) and the nonionic surfactant, it may be arranged as a set that includes the first-of-three-component treatment agent containing the silicone (A), the anionic ingredient, and optionally the silicone (C), the second-of-three-component treatment agent containing the silicone (D), and the third-of-three-component treatment agent containing the silicone (B). The nonionic surfactant may be contained in one of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent. By such an arrangement, the formulation stability and especially the preservation stability of the treatment agent can be improved.

<Second Embodiment>

[0090] Next, a second embodiment that embodies a first-of-two-component treatment agent of the present invention will be described, focusing on the differences from the above-described embodiment.

[0091] The first-of-two-component treatment agent of the present embodiment contains a silicone (A), an anionic ingredient, and optionally a silicone (C). The first-of-two-component treatment agent is combined in use with a second-of-two-component treatment agent containing a silicone (B). The first-of-two-component treatment agent contains the silicone (C) such that its content in a mixture in use, that is, a mixture of the first-of-two-component treatment agent and the second-of-two-component treatment agent is less than 10% by mass. If the treatment agent further contains a silicone (D) and the nonionic surfactant, the first-of-two-component treatment agent may contain the silicone (D) and the nonionic surfactant.

[0092] The silicone (A), the silicone (B), the anionic ingredient, the silicone (C), the silicone (D), and the nonionic surfactant are the same as those described respectively in the first embodiment.

(Solvent)

[0093] The first-of-two-component treatment agent of the present embodiment may be mixed as necessary with a solvent to prepare a composition containing a first-of-two-component polyester synthetic fiber treatment agent (hereinafter referred to as "first-of-two-component treatment agent-containing composition") and be preserved or distributed in the form of the first-of-two-component treatment agent-containing composition.

[0094] The solvent can be the same as exemplified in the first embodiment. Assuming that the sum of the amounts of the first-of-two-component treatment agent and the solvent contained in the first-of-two-component treatment agent-containing composition is 100 parts by mass, the amount of the first-of-two-component treatment agent contained in the first-of-two-component treatment agent-containing composition is not less than 10 parts by mass and not more than 80 parts by mass.

[0095] Effects of the first-of-two-component treatment agent of the second embodiment will now be described. With the second embodiment, the effects described below are provided in addition to the effects of the above-described embodiment.

[0096] (2-1) The first-of-two-component treatment agent of the second embodiment contains the silicone (A), the anionic ingredient, and optionally the silicone (C) and is combined in use with the second-of-two-component treatment agent containing the silicone (B). The formulation stability and especially the preservation stability of the first-of-two-component treatment agent can thus be improved. Also, by adjusting the mixing ratio with respect to the second-of-two-component treatment agent, the ingredients in the treatment agent obtained can be adjusted. Also, just the first-of-two-component treatment agent can be distributed as a separate agent from the second-of-two-component treatment agent.

<Third Embodiment>

[0097] Next, a third embodiment that embodies a second-of-two-component treatment agent of the present invention will be described, focusing on the differences with respect to the above-described embodiments.

[0098] The second-of-two-component treatment agent of the present embodiment contains a silicone (B). The second-of-two-component treatment agent is combined in use with a first-of-two-component treatment agent containing a silicone (A), an anionic ingredient, and optionally a silicone (C). The first-of-two-component treatment agent contains the silicone (C) such that its content in a mixture in use, that is, a mixture of the first-of-two-component treatment agent and the second-of-two-component treatment agent is less than 10% by mass. If the treatment agent further contains a silicone (D) and the nonionic surfactant, the first-of-two-component treatment agent may contain the silicone (D) and the nonionic surfactant.

[0099] The silicone (A), the silicone (B), the anionic ingredient, the silicone (C), the silicone (D), and the nonionic surfactant are the same as those described respectively in the first embodiment.

[0100] Effects of the second-of-two-component treatment agent of the third embodiment will now be described. With the third embodiment, the effects described below are provided in addition to the effects of the above-described embodiments.

[0101] (3-1) The second-of-two-component treatment agent of the third embodiment contains the silicone (B) and it is combined in use with the first-of-two-component treatment agent containing the silicone (A), the anionic ingredient, and optionally the silicone (C). The formulation stability and especially the preservation stability of the second-of-two-component treatment agent can thus be improved. Also, by adjusting the mixing ratio with respect to the first-of-two-component treatment agent, the ingredients in the treatment agent obtained can be adjusted. Also, just the second-of-two-component treatment agent can be distributed as a separate agent from the first-of-two-component treatment agent.

<Fourth Embodiment>

[0102] Next, a fourth embodiment that embodies a first-of-three-component treatment agent of the present invention will be described, focusing on the differences with respect to the above-described embodiments.

[0103] The first-of-three-component treatment agent of the present embodiment contains a silicone (A), an anionic ingredient, and optionally a silicone (C). The first-of-three-component treatment agent is combined in use with a second-

of-three-component treatment agent containing a silicone (D) and a third-of-three-component treatment agent containing a silicone (B). The nonionic surfactant is contained in one of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent.

[0104] The first-of-three-component treatment agent contains the silicone (C) such that its content in a mixture in use, that is, a mixture of the first-of-three-component treatment agent, the second-of-three-component treatment agent, and the third-of-three-component treatment agent is less than 10% by mass. The silicone (A), the silicone (B), the anionic ingredient, the silicone (C), the silicone (D), and the nonionic surfactant are the same as those described respectively in the first embodiment.

(Solvent)

[0105] The first-of-three-component treatment agent of the present embodiment may be mixed as necessary with a solvent to prepare a composition containing a first-of-three-component polyester synthetic fiber treatment agent (hereinafter referred to as "first-of-three-component treatment agent-containing composition") and be preserved or distributed in the form of the first-of-three-component treatment agent-containing composition.

[0106] The solvent can be the same as exemplified in the first embodiment. Assuming that the sum of the amounts of the first-of-three-component treatment agent and the solvent contained in the first-of-three-component treatment agent-containing composition is 100 parts by mass, the amount of the first-of-three-component treatment agent contained in the first-of-three-component treatment agent-containing composition is not less than 10 parts by mass and not more than 80 parts by mass.

[0107] Effects of the first-of-three-component treatment agent of the fourth embodiment will now be described. With the fourth embodiment, the effects described below are provided in addition to the effects of the above-described embodiments.

[0108] (4-1) The first-of-three-component treatment agent of the fourth embodiment contains the silicone (A), the anionic ingredient, and optionally the silicone (C) and is combined in use with the second-of-three-component treatment agent containing the silicone (D) and the third-of-three-component treatment agent containing the silicone (B). The nonionic surfactant is contained in one of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent. The formulation stability and especially the preservation stability of the first-of-three-component treatment agent can thus be improved. Also, by adjusting the mixing ratio with respect to the second- and third-of-three-component treatment agents, the ingredients in the treatment agent obtained can be adjusted. Also, just the first-of-three-component treatment agent can be distributed as a separate agent from the second- and third-of-three-component treatment agents.

<Fifth Embodiment>

[0109] Next, a fifth embodiment that embodies a second-of-three-component treatment agent of the present invention will be described, focusing on the differences with respect to the above-described embodiments.

[0110] The second-of-three-component treatment agent of the present embodiment contains a silicone (D). The second-of-three-component treatment agent is combined in use with a first-of-three-component treatment agent containing a silicone (A), an anionic ingredient, and optionally a silicone (C) and a third-of-three-component treatment agent containing a silicone (B). The nonionic surfactant is contained in one of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent. With the three-component treatment agent, the anionic ingredient may also be contained in the second-of-three-component treatment agent.

[0111] The first-of-three-component treatment agent contains the silicone (C) such that its content in a mixture in use, that is, a mixture of the first-of-three-component treatment agent, the second-of-three-component treatment agent, and the third-of-three-component treatment agent is less than 10% by mass. The silicone (A), the silicone (B), the anionic ingredient, the silicone (C), the silicone (D), and the nonionic surfactant are the same as those described respectively in the first embodiment.

(Solvent)

[0112] The second-of-three-component treatment agent of the present embodiment may be mixed as necessary with a solvent to prepare a composition containing a second-of-three-component polyester synthetic fiber treatment agent (hereinafter referred to as "second-of-three-component treatment agent-containing composition") and be preserved or distributed in the form of the second-of-three-component treatment agent-containing composition.

[0113] The solvent can be the same as exemplified in the first embodiment. Assuming that the sum of the amounts of the second-of-three-component treatment agent and the solvent contained in the second-of-three-component treatment agent-containing composition is 100 parts by mass, the amount of the second-of-three-component treatment agent

contained in the second-of-three-component treatment agent-containing composition is not less than 10 parts by mass and not more than 80 parts by mass.

[0114] Effects of the second-of-three-component treatment agent of the fifth embodiment will now be described. With the fifth embodiment, the effects described below are provided in addition to the effects of the above-described embodiments.

[0115] (5-1) The second-of-three-component treatment agent of the fifth embodiment contains the silicone (D) and is combined in use with the first-of-three-component treatment agent containing the silicone (A), the anionic ingredient, and optionally the silicone (C) and the third-of-three-component treatment agent containing the silicone (D). The nonionic surfactant is contained in one of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent. The formulation stability and especially the preservation stability of the second-of-three-component treatment agent can thus be improved. Also, by adjusting the mixing ratio with respect to the first- and third-of-three-component treatment agents, the ingredients in the treatment agent obtained can be adjusted. Also, just the second-of-three-component treatment agent can be distributed as a separate agent from the first- and third-of-three-component treatment agents.

<Sixth Embodiment>

[0116] Next, a sixth embodiment that embodies a third-of-three-component treatment agent of the present invention will be described, focusing on the differences with respect to the above-described embodiments.

[0117] The third-of-three-component treatment agent of the present embodiment contains a silicone (B). The third-of-three-component treatment agent is combined in use with a first-of-three-component treatment agent containing a silicone (A), an anionic ingredient, and optionally a silicone (C) and a second-of-three-component treatment agent containing a silicone (D). The nonionic surfactant is contained in one of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent.

[0118] The first-of-three-component treatment agent contains the silicone (C) such that its content in a mixture in use, that is, a mixture of the first-of-three-component treatment agent, the second-of-three-component treatment agent, and the third-of-three-component treatment agent is less than 10% by mass. The silicone (A), the silicone (B), the anionic ingredient, the silicone (C), the silicone (D), and the nonionic surfactant are the same as those described respectively in the first embodiment.

