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

(11) **EP 3 483 312 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
07.06.2023 Bulletin 2023/23

(21) Application number: **17827448.6**

(22) Date of filing: **30.06.2017**

(51) International Patent Classification (IPC):
D03D 15/283 *(2021.01)* ***D01F 8/14*** *(2006.01)*
D02G 1/02 *(2006.01)* ***D03D 15/00*** *(2021.01)*
D04B 1/16 *(2006.01)* ***D01F 8/12*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
D01F 8/12; D01F 8/14; D02G 1/02; D03D 15/00; D03D 15/283; D04B 1/16

(86) International application number:
PCT/JP2017/024110

(87) International publication number:
WO 2018/012318 (18.01.2018 Gazette 2018/03)

(54) **SEA-ISLANDS TYPE COMPOSITE FIBER HAVING EXCELLENT MOISTURE ABSORBABILITY, TEXTURED YARN, AND FIBER STRUCTURE**

VERBUNDSTOFFFASER VOM INSELTYP MIT HERVORRAGENDER FEUCHTIGKEITABSORPTIONSFÄHIGKEIT, TEXTURIERTES GARN UND FASERSTRUKTUR

FIBRE COMPOSITE DE TYPE MER-ÎLES PRÉSENTANT UNE EXCELLENTE CAPACITÉ D'ABSORPTION DE L'HUMIDITÉ, FIL TEXTURÉ, ET STRUCTURE FIBREUSE

(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

(30) Priority: **11.07.2016 JP 2016136660**
06.02.2017 JP 2017019577

(43) Date of publication of application:
15.05.2019 Bulletin 2019/20

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Description

TECHNICAL FIELD

[0001] The present invention relates to a sea-islands type composite fiber that includes an island component that is a polymer having moisture absorbability, and has excellent moisture absorbability. More specifically, the present invention relates to a sea-islands type composite fiber which does not undergo cracks of a sea component upon the volume expansion of a polymer having moisture absorbability that serves as an island component during a hot water treatment such as a dyeing treatment, rarely undergoes the generation of dyeing specks and/or fluffs when the composite fiber is formed into a fiber structure such as a woven fabric or a knitted fabric, has excellent quality, is reduced in the elution of the polymer having moisture absorbability, also has excellent moisture absorbability even after a hot water treatment such as a dyeing treatment, also has dry touch inherent to a polyester fiber when the sea component is polyester, and thus can be suitably used for clothing application.

BACKGROUND ART

[0002] Polyester fibers are inexpensive, excellent in mechanical properties and dry touch, and therefore are used in a wide range of applications. However, since they have poor moisture absorbability, they have problems to be solved from the viewpoint of wearing comfort, such as generation of a stuffy feeling at high humidity in the summer and generation of static electricity at low humidity in the winter.

[0003] So far, various proposals have been made on methods for imparting moisture absorbability to polyester fibers to solve the above-mentioned drawbacks. Examples of the common method for imparting moisture absorbability include copolymerization of a hydrophilic compound and addition of a hydrophilic compound to a polyester. Examples of the hydrophilic compound include polyethylene glycol.

[0004] For example, Patent Document 1 proposes a fiber including a polyester copolymerized with polyethylene glycol as a moisture absorbing polymer. In this proposal, the moisture absorbing polymer is singly formed into a fiber to impart moisture absorbability to a polyester fiber.

[0005] Patent Document 2 proposes a core-sheath type composite fiber in which a polyester copolymerized with polyethylene glycol is disposed as a core and polyethylene terephthalate is disposed as a sheath. In this proposal, moisture absorbability is imparted to the polyester fiber by disposing a moisture absorbing polymer on the core.

[0006] Patent Document 3 proposes a sea-islands type composite fiber in which a polyester copolymerized with polyethylene glycol is disposed as an island and polyethylene terephthalate is disposed as a sea. In this proposal, moisture absorbability is imparted to the polyester fiber by disposing a moisture absorbing polymer on the island.

[0007] Patent Document 4 proposes a sea-island composite fiber (using polyethylene terephthalate as the sea and polyether block amide copolymer as the islands, said to have excellent moisture absorption and release properties and antistatic properties even after high-pressure dyeing.

[0008] Patent Document 1: JP 2006-104379 A; Patent Document 2: JP 2001-172374 A; Patent Document 3: JP 8-198954 A; and Patent Document 4: JP 2016-069770 A. Further examples of fibers which contain a polymer having moisture absorbability are provided in: JP 2000-239918 A, JP H06-287815 A, JP 2004-277911 A and WO 2009/060985 A.

PROBLEMS TO BE SOLVED BY THE INVENTION

[0009] However, the method described in Patent Document 1 above has a problem that the moisture absorbing polymer is exposed on the whole fiber surface, and thus polyethylene glycol, which is a copolymerization component of the moisture absorbing polymer, elutes during a hot water treatment such as a dyeing treatment, resulting in reduced moisture absorbability after the hot water treatment.

[0010] The method described in Patent Document 2 has a problem that the sheath component cracks upon the volume expansion of the moisture absorbing polymer of the core component during a hot water treatment such as a dyeing treatment, and dyeing specks and/or fluffs are generated, resulting in reduced quality. Furthermore, the method has a problem that the moisture absorbing polymer of the core component elutes from the cracked portion of the sheath component as a starting point, resulting in reduced moisture absorbability after the hot water treatment.

[0011] The method described in Patent Document 3 has a problem that the sea component cracks upon the volume expansion of the moisture absorbing polymer of the island component during a hot water treatment such as a dyeing treatment due to the small thickness of the sea component of the outermost layer relative to the fiber diameter in the transverse cross-section of the fiber, and dyeing specks and/or fluffs are generated, resulting in the reduced quality, as in the method described in Patent Document 2. Furthermore, the method has a problem that the moisture absorbing polymer of the island component elutes from the cracked portion of the sea component as a starting point, resulting in reduced moisture absorbability after the hot water treatment.

[0012] An object of the present invention is to solve the problems of the prior art, and to provide a sea-islands type composite fiber which rarely undergoes the generation of dyeing specks and/or fluffs when the composite fiber is formed into a fiber structure such as a woven fabric or a knitted fabric, has excellent quality, has excellent moisture absorbability even after a hot water treatment such as a dyeing treatment, also has dry touch inherent to a polyester fiber when the sea component is polyester, and can be suitably used for clothing applications.

SOLUTIONS TO THE PROBLEMS

[0013] The present invention provides a sea-islands composite fiber comprising: an island component that is a polymer having moisture absorbability; a ratio (T/R) of a thickness T of an outermost layer to a diameter R of the fiber in a transverse cross-section of the fiber of 0.05 to 0.25; and a moisture absorption rate difference (ΔMR) after a hot water treatment of 2.0 to 10.0%; wherein the polymer having moisture absorbability is a polyetherester, the polyetherester containing an aromatic dicarboxylic acid and an aliphatic diol as main components, and containing the polyether as a copolymerization component; and wherein the thickness of an outermost layer is a difference between a radius of the fiber and a radius of a circumscribed circle formed by connecting an apex of the island component disposed in an outermost circle, and represents a thickness of a sea component in the outermost layer.

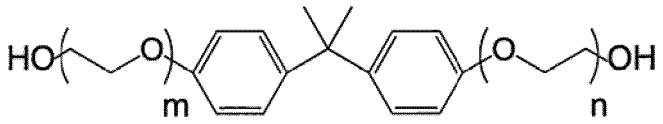
[0014] The thickness T of an outermost layer is preferably 500 to 3,000 nm, and the diameter r of the island component in the transverse cross-section of the fiber is preferably 10 to 5,000 nm.

[0015] Further, it is preferable that the island component be disposed to form 2 to 100 circles in the transverse cross-section of the fiber, a ratio (r1/r2) of a diameter r1 of the island component disposed to pass through a center of the transverse cross-section of the fiber to a diameter r2 of other island components be 1.1 to 10.0, the shape of the center side of the island component disposed in the outermost circle in the transverse cross-section of the fiber be non-circular, and a composite ratio (a weight ratio) of the sea component/the island component be 50/50 to 90/10.

[0016] The polymer of the island component is a polyetherester containing a polyether as a copolymerization component. The polyether is preferably at least one polyether selected from the group consisting of polyethylene glycol, polypropylene glycol, and polybutylene glycol, and it is preferable that the polyether have a number average molecular weight of 2,000 to 30,000 g/mol, and the copolymerization ratio of the polyether be 10 to 60% by weight.

[0017] The polyetherester contains an aromatic dicarboxylic acid and an aliphatic diol as main components, and contains the polyether as a copolymerization component, or contains the polyether and an alkylene oxide adduct of a bisphenol represented by General Formula (1) below as a copolymerization component. The aliphatic diol is preferably 1,4-butanediol.

[Chemical Formula 1]



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[0018] Wherein m and n are integers of 2 to 20 and m + n is 4 to 30.

[0019] Furthermore, the sea component of the sea-islands type composite fiber is preferably a cation dyeable polyester.

[0020] The false twist yarn of the present invention includes a twist of two or more of the sea-islands type composite fiber, and can be suitably used in the fiber structure including the sea-islands type composite fiber and/or the false twist yarn in at least a part of the fiber structure.

EFFECTS OF THE INVENTION

[0021] The fiber of the present invention does not undergo cracks of a sea component upon the volume expansion of a polymer having moisture absorbability that serves as an island component during a hot water treatment such as a dyeing treatment, thus rarely undergoes the generation of dyeing specks and/or fluffs when the composite fiber is formed into a fiber structure such as a woven fabric or a knitted fabric, and has excellent quality. In addition, the sea-islands type composite fiber is reduced in the elution of the polymer having moisture absorbability, thus has excellent moisture absorbability even after a hot water treatment such as a dyeing treatment, also has dry touch inherent to a polyester fiber when the sea component is polyester, and can be suitably used for, in particular, clothing applications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Figs. 1(a) to 1(m) show figures showing examples of the cross-sectional shape of the sea-islands type composite fiber of the present invention.

Figs. 2(a) to 2(c) show figures showing examples of the sea-island composite spinneret used in the method for manufacturing the sea-islands type composite fiber of the present invention. Fig. 2(a) shows a front cross-sectional view of a main part that constitutes the sea-island composite spinneret, Fig. 2(b) shows a cross-sectional view of a part of a distribution plate, and Fig. 2(c) shows a cross-sectional view of a discharge plate.

Fig. 3 shows a part of an example of the distribution plate.

Fig. 4 shows an example of a distribution groove and distribution hole disposition in the distribution plate.

EMBODIMENTS OF THE INVENTION

[0023] The sea-islands type composite fiber of the present invention includes: an island component that is a polymer having moisture absorbability; a ratio (T/R) of a thickness T of an outermost layer to a diameter R of the fiber in a transverse cross-section of the fiber of 0.05 to 0.25; and a moisture absorption rate difference (ΔMR) after a hot water treatment of 2.0 to 10.0%. The thickness of an outermost layer is a difference between a radius of the fiber and a radius of a circumscribed circle formed by connecting an apex of the island component disposed in an outermost circle, and represents a thickness of a sea component in the outermost layer.

[0024] A polymer having moisture absorbability (hereinafter may be simply referred to as a moisture absorbing polymer) generally tends to undergo volume expansion during a hot water treatment such as a dyeing treatment and easily elutes in hot water in nature. Therefore, when the moisture absorbing polymer is singly formed into a fiber, there is a problem that the moisture absorbing polymer is eluted by the hot water treatment, and the eluted portion causes dyeing specks and/or fluffs, resulting in the reduced quality. When the moisture absorbing polymer is a polymer copolymerized with a hydrophilic copolymerization component, there is also a problem that the hydrophilic copolymerization component is eluted by the hot water treatment, and the moisture absorbability is reduced after the hot water treatment.

[0025] Meanwhile, in the core-sheath type composite fiber in which the moisture absorbing polymer is disposed in the core, the moisture absorbing polymer disposed in the core undergoes volume expansion during a hot water treatment such as a dyeing treatment, and the stress concentrates at the interface between the core component and the sheath component, resulting in cracks of the sheath component. Due to the cracks of the sheath component, dyeing specks and/or fluffs are generated, resulting in the reduced quality. Furthermore, there is another problem that the moisture absorbing polymer disposed in the core elutes from the cracked portion of the sheath component as a starting point, resulting in reduced moisture absorbability after the hot water treatment.

[0026] In the sea-islands type composite fiber in which the moisture absorbing polymer is disposed in the island, there is the same problem as in the core-sheath type composite fiber. The conventional sea-islands type composite fiber can be obtained by a conventionally known pipe sea-island composite spinneret disclosed in, for example, Japanese Patent Laid-open Publication No. 2007-100243, and has the technical limit of the thickness of the sea component in the outermost layer of about 150 nm. That is, since the thickness of the sea component in the outermost layer of the sea-islands type composite fiber is very thin as compared to the thickness of the sheath component of the core-sheath type composite fiber, cracks of the sea component easily occurs due to the volume expansion of the moisture absorbing polymer disposed in the island caused by a hot water treatment such as a dyeing treatment. Due to the cracks of the sea component, dyeing specks and/or fluffs are generated, resulting in the reduced quality, and in addition, the moisture absorbing polymer disposed in the island elutes from the cracked portion of the sea component as a starting point, resulting in the reduced moisture absorbability after the hot water treatment.

[0027] In view of the above-mentioned problems, the inventors of the present invention have made intensive investigations and, as a result, have successfully obtained a sea-islands type composite fiber that resolves all above problems, and exhibits high quality and high moisture absorbability even after a hot water treatment by dispersing the stress upon the volume expansion by the dispersed disposition of the moisture absorbing polymer, and setting the ratio (T/R) of a thickness T of an outermost layer to a diameter R of the fiber within a specific range.

[0028] The island component of the sea-islands type composite fiber of the present invention is a polymer having moisture absorbability. In the present invention, the polymer having moisture absorbability is a polymer having a moisture absorption rate difference (ΔMR) of 2.0 to 30.0%. The moisture absorption rate difference (ΔMR) in the present invention refers to the value measured by the method described in Examples. When ΔMR of the moisture absorbing polymer is 2.0% or more, a sea-islands type composite fiber having excellent moisture absorbability can be obtained in combination with the sea component. The ΔMR of the moisture absorbing polymer is more preferably 5.0% or more, further preferably 7.0% or more, particularly preferably 10.0% or more. Meanwhile, when ΔMR of the moisture absorbing polymer is 30.0%

or less, the process passability and handleability are good, and the durability in use after the polymer is formed into a sea-islands type composite fiber is also excellent. Therefore it is preferable that ΔMR of the moisture absorbing polymer be 30.0% or less.

[0029] The island component of the sea-islands type composite fiber of the present invention includes a moisture absorbing polymer, namely a polyetherester. A polyetherester containing a polyether as a copolymerization component is selected because they have excellent moisture absorbability, and excellent heat resistance, and provide good mechanical properties and color of the obtained sea-islands type composite fiber. Only one type of these moisture absorbing polymers may be used, or two or more types may be used in combination. A blend of these moisture absorbing polymers and a polyester, a polyamide, a polyolefin or the like may be used as a moisture absorbing polymer.

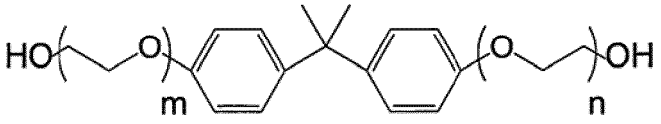
[0030] Specific examples of the polyether as the copolymerization component of the moisture absorbing polymer include, but are not limited to, homopolymers such as polyethylene glycol, polypropylene glycol, and polybutylene glycol, and copolymers such as a polyethylene glycol-polypropylene glycol copolymer and a polyethylene glycol-polybutylene glycol copolymer. Among these, polyethylene glycol, polypropylene glycol, and polybutylene glycol are preferable because they have good handleability in the production and use, and polyethylene glycol is particularly preferable because it has excellent moisture absorbability.

[0031] The polyether preferably has a number average molecular weight of 2,000 to 30,000 g/mol. When the polyether has a number average molecular weight of 2,000 g/mol or more, the moisture absorbability of the moisture absorbing polymer obtained by copolymerizing the polyether is high, and the sea-islands type composite fiber having excellent moisture absorbability is obtained when the moisture absorbing polymer is used as the island component. Therefore, it is preferable that the polyether have a number average molecular weight of 2,000 g/mol or more. The polyether more preferably has a number average molecular weight of 3,000 g/mol or more, further preferably 5,000 g/mol or more. Meanwhile, when the polyether has a number average molecular weight of 30,000 g/mol or less, the polyether has high polycondensation reactivity, thus unreacted polyethylene glycol can be decreased, the elution of the moisture absorbing polymer of the island component into hot water during a hot water treatment such as a dyeing treatment is suppressed, and the moisture absorbability can be maintained even after the hot water treatment. Therefore, it is preferable that the polyether have a number average molecular weight of 30,000 g/mol or less. The polyether more preferably has a number average molecular weight of 25,000 g/mol or less, further preferably 20,000 g/mol or less.

