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(54) **AQUEOUS SOLUTION OF SYNTHETIC FIBER TREATMENT AGENT, AND SYNTHETIC FIBERS**

(57) The present invention addresses the problem of providing: an aqueous solution of a synthetic fiber treatment agent that has excellent low-temperature handling properties and can impart quality stability; and synthetic fibers having said synthetic fiber treatment agent adhered thereto and having excellent quality stability. The present invention is an aqueous solution of a synthetic

fiber treatment agent comprising a smoothing agent, a nonionic surfactant and an ionic surfactant, and is characterized by the smoothing agent comprising a specific ester A1 and a specific ester A2, and the mass ratio of the content of the ester A1 with respect to the content of the ester A2 being ester A1/ester A2 = 3.0-9.0.

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## Description

### TECHNICAL FIELD

5 **[0001]** The present invention relates to an aqueous liquid of synthetic fiber treatment agent that is excellent in low-temperature stability and is capable of imparting quality stability and to a synthetic fiber to which the synthetic fiber treatment agent is adhered.

### BACKGROUND ART

10 **[0002]** Generally, in a spinning step of synthetic fibers, a treatment of adhering a synthetic fiber treatment agent to the surfaces of filament yarn threads of the synthetic fibers is performed at times from a standpoint of reducing friction and reducing yarn breakage or other damage of the fibers. Modes of the adhesion treatment include that in which the synthetic fiber treatment agent is diluted with water (emulsion oiling) and that in which the synthetic fiber treatment agent is applied upon diluting with a diluting agent such as a low-viscosity mineral oil or applied as it is without being diluted (straight oiling).

15 **[0003]** Conventionally, emulsions of synthetic fiber treatment agents disclosed in Patent Documents 1 and 2 are known. Patent Document 1 discloses an emulsion containing a synthetic fiber treatment agent that contains lauryl isostearate, a smoothing agent, such as a mineral oil, and a surfactant, such as an EO adduct of oleyl alcohol. Patent Document 2  
20 discloses an emulsion containing a synthetic fiber treatment agent that contains a glycerin ester compound and a branched ester compound.

### PRIOR ART LITERATURE

#### 25 PATENT LITERATURE

##### **[0004]**

30 Patent Document 1: Japanese Laid-Open Patent Publication No. 2006-70375

Patent Document 2: International Publication No. WO 2014/156318

### SUMMARY OF THE INVENTION

#### PROBLEMS THAT THE INVENTION IS TO SOLVE

35 **[0005]** However, with such conventional emulsions of synthetic fiber treatment agent, low-temperature stability and quality stability of a synthetic fiber to which the synthetic fiber treatment agent is adhered are insufficient.

**[0006]** The present invention has been made in view of such circumstances and an object thereof is to provide an aqueous liquid of synthetic fiber treatment agent that is excellent in low-temperature stability and is capable of imparting  
40 quality stability. It is also an object of the present invention to provide a synthetic fiber that is excellent in quality stability, to which the synthetic fiber treatment agent is adhered.

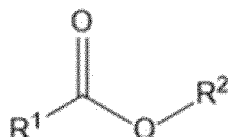
### MEANS FOR SOLVING THE PROBLEMS

45 **[0007]** As a result of performing research toward solving the above problem, the inventors of the present invention found that it is truly suitable for a specific ester compound as a smoothing agent and surfactants to be contained in an aqueous liquid of synthetic fiber treatment agent.

**[0008]** An aqueous liquid of synthetic fiber treatment agent for solving the above problem contains a smoothing agent, a nonionic surfactant, and an ionic surfactant and is characterized in that the smoothing agent contains an ester A1  
50 represented by Chemical Formula 1 shown below and an ester A2 represented by Chemical Formula 2 shown below and the mass ratio of the content of the ester A1 with respect to the content of the ester A2 is such that the ester A1/the ester A2 = 3.0 to 9.0.

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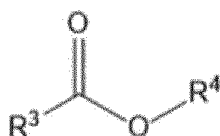
[Chemical Formula 1]



[0009] (In Chemical Formula 1,

R<sup>1</sup> is an unsaturated hydrocarbon group with 7 to 23 carbon atoms having one unsaturated bond, and R<sup>2</sup> is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

[Chemical Formula 2]



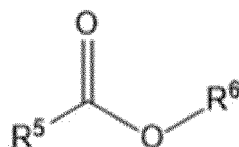
[0010] (In Chemical Formula 2,

R<sup>3</sup> is an unsaturated hydrocarbon group with 7 to 23 carbon atoms having two or more unsaturated bonds, and R<sup>4</sup> is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

[0011] Preferably with the aqueous liquid of synthetic fiber treatment agent, the mass ratio of the content of the ester A1 with respect to the content of the ester A2 is such that the ester A1/the ester A2 = 4.0 to 9.0.

[0012] Preferably with the aqueous liquid of synthetic fiber treatment agent, the smoothing agent further contains an ester A3 represented by Chemical Formula 3 shown below.

[Chemical Formula 3]



[0013] (In Chemical Formula 3,

R<sup>5</sup> is a saturated hydrocarbon group with 7 to 23 carbon atoms, and R<sup>6</sup> is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

[0014] Preferably with the aqueous liquid of synthetic fiber treatment agent, the mass ratio of the sum of the contents of the ester A1 and the ester A2 with respect to the content of the ester A3 is such that (the ester A1 + the ester A2)/the ester A3 = 5.0 to 40.0.

[0015] Preferably with the aqueous liquid of synthetic fiber treatment agent, the mass ratio of the sum of the contents of the ester A1 and the ester A2 with respect to the content of the ester A3 is such that (the ester A1 + the ester A2)/the ester A3 = 10.0 to 20.0.

[0016] Preferably, the aqueous liquid of synthetic fiber treatment agent further contains a fatty acid with 8 to 24 carbon atoms.

[0017] Preferably with the aqueous liquid of synthetic fiber treatment agent, the fatty acid contains an unsaturated fatty acid with 8 to 24 carbon atoms.

[0018] A synthetic fiber for solving the above problem is characterized in that the synthetic fiber treatment agent is adhered to the synthetic fiber.

## EFFECTS OF THE INVENTION

**[0019]** The aqueous liquid of synthetic fiber treatment agent of the present invention is excellent in low-temperature stability and is capable of imparting quality stability.