[0119] Effects of the third-of-three-component treatment agent of the sixth embodiment will now be described. With the sixth embodiment, the effects described below are provided in addition to the effects of the above-described embodiments.

[0120] (6-1) The third-of-three-component treatment agent of the sixth embodiment contains the silicone (B) and is combined in use with the first-of-three-component treatment agent containing the silicone (A), the anionic ingredient, and optionally the silicone (C) and the second-of-three-component treatment agent containing the silicone (D). The nonionic surfactant is contained in one of either or both of the first-of-three-component treatment agent and the second-of-three-component treatment agent. The formulation stability and especially the preservation stability of the third-of-three-component treatment agent can thus be improved. Also, by adjusting the mixing ratio with respect to the first- and second-of-three-component treatment agents, the ingredients in the treatment agent obtained can be adjusted. Also, just the third-of-three-component treatment agent can be distributed as a separate agent from the first- and second-of-three-component treatment agents.

<Seventh Embodiment>

[0121] Next, a seventh embodiment that embodies a method for treating a polyester synthetic fiber of the present invention (hereinafter referred to as "fiber treatment method") will be described.

[0122] The fiber treatment method of the present embodiment is characterized in that in a case of a two-component treatment agent, a treatment agent dilute liquid containing a solvent, the first-of-two-component treatment agent of the second embodiment, and the second-of-two-component treatment agent of the third embodiment is applied to a polyester synthetic fiber. The dilute liquid is prepared by, for example, adding the first-of-two-component treatment agent or the first-of-two-component treatment agent-containing composition and the second-of-two-component treatment agent to the solvent. The dilute liquid is preferably prepared by adding the first-of-two-component treatment agent-containing composition of the second embodiment and the second-of-two-component treatment agent of the third embodiment to the solvent. The ratio of the first-of-two-component treatment agent content and the second-of-two-component treatment agent content is preferably such that as a mass ratio of nonvolatile contents, first-of-two-component treatment agent/second-of-two-component treatment agent = 99.5/0.5 to 70/30. By specifying to be in such range, the handleability can be improved. The term a nonvolatile content as used herein refers to residue after sufficient removal of volatile matter by heat treating an object at 105°C for 2 hours, that is, to absolutely dry matter.

[0123] The fiber treatment method of the present embodiment is characterized in that in a case of a three-component

treatment agent, a treatment agent dilute liquid containing a solvent, the first-of-three-component treatment agent of the fourth embodiment, the second-of-three-component treatment agent of the fifth embodiment, and the third-of-three-component treatment agent of the sixth embodiment is applied to a polyester synthetic fiber. The dilute liquid is prepared by, for example, adding the first-of-three-component treatment agent or the first-of-three-component treatment agent-containing composition, the second-of-three-component treatment agent or the second-of-three-component treatment agent-containing composition, and the third-of-three-component treatment agent to the solvent. The dilute liquid is preferably prepared by adding the first-of-three-component treatment agent-containing composition of the fourth embodiment, the second-of-three-component treatment agent-containing composition of the fifth embodiment, and the third-of-three-component treatment agent of the sixth embodiment to the solvent.

[0124] The solvent used for producing the dilute liquid can be the same as exemplified in the first embodiment. The dilute liquid preferably has a nonvolatile content of not less than 0.01% by mass and not more than 10% by mass from a standpoint of, for example, the handleability.

[0125] By using the first-of-two-component treatment agent and the second-of-two-component treatment agent in combination or the first-of-three-component treatment agent, the second-of-three-component treatment agent, and the third-of-three-component treatment agent in combination, the mixing ratio of the respective components can be changed as desired. Therefore, even if production conditions differ due to differences in production equipment or differences in climate such as temperature and humidity, the mixing ratio can be adjusted finely such that it is easy to prepare the treatment agent or the dilute liquid for always imparting optimal fiber characteristics or fiber production characteristics.

[0126] To emulsify the treatment agent, the respective treatment agents or compositions may be mixed with the solvent and stirred using a known stirrer such as a homomixer, a homogenizer, a colloidal mill, or a line mixer.

[0127] The fiber treatment method includes applying to a fiber the dilute liquid obtained as described above, for example, in a spun yarn production step constituted of a fiber spinning or drawing step or a finishing step.

[0128] Examples of the fiber to which the dilute liquid is applied include a polyester synthetic fiber. Specific examples of the polyester synthetic fiber include polyethylene terephthalate (PET), polytrimethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polylactic acid, and a composite fiber containing these polyester resins.

[0129] Use of the fiber is not restricted in particular, and example thereof include wadding, a short fiber, a long fiber, a spun yarn, and a nonwoven fabric. Short fibers correspond to those that are generally called staples and do not include long fibers that are generally called filaments. The length of the short fiber is not restricted in particular as long as it corresponds to that of short fiber in the art and is, for example, not more than 100 mm. Among these, the dilute liquid of the present invention is preferably applied to a polyester synthetic fiber for wadding. By being applied to a polyester synthetic fiber for wadding, texture such as smoothness can be imparted to wadding, for example, for stuffed toys, futons, and clothing.

[0130] The proportion of adhering the dilute liquid to the fibers is not limited in particular, and the dilute liquid is adhered such that a final solids content is preferably not less than 0.01% by mass and not more than 10% by mass and more preferably not less than 0.1% by mass and not more than 3% by mass with respect to the fiber. By such arrangement, the benefits due to the respective ingredients can be exhibited effectively. The method for adhering the dilute liquid is not limited in particular, and a known method such as a roller lubricating method, a guide lubricating method using a metering pump, an immersion lubricating method, or a spray lubricating method can be used in accordance with, for example, type, form, and use of the fiber. When an immersion lubricating method is used, the immersion time is preferably not less than 1 minute and not more than 5 minutes.

[0131] The fiber to which the dilute liquid has been adhered may be dried or heat-treated using a known method. Water and other solvents are volatilized by the drying or heat treatment, and the fiber to which the ingredients contained in the first treatment agent, the second treatment agent, and the third treatment agent are adhered is thereby obtained.

[0132] The heat treatment is performed to form a silicone coating on the fiber surface. The heat treatment is preferably performed under a condition of not less than 100°C and not more than 200°C. The heating time is set as appropriate in accordance with, for example, treatment temperature and is preferably not less than 1 minute and not more than 20 minutes and more preferably not less than 1 minute and not more than 15 minutes. By such heat treatment, the reaction between the silicone (A) and the silicone (B) is promoted, and the silicone coating that is constituted of a crosslinked polymer compound is formed on the fiber.

[0133] Effects of the fiber treatment method of the seventh embodiment will now be described. With the seventh embodiment, the effects described below are provided in addition to the effects of the above-described embodiments.

[0134] (7-1) The fiber treatment method of the seventh embodiment includes applying the dilute liquid to a fiber, for example, in a spun yarn production step constituted of a fiber spinning or drawing step or a finishing step. In particular, the dilute liquid prepared by adding the first-of-two-component treatment agent or the first-of-two-component treatment agent-containing composition of the second embodiment and the second-of-two-component treatment agent of the third embodiment to the solvent is excellent in emulsion stability. Alternatively, the dilute liquid prepared by adding the first-of-three-component treatment agent or the first-of-three-component treatment agent-containing composition of the fourth embodiment, the second-of-three-component treatment agent or the second-of-three-component treatment agent-

containing composition of the fifth embodiment, and the third-of-three-component treatment agent of the sixth embodiment to the solvent is excellent in emulsion stability. Benefits due to the respective ingredients on wadding, a short fiber, a long fiber, a spun yarn, and a nonwoven fabric can thus be exhibited effectively.

[0135] (7-2) With the fiber treatment method of the seventh embodiment, the fiber to which the treatment agent dilute liquid has been adhered may be heat-treated at not less than 100°C and not more than 200°C. By such heat treatment, the reaction between the silicone (A) and the silicone (B) is promoted, and the silicone coating that is constituted of a crosslinked polymer compound is formed on the fiber. The more durable coating thus formed can improve the flexibility of the fiber.

[0136] The above-described embodiments may be modified as follows. The embodiments can be implemented in combination with the modifications described below within a range that is not technically inconsistent.

· The method for preparing the treatment agent dilute liquid of the embodiments is not limited in particular, and a method for preparation other than that described in the section on the fiber treatment method of the seventh embodiment may be used. For example, the respective silicones, the nonionic surfactant, and the anionic ingredient described above may be mixed with one another and thereafter mixed with the solvent.

[0137] · The respective treatment agents, respective compositions, or dilute liquid of the embodiments may further include another solvent, a stabilizer, an antistatic agent, a binder, an antioxidant, an ultraviolet absorber, an organic acid, a surfactant other than those mentioned above, and other ingredients that are ordinarily used in treatment agents or the like as other ingredients for quality maintenance of the respective treatment agents, respective compositions, or dilute liquid within a range that does not impair the effects of the present invention. The other ingredients that are ordinarily used in treatment agents other than the solvent are preferably of not more than 10% by mass in each treatment agent from a standpoint of efficiently exhibiting the benefits of the present invention.

EXAMPLES

[0138] Examples will now be given below to describe the features and effects of the present invention more specifically, but the present invention is not restricted to these examples. In the following description of working examples and comparative examples, parts means parts by mass and % means % by mass unless otherwise noted.

Experimental Part 1 (Preparation of treatment agents)

(Example 1)

[0139] As shown in Table 1, a treatment agent of Example 1 containing 6 parts (%) of a modified silicone having an amino group (side-chain type; viscosity: 6,000 mPa·s, functional group equivalent weight: 11,000 g/mol) (A-1) as the silicone (A), 5 parts (%) of N-2-(aminoethyl)-3-aminopropylmethyldimethoxysilane (functional groups: amino group and methoxy group) (B-1) as the silicone (B), 80 parts (%) of a both-terminal silanol-modified silicone (number average molecular weight: 100,000) (D-1) as the silicone (D), 4 parts (%) of sodium dodecyl sulfonate (E-1) as the anionic ingredient, and 5 parts (%) of polyoxyethylene (6) polyoxypropylene (2) dodecyl ether (F-1) as the nonionic surfactant was prepared.

