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

(11) **EP 4 268 652 A1**

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

(43) Date of publication:
01.11.2023 Bulletin 2023/44

(21) Application number: **21910819.8**

(22) Date of filing: **21.12.2021**

(51) International Patent Classification (IPC):
A41G 3/00 $^{(2006.01)}$ ***D06M 101/12*** $^{(2006.01)}$
D06M 11/54 $^{(2006.01)}$ ***D06M 13/148*** $^{(2006.01)}$
D06M 15/41 $^{(2006.01)}$ ***D06M 15/643*** $^{(2006.01)}$
D06M 15/65 $^{(2006.01)}$

(52) Cooperative Patent Classification (CPC):
A41G 3/00; D06M 11/54; D06M 13/148;
D06M 13/152; D06M 13/352; D06M 15/41;
D06M 15/643; D06M 15/65; D06M 2101/12

(86) International application number:
PCT/JP2021/047436

(87) International publication number:
WO 2022/138679 (30.06.2022 Gazette 2022/26)

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **25.12.2020 JP 2020217992**
31.03.2021 JP 2021061911

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(54) FIBER TREATMENT AGENT

(57) A one-part type or multiple-part type fiber-treating agent, the fiber-treating agent comprising components (A) to (C) in the total composition thereof, provided that, for the one-part type, a part or all of the components (A) and (B) is optionally a condensate formed from the components: (A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule; (B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position (wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group); and (C): water.

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Description

Field of the Invention

[0001] The present invention relates to a fiber-treating agent for imparting water resistance, heat resistance and heat shape memory ability to naturally derived fibers which are used for hair ornament products such as wigs and extensions.

Background of the Invention

[0002] Examples of applications of naturally derived fibers include hair ornament products such as wigs and extensions. Unlike synthetic fibers, naturally derived fibers have natural texture and appearance originating from a natural material. Among naturally derived fibers, regenerated protein fibers, for example, regenerated collagen fibers are obtained by solubilizing acid-soluble collagen or insoluble collagen with an alkali or an enzyme to obtain a spinning stock solution, and discharging the spinning stock solution into a coagulation bath through a spinning nozzle to form fibers.

[0003] However, regenerated collagen fibers generally have higher hydrophilicity and hence higher water absorption as compared to synthetic fibers, and the fibers have extremely low mechanical strength when they contain a large amount of water. This leads to deterioration of suitability as a hair ornament product such that during shampooing, mechanical strength significantly decreases because of the high water absorption, and during subsequent blowing with a hair drier, rupture occurs.

[0004] Regenerated collagen fibers also have the problem of low heat resistance, so that if a set using a hair iron is performed at a temperature as high as that for human hair, shrinkage or crimping occurs, resulting in impairment of visual quality.

[0005] Further, in plastic synthetic fibers, the shape in a heat set with a hair iron or the like is continuously memorized even after subsequent hair washing (there is heat shape memory ability), whereas in regenerated collagen fibers, the shape in a heat set with a hair iron or the like is lost through subsequent hair washing (there is no heat shape memory ability). Therefore, regenerated collagen fibers may be inferior to conventional plastic synthetic fibers in terms of degree of freedom of styling.

[0006] The three points described above are a factor in limiting popularization of regenerated collagen fibers which are used for hair ornament products. In particular, water resistance, that is, a decrease in mechanical strength has a significant impact when it is wet. Therefore, for modifying regenerated collagen fibers to impart water resistance and heat resistance, an attempt has been made to apply a reactive substance to amino groups of a collagen molecule, and as an example thereof, a method is known in which a compound having a methylol group is applied (Patent Literatures 1 and 2). In the field of human hair fibers also used for hair ornament products, a method is known in which to human hair fibers having essentially no heat shape memory ability, a compound having a methylol group is applied for newly imparting heat shape memory ability (Patent Literature 3).

Citation List

Patent Literature

[0007]

Patent Literature 1: JP-B-40-9062
Patent Literature 2: JP-B-41-15258
Patent Literature 3: JP-A-2019-143282

Summary of the Invention

[0008] The present invention provides a one-part type fiber-treating agent comprising a single composition or a multiple-part type fiber-treating agent comprising a plurality of compositions, wherein the fiber-treating agent comprises the following components (A) to (C) in the total composition thereof, provided that, for the one-part type, a part or all of the components (A) and (B) is optionally a condensate formed from the components:

(A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule;
(B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position, wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group; and
(C): water.

[0009] Further, the present invention provides a method for treating fibers, comprising the following step (i):

(i) immersing fibers in the fiber-treating agent.

[0010] Further, the present invention provides a method for producing fibers for hair ornament products, comprising the step of treating fibers by the method for treating fibers.

[0011] Further, the present invention provides a method for producing a hair ornament product, comprising the step of treating fibers by the method for treating fibers.

[0012] Further, the present invention provides a fiber for hair ornament products, comprising a condensate formed from the components (A) and (B).

[0013] Further, the present invention provides a hair ornament product having, as a constituent element, fibers comprising a condensate formed from the components (A) and (B).

Detailed Description of the Invention

[0014] In some situations of production of hair ornament products, fibers are intensively extended, and in the technique disclosed in Patent Literatures 1 to 3, there are cases where the stretchability (tenacity) of treated fibers is not sufficient. For this reason, it is required to enhance the stretchability of treated fibers for preventing rupture during extension.

[0015] Accordingly, the present invention relates to a fiber-treating agent for producing fibers for hair ornament products in which the water resistance and the heat resistance of naturally derived fibers typified by regenerated collagen fibers are improved, heat shape memory ability is imparted, and the fibers are excellent in stretchability (tenacity).

[0016] The present inventor found that by treating naturally derived fibers with a composition containing a specific methylol compound and a specific phenolic compound, not only water resistance and heat resistance in the naturally derived fibers are improved and heat shape memory ability can be imparted, but also surprisingly, the stretchability (tenacity) of the naturally derived fibers is improved as compared to that before the treatment, and can be enhanced to a level close to that of human hair, leading to completion of the invention. While it is common knowledge that a compound having a methylol group like that used in Cited Literatures 1 to 3 normally cross-link tissues, and therefore the tissues become fragile after the treatment, it is surprising that results have been obtained which show that by using the specific methylol compound, stretchability (tenacity) is improved as compared to that before the treatment when naturally derived fibers are used as an object to be treated.

[0017] According to the present invention, it is possible to provide a fiber-treating agent for producing fibers for hair ornament products in which the water resistance and the heat resistance of naturally derived fibers are improved, heat shape memory ability is imparted, and stretchability (tenacity) is improved.

[One-part type and multiple-part type]

[0018] The fiber-treating agent of the present invention comprises both the forms of a one-part type fiber-treating agent comprising a single composition and a multiple-part type fiber-treating agent comprising a plurality of compositions, where fibers are immersed sequentially in the plurality of compositions, such as a two-part type.

[0019] In the present invention, the term "total composition of fiber-treating agent" refers, in the case of the one-part type fiber-treating agent, to the composition of a single composition forming the one-part type fiber-treating agent, and refers, in the case of the multiple-part type fiber-treating agent in which fibers are immersed sequentially, to the composition of a mixture when all compositions forming the multiple-part type fiber-treating agent are virtually mixed. For example, when treatment is performed sequentially with a first part and a second part in the same amount (that is, at a mass ratio of 1 : 1) in the case of the two-part type, the concentration of each component based on the total composition of the fiber-treating agent is half the concentration of the component in each part.

[Fibers to be treated in the present invention]

[0020] Fibers to be treated with the fiber-treating agent of the present invention may be either synthetic fibers or naturally derived fibers, and are preferably naturally derived fibers. The naturally derived fiber refers to fibers which are taken from a natural animal or plant, or artificially produced using keratin, collagen, casein, soybeans, peanuts, corn, silk flocks, silk fibroin or the like as a raw material and which are used for production of a hair ornament product. Among them, fibers produced using keratin, collagen, casein, soybeans, peanuts, corn, silk flocks, silk fibroin or the like as a raw material are preferable, regenerated protein fibers such as regenerated collagen fibers made from collagen as a raw material or regenerated silk fibers made from silk fibroin as a raw material are more preferable, and regenerated collagen fibers are further more preferable.

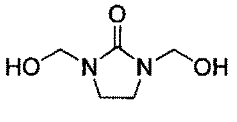
[0021] Regenerated collagen fibers can be produced by a known technique, are not required to have a composition of collagen 100%, and may contain a natural or synthetic polymer and additives for improvement of quality. The regenerated collagen fibers may be post-processed. Regenerated collagen fibers are preferably in the form of filaments. Filaments are generally taken from fibers wound around a bobbin or packed in a box. It is also possible to directly use filaments coming out from a drying step in a production process of regenerated collagen fibers.

[Condensate formed from components (A) and (B)]

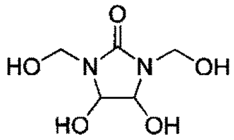
[0022] When the fiber-treating agent of the present invention is a one-part type, in the fiber-treating agent, a methylol compound as a component (A) and a phenolic compound as a component (B) may be contained as the compounds themselves, or may be contained with a part or all of the components (A) and (B) being a condensate formed from the components. The condensate may include water-soluble condensates having a small molecular weight, and water-insoluble condensates formed by linkage of the water-soluble condensates. Herein, the condensate includes both water-soluble and water-insoluble condensates when referred to simply as a "condensate".

[Component (A): specific methylol compound]

[0023] The component (A) is a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule. Examples of such a compound include compounds (A1) to (A4) shown below. Among them, the compounds (A3) and (A4) are preferable, and the compound (A3) is more preferable.



(A1)



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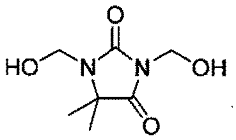

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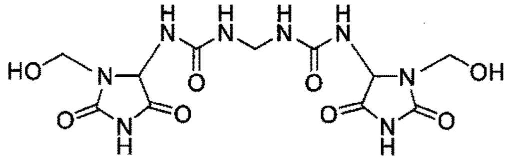


(A4)

[0024] The content of a constituent element derived from the component (A) in the fiber-treating agent of the present invention, based on the total composition of the fiber-treating agent, is preferably 0.1 mass% or more, more preferably 1 mass% or more, further more preferably 2.5 mass% or more, even more preferably 5 mass% or more, even more preferably 10 mass% or more, from the viewpoint of imparting higher shape sustainability and strength to naturally derived fibers after treatment, and preferably 80 mass% or less, more preferably 70 mass% or less, further more preferably 60 mass% or less, even more preferably 50 mass% or less, even more preferably 40 mass% or less, from the viewpoint of formulation compatibility in addition to the above-described viewpoint.

[0025] That is, the content of a constituent element derived from the component (A) in the fiber-treating agent of the present invention is preferably from 0.1 to 80 mass%, more preferably from 1 to 70 mass%, further more preferably from 2.5 to 60 mass%, even more preferably from 5 to 50 mass%, even more preferably from 10 to 40 mass%, based on the total composition of the fiber-treating agent, from the viewpoint of imparting higher shape sustainability and strength to naturally derived fibers after treatment and the viewpoint of formulation compatibility.

[0026] Herein, the term "constituent element derived from component (A)" refers, in the case of the one-part type, to a constituent part derived from the component (A) in the condensate and the remaining component (A), and refers, in the case of the multiple-part type, to the component (A) itself.

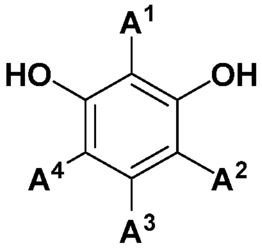
[Component (B): specific phenolic compound]

[0027] The component (B) is a phenolic compound having an electron donating group on at least one, preferably two of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position. The electron donating group on the meta-position of the phenolic compound may form a benzene ring together with an adjacent carbon atom, and the benzene ring may be further substituted with a hydroxy group. The molecular weight of the component (B) is preferably 110 or more, and preferably 1,000 or less, more preferably 700 or less, further more preferably 500 or less, from the viewpoint of good infiltration into naturally derived fibers. Examples of the phenolic compound of the component (B) include the following components (B1), (B2) and (B3).

[0028]

(B1) resorcin derivative of formula (1)
(B2) Naphthol derivative of formula (2) or (3)
(B3) Flavan-3-ol derivative of formula (4)

[0029] The component (B1) is a compound of the following formula (1):



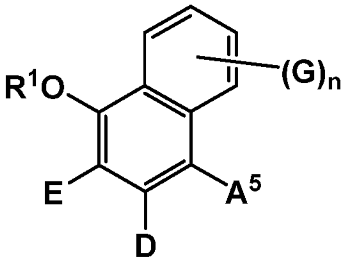
(1)

wherein

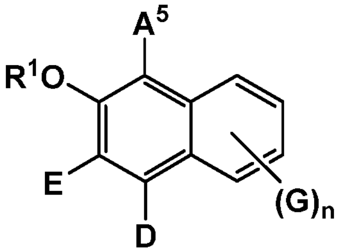
A^1 to A^4 are the same or different, and each represent a hydrogen atom, a hydroxy group, a halogen atom, a carboxyl group or a salt thereof, a sulfonic acid group or a salt thereof, a linear or branched alkyl group or alkenyl group having 1 to 6 carbon atoms, or a linear or branched alkoxy group or alkenyloxy group having 1 to 6 carbon atoms.

[0030] Examples of the component (B1) include resorcin, 2-methylresorcin, 4-chlororesorcin, and pyrogallol.

[0031] The component (B2) is a compound of the following formula (2) or (3) :



(2)



(3)

wherein

R^1 represents a hydrogen atom or a methyl group,

A^5 represents a hydrogen atom, a linear or branched alkyl group or alkenyl group having 1 to 12 carbon atoms, an optionally substituted aralkyl group or arylalkenyl group having 7 to 12 carbon atoms, a linear or branched alkoxy group or alkenyloxy group having 1 to 6 carbon atoms, a halogen atom or -CO-R^2 (R^2 is a linear or branched alkyl group or alkenyl group having 1 to 12 carbon atoms, an optionally substituted aralkyl group or arylalkenyl group having 7 to 12 carbon atoms, or an optionally substituted aromatic hydrocarbon group having 6 to 12 carbon atoms),

D represents a hydrogen atom, a hydroxy group, a methyl group, or a linear or branched alkoxy group or alkenyloxy group having 1 to 12 carbon atoms,

E represents a hydrogen atom, a hydroxy group, a linear or branched alkyl group or alkenyl group having 1 to 6

carbon atoms, or an alkoxy group or alkenyloxy group having 1 to 6 carbon atoms, and
G represents a hydroxy group, a linear or branched alkyl group or alkenyl group having 1 to 6 carbon atoms, or an alkoxy group having 1 to 6 carbon atoms, and n represents an integer of 0 to 2.

[0032] In the naphthol derivative of formula (2) or (3), R^1 in formula (2) or (3) is preferably a hydrogen atom, or an alkyl group or alkenyl group having 1 to 4 carbon atoms, more preferably a hydrogen atom.

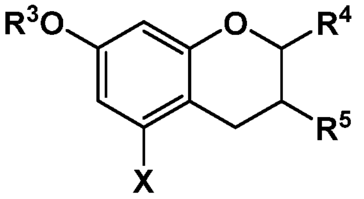
[0033] A^5 is preferably a hydrogen atom, a hydroxy group, a linear or branched alkyl group having 1 to 4 carbon atoms, or an alkoxy group having 1 to 4 carbon atoms, more preferably a hydrogen atom or a hydroxy group.

[0034] D is preferably a hydrogen atom, a hydroxy group, a linear or branched alkyl group having 1 to 4 carbon atoms, or an alkoxy group having 1 to 4 carbon atoms.

[0035] E is preferably a hydrogen atom, a hydroxy group, an alkyl group having 1 to 4 carbon atoms, or an alkoxy group having 1 to 4 carbon atoms.

[0036] Examples of the compound include 1-naphthol, 2-naphthol, 3-methylnaphthalen-1-ol, naphthalene-1,5-diol, and naphthalene-1,8-diol.

[0037] The compound (B3) is a flavan-3-ol derivative of the following formula (4):



(4)

wherein

R^3 represents a hydrogen atom or a methyl group,
X represents a hydrogen atom, a hydroxy group or a methoxy group,
R^4 represents an aromatic hydrocarbon group optionally substituted with up to 3 hydroxy groups or methoxy groups and optionally forming a fused ring with 1,3-dioxolane, and
R^5 represents a hydroxy group, a methoxy group, an aromatic hydrocarbon group optionally substituted with up to 3 hydroxy groups or methoxy groups and optionally forming a fused ring with 1,3-dioxolane, or an arylcarbonyloxy group or aralkylcarbonyloxy group optionally substituted with up to 3 hydroxy groups or methoxy groups.

[0038] The molecular weight of the compound of formula (4) is preferably 150 or more. From the viewpoint of good infiltration into fibers, the molecular weight is preferably 1,000 or less, more preferably 700 or less, further more preferably 500 or less.

[0039] Examples of the component (B3) include non-gallates such as catechin, epicatechin and epigallocatechin, and gallates such as catechin gallate, epicatechin gallate and epigallocatechin gallate, and herein, the term "catechins" is a generic term of these compounds. Among them, one or more selected from the group consisting of catechin, epigallocatechin and epigallocatechin gallate are preferable. It is also possible to use a mixture containing any of the above-described compounds, such as a tea extract.

