



(11) **EP 3 564 437 A1**

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

(43) Date of publication:
06.11.2019 Bulletin 2019/45

(51) Int Cl.:
D06M 11/00 (2006.01) D06M 101/32 (2006.01)

(21) Application number: **16924995.0**

(86) International application number:
PCT/JP2016/089171

(22) Date of filing: **28.12.2016**

(87) International publication number:
WO 2018/123043 (05.07.2018 Gazette 2018/27)

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

(71) Applicant: **ASAHI KASEI KABUSHIKI KAISHA**
Tokyo 100-0006 (JP)

(72) Inventors:
• **KINOUCHI, Hiroyuki**
Tokyo 101-8101 (JP)
• **DEGUCHI, Junko**
Tokyo 101-8101 (JP)

(74) Representative: **dompatent von Kreisler Selting**
Werner -
Partnerschaft von Patent- und Rechtsanwälten
mbB
Deichmannhaus am Dom
Bahnhofsvorplatz 1
50667 Köln (DE)

(54) **WOUND YARN BODY OF WATER ABSORBENT POLYESTER FIBER AND METHOD FOR MANUFACTURING SAME**

(57) A wound yarn body of a water-absorbent polyester fiber having a water absorbency under JIS L1907: 2010 falling-drop method after being washed 30 times under JIS L0217: 1995 103 C method of 5 seconds or less, the wound yarn body being characterized in that the deposition amount of white powder containing a cyclic oligomer that is the decomposition product of polyester

constituting the water-absorbent polyester fiber is less than 0.3 wt%; and a method for manufacturing the wound yarn body that includes a process for applying alkali reduction to a polyester fiber containing 0.005-1 wt% of an element S at reduction rate of a 0.6-9% against the polyester fiber.

EP 3 564 437 A1

Description

FIELD

[0001] The present invention relates to a wound yarn body of a water absorbent polyester fiber and a method for manufacturing the same. More particularly, the present invention relates to a wound yarn body of a water absorbent polyester fiber capable of rapidly absorbing perspiration when worn as a result of having semi-permanent water absorbency without requiring water absorbency processing and due to superior water absorbency, and can be preferably used in innerwear, sportswear or bedding and the like due to its superior comfort and softness and favorable feel on the skin.

BACKGROUND

[0002] Although synthetic fibers such as polyester or polyamide fibers are used as general-purpose materials in innerwear, sportswear and the like, since these synthetic fibers are hydrophobic fibers, they require water absorbency processing when used in products around the skin and have the problem of decreased absorbency following repeated washing. In particular, in the case of washing at high temperatures in the form of so-called industrial washing that is used to wash uniforms and the like, the loss of water absorbency processing agent is remarkable thereby requiring a need for improvement of washing durability.

[0003] Various studies have been conducted on methods for improving the water absorbency of polyester.

[0004] For example, PTL1 indicated below describes the production of a polyester fiber woven or knitted fabric having water absorbency by carrying out alkaline processing on polyester fiber followed by treating with a treatment solution containing a hydrophilic agent. However, since performance decreases due to repeated washing in the case of ordinary polyester subjected to alkaline processing and water absorbency processing, water absorbency having washing durability cannot be imparted.

[0005] In addition, PTL2 and PTL3 indicated below describe that water absorbency having washing durability can be imparted by carrying out alkaline treatment on a fabric containing polyester fiber containing 0.005% by weight to 0.5% by weight of elemental S in the case of PTL2, or carrying out alkaline treatment on a fabric containing polyester fiber containing 0.5 mol% to 5 mol% of an ester-forming sulfonate compound in the case of PTL3. However, alkaline treatment cannot be carried out on fabric containing a blend of materials not having resistance to alkali, and in the case of blending yarn subjected to water repellency processing, there is the problem of the water repellency decreasing.

[0006] In addition, although PTL4 indicated below describes a method for using a cheese dyeing machine as an alkaline treatment method, when alkaline treatment described in the form of cheese and washing are carried out, the precipitated cyclic oligomer adheres to the inside of the cheese due to filtration phenomenon resulting in the formation of a white powder. When yarn having this white powder adhered thereto is split using a winder for knitting or weaving, the white powder adheres to and accumulates on the guide or tensioner and the like, thereby increasing tension and disrupting the wound form resulting in the occurrence of the problems of increased end height or yarn breakage.

[0007] In addition, since white powder ends up adhering to the yarn guides of knitting machines or weaving machines when yarn having this white powder adhered thereto is used for weaving or knitting, frictional resistance value increases resulting in the problem of the occurrence of fluctuations in tension during knitting. In addition, when this white powder is introduced into a knitting machine and adheres to and accumulates on the knitting needle contacts, the movement of the contacts becomes poor thereby inhibiting the formation of stitches, and when the white powder adheres to and accumulates on needle grooves of the shuttle of the knitting machine, the movement of the knitting needle becomes poor resulting in the occurrence of problems such as needle breakage or pad breakage.

[CITATION LIST]

[PATENT LITERATURE]

[0008]

[PTL1] Japanese Unexamined Patent Publication No. 2005-200799

[PTL2] Japanese Unexamined Patent Publication No. 2014-101598

[PTL3] Japanese Unexamined Patent Publication No. 2014-101599

[PTL4] International Publication No. WO 2015-076412

SUMMARY

[TECHNICAL PROBLEM]

[0009] With the foregoing in view, a problem to be solved by the present invention is to provide a material that demonstrates semi-permanent water absorbency even in the case of not subjecting to water absorbency treatment and is free of resistance to alkali, and a wound yarn body of a water absorbent polyester fiber enabling interknitting of yarn and the like subjected to water repellency processing, and to inhibit the generation of white powder that causes problems in processes using the wound yarn body.