(Examples 2 to 31 and Comparative Examples 1 to 10)

[0140] Treatment agents of Examples 2 to 31 and Comparative Examples 1 to 10 were prepared in the same manner as the treatment agent of Example 1 such as to contain the silicones (A) to the silicones (D), the anionic ingredients, and the nonionic surfactants at the amounts indicated in Table 1.

[0141] The types and contents of the silicones (A), the types and contents of the silicones (B), the types and contents of the silicones (C), the types and contents of the silicones (D), the types and contents of the anionic ingredients, and the types and contents of the nonionic surfactants are respectively indicated in the "Silicone (A)" column, the "Silicone (B)" column, the "Silicone (C)" column, the "Silicone (D)" column, the "Anionic ingredient" column, and the "Nonionic surfactant" column of Table 1. Also, the contents of the silicones (B) assuming that the contents of the silicones (A) in the respective treatment agents are 100 parts by mass are indicated in the "Parts by mass of silicone (B) with respect to 100 parts by mass of silicone (A)" column of Table 1.

[Table 1]

Category	Silicone (A)		Silicone (B)		Silicone (C)		Silicone (D)		Anionic ingredient		Nonionic surfactant		Parts by mass of silicone (B) with respect to 100 parts by mass of silicone (A)	Emulsifiability	Antistatic property	Flexibility	Bulkiness
	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)					
Example 1	A-1	6	B-1	5			D-1	80	E-1	4	F-1	5	83.3	◎	◎	◎	◎
Example 2	A-2	55	B-2	5			D-2	25	E-2	5	F-2	10	9.1	◎	◎	◎	◎
Example 3	A-5	70	B-1	5			D-1	15	E-1	5	F-1	5	7.1	◎	◎	◎	◎
Example 4	A-4	10	B-3	10			D-3	75	E-4	2	F-1	3	100.0	◎	◎	◎	◎
Example 5	A-6	35	B-4	20			D-4	10	E-3	15	F-1	20	57.1	◎	◎	◎	◎
Example 6	A-3	65	B-1	5			D-2	12	E-1	8	F-1	10	7.7	◎	◎	◎	◎
Example 7	A-1	35	B-6	5			D-3	55	E-4	2	F-1	3	14.3	◎	◎	◎	◎
Example 8	A-2	45	B-3	5			D-4	15	E-2	25	F-2	10	11.1	◎	◎	◎	◎
Example 9	A-5	45	B-5	5			D-5	40	E-1	5	F-1	5	11.1	◎	◎	◎	◎
Example 10	A-6	60	B-2	20			D-5	10	E-2	5	F-2	5	33.3	◎	◎	◎	◎
Example 11	A-1	35	B-6	5			D-1	35	E-1	3	F-2	22	14.3	◎	◎	◎	◎
Example 12	A-2	10	B-1	15			D-2	60	E-1	7	F-1	8	150.0	◎	◎	◎	◎
Example 13	A-3	20	B-4	5	C-1	5	D-3	55	E-2	5	F-2	10	25.0	◎	◎	◎	◎
Example 14	A-4	55	B-1	5	C-2	5	D-1	15	E-2	3	F-1	17	9.1	◎	◎	◎	◎
Example 15	A-6	15	B-3	1	C-3	7	D-4	65	E-1	2	F-1	10	6.7	◎	◎	◎	◎
Example 16	A-5	55	B-1	5	C-2	5	D-1	15	E-2	3	F-1	17	9.1	◎	◎	◎	◎
Example 17	A-1	75	B-1	5			D-2	5	E-1	5	F-1	10	6.7	◎	◎	◎	◎
Example 18	A-2	60	B-6	10			D-1	8	E-4	2	F-1	20	16.7	◎	◎	◎	◎
Example 19	A-5	10	B-5	2			D-4	70	E-5	15	F-3	3	20.0	○	◎	◎	◎
Example 20	A-2	3	B-1	3			D-3	92	E-4	1	F-1	1	100.0	◎	◎	○	◎
Example 21	A-1	85	B-2	5			D-3	2	E-1	3	F-2	5	5.9	◎	◎	◎	○
Example 22	A-2	25	B-3	30			D-2	30	E-2	5	F-1	10	120.0	○	◎	◎	◎
Example 23	A-4	10	B-1	0.5			D-4	70	E-1	9.5	F-1	10	5.0	◎	◎	○	◎
Example 24	A-3	20	B-5	5			D-3	15	E-1	30	F-2	30	25.0	◎	◎	○	◎
Example 25	A-3	3	B-2	3			D-5	92	E-2	1	F-1	1	100.0	○	◎	◎	◎
Example 26	A-2	45	B-3	5			D-2	30	E-1	20			11.1	○	◎	◎	○
Example 27	A-5	55	B-4	5			D-1	20	E-1	15	f-4	5	9.1	○	◎	◎	○
Example 28	A-1	70	B-1	10					E-3	5	f-4	15	14.3	○	○	◎	○
Example 29	A-6	80	B-6	5					E-1	15			6.3	○	○	◎	○
Example 30	A-1	5	B-3	15					E-1	80			300.0	○	○	○	○
Example 31	A-1	75	B-1	2	C-1	3			E-1	20			2.7	○	○	○	○
Comparative example 1							D-4	80	E-1	10	F-1	10	-	○	○	×	○
Comparative example 2					C-1	40	D-5	40	E-2	5	F-1	15	-	×	×	×	○
Comparative example 3			B-1	10	C-2	50			E-1	20	F-1	20	-	×	×	×	×
Comparative example 4	A-3	80							E-2	5	F-1	15	0.0	○	○	×	×
Comparative example 5	A-2	40					D-2	35	E-1	20	F-2	5	0.0	○	○	×	×
Comparative example 6	A-2	10	b-1	10			D-3	65	E-2	10	F-2	5	100.0	○	○	×	×
Comparative example 7	A-3	45	B-1	5			D-4	50					11.1	×	×	○	○
Comparative example 8	A-2	35	B-3	5	C-1	15	D-3	35	E-1	5	F-1	5	14.3	○	×	○	○
Comparative example 9	A-4	30	B-5	5	C-2	25	D-5	30	E-1	5	F-2	5	16.7	○	×	○	○
Comparative example 10	A-2	30	B-2	5	C-3	20	D-1	35	E-2	5	F-1	5	16.7	○	×	○	○

[0142] Details of the silicones (A), the silicones (B), the silicones (C), the silicones (D), the anionic ingredients, and the nonionic surfactants indicated in Table 1 are as follows.

(Silicone (A))

[0143]

A-1: modified silicone having an amino group (side-chain type; viscosity: 6,000 mPa·s, functional group equivalent weight: 11,000 g/mol)

A-2: modified silicone having an amino group (both-terminal type; viscosity: 25 mPa·s, functional group equivalent weight: 800 g/mol)

A-3: modified silicone having an amino group (side-chain type; viscosity: 600 mPa·s, functional group equivalent weight: 3,700 g/mol)

A-4: modified silicone having an amino group (side-chain type; viscosity: 5,000 mPa·s, functional group equivalent

weight: 7,000 g/mol)
A-5: modified silicone having an amino group (side-chain type; viscosity: 3,500 mPa·s, functional group equivalent weight: 1,700 g/mol)
A-6: modified silicone having an amino group (both-terminal type; viscosity: 520 mPa·s, functional group equivalent weight: 7,000 g/mol)

(Silicone (B))

[0144]

B-1: N-2-(aminoethyl)-3-aminopropylmethyldimethoxysilane (functional groups: amino group and methoxy group)
B-2: 3-aminopropyltriethoxysilane (functional groups: amino group and methoxy group)
B-3: N-2-(aminoethyl)-3-aminopropyltrimethoxysilane (functional groups: amino group and methoxy group)
B-4: methyltrimethoxysilane (functional group: methoxy group)
B-5: methyltriethoxysilane (functional group: ethoxy group)
B-6: 3-isocyanatopropyltriethoxysilane (functional group: isocyanate group, ethoxy group)
b-1: 3-glycidoxypropylmethyldimethoxysilane (functional groups: epoxy group and methoxy group)

(Silicone (C))

[0145]

C-1: polydimethylsiloxane (viscosity: 1,000 mPa·s)
C-2: alkyl-modified silicone (viscosity: 500 mPa·s)
C-3: silicone resin (MQ type) (solid at ordinary temperature)

(Silicone (D))

[0146]

D-1: both-terminal silanol-modified silicone (number average molecular weight: 100,000)
D-2: both-terminal silanol-modified silicone (number average molecular weight: 150,000)
D-3: both-terminal silanol-modified silicone (number average molecular weight: 20,000)
D-4: both-terminal silanol-modified silicone (number average molecular weight: 50,000)
D-5: both-terminal silanol-modified silicone (number average molecular weight: 200,000)

(Anionic ingredient)

[0147]

E-1: sodium dodecyl sulfonate
E-2: octyl phosphoric acid ester potassium salt
E-3: oleic acid
E-4: acetic acid
E-5: sodium polyoxyethylene (3) dodecyl sulfate

(Nonionic surfactant)

[0148]

F-1: polyoxyethylene (6) polyoxypropylene (2) dodecyl ether
F-2: polyoxyethylene (10) C12-13 branched alkyl ether
F-3: polyoxyethylene (25) polyoxypropylene (15) block ether
f-4: polyoxyethylene (40) hydrogenated castor oil

Experimental Part 2 (Emulsifiability)

[0149] Each treatment agent prepared in Experimental Part 1 was diluted using ion exchanged water to prepare a dilute

liquid (emulsion) with a nonvolatile content of 1.0%. Emulsifiability was evaluated as stability using the dilute liquid.

[0150] With the dilute liquid of each treatment agent, light transmittance (%) at a wavelength of 750 nm was measured under conditions of 20°C and 60% RH. As a measuring device, a spectrophotometer, UV-1800 SPECTROPHOTOMETER, manufactured by Shimadzu Corporation was used. The emulsifiability of the dilute liquid was evaluated according to criteria indicated below. The results are indicated in the "Emulsifiability" column of Table 1.

· Evaluation criteria of emulsifiability

[0151]

◎ (satisfactory): There was no separation and the light transmittance was not less than 50%.
◦ (fair): There was no separation and the light transmittance was not less than 30% but less than 50%.
× (poor): There was separation.