[0040] Analysis of catechins in a mixture can be performed by an analysis method appropriate to a measurement sample among known methods for analyzing non-polymeric catechins. It is possible to perform the analysis by, for example, a liquid chromatography (HPLC) method. In the measurement, treatment may be appropriately performed if necessary, such as freeze-drying of the sample for adaptation to the detection range of an apparatus, or removal of contaminants in the sample for adaptation to the resolution of an apparatus.

[0041] From the viewpoint of more significantly changing the shape of naturally derived fibers after treatment with a fiber-treating agent of the present invention by a condensate of the component (A) and the component (B) which is formed in the naturally derived fibers, further improving the shape sustainability and durability of the naturally derived fibers, and further improving natural appearance and feel quality, the component (B) is preferably one or more selected from the group consisting of resorcin, 1-naphthol, 2-naphthol, 3-methylnaphthalen-1-ol, naphthalene-1-,5-diol, naphthalene-1,8-diol, catechin, epicatechin, epigallocatechin, catechin gallate, epicatechin gallate, epigallocatechin gallate and a tea extract, more preferably one or more selected from the group consisting of resorcin, catechin, epicatechin, epigallocatechin, catechin gallate, epicatechin gallate, epigallocatechin gallate and a tea extract.

[0042] One component (B) may be used alone, or two or more compounds (B) may be used in combination, and two or more of (B1) to (B3) may be used in combination. From the viewpoint of being able to impart higher shape sustainability and durability to naturally derived fibers, and the viewpoint of enhancing the feel property, one or more selected from the group consisting of (B1) and (B3) are preferable, and from the viewpoint of being able to suppress elution of the component (A) from naturally derived fibers after the treatment, and improve productivity in a factory by omitting a fiber washing step and the viewpoint of making coloring of fibers minimal to enhance suitability for use for hair ornament products, (B3) is more preferable.

[0043] The content of a constituent element derived from the component (B) in the fiber-treating agent of the present invention, based on the total composition of the fiber-treating agent, is preferably 0.1 mass% or more, more preferably 1 mass% or more, further more preferably 1.5 mass% or more, even more preferably 3 mass% or more, even more preferably 5 mass% or more, from the viewpoint of imparting higher shape sustainability and strength to naturally derived fibers after treatment, and preferably 80 mass% or less, more preferably 60 mass% or less, further more preferably 50 mass% or less, even more preferably 40 mass% or less, even more preferably 30 mass% or less, even more preferably 25 mass% or less, even more preferably 20 mass% or less, from the viewpoint of improving the feel of the fiber surfaces in addition to the above-described viewpoints. That is, the content of a constituent element derived from the component (B) in the fiber-treating agent of the present invention is preferably from 0.1 to 80 mass%, more preferably from 1 to 60 mass%, further more preferably from 1.5 to 50 mass%, even more preferably from 3 to 40 mass%, even more preferably from 5 to 30 mass%, even more preferably from 5 to 25 mass%, even more preferably from 5 to 20 mass%, based on the total composition of the fiber-treating agent, from the viewpoint of imparting higher shape sustainability and strength to naturally derived fibers after treatment and the viewpoint of improving the feel of the fiber surfaces. Herein, the term "constituent element derived from component (B)" refers, in the case of the one-part type, to a constituent part derived from the component (B) in the condensate and the remaining component (B), and refers, in the case of the multiple-part type, to the component (B) itself. When a mixture containing the component (B), such as a mixture containing catechins, such as a tea extract, is used, the term "constituent element derived from component (B)" refers to the component (B) contained in the mixture.

[0044] The total content of a constituent element derived from the component (A) and a constituent element derived from the component (B) in the fiber-treating agent of the present invention is preferably 0.1 mass% or more, more preferably 1 mass% or more, further more preferably 5 mass% or more, further more preferably 10 mass% or more, further more preferably 15 mass% or more, further more preferably 20 mass% or more, based on the total composition of the fiber-treating agent, from the viewpoint of imparting higher shape sustainability and strength to naturally derived fibers after treatment, and preferably 80 mass% or less, more preferably 70 mass% or less, further more preferably 60 mass% or less, further more preferably 50 mass% or less, further more preferably 40 mass% or less, based on the total composition of the fiber-treating agent, from the viewpoint of improving the feel of the fiber surfaces.

[0045] The molar ratio of a constituent element derived from the component (A) to a constituent element derived from the component (B), (A)/(B), in the fiber-treating agent of the present invention is preferably 0.1 or more, more preferably 0.3 or more, further more preferably 0.5 or more, from the viewpoint of further improving the shape sustainability and strength of naturally derived fibers after treatment by a condensate of the components which is formed in the naturally derived fibers, and preferably less than 20, more preferably 15 or less, further more preferably 10 or less, even more preferably 7.5 or less, from the viewpoint of a good feel.

[0046] That is, the molar ratio of a constituent element derived from the component (A) to a constituent element derived from the component (B), (A)/(B), is preferably 0.1 or more and less than 20, more preferably from 0.3 to 15, further more preferably from 0.5 to 10, even more preferably from 0.5 to 7.5, from the viewpoint of further improving the shape sustainability and strength of naturally derived fibers after treatment by a condensate of the components which is formed in the naturally derived fibers, and the viewpoint of a good feel.

[Component (C): water]

[0047] The fiber-treating agent of the present invention has (C) water as a medium. The content of the component (C) in the fiber-treating agent of the present invention is preferably 10 mass% or more, more preferably 20 mass% or more, further more preferably 30 mass% or more, even more preferably 40 mass% or more, and preferably 99 mass% or less, more preferably 97 mass% or less, further more preferably 95 mass% or less, even more preferably 90 mass% or less, based on the total composition of the fiber-treating agent.

[0048] That is, the content of the component (C) in the fiber-treating agent of the present invention is preferably from 10 to 99 mass%, more preferably from 20 to 97 mass%, further more preferably from 30 to 95 mass%, even more preferably from 40 to 90 mass%, based on the total composition of the fiber-treating agent.

[0049] The fiber-treating agent of the present invention can be not only of one-part type, but also in the form of multiple-part type which comprises a plurality of compositions and in which fibers are immersed sequentially. Examples of the multiple-part type fiber-treating agent include those in which all parts have (C) water as a medium and the component (A) and the component (B) are contained in different parts, for example, those comprising a first part containing the components (B) and (C) and a second part containing the components (A) and (C).

[Component (D): organic compound having a Hansen solubility parameter SP value of from 16 to 40 $\mathrm{Mpa}^{1/2}$]

[0050] If an insoluble condensate having a large molecular weight is formed in the fiber-treating agent of the present invention by a reaction with the components (A) and (B) when the fiber-treating agent is a one-part type, motions, such as bending and stretching, of naturally derived fibers may be restricted by a hard resin layer formed on the surfaces of the naturally derived fibers, resulting in not only impairment of the stretchability (tenacity) of the fibers but also deterioration of the feel of the fiber surfaces. Thus, it is preferable that the one-part type fiber-treating agent contains an organic compound having a Hansen solubility parameter SP value of 16 $\mathrm{Mpa}^{1/2}$ or more and 40 $\mathrm{Mpa}^{1/2}$ or less (excluding organic salts and compounds having an aldehyde group and having a molecular weight of 150 or less) from the viewpoint of easily dissolving oligomeric condensation products of the components (A) and (B), which are formed in the process of reaction and cause an increase in turbidity, by preventing aggregation of the oligomeric condensation products. Since organic salts, which have charge, rapidly increase the turbidity when present in the system, and compounds having an aldehyde group, such as glutaraldehyde, rapidly increase the turbidity by crosslinking phenol compounds of the component (B) at multiple points, the organic salts and the compounds having an aldehyde group are excluded from the component (D).

[0051] In the present invention, the Hansen solubility parameter SP value refers to δTot ($\mathrm{Mpa}^{1/2}$) calculated at 25°C in the DIY program using Software Package HSPiP 4th Edition 4.1.07 based on Hansen Solubility Parameters: A User's handbook, CRC Press, Boca Raton FL, 2007.

[0052] Examples of the organic compound having a Hansen solubility parameter SP value of 16 $\mathrm{Mpa}^{1/2}$ or more and 40 $\mathrm{Mpa}^{1/2}$ or less in the compound (D) include monohydric alcohols, dihydric alcohols, dihydric alcohol derivatives, polyhydric alcohols with a valence number of 3 or more, lactam, imidazolidinone, pyrimidinone, lactone, alkylene carbonate, and other general-purpose organic solvents whose SP value is within the above-described range.

[0053] Specific examples of the compound having a Hansen solubility parameter SP value of 16 $\mathrm{Mpa}^{1/2}$ or more and 40 $\mathrm{Mpa}^{1/2}$ or less are listed below. The parenthesized numerical value in each example is a SP value calculated by the above-described method.

- Examples of monohydric alcohol: ethanol (25.4), 1-propanol (22.9), isopropyl alcohol (22.3) and 1-butanol (22.9)
- Examples of dihydric alcohol: ethylene glycol (31.6), diethylene glycol (29.2), triethylene glycol (26.1), tetraethylene glycol (24.3), pentaethylene glycol (23.1), hexaethylene glycol (22.2), propylene glycol (31.7), 1-dipropylene glycol (26.0) and tripropylene glycol (23.4)
- Examples of dihydric alcohol derivative: dipropylene glycol monomethyl ether (21.1), dipropylene glycol dimethyl ether (17.8), dipropylene glycol diacetate (19.0) and dipropylene glycol monomethyl ether acetate (18.5)
- Examples of polyhydric alcohol with a valence number of 3 or more: glycerin (35.7) and sorbitol (35.8)
- Examples of lactam: 2-pyrrolidone (24.8) and N-methylpyrrolidone (22.0)
- Examples of imidazolidinone: urea of ethylene (28.5), 1,3-dimethyl-2-imidazolidinone (22.3)
- Examples of pyrimidinone: N,N'-dimethylpropyleneurea (21.3)
- Examples of lactone: γ-butyrolactone (24.6)
- Examples of alkylene carbonate: ethylene carbonate (29.2) and propylene carbonate (27.1)
- Examples of general-purpose organic solvent: DMF (N,N-dimethylformamide) (24.2), DMAc (N,N-dimethylacetamide) (23.0), DMSO (dimethylsulfoxide) (23.6), THF (tetrahydrofuran) (18.2), 1,4-dioxane (20.5) and acetonitrile (23.9)

[0054] Among them, compounds having a Hansen solubility parameter SP value of 35.8 $\mathrm{Mpa}^{1/2}$ or less are preferable, compounds having a Hansen solubility parameter SP value of 34.7 $\mathrm{Mpa}^{1/2}$ or less are more preferable, and compounds having a Hansen solubility parameter SP value of 29.2 $\mathrm{Mpa}^{1/2}$ or less are further more preferable, from the viewpoint of being able to maintain low turbidity over a longer time by adequately dissolving a condensate of the components (A) and (B) which is formed in the process of reaction and causes an increase in turbidity. From the same viewpoint, compounds having a Hansen solubility parameter SP value of 17.8 $\mathrm{Mpa}^{1/2}$ or more are preferable, compounds having a Hansen solubility parameter SP value of 21.1 $\mathrm{Mpa}^{1/2}$ or more are more preferable, and compounds having a Hansen solubility parameter SP value of 22.0 $\mathrm{Mpa}^{1/2}$ or more are more preferable.

[0055] Among them, dihydric alcohols, lactam and imidazolidinone are preferable, and at least one selected from the group consisting of diethylene glycol (29.2), triethylene glycol (26.1), N-methylpyrrolidone (22.0) and 1,3-dimethyl-2-imidazoridinone (22.3) is more preferable.

[0056] Any one component (D) may be used alone, or two or more compounds (D) may be used in combination. The content of the component (D) in the fiber-treating agent of the present invention is preferably 10 mass% or more, more preferably 15 mass% or more, further more preferably 25 mass% or more, from the viewpoint of maintaining longer a state in which the turbidity of the fiber-treating agent is low, and preferably 80 mass% or less, more preferably 60 mass% or less, further more preferably 45 mass% or less, from the viewpoint of efficiently carrying out a condensation reaction and further improving the shape sustainability and strength of naturally derived fibers after treatment by a condensate of the component (A) and the component (B) which is formed in the naturally derived fibers.

[Component (E): Sulfur-containing reducing agent]

[0057] It is preferable that the fiber-treating agent of the present invention contain a sulfur-containing reducing agent from the viewpoint of improving the heat resisting temperature and suppressing coloring of naturally derived fibers after treatment, and suppressing an increase in turbidity of the fiber-treating agent during heating treatment.

[0058] Examples of the component (E) include sulfurous acid salts and thiol compounds. The sulfurous acid salt is preferably sodium sulfite or sodium pyrosulfite, and the thiol compound is preferably thioglycerol or Mesna (sodium 2-mercaptoethanesulfonate) because compounds having a carboxy group (for example thioglycolic acid) or an amino group (for example cysteamine) cause yellowish coloring, resulting in deterioration of suitability as a hair ornament product. Above all, sodium sulfite is preferable.

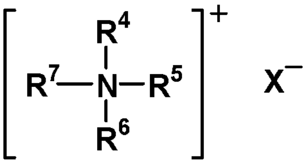
[0059] Any one component (E) may be used alone, or two or more components (E) may be used in combination. The content of the component (E) in the fiber-treating agent of the present invention is preferably 0.1 mass% or more, more preferably 0.5 mass% or more, further more preferably 2.0 mass% or more, based on the total composition of the fiber-treating agent, from the viewpoint of improving the heat resisting temperature, suppressing coloring and suppressing an increase in turbidity during heating treatment, and preferably 20 mass% or less, more preferably 10 mass% or less, further more preferably 5.0 mass% or less, based on the total composition of the fiber-treating agent, from the viewpoint of suppressing a decrease in fiber strength due to a reducing action. When the fiber-treating agent is of multiple-part type, the component (E) may be contained in the first part, or may be contained in the second part, or may be contained in both the first part and the second part.

[0060] The molar ratio of the component (E) to the component (A), (E)/(A), is preferably 0.1 or more, more preferably 0.3 or more, further more preferably 0.5 or more, from the viewpoint of sufficiently exhibiting the effect of improving the heat resistance and the effect of suppressing coloring of fibers treated with the component (E) and the effect of suppressing an increase in turbidity of the fiber-treating agent, and preferably 3.0 or less, more preferably 1.5 or less, further more preferably 1.0 or less from the viewpoint of suppressing a decrease in fiber strength by a reducing action.

[Cationic surfactant]

[0061] The fiber-treating agent of the present invention may contain a cationic surfactant as long as the effects of the present invention are not impaired. The cationic surfactant is preferably a long chain monoalkyl quaternary ammonium salt having one alkyl group having 8 to 24 carbon atoms and three alkyl groups having 1 to 4 carbon atoms.

[0062] Preferably, at least one long chain monoalkyl quaternary ammonium surfactant is selected from the group consisting of compounds of the following formula:



$$\left[\begin{array}{c} R^4 \\ | \\ R^7\text{—}N\text{—}R^5 \\ | \\ R^6 \end{array}\right]^+ X^-$$

wherein R^4 is a saturated or unsaturated linear or branched alkyl group having 8 to 22 carbon atoms, R^8-CO-NH-$(CH_2)_m$- or R^8-CO-O-$(CH_2)_m$- (R^8 represents a saturated or unsaturated linear or branched alkyl chain having 7 to 21 carbon atoms, and m represents an integer of 1 to 4), R^5, R^6 and R^7 independently represent an alkyl group having 1 to 4 carbon atoms, or a hydroxyalkyl group having 1 to 4 carbon atoms, and X^-represents a hydrochloride ion, a bromide ion, a methosulfate ion or an ethosulfate ion.

[0063] Examples of the suitable cationic surfactant include long chain quaternary ammonium compounds such as cetyltrimethylammonium chloride, myristyltrimethylammonium chloride, behentrimonium chloride, cetyltrimethylammonium bromide and stearamidopropyltrimonium chloride. One of them may be used alone, or a mixture thereof may be used.

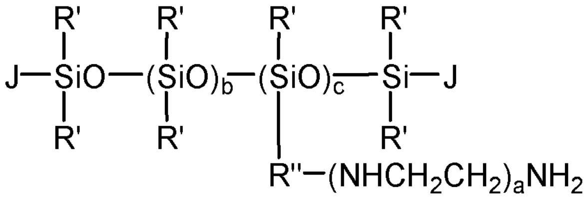
[0064] The content of the cationic surfactant in the fiber-treating agent of the present invention is preferably 0.05 mass% or more, more preferably 0.1 mass% or more, and preferably 10 mass% or less, more preferably 5 mass% or less, based on the total composition of the fiber-treating agent, from the viewpoint of improving the feel of naturally derived fibers after treatment to further improve the effects of the present invention. When the fiber-treating agent is of multiple-part type, the cationic surfactant may be contained in the first part, or may be contained in the second part, or may be contained in both the first part and the second part.