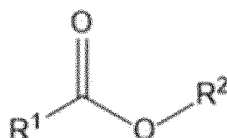
## MODES FOR CARRYING OUT THE INVENTION

(First Embodiment)

**[0020]** First, a first embodiment that embodies an aqueous liquid of synthetic fiber treatment agent according to the present invention (also referred to hereinafter as aqueous liquid) will now be described. The aqueous liquid of the present embodiment contains water and a synthetic fiber treatment agent (referred to hereinafter as treatment agent), which contains a smoothing agent, a nonionic surfactant, and an ionic surfactant. The treatment agent may further contain a fatty acid with 8 to 24 carbon atoms.

**[0021]** The smoothing agent used in the present embodiment contains an ester A1 represented by Chemical Formula 4 shown below.

[Chemical Formula 4]



**[0022]** (In Chemical Formula 4,

R<sup>1</sup> is an unsaturated hydrocarbon group with 7 to 23 carbon atoms having one unsaturated bond, and R<sup>2</sup> is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

**[0023]** One type of such esters A1 may be used alone or two or more types thereof may be used in combination.

**[0024]** The unsaturated hydrocarbon group that constitutes R<sup>1</sup> may be an alkenyl group having one double bond as the unsaturated carbon bond or may be an alkynyl group having one triple bond. Alternatively, it may be a straight chain unsaturated hydrocarbon group or an unsaturated hydrocarbon group having a branched chain structure.

**[0025]** Specific examples of the straight chain unsaturated hydrocarbon group having one double bond in the hydrocarbon group include a heptenyl group, an octenyl group, a nonenyl group, a decenyl group, an undecenyl group, a dodecenyl group, a tridecenyl group, a tetradecenyl group, a pentadecenyl group, a hexadecenyl group, a heptadecenyl group, an octadecenyl group, an icosenyl group, a docosenyl group, and a tricosenyl group.

**[0026]** Specific examples of the unsaturated hydrocarbon group having a branched chain structure having one double bond in the hydrocarbon group include an isoheptenyl group, an isoctenyl group, an isononenyl group, an isodecenyl group, an isoundecenyl group, an isododecenyl group, an isotridecenyl group, an isotetradecenyl group, an isopentadecenyl group, an isohexadecenyl group, an isoheptadecenyl group, an isoctadecenyl group, an isoicosenyl group, an isodocosenyl group, and an isotricosenyl group.

**[0027]** The hydrocarbon group that constitutes R<sup>2</sup> may be a straight chain saturated hydrocarbon group or a saturated hydrocarbon group having a branched chain structure. Alternatively, it may be a straight chain unsaturated hydrocarbon group or an unsaturated hydrocarbon group having a branched chain structure.

**[0028]** Specific examples of the straight chain saturated hydrocarbon group that constitutes R<sup>2</sup> include an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group, a hexadecyl group, a heptadecyl group, an octadecyl group, an icosyl group, a docosyl group, a tricosyl group, and a tetracosyl group.

**[0029]** Specific examples of the saturated hydrocarbon group having a branched chain structure that constitutes R<sup>2</sup> include an isoctyl group, an isononyl group, an isodecyl group, an isoundecyl group, an isododecyl group, an isotridecyl group, an isotetradecyl group, an isopentadecyl group, an isohexadecyl group, an isoheptadecyl group, an isoctadecyl group, an isoicosyl group, an isodocosyl group, an isotricosyl group, and an isotetracosyl group.

**[0030]** The unsaturated hydrocarbon group that constitutes R<sup>2</sup> may be an alkenyl group having one double bond as the unsaturated carbon bond or may be an alkadienyl group or alkatrienyl group having two or more double bonds. Alternatively, it may be an alkynyl group having one triple bond as the unsaturated carbon bond or may be an alkadiynyl group having two or more triple bonds.

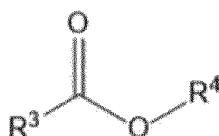
**[0031]** Specific examples of the straight chain unsaturated hydrocarbon group having one double bond in the hydrocarbon group include an octenyl group, a nonenyl group, a decenyl group, an undecenyl group, a dodecenyl group, a tridecenyl group, a tetradecenyl group, a pentadecenyl group, a hexadecenyl group, a heptadecenyl group, an octadecenyl group, an icosenyl group, a docosenyl group, a tricosenyl group, a tetracosenyl group.

**[0032]** Specific examples of the unsaturated hydrocarbon group having a branched chain structure having one double bond in the hydrocarbon group include an isooctenyl group, an isononenyl group, an isodecenyl group, an isoundecenyl group, an isododecenyl group, an isotridecenyl group, an isotetradecenyl group, an isopentadecenyl group, an isohexadecenyl group, an isoheptadecenyl group, an isoctadecenyl group, an isoicosenyl group, an isodocosenyl group, an isotricosenyl group, and an isotetracosenyl group.

**[0033]** Specific examples of the ester A1 include isotridecyl oleate, 2-propylheptyl oleate, 2-propylheptyl palmitoleate, octyl tetracosanoate, and 2-octyldodecyl oleate.

**[0034]** The smoothing agent used in the present embodiment contains an ester A2 represented by Chemical Formula 5 shown below.

[Chemical Formula 5]



(In Chemical Formula 5,

R³ is an unsaturated hydrocarbon group with 7 to 23 carbon atoms having two or more unsaturated bonds, and R⁴ is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

**[0035]** One type of such esters A2 may be used alone or two or more types thereof may be used in combination.

**[0036]** Examples of the unsaturated hydrocarbon group that constitutes R³ include an alkadienyl group and alkatrienyl group, each of which has two or more double bonds as the unsaturated carbon bonds, and an alkadiynyl group and alkatriynyl group, each of which has two or more triple bonds as the unsaturated carbon bonds. Alternatively, it may be a straight chain unsaturated hydrocarbon group or an unsaturated hydrocarbon group having a branched chain structure.

**[0037]** Specific examples of the straight chain unsaturated hydrocarbon group having two double bonds in the hydrocarbon group include a heptadienyl group, an octadienyl group, a nonadienyl group, a decadienyl group, a dodecadienyl group, an undecadienyl group, a tridecadienyl group, a tetradecadienyl group, a pentadecadienyl group, a hexadecadienyl group, a heptadecadienyl group, an octadecadienyl group, a nonadecadienyl group, an icosadienyl group, a docosadienyl group, and a tricosadienyl group.