Experimental Part 3 (Flexibility)

[0152] A wad of polyester synthetic fibers of 7 denier and a cut length of 32 mm generally used for cushion wadding, futons, etc., was used for evaluation. The evaluation was performed after first performing a washing operation with warm water of 40°C and then drying for 2 hours at 80°C to eliminate influence of lubricants, etc., used in producing the polyester synthetic fibers.

[0153] The treatment agent of each example prepared in Experimental Part 1 was diluted such as to be of an effective ingredient concentration of 12.5% to prepare a dilute liquid of emulsion form. 2.4 g of the emulsion were sprayed uniformly onto 100 g of the wad of polyester synthetic fibers. Thereafter, heat treatment (drying) at 180°C was performed for 10 minutes to prepare a sample wad for evaluation. 0.3 g of the treatment agent are adhered to 100 g of the wad.

· Evaluation of flexibility

[0154] Flexibility of each dried sample wad was scored according to criteria indicated below by five experts of texture evaluation of fibers and an average score of the five experts was calculated by rounding off to two significant digits. The flexibility was evaluated according to criteria indicated below based on the calculated average score. The results are indicated in the "Flexibility" column of Table 1.

1 point: Has approximately the same flexibility as the wad of polyester synthetic fibers without the treatment agent adhered thereto.
2 points: More flexibility is felt than the wad of polyester synthetic fibers without the treatment agent adhered thereto.
3 points: Much more flexibility is felt than the wad of polyester synthetic fibers without the treatment agent adhered thereto.
◎ (satisfactory): The average score of the five experts was not less than 2.5 points.
◦ (fair): The average score of the five experts was not less than 2.0 points but less than 2.5 points.
× (poor): The average score of the five experts was less than 2.0 points.

Experimental Part 4 (Antistatic property)

[0155] With each of the sample wads with the respective treatment agents adhered thereto prepared in Experimental Part 3, 5 g were moisture conditioned for 24 hours inside a thermostatic chamber at 20°C and 45% relative humidity. Thereafter, electrical resistances of the polyester synthetic fibers were measured using a known resistance measuring device and evaluated according to evaluation criteria indicated below. The results are indicated in the "Antistatic property" column of Table 1.

· Evaluation criteria of antistatic property

[0156]

◎ (satisfactory): Surface resistance was less than 1.0×10^{11} Ω.
◦ (fair): Surface resistance was not less than 1.0×10^{11} Ω but less than 1.0×10^{12} Ω.
× (poor): Surface resistance was not less than 1.0×10^{12} Ω.

Experimental Part 5 (Bulkiness)

[0157] Bulkiness was evaluated by measuring compressive elastic recovery rate. The compressive elastic recovery rate was measured by a test method similar to that of JIS L2001.

[0158] With each of the sample wads with the respective treatment agents adhered thereto prepared in Experimental Part 3, 40 g were fed into a roller carding machine to prepare web of 30 cm × 100 cm with the corresponding treatment agent adhered thereto. The web was cut out to prepare four sheets of fabric of 15 cm × 15 cm. The four sheets of fabric were overlapped such that fiber directions were mutually orthogonal to prepare a rectangular parallelepiped body.

[0159] After leaving still for 30 minutes at 20°C and 40% RH, a metal plate (135 g) of 15 cm × 15 cm was placed on the rectangular parallelepiped body and a height (h1) of the rectangular parallelepiped body after 1 minute was recorded in 0.1 cm units. Further, a weight of 1,125 g was placed on the metal plate and, after leaving still for 24 hours, was removed upon recording the height (h2). The height (h3) of the rectangular parallelepiped body 1 minute after removing the weight was recorded.

[0160] The recovery rate was calculated by a formula indicated below.

$$\text{Recovery rate (\%)} = 100 \times (h3-h2)/(h1-h2)$$

[0161] It was judged that the higher the recovery rate, the better the bulkiness of the test wad.

@ (satisfactory): The recovery rate (%) was not less than 80%.
◦ (fair): The recovery rate (%) was not less than 50% but less than 80%.
× (poor): The recovery rate (%) was less than 50%.

Experimental Part 6 (Preparation of first-of-two-component treatment agents)

(First-of-two-component treatment agent (P-1))

[0162] A first-of-two-component treatment agent (P-1) containing 6.3 parts (%) of the modified silicone having an amino group (side-chain type; viscosity: 6,000 mPa·s, functional group equivalent weight: 11,000 g/mol) (A-1) as the silicone (A), 84.2 parts (%) of the both-terminal silanol-modified silicone (number average molecular weight: 100,000) (D-1) as the silicone (D), 4.2 parts (%) of sodium dodecyl sulfonate (E-1) as the anionic ingredient, and 5.3 parts (%) of polyoxyethylene (6) polyoxypropylene (2) dodecyl ether (F-1) as the nonionic surfactant was prepared.

(First-of-two-component treatment agents P-2 to P-31)

[0163] First-of-two-component treatment agents P-2 to P-31 were prepared in the same manner as the first-of-two-component treatment agent (P-1) such as to contain the silicones (A), the silicones (C), the silicones (D), the anionic ingredients, and the nonionic surfactants at the amounts indicated in Table 2.

[0164] The types and contents of the silicones (A), the types and contents of the silicones (C), the types and contents of the silicones (D), the types and contents of the anionic ingredients, and the types and contents of the nonionic surfactants are respectively indicated in the "Silicone (A)" column, the "Silicone (C)" column, the "Silicone (D)" column, the "Anionic ingredient" column, and the "Nonionic surfactant" column of Table 2.

[Table 2]

First-of-two-component treatment agent	Silicone (A)		Silicone (C)		Silicone (D)		Anionic ingredient		Nonionic surfactant		Evaluation
	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)	Formulation stability
P-1	A-1	6.3			D-1	84.2	E-1	4.2	F-1	5.3	◎
P-2	A-2	57.9			D-2	26.3	E-2	5.3	F-2	10.5	◎
P-3	A-5	73.7			D-1	15.8	E-1	5.3	F-1	5.3	◎
P-4	A-4	11.1			D-3	83.3	E-4	2.2	F-1	3.3	◎
P-5	A-6	43.8			D-4	12.5	E-3	18.8	F-1	25.0	◎
P-6	A-3	68.4			D-2	12.6	E-1	8.4	F-1	10.5	◎

(continued)

First-of-two-component treatment agent	Silicone (A)		Silicone (C)		Silicone (D)		Anionic ingredient		Nonionic surfactant		Evaluation
	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)	Formulation stability
P-7	A-1	36.8			D-3	57.9	E-4	2.1	F-1	3.2	◎
P-8	A-2	47.4			D-4	15.8	E-2	26.3	F-2	10.5	◎
P-9	A-5	47.4			D-5	42.1	E-1	5.3	F-1	5.3	◎
P-10	A-6	75.0			D-5	12.5	E-2	6.3	F-2	6.3	◎
P-11	A-1	36.8			D-1	36.8	E-1	3.2	F-2	23.2	◎
P-12	A-2	11.8			D-2	70.6	E-1	8.2	F-1	9.4	◎
P-13	A-3	21.1	C-1	5.3	D-3	57.9	E-2	5.3	F-2	10.5	◎
P-14	A-4	57.9	C-2	5.3	D-1	15.8	E-2	3.2	F-1	17.9	◎
P-15	A-6	15.2	C-3	7.1	D-4	65.7	E-1	2.0	F-1	10.1	◎
P-16	A-5	57.9	C-2	5.3	D-1	15.8	E-2	3.2	F-1	17.9	◎
P-17	A-1	78.9			D-2	5.3	E-1	5.3	F-1	10.5	◎
P-18	A-2	66.7			D-1	8.9	E-4	2.2	F-1	22.2	◎
P-19	A-5	10.2			D-4	71.4	E-5	15.3	F-3	3.1	◎
P-20	A-2	3.1			D-3	94.8	E-4	1.0	F-1	1.0	◎
P-21	A-1	89.5			D-3	2.1	E-1	3.2	F-2	5.3	◎
P-22	A-2	35.7			D-2	42.9	E-2	7.1	F-1	14.3	◎
P-23	A-4	10.1			D-4	70.4	E-1	9.5	F-1	10.1	◎
P-24	A-3	21.1			D-3	15.8	E-1	31.6	F-2	31.6	◎
P-25	A-3	3.1			D-5	94.8	E-2	1.0	F-1	1.0	◎
P-26	A-2	47.4			D-2	31.6	E-4	21.1			◎
P-27	A-5	57.9			D-1	21.1	E-1	15.8	f-4	5.3	◎
P-28	A-1	77.8					E-3	5.6	f-4	16.7	◎
P-29	A-6	84.2					E-5	15.8			◎
P-30	A-1	5.9					E-5	94.1			◎
P-31	A-1	76.5	C-1	3.1			E-5	20.4			◎

Experimental Part 7 (Preparation of second-of-two-component treatment agents)

(Second-of-two-component treatment agent (S-1))

[0165] A second-of-two-component treatment agent (S-1) was made to contain 100 parts (%) of N-2-(aminoethyl)-3-aminopropylmethyldimethoxysilane (functional groups: amino group and methoxy group) (B-1) as the silicone (B).

(Second-of-two-component treatment agents S-2 to S-6)

[0166] Second-of-two-component treatment agents S-2 to S-6 were prepared such as to contain the silicones (B) at the amounts indicated in Table 3. The types and contents of the silicones (B) are indicated in the "Silicone (B)" column of Table 3.

[Table 3]

Second-of-two-component treatment agent	Silicone (B)		Evaluation
	Type	Content (%)	Formulation stability
S-1	B-1	100	◎
S-2	B-2	100	◎
S-3	B-3	100	◎
S-4	B-4	100	◎
S-5	B-5	100	◎
S-6	B-6	100	◎

Experimental Part 8 (Evaluation of formulation stability)

· Evaluation of formulation stabilities of first-of-two-component treatment agents

[0167] Each first-of-two-component treatment agent was adjusted to be 40% in concentration by adding ion exchanged water and emulsified by a homogenizer to prepare an emulsion (composition containing first-of-two-component treatment agent). The emulsion obtained was temperature controlled for 24 hours inside a thermostatic chamber at 20°C and 60% RH. The appearance was judged visually and evaluated according to criteria indicated below. The results are indicated in the "Formulation stability" column of Table 2.