[Silicone]

[0065] The fiber-treating agent of the present invention may contain silicone from the viewpoint of improving the feel of naturally derived fibers after treatment, and improving styling ease. The silicone is preferably one or more selected from the group consisting of dimethylpolysiloxane and amino-modified silicone.

[0066] As the dimethylpolysiloxane, any of cyclic or acyclic dimethylsiloxane polymers can be used, and examples thereof include SH200 Series, BY22-019, BY22-020, BY11-026, B22-029, BY22-034, BY22-050A, BY22-055, BY22-060, BY22-083 and FZ-4188 (each manufactured by Dow Corning Toray), and KF-9088, KM-900 Series, MK-15H and MK-88 (each manufactured by Shin-Etsu Chemical Co., Ltd.).

[0067] As the amino-modified silicone, any silicone having an amino group or an ammonium group can be used, and examples thereof include amino-modified silicone oil which is terminal-blocked at all or a part of terminal hydroxyl groups with a methyl group or the like, and amodimethicone which is not terminal-blocked. Examples of the amino-modified silicone preferable from the viewpoint of improving the feel of naturally derived fibers after treatment and improving styling ease include compounds of the following formula:



$$J-\overset{R'}{\underset{R'}{SiO}}-(\overset{R'}{\underset{R'}{SiO}})_b-(\overset{R'}{\underset{R''-(NHCH_2CH_2)_aNH_2}{SiO}})_c-\overset{R'}{\underset{R'}{Si}}-J$$

wherein R' represents a hydrogen atom, a hydroxy group or R^X, where R^X represents a substituted or unsubstituted monovalent hydrocarbon group having 1 to 20 carbon atoms, J represents R^X, $R''-(NHCH_2CH_2)aNH_2$, OR^X or a hydroxy group, R" represents a divalent hydrocarbon group having 1 to 8 carbon atoms, a represents a number of 0 to 3, and b and c represent numbers whose sum is 10 or more and less than 20,000, preferably 20 or more and less than 3,000, more preferably 30 or more and less than 1,000, further more preferably 40 or more and less than 800, in terms of number average.

[0068] Specific examples of the suitable marketed product of amino-modified silicone include amino-modified silicone oils such as SF8452C and SS3551 (each manufactured by Dow Corning Toray) and KF-8004, KF-867S and KF-8015 (each manufactured by Shin-Etsu Chemical Co., Ltd.), and amodimethicone emulsions such as SM8704C, SM8904, BY22-079, FZ-4671 and FZ4672 (each manufactured by Dow Corning Toray).

[0069] The content of the silicone in the fiber-treating agent of the present invention is preferably 0.1 mass% or more, more preferably 0.2 mass% or more, further more preferably 0.5 mass% or more, and preferably 20 mass% or less, more preferably 10 mass% or less, further more preferably 5 mass% or less, based on the total composition of the fiber-treating agent, from the viewpoint of improving the feel of naturally derived fibers after treatment to further improve the effects of the present invention. When the fiber-treating agent is of multiple-part type, the silicone may be contained in the first part, or may be contained in the second part, or may be contained in both the first part and the second part.

[Cationic polymer]

[0070] The fiber-treating agent of the present invention may contain a cationic polymer from the viewpoint of improving the feel of naturally derived fibers after treatment.

[0071] The cationic polymer refers to a polymer having a cationic group, or a group capable of being ionized into a cationic group, and also includes a generally cationic ampholytic polymer. That is, examples of the cationic polymer include those in the form of an aqueous solution, which contain an amino group or an ammonium group on the side chain of the polymer chain or contain a diallyl quaternary ammonium salt as a constituent unit, for example, cationized cellulose derivatives, cationic starch, cationized guar gum derivatives, polymers or copolymers of a diallyl quaternary ammonium salt, and quaternized polyvinylpyrrolidone derivatives. Among them, one or more selected from the group consisting of a polymer containing a diallyl quaternary ammonium salt as a constituent unit, a quaternized polyvinylpyrrolidone derivative and a cationized cellulose derivative are preferable, and one or more selected from the group consisting of a polymer or copolymer of a diallyl quaternary ammonium salt and a cationized cellulose derivative are more preferable, from the viewpoint of improving the effects of softness, smoothness and finger-combability in the feel during rinsing and shampooing and ease of styling and moisture retainability during blowing, and the stability of the agent.

[0072] Specific examples of the suitable polymer or copolymer of a diallyl quaternary ammonium salt include dimethyldiallylammonium chloride polymers (polyquaternium-6, for example, MERQUAT 100; Lubrizol Advanced Materials, Inc.), dimethyldiallylammonium chloride/acrylic acid copolymers (polyquaternium-22, for example, MERQUATs 280 and

295; Lubrizol Advanced Materials, Inc.), and dimethyldiallylammonium chloride/acrylamide copolymers (polyquaternium-7, for example, MERQUAT 550; Lubrizol Advanced Materials, Inc.).

[0073] Specific examples of the suitable quaternized polyvinylpyrrolidone derivative include polymers obtained by polymerizing a vinylpyrrolidone copolymer and dimethylaminoethyl methacrylate (polyquaternium 11, for example, GAFQUAT 734, GAFQUAT 755 and GAFQUAT 755N (Ashland Inc.)).

[0074] Specific examples of the suitable cationized cellulose include polymers obtained by adding glycidyltrimethylammonium chloride to hydroxycellulose (polyquaternium 10, for example, LEOGARDs G and GP (Lion Corporation) and POLYMERs JR-125, JR-400, JR-30M, LR-400 and LR-30M (Amerchol Corporation)), and hydroxyethylcellulose dimethyldiallylammonium chloride (polyquaternium-4, for example, CELQUATs H-100 and L-200 (Akzo Nobel N.V.).

[0075] The content of the cationic polymer in the fiber-treating agent of the present invention is preferably 0.001 mass% or more, more preferably 0.01 mass% or more, further more preferably 0.05 mass% or more, and preferably 20 mass% or less, more preferably 10 mass% or less, based on the total composition of the fiber-treating agent, from the viewpoint of improving the feel of naturally derived fibers after treatment. When the fiber-treating agent is of multiple-part type, the cationic polymer may be contained in the first part, or may be contained in the second part, or may be contained in both the first part and the second part.

[0076] Further, the fiber-treating agent of the present invention may contain an antioxidant such as ascorbic acid, and a pH adjuster such as sodium hydroxide, potassium hydroxide, phosphoric acid or hydrochloric acid.

[pH]

[0077] When the fiber-treating agent of the present invention is a one-part type, the pH of the fiber-treating agent is preferably 3.0 or more, more preferably 3.5 or more, further more preferably 4.0 or more, and preferably 11.0 or less, more preferably 9.0 or less, further more preferably 7.0 or less, from the viewpoint of suppressing damage to naturally derived fibers. The pH in the present invention is a value at 25°C.

[0078] That is, when the pH of the fiber-treating agent of the present invention is a one-part type, the pH of the fiber-treating agent is preferably from 3.0 to 11.0, more preferably from 3.5 to 9.0, further more preferably from 4.0 to 7.0, from the viewpoint of suppressing damage to naturally derived fibers.

[0079] In the case of the multiple-part type, it is preferable that the pHs of both a part containing the component (A), that is, the second part and a part containing the component (B), that is, the first part be in the above-described range. In the present invention, the pH of the hair-treating agent shows a value obtained by performing measurement directly at room temperature (25°C) by a pH meter (manufactured by HORIBA, Ltd./Model: F-52) without diluting the hair-treating agent.

[Method for storing fiber-treating agent]

[0080] When the fiber-treating agent produced as described above is transported and stored before being applied to fibers, the storage temperature can be set to a cool temperature for the purpose of preventing coloring of the component (B) by oxidation, and progress of an unintentional reaction during transportation. The storage temperature is preferably 1°C or higher, more preferably 2°C or higher, further more preferably 5°C or higher, from the viewpoint of preventing occurrence of freezing and recrystallization, and preferably 25°C or lower, more preferably 20°C or lower, further more preferably 15°C or lower, from the viewpoint of preventing coloring by oxidation and progress of an unintentional reaction.

[Method for treating fibers]

(Basic treatment)

[0081] When using the fiber-treating agent of the present invention, naturally derived fibers are treated by a method comprising the following step (i), it is possible to impart shape sustainability and high durability to the naturally derived fibers while maintaining high stretchability (tenacity) of the naturally derived fibers.

(i) Immersing naturally derived fibers in the fiber-treating agent of the present invention.

[0082] When the fiber-treating agent is of multiple-part type, and comprises, for example, the first part containing the components (B) and (C) and the second part containing the components (A) and (C), the step (i) is a step of immersing fibers in one of the first part and the second part, and then in the other, and it is preferable that the fibers be immersed first in the first part, and then in the second part.

[0083] When the fiber-treating agent of the present invention is a one-part type, the fiber-treating agent may be directly applied to fibers, but when the fiber-treating agent is applied to the fibers after being heated for a certain time without causing an increase in turbidity of the treating agent, the stretchability of the fibers can be further enhanced. For this reason, the following step (0) may be provided before the step (i) .

(0) step of heating fiber-treating agent

[0084] The heating treatment in the step (0) is preferably 40°C or higher, more preferably 45°C or higher, further more preferably 50°C or higher, from the viewpoint of improvement of productivity, and preferably 100°C or lower, more preferably 80°C or lower, further more preferably 70°C or lower, from the viewpoint of being able to stop heating at an appropriate point.

[0085] Assuming that T is a heating time until the treating agent has a turbidity of more than 1,000 NTU after the treating agent is heated immediately after being prepared by mixing the components, the heating time in the step (0) is preferably 0.2T or more, more preferably 0.3T or more, further more preferably 0.4T or more, from the viewpoint of exhibiting a stretchability improving effect on naturally derived fibers, and preferably 0.8T or less, more preferably 0.7T or less, further more preferably 0.6T or less, from the viewpoint of exhibiting ability to treat naturally derived fibers for a long time.

[0086] Here, NTU (nephelometric turbidity unit) is a unit of turbidity in a turbidimetric method using formazin as a turbidity standard solution. The turbidity of the fiber-treating agent can be measured at room temperature (25°C) with the fiber-treating agent directly placed in a measurement cell of a digital turbidimeter (manufactured by AS ONE Corporation/model: TB700).

[0087] In the step (i), the naturally derived fibers immersed in the fiber-treating agent may be dry or wet. The amount of the fiber-treating agent in which the naturally derived fibers are immersed is preferably 2 or more, more preferably 3 or more, further more preferably 5 or more, even more preferably 10 or more, even more preferably 20 or more, and preferably 500 or less, more preferably 250 or less, further more preferably 100 or less, in terms of bath ratio to the mass of the naturally derived fibers (mass of fiber-treating agent/mass of naturally derived fibers).

[0088] That is, the bath ratio is preferably from 2 to 500, more preferably from 3 to 250, further more preferably from 5 to 100, even more preferably from 10 to 100, even more preferably from 20 to 100. When the fiber-treating agent is of multiple-part type, the above-described bath ratio is applied for each part.

[0089] In the step (i), the naturally derived fibers may be fixed with a curler or the like, followed by immersion in the fiber-treating agent of the present invention under heating. This enables a desired shape to be imparted to the naturally derived fibers together with shape sustainability and high durability.

[0090] It is preferable that the immersion of the naturally derived fibers in the fiber-treating agent in the step (i) be performed under heating, and this heating is performed by heating the fiber-treating agent. This heating may be performed by immersing the naturally derived fibers in the fiber-treating agent being heated, or by immersing the naturally derived fibers in the fiber-treating agent at a low temperature, and then performing heating. The temperature of the fiber-treating agent is preferably 20° or higher, more preferably 35°C or higher, further more preferably 45°C or higher for increasing interaction of the component (A) and the component (B) with fiber constituent molecules, for example protein molecules, in the naturally derived fibers, and accelerating a condensation reaction between the component (A) and the component (B) in the naturally derived fibers to obtain the effects of the present invention, and preferably lower than 100°C, more preferably 80°C or lower, further more preferably 70°C or lower, further more preferably 60°C or lower for preventing the naturally derived fibers from being degenerated by heat and thus degraded. When the fiber-treating agent is of multiple-part type, the above-described temperature is applied for each part.

[0091] The component (A) and the component (B) in the fiber-treating agent form a condensate after infiltration into the fiber, so that the effects of the present invention are exhibited by interaction with the fiber, and even in the one-part type fiber-treating agent, the components (A) and (B) are fused with each other to form a water-soluble condensate, and similarly form a condensate having a larger molecular weight after infiltration into the fiber, so that the effects of the present invention are exhibited. On the other hand, with the progress of fiber treatment, the water-soluble condensates in the one-part type fiber-treating agent are bonded to each other to gradually form water-insoluble condensates, leading to an increase in turbidity of the fiber-treating agent. If the water-insoluble condensate comes into contact with the fibers, a hard resin layer is formed on the surfaces of the fibers, and thus motions, such as bending and stretching, of the fibers are restricted, so that it is difficult to maintain the stretchability (tenacity) of the fibers. Thus, from the viewpoint of further enhancing the stretchability (tenacity) of naturally derived fibers and improving the feel of the fiber surfaces, it is desirable to carry out the step (i) in a state in which the turbidity of the one-part type fiber-treating agent is as low as possible. The turbidity of the fiber-treating agent during treatment is preferably 1,000 NTU or less, more preferably 500 NTU or less, further more preferably 100 NTU or less, further more preferably 20 NTU or less. The turbidity of the fiber-treating agent refers to one from turbidness originating from a condensate of the components (A) and (B), and when other components causing turbidness are present, only turbidness caused by the condensate of the components (A) and (B) is taken into account. The amount of the condensate can be determined by, for example, a derivatization-pyrolysis GC/MS method after filtration with a membrane filter having a pore diameter of 0.1 μm.

[0092] Assuming that T is a heating time until the treating agent has a turbidity of more than 1,000 NTU after the treating agent is heated immediately after being prepared by mixing the components, the immersion time in the step (i) when the fiber-treating agent is a one-part type is preferably 0.3T or more, more preferably 0.4T or more, further more preferably 0.5T or more, from the viewpoint of exhibiting a stretchability improving effect on naturally derived fibers, and preferably 0.95T or less, more preferably 0.90T or less, further more preferably 0.85T or less, for suppressing damage to naturally derived fibers.

[0093] The specific immersion time is appropriately adjusted depending on a heating temperature used, and is preferably 15 minutes or more, more preferably 30 minutes or more, further more preferably 1 hour or more, from the viewpoint of exhibiting a stretchability improving effect on naturally derived fibers, and preferably 48 hours or less, more preferably 24 hours or less, further more preferably 12 hours or less for suppressing damage to naturally derived fibers, for example. When the fiber-treating agent is of multiple-part type, the immersion time is applied for each part.

[0094] It is preferable to carry out the step (i) in an environment where evaporation of moisture is suppressed. Examples of the specific means for suppressing evaporation of moisture include a method in which a container of the fiber-treating agent in which naturally derived fibers are immersed is covered with a film-shaped material, a cap, a lid or the like made of a material impermeable to water vapor.

[0095] After the step (i), the naturally derived fibers may be rinsed, or is not required to be rinsed, and it is preferable to rinse the naturally derived fibers from the viewpoint of preventing deterioration of the feel of the naturally derived fibers by an excess polymerized product.

[0096] These treatments may allow the components (A) and (B) to infiltrate the naturally derived fibers and interact with fiber constituent molecules, for example protein molecules, in the naturally derived fibers. In the naturally derived fibers, a condensate of the component (A) and the component (B) is formed. Therefore, the naturally derived fibers treated by the method of the present invention does not lose shape even when washed.

[0097] If the turbidity of the treating agent increases during treatment in the step (i) when the fiber-treating agent is a one-part type, a hard resin layer is formed on the surfaces of naturally derived fibers, so that it is difficult to maintain high stretchability (tenacity) of the naturally derived fibers, and it is difficult to secure a good feel of the fiber surfaces, and therefore it is preferable to take out the naturally derived fibers from the treating agent before the turbidity of the treating agent exceeds 1,000 NTU. The turbidity of the treating agent can be confirmed by the above-described turbidity measurement method with a sample appropriately taken from the treating agent. If the naturally derived fibers taken out during treatment have not been sufficiently treated, the step (i) may be carried out again. That is, when the fiber-treating agent is a one-part type, it is preferable to provide the following step (ii-2) after the step (i) and repeat the step (i) and the step (ii-a) two or more times.

[0098] (ii-a) Taking out naturally derived fibers from the treating agent before the turbidity of the one-part type treating agent exceeds 1,000 NTU.

[0099] On the other hand, when the fiber-treating agent is of multiple-part type, naturally derived fibers may be merely taken out from the treating agent by the following the step (ii-b) after the step (i).

[0100] (ii-b) Taking out naturally derived fibers from the treating agent.

[0101] It is preferable to wash out insoluble condensates by rinsing the surfaces of naturally derived fibers after the naturally derived fibers are taken out from the treating agent in the step (ii-a) or the step (ii-b). That is, it is preferable to carry out the following step (iii) after the step (ii).