**[0038]** Specific examples of the unsaturated hydrocarbon group having a branched chain structure having two double bond in the hydrocarbon group include an isoheptadienyl group, an isoctadienyl group, an isononadienyl group, an isodecadienyl group, an isododecadienyl group, an isoundecadienyl group, an isotridecadienyl group, an isotetradecadienyl group, an isopentadecadienyl group, an isohexadecadienyl group, an isoheptadecadienyl group, an isoctadecadienyl group, an isononadecadienyl group, an isoicosadienyl group, an isodocosadienyl group, and an isotricosadienyl group.

**[0039]** The hydrocarbon group that constitutes R⁴ may be a straight chain saturated hydrocarbon group or a saturated hydrocarbon group having a branched chain structure. Alternatively, it may be a straight chain unsaturated hydrocarbon group or an unsaturated hydrocarbon group having a branched chain structure.

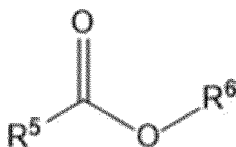
**[0040]** Specific examples of the saturated hydrocarbon group or the unsaturated hydrocarbon group that constitutes R⁴ include the examples given for the saturated hydrocarbon group or the unsaturated hydrocarbon group that constitutes R² of Chemical Formula 4.

**[0041]** Specific examples of the ester A2 include octyl linoleate and isotridecyl linoleate.

**[0042]** The mass ratio of the content of the ester A1 with respect to the content of the ester A2 in the treatment agent is specified such that ester A1/ester A2 = 3.0 to 9.0. By being specified to be in such range, the effects of the present invention can be improved. The mass ratio is preferably specified to be 4.0 to 9.0. By being specified to be in such range, especially quality stability can be imparted.

**[0043]** The smoothing agent used in the present embodiment may contain an ester A3 represented by Chemical Formula 6 shown below. By containing the ester A3, the effects of the present invention can be improved further.

## [Chemical Formula 6]



(In Chemical Formula 6,

$R^5$  is a saturated hydrocarbon group with 7 to 23 carbon atoms, and

$R^6$  is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

**[0044]** One type of such esters A3 may be used alone or two or more types thereof may be used in combination.

**[0045]** The hydrocarbon group that constitutes  $R^5$  may be a straight chain saturated hydrocarbon group or a saturated hydrocarbon group having a branched chain structure.

**[0046]** Specific examples of the straight chain saturated hydrocarbon group that constitutes  $R^5$  include a heptyl group, an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group, a hexadecyl group, a heptadecyl group, an octadecyl group, an icosyl group, a docosyl group, and a tricosyl group.

**[0047]** Specific examples of the saturated hydrocarbon group having a branched chain structure that constitutes  $R^5$  include an isoheptyl group, an isooctyl group, an isononyl group, an isodecyl group, an isoundecyl group, an isododecyl group, an isotridecyl group, an isotetradecyl group, an isopentadecyl group, an isohexadecyl group, an isoheptadecyl group, an isoctadecyl group, an isoicosyl group, an isodocosyl group, and an isotricosyl group.

**[0048]** The hydrocarbon group that constitutes  $R^6$  may be a straight chain saturated hydrocarbon group or a saturated hydrocarbon group having a branched chain structure. Alternatively, it may be a straight chain unsaturated hydrocarbon group or an unsaturated hydrocarbon group having a branched chain structure.

**[0049]** Specific examples of the saturated hydrocarbon group or the unsaturated hydrocarbon group that constitutes  $R^6$  include the examples given for the saturated hydrocarbon group or the unsaturated hydrocarbon group that constitutes  $R^2$  of Chemical Formula 4 can be cited.

**[0050]** Specific examples of the ester A3 include 2-ethylhexyl stearate and isotridecyl palmitate.

**[0051]** The mass ratio of the sum of the contents of the ester A1 and the ester A2 with respect to the content of the ester A3 in the treatment agent is set as appropriate, and preferably it is specified such that (the ester A1 + the ester A2)/the ester A3 = 5.0 to 40.0. By being specified to be in such range, especially quality stability can be imparted. The mass ratio is more preferably specified to be 10.0 to 20.0. By being specified to be in such range, especially low-temperature stability can be improved further.

**[0052]** The smoothing agent described above and used in the present embodiment may be used in combination with another smoothing agent. Another smoothing agent used as appropriate may be a known one. Specific examples of the smoothing agent include known smoothing agents used in treatment agents including (1) ester compounds of an aliphatic monoalcohol and an aliphatic monocarboxylic acid and ester compounds of an aliphatic monocarboxylic acid and a (poly)oxyalkylene adduct in which an alkylene oxide with 2 to 4 carbon atoms is added to an aliphatic monoalcohol, such as butyl stearate, (2) ester compounds of an aliphatic polyhydric alcohol and an aliphatic monocarboxylic acid, such as 1,6-hexanediol didecanoate, trimethylolpropane monooleate monolaurate, sorbitan trioleate, sorbitan monooleate, sorbitan monostearate, and glycerin monolaurate, (3) ester compounds of an aliphatic monoalcohol and an aliphatic polycarboxylic acid and ester compounds of an aliphatic polycarboxylic acid and a (poly)oxyalkylene adduct in which an alkylene oxide with 2 to 4 carbon atoms is added to an aliphatic monoalcohol, such as dilauryl adipate, dioleoyl azelate, diisocetyl thiodipropionate, and bispolyoxyethylene lauryl ether adipate, (4) ester compounds of an aromatic monoalcohol and an aliphatic monocarboxylic acid and ester compounds of an aliphatic monocarboxylic acid and a (poly)oxyalkylene adduct in which an alkylene oxide with 2 to 4 carbon atoms is added to an aromatic monoalcohol, such as benzyl oleate, benzyl laurate, and polyoxypropylene benzyl stearate, (5) ester compounds of an aromatic polyhydric alcohol and an aliphatic monocarboxylic acid and ester compounds of an aliphatic monocarboxylic acid and a (poly)oxyalkylene adduct in which an alkylene oxide with 2 to 4 carbon atoms is added to an aromatic polyhydric alcohol, such as bisphenol A dilaurate and polyoxyethylene bisphenol A dilaurate, (6) ester compounds of an aliphatic monoalcohol and an aromatic polycarboxylic acid and ester compounds of an aromatic polycarboxylic acid and a (poly)oxyalkylene adduct in which an alkylene oxide with 2 to 4 carbon atoms is added to an aliphatic monoalcohol, such as bis 2-ethylhexyl phthalate, diisostearyl isophthalate, and trioctyl trimellitate, (7) natural oils and fats, such as coconut oil, rapeseed oil, sunflower

oil, soybean oil, castor oil, sesame oil, fish oil, and beef tallow, and (8) mineral oils. One type of such smoothing agents may be used alone or two or more types thereof may be used in combination.