· Evaluation of formulation stabilities of second-of-two-component treatment agents

[0168] Each second-of-two-component treatment agent was temperature controlled for 24 hours inside a thermostatic chamber at 20°C and 60% RH. The appearance was judged visually and evaluated according to criteria indicated below. The results are indicated in the "Formulation stability" column of Table 3.

· Evaluation criteria of formulation stability (first-of-two-component treatment agent and second-of-two-component treatment agent)

[0169]

◎ (satisfactory): Separation did not occur.
× (poor): Separation occurred.

Experimental Part 9 (Preparation of treatment agents from first-of-two-component treatment agents and second-of-two-component treatment agents)

(Example 32)

[0170] A treatment agent of Example 32 was prepared by mixing 95% (parts) of the first-of-two-component treatment agent (P-1) and 5% (parts) of the second-of-two-component treatment agent (S-1) shown in Table 4.

(Examples 33 to 62)

[0171] Treatment agents of respective examples were prepared in the same manner as Example 32 by mixing the first-of-two-component treatment agents and the second-of-two-component treatment agents shown in Table 4. The types and mass ratios of the first-of-two-component treatment agents and the types and mass ratios of the second-of-two-component treatment agents are respectively indicated in the "First-of-two-component treatment agent" column and the "Second-of-two-component treatment agent" column of Table 4.

[0172] The emulsifiability, antistatic property, flexibility, and bulkiness were evaluated by the same methods as with Example 1 using the treatment agents of the respective examples obtained. The results are respectively indicated in the "Emulsifiability" column, the "Antistatic property" column, the "Flexibility" column, and the "Bulkiness" column of Table 4.

[Table 4]

Category	First-of-two-component treatment agent		Second-of-two-component treatment agent		Emulsifiability	Antistatic property	Flexibility	Bulkiness
	Type	Mass ratio (%)	Type	Mass ratio (%)				
Example 32	P-1	95	S-1	5	◎	◎	◎	◎
Example 33	P-2	95	S-2	5	◎	◎	◎	◎
Example 34	P-3	95	S-1	5	◎	◎	◎	◎
Example 35	P-4	90	S-3	10	◎	◎	◎	◎
Example 36	P-5	80	S-4	20	◎	◎	◎	◎
Example 37	P-6	95	S-1	5	◎	◎	◎	◎
Example 38	P-7	95	S-6	5	◎	◎	◎	◎
Example 39	P-8	95	S-3	5	◎	◎	◎	◎
Example 40	P-9	95	S-5	5	◎	◎	◎	◎
Example 41	P-10	80	S-2	20	◎	◎	◎	◎
Example 42	P-11	95	S-6	5	◎	◎	◎	◎
Example 43	P-12	85	S-1	15	◎	◎	◎	◎
Example 44	P-13	95	S-4	5	◎	◎	◎	◎
Example 45	P-14	95	S-1	5	◎	◎	◎	◎
Example 46	P-15	99	S-3	1	◎	◎	◎	◎
Example 47	P-16	95	S-1	5	◎	◎	◎	◎
Example 48	P-17	95	S-1	5	◎	◎	◎	◎
Example 49	P-18	90	S-6	10	◎	◎	◎	◎
Example 50	P-19	98	S-5	2	○	◎	◎	◎
Example 51	P-20	97	S-1	3	◎	◎	○	◎
Example 52	P-21	95	S-2	5	◎	◎	◎	○
Example 53	P-22	70	S-3	30	○	◎	◎	◎
Example 54	P-23	99.5	S-1	0.5	◎	◎	○	◎
Example 55	P-24	95	S-5	5	◎	◎	○	◎
Example 56	P-25	97	S-2	3	○	◎	◎	◎
Example 57	P-26	95	S-3	5	○	◎	◎	○
Example 58	P-27	95	S-4	5	○	◎	◎	○
Example 59	P-28	90	S-1	10	○	○	◎	○
Example 60	P-29	95	S-6	5	○	○	◎	○
Example 61	P-30	85	S-3	15	○	○	○	○
Example 62	P-31	98	S-1	2	○	○	○	○

Experimental Part 10 (Preparation of first-of-three-component treatment agents)

(First-of-three-component treatment agent (TP-1))

[0173] A first-of-three-component treatment agent (TP-1) containing 90.5 parts (%) of the modified silicone having an

amino group (side-chain type; viscosity: 6,000 mPa·s, functional group equivalent weight: 11,000 g/mol) (A-1) as the silicone (A), 4.2 parts (%) of sodium dodecyl sulfonate (E-1) as the anionic ingredient, and 5.3 parts (%) of polyoxyethylene (6) polyoxypropylene (2) dodecyl ether (F-1) as the nonionic surfactant was prepared.

(First-of-three-component treatment agents TP-2 to TP-26)

[0174] First-of-three-component treatment agents TP-2 to TP-26 were prepared in the same manner as the first-of-three-component treatment agent (TP-1) such as to contain the silicones (A), the silicones (C), the anionic ingredients, and the nonionic surfactants at the amounts indicated in Table 5.

[0175] The types and contents of the silicones (A), the types and contents of the silicones (C), the types and contents of the anionic ingredients, and the types and contents of the nonionic surfactants are respectively indicated in the "Silicone (A)" column, the "Silicone (C)" column, the "Anionic ingredient" column, and the "Nonionic surfactant" column of Table 5.

[Table 5]

First-of-three-component treatment agent	Silicone (A)		Silicone (C)		Nonionic surfactant		Anionic ingredient		Evaluation
	Type	Content (%)	Type	Content (%)	Type	Content (%)	Type	Content (%)	Formulation stability
TP-1	A-1	90.5			E-1	4.2	F-1	5.3	◎
TP-2	A-2	84.2			E-2	5.3	F-2	10.5	◎
TP-3	A-5	89.5			E-1	5.3	F-1	5.3	◎
TP-4	A-4	94.4			E-4	2.2	F-1	3.3	◎
TP-5	A-6	56.3			E-3	18.8	F-1	25.0	◎
TP-6	A-3	81.1			E-1	8.4	F-1	10.5	◎
TP-7	A-1	94.7			E-4	2.1	F-1	3.2	◎
TP-8	A-2	63.2			E-2	26.3	F-2	10.5	◎
TP-9	A-5	89.5			E-1	5.3	F-1	5.3	◎
TP-10	A-6	87.5			E-2	6.3	F-2	6.3	◎
TP-11	A-1	73.7			E-1	3.2	F-2	23.2	◎
TP-12	A-2	82.4			E-1	8.2	F-1	9.4	◎
TP-13	A-3	69.0	C-1	17.2	E-2	4.6	F-2	9.2	◎
TP-14	A-4	72.6	C-2	6.6	E-2	3.1	F-1	17.6	◎
TP-15	A-6	61.9	C-3	28.9	E-1	1.5	F-1	7.7	◎
TP-16	A-5	72.6	C-2	6.6	E-2	3.1	F-1	17.6	◎
TP-17	A-1	84.2			E-1	5.3	F-1	10.5	◎
TP-18	A-2	75.6			E-4	2.2	F-1	22.2	◎
TP-19	A-5	81.6			E-5	15.3	F-3	3.1	◎
TP-20	A-2	97.9			E-4	1.0	F-1	1.0	◎
TP-21	A-1	91.6			E-1	3.2	F-2	5.3	◎
TP-22	A-2	78.6			E-2	7.1	F-1	14.3	◎
TP-23	A-4	80.4			E-1	9.5	F-1	10.1	◎
TP-24	A-3	36.8			E-1	31.6	F-2	31.6	◎
TP-25	A-3	97.9			E-2	1.0	F-1	1.0	◎
TP-26	A-2	78.9			E-1	21.1			◎

Experimental Part 11 (Preparation of second-of-three-component treatment agents)

(Second-of-three-component treatment agent (TS-1))

[0176] A second-of-three-component treatment agent (TS-1) containing 90.5 parts (%) of both-terminal silanol-modified silicone (number average molecular weight: 100,000) (D-1) as the silicone (D), 4.2 parts (%) of sodium dodecyl sulfonate (E-1) as the anionic ingredient, and 5.3 parts (%) of polyoxyethylene (6) polyoxypropylene (2) dodecyl ether (F-1) as the nonionic surfactant was prepared.

(Second-of-three-component treatment agents TS-2 to TS-26)

[0177] Second-of-three-component treatment agents TS-2 to TS-26 were prepared in the same manner as the second-of-three-component treatment agent (TS-1) such as to contain the silicones (D), the anionic ingredients, and the nonionic surfactants at the amounts indicated in Table 6.

[0178] The types and contents of the silicones (D), the types and contents of the anionic ingredients, and the types and contents of the nonionic surfactants are respectively indicated in the "Silicone (D)" column, the "Anionic ingredient" column, and the "Nonionic surfactant" column of Table 6.

[Table 6]

Second-of-three-component treatment agent	Silicone (D)		Anionic ingredient		Nonionic surfactant		Evaluation
	Type	Content (%)	Type	Content (%)	Type	Content (%)	Formulation stability
TS-1	D-1	90.5	E-1	4.2	F-1	5.3	◎
TS-2	D-2	84.2	E-2	5.3	F-2	10.5	◎
TS-3	D-1	89.5	E-1	5.3	F-1	5.3	◎
TS-4	D-3	94.4	E-4	2.2	F-1	3.3	◎
TS-5	D-4	56.3	E-3	18.8	F-1	25.0	◎
TS-6	D-2	81.1	E-1	8.4	F-1	10.5	◎
TS-7	D-3	94.7	E-4	2.1	F-1	3.2	◎
TS-8	D-4	63.2	E-2	26.3	F-2	10.5	◎
TS-9	D-5	89.5	E-1	5.3	F-1	5.3	◎
TS-10	D-5	87.5	E-2	6.3	F-2	6.3	◎
TS-11	D-1	73.7	E-1	3.2	F-2	23.2	◎
TS-12	D-2	82.4	E-1	8.2	F-1	9.4	◎
TS-13	D-3	83.3	E-2	5.6	F-2	11.1	◎
TS-14	D-1	77.8	E-2	3.3	F-1	18.9	◎
TS-15	D-4	87.0	E-1	2.2	F-1	10.9	◎
TS-16	D-1	77.8	E-2	3.3	F-1	18.9	◎
TS-17	D-2	84.2	E-1	5.3	F-1	10.5	◎
TS-18	D-1	75.6	E-4	2.2	F-1	22.2	◎
TS-19	D-4	81.6	E-5	15.3	F-3	3.1	◎
TS-20	D-3	97.9	E-4	1.0	F-1	1.0	◎
TS-21	D-3	91.6	E-1	3.2	F-2	5.3	◎
TS-22	D-2	78.6	E-2	7.1	F-1	14.3	◎
TS-23	D-4	80.4	E-1	9.5	F-1	10.1	◎
TS-24	D-3	36.8	E-1	31.6	F-2	31.6	◎

(continued)

Second-of-three-component treatment agent	Silicone (D)		Anionic ingredient		Nonionic surfactant		Evaluation
	Type	Content (%)	Type	Content (%)	Type	Content (%)	Formulation stability
TS-25	D-5	97.9	E-2	1.0	F-1	1.0	◎
TS-26	D-2	78.9	E-1	21.1			◎

Experimental Part 12 (Preparation of third-of-three-component treatment agents)

(Third-of-three-component treatment agent (TT-1))

[0179] A third-of-three-component treatment agent (TT-1) was made to contain 100 parts (%) of N-2-(aminoethyl)-3-aminopropylmethyldimethoxysilane (functional groups: amino group and methoxy group) (B-1) as the silicone (B).