(iii) Rinsing naturally derived fibers taken out

[0102] It is desirable that the rinsing in the step (iii) be performed using a composition containing the component (D). The rinsing composition may be composed only of the component (D), or may contain water in addition to the component (D). When water is contained, the content of the component (D) in the rinsing composition is preferably 60 mass% or more, more preferably 80 mass% or more, further more preferably 95 mass% or more.

[Optionally added treatment]

[0103] In the method for treating fibers according to the present invention, one or more treatments selected from the group consisting of bleaching, dyeing, surface finish for imparting hydrophobicity and reducing friction, and heating treatment for further improving fiber stretchability (tenacity) may be performed in addition to the steps (i) to (iii).

[0104] Here, the treatments of bleaching and dyeing may be performed before or after the steps (i) to (iii), or between the steps (i) to (iii). A plurality of steps may be combined and added, and when both bleaching and dyeing are added, any of the treatments may be performed first except that it is necessary to perform bleaching before dyeing. It is also possible to perform another treatment between bleaching and dyeing.

[0105] On the other hand, it is necessary that surface finish for imparting hydrophobicity and reducing friction and heating treatment for further improving fiber stretchability (tenacity) be performed after the steps (i) to (iii). As long as surface finish for imparting hydrophobicity and reducing friction and heating treatment for further improving fiber stretchability (tenacity) are performed after the steps (i) to (iii) as described above, their treatment order relation with bleaching and dyeing is not particularly limited. One of surface finish for imparting hydrophobicity and reducing friction and heating treatment for further improving fiber stretchability (tenacity) may be performed before or after the other.

(Bleaching)

[0106] The bleaching is performed by immersing naturally derived fibers in a bleach composition containing an alkali agent, an oxidizing agent and water. The bleach composition is typically of two-part type. The first part contains an alkali agent and water, and the second part contains an oxidizing agent and water. These two parts are typically stored separately, and mixed before immersion of naturally derived fibers.

[0107] Examples of the suitable alkali agent include, but are not limited to, ammonia and salts thereof; alkanolamines (monoethanolamine, isopropanolamine, 2-amino-2-methylpropanol, 2-aminobutanol and the like) and salts thereof; alkanediamines (1,3-propanediamine and the like) and salts thereof; carbonates (guanidine carbonate, sodium carbonate, potassium carbonate, sodium hydrogen carbonate, potassium hydrogen carbonate and the like); and mixtures thereof.

[0108] The content of the alkali agent in the bleach composition (mixture of first part and second part for two-agent type) is preferably 0.1 mass% or more, more preferably 0.5 mass% or more, further more preferably 1 mass% or more, and preferably 15 mass% or less, more preferably 10 mass% or less, further more preferably 7.5 mass% or less).

[0109] Examples of the suitable oxidizing agent include, but are not limited to, hydrogen peroxide, urea peroxide, melamine peroxide and sodium bromate. Among these oxidizing agents, hydrogen peroxide is preferable.

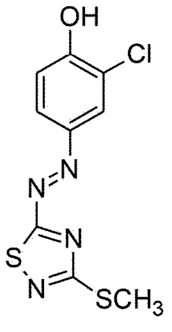
[0110] The content of the oxidizing agent in the bleach composition is preferably 1 mass% or more, more preferably 2 mass% or more, and preferably 15 mass% or less, more preferably 12 mass% or less, further more preferably 9 mass% or less.

[0111] When the first part and the second part are stored separately, the pH of the second part at 25°C is preferably 2 or more, more preferably 2.5 or more, and preferably 6 or less, more preferably 4 or less. The pH can be adjusted by a suitable buffering agent. The pH of the bleach composition at 25°C is preferably 6 or more, more preferably 6.5 or more, further more preferably 6.8 or more, and preferably 11 or less, more preferably 10.5 or less, further more preferably 10 or less.

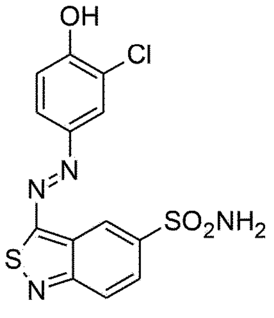
(Dyeing)

[0112] The dyeing is performed by immersing naturally derived fibers in a dyeing composition. The dyeing composition contains a dye, and optionally contains an alkali agent or an acid, an oxidizing agent or the like. Examples of the dye include direct dyes, oxidizing dyes, and combinations thereof.

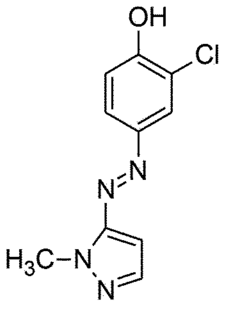
[0113] The type of the direct dye is not particularly limited, and any direct dye suitable for dyeing can be used. Examples of the direct dye include anionic dyes, nitro dyes, disperse dyes, cationic dyes, and dyes having an azo-phenol structure selected from the group consisting of the following HC Red 18, HC Blue 18 and HC Yellow 16, salts thereof, and mixtures thereof.



HC Red 18



HC Blue 18



HC Yellow 16

[0114] Examples of the cationic dye include, but are not limited to, Basic Blue 6, Basic Blue 7, Basic Blue 9, Basic Blue 26, Basic Blue 41, Basic Blue 99, Basic Brown 4, Basic Brown 16, Basic Brown 17, Natural Brown 7, Basic Green 1, Basic Orange 31, Basic Red 2, Basic Red 12, Basic Red 22, Basic Red 51, Basic Red 76, Basic Violet 1, Basic Violet 2, Basic Violet 3, Basic Violet 10, Basic Violet 14, Basic yellow 57, Basic Yellow 87, and mixtures thereof. Basic Red 51, Basic Orange 31, Basin Yellow 87 and Mixtures thereof are particularly preferable.

[0115] Examples of the anionic dye include, but are not limited to, Acid Black 1, Acid Blue 1, Acid Blue 3, Food Blue 5, Acid Blue 7, Acid Blue 9, Acid Blue 74, Acid Orange 3, Acid Orange 4, Acid Orange 6, Acid Orange 7, Acid Orange 10, Acid Red 1, Acid Red 14, Acid Red 18, Acid Red 27, Acid Red 33, Acid Red 50, Acid Red 52, Acid Red 73, Acid Red 87, Acid Red 88, Acid Red 92, Acid Red 155, Acid Red 180, Acid Violet 2, Acid Violet 9, Acid Violet 43, Acid Violet 49, Acid Yellow 1, Acid Yellow 10, Acid Yellow 23, Acid Yellow 3, Food Yellow No. 8, D&C Brown No. 1, D&C Green No. 5, D&C Green No. 8, D&C Orange No. 4, D&C Orange No. 10, D&C Orange No. 11, D&C Red No. 21, D&C Red No. 27, D&C Red No. 33, D&C Violet 2, D&C Yellow No. 7, D&C Yellow No. 8, D&C Yellow No. 10, FD&C Red 2, FD&C Red 40, FD&C Red No. 4, FD&C Yellow No. 6, FD&C Blue 1, Food Black 1, Food Black 2, alkali metal salts (sodium salts, potassium salts and the like), and mixtures thereof.

[0116] Among them, preferred anionic dyes are Acid Black 1, Acid Red 52, Acid Violet 2, Acid Violet 43, Acid Red 33, Acid Orange 4, Acid Orange 7, Acid Red 27, Acid Yellow 3, Acid Yellow 10, and salts thereof. More preferred anionic dyes are Acid Red 52, Acid Violet 2, Acid red 33, Acid Orange 4, Acid Yellow 10, and salts and mixtures thereof.

[0117] Examples of the nitro dye include, but are not limited to, HC Blue No. 2, HC Blue No. 4, HC Blue No. 5, HC Blue No. 6, HC Blue No. 7, HC Blue No. 8, HC Blue No. 9, HC Blue No. 10, HC Blue No. 11, HC Blue No. 12, HC Blue No. 13, HC Brown No. 1, HC Brown No. 2, HC Green No. 1, HC Orange No. 1, HC Orange No. 2, HC Orange No. 3, HC Orange No. 5, HC Red BN, HC Red No. 1, HC Red No. 3, HC Red No. 7, HC Red No. 8, HC Red No. 9, HC Red No. 10, HC Red No. 11, HC Red No. 13, HC Red No. 54, HC Red No. 14, HC Violet BS, HC Violet No. 1, HC Violet No. 2, HC Yellow No. 2, HC Yellow No. 4, HC Yellow No. 5, HC Yellow No. 6, HC Yellow No. 7, HC Yellow No. 8, HC Yellow No. 9, HC Yellow No. 10, HC Yellow No. 11, HC Yellow No. 12, HC Yellow No. 13, HC Yellow No. 14, HC Yellow No. 15, 2-amino-6-chloro-4-nitrophenol, picramic acid, 1,2-diamino-4-nitrobenzol, 1,4-diamino-2-nitrobenzol, 3-nitro-4-aminophenol, 1-hydroxy-2-amino-3-nitrobenzol, 2-hydroxyethylepicramic acid, and mixtures thereof.

[0118] Examples of the disperse dye include, but are not limited to, Disperse Blue 1, Disperse Black 9, Disperse Violet 1, and mixtures thereof.

[0119] One of these direct dyes may be used alone, or two or more thereof may be used in combination. Direct dyes different in ionicity may be used in combination.

[0120] The content of the direct dye in the dyeing composition is preferably 0.001 mass% or more, more preferably 0.01 mass% or more, further more preferably 0.05 the mass% or more, from the viewpoint of obtaining sufficient dyeability, and preferably 10 mass% or less, more preferably 7.5 mass% or less, further more preferably 5.0 mass% or less, further more preferably 3.0 mass% or less, from the viewpoint of compatibility.

[0121] When the dyeing composition contains only direct dyes, an oxidizing agent is not necessary for dyeing naturally derived fibers. When it is desirable that naturally derived fibers be light-colored, the composition may contain an oxidizing agent.

[0122] When the dyeing composition contains an oxidizing dye, the composition is typically of two-part type. The first part contains an oxidizing dye intermediate (precursor and coupler) and an alkali agent, and the second part contains an oxidizing agent such as hydrogen peroxide. These two parts are typically stored separately, and mixed before immersion of naturally derived fibers.

[0123] The oxidizing dye intermediate is not particularly limited, and it is possible to suitably use any known of precursors and couplers which are commonly used for dyeing products.

[0124] Examples of the precursor include, but are not limited to, paraphenylenediamine, toluene-2,5-diamine, 2-chloro-paraphenylenediamine, N-methoxyethyl-para-phenylenediamine, N-phenylparaphenylenediamine, N,N-bis(2-hydroxyethyl)-paraphenylenediamine, 2-(2-hydroxyethyl)-paraphenylenediamine, 2,6-dimethyl-paraphenylenediamine, 4,4'-diaminodiphenylamine, 1,3-bis(N-(2-hydroxyethyl)-N-(4-aminophenyl)amino)-2-propanol, PEG-3,3,2'-paraphenylenediamine, paraaminophenol, paramethylaminophenol, 3-methyl-4-aminophenol, 2-aminomethyl-4-aminophenol, 2-(2-hydroxyethylaminoethyl)-4-aminophenol, ortho-aminophenol, 2-amino-5-methylphenol, 2-amino-6-methylphenol, 2-amino-5-acetamidophenol, 3,4-diaminobenzoic acid, 5-aminosalicylic acid, 2,4,5,6-tetraaminopyrimidine, 2,5,6-triamino-4-hydroxypyrimidine, 4,5-diamino-1-(4'-chlorobenzyl)pyrazole, 4,5-diamino-1-hydroxyethylpyrazole, salts of these substances, and mixture thereof.

[0125] Examples of the coupler include, but are not limited to, metaphenylenediamine, 2,4-diaminophenoxyethanol, 2-amino-4-(2-hydroxyethylamino)anisole, 2,4-diamino-5-methylphenetole, 2,4-diamino-5-(2-hydroxyethoxy)toluene, 2,4-dimethoxy-1,3-diaminobenzene, 2,6-bis(2-hydroxyethylamino)toluene, 2,4-diamino-5-fluorotoluene, 1,3-bis(2,4-diaminophenoxy)propane, metaaminophenol, 2-methyl-5-aminophenol, 2-methyl-5-(2-hydroxyethylamino)phenol, 2,4-dichloro-3-aminophenol, 2-chloro-3-amino-6-methylphenol, 2-methyl-4-chloro-5-aminophenol, N-cyclopentyl-metaaminophenol, 2-methyl-4-methoxy-5-(2-hydroxyethylamino)phenol, 2-methyl-4-fluoro-5-aminophenol, paraaminoorthocresol, resorcin, 2-methylresorcin, 4-chlororesorcin, 1-naphthol, 1,5-dihydroxynaphthalene, 1,7-dihydroxynaphthalene, 2,7-dihydroxynaphthalene, 2-isopropyl-5-methylphenol, 4-hydroxyindole, 5-hydroxyindole, 6-hydroxyindole, 7-hydroxyindole, 6-hydroxybenzomorpholine, 3,4-methylenedioxyphenol, 2-bromo-4,5-methylenedioxyphenol, 3,4-methylenedioxyaniline, 1-(2-hydroxyethyl)amino-3,4-methylenedioxybenzene, 2,6-dihydroxy-3,4-dimethylpyridine, 2,6-dimethoxy-3,5-diaminopyridine, 2,3-diamino-6-methoxypyridine, 2-methylamino-3-amino-6-methoxypyridine, 2-amino-3-hydroxypyridine, 2,6-diaminopyridine, salts of these substances, and mixtures thereof.

[0126] The content of each of the precursor and the coupler in the dyeing composition is preferably 0.01 mass% or more, more preferably 0.1 mass% or more, and preferably 10 mass% or less, more preferably 7.5 mass% or less, further more preferably 5 mass% or less.

[0127] When the dyeing composition contains an oxidizing dye, the dyeing composition further contains an alkali agent. Examples of the suitable alkali agent include, but are not limited to, ammonia and salts thereof; alkanolamines (monoethanolamine, isopropanolamine, 2-amino-2-methylpropanol, 2-aminobutanol and the like) and salts thereof; alkanediamines (1,3-propanediamine and the like) and salts thereof; carbonates (guanidine carbonate, sodium carbonate, potassium carbonate, sodium hydrogen carbonate, potassium hydrogen carbonate and the like); and mixtures thereof.

[0128] The content of the alkali agent in the dyeing composition is preferably 0.1 mass% or more, more preferably 0.5 mass% or more, further more preferably 1 mass% or more, and preferably 15 mass% or less, more preferably 10 mass% or less, further more preferably 7.5 mass% or less.

[0129] The composition containing an oxidizing agent (second part) when the dyeing composition contains an oxidizing dye is stored separately from the composition containing an oxidizing agent (first part), and mixed before naturally derived fibers are immersed. Examples of the suitable oxidizing agent include, but are not limited to, hydrogen peroxide, urea peroxide, melamine peroxide and sodium brominate. Among these oxidizing agents, hydrogen peroxide is preferable.

[0130] The content of the oxidizing agent in the dyeing composition is preferably 1 mass% or more, more preferably 2 mass% or more, and preferably 15 mass% or less, more preferably 12 mass% or less, further more preferably 9 mass% or less.

[0131] When the first part and the second part are stored separately, the pH of the second part at 25°C is preferably 2 or more, more preferably 2.5 or more, and preferably 6 or less, more preferably 4 or less. The pH can be adjusted by a suitable buffering agent. The pH of the dyeing composition obtained by mixing the first part and the second part at 25°C is preferably 6 or more, more preferably 6.5 or more, further more preferably 6.8 or more, and preferably 11 or less, more preferably 10.5 or less, further more preferably 10 or less.

[0132] When the dyeing composition contains an oxidizing dye, the dyeing composition may further contain any of the direct dyes exemplified above.

[0133] Preferably, the dyeing composition may further contain the following surfactant, conditioning component and the like. Preferably, the dyeing composition can be in the form of solution, emulsion, cream, paste and mousse.

[0134] The temperature of the dyeing composition is preferably 0°C or higher, more preferably 10°C or higher, further more preferably 20°C or higher, and preferably 90°C or lower, more preferably 80°C or lower, from the viewpoint of efficiently infiltrating and diffusing the dyeing composition into naturally derived fibers to enhance the effect of dyeing.

(Surface finish for imparting hydrophobicity and reducing friction)

[0135] The surface finish for imparting hydrophobicity and reducing friction is performed by immersing naturally derived fibers in the following surface finish agent after the steps (i) to (iii), or alternatively, when step (iv) for improving the feel is carried out, after the step (iv).

[0136] The surface finish agent comprises the following component (F) and water.

(F) epoxyaminosilane copolymer which is a reaction product of the following compounds (a) to (d):

(a) polysiloxane having at least two oxiranyl groups or oxetanyl groups;
(b) polyether having at least two oxiranyl groups or oxetanyl groups;
(c) aminopropyltrialkoxysilane; and
(d) a compound selected from the group consisting of the following primary and secondary amines:

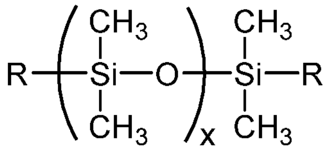
- primary amine: methylamine, ethylamine, propyleneamine, ethanolamine, isopropylamine, butylamine, isobutylamine, hexylamine, dodecylamine, oleylamine, aniline, aminopropyltrimethylsilane, aminopropyltriethylsilane, aminomorpholine, aminopropyldiethylamine, benzylamine, naphthylamine, 3-amino-9-ethylcarbazole, 1-aminoheptafluorohexane and 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-pentadecafluoro-1-octaneamine; and
- secondary amine: methylethylamine, methyloctadecylamine, diethanolamine, dibenzylamine, dihexylamine, dicyclohexylamine, piperidine, pyrrolidine phthalimide and polymer amine.