**[0053]** The sum of the contents of the ester A1, the ester A2, and the ester A3 in the treatment agent is set as appropriate and is preferably 20% to 80% by mass, more preferably 30% to 70% by mass, and even more preferably 40% to 60% by mass. By being specified to be in such ranges, smoothness of fibers can be improved.

**[0054]** The sum of the contents of the ester A1, the ester A2, and the ester A3 in the entire smoothing agent is preferably not less than 50% by mass, more preferably not less than 70% by mass, and especially preferably not less than 90% by mass. By specifying to be in such ranges, the effects of the present invention can be improved further.

**[0055]** As the nonionic surfactant used in the present embodiment, that which is known can be adopted as appropriate. Specific examples of the nonionic surfactant include (1) compounds in which an alkylene oxide with 2 to 4 carbon atoms is added to an organic acid, an organic alcohol, an organic amine, and/or an organic amide, for example, polyoxyethylene dilaurate, polyoxyethylene oleate, polyoxyethylene dioleate and ether type nonionic surfactants, such as polyoxyethylene octyl ether, polyoxyethylene lauryl ether, polyoxyethylene lauryl ether methyl ether, polyoxyethylene polyoxypropylene lauryl ether, polyoxypropylene lauryl ether methyl ether, polyoxyethylene oleyl ether, polyoxybutylene oleyl ether, polyoxyethylene polyoxypropylene nonyl ether, polyoxypropylene nonyl ether, polyoxyethylene polyoxypropylene octyl ether, ethylene oxide adduct of 2-hexyl hexanol, polyoxyethylene 2-ethyl-1-hexyl ether, polyoxyethylene dodecyl ether, polyoxyethylene tridecyl ether, polyoxyethylene lauryl aminoether, polyoxyethylene lauramide ether, and polyoxyethylene tristyrenated phenyl ether, (2) polyoxyalkylene polyhydric alcohol fatty acid ester type nonionic surfactants, such as polyoxyalkylene sorbitan trioleate, polyoxyalkylene coconut oil, polyoxyalkylene castor oil, polyoxyalkylene hydrogenated castor oil, polyoxyalkylene hydrogenated castor oil trioctanoate, and maleic acid ester, stearic acid ester, or oleic acid ester of polyoxyalkylene hydrogenated castor oil, (3) alkyl amide type nonionic surfactants, such as stearic acid diethanolamide and diethanolamine monolauramide, and (4) polyoxyalkylene fatty acid amide type nonionic surfactants, such as polyoxyethylene diethanolamine monooleylamide, polyoxyethylene laurylamine, and polyoxyethylene beef tallow amine.

**[0056]** The content of the nonionic surfactant in the treatment agent is set as appropriate and is preferably 5% to 70% by mass, more preferably 15% to 60% by mass, and even more preferably 25% to 55% by mass. By being specified to be in such ranges, the effects of the present invention and stability of the aqueous liquid can be improved.

**[0057]** As the ionic surfactant used in the present embodiment, that which is known can be adopted as appropriate. Examples of the ionic surfactant include anionic surfactants, cationic surfactants, and amphoteric surfactants. One type of such ingredients may be used alone or two or more types thereof may be used in combination.

**[0058]** As the anionic surfactant used in the present embodiment, that which is known can be adopted as appropriate. Specific examples of the anionic surfactant include (1) phosphoric acid ester salts of aliphatic alcohols, such as lauryl phosphoric acid ester salts, cetyl phosphoric acid ester salts, octyl phosphoric acid ester salts, oleyl phosphoric acid ester salts, and stearyl phosphoric acid ester salts, (2) phosphoric acid ester salts of adducts of at least one type of alkylene oxide selected from among ethylene oxide and propylene oxide with an aliphatic alcohol, such as polyoxyethylene lauryl ether phosphoric acid ester salts, polyoxyethylene oleyl ether phosphoric acid ester salts, and polyoxyethylene stearyl ether phosphoric acid ester salts, (3) aliphatic sulfonic acid salts or aromatic sulfonic acid salts, such as lauryl sulfonic acid salts, myristyl sulfonic acid salts, cetyl sulfonic acid salts, oleyl sulfonic acid salts, stearyl sulfonic acid salts, tetradecane sulfonic acid salts, dodecylbenzene sulfonic acid salts, and secondary alkyl (C13 to 15) sulfonic acid salts, (4) sulfuric acid ester salts of aliphatic alcohols, such as lauryl sulfuric acid ester salts, oleyl sulfuric acid ester salts, and stearyl sulfuric acid ester salts, (5) sulfuric acid ester salts of adducts of at least one alkylene oxide selected from among ethylene oxide and propylene oxide with an aliphatic alcohol, such as polyoxyethylene lauryl ether sulfuric acid ester salts, polyoxyalkylene (polyoxyethylene, polyoxypropylene) lauryl ether sulfuric acid ester salts, and polyoxyethylene oleyl ether sulfuric acid ester salts, (6) sulfuric acid ester salts of fatty acids, such as castor oil fatty acid sulfuric acid ester salts, sesame oil fatty acid sulfuric acid ester salts, tall oil fatty acid sulfuric acid ester salts, soybean oil fatty acid sulfuric acid ester salts, rapeseed oil fatty acid sulfuric acid ester salts, palm oil fatty acid sulfuric acid ester salts, lard fatty acid sulfuric acid ester salts, beef tallow fatty acid sulfuric acid ester salts, and whale oil fatty acid sulfuric acid ester salts, (7) sulfuric acid ester salts of oils and fats, such as sulfuric acid ester salts of castor oil, sulfuric acid ester salts of sesame oil, sulfuric acid ester salts of tall oil, sulfuric acid ester salts of soybean oil, sulfuric acid ester salts of rapeseed oil, sulfuric acid ester salts of palm oil, sulfuric acid ester salts of lard, sulfuric acid ester salts of beef tallow, and sulfuric acid ester salts of whale oil, (8) fatty acid salts, such as lauric acid salts, oleic acid salts, and stearic acid salts, and (9) sulfosuccinic acid ester salts of aliphatic alcohols, such as dioctyl sulfosuccinic acid salts. Examples of a counterion of the anionic surfactant include alkali metal salts, such as a potassium salt and a sodium salt, an ammonium salt, and alkanolamine salts, such as triethanolamine.