(Third-of-three-component treatment agents TT-2 to TT-6)

[0180] Third-of-three-component treatment agents TT-2 to TT-6 were prepared such as to contain the silicones (B) at the amounts indicated in Table 7. The types and contents of the silicones (B) are indicated in the "Silicone (B)" column of Table 7.

[Table 7]

Third-of-three-component treatment agent	Silicone (B)		Evaluation
	Type	Content (%)	Formulation stability
TT-1	B-1	100	◎
TT-2	B-2	100	◎
TT-3	B-3	100	◎
TT-4	B-4	100	◎
TT-5	B-5	100	◎
TT-6	B-6	100	◎

Experimental Part 13 (Evaluation of formulation stability)

· Evaluation of formulation stabilities of first-of-three-component treatment agents

[0181] Each first-of-three-component treatment agent was adjusted to be 40% in concentration by adding ion exchanged water and emulsified by a homogenizer to prepare an emulsion (first-of-three-component treatment agent-containing composition). The emulsion obtained was temperature controlled for 24 hours inside a thermostatic chamber at 20°C and 60% RH. The appearance was judged visually and evaluated according to criteria indicated below. The results are indicated in the "Formulation stability" column of Table 5.

· Evaluation of formulation stabilities of second-of-three-component treatment agents

[0182] Each second-of-three-component treatment agent was adjusted to be 40% in concentration by adding ion exchanged water and emulsified by a homogenizer to prepare an emulsion (second-of-three-component treatment agent-containing composition). The emulsion obtained was temperature controlled for 24 hours inside a thermostatic chamber at 20°C and 60% RH. The appearance was judged visually and evaluated according to criteria indicated below. The results are indicated in the "Formulation stability" column of Table 6.

· Evaluation of formulation stabilities of third-of-three-component treatment agents

[0183] Each third-of-three-component treatment agent was temperature controlled for 24 hours inside a thermostatic

chamber at 20°C and 60% RH. The appearance was judged visually and evaluated according to criteria indicated below. The results are indicated in the "Formulation stability" column of Table 7.

· Evaluation criteria of formulation stability (first-of-three-component treatment agent, second-of-three-component treatment agent, and third-of-three-component treatment agent)

[0184]

◎ (satisfactory): Separation did not occur.
× (poor): Separation occurred.

[0185] Experimental Part 14 (Preparation of treatment agents from first-of-three-component treatment agents, second-of-three-component treatment agents, and third-of-three-component treatment agents)

(Example 63)

[0186] A treatment agent of Example 63 was prepared by mixing 6.6% (parts) of the first-of-three-component treatment agent (TP-1), 88.4% (parts) of the second-of-three-component treatment agent (TS-1), and 5% (parts) of the third-of-three-component treatment agent shown in Table 8.

(Examples 64 to 88)

[0187] Treatment agents of respective examples were prepared in the same manner as Example 63 by mixing the first-of-three-component treatment agents, the second-of-three-component treatment agents, and the third-of-three-component treatment agents shown in Table 8. The types and mass ratios of the first-of-three-component treatment agents, the types and mass ratios of the second-of-three-component treatment agents, and the types and mass ratios of the third-of-three-component treatment agents are respectively indicated in the "First-of-three-component treatment agent" column, the "Second-of-three-component treatment agent" column, and the "Third-of-three-component treatment agent" column of Table 8.

[0188] The emulsifiability, antistatic property, flexibility, and bulkiness were evaluated by the same methods as with Example 1 using the treatment agents of the respective examples obtained. The results are respectively indicated in the "Emulsifiability" column, the "Antistatic property" column, the "Flexibility" column, and the "Bulkiness" column of Table 8.

[Table 8]

Category	First-of-three-component treatment agent		Second-of-three-component treatment agent		Third-of-three-component treatment agent		Emulsifiability	Antistatic property	Flexibility	Bulkiness
	Type	Mass ratio (%)	Type	Mass ratio (%)	Type	Mass ratio (%)				
Example 63	TP-1	6.6	TS-1	88.4	TT-1	5	◎	◎	◎	◎
Example 64	TP-2	65.3	TS-2	29.7	TT-2	5	◎	◎	◎	◎
Example 65	TP-3	78.2	TS-3	16.8	TT-1	5	◎	◎	◎	◎
Example 66	TP-4	10.6	TS-4	79.4	TT-3	10	◎	◎	◎	◎
Example 67	TP-5	62.2	TS-5	17.8	TT-4	20	◎	◎	◎	◎
Example 68	TP-6	80.2	TS-6	14.8	TT-1	5	◎	◎	◎	◎
Example 69	TP-7	36.9	TS-7	58.1	TT-6	5	◎	◎	◎	◎
Example 70	TP-8	71.3	TS-8	23.8	TT-3	5	◎	◎	◎	◎
Example 71	TP-9	50.3	TS-9	44.7	TT-5	5	◎	◎	◎	◎
Example 72	TP-10	68.6	TS-10	11.4	TT-2	20	◎	◎	◎	◎
Example 73	TP-11	47.5	TS-11	47.5	TT-6	5	◎	◎	◎	◎
Example 74	TP-12	12.1	TS-12	72.9	TT-1	15	◎	◎	◎	◎
Example 75	TP-13	29	TS-13	66	TT-4	5	◎	◎	◎	◎
Example 76	TP-14	75.7	TS-14	19.3	TT-1	5	◎	◎	◎	◎
Example 77	TP-15	24.3	TS-15	74.8	TT-3	1	◎	◎	◎	◎
Example 78	TP-16	75.7	TS-16	19.3	TT-1	5	◎	◎	◎	◎
Example 79	TP-17	89.1	TS-17	5.9	TT-1	5	◎	◎	◎	◎
Example 80	TP-18	79.4	TS-18	10.6	TT-6	10	◎	◎	◎	◎
Example 81	TP-19	12.3	TS-19	85.8	TT-5	2	○	◎	◎	◎
Example 82	TP-20	3.1	TS-20	93.9	TT-1	3	◎	◎	○	◎
Example 83	TP-21	92.8	TS-21	2.2	TT-2	5	◎	◎	◎	○
Example 84	TP-22	31.8	TS-22	38.2	TT-3	30	○	◎	◎	◎
Example 85	TP-23	12.4	TS-23	87.1	TT-1	1	◎	◎	○	◎
Example 86	TP-24	54.3	TS-24	40.7	TT-5	5	◎	◎	○	◎
Example 87	TP-25	3.1	TS-25	93.9	TT-2	3	○	◎	◎	◎
Example 88	TP-26	57	TS-26	38	TT-3	5	○	◎	◎	○

[0189] As is clear from a comparison of the evaluation results of the respective Examples and the respective Comparative Examples in the respective tables, the treatment agent of the present invention is capable of improving emulsifiability. Also, the fibers with the treatment agent applied thereto can be improved in antistatic property, flexibility, and bulkiness. Also, the first treatment agent, the second treatment agent, and the third treatment agent of the present invention are respectively capable of improving the formulation stability.

[0190] The present disclosure also encompasses the following embodiments.

(Additional Embodiment A1)

[0191] A polyester synthetic fiber treatment agent comprising a silicone (A) described below, a silicone (B) described below, an anionic ingredient, and optionally a silicone (C) described below, wherein

the amount of the silicone (C) contained in the treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule, and
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones.

(Additional Embodiment A2)

[0192] The polyester synthetic fiber treatment agent according to additional embodiment A1, wherein assuming that the amount of the silicone (A) contained in the polyester synthetic fiber treatment agent is 100 parts by mass, the amount of the silicone (B) contained in the polyester synthetic fiber treatment agent is not less than 5 parts by mass and not more than 200 parts by mass.

(Additional Embodiment A3)

[0193] The polyester synthetic fiber treatment agent according to additional embodiment A1 or A2, wherein the anionic ingredient includes at least one selected from the group consisting of organic acids, alkyl sulfonic acids, alkyl phosphoric acid esters, polyoxyalkylene alkyl phosphoric acid esters, and metal salts thereof.

(Additional Embodiment A4)

[0194] The polyester synthetic fiber treatment agent according to any one of additional embodiments A1 to A3, further comprising a silicone (D), wherein
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000.

(Additional Embodiment A5)

[0195] The polyester synthetic fiber treatment agent according to any one of additional embodiments A1 to A4, further comprising a nonionic surfactant, wherein
[0196] the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A6)

[0197] The polyester synthetic fiber treatment agent according to any one of additional embodiments A1 to A3, further comprising a silicone (D) described below and a nonionic surfactant described below, wherein

in the polyester synthetic fiber treatment agent, the silicone (A) is contained at an amount of not less than 5% by mass and not more than 80% by mass, the silicone (B) is contained at an amount of not less than 1% by mass and not more than 25% by mass, the silicone (C) is contained at an amount of not less than 0% by mass but less than 10% by mass, the silicone (D) is contained at an amount of not less than 5% by mass and not more than 90% by mass, the nonionic surfactant is contained at an amount of not less than 1% by mass and not more than 25% by mass, and the anionic ingredient is contained at an amount of not less than 0.1% by mass and not more than 25% by mass,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000.
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A7)

[0198] The polyester synthetic fiber treatment agent according to any one of additional embodiments A1 to A3, wherein the polyester synthetic fiber treatment agent is arranged as a set that includes a first component of two-component polyester synthetic fiber treatment agent containing the silicone (A), the anionic ingredient, and optionally the silicone (C) and a second component of two-component polyester synthetic fiber treatment agent containing the silicone (B).