[0032] The copolymerization ratio of the polyether is preferably 10 to 60% by weight. When the copolymerization ratio of the polyether is 10% by weight or more, the moisture absorbability of the moisture absorbing polymer obtained by copolymerizing the polyether is high, and the sea-islands type composite fiber having excellent moisture absorbability is obtained when the moisture absorbing polymer is used as the island component. Therefore it is preferable that the copolymerization ratio of the polyether be 10% by weight or more. The copolymerization ratio of the polyether is more preferably 20% by weight or more, and further preferably 30% by weight or more. Meanwhile, when the copolymerization ratio of the polyether is 60% by weight or less, unreacted polyethylene glycol can be decreased, the elution of the moisture absorbing polymer of the island component into hot water during a hot water treatment such as a dyeing treatment is suppressed, and the moisture absorbability can be maintained even after the hot water treatment. Therefore, it is preferable that the copolymerization ratio of the polyether be 60% by weight or less. The copolymerization ratio of the polyether is more preferably 55% by weight or less, and further preferably 50% by weight or less.

[0033] From the viewpoint of heat resistance and mechanical properties, it is preferable that the polyetherester contain an aromatic dicarboxylic acid and an aliphatic diol as main components, and a polyether as a copolymerization component, or contain an aromatic dicarboxylic acid and an aliphatic diol as main components, and a polyether and an alkylene oxide adduct of a bisphenol represented by General Formula (1) below as copolymerization components:

[Chemical Formula 1]



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wherein m and n are integers of 2 to 20 and m + n is 4 to 30.

[0034] Specific examples of the aromatic dicarboxylic acid include, but are not limited to, terephthalic acid, isophthalic acid, phthalic acid, 5-sodium sulfoisophthalic acid, 5-lithium sulfoisophthalic acid, 5- (tetraalkyl) phosphonium sulfoisophthalic acid, 4,4'-diphenyl dicarboxylic acid, and 2,6-naphthalene dicarboxylic acid.

[0035] Specific examples of the aliphatic diol include, but are not limited to, ethylene glycol, 1,3-propanediol, 1,4-butanediol, hexanediol, cyclohexanediol, diethylene glycol, hexamethylene glycol, and neopentyl glycol. Among these, ethylene glycol, propylene glycol, and 1,4-butanediol are preferable because of good handleability in the production and

use, ethylene glycol can be suitably employed from the viewpoint of the heat resistance and mechanical properties, and 1,4-butanediol can be suitably employed from the viewpoint of crystallinity.

[0036] When the polyetherester contains the polyether and the alkylene oxide adduct of a bisphenol represented by General Formula (1) above as copolymerization components, the polyetherester has good forming processability, the mechanical properties of the obtained sea-islands type composite fiber is high, generation of unevenness of fineness can be suppressed, and dyeing specks and/or fluffs are small, resulting in the good quality. Therefore, it is preferable that the polyetherester contain the polyether and the alkylene oxide adduct of a bisphenol represented by General Formula (1) above as copolymerization components.

[0037] In the alkylene oxide adduct of a bisphenol represented by General Formula (1) above, m + n is preferably 4 to 30. When m + n is 4 or more, the polyetherester has good forming processability, generation of unevenness of fineness in the obtained sea-islands type composite fiber can be suppressed, and dyeing specks and/or fluffs are small, resulting in the good quality. Therefore, it is preferable that m + n be 4 or more. Meanwhile, when m + n is 30 or less, the polyetherester has good heat resistance and color, and the mechanical properties and color of the obtained sea-islands type composite fiber are good. Therefore it is preferable that m + n be 30 or less. More preferably, m + n is 20 or less, and further preferably, 10 or less.

[0038] Specific examples of the alkylene oxide adduct of a bisphenol represented by General Formula (1) above include, but are not limited to, an ethylene oxide adduct of bisphenol A and an ethylene oxide adduct of bisphenol S. Among these, the ethylene oxide adduct of bisphenol A is preferable because of the good handleability in the production and use, and also can be suitably employed from the viewpoint of the heat resistance and mechanical properties.

[0039] When the polyetherester includes the polyether and the alkylene oxide adduct of a bisphenol represented by General Formula (1) above as copolymerization components, it is preferable that the copolymerization ratio of the polyether be 10 to 45% by weight, and the copolymerization ratio of the alkylene oxide adduct of a bisphenol be 10 to 30% by weight. When the copolymerization ratio of the polyether is 10% by weight or more, the moisture absorbability of the moisture absorbing polymer obtained by copolymerizing the polyether is high, and the sea-islands type composite fiber having excellent moisture absorbability is obtained when the moisture absorbing polymer is used as the island component. Therefore it is preferable that the copolymerization ratio of the polyether be 10% by weight or more. The copolymerization ratio of the polyether is more preferably 20% by weight or more, and further preferably 30% by weight or more. Meanwhile, when the copolymerization ratio of the polyether is 45% by weight or less, unreacted polyethylene glycol can be decreased, the elution of the moisture absorbing polymer of the island component into hot water during a hot water treatment such as a dyeing treatment is suppressed, and the moisture absorbability can be maintained even after the hot water treatment. Therefore, it is preferable that the copolymerization ratio of the polyether be 45% by weight or less. The copolymerization ratio of the polyether is more preferably 40% by weight or less, and further preferably 35% by weight or less. When the copolymerization ratio of the alkylene oxide adduct of a bisphenol is 10% by weight or more, the polyetherester has good forming processability, generation of unevenness of fineness in the obtained sea-islands type composite fiber can be suppressed, and dyeing specks and/or fluffs are small, resulting in the good quality. Therefore it is preferable that the copolymerization ratio of the alkylene oxide adduct of a bisphenol be 10% by weight or more. The copolymerization ratio of the alkylene oxide adduct of a bisphenol is more preferably 12% by weight or more, and further preferably 14% by weight or more. Meanwhile, when the copolymerization ratio of the alkylene oxide adduct of a bisphenol is 30% by weight or less, the polyetherester has good heat resistance and color, and the mechanical properties and color of the obtained sea-islands type composite fiber are good. Therefore, it is preferable that the copolymerization ratio of the alkylene oxide adduct of a bisphenol be 30% by weight or less. The copolymerization ratio of the alkylene oxide adduct of a bisphenol is more preferably 25% by weight or less, and further preferably 20% by weight or less.

[0040] The island component of the sea-islands type composite fiber of the present invention is preferably a polymer having crystallinity. When the island component has crystallinity, a melting peak associated with the melting of the crystal is observed in the measurement of the extrapolated melting onset temperature by the method described in Examples. When the island component has crystallinity, the elution of the moisture absorbing polymer of the island component into hot water during a hot water treatment such as a dyeing treatment is suppressed, and thus moisture absorbability can be maintained even after the hot water treatment. Therefore, it is preferable that the island component have crystallinity.

[0041] The sea component of the sea-islands type composite fiber of the present invention preferably has crystallinity. When the sea component has crystallinity, a melting peak associated with the melting of the crystal is observed in the measurement of the extrapolated melting onset temperature by the method described in Examples. When the sea component has crystallinity, fusion between fibers due to the contact with a heating roller and a heating heater in the drawing and false twisting processes is suppressed, thus the deposit, yarn breakage and fluffs generation on the heating roller, the heating heater, and the guide are small, the process passability is good, and, in addition, generation of dyeing specks and/or fluffs are small when the fiber is formed into a fiber structure such as a woven fabric and a knitted fabric, resulting in excellent quality. The elution of the sea component into hot water during a hot water treatment such as a dyeing treatment is also suppressed. Therefore, it is preferable that the sea component have crystallinity.

[0042] Specific examples of the sea component of the sea-islands type composite fiber of the present invention include, but are not limited to, polyesters such as polyethylene terephthalate and polybutylene terephthalate, polyamides such as nylon 6 and nylon 66, and polyolefins such as polyethylene and polypropylene. Among these, polyesters are preferable because they are excellent in mechanical properties and durability. When the sea component is a hydrophobic polymer such as a polyester or a polyolefin, both the moisture absorbability provided by the moisture absorbing polymer of the island component and the dry touch provided by the hydrophobic polymer of the sea component can be obtained and a fiber structure having excellent wearing comfort can be obtained. Therefore, it is preferable that the sea component be a hydrophobic polymer such as a polyester or a polyolefin.

[0043] Specific examples of the polyester according to the sea component of the sea-islands type composite fiber of the present invention include, but are not limited to, aromatic polyesters such as polyethylene terephthalate, polypropylene terephthalate, and polybutylene terephthalate, and aliphatic polyesters such as polylactic acid and polyglycolic acid. Among these, polyethylene terephthalate, polypropylene terephthalate, and polybutylene terephthalate are preferable because they are excellent in mechanical properties and durability, and have good handleability in the production and use. The polyethylene terephthalate is preferable because it gives a tension and elasticity feeling peculiar to polyester fiber, and polybutylene terephthalate is preferable because it has high crystallinity.

[0044] The sea component of the sea-islands type composite fiber of the present invention is preferably a cation dyeable polyester. When a polyester has an anionic site such as a sulfonic acid group, it has cationic dyeability due to the interaction with a cationic dye having a cation site. When the sea component is a cation dyeable polyester, vivid coloring is exhibited and dye contamination can be prevented in combined use with a polyurethane fiber. Therefore, it is preferable that the sea component be a cation dyeable polyester. Specific examples of the copolymerization component of the cation dyeable polyester include a metal salt of 5-sulfoisophthalic acid, and examples of the metal salt include, but are not limited to, a lithium salt, a sodium salt, a potassium salt, a rubidium salt, and a cesium salt. Among these, the lithium salt and the sodium salt are preferable, and, in particular, the sodium salt can be suitably employed because it is excellent in crystallinity.

[0045] The sea-islands type composite fiber of the present invention may be one in which various modifications are made by adding secondary additives to the sea component and/or the island component. Specific examples of the secondary additives include, but are not limited to, a compatibilizer, a plasticizer, an antioxidant, an ultraviolet absorber, an infrared absorber, a fluorescent whitening agent, a release agent, an antibacterial agent, a nucleating agent, a thermal stabilizer, an antistatic agent, a coloring inhibitor, a regulator, a delustering agent, a defoaming agent, a preservative, a gelling agent, a latex, a filler, an ink, a colorant, a dye, a pigment, and a perfume. These secondary additives may be used singly or in combination.

[0046] The extrapolated melting onset temperature of the sea-islands type composite fiber of the present invention is preferably 150 to 300°C. The extrapolated melting onset temperature of the sea-islands type composite fiber in the present invention refers to the value calculated by the method described in Examples. When a plurality of melting peaks were observed, the extrapolated melting onset temperature was calculated from the melting peak at the lowest temperature. When the extrapolated melting onset temperature of the sea-islands type composite fiber is 150°C or more, fusion between fibers due to the contact with a heating roller and a heating heater in the drawing and false twisting processes is suppressed, thus the deposit, yarn breakage and fluffs generation on the heating roller, the heating heater, and the guide are small, the process passability is good, and, in addition, generation of dyeing specks and/or fluffs are small when the fiber is formed into a fiber structure such as a woven fabric and a knitted fabric, resulting in excellent quality. Therefore, it is preferable that the extrapolated melting onset temperature of the sea-islands type composite fiber be 150°C or more. The extrapolated melting onset temperature of the sea-islands type composite fiber is more preferably 170°C or more, further preferably 190°C or more, particularly preferably 200°C or more. Meanwhile, when the extrapolated melting onset temperature of the sea-islands type composite fiber is 300°C or less, the yellowing due to thermal deterioration is suppressed in the melt spinning process, and a sea-islands type composite fiber having good color is obtained. Therefore, it is preferable that the extrapolated melting onset temperature of the sea-islands type composite fiber be 300°C or less.

[0047] The sea-islands type composite fiber of the present invention includes a ratio (T/R) of a thickness T of an outermost layer to a diameter R of the fiber in a transverse cross-section of the fiber of 0.05 to 0.25. The thickness of an outermost layer in the present invention is a difference between a radius of the fiber and a radius of a circumscribed circle formed by connecting an apex of the island component disposed in an outermost circle, and represents a thickness of a sea component in the outermost layer. The ratio (T/R) of a thickness T of an outermost layer to a diameter R of the fiber in the present invention refers to the value calculated by the method described in Examples. When the sea-islands type composite fiber of the present invention includes T/R of 0.05 or more, the thickness of the outermost layer relative to the fiber diameter is sufficient, thus the cracks of the sea component upon the volume expansion of the moisture absorbing polymer disposed in the island due to a hot water treatment such as a dyeing treatment can be suppressed, the generation of dyeing specks and/or fluffs caused by the cracks of the sea component is small, the fiber has excellent quality, the elution of the moisture absorbing polymer is also suppressed, and thus high moisture absorbability is exhibited

even after the hot water treatment. Also, by dyeing the sea component, sufficient coloring can be obtained, and a fiber and a fiber structure having high quality from the viewpoint of coloring can be obtained. The sea-islands type composite fiber of the present invention more preferably includes T/R of 0.07 or more, further preferably 0.09 or more, particularly preferably 0.10 or more. Meanwhile, when the sea-islands type composite fiber includes T/R of 0.25 or less, the volume expansion of the moisture absorbing polymer disposed in the island is not impaired by the thickness of the outermost layer with respect to the fiber diameter, moisture absorbability provided by the moisture absorbing polymer is exhibited, and thus a fiber and a fiber structure having high moisture absorbability can be obtained. The sea-islands type composite fiber of the present invention more preferably includes T/R of 0.22 or less, further preferably 0.20 or less.

[0048] The thickness T of an outermost layer of the sea-islands type composite fiber of the present invention is preferably 500 to 3,000 nm. The thickness T of an outermost layer in the present invention refers to the value calculated by the method described in Examples. When the thickness T of an outermost layer of the sea-islands type composite fiber is 500 nm or more, the thickness of the outermost layer is sufficient, thus the cracks of the sea component upon the volume expansion of the moisture absorbing polymer disposed in the island due to a hot water treatment such as a dyeing treatment can be suppressed, the generation of dyeing specks and/or fluffs caused by the cracks of the sea component is small, the fiber has excellent quality, the elution of the moisture absorbing polymer is also suppressed, and thus high moisture absorbability is exhibited even after the hot water treatment. Also, by dyeing the sea component, sufficient coloring can be obtained, and a fiber and a fiber structure having high quality from the viewpoint of coloring can be obtained. Therefore, it is preferable that the thickness T of an outermost layer of the sea-islands type composite fiber be 500 nm or more. The thickness T of an outermost layer of the sea-islands type composite fiber is more preferably 700 nm or more, further preferably 800 nm or more, particularly preferably 1,000 nm or more. Meanwhile, when the thickness T of an outermost layer of the sea-islands type composite fiber is 3,000 nm or less, the volume expansion of the moisture absorbing polymer disposed in the island is not impaired by the thickness of the outermost layer with respect to the fiber diameter, moisture absorbability provided by the moisture absorbing polymer is exhibited, and thus a fiber and a fiber structure having high moisture absorbability can be obtained. Therefore, it is preferable that the thickness T of an outermost layer of the sea-islands type composite fiber be 3,000 nm or less. The thickness T of an outermost layer of the sea-islands type composite fiber is more preferably 2,500 nm or less, further preferably 2,000 nm or less.

[0049] The number of the island of the sea-islands type composite fiber of the present invention is preferably 3 to 10,000. When the number of the islands of the sea-islands type composite fiber is 3 or more, the dispersed disposition of the moisture absorbing polymer, the island component, disperses the stress generated by the volume expansion of the moisture absorbing polymer during a hot water treatment such as a dyeing treatment, and thus the cracks of the sheath component due to the stress concentration, which is a problem of the conventional core-sheath type composite fiber, can be suppressed. Therefore, it is preferable that the number of the islands of the sea-islands type composite fiber be 3 or more. The number of the islands of the sea-islands type composite fiber is more preferably 6 or more, further preferably 12 or more, particularly preferably 20 or more. Meanwhile, when the number of the islands of the sea-islands type composite fiber is 10,000 or less, the disposition of the island component in transverse cross-section of the fiber can be precisely controlled, and a fiber and a fiber structure having high quality from the viewpoint of feel and coloring can be obtained. Therefore, it is preferable that the number of the islands of the sea-islands type composite fiber be 10,000 or less. The number of the islands of the sea-islands type composite fiber is more preferably 5,000 or less, further preferably 1,000 or less.

[0050] In the sea-islands type composite fiber of the present invention, the diameter r of the island component in the transverse cross-section of the fiber is preferably 10 to 5,000 nm. The diameter r of the island component in the present invention refers to the value calculated by the method described in Examples. When the diameter r of the island component in the transverse cross-section of the fiber is 10 nm or more, the moisture absorbability provided by the moisture absorbing polymer of the island component dispersively disposed in the transverse cross-section of the fiber is exhibited. Therefore, it is preferable that the diameter r of the island component in the transverse cross-section of the fiber be 10 nm or more. The diameter r of the island component in the transverse cross-section of the fiber of the sea-islands type composite fiber is more preferably 100 nm or more, further preferably 500 nm or more. Meanwhile, when the diameter r of the island component in the transverse cross-section of the fiber is 5,000 nm or less, the stress generated by the volume expansion of the moisture absorbing polymer disposed in the island component during a hot water treatment such as a dyeing treatment can be decreased, and the cracks of the sea component can be suppressed. Therefore, it is preferable that the diameter r of the island component in the transverse cross-section of the fiber be 5,000 nm or less. The diameter r of the island component in the transverse cross-section of the fiber of the sea-islands type composite fiber is more preferably 3,000 nm or less, further preferably 2,000 nm or less.