[Component (F): epoxyaminosilane copolymer]

[0137] The epoxyaminosilane copolymer as the component (F) is a reaction product of the following compounds (a) to (d).

<Compounds (a) and (b)>

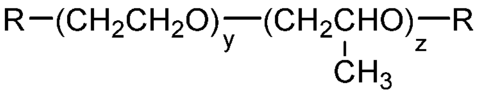
[0138] The compound (a) is polysiloxane having at least two oxiranyl groups or oxetanyl groups, and examples thereof include compounds of the following formula (5):



$$R-\left(\overset{CH_3}{\underset{CH_3}{Si}}-O\right)_x-\overset{CH_3}{\underset{CH_3}{Si}}-R \qquad (5)$$

wherein R represents a hydrocarbon group having 1 to 6 carbon atoms and an oxiranyl group or an oxetanyl group at the terminal and optionally having a hetero atom, and x represents a number of 1 to 1,000.

[0139] The compound (b) is polyether having at least two oxiranyl groups or oxetanyl groups, and examples thereof include compounds of the following formula (6):



$$R-(CH_2CH_2O)_y-(CH_2\underset{CH_3}{C}HO)_z-R \qquad (6)$$

wherein R represents the same meaning as described above, y is 1 to 100, z is 0 to 100, and y + z represents a number of 1 to 200.

[0140] In formulae (5) and (6), the hetero atom optionally contained in R is preferably an oxygen atom. Examples of R include an oxiranylmethyl group (glycidyl group), an oxiranylmethoxy group (glycidyloxy group), an oxiranylmethoxypropyl group (glycidyloxypropyl group), an oxetanylmethyl group, an oxetanylmethoxy group, an oxetanylmethoxypropyl group and a 3-ethyloxetanylmethyl group. Among them, hydrocarbon groups having 1 to 4 carbon atoms and an oxiranyl group and optionally having a hetero oxygen atom are preferable, and at least one selected from the group consisting of an oxiranylmethyl group (glycidyl group), an oxiranylmethoxy group (glycidyloxy group) and an oxetanylmethyl group, an oxiranylmethoxypropyl group (glycidyloxypropyl group) is more preferable.

<Compound (c)>

[0141] The compound (c) is aminopropyltrialkoxysilane. Examples of the alkoxy group in the compound (c) include alkoxy groups having 1 to 6 carbon atoms, preferably 2 to 4 carbon atoms, more preferably 3 carbon atoms, and among them, an isopropoxy group is preferable. Examples of the compound (c) include aminopropyltrimethoxysilane, aminopropyltriethoxysilane, aminopropyltripropoxysilane, aminopropyltriisopropoxysilane, aminopropyltributoxysilane, and aminopropyltri-tert-butoxysilane, and among them, aminopropyltriisopropoxysilane is preferable. Any one compound (c) may be used alone, or two or more compounds (c) may be used in combination.

<Compound (d)>

[0142] The compound (d) is a compound selected from the group consisting of the following primary and secondary amines:

- primary amine: methylamine, ethylamine, propyleneamine, ethanolamine, isopropylamine, butylamine, isobutylamine, hexylamine, dodecylamine, oleylamine, aniline, aminopropyltrimethylsilane, aminopropyltriethylsilane, aminomorpholine, aminoethyldimethylamine, aminoethyldiethylamine, aminoethyldibutylamine, aminopropyldimethylamine, aminopropyldiethylamine, aminopropyldibutylamine, benzylamine, naphthylamine, 3-amino-9-ethylcarbazole, 1-aminoheptafluorohexane and 2,2,3,3,4,4,5,5, 6, 6,7,7, 8, 8, 8-pentadecafluoro-1-octane amine
- secondary amine: methylethylamine, methyloctadecylamine, diethanolamine, dibenzylamine, dihexylamine, dicyclohexylamine, piperidine, pyrrolidine phthalimide and polymer amine.

[0143] Among them, primary amines are preferable, and one selected from the group consisting of aminopropyldiethylamine, aminopropyldimethylamine and aminopropyldibutylamine is more preferable. One compound (d) may be used alone, or two or more compounds (d) may be used in combination.

[0144] The reaction of compounds (a) to (d) is carried out by, for example, refluxing the compounds in a solvent such as isopropanol for a certain time. Here, the molar ratio of oxiranyl groups or oxetanyl groups of compounds (a) and (b) to amino groups of the compound (c) is preferably 1 or more, more preferably 1.1 or more, further more preferably 1.2

or more, and preferably 4 or less, more preferably 3.9 or less, further more preferably 3.8 or less.

[0145] Examples of the component (F) include those having the INCI name of polysilicone-29, and examples of the marketed product thereof include Silsoft CLX-E (containing an active ingredient at 15 mass%, dipropylene glycol and water) from Momentive Performance Materials Company.

[0146] The content of the component (F) in the surface finish agent is preferably 0.01 mass% or more, more preferably 0.05 mass% or more, further more preferably 0.10 mass% or more, further more preferably 0.20 mass% or more, from the viewpoint of imparting sufficient hydrophobicity to naturally derived fibers, and preferably 15.00 mass% or less, more preferably 10.00 mass% or less, further more preferably 8.00 mass% or less, further more preferably 6.00 mass% or less, from the viewpoint that a sticky feel is not given.

[0147] From the viewpoint of increasing the reaction rate of the trialkoxysilane part of the component (F) in an acidic region or a basic region, the pH of the surface finish agent at 25°C is preferably in the following range. When the surface finish agent is set as an acidic region, the pH is preferably 1.0 or more, more preferably 1.5 or more, further more preferably 2.0 or more, and preferably 5.0 or less, more preferably 4.0 or less, further more preferably 3.5 or less. When the surface finish agent is set as a basic region, the pH is preferably 7.0 or more, more preferably 7.5 or more, further more preferably 8.0 or more, and preferably 11.0 or less, more preferably 10.5 or less, further more preferably 10.0 or less. The surface finish agent may appropriately contain a pH adjuster for adjusting the pH of the surface finish agent to be within the above-described range. As the pH adjuster, alkanol amines such as monoethanolamine, isopropanolamine, 2-amino-2-methylpropanol and 2-aminobutanol, or salts thereof; alkanediamines such as 1,3-propanediamine, or salts thereof; carbonates such as guanidine carbonate, sodium carbonate, potassium carbonate, sodium hydrogen carbonate and potassium hydrogen carbonate; hydroxides such as sodium hydroxide, potassium hydroxide; and the like can be used as the alkali agent. As the acid agent, inorganic acids such as hydrochloric acid and phosphoric acid, hydrochlorides such as monoethanolamine hydrochloride, phosphorates such as monopotassium dihydrogen phosphate and disodium monohydrogen phosphate, and organic acids such as lactic acid and malic acid, and the like can be used.

[0148] The amount of the surface finish agent in which naturally derived fibers are immersed is preferably 2 or more, more preferably 5 or more, further more preferably 10 or more, and preferably 100 or less, more preferably 50 or less, further more preferably 20 or less, in terms of bath ratio to the mass of the naturally derived fibers (mass of surface finish agent/mass of naturally derived fibers).

(Post-heating: heating treatment for further improving fiber stretchability (tenacity))

[0149] Further, from the viewpoint of more effectively improving the stretchability of naturally derived fibers, naturally derived fibers can be heated while being stretched by applying tension to the fibers. When the naturally derived fibers are small in amount, it is preferable to use a hair iron for the heating, and when the naturally derived fibers are large in amount, an equivalent result can be obtained by, for example, performing hot air heating while applying tension by a rewinder.

[0150] The fiber draw ratio during heating is preferably 0.1% or more, more preferably 0.2% or more, further more preferably 0.5% or more, from the viewpoint of more effectively improving the stretchability of the fibers, and preferably 10% or less, more preferably 5% or less, further more preferably 2% or less, from the viewpoint of suppressing damage to the fibers.

[0151] The heating temperature is preferably 120°C or higher, more preferably 140°C or higher, further more preferably 160°C or higher, from the viewpoint of more effectively improving the stretchability of the fibers, and preferably 240°C or lower, more preferably 220°C or lower, further more preferably 200°C or lower, from the viewpoint of suppressing damage to the fibers.

[0152] The heating time is preferably 1 second or more, more preferably 3 seconds or more, further more preferably 5 seconds or more, from the viewpoint of more effectively improving the stretchability of the fibers, and preferably 60 seconds or less, more preferably 30 seconds or less, further more preferably 20 seconds or less, from the viewpoint of suppressing damage to the fibers.

[0153] After heating, from the viewpoint of more effectively improving the stretchability of the fibers, naturally derived fibers can be left to stand in water while being stretched by applying tension to the fibers.

[0154] The draw ratio here is preferably 0.1% or more, more preferably 0.2% or more, further more preferably 0.5% or more, from the viewpoint of more effectively improving the stretchability of the fibers, and preferably 10% or less, more preferably 5% or less, further more preferably 2% or less, from the viewpoint of suppressing damage to the fibers.

[0155] The water temperature is preferably 5°C or higher, more preferably 20°C or higher, further more preferably 30°C or higher, from the viewpoint of more effectively improving the stretchability of the fibers, and preferably 80°C or lower, more preferably 60°C or lower, further more preferably 50°C or lower, from the viewpoint of suppressing damage to the fibers.

[0156] The time for leaving the fibers to stand in water is preferably 1 minute or more, more preferably 5 minutes or more, further more preferably 30 minutes or more, from the viewpoint of more effectively improving the stretchability of the fibers, and preferably 48 hours or less, more preferably 24 hours or less, further more preferably 3 hours or less, from the viewpoint of suppressing damage to the fibers.

[0157] Depending on conditions for polymerization in the steps (i) to (iii), stretchability equivalent to that of human hair can be achieved during drying of the fibers.

(Suppression or elimination of coloring)

[0158] Further, for the purpose of suppressing or eliminating coloring in naturally derived fibers treated with the fiber-treating agent of the present invention, treatment can be performed with a composition containing the component (E). The preferred component (E) is as described above. The composition is preferably an aqueous solution of the component (E). The pH of the composition is preferably 2.0 or more, more preferably 3.0 or more, further more preferably 4.0 or more, and preferably 9.0 or less, more preferably 7.0 or less, further more preferably 6.0 or less, from the viewpoint of preventing a decrease in strength of naturally derived fibers.

[0159] The content of the component (E) in the composition is preferably 0.5 mass% or more, more preferably 1.0 mass% or more, further more preferably 2.0 mass% or more, from the viewpoint of exhibiting an effect of suppressing or eliminating coloring of naturally derived fibers, and preferably 20 mass% or less, more preferably 10 mass% or less, further more preferably 5.0 mass% or less, from the viewpoint of preventing a decrease in strength of naturally derived fibers by a reducing action.

[0160] The temperature for the treatment with the composition containing the component (E) is preferably 5°C or higher, more preferably 10°C or higher, further more preferably 20°C or higher, from the viewpoint of exhibiting an effect of suppressing or eliminating coloring of naturally derived fibers, and preferably 100°C or lower, more preferably 60°C or lower, further more preferably 40°C or lower, from the viewpoint of avoiding the onset of yellowish coloring.

[0161] The time for the treatment with a composition containing the component (E) is preferably 1 second or more, more preferably 30 seconds or more, further more preferably 1 minute or more, from the viewpoint of exhibiting an effect of suppressing or eliminating coloring of naturally derived fibers, and preferably 60 minutes or less, more preferably 30 minutes or less, further more preferably 15 minutes or less, from the viewpoint of avoiding the onset of yellowish coloring.

[0162] For the purpose of suppressing or eliminating coloring in naturally derived fibers treated with the fiber-treating agent of the present invention, the naturally derived fibers can be treated with a composition containing the following component (G) as in the treatment with a composition containing the component (E).

Component (G): compound having chelating action

[Component (G): compound having chelating action]

[0163] Examples of the component (G) include compounds in which the total number of hydroxy groups, carboxy groups and phosphoric acid groups is 2 or more, and specifically, etidronic acid, disodium ethylenediaminetetraacetate, disodium catechol-3,5-disulfonate monohydrate and phytic acid are preferably exemplified.

[0164] The composition containing the component (G) is preferably an aqueous solution. The pH of the composition is preferably 2.0 or more, more preferably 3.0 or more, further more preferably 4.0 or more, and preferably 9.0 or less, more preferably 7.0 or less, further more preferably 6.0 or less, from the viewpoint of preventing a decrease in strength of naturally derived fibers.

[0165] Any one component (G) may be used alone, or two or more components (G) may be used in combination. The content of the component (G) in the composition containing the component (G) is preferably 0.1 mass% or more, more preferably 0.5 mass% or more, furthermore preferably 2.0 mass% or more, from the viewpoint of exhibiting an effect of suppressing or eliminating coloring of naturally derived fibers, and preferably 20 mass% or less, more preferably 10 mass% or less, further more preferably 5.0 mass% or less, from the viewpoint of suppressing a decrease in fiber strength.

[0166] The temperature for the treatment with the composition containing the component (G) is preferably 5°C or higher, more preferably 10°C or higher, further more preferably 20°C or higher, from the viewpoint of exhibiting an effect of suppressing or eliminating coloring of naturally derived fibers, and preferably 100°C or lower, more preferably 60°C or lower, further more preferably 40°C or lower, from the viewpoint of suppressing a decrease in fiber strength.

[0167] The time for the treatment with the composition containing the component (G) is preferably 1 second or more, more preferably 30 seconds or more, further more preferably 1 minute or more, from the viewpoint of exhibiting an effect of suppressing or eliminating coloring of naturally derived fibers, and preferably 72 hours or less, more preferably 48 hours or less, further more preferably 24 hours or less, from the viewpoint of suppressing a decrease in fiber strength.

[0168] It is more preferable that the treatment with the composition containing the component (E) and the treatment with the composition containing the component (G) be performed in combination as the treatment for suppressing or eliminating coloring of naturally derived fibers. Coloring of fibers which is caused by treatment with the fiber-treating agent of the present invention is considered to include both brownish coloring by oxidation (which can be countered by treatment with a sulfur-containing reducing agent as the component (E)) and yellowish coloring by a catechin-metal complex (which can be countered by a chelating agent as the component (G)), and it may be possible to more adequately suppress coloring of the fibers by performing bleaching treatment corresponding to each case.

[0169] When the treatment with the composition containing the component (E) and the treatment with the composition containing the component (G) are performed in combination, the treatments with the compositions may be performed in a sequential order (the treatment order is not limited), and it is also possible to perform the treatments as one treatment using a single composition containing the components (E) and (G). Here, the contents of each of components in the composition, the treatment temperature and the treatment time are the same as in the case where separate compositions are used. With regard to the treatment time, the upper limit for the composition containing the component (G) is greater than that for the composition containing the component (E), and in the case of the treatment with a single composition containing both the components, the treatment time may be in the treatment time range for the composition containing the component (E) from the viewpoint of avoiding the onset of yellowish coloring.

[0170] When naturally derived fibers are treated by the above method for treating fibers, the fibers contain a condensate formed from the components (A) and (B), so that it is possible to produce fibers for hair ornament products in which the fibers are excellent in shape sustainability and tensile elastic modulus and the stretchability (tenacity) of the naturally derived fibers is highly improved, and it is also possible to produce a hair ornament product using the fibers.

[0171] In the present invention, examples of the hair ornament product include hair wigs, wigs, weavings, hair extensions, blade hairs, hair accessories, and doll hairs.

[0172] Concerning the embodiments described above, preferred aspects of the present invention will be further disclosed below.

[0173]

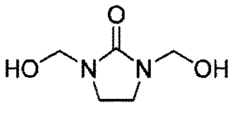
<1> A one-part type fiber-treating agent comprising a single composition or a multiple-part type fiber-treating agent comprising a plurality of compositions, wherein the fiber-treating agent comprises the following components (A) to (C) in the total composition thereof, provided that, a part or all of the components (A) and (B) is optionally a condensate formed from the components:

(A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule; and

(B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position, wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group; and

(C): water.