**[0059]** As the cationic surfactant used in the present embodiment, that which is known can be adopted as appropriate. Specific examples of the cationic surfactant include lauryltrimethylammonium chloride, cetyltrimethylammonium chloride, stearyltrimethylammonium chloride, behenyltrimethylammonium chloride, and didecyldimethylammonium chloride.

**[0060]** As the amphoteric surfactant used in the present embodiment, that which is known can be adopted as appro-

prate. Specific examples of the amphoteric surfactant include a betaine type amphoteric surfactant.

**[0061]** The content of the ionic surfactant in the treatment agent is set as appropriate and is preferably 1% to 20% by mass, more preferably 3% to 16% by mass, and even more preferably 6% to 13% by mass. By being specified to be in such ranges, the effects of the present invention, the stability of the aqueous liquid, or antistatic properties can be improved.

**[0062]** The aqueous liquid of the present embodiment preferably contains a fatty acid with 8 to 24 carbon atoms. By containing the fatty acid with 8 to 24 carbon atoms, the effects of the present invention can be improved further. As the fatty acid with 8 to 24 carbon atoms, that which is known can be adopted as appropriate and it may be a saturated fatty acid or an unsaturated fatty acid. Alternatively, it may be a monocarboxylic fatty acid or a dicarboxylic or higher polycarboxylic fatty acid. One type of such ingredients may be used alone or two or more types thereof may be used in combination.

**[0063]** Specific examples of the saturated fatty acid include 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. Specific examples of the unsaturated fatty acid include myristoleic acid, palmitoleic acid, oleic acid, vaccenic acid, eicosenoic acid, linoleic acid,  $\alpha$ -linolenic acid,  $\gamma$ -linolenic acid, and arachidonic acid. The fatty acid preferably contains an unsaturated fatty acid with 8 to 24 carbon atoms among the above. By this arrangement, especially the low-temperature stability can be improved further.

**[0064]** The content of the fatty acid in the treatment agent is set as appropriate and is preferably 0.1% to 5% by mass and more preferably 0.5% to 3% by mass. By being specified to be in such ranges, the effects of the present invention can be improved further.

**[0065]** The contents of the treatment agent and water in the aqueous liquid are not restricted in particular. The content of water in the aqueous liquid is preferably 5 to 30 parts by mass and more preferably 5 to 20 parts by mass if the content of the treatment agent in the aqueous liquid is taken as 100 parts by mass. By specifying to be of such ratios, the aqueous liquid can be improved in handling properties and improved in temporal stability.

(Second Embodiment)

**[0066]** Next, a second embodiment that embodies a synthetic fiber according to the present invention will be described. The synthetic fiber of the present embodiment is obtained by undergoing the step of adhering the aqueous liquid of the first embodiment or an emulsion obtained by further diluting the aqueous liquid with water to a synthetic fiber, for example, in a spinning or drawing step. A water content of the aqueous liquid or the emulsion that has been adhered to the synthetic fiber may be evaporated by a drying step. The synthetic fiber to be manufactured is not restricted in particular, and specific examples thereof include (1) polyethylene terephthalate, polypropylene terephthalate, polylactic acid ester, and other polyester fibers, (2) nylon 6, nylon 66, and other polyamide fibers, (3) polyacrylic, modacrylic, and other polyacrylic fibers, and (4) polyethylene, polypropylene, and other polyolefin fibers.

**[0067]** The amount of the treatment agent to be adhered to the synthetic fiber is not restricted in particular, and the treatment agent is preferably adhered such as to be of a ratio of 0.1% to 3% by mass (not including water) with respect to the synthetic fiber. By this arrangement, the effects of the present invention can be improved further. The method for adhering the treatment agent to the synthetic fiber is not restricted in particular, and a known method such as a roller oiling method, a guide oiling method using a metering pump, an immersion oiling method, or a spray oiling method can be adopted.

**[0068]** The following effects can be obtained by the aqueous liquid and the synthetic fiber of the above-described embodiments.

(1) The aqueous liquid of the above-described embodiments contains the ester A1 represented by Chemical Formula 1 and the ester A2 represented by Chemical Formula 2 at specific ratios as the smoothing agents and contain surfactants. The effect of being excellent in low-temperature stability thus arises. For example, coagulation of ingredients, separation due to coagulation of just specific ingredients, etc., during low-temperature storage of the aqueous liquid can be suppressed to improve the stability of the aqueous liquid at low temperature. Also, quality stability can be imparted to the synthetic fibers.

(2) With the synthetic fiber of the above-described embodiments, the treatment agent is adhered to the fiber by the aqueous liquid that is excellent in quality stability. Therefore, various functions imparted by the treatment agent such as a friction reducing effect can be maintained even after the synthetic fiber is put into long-term storage.

**[0069]** The above-described embodiments may be modified as follows.

**[0070]** Stabilizers, antistatic agents, binders, antioxidant agents, ultraviolet absorbers, and other ingredients that are ordinarily used in aqueous liquids for quality maintenance of the aqueous liquids may further be blended in the aqueous



liquid of the embodiments within a range that does not impair the effects of the present invention.

**[0071]** Specific examples of the antioxidant agent include (1) phenol-based antioxidant agents, such as 1,3,5-tris(3',5'-di-t-butyl-4-hydroxybenzyl)isocyanuric acid, 1,3,5-tris(4-t-butyl-3-hydroxy-2,6-dimethylbenzyl)isocyanuric acid, 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene, 2,2'-methylene-bis(4-methyl-6-t-butylphenol), 1,1,3-tris(2-methyl-4-hydroxy-5-t-butylphenyl)butane, tetrakis[methylene-3-(3',5'-di-t-butyl-4'-hydroxyphenyl)propionate]methane, and triethylene glycolbis[3-(3-t-butyl-5-methyl-4-hydroxyphenyl)propionate], (2) phosphite-based antioxidant agents, such as octyl diphenyl phosphite, tris nonylphenyl phosphite, and tetratridecyl-4,4'-butylidene-bis-(2-t-butyl-5-methylphenol) diphosphate, and (3) thioether-based antioxidant agents, such as 4,4'-thiobis-(6-t-butyl-3-methylphenol), and dilauryl-3,3'-thiodipropionate. One type of such antioxidant agents may be used alone or two or more types thereof may be used in combination.