[0051] In the sea-islands type composite fiber of the present invention, the island component is preferably disposed to from 2 to 100 circles in the transverse cross-section of the fiber. In the present invention, the island components disposed concentrically in the transverse cross-section of the fiber is defined as one circle, and the number of the concentric circles having different diameters is the number of the circles. When one island component is disposed at the center of the transverse cross-section of the fiber, the one island component disposed at the center is defined as

one circle. Figs. 1(a) to 1(m) are examples of the cross-sectional shape of the sea-islands type composite fiber of the present invention. The island component is disposed to form one circle in Figs. 1(b) and (c), two circles in Figs. 1(a), (d), (h), (i), (j), (k), and (m), three circles in Figs. 1(e), (g), and (1), and seven circles in Fig. 1(f). For the stress generated by the volume expansion of the moisture absorbing polymer during a hot water treatment such as a dyeing treatment, those skilled in the art analyzed in detail the stress distribution in the transverse cross-section of the fiber, and obtained a result that, in the core-sheath type composite fiber, the stress is maximum at the interface between the core component and the sheath component, and in the sea-islands type composite fiber in which the island component is disposed to form one circle as shown in Figs. 1(b) and (c), the stress is maximum at the interface between the fiber surface side of the island component and the sea component. That is, it was found that in the core-sheath type composite fiber, breaks are generated at the interface between the core component and the sheath component which is subjected to the maximum stress upon the volume expansion of the moisture absorbing polymer of the core component, and these breaks propagate to the fiber surface, whereby the cracks of the sheath component is generated. Similarly, in the sea-islands type composite fiber in which the island component is disposed to form one circle, breaks are generated at the interface between the fiber surface side of the island component and the sea component which is subjected to the maximum stress upon the volume expansion of the moisture absorbing polymer of the island component, and these breaks propagate to the fiber surface , whereby the cracks of the sea component is generated. In contrast, in the sea-islands type composite fiber in which the island component is disposed to form two or more circles in the transverse cross-section of the fiber, the stress is maximum between the fiber internal side of the island component disposed in the outermost circle and the fiber surface side of the island component disposed one circle inward from the outermost circle, and the propagation of breaks to the fiber surface is blocked, thereby the cracks of the sea component is suppressed. Thus, such a disposition is preferable. In the transverse cross-section of the fiber of the sea-islands type composite fiber, the island component is more preferably disposed to form three or more circles, and is further preferably disposed to form four or more circles. Meanwhile, when the island component is disposed to form 100 or less circles, a space can be provided between neighboring island components, thus the moisture absorbing polymer of the island component can undergo the volume expansion due to the moisture absorption, and a sea-islands type composite fiber having excellent moisture absorbability can be obtained. Therefore, such a disposition is preferable.

[0052] The sea-islands type composite fiber of the present invention preferably includes a ratio (r1/r2) of a diameter r1 of the island component disposed to pass through a center of the transverse cross-section of the fiber to a diameter r2 of other island components of 1.1 to 10.0. The ratio (r1/r2) of a diameter r1 of the island component disposed to pass through a center of the transverse cross-section of the fiber to a diameter r2 of other island components in the present invention refers to the value calculated by the method described in Examples. When the diameter r2 of other island components is smaller than the diameter r1 of the island component disposed to pass through a center of the transverse cross-section of the fiber, r1/r2 is more than 1.0. Examples of the cross-sectional shape of the sea-islands type composite fiber having such r1/r2 include Figs. 1(k) to (m). When the sea-islands type composite fiber includes r1/r2 of 1.1 or more, the diameter r2 of other island components is smaller than the diameter r1 of the island component disposed to pass through a center of the transverse cross-section of the fiber, thus the stress generated by the volume expansion of the moisture absorbing polymer of the island component close to the fiber surface can be decreased, and the cracks of the sea component can be suppressed. Therefore, it is preferable that the sea-islands type composite fiber include r1/r2 of 1.1 or more. The sea-islands type composite fiber more preferably includes r1/r2 of 1.2 or more, further preferably includes r1/r2 of 1.5 or more. Meanwhile, when the sea-islands type composite fiber includes r1/r2 of 10.0 or less, the stress generated by the volume expansion of the moisture absorbing polymer of the island component disposed to pass through a center of the transverse cross-section of the fiber can be absorbed by other island components, thus the propagation of breaks to the fiber surface is blocked, and the cracks of the sea component can be suppressed. Therefore, it is preferable that the sea-islands type composite fiber include r1/r2 of 10.0 or less. The sea-islands type composite fiber more preferably includes r1/r2 of 7.0 or less, further preferably 5.0 or less.

[0053] The shape of the island component in the transverse cross-section of the fiber in the sea-islands type composite fiber of the present invention is not particularly limited, and may be a circular cross-section of a perfect circle or non-circular cross-section.

Specific examples of the non-circular cross-section include, but are not limited to, a multifoil, a polygon, a flat shape, and an oval. Among these, when the island component has a circular cross-section of a perfect circle, the stress is evenly generated over the circumference and not concentrated when the moisture absorbing polymer disposed in the island undergoes volume expansion, and thus the cracks of the sea component can be suppressed. Therefore, it is preferable that the island component have a circular cross-section. The shape of the center side of the island component disposed in the outermost circle in the transverse cross-section of the fiber is preferably non-circular. In this case, in the island component disposed in the outermost circle, the stress is concentrated not on the surface side of the fiber but on the non-circular portion on the center side of the fiber, thus the cracks of the sea component to the fiber surface can be suppressed. Therefore, it is preferable that the shape of the center side of the island component disposed in the outermost circle in the transverse cross-section of the fiber be non-circular.

[0054] The sea-islands type composite fiber of the present invention preferably includes a composite ratio (a weight ratio) of the sea component/island component of 50/50 to 90/10. The composite ratio (the weight ratio) of the sea component/island component of the sea-islands type composite fiber in the present invention refers to the value calculated by the method described in Examples. When the sea-islands type composite fiber of the present invention includes a composite ratio of the sea component of 50% by weight or more, the sea component gives a tension feeling, elasticity feeling, and a dry touch. In addition, the cracks of the sea component due to an external force during drawing and false twisting and the cracks of a sea component upon the volume expansion of the moisture absorbing polymer of the island component during moisture absorption and water absorption are suppressed, thus the reduction of quality due to the generation of dyeing specks and/or fluffs and the reduction of moisture absorbability due to the elution of the polymer having moisture absorbability of the island component into hot water during a hot water treatment such as a dyeing treatment are suppressed. Therefore, it is preferable that the sea-islands type composite fiber of the present invention include a composite ratio of the sea component of 50% by weight or more. The sea-islands type composite fiber more preferably includes a composite ratio of the sea component of 55% by weight or more, further preferably 60% by weight or more. Meanwhile, when the sea-islands type composite fiber includes a composite ratio of the sea component of 90% by weight or less, that is, the sea-islands type composite fiber includes a composite ratio of the island component of 10% by weight or more, moisture absorbability of the moisture absorbing polymer of the island component is exhibited, and the sea-islands type composite fiber having excellent moisture absorbability can be obtained. Therefore, it is preferable that the sea-islands type composite fiber include a composite ratio of the sea component of 90% by weight or less, that is, the sea-islands type composite fiber include a composite ratio of the island component of 10% by weight or more. The sea-islands type composite fiber more preferably includes a composite ratio of the sea component of 85% by weight or less, further preferably 80% by weight or less.

[0055] The fineness of the sea-islands type composite fiber of the present invention as a multifilament is not particularly limited, and may be appropriately selected depending on the application and required properties. It is preferably 10 to 500 dtex. The fineness in the present invention refers to the value measured by the method described in Examples. When the sea-islands type composite fiber has a fineness of 10 dtex or more, the yarn breakage is small, the process passability is good, in addition, the generation of fluffs is small in use, and the durability is excellent. Therefore, it is preferable that the sea-islands type composite fiber have a fineness of 10 dtex or more. The sea-islands type composite fiber more preferably has a fineness of 30 dtex or more, further preferably 50 dtex or more. Meanwhile, when the sea-islands type composite fiber has a fineness of 500 dtex or less, the flexibility of the fiber and fiber structure is not impaired. Therefore, it is preferable that the sea-islands type composite fiber have a fineness of 500 dtex or less. The sea-islands type composite fiber more preferably has a fineness of 400 dtex or less, further preferably 300 dtex or less.

[0056] The single yarn fineness of the sea-islands type composite fiber of the present invention is not particularly limited, and may be appropriately selected depending on the application and required properties. It is preferably 0.5 to 4.0 dtex. The single yarn fineness in the present invention refers to the value obtained by dividing the fineness measured by the method described in Examples by the number of the single yarn. When the sea-islands type composite fiber has a single yarn fineness of 0.5 dtex or more, the yarn breakage is small, the process passability is good, in addition, the generation of fluffs is small in use, and the durability is excellent. Therefore, it is preferable that the sea-islands type composite fiber have a single yarn fineness of 0.5 dtex or more. The sea-islands type composite fiber more preferably has a single yarn fineness of 0.6 dtex or more, further preferably 0.8 dtex or more. Meanwhile, when the sea-islands type composite fiber has a single yarn fineness of 4.0 dtex or less, the flexibility of the fiber and fiber structure is not impaired. Therefore, it is preferable that the sea-islands type composite fiber have a single yarn fineness of 4.0 dtex or less. The sea-islands type composite fiber more preferably has a single yarn fineness of 2.0 dtex or less, further preferably 1.5 dtex or less.

[0057] The strength of the sea-islands type composite fiber of the present invention is not particularly limited, and may be appropriately selected depending on the application and required properties. It is preferably 2.0 to 5.0 cN/dtex from the viewpoint of the mechanical properties. The strength in the present invention refers to the value measured by the method described in Examples. When the sea-islands type composite fiber has a strength of 2.0 cN/dtex or more, the generation of fluffs is small in use, and the durability is excellent. Therefore, it is preferable that the sea-islands type composite fiber have a strength of 2.0 cN/dtex or more. The sea-islands type composite fiber more preferably has a strength of 2.5 cN/dtex or more, further preferably 3.0 cN/dtex or more. Meanwhile, when the sea-islands type composite fiber has a strength of 5.0 cN/dtex or less, the flexibility of the fiber and fiber structure is not impaired. Therefore, it is preferable that the sea-islands type composite fiber have a strength of 5.0 cN/dtex or less.

[0058] The elongation percentage of the sea-islands type composite fiber of the present invention is not particularly limited, and may be appropriately selected depending on the application and required properties. It is preferably 10 to 60% from the viewpoint of durability. The elongation percentage in the present invention refers to the value measured by the method described in Examples. When the sea-islands type composite fiber has an elongation percentage of 10% or more, the abrasion resistance of the fiber and the fiber structure is good, thus the generation of fluffs is small in use, and the durability is good. Therefore, it is preferable that the sea-islands type composite fiber have an elongation

percentage of 10% or more. The sea-islands type composite fiber more preferably has an elongation percentage of 150 or more, further preferably 20% or more. Meanwhile, when the sea-islands type composite fiber has an elongation percentage of 600 or less, the dimensional stability of the fiber and the fiber structure is good. Therefore, it is preferable that the sea-islands type composite fiber have an elongation percentage of 60% or less. The sea-islands type composite fiber more preferably has an elongation percentage of 55% or less, further preferably 50% or less.

[0059] The sea-islands type composite fiber of the present invention has a moisture absorption rate difference (ΔMR) after a hot water treatment of 2.0 to 10.0%. The moisture absorption rate difference (ΔMR) after a hot water treatment in the present invention refers to the value measured by the method described in Examples. ΔMR is the difference between the moisture absorption rate at a temperature of 30°C and a humidity of 90%RH, which are an assumed temperature and humidity inside clothes after light exercise, and the moisture absorption rate at a temperature of 20°C and a humidity of 65%RH, which are an ambient temperature and humidity. That is, ΔMR is an index of the moisture absorbability. The higher the value of ΔMR is, the more the wearing comfort improves. The moisture absorption rate difference (ΔMR) of the present invention is a value after a hot water treatment, and is very important value in that it shows that the moisture absorbability is exhibited even after a hot water treatment such as a dyeing treatment. When ΔMR after a hot water treatment of the sea-islands type composite fiber is 2.0% or more, a stuffy feeling in clothes is small, and wearing comfort is exhibited. The sea-islands type composite fiber more preferably includes ΔMR after a hot water treatment of 2.50 or more, further preferably 3.0% or more, particularly preferably 4.0% or more. Meanwhile, when the sea-islands type composite fiber includes ΔMR after a hot water treatment of 10.0% or less, the process passability and handleability are good, and the durability in use is also excellent.

[0060] The cross-sectional shape of the sea-islands type composite fiber of the present invention is not particularly limited, may be appropriately selected depending on the application and required properties, and may be a circular cross-section of a perfect circle or non-circular cross-section. Specific examples of the non-circular cross-section include, but are not limited to, a multifoil, a polygon, a flat shape, and an oval.

[0061] The form of the sea-islands type composite fiber of the present invention is not particularly limited, and may be in any form such as a monofilament, a multifilament, and a staple.

[0062] The sea-islands type composite fiber of the present invention can be processed into a false twist yarn or a twist yarn in the same way as in usual fibers, and can be weaved or knitted in the same way as in usual fibers.

[0063] The form of the fiber structure including the sea-islands type composite fiber and/or the false twist yarn of the present invention is not particularly limited, and the sea-islands type composite fiber and/or the false twist yarn can be formed into a woven fabric, a knitted fabric, a pile fabric, a nonwoven fabric, a spun yarn, a wad or the like according to a known method. The fiber structure including the sea-islands type composite fiber and/or the false twist yarn of the present invention may be any woven or knitted structure. A plain weave, a twill weave, a satin weave, or a weave changed from these weaves; or warp knitting, weft knitting, circular knitting, lace stitching, knitting or stitching changed from these knitting or stitching or the like can be suitably employed.

[0064] The sea-islands type composite fiber of the present invention may be combined with other fibers by union weaving or union knitting during the formation of the fiber structure, or may be combined with other fibers to form a combined filament yarn and then the combined filament yarn may be formed into the fiber structure.

[0065] Next, a method for manufacturing the sea-islands type composite fiber of the present invention will be described below.

[0066] As the method for manufacturing the sea-islands type composite fiber of the present invention, a known melt spinning method, a drawing method, a crimping process method such as a false twisting method can be employed.

[0067] In the present invention, the sea component and the island component are preferably dried before the melt spinning to reduce the water content to 300 ppm or less. When the water content is 300 ppm or less, molecular weight reduction due to hydrolysis and foaming due to moisture during the melt spinning is suppressed, and thus spinning can be stably performed. Therefore, it is preferable that the water content be 300 ppm or less. The water content is more preferably 100 ppm or less, further preferably 50 ppm or less.

[0068] In the present invention, a preliminarily dried chip is supplied to a melt spinning machine such as an extruder type machine and a pressure melter type machine, and the sea component and the island component are separately melted and measured by a measuring pump. Thereafter, the measured sea component and island component are loaded into heated spinning packs at a spinning block, the melted polymers are filtered within the spinning packs, and then joined by a sea-island composite spinneret below and discharged as a sea-island structure from the spinneret to form a fiber yarn.

[0069] In the present invention, as the sea-island composite spinneret, for example, the conventionally known pipe sea-island composite spinneret in which pipes are disposed and which is disclosed in Japanese Patent Laid-open Publication No. 2007-100243 can be used for manufacturing. However, the conventional pipe sea-island composite spinneret has a technical limit on the thickness of the sea component of the outermost layer around 150 nm, and has a difficulty to satisfy the ratio (T/R) of a thickness T of an outermost layer to a diameter R of the fiber in the transverse cross-section of the fiber of the requirement of the present invention. Therefore, in the present invention, the method

described in Japanese Patent Laid-open Publication No. 2011-174215 in which a sea-island composite spinneret is used is preferably used.

[0070] As an example of the sea-island composite spinneret used in the present invention, the sea-island composite spinneret composed of the members shown in Figs. 2 to 4 will be described. Figs. 2(a) to (c) are illustrations to schematically describe an examples of the sea-island composite spinneret used in the present invention. Fig. 2(a) shows a front cross-sectional view of a main part that constitutes a sea-island composite spinneret, Fig. 2(b) shows a cross-sectional view of a part of a distribution plate, and Fig. 2(c) shows a cross-sectional view of a part of a discharge plate. Figs. 2(b) and 2(c) show a distribution plate and a discharge plate that constitute Fig. 2 (a). Fig. 3 shows a plan view of the distribution plate, and Fig. 4 shows an enlarged view of a part of the distribution plate in the present invention, in which each groove and hole are related to one discharge hole.