<2> The fiber-treating agent according to <1>, wherein the component (A) is preferably one or more selected from the group consisting of the following compounds (A1) to (A4), more preferably one or more selected from the group consisting of the compounds (A3) and (A4), further more preferably the compound (A3).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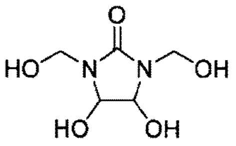
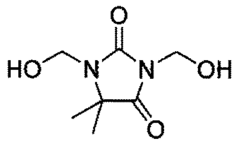
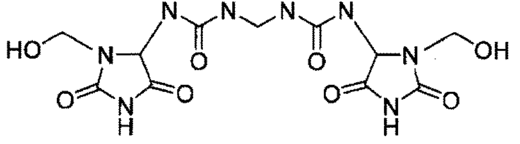

(A2)


(A3)

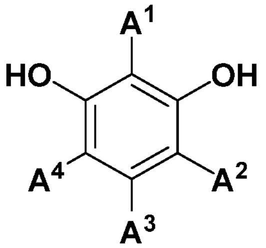

(A4)

<3> The fiber-treating agent according to <1> or <2>, wherein a content of a constituent element derived from the component (A) in the fiber-treating agent is preferably 0.1 mass% or more, more preferably 1 mass% or more, further more preferably 2.5 mass% or more, even more preferably 5 mass% or more, even more preferably 10

mass% or more, and preferably 80 mass% or less, more preferably 70 mass% or less, further more preferably 60 mass% or less, even more preferably 50 mass% or less, even more preferably 40 mass% or less, based on the total composition of the fiber-treating agent.

<4> The fiber-treating agent according to any one of <1> to <3>, wherein the component (B) is preferably one or more selected from the group consisting of the following components (B1), (B2) and (B3):

(B1) a resorcin derivative of formula (1):

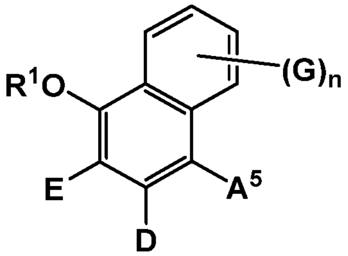


(1)

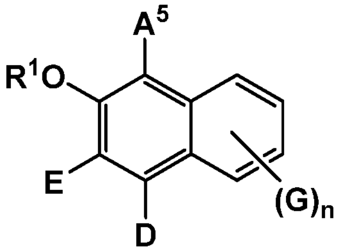
wherein

A^1 to A^4 are the same or different, and each represent a hydrogen atom, a hydroxy group, a halogen atom, a carboxyl group or a salt thereof, a sulfonic acid group or a salt thereof, a linear or branched alkyl group or alkenyl group having 1 to 6 carbon atoms, or a linear or branched alkoxy group or alkenyloxy group having 1 to 6 carbon atoms;

(B2) a naphthol derivative of formula (2) or (3):



(2)



(3)

wherein

R^1 represents a hydrogen atom or a methyl group,

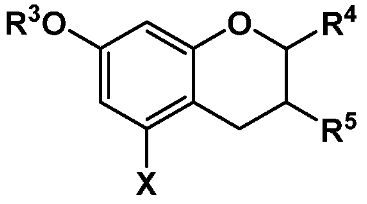
A^5 represents a hydrogen atom, a linear or branched alkyl group or alkenyl group having 1 to 12 carbon atoms, an optionally substituted aralkyl group or arylalkenyl group having 7 to 12 carbon atoms, a linear or branched alkoxy group or alkenyloxy group having 1 to 6 carbon atoms, a halogen atom or -CO-R^2 (R^2 is a linear or branched alkyl group or alkenyl group having 1 to 12 carbon atoms, an optionally substituted aralkyl group or arylalkenyl group having 7 to 12 carbon atoms, or an optionally substituted aromatic hydrocarbon group having 6 to 12 carbon atoms),

D represents a hydrogen atom, a hydroxy group, a methyl group, or a linear or branched alkoxy group or alkenyloxy group having 1 to 12 carbon atoms,

E represents a hydrogen atom, a hydroxy group, a linear or branched alkyl group or alkenyl group having 1 to 6 carbon atoms, or a linear or branched alkoxy group or alkenyloxy group having 1 to 6 carbon atoms, and

G represents a hydroxy group, a linear or branched alkyl group or alkenyl group having 1 to 6 carbon atoms, or an alkoxy group having 1 to 6 carbon atoms, and n represents an integer of 0 to 2; and

(B3) a flavan-3-ol derivative of formula (4):



(4)

wherein

R^3 represents a hydrogen atom or a methyl group,
X represents a hydrogen atom, a hydroxy group or a methoxy group,
R^4 represents an aromatic hydrocarbon group optionally substituted with up to 3 hydroxy groups or methoxy groups and optionally forming a fused ring with 1,3-dioxolane, and
R^5 represents a hydroxy group, a methoxy group, an aromatic hydrocarbon group optionally substituted with up to 3 hydroxy groups or methoxy groups and optionally forming a fused ring with 1,3-dioxolane, or an arylcarbonyloxy group or aralkylcarbonyloxy group optionally substituted with up to 3 hydroxy groups or methoxy groups,
more preferably one or more selected from the group consisting of resorcin, 1-naphthol, 2-naphthol, 3-methylnaphthalen-1-ol, naphthalene-1-,5-diol, naphthalene-1,8-diol, catechin, epicatechin, epigallocatechin, catechin gallate, epicatechin gallate, epigallocatechin gallate and a tea extract, further more preferably one or more selected from the group consisting of resorcin, catechin, epicatechin, epigallocatechin, catechin gallate, epicatechin gallate, epigallocatechin gallate and a tea extract.

<5> The fiber-treating agent according to any one of <1> to <4>, wherein a content of a constituent element derived from the component (B) in the fiber-treating agent is preferably 0.1 mass% or more, more preferably 1 mass% or more, further more preferably 1.5 mass% or more, even more preferably 3 mass% or more, even more preferably 5 mass% or more, and preferably 80 mass% or less, more preferably 60 mass% or less, further more preferably 50 mass% or less, even more preferably 40 mass% or less, even more preferably 30 mass% or less, even more preferably 25 mass% or less, even more preferably 20 mass% or less, based on the total composition of the fiber-treating agent.
<6> The fiber-treating agent according to any one of <1> to <5>, wherein a total content of the constituent element derived from the component (A) and the constituent element derived from the component (B) in the fiber-treating agent is preferably 0.1 mass% or more, more preferably 1 mass% or more, further more preferably 5 mass% or more, further more preferably 10 mass% or more, further more preferably 15 mass% or more, further more preferably 20 mass% or more, and preferably 80 mass% or less, more preferably 70 mass% or less, further more preferably 60 mass% or less, further more preferably 50 mass% or less, further more preferably 40 mass% or less, based on the total composition of the fiber-treating agent.
<7> The fiber-treating agent according to any one of <1> to <6>, wherein a molar ratio of the constituent element derived from the component (A) to the constituent element derived from the component (B), (A)/(B), is preferably 0.1 or more, more preferably 0.3 or more, further more preferably 0.5 or more, and preferably 20 or less, more preferably 15 or less, further more preferably 10 or less, even more preferably 7.5 or less.
<8> The fiber-treating agent according to any one of <1> to <7>, wherein a content of the component (C) in the fiber-treating agent is preferably 10 mass% or more, more preferably 20 mass% or more, further more preferably 30 mass% or more, even more preferably 40 mass% or more, and preferably 99 mass% or less, more preferably 97 mass% or less, further more preferably 95 mass% or less, even more preferably 90 mass% or less, based on the total composition of the fiber-treating agent.
<9> The fiber-treating agent according to any one of <1> to <8>, which is of multiple-part type fiber-treating agent comprising a first part containing the components (B) and (C) and a second part containing the components (A) and (C).
<10> The fiber-treating agent according to any one of <1> to <8>, wherein the fiber-treating agent is a one-part type, and preferably, further comprises the following component (D):
(D): an organic compound having a Hansen solubility parameter SP value of 16 Mpa$^{1/2}$ or more and 40 Mpa$^{1/2}$ or less (excluding organic salts and compounds having an aldehyde group and having a molecular weight of 150 or less).

<11> The fiber-treating agent according to <10>, wherein the component (D) is preferably at least one selected from the group consisting of a monohydric alcohol, a dihydric alcohol, a dihydric alcohol derivative, a polyhydric alcohol with a valence number of 3 or more, lactam, imidazolidinone, pyrimidinone, lactone, alkylene carbonate and a general-purpose organic solvent, more preferably at least one selected from the group consisting of a dihydric alcohol, lactam and imidazoline, further more preferably at least one selected from the group consisting of diethylene glycol, triethylene glycol, N-methylpyrrolidone, 1,3-dimethyl-2-imidazolidinone and DMDM hydantoin.

<12> The fiber-treating agent according to <10> or <11>, wherein Hansen solubility parameter SP value of the component (D) is preferably 35.8 Mpa$^{1/2}$ or less, more preferably 34.7 Mpa$^{1/2}$ or less, further more preferably 29.2 Mpa$^{1/2}$ or less, and preferably 17.8 Mpa$^{1/2}$ or more, more preferably 21.1 Mpa$^{1/2}$ or more, further more preferably 22.0 Mpa$^{1/2}$ or more.

<13> The fiber-treating agent according to any one of <10> to <12>, wherein a content of the component (D) in the fiber-treating agent is preferably 10 mass% or more, more preferably 15 mass% or more, further more preferably 25 mass% or more, and preferably 80 mass% or less, more preferably 60 mass% or less, further more preferably 45 mass% or less.

<14> The fiber-treating agent according to any one of <1> to <13>, preferably further comprising the following component (E):

(E): a sulfur-containing reducing agent.

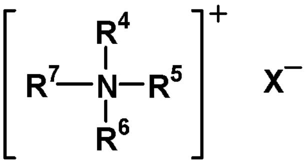
<15> The fiber-treating agent according to <14>, wherein the component (E) is one or more selected from the group consisting of a sulfurous acid salt and a thiol compound, more preferably one or more selected from the group consisting of sodium sulfite, sodium pyrosulfite, thioglycerol and Mesna (sodium 2-mercaptoethanesulfonate), further more preferably sodium sulfite.

<16> The fiber-treating agent according to <14> or <15>, wherein a content of the component (E) in the fiber-treating agent is preferably 0.1 mass% or more, more preferably 0.5 mass% or more, further more preferably 2.0 mass% or more, and preferably 20 mass% or less, more preferably 10 mass% or less, further more preferably 5.0 mass% or less, based on the total composition of the fiber-treating agent.

<17> The fiber-treating agent according to any one of <14> to <16>, wherein a molar ratio of the component (E) to the component (A), (E)/(A), is preferably 0.1 or more, more preferably 0.3 or more, further more preferably 0.5 or more, and preferably 3.0 or less, more preferably 1.5 or less, further more preferably 1.0 or less.

<18> The fiber-treating agent according to any one of <1> to <17>, preferably further comprising a cationic surfactant.

<19> The fiber-treating agent according to <18>, wherein the cationic surfactant is preferably a long chain monoalkyl quaternary ammonium salt having one alkyl group having 8 to 24 carbon atoms and three alkyl groups having 1 to 4 carbon atoms, more preferably at least one selected from the group consisting of compounds of the following formula:



$$\left[R^7{-}\overset{\displaystyle R^4}{\underset{\displaystyle R^6}{N}}{-}R^5 \right]^+ \quad X^-$$

wherein R^4 is a saturated or unsaturated linear or branched alkyl group having 8 to 22 carbon atoms, R^8-CO-NH-$(CH_2)_m$- or R^8-CO-O-$(CH_2)_m$- (R^8 represents a saturated or unsaturated linear or branched alkyl chain having 7 to 21 carbon atoms, and m represents an integer of 1 to 4), R^5, R^6 and R^7 independently represent an alkyl group having 1 to 4 carbon atoms, or a hydroxyalkyl group having 1 to 4 carbon atoms, and X^-represents a hydrochloride ion, a bromide ion, a methosulfate ion or an ethosulfate ion,

further more preferably at least one selected from the group consisting of cetyltrimethylammonium chloride, myristyltrimethylammonium chloride, behentrimonium chloride, cetyltrimethylammonium bromide and stearamidopropyltrimonium chloride.

<20> The fiber-treating agent according to <18> or <19>, wherein a content of the cationic surfactant is preferably 0.05 mass% or more, more preferably 0.10 mass% or more, and preferably 10 mass% or less, more preferably 5 mass% or less, based on the total composition of the fiber-treating agent.

<21> The fiber-treating agent according to any one of <1> to <20>, preferably further comprising silicone, more preferably one or more selected from the group consisting of dimethylpolysiloxane and amino acid-modified silicone.

<22> The fiber-treating agent according to <21>, wherein a content of the silicone is preferably 0.1 mass% or more, more preferably 0.2 mass% or more, further more preferably 0.5 mass% or more, and preferably 20 mass% or less, more preferably 10 mass% or less, further more preferably 5 mass% or less, based on the total composition of the fiber-treating agent.

<23> The fiber-treating agent according to any one of <1> to <22>, preferably further comprising a cationic polymer.

<24> The fiber-treating agent according to <23>, wherein a content of the cationic polymer is preferably 0.001 mass% or more, more preferably 0.01 mass% or more, further more preferably 0.05 mass% or more, and preferably 20 mass% or less, more preferably 10 mass% or less, based on the total composition of the fiber-treating agent.

<25> The fiber-treating agent according to any one of <1> to <24>, wherein a pH is preferably 3.0 or more, more preferably 3.5 or more, further more preferably 4.0 or more, and preferably 11.0 or less, more preferably 9.0 or less, further more preferably 7.0 or less.

<26> The fiber-treating agent according to any one of <1> to <25>, wherein the fiber-treating agent is a treating agent preferably for naturally derived fibers, more preferably for fibers taken from a natural animal or plant, or fibers artificially produced using keratin, collagen, casein, soybeans, peanuts, corn, silk flocks, silk fibroin or the like as a raw material, further more preferably for regenerated protein fibers selected from the group consisting of regenerated collagen fibers made from collagen as a raw material and regenerated silk fibers made from silk fibroin as a raw material, even more preferably for regenerated collagen fibers.

<27> A method for treating fibers, comprising the following step (i):

(i) immersing fibers in the fiber-treating agent according to any one of <1> to <26>.

<28> The method for treating fibers according to <29>, wherein the fiber-treating agent is a one-part type, and preferably, the step (i) is carried out while a state is maintained in which a turbidity of the treating agent is 1,000 NTU or less.

<29> The method for treating fibers according to <27> or <28>, wherein the fiber-treating agent is a one-part type, and preferably, the following step (0) is carried out before the step (i).

(0) heating the fiber-treating agent.

<30> The method for treating fibers according to <29>, wherein, assuming that T is a heating time until the treating agent has a turbidity of more than 1,000 NTU after the treating agent is heated immediately after being prepared by mixing the components, the heating time in the step (0) is preferably 0.2T or more, more preferably 0.3T or more, further more preferably 0.4T or more, and preferably 0.8T or less, more preferably 0.7T or less, further more preferably 0.6T or less.

<31> The method for treating fibers according to any one of <27> to <30>, wherein an amount of the fiber-treating agent in which the fibers are immersed in the step (i) is preferably 2 or more, more preferably 3 or more, further more preferably 5 or more, even more preferably 10 or more, even more preferably 20 or more, and preferably 500 or less, more preferably 250 or less, further more preferably 100 or less, in terms of bath ratio to a mass of the fibers (mass of fiber-treating agent/mass of fibers).

<32> The method for treating fibers according to any one of <27> to <31>, wherein a temperature of the fiber-treating agent in the step (i) is preferably 20°C or higher, more preferably 35°C or higher, further more preferably 45°C or higher, and preferably lower than 100°C, more preferably 80°C or lower, further more preferably 70°C or lower, further more preferably 60°C or lower.

<33> The method for treating fibers according to any one of <27> to <32>, wherein the fiber-treating agent is a one-part type, and wherein, assuming that T is a heating time until the treating agent has a turbidity of more than 1,000 NTU after the treating agent is heated immediately after being prepared by mixing the components, an immersion time in the step (i) is preferably 0.3T or more, more preferably 0.4T or more, further more preferably 0.5T or more, and preferably 0.95T or less, more preferably 0.90T or less, further more preferably 0.85T or less.

<34> The method for treating fibers according to any one of <27> to <33>, wherein the fiber-treating agent is a one-part type, and preferably, the following step (ii-a) is carried out after the step (i), and the step (i) and the step (ii-a) are repeated two or more times:

(ii-a) taking out the fibers from the treating agent before the turbidity of the treating agent exceeds 1,000 NTU.

<35> The method for treating fibers according to <27>, <31> or <32>, wherein the fiber-treating agent is of multiple-part type, and the step (i) is preferably a step of immersing fibers in one of the first part and the second part set forth in <9>, and then in the other, more preferably a step of immersing fibers first in the first part set forth in <9>, and then in the second part set forth in <9>.

<36> The method for treating fibers according to <35>, wherein the following step (ii-b) is carried out after the step (i):

(ii-b) taking out the fibers from the treating agent.

<37> The method for treating fibers according to <34> or <36>, wherein preferably, the following step (iii) is carried out after the step (ii-a) or the step (ii-b):

(iii) rinsing the fibers taken out.