## EXAMPLES

**[0072]** 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 examples and comparative examples, parts means parts by mass and % means % by mass.

### Experimental Part 1 (Preparation of aqueous liquid of synthetic fiber treatment agents)

#### · Preparation of aqueous liquid (Example 1)

**[0073]** Uniform mixing of 40.5% of isotridecyl oleate (A1-1), 6% of octyl linoleate (A2-1), and 3.5% of 2-ethylhexyl stearate as smoothing agents, 15% of a 20 mole ethylene oxide adduct of hydrogenated castor oil (B-1), 13.9% of a 7 mole ethylene oxide adduct of oleic acid (B-2), and 10% of a 7 mole ethylene oxide adduct of lauryl alcohol (B-3) as nonionic surfactants, 4.9% of a salt of a phosphoric acid ester of polyoxyethylene (2 moles; represents the number of added moles of ethylene oxide (the same applies hereinafter)) lauryl ether and potassium (C-1), 4% of a sodium secondary alkyl sulfonate (number of carbon atoms: 13 to 15) (C-2), and 1% of potassium oleate (C-3) as ionic surfactants, 1.1% of oleic acid (D-3) as a fatty acid, and 0.1% of 1,1,3-tris(2-methyl-4-hydroxy-5-t-butylphenyl)butane (E-1) as an antioxidant agent was performed to obtain a mixture as a treatment agent.

**[0074]** Further, with the treatment agent being 100 parts by mass, 11.11 parts by mass of ion exchanged water were added and mixed uniformly to prepare an aqueous liquid of Example 1 such that a water content in the aqueous liquid is 10%.

#### · Preparation of aqueous liquids (Examples 2 to 12 and Comparative Examples 1 to 5)

**[0075]** Aqueous liquids of Examples 2 to 12 and Comparative Examples 1 to 5 were prepared in the same manner as in preparing the aqueous liquid of Example 1 and using the ingredients shown in Table 1. In Table 1, along with indicating the types of the respective ingredients in each treatment agent, blending ratios (%) of the respective ingredients with the ingredients (treatment agent) besides water being 100% are indicated. Also, an addition ratio (parts) of water with each treatment agent being 100 parts is indicated.

**[0076]** Types and contents of the smoothing agents, types and contents of the nonionic surfactants, types and contents of the ionic surfactants, type and contents of the fatty acids, and types and contents of the other ingredients in the treatment agents of the respective examples are as respectively indicated in the "Smoothing agent" column, the "Nonionic surfactant" column, the "Ionic surfactant" column, the "Fatty acid" column, and the "Other ingredient" column of Table 1. The mass ratio of the content of the ester A1 with respect to the content of the ester A2 in each treatment agent is indicated in the "Mass ratio: Ester A1/Ester A2" column of Table 1 and the mass ratio of the sum of the contents of the ester A1 and the ester A2 with respect to the content of the ester A3 is indicated in the "Mass ratio: (Ester A1 + Ester A2)/Ester A3" column of Table 1. The addition ratio (parts) of water is indicated in the "Water" column of Table 1.

[Table 1]

Category	Synthetic fiber treatment agent												Water	Evaluation		
	Smoothing agent		Nonionic surfactant		Ionic surfactant		Fatty acid		Other ingredient		Mass ratio: Ester A1/ Ester A2	Mass ratio: (Ester A1 + Ester A2)/ Ester A3		Low-temperature stability		Quality stability
	Type	Percentage (% by mass)	Type	Percentage (% by mass)	Type	Percentage (% by mass)	Type	Percentage (% by mass)	Type	Percentage (% by mass)			Parts by mass with respect to 100 parts by mass of treatment agent	Liquid uniformity retention	Coagulability	
Example 1	A1-1 A2-1 A3-1	40.5 6.0 3.5	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	6.8	13.3	11.11	○○○	○○○	○○○
Example 2	A1-1 A2-2 A3-2	40.5 6.0 3.5	B-1 B-2 B-5	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	6.8	13.3	11.11	○○○	○○○	○○○
Example 3	A1-1 A1-2 A2-2 A3-2	15.0 26.7 5.9 2.4	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-2	0.1	7.1	19.5	11.11	○○○	○○○	○○○
Example 4	A1-1 A1-3 A2-2 A3-1	15.0 26.7 5.9 2.4	B-4 B-5 B-6	15.0 13.9 10.0	C-1 C-2 C-3	5.0 4.0 1.0	D-1	1.1			7.1	19.5	11.11	○○○	○○○	○○○
Example 5	A1-2 A1-4 A2-2 A3-2	15.0 26.7 5.9 2.4	B-1 B-3 B-6	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	7.1	19.5	11.11	○○○	○○○	○○○
Example 6	A1-1 A1-5 A2-2 A3-1 a-1	20.0 21.7 5.9 2.4 5.0	B-1 B-2 B-6	10.0 13.9 10.0	C-1 C-2 C-3	5.5 4.0 1.0	D-1	0.50	E-2	0.1	7.1	19.5	11.11	○○○	○○○	○○○
Example 7	A1-1 A2-1 A3-1	46.5 8.0 4.5	B-2 B-4 B-5	10.0 13.9 6.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	5.8	12.1	11.11	○○	○○○	○○○
Example 8	A1-1 A2-2 A3-2	40.5 6.0 3.5	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-2	1.1	E-1	0.1	6.8	13.3	11.11	○○	○○○	○○○
Example 9	A1-1 A2-2 A3-2	40.5 6.0 3.5	B-1 B-3 B-5	16.1 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0			E-1	0.1	6.8	13.3	11.11	○	○○	○○
Example 10	A1-1 A2-2 A3-2	38.3 5.9 5.8	B-2 B-3 B-4	16.1 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0			E-1	0.1	6.5	7.7	11.11	○	○	○○
Example 11	A1-1 A2-2 A3-2	33.3 10.9 5.8	B-1 B-2 B-3	16.1 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0			E-2	0.1	3.1	7.7	11.11	○	○	○
Example 12	A1-1 A2-1 A3-1	30 5 15	B-1 B-2 B-3	16.1 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0			E-1	0.1	6.0	2.3	11.11	○	○	○
Comparative Example 1	A1-4 A2-1 A3-1	24.4 10.6 15	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	2.3	2.3	11.11	×	×	×
Comparative Example 2	A3-1	50.0	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	-	-	11.11	×	×	○○
Comparative Example 3	A1-4 A2-1 A3-1	45.0 4.0 1	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	11.3	49.0	11.11	×	×	○
Comparative Example 4	A1-4 A2-1 A3-1	5.0 44.0 1	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	0.1	49.0	11.11	○	○	×
Comparative Example 5	a-1	50.0	B-1 B-2 B-3	15.0 13.9 10.0	C-1 C-2 C-3	4.9 4.0 1.0	D-1	1.1	E-1	0.1	-	-	11.11	×	×	×