[0071] Hereinafter, the process from the formation of the composite polymer flow through the measuring plate and the distribution plate to the discharge from the discharge hole of the discharge plate will be described. From the upstream of the spinning pack, a polymer A (an island component) and a polymer B (a sea component) are poured into a measuring hole for the polymer A (10-(a)) and a measuring hole for the polymer B (10-(b)) on the measuring plate in Fig. 2, measured by a hole restriction drilled at the lower end, and then poured into the distribution plate. In the distribution plate, distribution grooves 11 (Fig. 3: 11-(a) and 11-(b)) for joining the polymers flowing in from the measuring holes 10 and distribution holes 12 (Fig. 4: 12-(a) and 12-(b)) for flowing the polymers downstream on the lower surface of the distribution groove are drilled. To form a layer composed of the polymer B, the sea component, in the outermost layer of the composite polymer flow, an annular groove 16 having distribution holes drilled on the bottom as shown in Fig. 3 is placed.

[0072] The composite polymer flow composed of the polymer A and the polymer B discharged from the distribution plate flows into a discharge plate 9 from a discharge loading hole 13. Then, the composite polymer flow is reduced in the cross-sectional direction along the polymer flow by a reduction hole 14 during loading of the flow into the discharge hole having a desired diameter, and discharged from a discharge hole 15 with the cross-sectional form formed in the distribution plate being maintained.

[0073] The fiber yarn discharged from the sea-island composite spinneret is cooled and solidified by a cooling device, taken up by a first godet roller, and wound by a winder through a second godet roller as a wound yarn. To improve the spinning operability, productivity, and mechanical properties of the fiber, a heating cylinder or a heat insulating cylinder having a length of 2 to 20 cm may be placed under the spinneret as necessary. An oil may be fed to the fiber yarn using an oiling device, and entanglement may be imparted to the fiber yarn using the entangling device.

[0074] The spinning temperature in the melt spinning may be appropriately selected depending on the melting points and the heat resistance of the sea component and the island component, but it is preferably 240 to 320°C. When the spinning temperature is 240°C or more, the elongation viscosity of the fiber yarn discharged from the spinneret is sufficiently reduced, thus the discharge is stabilized, further, the spinning tension does not excessively increase, and the yarn breakage is suppressed. Therefore, it is preferable that the spinning temperature be 240°C or more. The spinning temperature is more preferably 250°C or more, further preferably 260°C or more. Meanwhile, when the spinning temperature is 320°C or less, the thermal decomposition during spinning can be suppressed, and the deterioration of mechanical properties of the fiber and coloring can be suppressed. Therefore, it is preferable that the spinning temperature be 320°C or less. The spinning temperature is more preferably 310°C or less, further preferably 300°C or less.

[0075] The spinning speed in the melt spinning may be appropriately selected depending on the compositions of the sea component and the island component, the spinning temperature and the like. In the case of the two-step process in which drawing or false twisting is performed separately after melt spinning is performed and the yarn is wound, the spinning speed is preferably 500 to 6,000 m/min. When the spinning speed is 500 m/min or more, the traveling yarn is stabilized, and yarn breakage can be suppressed. Therefore, it is preferable that the spinning speed be 500 m/min or more. In the two-step process, the spinning speed is more preferably 1,000 m/min or more, further preferably 1,500 m/min or more. Meanwhile, when the spinning speed is 6,000 m/min or less, due to suppression of spinning tension, stable spinning can be carried out without yarn breakage. Therefore, it is preferable that the spinning speed be 6,000 m/min or less. In the two-step process, the spinning speed is more preferably 4,500 m/min or less, further preferably 4,000 m/min or less. In the case of the onestep process in which spinning and drawing are simultaneously performed without winding up once, it is preferable that the spinning speed of the low speed roller be set to 500 to 5,000 m/min and the spinning speed of the high speed roller be set to 2,500 to 6,000 m/min. When the spinning speeds of the low speed roller and the high speed roller are within the above-mentioned ranges, the traveling yarn is stabilized, yarn breakage can be suppressed, and stable spinning can be performed. Therefore, it is preferable that the spinning speeds of the low speed roller and the high speed roller be within the above-mentioned ranges. In the case of the one-step process, it is more preferable that the spinning speed of the low speed roller be set to 1,000 to 4,500 m/min, and the spinning speed of the high speed roller be set to 3,500 to 5,500 m/min, and it is further preferable that the spinning speed of the low speed roller be set to 1,500 to 4,000 m/min, and the spinning speed of the high speed roller be set to 4,000 to 5,000 m/min.

[0076] When drawing is performed in the one-step process or the two-step process, the one-step drawing method or

the multi-step drawing method having two or more-steps may be used. The heating method in drawing is not particularly limited as long as the device can directly or indirectly heat the traveling yarn. Specific examples of the heating method include, but are not limited to, a heating roller method, a thermal pin method, a hot plate method, liquid baths such as a warm water bath and a hot water bath, gas baths such as a hot air bath and a steam bath, and a laser method. These heating methods may be used singly, or in combination. As the heating method, from the viewpoint of the control of the heating temperature, the uniform heating of the traveling yarn, and the simple device, contact with a heating roller, contact with a thermal pin, contact with a hot plate, and dipping in a liquid bath can be suitably employed.

[0077] When the drawing is performed, the drawing temperature may be appropriately selected depending on the extrapolated melting onset temperature of the polymers of the sea component and the island component, and the strength and elongation percentage of the fiber after drawing and the like, but it is preferably 50 to 150°C. When the drawing temperature is 50°C or more, the preheating of the yarn supplied for drawing is sufficiently performed, thermal deformation during drawing is uniform, generation of unevenness of fineness can be suppressed, dyeing specks and/or fluffs are small, and thus the quality is good. Therefore, it is preferable that the drawing temperature be 50°C or more. The drawing temperature is more preferably 60°C or more, and further preferably 70°C or more. Meanwhile, when the drawing temperature is 150°C or less, fusion between fibers and thermal decomposition due to the contact with the heating roller can be suppressed, and the process passability and quality are good. In addition, the slipperiness of the fiber to the drawing roller is good, thus yarn breakage is suppressed, and stable drawing can be performed. Therefore, it is preferable that the drawing temperature be 150°C or less. The drawing temperature is more preferably 145°C or less, and further preferably 140°C or less. The heat setting at 60 to 150°C may be performed as needed.

[0078] When the drawing is performed, the drawing rate may be appropriately selected depending on the elongation percentage of the fiber before drawing, the strength and the elongation percentage of the fiber after drawing and the like, but it is preferably 1.02 to 7.0 times. When the drawing rate is 1.02 or more, mechanical properties such as strength and elongation percentage of the fiber can be improved by drawing. Therefore, it is preferable that the drawing rate be 1.02 or more. The drawing rate is more preferably 1.2 times or more, further preferably 1.5 times or more. Meanwhile, when the drawing rate is 7.0 times or less, yarn breakage during drawing is suppressed, and drawing can be stably performed. Therefore, it is preferable that the drawing rate be 7.0 times or less. The drawing rate is more preferably 6.0 times or less, further preferably 5.0 times or less.

[0079] When the drawing is performed, the drawing speed may be appropriately selected depending on drawing methods such as the one-step process or the two-step process. In the case of the one-step process, the speed of the high speed roller of the above-mentioned spinning speed corresponds to the drawing speed. When the drawing is performed in the two-step process, the drawing speed is preferably 30 to 1,000 m/min. When the drawing speed is 30 m/min or more, the traveling yarn is stabilized, and yarn breakage can be suppressed. Therefore, it is preferable that the drawing speed be 30 m/min or more. When the drawing is performed in the two-step process, the drawing speed is more preferably 50 m/min or more, further preferably 100 m/min or more. Meanwhile, when the drawing speed is 1,000 m/min or less, yarn breakage during drawing is suppressed, and drawing can be stably performed. Therefore, it is preferable that the drawing speed be 1,000 m/min or less. When the drawing is performed in the two-step process, the drawing speed is more preferably 900 m/min or less, further preferably 800 m/min or less.

[0080] When false twisting processing is performed, a so-called buleria processing in which both a one-stage heater and a two-stage heater are used can be appropriately selected in addition to a so-called woolie finish in which only a one-stage heater is used. The heating method of the heater may be a contact type or a non-contact type. Specific examples of the false twisting processing machine include, but are not limited to, a friction disc type machine, a belt nip type machine, and a pin type machine.

[0081] When the false twisting processing is performed, the temperature of the heater may be appropriately selected depending on the extrapolated melting onset temperature of the polymers of the sea component and the island component and the like, but it is preferably 120 to 210°C. When the temperature of the heater is 120°C or more, the preheating of the yarn supplied for the false twisting processing is sufficiently performed, thermal deformation due to drawing is uniform, generation of unevenness of fineness can be suppressed, dyeing specks and/or fluffs are small, and thus the quality is good. Therefore, it is preferable that the temperature of the heater be 120°C or more. The temperature of the heater is more preferably 140°C or more, further preferably 160°C or more. Meanwhile, when the temperature of the heater is 210°C or less, fusion between fibers and thermal decomposition due to the contact with the heating heater is suppressed, thus yarn breakage and dirt in the heating heater are small, and the process passability and quality are good. Therefore, it is preferable that the temperature of the heater be 210°C or less. The temperature of the heater is more preferably 200°C or less, further preferably 190°C or less.

[0082] When the false twisting processing is performed, the drawing rate may be appropriately selected depending on the elongation percentage of the fiber before false twisting processing, the strength and the elongation percentage of the fiber after false twisting processing and the like, but it is preferably 1.01 to 2.5 times. When the drawing rate is 1.01 or more, mechanical properties such as strength and elongation percentage of the fiber can be improved by drawing. Therefore, it is preferable that the drawing rate be 1.01 or more. The drawing rate is more preferably 1.2 times or more,

further preferably 1.5 times or more. Meanwhile, when the drawing rate is 2.5 times or less, yarn breakage during false twisting processing is suppressed, and false twisting processing can be stably performed. Therefore, it is preferable that the drawing rate be 2.5 times or less. The drawing rate is more preferably 2.2 times or less, further preferably 2.0 times or less.

[0083] When the false twisting processing is performed, the processing speed may be appropriately selected, but it is preferably 200 to 1,000 m/min. When the processing speed is 200 m/min or more, the traveling yarn is stabilized, and yarn breakage can be suppressed. Therefore, it is preferable that the processing speed be 200 m/min or more. The processing speed is more preferably 300 m/min or more, further preferably 400 m/min or more. Meanwhile, when the processing speed is 1,000 m/min or less, yarn breakage during false twisting processing is suppressed, and false twisting processing can be stably performed. Therefore, it is preferable that the processing speed be 1,000 m/min or less. The processing speed is more preferably 900 m/min or less, further preferably 800 m/min or less.

[0084] In the present invention, the fiber or the fiber structure can be dyed as needed. In the present invention, a disperse dye can be suitably employed as a dye.

[0085] The dyeing method in the present invention is not particularly limited, and a cheese dyeing machine, a liquid flow dyeing machine, a drum dyeing machine, a beam dyeing machine, a jigger, a high-pressure jigger or the like can be suitably employed according to a known method.

[0086] In the present invention, the dye concentration and the dyeing temperature are not particularly limited, and a known method can be suitably employed. Scouring may be performed before the dyeing process, or reduction cleaning may be performed after the dyeing process as needed.

[0087] The sea-islands type composite fiber of the present invention, and the false twist yarn and the fiber structure including the same are excellent in moisture absorbability. Therefore, they can be suitably used in applications requiring comfort and quality. Examples of the applications include, but are not limited to, general clothing applications, sports apparel applications, bedding applications, interior applications, and materials applications.

EXAMPLES

[0088] The present invention will be described in more detail with reference to Examples; Examples 29 to 31 do not illustrate claim 1. Each characteristic value in Examples was obtained by the following methods.

A. Moisture absorption rate difference (ΔMR) of sea component and island component

[0089] The polymer of the sea component or the island component as a sample was first dried with hot air at 60°C for 30 minutes, then allowed to stand in constant temperature and humidity chamber LHU-123 manufactured by ESPEC CORP. conditioned at a temperature of 20°C and a humidity of 65%RH for 24 hours, and the weight of the polymer (W1) was measured. Then, the polymer was allowed to stand in the constant temperature and humidity chamber conditioned at a temperature of 30°C and a humidity of 90%RH for 24 hours, and then the weight of the polymer (W2) was measured. Thereafter, the polymer was dried with hot air at 105°C for 2 hours, and the weight of the polymer (W3) after absolute drying was measured. The moisture absorption rate MR1 (%) from the absolute dry condition to the condition after being allowed to stand under the atmosphere of a temperature of 20°C and a humidity of 65%RH for 24 hours was calculated from the following formula using the weights of the polymer, W1 and W3, and the moisture absorption rate MR2 (%) from the absolute dry condition to the condition after being allowed to stand under the atmosphere of a temperature of 30°C and a humidity of 90%RH for 24 hours was calculated from the following formula using the weights of the polymer, W2 and W3. Then, the moisture absorption rate difference (ΔMR) was calculated by the following formula. Measurement was performed 5 times per sample, and the average value was taken as the moisture absorption rate difference (ΔMR).

$$MR1(\%)=\{(W1-W3)/W3\}\times 100$$

$$MR2(\%)=\{(W2-W3)/W3\}\times 100$$

$$\text{Moisture absorption rate difference } (\Delta MR)\ (\%) = MR2-MR1.$$

B. Extrapolated melting onset temperature

[0090] The extrapolated melting onset temperature was measured using differential scanning calorimeter (DSC) model

Q2000 manufactured by TA Instruments, using the polymers of the sea component and the island component, and the fiber obtained according to Examples as a sample. First, about 5 mg of the sample was heated from 0°C to 280°C under a nitrogen atmosphere at a heating rate of 50°C/min, and then kept at 280°C for 5 minutes to remove the thermal history of the sample. Then, the sample was rapidly cooled from 280°C to 0°C, then heated again from 0°C to 280°C at a heating rate of 3°C/min, a temperature modulation amplitude of ± 1°C, and a temperature modulation period of 60 seconds, and TMDSC measurement was performed. According to JIS K 7121: 1987 (Testing Methods for Transition Temperatures of Plastics) 9.1, the extrapolated melting onset temperature was calculated from the melting peak observed during the second heating process. Measurement was performed 3 times per sample, and the average value was taken as the extrapolated melting onset temperature. When a plurality of melting peaks were observed, the extrapolated melting onset temperature was calculated from the melting peak at the lowest temperature.

C. Sea/island composite ratio

[0091] The sea/island composite ratio (the weight ratio) was calculated from the weight of the sea component and the weight of the island component used as the raw material of the sea-islands type composite fiber.

D. Fineness

[0092] Under an environment of a temperature of 20°C and a humidity of 65%RH, a skein of 100 m of the fiber obtained according to Examples was obtained using an electric measuring machine manufactured by INTEC Inc. The weight of the obtained skein was measured, and the fineness (dtex) was calculated using the following formula. The measurement was carried out 5 times per sample, and the average value was taken as the fineness.

$$\text{Fineness (dtex)} = \text{weight (g) of 100 m of fiber} \times 100.$$

E. Strength and elongation percentage

[0093] The strength and elongation percentage were calculated according to JIS L 1013: 2010 (Testing methods for man-made filament yarns) 8.5.1 using the fiber obtained in Examples as a sample. Tension test was performed under the conditions of an initial sample length of 20 cm and a tension rate of 20 cm/min using Tensilon UTM-III-100 manufactured by ORIENTEC co., LTD under an environment of a temperature of 20°C and a humidity of 65%RH. The strength (cN/dtex) was calculated by dividing the stress (cN) at the point showing the maximum load by the fineness (dtex), and the elongation percentage (%) was calculated by the following formula using the elongation (L1) at the point showing the maximum load and the initial sample length (L0). Measurement was carried out ten times per sample, and the average value was taken as the strength and the elongation percentage.

$$\text{Elongation percentage (\%)} = \{(L1-L0)/L0\} \times 100.$$

F. Diameter R of fiber

[0094] The fiber obtained according to Examples was embedded in epoxy resin, frozen by FC·4E cryo sectioning system manufactured by Reichert, Inc., and cut with Reichert-Nissei ultracut N (ultramicrotome) equipped with a diamond knife. Thereafter, the cut surface, that is, the transverse cross-section of the fiber was observed at a magnification of 1,000 using transmission electron microscope (TEM) H-7100FA model manufactured by Hitachi, Ltd., and a micrograph of the transverse cross-section of the fiber was taken. Ten single yarns were randomly extracted from the obtained photograph, the diameters of the fiber of all extracted single yarns were measured using image processing software (WINROOF manufactured by MITANI CORPORATION), and the average value was taken as the diameter R of the fiber (nm). The transverse cross-section of the fiber was not necessarily a perfect circle. Thus, when the transverse cross-section of the fiber was not a perfect circle, the diameter of the circumscribed circle of the transverse cross-section of the fiber was taken as the diameter of the fiber.

G. Thickness T of outermost layer

[0095] The transverse cross-section of the fiber was observed in the same manner as in the diameter of the fiber

described in F above, and a micrograph was taken at the highest magnification that allows the observation of the entire image of the single yarn. In the obtained photograph, using the image processing software (WINROOF manufactured by MITANI CORPORATION), the radius of the perfect circle in contact with the outline of the transverse cross-section of the fiber at two or more points is determined as the radius of the fiber. Further, the radius of the perfect circle (the circumscribed circle) circumscribing two or more island components disposed in the outer circumference of the sea-island structure, as shown in 4 in Fig. 1, was determined. Ten single yarns were randomly extracted from the obtained photograph, and the radius of the fiber and the radius of the circumscribed circle of the sea-island structure portion were determined in the same manner. Then, the difference between the radius of the fiber and the radius of the circumscribed circle of the sea-island structure portion was calculated in each single yarn, and the average value was taken as the thickness T of the outermost layer (nm).