(Additional Embodiment A8)

[0199] The polyester synthetic fiber treatment agent according to additional embodiment A7, wherein the first component of two-component polyester synthetic fiber treatment agent further contains a silicone (D) and a nonionic surfactant, wherein

the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18

carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A9)

[0200] The polyester synthetic fiber treatment agent according to any one of additional embodiments A1 to A3, further comprising a silicone (D) described below and a nonionic surfactant described below, wherein
the e polyester synthetic fiber treatment agent is arranged as a set that includes:

a first component of three-component polyester synthetic fiber treatment agent containing the silicone (A), the anionic ingredient, and optionally the silicone (C);
a second component of three-component polyester synthetic fiber treatment agent containing the silicone (D); and
a third component of three-component polyester synthetic fiber treatment agent containing the silicone (B),
the nonionic surfactant is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A10)

[0201] A composition containing a polyester synthetic fiber treatment agent, comprising the polyester synthetic fiber treatment agent according to any one of additional embodiments A1 to A9 and a solvent.

(Additional Embodiment A11)

[0202] A first component of two-component polyester synthetic fiber treatment agent that is combined in use with a second component of two-component polyester synthetic fiber treatment agent containing a silicone (B) described below, the first component comprising a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below, wherein

the amount of the silicone (C) contained in a mixture of the first component of two-component polyester synthetic fiber treatment agent and the second component of two-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule, and
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones.

(Additional Embodiment A12)

[0203] The first component of two-component polyester synthetic fiber treatment agent according to additional embodiment A11, further comprising a silicone (D) and a nonionic surfactant, wherein

the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A13)

[0204] A second component of two-component polyester synthetic fiber treatment agent that is combined in use with a first component of two-component polyester synthetic fiber treatment agent containing a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below, the second component comprising a silicone (B) described below, wherein

the first component of two-component polyester synthetic fiber treatment agent contains the silicone (C) such that its content in a mixture of the first component of two-component polyester synthetic fiber treatment agent and the second component of two-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule, and
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones.

(Additional Embodiment A14)

[0205] The second component of two-component polyester synthetic fiber treatment agent according to additional embodiment A13, wherein

the first component of two-component polyester synthetic fiber treatment agent further contains a silicone (D) and a nonionic surfactant,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A15)

[0206] A first component of three-component polyester synthetic fiber treatment agent that is combined in use with a second component of three-component polyester synthetic fiber treatment agent containing a silicone (D) described below and a third component of three-component polyester synthetic fiber treatment agent containing a silicone (B) described below, the first component comprising:

a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below, wherein
a nonionic surfactant described below is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the amount of the silicone (C) contained in a mixture of the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A16)

[0207] A second component of three-component polyester synthetic fiber treatment agent that is combined in use with a first component of three-component polyester synthetic fiber treatment agent containing a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below and a third component of three-component polyester synthetic fiber treatment agent containing a silicone (B) described below, the second component comprising a silicone (D) described below, wherein

a nonionic surfactant described below is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the first component of three-component polyester synthetic fiber treatment agent contains the silicone (C) such that its content in a mixture of the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A17)

[0208] A third component of three-component polyester synthetic fiber treatment agent that is combined in use with a first component of three-component polyester synthetic fiber treatment agent containing a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below and a second component of three-component polyester synthetic fiber treatment agent containing a silicone (D) described below, the third component comprising a silicone (B) described below, wherein

a nonionic surfactant described below is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the first component of three-component polyester synthetic fiber treatment agent contains the silicone (C) such that its content in a mixture of the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment A18)

[0209] A composition containing a first component of two-component polyester synthetic fiber treatment agent, comprising the first component of two-component polyester synthetic fiber treatment agent according to any one of additional embodiment A11 or A12 and a solvent.

(Additional Embodiment A19)

[0210] A composition containing a first component of three-component polyester synthetic fiber treatment agent, comprising the first component of three-component polyester synthetic fiber treatment agent according to additional embodiment A15 and a solvent.

(Additional Embodiment A20)

[0211] A composition containing a second component of three-component polyester synthetic fiber treatment agent, comprising the second component of three-component polyester synthetic fiber treatment agent according to additional embodiment A16 and a solvent.

(Additional Embodiment A21)

[0212] A method for treating a polyester synthetic fiber, comprising applying to a polyester synthetic fiber a dilute liquid of a polyester synthetic fiber treatment agent that is obtained by adding to a solvent the composition containing a first component of two-component polyester synthetic fiber treatment agent according to additional embodiment A18 and the second component of two-component polyester synthetic fiber treatment agent according to additional embodiment A13.

(Additional Embodiment A22)

[0213] A method for treating a polyester synthetic fiber, comprising applying to a polyester synthetic fiber a dilute liquid of a polyester synthetic fiber treatment agent that is obtained by adding to a solvent the composition containing a first component of three-component polyester synthetic fiber treatment agent according to additional embodiment A19, the composition containing a second component of three-component polyester synthetic fiber treatment agent according to additional embodiment A20, and the third component of three-component polyester synthetic fiber treatment agent according to additional embodiment A17.

(Additional Embodiment A23)

[0214] The method for treating a polyester synthetic fiber according to additional embodiment A21 or A22, wherein the fiber to which the dilute liquid of a polyester synthetic fiber treatment agent has been applied is heat-treated at not less than 100°C and not more than 200°C.

(Additional Embodiment A24)

[0215] A polyester synthetic fiber to which the polyester synthetic fiber treatment agent according to any one of additional embodiments A1 to A9 adhered.

(Additional Embodiment A25)

[0216] The polyester synthetic fiber according to additional embodiment A24, wherein the polyester synthetic fiber is applied to wadding.

(Additional Embodiment B1)

[0217] A polyester synthetic fiber treatment agent set comprising a first component of two-component polyester synthetic fiber treatment agent and a second component of two-component polyester synthetic fiber treatment agent, wherein

the first component contains a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below,

the second component contains a silicone (B) described below,
the amount of the silicone (C) contained in a polyester synthetic fiber treatment agent obtained by mixing the first component of two-component polyester synthetic fiber treatment agent with the second component of two-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule, and
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000.

(Additional Embodiment B2)

[0218] The polyester synthetic fiber treatment agent set according to additional embodiment B1, wherein assuming that the amount of the silicone (A) contained in the polyester synthetic fiber treatment agent obtained by mixing the first component of two-component polyester synthetic fiber treatment agent with the second component of two-component polyester synthetic fiber treatment agent is 100 parts by mass, the amount of the silicone (B) contained in the polyester synthetic fiber treatment agent is not less than 5 parts by mass and not more than 200 parts by mass.

(Additional Embodiment B3)

[0219] The polyester synthetic fiber treatment agent set according to additional embodiment B1 or B2, wherein the first component of two-component polyester synthetic fiber treatment agent further contains a silicone (D) and a nonionic surfactant, wherein

the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment B4)

[0220] A polyester synthetic fiber treatment agent set comprising a first component of three-component polyester synthetic fiber treatment agent, a second component of three-component polyester synthetic fiber treatment agent, and a third component of three-component polyester synthetic fiber treatment agent, wherein

the first component of three-component polyester synthetic fiber treatment agent contains a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below,
the second component of three-component polyester synthetic fiber treatment agent contains a silicone (D) described below,
the third component of three-component polyester synthetic fiber treatment agent contains a silicone (B) described below,
a nonionic surfactant described below is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the amount of the silicone (C) contained in a polyester synthetic fiber treatment agent obtained by mixing the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent with the third component of three-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a

number average molecular weight of not less than 20,000 but less than 200,000,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment B5)

[0221] The polyester synthetic fiber treatment agent set according to additional embodiment B4, wherein assuming that the amount of the silicone (A) contained in the polyester synthetic fiber treatment agent obtained by mixing the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent with the third component of three-component polyester synthetic fiber treatment agent is 100 parts by mass, the amount of the silicone (B) contained in the polyester synthetic fiber treatment agent is not less than 5 parts by mass and not more than 200 parts by mass.

(Additional Embodiment B6)

[0222] The polyester synthetic fiber treatment agent set according to any one of additional embodiment B1 to B5, wherein the anionic ingredient includes at least one selected from the group consisting of organic acids, alkyl sulfonic acids, alkyl phosphoric acid esters, polyoxyalkylene alkyl phosphoric acid esters, and metal salts thereof.

(Additional Embodiment B7)

[0223] A method for producing a composition containing a polyester synthetic fiber treatment agent, comprising mixing a solvent with the first component of two-component polyester synthetic fiber treatment agent and the second component of two-component polyester synthetic fiber treatment agent in the polyester synthetic fiber treatment agent set according to any one of additional embodiments B1 to B3.

(Additional Embodiment B8)

[0224] A method for producing a composition containing a polyester synthetic fiber treatment agent, comprising mixing a solvent with the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent in the polyester synthetic fiber treatment agent set according to additional embodiment B4 or B5.

(Additional Embodiment B9)

[0225] A first component of two-component polyester synthetic fiber treatment agent that is combined in use with a second component of two-component polyester synthetic fiber treatment agent containing a silicone (B) described below, the first component comprising a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below, wherein

the amount of the silicone (C) contained in a mixture of the first component of two-component polyester synthetic fiber treatment agent and the second component of two-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule, and
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000.

(Additional Embodiment B10)

[0226] The first component of two-component polyester synthetic fiber treatment agent according to additional embodiment B9, further comprising a silicone (D) and a nonionic surfactant, wherein

the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment B11)

[0227] A second component of two-component polyester synthetic fiber treatment agent that is combined in use with a first component of two-component polyester synthetic fiber treatment agent containing a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below, the second component comprising a silicone (B) described below, wherein

the first component of two-component polyester synthetic fiber treatment agent contains the silicone (C) such that its content in a mixture of the first component of two-component polyester synthetic fiber treatment agent and the second component of two-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule, and
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000.