[0077] The following are indicated in Table 1.

A1-1: isotridecyl oleate

A1-2: 2-propylheptyl oleate  
 A1-3: 2-propylheptyl palmitoleate  
 A1-4: octyl tetracosanoate  
 A1-5: 2-octyldodecyl oleate  
 5 A2-1: octyl linoleate  
 A2-2: isotridecyl linoleate  
 A3-1: 2-ethylhexyl stearate  
 A3-2: isotridecyl palmitate  
 a-1: butyl stearate  
 10 B-1: 20 mole ethylene oxide adduct of hydrogenated castor oil  
 B-2: 7 mole ethylene oxide adduct of oleic acid  
 B-3: 7 mole ethylene oxide adduct of lauryl alcohol  
 B-4: 15 mole ethylene oxide adduct of castor oil  
 B-5: diester of polyethylene glycol (mass average molecular weight: 600) and oleic acid  
 15 B-6: 8 mole ethylene oxide and 2 mole propylene oxide adduct of octyl alcohol  
 C-1: salt of phosphoric acid ester of polyoxyethylene (2 moles) lauryl ether and potassium  
 C-2: sodium secondary alkyl sulfonate (number of carbon atoms: 13 to 15)  
 C-3: potassium oleate  
 D-1: oleic acid  
 20 D-2: stearic acid  
 E-1: 1,1,3-tris(2-methyl-4-hydroxy-5-*t*-butylphenyl)butane  
 E-2: triethylene glycol-bis[3-(3-*t*-butyl-5-methyl-4-hydroxyphenyl)propionate]

## Experimental Part 2 (Evaluation of aqueous liquids)

### · Manufacture of drawn yarn

[0078] A specific amount of ion exchanged water was further added to the aqueous liquid of each example obtained as described above and mixed uniformly to prepare an emulsion with a treatment agent concentration of 10%. Chips of polyethylene terephthalate with an intrinsic viscosity of 0.64 and a titanium oxide content of 0.2% were dried by a routine method and thereafter spun into a yarn at 295°C using an extruder. After discharging from a nozzle to cool and solidify, the running yarn thread was subject to adhesion of the abovementioned emulsion at 1.0% as treatment agent with respect to the running yarn thread by a guide oiling method using a metering pump. Thereafter, bundling by a guide was performed, taking off at a speed of 1,400 m/minute by a takeoff roller heated to 90°C was performed, and then drawing to 3.2 times between the takeoff roller and a drawing roller rotating at a speed of 4,800 m/minute was performed to manufacture a drawn yarn of 83.3 decitex (75 denier) and 36 filaments. Using the manufactured drawn yarn, quality stability was evaluated by the following method. Also, low-temperature stability of each aqueous liquid was evaluated by the following method. The results are shown in Table 1.

### · Evaluation of quality stability

[0079] The drawn yarn obtained by the above-described method was stored for 3 months under an environment of 25°C and 65% RH. After storage, a friction coefficient of the yarn was measured and a change before and after storage was observed. The quality stability was evaluated based on the following evaluation criteria. The results are shown in the "Quality stability" column of Table 1. The friction coefficient was determined by the following method.

[0080] A friction measurement meter (SAMPLE FRICTION UNIT MODEL TB-1, manufactured by Eiko Sokki Co., Ltd.) was used, a chrome-plated textured pin with a diameter of 1 cm and a surface roughness of 2S was disposed between two free rollers, and the drawn yarn led out from the package (500 g coil) was arranged such as to be 90 degrees in contact angle with respect to the chrome-plated textured pin. Under conditions of 25° C and 60% RH, an initial tension (T<sub>1</sub>) of 5 g was applied to an inlet side and a secondary tension (T<sub>2</sub>) at an exit side when the yarn was made to run at a speed of 100 m/minute was measured every 0.1 seconds for 1 minute. The friction coefficient was determined from the following formula.

[Numerical Formula 1]

$$\text{Friction coefficient} = (2/3.14) \times 1n(T_2 / T_1)$$

- [0081] ∞ (excellent): A change in friction coefficient was less than 1%.  
 [0082] ∞ (satisfactory): The friction coefficient was an increase of not less than 1% but less than 5%.  
 [0083] ◦ (fair): The friction coefficient was an increase of not less than 5% but less than 10%.  
 [0084] × (poor): The friction coefficient was an increase of not less than 10%.

· Evaluation of low-temperature stability

[0085] The low-temperature stability of each aqueous liquid was evaluated as liquid uniformity retention and coagulability. The liquid uniformity retention and coagulability were determined by the following methods.

[0086] From each aqueous liquid that was heated to 30°C and made uniform by stirring, 60 mL were placed in a plastic bottle with lid of 100 mL volume (inner diameter: 45 mm) and the container was sealed shut. The plastic bottle containing the aqueous liquid was left to stand for 7 days in an incubator with a temperature set to 0°C. After leaving to stand, the appearance of the aqueous liquid was judged visually and the liquid uniformity retention and coagulability were evaluated based on the following criteria. In regard to "fluidity" as mentioned in the following criteria, it was judged that there is fluidity if, when the plastic bottle containing the aqueous liquid was tilted to its side (90°), a portion of the aqueous liquid flowed out of the container within 30 seconds. The results are shown in the "Liquid uniformity retention" column and the "Coagulability" column of Table 1.