H. T/R

[0096] T/R was calculated by dividing the thickness T of the outermost layer (nm) calculated in G above by the diameter R of the fiber (nm) calculated in F above.

I. Diameter r, r1, and r2 of island component

[0097] The transverse cross-section of the fiber was observed in the same manner as in the diameter of the fiber described in F above, and a micrograph was taken at the highest magnification that allows the observation of the entire image of the single yarn. In the obtained photograph, the diameters of all the island components in the transverse cross-section of the fiber were measured using the image processing software (WINROOF manufactured by MITANI CORPORATION). The island component was not necessarily a perfect circle. Thus, when the island component was not a perfect circle, the diameter of the circumscribed circle of the island component was taken as the diameter of the island component. In the transverse cross-section of the fiber,
the average value of the diameters of all the island components was calculated as r, the diameter of the island component passing through the center was calculated as r1, and the average value of the diameters of all the island components except the island component passing through the center was calculated as r2. Ten single yarns were randomly extracted from the obtained photograph, r, r1, and r2 were determined in the same manner in each single yarn, and the average values were taken as r (nm), r1 (nm), and r2 (nm).

J. r1/r2

[0098] r1/r2 was calculated by dividing r1 (nm) calculated in I above by r2 (nm) calculated in I above.

K. Moisture absorption rate difference (ΔMR) after scouring and after hot water treatment

[0099] Approximately 2 g of tubular knitting was prepared using the fiber obtained according to Examples as a sample using circular knitting machine NCR-BL manufactured by EIKO INDUSTRIAL CO,.LTD. (caliber: 3 inch half (8.9 cm), 27 gauges), then scoured at 80°C for 20 minutes in an aqueous solution containing 1 g / L of sodium carbonate and surfactant SUNMORL BK-80 manufactured by NICCA CHEMICAL CO., LTD., and dried at 60°C for 60 minutes in a hot air dryer to obtain the tubular knitting after scouring. The tubular knitting after scouring was subjected to a hot water treatment under the conditions of a bath ratio of 1 : 100, a treatment temperature of 130°C, and a treatment time of 60 minutes, and then dried in a hot air dryer at 60°C for 60 minutes to obtain the tubular knitting after a hot water treatment.

[0100] The moisture absorption rate (%) was calculated according to the moisture percentage of JIS L 1096: 2010 (Testing methods for woven and knitted fabrics) 8.10 using the tubular knitting after scouring and the tubular knitting after a hot water treatment as samples. First, the tubular knitting was dried with hot air at 60°C for 30 minutes, then allowed to stand in constant temperature and humidity chamber LHU-123 manufactured by ESPEC CORP. conditioned at a temperature of 20°C and a humidity of 65%RH for 24 hours, and the weight of the tubular knitting (W1) was measured. Then, the tubular knitting was allowed to stand in the constant temperature and humidity chamber conditioned at a temperature of 30°C and a humidity of 90%RH for 24 hours, and then the weight of the tubular knitting (W2) was measured. Thereafter, the tubular knitting was dried with hot air at 105°C for 2 hours, and the weight of the tubular knitting (W3) after absolute drying was measured. The moisture absorption rate MR1 (%) from the absolute dry condition to the condition after being allowed to stand under the atmosphere of a temperature of 20°C and a humidity of 65%RH for 24 hours was calculated from the following formula using the weights of the tubular knitting, W1 and W3, and the moisture absorption rate MR2 (%) from the absolute dry condition to the condition after being allowed to stand under the atmosphere of a temperature of 30°C and a humidity of 90%RH for 24 hours was calculated from the following formula using the weights of the tubular knitting, W2 and W3. Then, the moisture absorption rate difference (ΔMR) was

calculated by the following formula. Measurement was performed 5 times per sample, and the average value was taken as the moisture absorption rate difference (ΔMR).

$$MR1(\%)=\{(W1-W3)/W3\} \times 100$$

$$MR2(\%)=\{(W2-W3)/W3\} \times 100$$

$$\text{Moisture absorption rate difference } (\Delta MR)\ (\%) = MR2-MR1.$$

L. Cracks of sea component

[0101] The tubular knitting after a hot water treatment produced in K above was vapor-deposited with a platinum-palladium alloy, and observed at a magnification of 1,000 using scanning electron microscope (SEM) S-4000 manufactured by Hitachi, Ltd., and micrographs of 10 fields were randomly taken. In the obtained 10 micrographs, the total of the places where the sea component is cracked was taken as the cracks (the places) of the sea component.

M. L* value

[0102] The tubular knitting after scouring produced in the same manner as in K above was subjected to dry heat setting at 160°C for 2 minutes, and the tubular knitting after dry heat setting was dyed under the conditions of a bath ratio of 1 : 100, a dyeing temperature of 130°C, a dyeing time of 60 minutes in a dyeing solution to which 1.3% by weight of Kayalon Polyester Blue UT-YA manufactured by Nippon Kayaku Co.,Ltd. as a disperse dye was added and which was adjusted to pH 5.0. When a cation dyeable polyester was used as the sea component, the knitting was dyed under the conditions of a bath ratio of 1 : 100, a dyeing temperature of 130°C, a dyeing time of 60 minutes in a dyeing solution to which 1.0% by weight of Kayacryl Blue 2RL-ED manufactured by Nippon Kayaku Co.,Ltd. as a cationic dye was added and which was adjusted to pH 4.0.

[0103] Using the tubular knitting after dyeing as a sample, L* value was measured under the conditions of D65 light source, a viewing angle of 10°, and an optical condition of SCE (Specular Component Exclude) using spectrophotometer CM-3700d model manufactured by KONICA MINOLTA JAPAN, INC. The measurement was carried out three times per sample, and the average value was taken as the L* value.

N. Leveling

[0104] Five inspectors having experience of quality judgment of 5 years or more discussed and determined the leveling of the tubular knitting after dyeing produced in M above as follows: "the knitting that is very levelly dyed and has no dyeing specks confirmed" was determined as S, "the knitting that is almost levelly dyed and has almost no dyeing specks confirmed" was determined as A, "the knitting that is almost not levelly dyed and has slight dyeing specks confirmed" was determined as B, and "the knitting that is not levelly dyed and has clear dyeing specks confirmed" was determined as C. A and S were defined as acceptable levels.

O. Quality

[0105] Five inspectors having experience of quality judgment of 5 years or more discussed and determined the quality of the tubular knitting after dyeing produced in M above as follows: "the knitting that has no fluffs and has extremely excellent quality" was determined as S, "the knitting that has almost no fluffs and has excellent quality" was determined as A, "the knitting that has fluffs and has poor quality" was determined as B, and "the knitting that has many fluffs and has extremely poor quality" was determined as C. A and S were defined as acceptable levels.

P. Dry touch

[0106] Five inspectors having experience of quality judgment of 5 years or more discussed and determined the dry touch of the tubular knitting after dyeing produced in M above as follows: "the knitting that has no slime or stickiness and has extremely excellent dry touch" was determined as S, "the knitting that has almost no slime or stickiness and has excellent dry touch" was determined as A, "the knitting that has slime or stickiness and has poor dry touch" was

determined as B, and "the knitting that has strong slime or stickiness and has extremely poor dry touch" was determined as C. A and S were defined as acceptable levels.

(Example 1)

[0107] Polyethylene terephthalate copolymerized with 30% by weight of polyethylene glycol having a number average molecular weight of 8,300 g/mol (PEG 6000S manufactured by Sanyo Chemical Industries, Ltd.) as an island component, and polyethylene terephthalate (IV = 0.66) as a sea component were each vacuum dried at 150°C for 12 hours, then separately supplied and melted in a extruder type composite spinning machine at a compounding ratio of 30% by weight of the island component and 70% by weight of the sea component, poured into the spinning pack having the sea-island composite spinneret shown in Fig. 2 (a) incorporated therein at a spinning temperature of 285°C, and a composite polymer flow was discharged from the discharge hole at a discharge rate of 25 g/min to obtain a spun yarn. The distribution plate on the discharge plate used had 18 distribution holes drilled per one discharge hole for the island component. The annular groove used for the sea component, as shown in 16 of Fig. 3, had distribution holes drilled every 1° in the circumferential direction. The discharge loading hole length was 5 mm, the reduction hole angle was 60°, the discharge hole diameter was 0.18 mm, the discharge hole length/discharge hole diameter was 2.2, and the discharge hole number was 72. The spun yarn was cooled with cooling air at an wind temperature of 20°C and a wind speed of 20 m/min. An oil agent was applied to the yarn by an oiling device to converge the yarn. The yarn was taken up by a first godet roller rotating at 2,700 m/min, and wound by a winder through a second godet roller rotating at the same speed as the first godet roller to obtain an undrawn yarn of 92 dtex-72 f. Thereafter, the obtained undrawn yarn was drawn and false twisted under the conditions of the temperature of the heater of 140°C and a rate of 1.4 times using a drawing and false twisting machine (the twisting portion: a friction disc type, the heater portion: a contact type) to obtain a false twist yarn of 66 dtex-72 f.

[0108] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 1. Although there was a slight number of cracks of the sea component, the moisture absorbability reduction due to the hot water treatment was little, and the moisture absorbability was good even after the hot water treatment. The coloring was also good, and the leveling, quality, and dry touch were all at acceptable levels.

(Examples 2 to 5) and (Comparative Example 1)

[0109] A false twist yarn was produced in the same manner as in Example 1 except that the ratio (T/R) of a thickness T of an outermost layer to a diameter R of the fiber was changed as shown in Table 1.

[0110] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 1. In Examples 2 to 5, as T/R increased, the cracks of the sea component decreased, and the coloring improved. Meanwhile, the moisture absorbability after the hot water treatment was decreased, but the moisture absorbability was good. In all cases, the leveling, quality, and dry touch were all at acceptable levels. Meanwhile, in Comparative Example 1, though the coloring, leveling, quality, and dry touch were good, both the moisture absorbability after the scouring and the moisture absorbability after the hot water treatment were low. This is because T/R was large, and thus the volume expansion of the moisture absorbing polymer of the island component was suppressed.

(Comparative Example 2)

[0111] A false twist yarn was produced in the same manner as in Example 1 except that a conventionally known pipe sea-island composite spinneret (18 islands per discharge hole) described in Japanese Patent Laid-open Publication No. 2007-100243 was used.

[0112] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 1. When the conventionally known pipe sea-island composite spinneret was used, the thickness of the outermost layer of the obtained fiber was thin, and thus the cracks of the sea component upon the volume expansion of the moisture absorbing polymer of the island component during the hot water treatment was extremely large. Due to the cracks of the sea component, the moisture absorbing polymer of the island component eluted during the hot water treatment, the moisture absorbability greatly reduced after the hot water treatment, and the moisture absorbability was poor. Many dyeing specks and/or fluffs caused by the cracks of the sea component were observed, and the leveling and quality were extremely poor. Further, due to the cracks of the sea component, a part of the moisture absorbing polymer of the island component was exposed on the surface, thus there was slime and stickiness, and the dry touch was poor.

(Comparative Example 3)

[0113] A false twist yarn was produced in the same manner as in Example 1 except that a core-sheath composite

spinneret was used. In Comparative Example 3, the sea component and the island component described in Table 1 correspond to the sheath component and the core component, respectively.

[0114] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 1. The cracks of the sheath component upon the volume expansion of the moisture absorbing polymer of the core component during the hot water treatment was extremely large. Due to the cracks of the sheath component, the moisture absorbing polymer of the core component eluted during the hot water treatment, the moisture absorbability greatly reduced after the hot water treatment, and the moisture absorbability was poor. Many dyeing specks and/or fluffs caused by the cracks of the sheath component were observed, and the leveling and quality were extremely poor. Further, due to the cracks of the sheath component, a part of the moisture absorbing polymer of the core component was exposed on the surface, thus there was slime and stickiness, and the dry touch was poor.

(Examples 6 to 11)

[0115] A false twist yarn was produced in the same manner as in Example 1 except that the number and disposition of the island component were changed as shown in Table 2 in the distribution plate of the sea-island composite spinneret described in Example 1.

[0116] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 2. Though the number and disposition of the island component were changed, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment was also good. The coloring was also good, and the leveling, quality, and dry touch were all at acceptable levels.

(Examples 12 to 15)

[0117] A false twist yarn was prepared in the same manner as in Example 9 except that the sea/island composite ratio was changed as shown in Table 3.

[0118] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 3. In all the sea/island composite ratios, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Examples 16 to 18)

[0119] A false twist yarn was produced in the same manner as in Example 1 except that, in the distribution plate of the sea-island composite spinneret described in Example 1, the shape of the island component was changed to a hexagon as shown in Fig. 1(h) in Example 16, and a trefoil as shown in Fig. 1(i) in Example 17, and the shape of the center side of the island component disposed in the outermost circle in the transverse cross-section of the fiber was changed to a non-circular shape as shown in Fig. 1(j) in Example 18.

[0120] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 3. Though the shape of the island component was changed, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good. In particular, in Example 18, in the island component disposed in the outermost circle, the fiber internal side was non-circular, thus the stress was concentrated not on the fiber surface side but on the non-circular portion, and the propagation of breaks to the fiber surface was blocked, thereby the effect of suppressing the cracks of the sea component was excellent.

(Examples 19 to 23)

[0121] A false twist yarn was produced in the same manner as in Example 1 except that, in the distribution plate of the sea-island composite spinneret described in Example 1, the number and disposition of the island component were changed, and the ratio (r1/r2) of a diameter r1 of the island component disposed to pass through a center of the transverse cross-section of the fiber to a diameter r2 of other island components was changed as shown in Table 4.

[0122] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 4. As r1/r2 increased, the cracks of the sea component decreased, and the coloring was improved, while the moisture absorbability after the hot water treatment decreased. However, the moisture absorbability was good. In all cases, the leveling, quality, and dry touch were all at acceptable levels.

(Examples 24 to 26) and (Comparative Examples 4 and 5)

[0123] A false twist yarn was prepared in the same manner as in Example 9 except that the number average molecular weight and the copolymerization ratio of polyethylene glycol, the copolymerization component of the island component

were changed as shown in Table 5.

[0124] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 5. Though the number average molecular weight and the copolymerization ratio of polyethylene glycol were changed in Examples 24 to 26, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good. Meanwhile, in Comparative Examples 4 and 5, though there was no crack of the sea component and the coloring, leveling, and dry touch were good, the moisture absorbability of the moisture absorbing polymer of the island component was low. Thus, both the moisture absorbability after the scouring and the moisture absorbability after the hot water treatment were low, and the moisture absorbability was extremely poor.

(Examples 27 and 28)

[0125] A false twist yarn was prepared in the same manner as in Example 9 except that the island component was changed to polybutylene terephthalate copolymerized with polyethylene glycol at the number average molecular weight and the copolymerization ratio as shown in Table 6.

[0126] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 6. Though the polybutylene terephthalate copolymerized with polyethylene glycol was used as the island component, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Examples 29 and 30)- Included for information only

[0127] A false twist yarn was prepared in the same manner as in Example 9 except that the island component was changed to nylon 6 copolymerized with 30% by weight of polyethylene glycol having a number average molecular weight of 3,400 g/mol (PEG 4000S manufactured by Sanyo Chemical Industries, Ltd.) in Example 29, and "PEBAX MH 1657" manufactured by Arkema in Example 30.

[0128] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 6. Though polyether amide was used as the island component, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Example 31)

[0129] A false twist yarn was prepared in the same manner as in Example 9 except that the island component was changed to "PAS-40N" manufactured by TORAY INDUSTRIES, INC.

[0130] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 6. Though polyetherester amide was used as the island component, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Examples 32, 33)

[0131] A false twist yarn was produced in the same manner as in Example 19 except that the sea component was changed to polyethylene terephthalate (IV = 0.66) copolymerized with 1.5% by mole of 5-sulfoisophthalic acid sodium salt and 1.0% by weight of polyethylene glycol having a number average molecular weight of 1,000 g/mol (PEG 1,000 manufactured by Sanyo Chemical Industries, Ltd.) in Example 32, and polybutylene terephthalate (IV = 0.66) in Example 33.

[0132] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 7. Though an cation dyeable polyester was used in Example 32, and polybutylene terephthalate was used in Example 33 as the sea component, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Examples 34 to 37)

[0133] A false twist yarn was produced in the same manner as in Example 19 except that the discharge rate was changed to 32 g/min and the number of the discharge hole of the sea-island composite spinneret was changed to 24 in Example 34, the discharge rate was changed to 32 g/min and the number of the discharge hole of the sea-island composite spinneret was changed to 48 in Example 35, the discharge rate was changed to 32 g/min in Example 36, and the discharge rate was changed to 38 g/min in Example 37. A false twist yarn of 84 dtex-24f was obtained in Example 34, a false twist yarn of 84 dtex-48f was obtained in Example 35, a false twist yarn of 84 dtex-72f was obtained in Example

36, and a false twist yarn of 100 dtex-72f was obtained in Example 37.