<38> The method for treating fibers according to <37>, wherein preferably, the rinsing in the step (iii) is performed using a rinsing composition containing a component (D):

(D): an organic compound having a Hansen solubility parameter SP value of 16 $\mathrm{Mpa}^{1/2}$ or more and 40 $\mathrm{Mpa}^{1/2}$ or

less (excluding organic salts and compounds having an aldehyde group and having a molecular weight of 150 or less).
<39> The method for treating fibers according to <38>, wherein the rinsing composition contains water in addition to the component (D), and the content of the component (D) in the rinsing composition is preferably 60 mass% or more, more preferably 80 mass% or more, further more preferably 95 mass% or more.
<40> The method for treating fibers according to any one of <27> to <39>, wherein the step of immersing the fibers in a surface finish agent containing the following components (F) and (C) is further carried out after the steps (i) to (iii):

(F) an epoxyaminosilane copolymer which is a reaction product of the following compounds (a) to (d):

(a) polysiloxane having at least two oxiranyl groups or oxetanyl groups;
(b) polyether having at least two oxiranyl groups or oxetanyl groups;
(c) aminopropyltrialkoxysilane; and
(d) a compound selected from the group consisting of the following primary and secondary amines:

- primary amine: methylamine, ethylamine, propyleneamine, ethanolamine, isopropylamine, butylamine, isobutylamine, hexylamine, dodecylamine, oleylamine, aniline, aminopropyltrimethylsilane, aminopropyltriethylsilane, aminomorpholine, aminopropyldiethylamine, benzylamine, naphthylamine, 3-amino-9-ethylcarbazole, 1-aminoheptafluorohexane and 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-pentadecafluoro-1-octaneamine; and
- secondary amine: methylethylamine, methyloctadecylamine, diethanolamine, dibenzylamine, dihexylamine, dicyclohexylamine, piperidine, pyrrolidine phthalimide and polymer amine; and

(C) water.

<41> The method for treating fibers according to <40>, wherein preferably, the component (F) is polysilicone-29.
<42> The method for treating fibers according to <40> or <41>, wherein a content of the component (F) in the surface finish agent is preferably 0.01 mass% or more, more preferably 0.05 mass% or more, further more preferably 0.10 mass% or more, further more preferably 0.20 mass% or more, and preferably 15.00 mass% or less, more preferably 10.00 mass% or less, further more preferably 8.00 mass% or less, further more preferably 6.00 mass% or less.
<43> The method for treating fibers according to any one of <27> to <42>, wherein preferably, the fibers are further heated while being stretched by applying tension to the fibers.
<44> The method for treating fibers according to <43>, wherein a fiber draw ratio during heating is preferably 0.1% or more, more preferably 0.2% or more, further more preferably 0.5% or more, and preferably 10% or less, more preferably 5% or less, further more preferably 2% or less.
<45> The method for treating fibers according to <43> or <44>, wherein a heating temperature is preferably 120°C or higher, more preferably 140°C or higher, further more preferably 160°C or higher, and preferably 240°C or lower, more preferably 220°C or lower, further more preferably 200°C or lower.
<46> The method for treating fibers according to any one of <43> to <45>, wherein a heating time is preferably 1 second or more, more preferably 3 seconds or more, further more preferably 5 seconds or more, and
preferably 60 seconds or less, more preferably 30 seconds or less, further more preferably 20 seconds or less.
<47> The method for treating fibers according to any one of <43> to <46>, wherein preferably, the fibers are left to stand while being stretched by applying tension to the fibers after heating.
<48> The method for treating fibers according to <47>, wherein the draw ratio is preferably 0.1% or more, more preferably 0.2% or more, further more preferably 0.5% or more, and preferably 10% or less, more preferably 5% or less, further more preferably 2% or less.
<49> The method for treating fibers according to <47> or <48>, wherein a water temperature is preferably 5°C or higher, more preferably 20°C or higher, further more preferably 30°C or higher, and preferably 80°C or lower, more preferably 60°C or lower, further more preferably 50°C or lower.
<50> The method for treating fibers according to any one of <47> to <49>, wherein a time for standing in water is preferably 1 minute or more, more preferably 5 minutes or more, further more preferably 30 minutes or more, and preferably 48 hours or less, more preferably 24 hours or less, further more preferably 3 hours or less.
<51> The method for treating fibers according to any one of <27> to <50>, wherein further, the treated fibers are treated with a composition containing the following component (E):
(E): a sulfur-containing reducing agent.
<52> The method for treating fibers according to any one of <27> to <51>, wherein further, the treated fibers are treated with a composition containing the following component (G):
(G): a compound having a chelating action.

<53> The method for treating fibers according to any one of <27> to <50>, wherein further, the treated fibers are treated with a composition containing the following components (E) and (G).

(E): a sulfur-containing reducing agent; and
(G): a compound having a chelating action.

<54> The method for treating fibers according to any one of <27> to <53>, wherein the fibers to be treated are preferably naturally derived fibers, more preferably fibers taken from a natural animal or plant, or fibers artificially produced using keratin, collagen, casein, soybeans, peanuts, corn, silk flocks, silk fibroin or the like as a raw material, further more preferably regenerated protein fibers selected from the group consisting of regenerated collagen fibers made from collagen as a raw material and regenerated silk fibers made from silk fibroin as a raw material, even more preferably regenerated collagen fibers.

<55> A method for producing fibers for hair ornament products, comprising the step of treating fibers by the method for treating fibers according to any one of <27> to <54>.

<56> A method for producing a hair ornament product, comprising the step of treating fibers by the method for treating fibers according to any one of <27> to <54>.

<57> A fiber for hair ornament products comprising a condensate formed from components (A) and (B):

(A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule; and
(B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position, wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group.

<58> A hair ornament product having, as a constituent element, fibers comprising a condensate formed from components (A) and (B):

(A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule; and
(B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position, wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group).

<59> A fiber-treating agent comprising the following components (A) to (C) :

(A) DMDM hydantoin or imidazodinyl urea: 10 to 50 mass%;
(B) resorcin or catechins: 5 to 30 mass%; and
(C) water: balance.

<60> The fiber-treating agent according to <59>, wherein the fiber-treating agent is a one-part type, and further comprises the following component (D).

(D) one or more selected from the group consisting of diethylene glycol, triethylene glycol, N-methylpyrrolidone and 1,3-dimethyl-2-imidazolidinone: 15 to 45 mass%

<61> A fiber-treating agent comprising the following components (A) to (C) and (E):

(A) DMDM hydantoin or imidazodinyl urea: 10 to 50 mass%;
(B) resorcin or catechins: 5 to 30 mass%;
(C) water: balance; and
(E) one or more selected from the group consisting of sodium sulfite, thioglycerol and Mesna (sodium 2-mercaptoethanesulfonate): 2 to 10 mass%.

<62> The fiber-treating agent according to any one of <59> to <61>, wherein the fiber-treating agent is a treating agent preferably for naturally derived fibers, more preferably for fibers taken from a natural animal or plant, or fibers artificially using keratin, collagen, casein, soybeans, peanuts, corn, silk flocks, silk fibroin or the like as a raw material, further more preferably for regenerated protein fibers selected from the group consisting of regenerated collagen fibers made from collagen as a raw material and regenerated silk fibers made from silk fibroin as a raw material,

even more preferably for regenerated collagen fibers.

<63> A fiber-treating agent kit comprising the fiber-treating agent according to any one of <59> to <62>, and a surface finish agent containing components (F) and (C):

(F) polysilicone-29: 0.1 to 15 mass%; and
(C) water: balance.

Examples

Examples 1 to 9 and Comparative Examples 1 and 2

[0174] Using compositions whose formulations are shown in Table 1, regenerated collagen fibers were treated by the following method, and various properties were evaluated. The pH of each composition was measured with the prepared composition directly applied to a pH meter (F-52 manufactured by HORIBA, Ltd.) at room temperature (25°C). The turbidity of the composition was measured with a fiber-treating agent directly placed in a measurement cell (ϕ25 × 60 mm borosilicate glass) of a digital turbidimeter (manufactured by AS ONE Corporation/model: TB700/measurement method: equivalent to ISO 7027, Nephelometry (90°)/light source: infrared emitting diode (850 nm)/detector: crystal silicon solar cell module) at room temperature (25°C).

<Treatment method (the following cycle repeated a predetermined number of times when the number of treatments was 2 or more)>

[0175]

1. A 22 cm-long tress with 0.5 g of regenerated collagen fibers (*) was immersed in a container containing 40 g of the fiber-treating agent, the opening of the container was closed, the container was immersed together with its contents in a water bath (manufacturer: TOYO SEISAKUSHO, Ltd./Model: TBS221FA) at 50°C, and heating was performed for a predetermined time. For Examples other than Example 7, the heating time was fixed to a time equivalent to about 0.6T (T is as described above). For Example 7, heating for a time equivalent to 0.3T was performed as the step (0), then the fibers were immersed, and then further heating for a time equivalent to 0.3T was performed twice.

    *: Regenerated collagen fibers manufactured by Kaneka Corporation were purchased in the form of a marketed extension product, and cut, and the cut fibers were segmented into tresses, and used for evaluation. In this evaluation, extension products were used which display the use of Ultima 100% as a fiber species, and are brown with a color number of 3, and straight in shape.

2. The container containing the tress was taken out from the water bath, and brought back to room temperature.
3. The tress was taken out from the container, immersed in 50 g of triethylene glycol for 30 seconds, then rinsed with running tap water at 30°C for 30 seconds, lathered with evaluating shampoo for 60 seconds, rinsed with running tap water at 30°C for 30 seconds, and lightly drained with a towel, and the tress was blown by a hot air dryer (Nobby White NB 3000 manufactured by TESCOM Company) while being combed. At this time, the tress remained straight.

<Increase in average breaking elongation during fiber tensioning>

[0176] As an index of stretchability (tenacity) during fiber tensioning, an average breaking elongation, that is, an average value in evaluation on a plurality of fibers (ten fibers) for the percentage by which the fiber was stretched by tensioning with respect to the original fiber length when rupture occurred was used. The evaluation was performed in the following procedure using a tress immediately after treatment performed as described in <Treatment method> above.

1. Ten fibers were cut from the root of the tress. A 3 cm fiber fragment was taken from near the center between the root and the hair tip of each fiber, so that a total of ten 3 cm hair fragments were obtained.
2. The fiber fragment was set in "MTT690 Miniature Tensile Tester" manufactured by DIA-STRON Limited, automatic measurement was started, and an average breaking elongation was determined when the fiber was in a wet. A large numerical value indicates that the fiber has high stretchability, and is excellent in tenacity and excellent in durability.

[0177] The degree of increase (C%) in average breaking elongation of the treated tress (B%) with respect to an untreated state when the average breaking elongation during fiber tensioning in an intact state (untreated) at the time of being cut from the marketed product (A%) is used as a reference is determined from the following expression, and shown as "ratio of increase in average breaking elongation during fiber tensioning [%]" in the table.

$$C\ (\%) = B\ (\%) - A\ (\%)$$

<Increase in average breaking load during fiber tensioning>

[0178] Evaluation of the average breaking load during fiber tensioning was performed using a tress immediately after treatment performed as described in <Treatment method> above. As a numerical value, an average value in evaluation on a plurality of fibers (ten fibers) was used. The evaluation was performed in the following procedure.

1. Ten fibers were cut from the root of the tress. A 3 cm fiber fragment was taken from near the center between the root and the hair tip of each fiber, so that a total of ten 3 cm hair fragments were obtained.
2. The fiber fragment was set in "MTT690 Miniature Tensile Tester" manufactured by DIA-STRON Limited, automatic measurement was started, and a breaking load was determined when the fiber stretched in a wet state. A large numerical value indicates that the fiber has suppleness and resilience, and is insusceptible to stretching by an external force, and excellent in durability.

[0179] The degree of increase (Y (gf)) in average breaking load of the treated tress with respect to an untreated state when the average breaking load during fiber tensioning in an intact state (untreated) at the time of being cut from the marketed product (Wo (gf)) is used as a reference is determined from the following expression, and shown as "amount of increase in average breaking load during fiber tensioning [gf]" in the table.

$$Y\ (gf) = W_1\ (gf) - W_0\ (gf)$$

<Suppression of shrinkage during set with iron at high temperature>

[0180] Suppression of shrinkage during a set with an iron at a high temperature was performed using a tress immediately after treatment performed as described in <Treatment method> above. As a numerical value, an average value in evaluation on a plurality of fibers (ten fibers) was used. The evaluation was performed in the following procedure.

1. Ten fibers were cut from the root of the tress, an average value of the lengths of the fibers was recorded (length L_1), the fibers were bundled together with two untreated tresses with 0.5 g of regenerated collagen fibers, and a flat iron (manufactured by Miki Denki Sangyo K.K./Model: AHI-938) set at 180°C was applied ten times over the whole tress at a rate of 5 cm/sec.
2. After the iron operation, ten fibers were taken out, and an average value of the lengths of the fibers were recorded again (length L_2).
3. The shrinkage ratio during a set with an iron at a high temperature was defined as $S = \{1 - (L_2/L_1)\} \times 100$ [%] . When S is close to 0%, the fiber is hardly shrunk, and thus excellent in heat resistance.

<Heatshape memory ability>

[0181] Evaluation of heat shape memory ability was performed using a tress immediately after treatment performed as described in <Treatment method> above. When the value of the result of "I: shaping (curl)" was 5% or less, it was determined that there was no effect, and subsequent treatment and evaluation were not performed.

- I: Shaping (curl)

[0182]

1. A 22 cm-long tress with 0.5 g of regenerated collagen fibers was wetted with tap water at 30°C for 30 seconds, and the wet tress was then wound around a plastic rod having a diameter of 14 mm, and fixed with a clip.
2. The tress wound around the rod was immersed together with the rod in a water bath (manufacturer: TOYO SEISAKUSHO, Ltd./Model: TBS221FA) at 60°C, and heated for 1 minute.
3. The tress was taken out from the water bath, and immersed in water at 25°C for 1 minute to be brought back to

room temperature.
4. The tress was removed from the rod, combed three times, and then hung, and photographed right from the side.

(Evaluation Criteria)

[0183] The curling-up ratio = ratio of decrease in tress length (I) (%) determined from the following expression, where Lo is an untreated tress length (22 cm) and L is a treated tress length, was defined as curling strength.

$$I = [(L_0 - L)/L_0] \times 100$$

- II: Reshaping (straight)

[0184]

1. The tress evaluated in I was combed to eliminate entanglement, and a flat iron (manufactured by Miki Denki Sangyo K.K./Model: AHI-938) at a measured temperature of 140°C was then slid over the tress six times at a rate of 5 cm/sec.
2. The tress was rinsed with running tap water at 30°C for 30 seconds, lathered with evaluating shampoo for 60 seconds, then rinsed with running tap water at 30°C for 30 seconds, and dried with a towel.
3. The tress was dried (without using a dryer) while being vibrated so as to obtain a natural shape as hair, and was combed, then hung, and visually observed right from the side.

(Evaluation Criteria)

[0185] The straightening ratio (ST) (%) determined from the following expression, where Lo is an untreated tress length (22 cm) and L is a treated tress length, was defined as a degree of attainment straightening. The tress is completely straightened when ST is 100%.

$$ST = [1 - (L_0 - L)/L_0] \times 100$$

- III: Re-reshaping (Curl)

[0186]

1. The tress evaluated in II was wetted with tap water at 30°C for 30 seconds, and the wet tress was then wound around a plastic rod having a diameter of 14 mm, and fixed with a clip.
2. The tress wound around the rod was immersed together with the rod in a water bath (manufacturer: TOYO SEISAKUSHO, Ltd./Model: TBS221FA) at 60°C, and heated for 1 minute.
3. The tress was taken out from the water bath, and immersed in water at 25°C for 1 minute to be brought back to room temperature.
4. The tress was removed from the rod, combed three times, and then hung, and photographed right from the side.

(Evaluation Criteria)

[0187] The curling-up ratio = ratio of decrease in tress length (I) (%) determined from the following expression, where Lo is an untreated tress length (22 cm) and L is a treated tress length, was defined as curling strength.

$$I = [(L_0 - L)/L_0] \times 100$$

<Formulation of evaluating shampoo>

[0188]

Component	(mass%)
sodium laureth sulfate	15.5
lauramide DEA	1.5
sodium benzoate	0.5
EDTA-2Na	0.3
phosphoric acid	amount required to adjust pH to 7
ion-exchange water	balance
total	100

<Surface feel quality>

[0189] For evaluation of the feel, five skilled panelists performed evaluation on the basis of the following criteria for feel smoothness when the tress immediately after evaluation in <Shape sustainability> was touched by hand, and a total value for the five panelists was taken as an evaluation result.

(Evaluation Criteria)

[0190]

5: Much smoother hand feel over untreated fibers.
4: Smoother hand feel over untreated fibers.
3: Slightly smoother hand feel over untreated fibers.
2: Comparable in hand feel to untreated fibers.
1: Rougher, more frictional and poorer in hand feel than untreated fibers.