· Evaluation of liquid uniformity retention

[0087]

- ∞ (excellent): The liquid state is retained and the liquid is in a uniform state.  
 ∞ (satisfactory): Although the liquid state is retained and there is no separation, the liquid is in a nonuniform state.  
 ◦ (fair): Although the liquid state is retained, the liquid is separated into two or more layers.  
 × (poor): The liquid state is not retained and coagulation has occurred.

· Evaluation of coagulability

[0088]

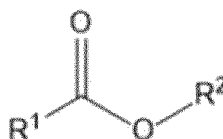
- ∞ (excellent): There is no clouding or turbidity in appearance and there is fluidity.  
 ∞ (satisfactory): There is clouding or turbidity in appearance and a portion is solidified.  
 ◦ (fair): There is clouding or turbidity in appearance and a large portion is solidified.  
 × (poor): Completely coagulated and there is no fluidity.

[0089] As is clear from the results of Table 1, the aqueous liquids of the respective examples were all evaluated as being fair or better in the evaluations of low-temperature stability and quality stability. The present invention succeeds in obtaining aqueous liquids that are excellent in low-temperature stability and are capable of imparting quality stability to a fiber.

## Claims

1. An aqueous liquid of synthetic fiber treatment agent comprising a smoothing agent, a nonionic surfactant, and an ionic surfactant, wherein the smoothing agent contains an ester A1 represented by Chemical Formula 1 shown below and an ester A2 represented by Chemical Formula 2 shown below, and the aqueous liquid of synthetic fiber treatment agent has a mass ratio of the content of the ester A1 with respect to the content of the ester A2 such that the ester A1/the ester A2 = 3.0 to 9.0.

[Chemical Formula 1]

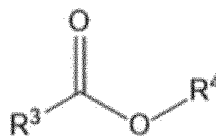


(In Chemical Formula 1,

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R<sup>1</sup> is an unsaturated hydrocarbon group with 7 to 23 carbon atoms having one unsaturated bond, and  
R<sup>2</sup> is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

[Chemical Formula 2]



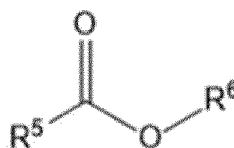
(In Chemical Formula 2,

R<sup>3</sup> is an unsaturated hydrocarbon group with 7 to 23 carbon atoms having two or more unsaturated bonds,  
and

R<sup>4</sup> is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

2. The aqueous liquid of synthetic fiber treatment agent according to claim 1, wherein the mass ratio of the content of the ester A1 with respect to the content of the ester A2 is such that the ester A1/the ester A2 = 4.0 to 9.0.
3. The aqueous liquid of synthetic fiber treatment agent according to claim 1 or 2, wherein the smoothing agent further contains an ester A3 represented by Chemical Formula 3 shown below.

[Chemical Formula 3]



(In Chemical Formula 3,

R<sup>5</sup> is a saturated hydrocarbon group with 7 to 23 carbon atoms, and

R<sup>6</sup> is a saturated hydrocarbon group with 8 to 24 carbon atoms or an unsaturated hydrocarbon group with 8 to 24 carbon atoms.)

4. The aqueous liquid of synthetic fiber treatment agent according to claim 3, wherein the aqueous liquid of synthetic fiber treatment agent has a mass ratio of the sum of the contents of the ester A1 and the ester A2 with respect to the content of the ester A3 such that (the ester A1 + the ester A2)/the ester A3 = 5.0 to 40.0.
5. The aqueous liquid of synthetic fiber treatment agent according to claim 3, wherein the aqueous liquid of synthetic fiber treatment agent has a mass ratio of the sum of the contents of the ester A1 and the ester A2 with respect to the content of the ester A3 such that (the ester A1 + the ester A2)/the ester A3 = 10.0 to 20.0.
6. The aqueous liquid of synthetic fiber treatment agent according to any one of claims 1 to 5, further comprising a fatty acid with 8 to 24 carbon atoms.
7. The aqueous liquid of synthetic fiber treatment agent according to claim 6, wherein the fatty acid contains an unsaturated fatty acid with 8 to 24 carbon atoms.
8. A synthetic fiber to which the aqueous liquid of synthetic fiber treatment agent according to any one of claims 1 to 7 is adhered.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/021317

## A. CLASSIFICATION OF SUBJECT MATTER

D06M 13/224 (2006.01) i

FI: D06M13/224

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)

D06M13/00-15/715

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 1971-2021

Registered utility model specifications of Japan 1996-2021

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 2010-121223 A (TAKEMOTO OIL & FAT CO., LTD.) 03 June 2010 (2010-06-03) claims, example 34	1-8
A	WO 2019/176892 A1 (TAKEMOTO OIL & FAT CO., LTD.) 19 September 2019 (2019-09-19)	1-8
A	JP 7-216733 A (SANYO CHEMICAL INDUSTRIES, LTD.) 15 August 1995 (1995-08-15)	1-8
A	JP 2018-135619 A (TAKEMOTO OIL & FAT CO., LTD.) 30 August 2018 (2018-08-30)	1-8
A	JP 2018-204131 A (TAKEMOTO OIL & FAT CO., LTD.) 27 December 2018 (2018-12-27)	1-8
A	JP 2018-95982 A (TAKEMOTO OIL & FAT CO., LTD.) 21 June 2018 (2018-06-21)	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

16 July 2021 (16.07.2021)

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Name and mailing address of the ISA/

Japan Patent Office

3-4-3, Kasumigaseki, Chiyoda-ku,

Tokyo 100-8915, Japan

Authorized officer

Telephone No.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/JP2021/021317

5	Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
10	JP 2010-121223 A WO 2019/176892 A1	03 Jun. 2010 19 Sep. 2019	CN 101736577 A EP 3656897 A1 KR 10-2020-0029604 A CN 111065767 A TW 201938876 A	
15	JP 7-216733 A JP 2018-135619 A JP 2018-204131 A JP 2018-95982 A	15 Aug. 1995 30 Aug. 2018 27 Dec. 2018 21 Jun. 2018	(Family: none) (Family: none) (Family: none) (Family: none)	
20				
25				
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35				
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Form PCT/ISA/210 (patent family annex) (January 2015)

**REFERENCES CITED IN THE DESCRIPTION**

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- JP 2006070375 A [0004]
- WO 2014156318 A [0004]