[0134] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 7. Though the fineness and the single yarn fineness were changed, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Comparative Example 6)

[0135] A false twist yarn was produced in the same manner as in Example 1 except that the spinneret was changed to a spinneret for single component (the number of the hole: 72, round holes) and only the moisture absorbing polymer was used for spinning, drawing, and false twisting.

[0136] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 8. Because the fiber was composed of only the moisture absorbing polymer, the moisture absorbability after the hot water treatment was high. However, the discharge from the spinneret was unstable, many of the obtained fiber had thick parts and thin parts, the strength was low, many dyeing specks and/or fluffs were observed, and the leveling and quality were extremely poor. Further, because the moisture absorbing polymer was exposed on the fiber surface, there was slime and stickiness, and the dry touch was extremely poor.

(Comparative Example 7)

[0137] A false twist yarn was produced in the same manner as in Example 19 except that the sea component and the island component in Example 19 were interchanged and the sea/island composite ratio was changed to 30/70.

[0138] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 8. There was no crack of the sea component and the moisture absorbability after the hot water treatment and coloring are good. However, the moisture absorbing polymer of the sea component was exposed on the fiber surface, and thus there were slime and stickiness, and the dry touch was extremely poor. Also, the leveling and quality were also not at acceptable levels.

(Comparative Example 8)

[0139] A false twist yarn was produced in the same manner as in Example 32 except that the island component was changed to polyethylene terephthalate (IV = 0.66).

[0140] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 8. There was no crack of the sea component, and the coloring, leveling, quality, and dry touch were good. However, the moisture absorbability was extremely poor, because both the sea component and the island component were not moisture absorbing polymers.

(Example 38)

[0141] A false twist yarn was prepared in the same manner as in Example 9 except that the island component was changed to polyethylene terephthalate copolymerized with 35% by weight of polyethylene glycol having a number average molecular weight of 8,300 g/mol (PEG 6000S manufactured by Sanyo Chemical Industries, Ltd.) and 19% by weight of ethylene oxide adduct of bisphenol A [m + n = 4] (NEWPOL BPE-40 manufactured by Sanyo Chemical Industries, Ltd.).

[0142] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 9. Though the polyethylene terephthalate copolymerized with polyethylene glycol and ethylene oxide adduct of bisphenol A was used as the island component, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Examples 39 to 41)

[0143] A false twist yarn was prepared in the same manner as in Example 38 except that "m + n" of ethylene oxide adduct of bisphenol A, the copolymerization component of the island component in Example 38, and the copolymerization ratio were changed as shown in Table 9.

[0144] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 9. Though "m + n" of ethylene oxide adduct of bisphenol A and the copolymerization ratio were changed, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Examples 42, 43)

[0145] A false twist yarn was prepared in the same manner as in Example 40 except that the copolymerization ratio of polyethylene glycol, the copolymerization component of the island component in Example 40 was changed as shown in Table 10.

[0146] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 10. Though the copolymerization ratio of polyethylene glycol was changed, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

(Examples 44, 45)

[0147] A false twist yarn was prepared in the same manner as in Example 38 except that the number average molecular weight of polyethylene glycol, the copolymerization component of the island component in Example 38 was changed as shown in Table 10.

[0148] The evaluation results of the fiber properties and fabric properties of the obtained fiber are shown in Table 10. Though the number average molecular weight of polyethylene glycol was changed, the number of the cracks of the sea component was small, and the moisture absorbability after the hot water treatment, coloring, leveling, quality, and dry touch were all good.

[Table 1-1]

			Example 1	Example 2	Example 3	Example 4	Example 5
Production conditions	Sea component	Polymer type	PET	PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]	0.1	0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]	239	239	239	239	239
	Island component	Polymer type	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester
		Polyether type	PEG	PEG	PEG	PEG	PEG
		Number average molecular	8300	8300	8300	8300	8300
		Copolymerization ratio of polyether [% by weight]	30	30	30	30	30
		Moisture absorption rate difference (ΔMR) [%]	11.0	11.0	11.0	11.0	11.0
		Extrapolated melting onset temperature [°C]	236	236	236	236	236
	Sea/Island composite ratio [weight ratio]		70/30	70/30	70/30	70/30	70/30
	Cross-sectional shape		Fig. 1 (a)	Fig. 1 (a)	Fig. 1 (a)	Fig. 1 (a)	Fig. 1 (a)
	Number of islands [pieces]		18	18	18	18	18
	Disposition of islands [circles]		2	2	2	2	2
Fiber	Fineness [dtex]		66	66	66	66	66
	Strength [cN/dtex]		2.2	2.4	2.5	2.6	2.6

(continued)

			Example 1	Example 2	Example 3	Example 4	Example 5
properties	Elongation percentage [%]	36	38	39	37	38	
	Extrapolated melting onset temperature [°C]	236	236	236	236	236	
	Diameter R of fiber [nm]	9158	9057	9184	9155	9229	
	Thickness T of outermost layer [nm]	475	720	1030	1935	2125	
	T/R	0.052	0.079	0.112	0.211	0.230	
	Diameter r of island component [nm]	1202	1194	1173	1224	1185	
	Diameter r1 of island component [nm]	-	-	-	-	-	
	Diameter r2 of island component [nm]	1202	1194	1173	1224	1185	
	r1/r2	-	-	-	-	-	
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	3.1	3.1	3.0	2.7	2.5	
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	2.8	3.0	2.9	2.6	2.4	
	Cracks of sea component [places]	9	5	3	1	0	
	L* value	33	27	24	23	23	
	Leveling	A	A	S	S	S	
	Quality	A	S	S	S	S	
	Dry touch	S	S	S	S	S	
PET: polyethylene terephthalate, PEG: polyethylene glycol							

[Table 1-2]

			Comparative Example 1	Comparative Example 2	Comparative Example 3
Production conditions	Sea component	Polymer type	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]	239	239	239
	Island component	Polymer type	Polyether ester	Polyether ester	Polyether ester
		Polyether type	PEG	PEG	PEG
		Number average molecular weight of polyether [g/mol]	8300	8300	8300
		Copolymerization ratio of polyether [% by weight]	30	30	30
		Moisture absorption rate difference (ΔMR) [%]	11.0	11.0	11.0
		Extrapolated melting onset temperature [°C]	236	236	236
	Sea/Island composite ratio [weight ratio]		70/30	70/30	70/30
	Cross-sectional shape		Fig. 1 (a)	Fig. 1 (a)	-
	Number of islands [pieces]		18	18	1
	Disposition of islands [circles]		2	2	1
Fiber	Fineness [dtex]		66	66	66

(continued)

			Comparative Example 1	Comparative Example 2	Comparative Example 3
properties	Strength [cN/dtex]	2.7	1.8	2.4	
	Elongation percentage [%]	39	33	33	
	Extrapolated melting onset temperature [°C]	236	236	236	
	Diameter R of fiber [nm]	9325	9212	9202	
	Thickness T of outermost layer [nm]	2343	153	1581	
	T/R	0.251	0.017	0.172	
	Diameter r of island component [nm]	1152	1189	5037	
	Diameter r1 of island component [nm]	-	-	5037	
	Diameter r2 of island component [nm]	1152	1189	-	
	r1/r2	-	-	-	
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	1.9	3.2	2.8	
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	1.8	1.3	1.2	
	Cracks of sea component [places]	0	47	43	
	L* value	22	41	25	
	Leveling	S	C	C	
	Quality	S	C	C	
	Dry touch	S	B	B	
PET: polyethylene terephthalate, PEG: polyethylene glycol					

[Table 2]

			Example 6	Example 7	Example 8	Example 9	Example 10	Example 11
Production conditions	Sea component	Polymer type	PET	PET	PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]	0.1	0.1	0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]	239	239	239	239	239	239
	Island component	Polymer type	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester
		Polyether type	PEG	PEG	PEG	PEG	PEG	PEG
		Number average molecular weight of polyether [g/mol]	8300	8300	8300	8300	8300	8300
		Copolymerization ratio of polyether [% by weight]	30	30	30	30	30	30
		Moisture absorption rate difference (ΔMR) [%]	11.0	11.0	11.0	11.0	11.0	11.0
		Extrapolated melting onset temperature [°C]	236	236	236	236	236	236
	Sea/Island composite ratio [weight ratio]		70/30	70/30	70/30	70/30	70/30	70/30
	Cross-sectional shape		Fig. 1 (b)	Fig. 1 (c)	Fig. 1 (k)	Fig. 1 (e)	Fig. 1 (f)	-
	Number of islands [pieces]		2	3	6	24	128	1024
	Disposition of islands [circles]		1	1	2	3	7	12
Fiber	Fineness [dtex]		66	66	66	66	66	66

(continued)

			Example 6	Example 7	Example 8	Example 9	Example 10	Example 11
properties	Strength [cN/dtex]	2.4	2.5	2.4	2.5	2.6	2.7	
	Elongation percentage [%]	36	36	37	38	40	39	
	Extrapolated melting onset temperature [°C]	236	236	236	236	236	236	
	Diameter R of fiber [nm]	9194	9279	9068	9265	9163	9270	
	Thickness T of outermost layer [nm]	1012	1055	1048	1061	1024	1007	
	T/R	0.110	0.114	0.116	0.115	0.112	0.109	
	Diameter r of island component [nm]	3421	2908	1989	1028	445	157	
	Diameter r1 of island component [nm]	-	-	2005	-	-	-	
	Diameter r2 of island component [nm]	3421	2908	1986	1028	445	157	
	r1/r2	-	-	1.01	-	-	-	
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	2.9	2.9	3.0	3.0	3.1	3.2	
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	2.4	2.5	2.9	2.9	3.0	3.1	
	Cracks of sea component [places]	17	11	5	2	1	0	
	L* value	26	24	25	24	23	24	
	Leveling	A	A	A	S	S	S	
	Quality	A	A	S	S	S	S	
	Dry touch	A	S	S	S	S	S	
PET: polyethylene terephthalate, PEG: polyethylene glycol								

[Table 3]

			Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18
Production conditions	Sea component	Polymer type	PET	PET	PET	PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]	239	239	239	239	239	239	239
	Island component	Polymer type	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester
		Polyether type	PEG	PEG	PEG	PEG	PEG	PEG	PEG
		Number average molecular weight of polyether [g/mol]	8300	8300	8300	8300	8300	8300	8300
		Copolymerization ratio of polyether [% bv weight]	30	30	30	30	30	30	30
		Moisture absorption rate difference (ΔMR) [%]	11.0	11.0	11.0	11.0	11.0	11.0	11.0
		Extrapolated melting onset temperature [°C]	236	236	236	236	236	236	236
	Sea/Island composite ratio [weight ratio]		45/55	50/50	60/40	80/20	70/30	70/30	70/30
	Cross-sectional shape		Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (h)	Fig. 1 (i)	Fig. 1 (j)
	Number of islands [pieces]		24	24	24	24	18	18	18
	Disposition of islands [circles]		3	3	3	3	2	2	2
Fiber	Fineness [dtex]		66	66	66	66	66	66	66

(continued)

			Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18
properties	Strength [cN/dtex]	2.0	2.2	2.4	2.7	2.5	2.4	2.6	
	Elongation percentage [%]	36	35	38	39	36	37	39	
	Extrapolated melting onset temperature [°C]	236	236	236	236	236	236	236	
	Diameter R of fiber [nm]	9312	9292	9286	9232	9315	9301	9277	
	Thickness T of outermost layer [nm]	491	635	1036	1059	1095	1042	1138	
	T/R	0.053	0.068	0.112	0.115	0.118	0.112	0.123	
	Diameter r of island component [nm]	1345	1321	1187	840	1212	1243	1264	
	Diameter r1 of island component [nm]	-	-	-	-	-	-	-	
	Diameter r2 of island component [nm]	1345	1321	1187	840	1212	1243	1264	
	r1/r2	-	-	-	-	-	-	-	

(continued)

			Example 12	Example 13	Example 14	Example 15	Example 16	Example 17	Example 18
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	5.5	5.1	4.0	2.2	3.0	3.0	3.0	
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	5.0	4.7	3.8	2.1	2.9	2.9	2.9	
	Cracks of sea component [places]	10	7	4	0	3	4	0	
	L* value	35	32	27	21	24	24	23	
	Leveling	A	A	A	S	A	A	S	
	Quality	A	A	S	S	A	A	S	
	Dry touch	S	S	S	S	S	S	S	
PET: polyethylene terephthalate, PEG: polyethylene glycol									

[Table 4]

			Example 19	Example 20	Example 21	Example 22	Example 23
Production conditions	Sea component	Polymer type	PET	PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]	0.1	0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]	239	239	239	239	239
	Island component	Polymer type	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester
		Polyether type	PEG	PEG	PEG	PEG	PEG
		Number average molecular weight of polyether [g/mol]	8300	8300	8300	8300	8300
		Copolymerization ratio of polyether [% by weight]	30	30	30	30	30
		Moisture absorption rate difference (ΔMR) [%]	11.0	11.0	11.0	11.0	11.0
		Extrapolated melting onset temperature [°C]	236	236	236	236	236
	Sea/Island composite ratio [weight ratio]		70/30	70/30	70/30	70/30	70/30
	Cross-sectional shape		Fig. 1 (I)	Fig. 1 (I)	Fig. 1 (I)	Fig. 1 (I)	Fig. 1 (I)
	Number of islands [pieces]		18	18	18	18	18
	Disposition of islands [circles]		3	3	3	3	3
Fiber properties	Fineness [dtex]		66	66	66	66	66
	Strength [cN/dtex]		2.5	2.6	2.7	2.7	2.8
	Elongation percentage [%]		38	38	37	38	39

(continued)

			Example 19	Example 20	Example 21	Example 22	Example 23
	Extrapolated melting onset temperature [°C]	236	236	236	236	236	
	Diameter R of fiber [nm]	9156	9355	9084	9177	9215	
	Thickness T of outermost layer [nm]	1033	1141	1072	1096	1127	
	T/R	0.113	0.122	0.118	0.119	0.122	
	Diameter r of island component [nm]	-	-	-	-	-	
	Diameter r1 of island component [nm]	1259	1708	2871	4104	4565	
	Diameter r2 of island component [nm]	1127	1029	845	675	498	
	r1/r2	1.12	1.66	3.40	6.08	9.17	
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	3.0	2.9	2.9	2.8	2.7	
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	2.9	2.8	2.8	2.7	2.6	
	Cracks of sea component [places]	2	1	1	0	0	
	L* value	23	23	22	21	20	
	Leveling	S	S	S	S	S	
	Quality	S	S	S	S	S	
	Dry touch	S	S	S	S	S	
PET: polyethylene terephthalate, PEG: polyethylene glycol							

[Table 5]

			Example 24	Example 25	Example 26	Comparative Example 4	Comparative Example 5
Production conditions	Sea component	Polymer type	PET	PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]	0.1	0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]	239	239	239	239	239
	Island component	Polymer type	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester
		Polyether type	PEG	PEG	PEG	PEG	PEG
		Number average molecular weight of polyether [g/mol]	3400	11000	20000	3400	8300
		Copolymerization ratio of polyether [% by weight]	55	20	20	15	5
		Moisture absorption rate difference (ΔMR) [%]	17.5	6.8	7.5	1.4	0.4
		Extrapolated melting onset temperature [°C]	221	238	238	235	238
	Sea/Island composite ratio [weight ratio]		70/30	70/30	70/30	70/30	70/30
	Cross-sectional shape		Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)
	Number of islands [pieces]		24	24	24	24	24
	Disposition of islands [circles]		3	3	3	3	3
Fiber properties	Fineness [dtex]		66	66	66	66	66
	Strength [cN/dtex]		2.1	2.5	2.6	2.4	2.9

(continued)

			Example 24	Example 25	Example 26	Comparative Example 4	Comparative Example 5
	Elongation percentage [%]	37	39	37	38	36	
	Extrapolated melting onset temperature [°C]	221	238	238	235	238	
	Diameter R of fiber [nm]	9301	9251	9278	9315	9322	
	Thickness T of outermost layer [nm]	978	1023	1038	1011	1056	
	T/R	0.105	0.111	0.112	0.109	0.113	
	Diameter r of island component [nm]	1021	1037	1002	1016	985	
	Diameter r1 of island component [nm]	-	-	-	-	-	
	Diameter r2 of island component [nm]	1021	1037	1002	1016	985	
	r1/r2	-	-	-	-	-	
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	5.2	2.1	2.3	0.4	0.1	
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	5.0	2.0	2.2	0.4	0.1	
	Cracks of sea component [places]	3	2	2	0	0	
	L* value	24	23	24	21	19	
	Leveling	S	S	S	S	S	
	Quality	S	S	S	S	S	
	Dry touch	S	S	S	S	s	
PET: polyethylene terephthalate, PEG: polyethylene glycol							

[Table 6]