(Additional Embodiment B12)

[0228] The second component of two-component polyester synthetic fiber treatment agent according to additional embodiment B11, wherein

the first component of two-component polyester synthetic fiber treatment agent further contains a silicone (D) and a nonionic surfactant,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment B13)

[0229] A first component of three-component polyester synthetic fiber treatment agent that is combined in use with a second component of three-component polyester synthetic fiber treatment agent containing a silicone (D) described below and a third component of three-component polyester synthetic fiber treatment agent containing a silicone (B) described below, the first component comprising:

a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below, wherein
a nonionic surfactant described below is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the amount of the silicone (C) contained in a mixture of the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent is less than 10% by mass,

the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment B14)

[0230] A second component of three-component polyester synthetic fiber treatment agent that is combined in use with a first component of three-component polyester synthetic fiber treatment agent containing a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below and a third component of three-component polyester synthetic fiber treatment agent containing a silicone (B) described below, the second component comprising a silicone (D) described below, wherein

a nonionic surfactant described below is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the first component of three-component polyester synthetic fiber treatment agent contains the silicone (C) such that its content in a mixture of the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent is less than 10% by mass,
the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment B15)

[0231] A third component of three-component polyester synthetic fiber treatment agent that is combined in use with a first component of three-component polyester synthetic fiber treatment agent containing a silicone (A) described below, an anionic ingredient, and optionally a silicone (C) described below and a second component of three-component polyester synthetic fiber treatment agent containing a silicone (D) described below, the third component comprising a silicone (B) described below, wherein

a nonionic surfactant described below is contained in one of either or both of the first component of three-component polyester synthetic fiber treatment agent and the second component of three-component polyester synthetic fiber treatment agent,
the first component of three-component polyester synthetic fiber treatment agent contains the silicone (C) such that its content in a mixture of the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent is less than 10% by mass,

the silicone (A) is a modified silicone having an amino group in the molecule,
the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000,
the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000, and
the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

(Additional Embodiment B16)

[0232] A composition containing a first component of two-component polyester synthetic fiber treatment agent, comprising the first component of two-component polyester synthetic fiber treatment agent according to any one of additional embodiment B9 or B10 and a solvent.

(Additional Embodiment B17)

[0233] A composition containing a first component of three-component polyester synthetic fiber treatment agent, comprising the first component of three-component polyester synthetic fiber treatment agent according to additional embodiment B13 and a solvent.

(Additional Embodiment B18)

[0234] A composition containing a second component of three-component polyester synthetic fiber treatment agent, comprising the second component of three-component polyester synthetic fiber treatment agent according to additional embodiment B14 and a solvent.

(Additional Embodiment B19)

[0235] A method for treating a polyester synthetic fiber, comprising applying to a polyester synthetic fiber a dilute liquid of a polyester synthetic fiber treatment agent that is obtained by adding to a solvent the composition containing a first component of two-component polyester synthetic fiber treatment agent according to additional embodiment B16 and the second component of two-component polyester synthetic fiber treatment agent according to additional embodiment B11.

(Additional Embodiment B20)

[0236] A method for treating a polyester synthetic fiber, comprising applying to a polyester synthetic fiber a dilute liquid of a polyester synthetic fiber treatment agent that is obtained by adding to a solvent the composition containing a first component of three-component polyester synthetic fiber treatment agent according to additional embodiment B17, the composition containing a second component of three-component polyester synthetic fiber treatment agent according to additional embodiment B18, and the third component of three-component polyester synthetic fiber treatment agent according to additional embodiment B15.

(Additional Embodiment B21)

[0237] The method for treating a polyester synthetic fiber according to additional embodiment B19 or B20, wherein the fiber to which the dilute liquid of a polyester synthetic fiber treatment agent has been applied is heat-treated at not less than 100°C and not more than 200°C.

(Additional Embodiment B22)

[0238] A method for producing a polyester synthetic fiber, comprising adhering a polyester synthetic fiber treatment agent dilute liquid to a polyester synthetic fiber, wherein the dilute liquid is obtained by mixing a solvent with the first

component of two-component polyester synthetic fiber treatment agent and the second component of two-component polyester synthetic fiber treatment agent in the polyester synthetic fiber treatment agent set according to any one of additional embodiments B1 to B3.

(Additional Embodiment B23)

[0239] A method for producing a polyester synthetic fiber, comprising adhering a polyester synthetic fiber treatment agent dilute liquid to a polyester synthetic fiber, wherein the dilute liquid is obtained by mixing a solvent with the first component of three-component polyester synthetic fiber treatment agent, the second component of three-component polyester synthetic fiber treatment agent, and the third component of three-component polyester synthetic fiber treatment agent in the polyester synthetic fiber treatment agent set according to additional embodiment B4 or B5.

(Additional Embodiment B24)

[0240] The method for producing a polyester synthetic fiber according to additional embodiment B22 or B23, wherein the polyester synthetic fiber is applied to wadding.

Claims

1. A polyester synthetic fiber treatment agent comprising a silicone (A) described below, a silicone (B) described below, an anionic ingredient, a silicone (D) described below, and optionally a silicone (C) described below, wherein

   the amount of the silicone (C) contained in the treatment agent is less than 10% by mass,
   the silicone (A) is a modified silicone having an amino group in the molecule,
   the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
   the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000, and
   the silicone (D) is a silanol-modified silicone with a number average molecular weight of not less than 20,000 but less than 200,000.

2. A polyester synthetic fiber treatment agent comprising a silicone (A) described below, a silicone (B) described below, an anionic ingredient, a nonionic surfactant described below, and optionally a silicone (C) described below, wherein

   the amount of the silicone (C) contained in the treatment agent is less than 10% by mass,
   the silicone (A) is a modified silicone having an amino group in the molecule,
   the silicone (B) is a silane coupling agent having at least one functional group selected from the group consisting of a methoxy group, an ethoxy group, an amino group, and an isocyanate group but not including an epoxy group in the molecule,
   the silicone (C) is at least one selected from the group consisting of silicone resins, dimethyl silicones, and alkyl-modified silicones but excluding those corresponding to being the silicone (A) and silanol-modified silicones with a number average molecular weight of not less than 20,000 but less than 200,000, and
   the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

3. The polyester synthetic fiber treatment agent according to claim 1 or 2, wherein assuming that the amount of the silicone (A) contained in the polyester synthetic fiber treatment agent is 100 parts by mass, the amount of the silicone (B) contained in the polyester synthetic fiber treatment agent is not less than 5 parts by mass and not more than 200 parts by mass.

4. The polyester synthetic fiber treatment agent according to any one of claims 1 to 3, wherein the anionic ingredient includes at least one selected from the group consisting of organic acids, alkyl sulfonic acids, alkyl phosphoric acid esters, polyoxyalkylene alkyl phosphoric acid esters, and metal salts thereof.

5. The polyester synthetic fiber treatment agent according to claim 1, further comprising a nonionic surfactant, wherein the nonionic surfactant is at least one selected from the group consisting of compounds in which not less than 3 moles and not more than 50 moles in total of an alkylene oxide with not less than 2 and not more than 3 carbon atoms are added to 1 mole of a monohydric or higher and tetrahydric or lower alcohol with not less than 2 and not more than 18 carbon atoms, and block copolymers of a polyoxyethylene chain and a polyoxypropylene chain.

6. The polyester synthetic fiber treatment agent according to claim 5, wherein in the polyester synthetic fiber treatment agent, the silicone (A) is contained at an amount of not less than 5% by mass and not more than 80% by mass, the silicone (B) is contained at an amount of not less than 1% by mass and not more than 25% by mass, the silicone (C) is contained at an amount of not less than 0% by mass but less than 10% by mass, the silicone (D) is contained at an amount of not less than 5% by mass and not more than 90% by mass, the nonionic surfactant is contained at an amount of not less than 1% by mass and not more than 25% by mass, and the anionic ingredient is contained at an amount of not less than 0.1 % by mass and not more than 25% by mass.

7. A composition containing a polyester synthetic fiber treatment agent comprising the polyester synthetic fiber treatment agent according to any one of claims 1 to 6 and a solvent.

8. A polyester synthetic fiber to which the polyester synthetic fiber treatment agent according to any one of claims 1 to 6 is adhered.

9. The polyester synthetic fiber according to claim 8, wherein the polyester synthetic fiber is applied to wadding.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/000718

A. CLASSIFICATION OF SUBJECT MATTER

D06M 15/643(2006.01)i; ***D06M 13/256***(2006.01)i; *D06M 101/32*(2006.01)n
FI: D06M15/643; D06M13/256; D06M101:32

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)

D06M15/643; D06M13/256; D06M101/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 53-6700 A (TAKEMOTO OIL & FAT, INC.) 21 January 1978 (1978-01-21)	1-9
A	JP 2018-104866 A (NICCA CHEMICAL CO., LTD.) 05 July 2018 (2018-07-05)	1-9
A	JP 2001-234477 A (TOYOBO CO., LTD.) 31 August 2001 (2001-08-31)	1-9
A	WO 2019/131456 A1 (NICCA CHEMICAL CO., LTD.) 04 July 2019 (2019-07-04)	1-9
A	JP 2020-59799 A (WACKER ASAHIKASEI SILICONE CO., LTD.) 16 April 2020 (2020-04-16)	1-9
A	JP 2002-143575 A (TOYOBO CO., LTD.) 21 May 2002 (2002-05-21)	1-9

☐ 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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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	Date of mailing of the international search report
08 March 2023	**20 March 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/000718

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 53-6700 A	21 January 1978	(Family: none)	
JP 2018-104866 A	05 July 2018	CN 108252082 A KR 10-2018-0077033 A TW 201835240 A	
JP 2001-234477 A	31 August 2001	(Family: none)	
WO 2019/131456 A1	04 July 2019	US 2020/0332148 A1 EP 3733809 A1 CN 111386327 A KR 10-2020-0100135 A TW 201930544 A	
JP 2020-59799 A	16 April 2020	WO 2020/074277 A1	
JP 2002-143575 A	21 May 2002	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2013177495 A **[0004]**
- WO 2019131456 A **[0004]**
- JP 2020059799 A **[0004]**
- JP 4749677 B **[0004]**