[Table 1]

			Example									Comparative Example	
			1	2	3	4	5	6	7	8	9	1	2
Treating agent (mass%)	(A)	(A3) : DMDM hydantoin	25.5	12.8	6.4	25.5	25.5	25.5	25.5	25.5	-	Not treated	25.5
		(A4) : Imidazodinyl urea	-	-	-	-	-	-	-	-	25.5		-
	(B)	Tea extract(*1)	7.5	3.8	1.9	7.5	7.5	7.5	-	-	-		-
		Resorcin	-	-	-	-	-	-	15.0	15.0	7.5		-
	(C)	Water	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance		Balance
	(D)	Triethylene glycol	-	-	-	30.7	-	-	-	-	-		-
		1,3-dimethyl-2-imidazolidinone	-	-	-	-	30.7	-	-	-	-		-
	pH adjuster	Hydrochloric acid or sodium hydroxide	*2	*2	*2	*2	*2	*2	*2	*2	*2		*2
		Total	100	100	100	100	100	100	100	100	100		100
	pH (25°C)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	9.0	4.0		4.0
	Molar ratio (A)/(B)		6.7	6.7	6.7	6.7	6.7	6.7	1.0	1.0	0.96		-
Treatment method	Bath ratio (mass ratio of treating agent to fibers)		80	80	80	80	80	80	80	80	80		80
	Heating in step (0) (Preheating of formulation alone before immersion of fibers)		None	None	None	None	None	50°C 1.5 h	None	None	None		None
	Action for preventing formulation turbidity from exceeding 1,000 NTU during immersion of fibers		Take out fibers	Take out fibers	Take out fibers	Take out fibers	Take out fibers	Replace agent	Take out fibers	Take out fibers	Take out fibers		Take out fibers
	Heating condition		50°C 4.0 h ×1	50°C 2.5 h ×1	50°C 2.0 h ×1	50°C 7.0 h ×1	50°C 7.0 h × 1	50°C 1.5 h ×2	50°C 50.0 h ×1	50°C 50.0 h ×1	50°C 63.0 h ×1		50°C 4.0 h ×1
Effect	Durability improvement	Ratio of increase in average breaking elongation during fiber tensioning [%]	3.0	1.6	1.6	2.1	2.1	3.2	7.5	7.5	1.7	0.0 (reference)	0.0
		Amount of increase in average breaking load during fiber tensioning [gf]	26.2	20.1	9.5	18.0	14.7	36.0	21.4	0.3	27.4	0.0 (reference)	-1.0
		Suppression of shrinkage during set with iron at high temperature	-	-	-	-	-	-	-4.4	-	-	-7.7	-
	Heat shape memory ability	I: Shaping (curl)	41	33	24	27	27	-	52	-	37	3	4
		II: Reshaping (straight)	100	98	97	97	97	-	97	-	100	-	-
		III: Re-reshaping (curl)	44	35	32	29	25	-	54	-	38	-	-
	Surface feel quality		15	14	13	16	15	15	13	11	12	10	10

*1: Total active amount of catechins in tea extract (analyzed by HPLC in accordance with Mizukami et al. (2007) J. Agric. Food Chem. 55: 4957-4964)

*2: Amount of pH adjustment

Example 10 (surface finish treatment)

[0191] The regenerate collagen fibers treated in Example 1 were treated with a surface finish agent shown in Table 2, and various properties were evaluated.

<Treatment method>

[0192]

1. The tress was immersed in a container containing 40 g of the surface finish agent, and left to stand at room temperature for 30 minutes.
2. The tress was taken out from the container, and dried for 5 minutes with a household centrifugal dryer (Ultrafast Dryer Powerful Spin Dry APD-6.0 manufactured by ALUMIS CO., LTD.).
3. The tress was taken out from the dryer, and heated for 3 hours in an oven (forced circulation dryer with a stainless window; SOFW-450 manufactured by AS ONE Corporation) set at 60°C (spin coating method).
4. The tress was taken out from the oven, and brought back to room temperature.
5. The tress was rinses with running water at 30°C for 30 seconds, and lightly drained with a towel, and the tress was then blown by a hot air dryer (Nobby White NB 3000 manufactured by TESCOM Company) while being combed.

[Table 2]

			Example 10
Surface finish agent (mass%)	(F)	Polvsilicone-29	5.0
	(C)	Water	Balance
	Total		100
	pH (25°C)		4.0
Treatment method	Method for surface finish treatment		Spin coating
Effect	Durability improvement	Ratio of increase in average breaking elongation during fiber tensioning [%]	5.6
		Amount of increase in average breaking load during fiber tensioning [gf]	20.2
	Surface feel quality		24

Examples 11 to 13

[0193] Over the regenerated collagen fiber tress treated in Examples 7 and 8, a flat iron (manufactured by Miki Denki Sangyo K.K./Model: AHI-938) at a measured temperature of 180°C was slid six times at a rate of 5 cm/sec, and various properties were then evaluated (Examples 11 and 13).

[0194] Further, for the tresses treated with an iron as described above (Example 11), the tress was drawn with each of its both ends held by a hairpin for applying tension to the extent that each fiber forming the tress was stretched at 0.1 to 0.5% on average, and in this state, the tress was left to stand in water at 40°C for 1 hour with the hairpins fixed to the wall of a water bath by a tape, and was then blown with a dryer. For the thus-obtained tress, various properties were evaluated (Example 12).

[0195] Table 3 shows the results.

[Table 3]

			Example		
			11	12	13
Object to be treated			Regenerated collagen fibers treated in Example 7		Regenerated collagen fibers treated in Example 8
Hair iron treatment			Slided six times at 180°C		Slided six times at 180°C
Water immersion treatment			-	40°C 1 hr	-
Effect	Durability improvement	Ratio of increase in average breaking elongation during fiber tensioning [%]	12.3	18.5	13.9
		Amount of increase in average breaking load during fiber tensioning [gf]	30.5	33.8	27.3
		Suppression of shrinkage during setting with iron at high temperature	-	-	-
	Heat shape memory ability	I: Shaping (curl)	-	48	-
		II: Reshaping (straight)	-	92	-
		III: Re-reshaping (curl)	-	46	-
	Surface feel quality		17	18	16

Examples 14 to 17

[0196] Using the first part and the second part whose formulations are shown in Table 4, the regenerated collagen fibers were treated in accordance with the following method, and various properties were evaluated. The pH of each composition was directly measured with a pH meter (F-52 manufactured by HORIBA, Ltd) with the prepared composition placed at room temperature (25°C).

[0197] The concentrations of each component described in the table are concentrations in the first part and the second part, respectively, and the numerical value as the above-described "total composition of fiber-treating agent" is half the numerical value in the table because equal amounts (40 g) of the first part and the second part were used as shown below.

<Treatment method>

[0198]

1. A 22 cm-long tress with 0.5 g of regenerated collagen fibers (*) was immersed in a container containing 40 g of the first part, the opening of the container was closed, the container was immersed together with its contents in a water bath (manufacturer: TOYO SEISAKUSHO, Ltd./Model: TBS221FA) at 50°C, and heating was performed for a time shown in the table.

   *: Regenerated collagen fibers manufactured by Kaneka Corporation were purchased in the form of a marketed extension product, and cut, and the cut fibers were segmented into tresses, and used for evaluation. In this evaluation, extension products were used which display the use of Ultima 100% as a fiber species, and are brown with a color number of 3, and straight in shape.

2. The container containing the tress was taken out from the water bath, and brought back to room temperature.
3. The tress was taken out from the container, rinsed with running tap water at 30°C for 30 seconds, lathered with evaluating shampoo for 60 seconds, rinsed with running tap water at 30°C for 30 seconds, and lightly drained with a towel, and the tress was then blown by a hot air dryer (Nobby White NB 3000 manufactured by TESCOM Company) while being combed.

4. The tress was immersed in a container containing 40 g of the second part, the opening of the container was closed, the container was immersed together with its contents in a water bath (manufacturer: TOYO SEISAKUSHO, Ltd./Model: TBS221FA) at 50°C, and heating was performed for a time shown in the table.
5. The container containing the tress was taken out from the water bath, and brought back to room temperature.
6. The tress was taken out from the container, immersed in 50 g of triethylene glycol for 30 seconds, then rinsed with running tap water at 30°C for 30 seconds, lathered with evaluating shampoo for 60 seconds, rinsed with running tap water at 30°C for 30 seconds, and lightly drained with a towel, and the tress was then blown by a hot air dryer (Nobby White NB 3000 manufactured by TESCOM Company) while being combed. At this time, the tress remained straight.

[Table 4]

			Example			
			14	15	16	17
First part (mass%)	(B)	Tea extract(*1)	11.3	5.0	5.0	5.0
	(C)	Water	Balance	Balance	Balance	Balance
	pH adjuster	Hydrochloric acid or sodium hydroxide	*2	*2	*2	*2
	Total		100	100	100	100
	pH(25°C)		4.0	4.0	4.0	4.0
	Bath ratio (mass ratio of first part to fibers)		80	80	80	80
	Heating condition		50°C 18.0 h	50°C 4.0 h	50°C 4.0 h	50°C 4.0 h
Second part (mass%)	(A)	(A3): DMDM hydantoin	20.0	-	-	-
		(A4): Imidazodinyl urea	-	2.5	5.0	10.0
	(C)	Water	Balance	Balance	Balance	Balance
	pH adjuster	Hydrochloric acid or sodium hydroxide	*2	*2	*2	*2
	Total		100	100	100	100
	pH (25°C)		4.0	4.0	4.0	4.0
	Bath ratio (mass ratio of second part to fibers)		80	80	80	80
	Heating condition		50°C 18.0 h	50°C 4.0 h	50°C 4.0 h	50°C 4.0 h
	Molar ratio (A)/(B)		3.5	0.5	1.0	1.9

(continued)

			Example			
			14	15	16	17
Effect	Durability improvement	Ratio of increase in average breaking elongation during fiber tensioning [%]	1.5	4.6	3.0	2.8
		Amount of increase in average breaking load during fiber tensioning [gf]	57.8	26.0	33.5	29.9
	Heat shape memory ability	I: Shaping (curl)	38	33	35	33
		II: Reshaping (straight)	95	98	98	98
		III: Re-reshaping (curl)	30	33	35	33
	Surface feel quality		17	15	16	15
*1: Total active amount of catechins in tea extract (analyzed by HPLC in accordance with Mizukami et al. (2007) J. Agric. Food Chem. 55: 4957-4964) *2: Amount of pH adjustment						

[0199] The tresses treated in Examples above can all be directly used as extensions by attachment to head hair with pins or the like, and can exhibit sufficient performance on the human head.

Claims

1. A one-part type fiber-treating agent comprising a single composition or a multiple-part type fiber-treating agent comprising a plurality of compositions, wherein the fiber-treating agent comprises the following components (A) to (C) in the total composition thereof, provided that, for the one-part type, a part or all of the components (A) and (B) is optionally a condensate formed from the components:

   (A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule;
   (B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position, wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group; and
   (C): water.

2. The fiber-treating agent according to claim 1, wherein a content of a constituent element derived from the component (A) in the fiber-treating agent is 0.1 mass% or more and 80 mass% or less based on the total composition of the fiber-treating agent.

3. The fiber-treating agent according to claim 1 or 2, wherein a content of a constituent element derived from the component (B) in the fiber-treating agent is 0.1 mass% or more and 80 mass% or less based on the total composition of the fiber-treating agent.

4. The fiber-treating agent according to any one of claims 1 to 3, wherein a total of the content of a constituent element derived from the component (A) and the content of a constituent element derived from the component (B) in the fiber-treating agent is 0.1 mass% or more and 80 mass% or less based on the total composition of the fiber-treating agent.

5. The fiber-treating agent according to any one of claims 1 to 4, wherein a molar ratio of the constituent element derived from the component (A) to the constituent element derived from the component (B), (A)/(B), is 0.1 or more and less than 20.

6. The fiber-treating agent according to any one of claims 1 to 5, which is of multiple-part type fiber-treating agent comprising a first part containing the components (B) and (C) and a second part containing the components (A) and (C).

7. The fiber-treating agent according to any one of claims 1 to 5, wherein the fiber-treating agent is of one-part type, and further comprises the following component (D):
(D): an organic compound having a Hansen solubility parameter SP value of 16 $\mathrm{Mpa}^{1/2}$ or more and 40 $\mathrm{Mpa}^{1/2}$ or less (excluding organic salts and compounds having an aldehyde group and having a molecular weight of 150 or less).

8. The fiber-treating agent according to any one of claims 1 to 7, further comprising the following component (E):
(E): a sulfur-containing reducing agent.

9. A method for treating fibers, comprising the following step (i):

(i) immersing fibers in the fiber-treating agent according to any one of claims 1 to 8.

10. The method for treating fibers according to claim 9, wherein the fiber-treating agent is a one-part type, the step (i) is carried out while a state is maintained in which a turbidity of the treating agent is 1,000 NTU or less.

11. The method for treating fibers according to claim 9 or 10, wherein the fiber-treating agent is a one-part type, and the following step (0) is carried out before the step (i):
(0) heating the fiber-treating agent.

12. The method for treating fibers according to claim 11, wherein, assuming that T is a heating time until the treating agent has a turbidity of more than 1,000 NTU after the treating agent is heated immediately after being prepared by mixing the components, a heating time in the step (0) is 0.2T or more and 0.8T or less.

13. The method for treating fibers according to any one of claims 9 to 12, wherein the fiber-treating agent is a one-part type, the following step (ii-a) is carried out after the step (i), and the step (i) and the step (ii-a) are repeated two or more times:
(ii-a) taking out the fibers from the treating agent before the turbidity of the treating agent exceeds 1,000 NTU.

14. The method for treating fibers according to claim 9, wherein the fiber-treating agent is of multiple-part type, and the step (i) is a step of immersing the fibers in one of the first part and the second part set forth in claim 6, and then in the other.

15. The method for treating fibers according to claim 14, wherein the following step (ii-b) is carried out after the step (i):
(ii-b) taking out the fibers from the treating agent.

16. The method for treating fibers according to claim 13 or 15, wherein the following step (iii) is carried out after the step (ii-a) or (ii-b):
(iii) rinsing the fibers taken out.

17. The method for treating fibers according to claim 16, wherein the rinsing in the step (iii) is performed using a composition containing a component (D):
(D): an organic compound having a Hansen solubility parameter SP value of 16 $\mathrm{Mpa}^{1/2}$ or more and 40 $\mathrm{Mpa}^{1/2}$ or less (excluding organic salts and compounds having an aldehyde group and having a molecular weight of 150 or less).

18. The method for treating fibers according to any one of claims 9 to 17, wherein the step of immersing the fibers in a surface finish agent containing the following components (F) and (C) is further carried out after the steps (i) to (iii):

(F) an epoxyaminosilane copolymer which is a reaction product of the following compounds (a) to (d):

(a) polysiloxane having at least two oxiranyl groups or oxetanyl groups;
(b) polyether having at least two oxiranyl groups or oxetanyl groups;
(c) aminopropyltrialkoxysilane; and
(d) a compound selected from the group consisting of the following primary and secondary amines:

- primary amine: methylamine, ethylamine, propyleneamine, ethanolamine, isopropylamine, butylamine, isobutylamine, hexylamine, dodecylamine, oleylamine, aniline, aminopropyltrimethylsilane, aminopropyltriethylsilane, aminomorpholine, aminopropyldiethylamine, benzylamine, naphthylamine, 3-amino-9-ethylcarbazole, 1-aminoheptafluorohexane and 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-pentadecafluoro-1-octaneamine; and
- secondary amine: methylethylamine, methyloctadecylamine, diethanolamine, dibenzylamine, dihexylamine, dicyclohexylamine, piperidine, pyrrolidine phthalimide and polymer amine; and

(C) water.

19. A method for producing fibers for hair ornament products, comprising the step of treating fibers by the method for treating fibers according to any one of claims 9 to 18.

20. A method for producing a hair ornament product, comprising the step of treating fibers by the method for treating fibers according to any one of claims 9 to 18.

21. A fiber for hair ornament products comprising a condensate formed from components (A) and (B):

(A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule; and
(B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position, wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group.

22. A hair ornament product having, as a constituent element, fibers containing a condensate formed from components (A) and (B):

(A): a compound having a structure in which a methylol group is bonded to each of two nitrogen atoms in the molecule; and
(B): a phenolic compound having an electron donating group on at least one of meta-positions and a hydrogen atom on at least one of ortho-positions and a para-position, wherein the electron donating group on the meta-position optionally forms, together with adjacent carbon atoms, a benzene ring optionally substituted with a hydroxy group.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/047436

A. CLASSIFICATION OF SUBJECT MATTER

A41G 3/00(2006.01)i; *D06M 101/12*(2006.01)n; ***D06M 11/54***(2006.01)i; ***D06M 13/148***(2006.01)i; ***D06M 15/41***(2006.01)i; ***D06M 15/643***(2006.01)i; ***D06M 15/65***(2006.01)i

FI: A41G3/00; D06M13/148; D06M15/643; D06M11/54; D06M15/65; D06M15/41; D06M101:12

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)

A41G3/00; D06M101/12; D06M11/54; D06M13/148; D06M15/41; D06M15/643; D06M15/65

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 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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.
Y	WO 01/06045 A1 (KANEKA CORPORATION) 25 January 2001 (2001-01-25) pp. 6-7	1-22
Y	WO 2019/159866 A1 (KAO CORPORATION) 22 August 2019 (2019-08-22) paragraphs [0007]-[0207]	1-22
Y	JP 11-172073 A (BORDEN CHEMICAL INCORPORATED) 29 June 1999 (1999-06-29) claim 12, paragraphs [0080], [0081], [0086]-[0089]	10-20

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search **09 February 2022**	Date of mailing of the international search report **22 February 2022**
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.

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INTERNATIONAL SEARCH REPORT
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International application No.
PCT/JP2021/047436

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