			Example 27	Example 28	Example 29	Example 30	Example 31
Production conditions	Sea component	Polymer type	PET	PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]	0.1	0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]	239	239	239	239	239
	Island component	Polymer type	Polyether ester	Polyether ester	Polyether amide	Polyether amide	Polyether ester amide
		Polyether type	PEG	PEG	PEG	-	-
		Number average molecular weight of polyether [g/mol]	3400	8300	3400	-	-
		Copolymerization ratio of polyether [$ by weight]	50	30	30	-	-
		Moisture absorption rate difference (ΔMR) [%]	13.1	10.8	11.8	17.0	12.1
		Extrapolated melting onset temperature [°C]	185	208	194	179	155
	Sea/Island composite ratio [weight ratio]		70/30	70/30	70/30	70/30	70/30
	Cross-sectional shape		Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)
	Number of islands [pieces]		24	24	24	24	24
	Disposition of islands [circles]		3	3	3	3	3
Fiber	Fineness [dtex]		66	66	66	66	66
	Strength [cN/dtex]		2.3	2.7	2.3	2.2	2.4

(continued)

			Example 27	Example 28	Example 29	Example 30	Example 31
properties	Elongation percentage [%]	38	36	37	38	37	
	Extrapolated melting onset temperature [°C]	185	208	194	179	155	
	Diameter R of fiber [nm]	9317	9175	9114	9244	9358	
	Thickness T of outermost layer [nm]	986	1049	1004	991	1018	
	T/R	0.106	0.114	0.110	0.107	0.109	
	Diameter r of island component [nm]	1046	1054	995	1009	976	
	Diameter r1 of island component [nm]	-	-	-	-	-	
	Diameter r2 of island component [nm]	1046	1054	995	1009	976	
	r1/r2	-	-	-	-	-	
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	3.9	3.2	3.4	5.0	3.6	
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	3.8	3.1	3.3	4.8	3.5	
	Cracks of sea component [places]	3	2	4	4	2	
	L* value	25	24	28	29	27	
	Leveling	S	S	A	A	S	
	Quality	S	S	S	A	S	
	Dry touch	S	S	S	S	S	
PET: polyethylene terephthalate, PEG: polyethylene glycol							

[Table 7]

		Example 32	Example 33	Example 34	Example 35	Example 36	Example 37
Production conditions	Sea component	Copolymerized PET	PBT	PET	PET	PET	PET
		-	-	-	-	-	-
		-	-	-	-	-	-
		-					
		0.2	0.1	0.1	0.1	0.1	0.1
		233	211	239	239	239	239
	Island component	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester	Polyether ester
		PEG	PEG	PEG	PEG	PEG	PEG
		8300	3400	8300	8300	8300	8300
		30	50	30	30	30	30
		11.0	13.1	11.0	11.0	11.0	11.0
		236	185	236	236	236	236
	Sea/Island composite ratio [weight ratio]	70/30	70/30	70/30	70/30	70/30	70/30
	Cross-sectional shape	Fig. 1 (1)	Fig. 1 (1)	Fig. 1 (1)	Fig. 1 (1)	Fig. 1 (1)	Fig. 1 (1)

(continued)

	Number of islands [pieces]	18	18	18	18	18	18
	Disposition of islands [circles]	3	3	3	3	3	3
Fiber properties	Fineness [dtex]	66	66	84	84	84	100
	Strength [cN/dtex]	2.3	2.1	3.5	3.0	2.6	2.7
	Elongation percentage [%]	37	39	38	37	38	37
	Extrapolated melting onset temperature [°C]	233	185	236	236	236	236
	Diameter R of fiber [nm]	9215	9169	17965	12707	10373	11320
	Thickness T of outermost layer [nm]	1047	1032	1855	1368	1152	1187
	T/R	0.114	0.113	0.103	0.108	0.111	0.105
	Diameter r of island component [nm]	1159	1084	2320	1639	1341	1467
	Diameter r1 of island component [nm]	1198	1043	2287	1676	1379	1455
	Diameter r2 of island component [nm]	1157	1086	2322	1637	1339	1468
	r1/r2	1.04	0.96	0.98	1.02	1.03	0.99
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	3.1	3.8	3.3	3.2	3.1	3.2
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	3.0	3.7	3.2	3.1	3.0	3.1
	Cracks of sea component [places]	3	2	0	1	2	2
	L* value	21	24	20	21	23	22
	Leveling	S	S	S	S	S	S
	Quality	S	S	S	S	S	S
	Dry touch	S	S	S	S	S	S
PET: polyethylene terephthalate, PEG: polyethylene glycol, PBT: polybutylene terephthalate							

[Table 8]

			Comparative Example 6	Comparative Example 7	Comparative Example 8
Production conditions	Sea component	Polymer type	Polyether ester	Polyether ester	Copolymerized PET
		Polyether type	PEG	PEG	-
		Number average molecular weight of polyether [g/mol]	8300	8300	-
		Copolymerization ratio of polyether [% by weight]	30	30	-
		Moisture absorption rate difference (ΔMR) [%]	11.0	11.0	0.2
		Extrapolated melting onset temperature	236	236	233
	Island component	Polymer type	-	PET	PET
		Polyether type	-	-	-
		Number average molecular weight of polyether [g/mol]	-	-	-
		Copolymerization ratio of polyether [$ by weight]	-	-	-
		Moisture absorption rate difference (ΔMR) [%]	-	0.1	0.1
		Extrapolated melting onset temperature [°C]	-	239	239
	Sea/Island composite ratio [weight ratio]		100/0	30/70	70/30
	Cross-sectional shape		-	Fig. 1 (1)	Fig. 1 (1)
	Number of islands [pieces]		-	18	18
	Disposition of islands [circles]		-	3	3

(continued)

		Comparative Example 6	Comparative Example 7	Comparative Example 8
Fiber properties	Fineness [dtex]	66	66	66
	Strength [cN/dtex]	0.9	1.6	3.4
	Elongation percentage [%]	21	24	35
	Extrapolated melting onset temperature [°C]	236	236	233
	Diameter R of fiber [nm]	9051	9196	9248
	Thickness T of outermost layer [nm]	-	932	1089
	T/R	-	0.101	0.118
	Diameter r of island component [nm]	-	1825	1065
	Diameter r1 of island component [nm]	-	1868	1095
	Diameter r2 of island component [nm]	-	1822	1063
	r1/r2	-	1.02	1.03
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	11.0	3.3	0.1
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	10.7	3.0	0.1
	Cracks of sea component [places]	-	0	0
	L* value	20	21	18
	Leveling	C	B	S
	Quality	C	B	S
	Dry touch	C	C	S
PET: polyethylene terephthalate, PEG: polyethylene glycol				

[Table 9]

				Example 38	Example 39	Example 40	Example 41
Production conditions	Sea component	Polymer type		PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]		0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]		239	239	239	239
	Island component	Polymer type		Polyether ester	Polyether ester	Polyether ester	Polyether ester
		Polyether type		PEG	PEG	PEG	PEG
		Number average molecular weight of polyether [g/mol]		8300	8300	8300	8300
		Copolymerization ratio of polyether [% by weight]		35	35	35	35
		Alkylene oxide adduct of bisphenol	m+n	4	6	10	30
			Copolymerization ratio [% by weight]	19	16	14	14
		Moisture absorption rate difference (ΔMR) [%]		11.5	11.2	11.0	13.3
		Extrapolated melting onset temperature [°C]		196	214	228	240
	Sea/Island composite ratio [weight ratio]			70/30	70/30	70/30	70/30
	Cross-sectional shape			Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)
	Number of islands [pieces]			24	24	24	24
	Disposition of islands [circles]			3	3	3	3

(continued)

		Example 38	Example 39	Example 40	Example 41
Fiber properties	Fineness [dtex]	66	66	66	66
	Strength [cN/dtex]	2.9	2.8	2.6	2.3
	Elongation percentage [%]	36	38	35	37
	Extrapolated melting onset temperature [°C]	196	214	228	239
	Diameter R of fiber [nm]	9215	9349	9162	9204
	Thickness T of outermost layer [nm]	997	1009	1034	1013
	T/R	0.108	0.108	0.113	0.110
	Diameter r of island component [nm]	1025	1041	986	975
	Diameter r1 of island component [nm]	-	-	-	-
	Diameter r2 of island component [nm]	1025	1041	986	975
	r1/r2	-	-	-	-
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	3.5	3.4	3.3	4.0
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	3.4	3.3	3.2	3.8
	Cracks of sea component [places]	3	2	2	4
	L* value	24	24	25	26
	Leveling	S	S	S	A
	Quality	S	S	S	S
	Dry touch	S	S	S	S
PET: polyethylene terephthalate, PEG: polyethylene glycol					

[Table 10]

				Example 42	Example 43	Example 44	Example 45
Production conditions	Sea component	Polymer type		PET	PET	PET	PET
		Moisture absorption rate difference (ΔMR) [%]		0.1	0.1	0.1	0.1
		Extrapolated melting onset temperature [°C]		239	239	239	239
	Island component	Polymer type		Polyether ester	Polyether ester	Polyether ester	Polyether ester
		Polyether type		PEG	PEG	PEG	PEG
		Number average molecular weight of polyether [g/mol]		8300	8300	11000	20000
		Copolymerization ratio of polyether [% by weight]		30	45	35	35
		Alkylene oxide adduct of bisphenol	m+n	10	10	4	4
			Copolymerization ratio [% by weight]	14	14	19	19
		Moisture absorption rate difference (ΔMR) [%]		8.9	18.6	12.0	12.5
		Extrapolated melting onset temperature [°C]		232	218	198	200
	Sea/Island composite ratio [weight ratio]			70/30	70/30	70/30	70/30
	Cross-sectional shape			Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)	Fig. 1 (e)
	Number of islands [pieces]			24	24	24	24
	Disposition of islands [circles]			3	3	3	3
Fiber	Fineness [dtex]			66	66	66	66

(continued)

		Example 42	Example 43	Example 44	Example 45
properties	Strength [cN/dtex]	2.9	2.3	2.8	2.9
	Elongation percentage [%]	37	34	38	37
	Extrapolated melting onset temperature [°C]	232	218	198	200
	Diameter R of fiber [nm]	9370	9136	9117	9281
	Thickness T of outermost layer [nm]	1011	1005	1026	988
	T/R	0.108	0.110	0.113	0.106
	Diameter r of island component [nm]	1013	992	1037	1004
	Diameter r1 of island component [nm]	-	-	-	-
	Diameter r2 of island component [nm]	1013	992	1037	1004
	r1/r2	-	-	-	-
Fabric properties	Moisture absorption rate difference after scouring (ΔMR) [%]	2.7	5.6	3.6	3.8
	Moisture absorption rate difference after hot water treatment (ΔMR) [%]	2.6	5.4	3.5	3.7
	Cracks of sea component [places]	1	4	3	3
	L* value	24	28	24	24
	Leveling	S	A	S	S
	Quality	S	A	S	S
	Dry touch	S	S	S	S
PET: polyethylene terephthalate, PEG: polyethylene glycol					

INDUSTRIAL APPLICABILITY

[0149] The sea-islands type composite fiber of the present invention does not undergo the cracks of a sea component upon the volume expansion of a polymer having moisture absorbability that serves as an island component during a hot water treatment such as a dyeing treatment, thus rarely undergoes the generation of dyeing specks and/or fluffs when the composite fiber is formed into a fiber structure such as a woven fabric or a knitted fabric, and has excellent quality. In addition, the fiber of the present invention is reduced in the elution of the polymer having moisture absorbability, thus has excellent moisture absorbability even after a hot water treatment, and also has dry touch inherent to a polyester fiber when the sea component is a polyester. Therefore, it can be suitably used as fiber structures such as a woven fabric, a knitted fabric, and a nonwoven fabric for clothing.

DESCRIPTION OF REFERENCE SIGNS

[0150]

1: Sea component
2: Island component
3: Diameter of fiber
4: Circumscribed circle formed by connecting apexes of island components disposed in outermost circle
5: Thickness of outermost layer
6: Diameter of island component
7: Measuring plate
8: Distribution plate
9: Discharge plate
10-(a): Measuring hole 1
10-(b): Measuring hole 2
11-(a): Distribution groove 1
11-(b): Distribution groove 2
12-(a): Distribution hole 1
12-(b): Distribution hole 2
13: Discharge loading hole
14: Reduction hole
15: Discharge hole
16: Annular groove

Claims

1. A sea-islands type composite fiber comprising:

an island component that is a polymer having moisture absorbability;
a ratio T/R of a thickness T of an outermost layer to a diameter R of the fiber in a transverse cross-section of the fiber of 0.05 to 0.25, as measured by the method of the description; and
a moisture absorption rate difference ΔMR after a hot water treatment of 2.0 to 10.0%,as measured by the method of the description;
wherein the polymer having moisture absorbability is a polyetherester, the polyetherester containing an aromatic dicarboxylic acid and an aliphatic diol as main components, and containing the polyether as a copolymerization component;
and
wherein the thickness of an outermost layer is a difference between a radius of the fiber and a radius of a circumscribed circle formed by connecting apexes of the island components disposed in an outermost circle, and represents a thickness of a sea component in the outermost layer.

2. The sea-islands type composite fiber according to claim 1, wherein the thickness T of an outermost layer is 500 to 3,000 nm.

3. The sea-islands type composite fiber according to claim 1 or 2, wherein the island component has a diameter r of 10 to 5,000 nm in the transverse cross-section of the fiber.

4. The sea-islands type composite fiber according to any one of claims 1 to 3, wherein the island component is disposed to from 2 to 100 circles in the transverse cross-section of the fiber.

5. The sea-islands type composite fiber according to any one of claims 1 to 4, comprising a ratio r1/r2 of a diameter r1 of the island component disposed to pass through a center of the transverse cross-section of the fiber to a diameter r2 of other island components of 1.1 to 10.0.

6. The sea-islands type composite fiber according to any one of claims 1 to 5, wherein a shape of a center side of the island component disposed in an outermost circle in the transverse cross-section of the fiber is non-circular.

7. The sea-islands type composite fiber according to any one of claims 1 to 6, comprising a composite ratio (a weight ratio) of the sea component/the island component of 50/50 to 90/10.

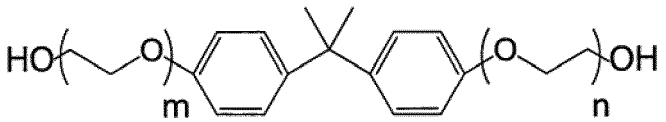
8. The sea-islands type composite fiber according to any one of claims 1 to 7, wherein the polyether is at least one polyether selected from the group consisting of polyethylene glycol, polypropylene glycol, and polybutylene glycol.

9. The sea-islands composite fiber according to any one of claims 1 to 8, wherein the polyether has a number average molecular weight of 2,000 to 30,000 g/mol.

10. The sea-islands composite fiber according any one of claims 1 to 9, wherein a copolymerization ratio of the polyether is 10 to 60% by weight.

11. The sea-islands type composite fiber according to any one of claims 1 to 10, wherein the polyetherester contains an aromatic dicarboxylic acid and an aliphatic diol as main components, and contains the polyether and an alkylene oxide adduct of a bisphenol represented by General Formula (1) below as copolymerization components:

[Chemical Formula 1]



··· (1)

wherein m and n are integers of 2 to 20 and m + n is 4 to 30.

12. The sea-islands type composite fiber according to any one of claims 1 to 11, wherein the aliphatic diol is 1,4-butanediol.

13. The sea-islands type composite fiber according to any one of claims 1 to 12, wherein the sea component is a cation dyeable polyester.

14. A false twist yarn comprising a twist of two or more of the sea-islands type composite fiber according to any one of claims 1 to 13.

15. A fiber structure comprising the sea-islands type composite fiber according to any one of claims 1 to 13 and/or the false twist yarn according to claim 14 in at least a part of the fiber structure.

Patentansprüche

1. Verbundfaser vom Meer-Insel-Typ, die Folgendes aufweist:

eine Inselkomponente, die ein Polymer mit Feuchtigkeitsabsorptionsfähigkeit ist;
ein T/R-Verhältnis zwischen der Dicke T einer äußersten Schicht und dem Durchmesser R der Faser im transversalen Querschnitt der Faser von 0,05 bis 0,25, gemessen durch das Verfahren der Beschreibung; und
eine Feuchtigkeitsabsorptionsratendifferenz ΔMR nach einer Behandlung mit heißem Wasser von 2,0 bis 10,0 %, gemessen durch das Verfahren der Beschreibung;

wobei das Polymer mit Feuchtigkeitsabsorptionsfähigkeit ein Polyetherester ist, wobei der Polyetherester eine aromatische Dicarbonsäure und ein aliphatisches Diol als Hauptkomponenten enthält und den Polyether als Copolymerisationskomponente enthält;
und
wobei die Dicke der äußersten Schicht eine Differenz zwischen dem Radius der Faser und dem Radius eines umschriebenen Kreises ist, der durch Verbinden von Scheitelpunkten der Inselkomponenten, die im äußersten Kreis angeordnet sind, gebildet wird und die Dicke der Meerkomponente in der äußersten Schicht darstellt.

2. Verbundfaser vom Meer-Insel-Typ nach Anspruch 1, wobei die Dicke T der äußersten Schicht 500 bis 3.000 nm beträgt.

3. Verbundfaser vom Meer-Insel-Typ nach Anspruch 1 oder 2, wobei die Inselkomponente einen Durchmesser r von 10 bis 5.000 nm im transversalen Querschnitt der Faser aufweist.

4. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 3, wobei die Inselkomponente in 2 bis 100 Kreisen im transversalen Querschnitt der Faser angeordnet ist.

5. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 4, die ein Verhältnis r1/r2 zwischen dem Durchmesser r1 der Inselkomponente, der angeordnet ist, um durch die Mitte des transversalen Querschnitts der Faser zu verlaufen, und dem Durchmesser r2 anderer Inselkomponenten von 1,1 bis 10,0 aufweist.

6. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 5, wobei die Form der mittigen Seite der Inselkomponente, die im äußersten Kreis im transversalen Querschnitt der Faser angeordnet ist, nicht kreisförmig ist.

7. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 6, die ein Verbundverhältnis (Gewichtsverhältnis) zwischen der Meerkomponente/der Inselkomponente von 50/50 bis 90/10 aufweist.

8. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 7, wobei der Polyether zumindest ein aus der aus Polyethylenglykol, Polypropylenglykol und Polybutylenglykol bestehenden Gruppe ausgewählter Polyether ist.

9. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 8, wobei der Polyether ein zahlenmittleres Molekulargewicht von 2.000 bis 30.000 g/mol aufweist.

10. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 9, wobei der Copolymerisationsgrad des Polyethers 10 bis 60 Gew.-% beträgt.

11. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 10, wobei der Polyetherester eine aromatische Dicarbonsäure und ein aliphatisches Diol als Hauptkomponenten enthält und den Polyether und ein Alkylenoxidaddukt eines Bisphenols der nachstehenden allgemeinen Formel (1) als Copolymerisationskomponenten enthält:

[chemische Formel 1]

··· (1)

worin m und n ganze Zahlen von 2 bis 20 sind und m+n = 4 bis 30 ist.

12. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 11, wobei das aliphatische Diol 1,4-Butandiol ist.

13. Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 12, wobei die Meerkomponente ein durch Kationen färbbarer Polyester ist.

14. Falschzwirngarn, das eine Verdrehung aus zwei oder mehr Verbundfasern vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 13 umfasst.

15. Faserstruktur, die eine Verbundfaser vom Meer-Insel-Typ nach einem der Ansprüche 1 bis 13 und/oder ein Falschzwirngarn nach Anspruch 14 in zumindest einem Teil der Faserstruktur umfasst.

Revendications

1. Fibre composite de type mer-îlots comprenant :

un composant îlot qui est un polymère présentant une capacité d'absorption d'humidité ;
un rapport T/R d'une épaisseur T d'une couche la plus extérieure à un diamètre R de la fibre dans une section transversale de la fibre de 0,05 à 0,25, tel que mesuré par le procédé de la description ; et
une différence de taux d'absorption d'humidité ΔMR après un traitement à l'eau chaude de 2,0 à 10,0 %, telle que mesurée par le procédé de la description ;
dans laquelle le polymère présentant une capacité d'absorption d'humidité est un polyétherester, le polyétherester contenant un acide dicarboxylique aromatique et un diol aliphatique en tant que composants principaux, et contenant le polyéther en tant que composant de copolymérisation ; et
dans laquelle l'épaisseur d'une couche la plus extérieure est une différence entre un rayon de la fibre et un rayon d'un cercle circonscrit formé en connectant des sommets des composants îlots disposés dans un cercle le plus extérieur, et représente une épaisseur d'un composant mer dans la couche la plus extérieure.

2. Fibre composite de type mer-îlots selon la revendication 1, dans laquelle l'épaisseur T d'une couche la plus extérieure est de 500 à 3 000 nm.

3. Fibre composite de type mer-îlots selon la revendication 1 ou 2, dans laquelle le composant îlot présente un diamètre r de 10 à 5 000 nm dans la section transversale de la fibre.

4. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 3, dans laquelle le composant îlot est disposé sur 2 à 100 cercles dans la section transversale de la fibre.

5. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 4, comprenant un rapport r1/r2 d'un diamètre r1 du composant îlot disposé pour passer à travers un centre de la section transversale de la fibre à un diamètre r2 d'autres composants îlots de 1,1 à 10,0.

6. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 5, dans laquelle une forme d'un côté central du composant îlot disposé dans un cercle le plus extérieur dans la section transversale de la fibre est non circulaire.

7. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 6, comprenant un rapport de composite (un rapport de poids) du composant mer/du composant îlot de 50/50 à 90/10.

8. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 7, dans laquelle le polyéther est au moins un polyéther choisi dans le groupe constitué de polyéthylène glycol, de polypropylène glycol et de polybutylène glycol.

9. Fibre composite mer-îlots selon l'une quelconque des revendications 1 à 8, dans laquelle le polyéther présente une masse moléculaire moyenne en nombre de 2 000 à 30 000 g/mole.

10. Fibre composite mer-îlots selon l'une quelconque des revendications 1 à 9, dans laquelle un rapport de copolymérisation du polyéther est de 10 à 60 % en poids.

11. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 10, dans laquelle le polyétherester contient un acide dicarboxylique aromatique et un diol aliphatique en tant que composants principaux, et contient le polyéther et un produit d'addition d'oxyde d'alkylène d'un bisphénol représenté par la formule générale (1) ci-dessous en tant que composants de copolymérisation :

[Formule chimique 1]

... (1)

dans laquelle m et n sont des nombres entiers de 2 à 20 et m+n est de 4 à 30.

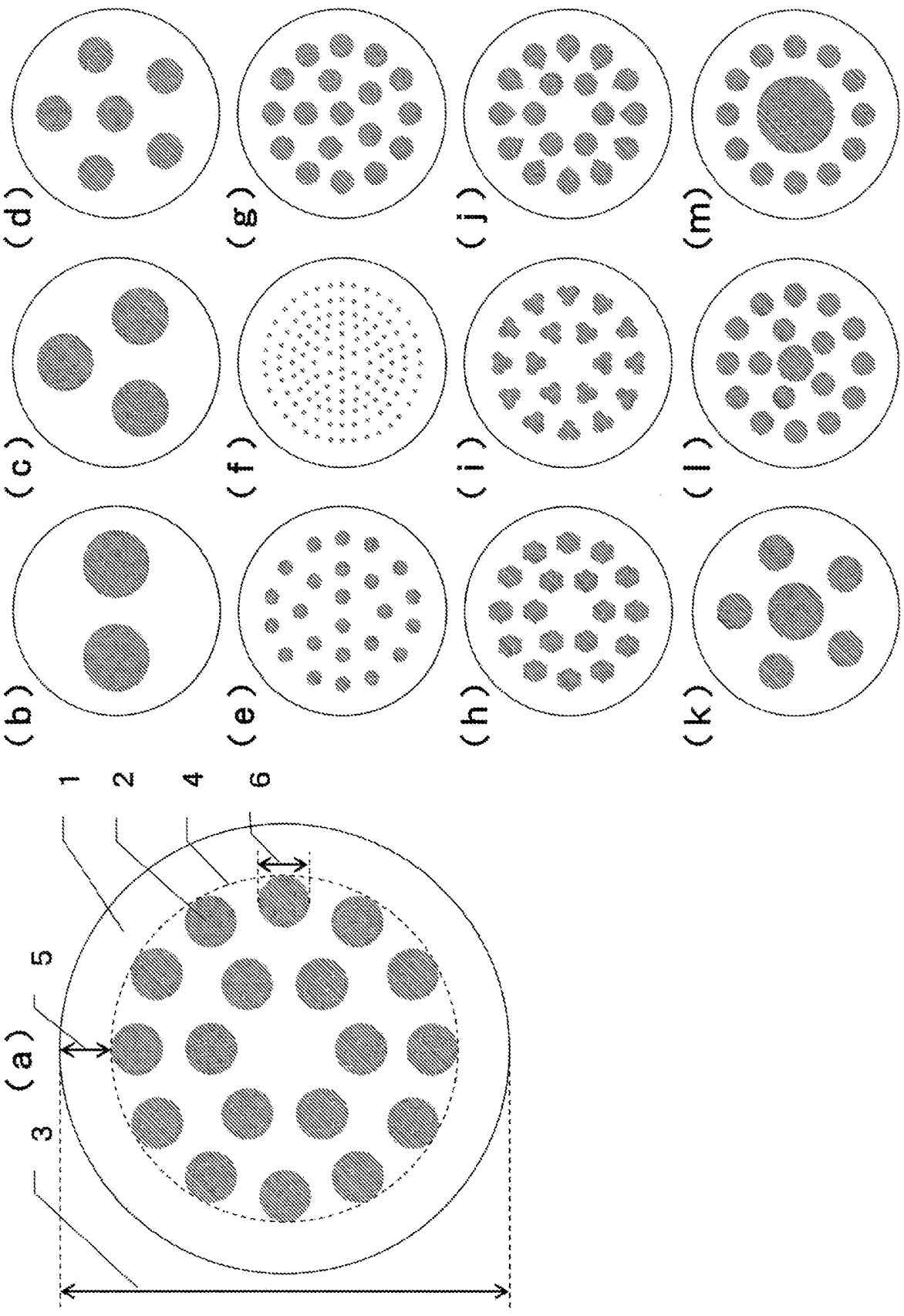
12. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 11, dans laquelle le diol aliphatique est le 1,4-butanediol.

13. Fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 12, dans laquelle le composant mer est un polyester pouvant être teint par cations.

14. Fil de fausse torsion comprenant une torsion de deux ou plus de la fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 13.

15. Structure fibreuse comprenant la fibre composite de type mer-îlots selon l'une quelconque des revendications 1 à 13 et/ou le fil de fausse torsion selon la revendication 14 dans au moins une partie de la structure fibreuse.

[1]



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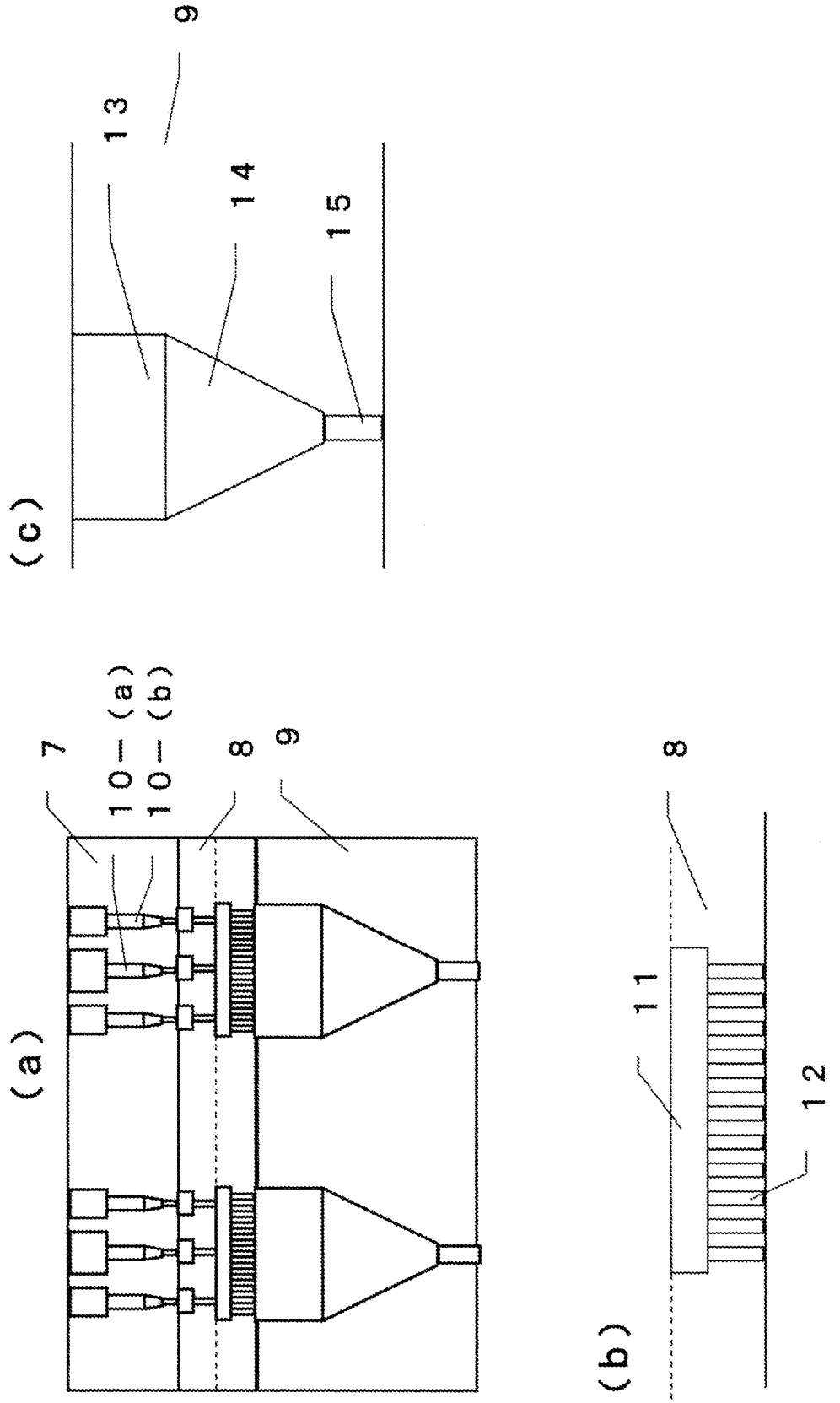
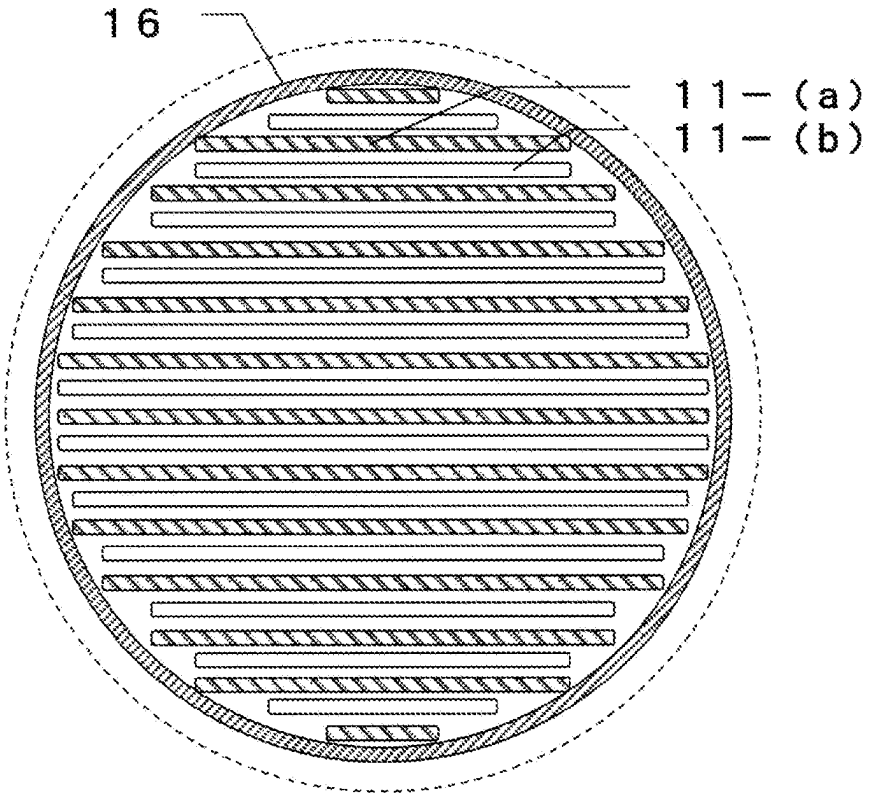


[3]



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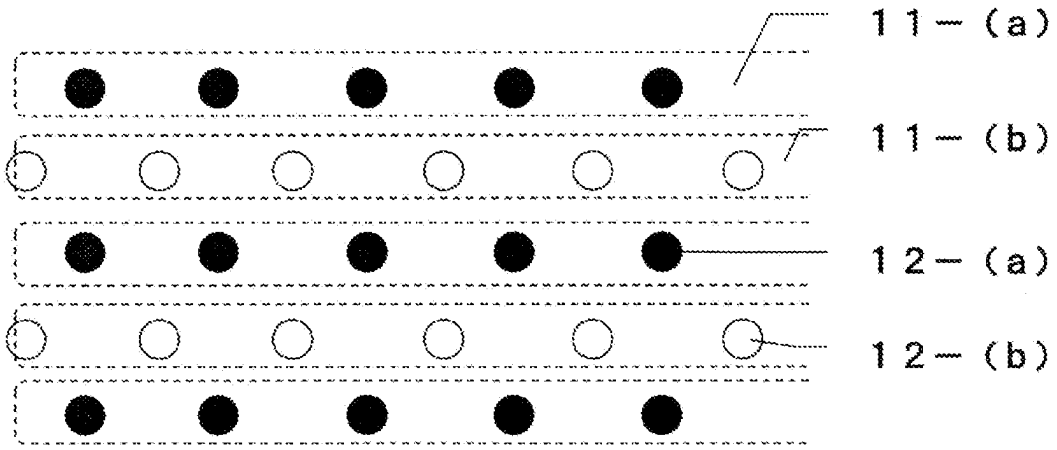

REFERENCES CITED IN THE DESCRIPTION

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