[SOLUTION TO PROBLEM]

[0010] As a result of conducting extensive studies and experimentation to solve the aforementioned problem, the inventors of the present invention found that the aforementioned problem can be solved by preventing re-adherence of a cyclic oligomer that is the origin of a white powder to polyester fiber when alkaline treatment is carried out on a specific polyester fiber by a specific method, thereby leading to completion of the present invention.

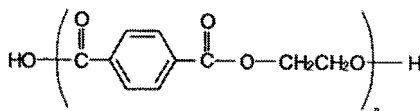
[0011] Namely, the present invention is as indicated below.

[1] A wound yarn body of a water absorbent polyester fiber having water absorbency as determined by the falling-drop method of JIS L1907:2010 after washing 30 times according to Method 103 C of JIS L0217:1995 of 5 seconds or less, wherein the adhered amount of a white powder containing a cyclic oligomer that is a decomposition product of the polyester that composes the water absorbent polyester fiber is less than 0.3% by weight.

[2] The wound yarn body described in [1] above, wherein the water absorbent polyester fiber contains 0.005% by weight to 1% by weight of elemental S and 95 mol% or more of the repeating units of the polyester is ethylene terephthalate.

[3] The wound yarn body described in [1] or [2] above, wherein a terminal carboxylic acid linear oligomer component represented by the following formula (1):

[Chem. 1]



(wherein n is an integer of 3 to 10) is present on the surface of the water absorbent polyester fiber, and among the terminal carboxylic acid linear oligomer components, the terminal carboxylic acid linear oligomer component in which n = 4 is contained in an amount equivalent to the concentration as internal standard of 2 µg/ml to 15 µg/ml.

[4] The wound yarn body described in any of [1] to [3] above, wherein the wound amount of the water absorbent polyester fiber is 0.5 kg to 4 kg per single wound yarn body.

[5] The wound yarn body described in any of [1] to [4] above, wherein the water absorbent polyester fiber is a false twisted yarn.

[6] The wound yarn body described in any of [1] to [5] above, wherein the water absorbent polyester fiber does not have needle loop-shaped crimps.

[7] A method for manufacturing the wound yarn body described in any of [2] to [6] above, including a step for carrying out alkali reduction on the polyester fiber containing 0.005% by weight to 1% by weight of elemental S at a reduction rate of 0.6% to 9% with respect to the polyester fiber.

[8] The method described in [7] above, wherein a chelating agent is used in combination in the step for carrying out alkali reduction and an oligomer dispersant is further used in combination during soaping and neutralization.

[ADVANTAGEOUS EFFECTS OF INVENTION]

[0012] The wound yarn body of a water absorbent polyester fiber of the present invention can be preferably used in innerwear or sportswear and the like since it absorbs water semi-permanently even in the case of not subjecting to water absorbency processing without generating a white powder in the winding and knitting steps of wound yarn, is able to

rapidly absorb perspiration when worn, demonstrates superior comfort and has a favorable soft feel on the skin.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

FIG. 1 is a schematic diagram of a wrap reel used when measuring the adhered amount of a white powder.

FIG. 2 is UV chromatograph (240 nm) obtained during LC/MS measurement.

FIG. 3 is a drawing showing the estimated structures of characteristic peaks in the UV chromatogram of FIG. 2.

DESCRIPTION OF EMBODIMENTS

[0014] The following provides a detailed explanation of embodiments of the present invention.

[0015] The water absorbent polyester fiber composing the wound yarn body of the present embodiment has water absorbency (as determined by JIS L1907:2010) after washing 30 times according to Method 103 C of JIS L0217:1995 of 5 seconds or less when producing a knitted fabric using that fiber and measuring the water absorbency thereof. Water absorbency after washing 30 times is preferably 3 seconds or less, more preferably 2 seconds or less and even more preferably 1 second or less. Water absorbency after washing 15 times according to the same method is preferably 5 seconds or less, more preferably 3 seconds or less, even more preferably 2 seconds or less and particularly preferably 1 second or less. The polyester fiber that composes the wound yarn body of the present embodiment is able to retain water absorbency even after washing in the same manner 50 times or 100 times, and water absorbency after washing 50 times or 100 times is more preferably 5 seconds or less. Ordinary detergents such as neutral detergents or weakly alkaline detergents are preferably used for the detergent when washing.

[0016] In addition, the water absorbent polyester fiber composing the wound yarn body of the present embodiment also has the superior effect of sustaining water absorbency effects even during industrial washing. Industrial washing refers to washing under severe conditions using a home washing machine that is applied to the laundering of work clothes or uniforms and the like, an example of a method thereof is defined by the F-2 medium temperature washer method of JIS L1096:2010 8.39.5b) 2.2.2), and an additive such as hydrogen peroxide or sodium silicate is normally added in addition to the detergent component. A fabric of the present embodiment preferably has water absorbency of 5 seconds or less after washing 30 times for 30 minutes at 60°C in accordance with the F-2 method of JIS L1096:2010.

[0017] In the wound yarn body of the present embodiment, the adhered amount of white powder is measured using the wrap reel shown in FIG. 1 (Model SSD-3, Daiei Kagaku Seiki Mfg. Co., Ltd.). White powder adhered to the fiber surface can be collected by rubbing the yarn surface with a tensioner for applying tension when winding with the wrap reel. According to this method, although the adhered white powder cannot be completely collected from the yarn surface, whether or not there is a problem with the level at which the white powder is collected can be judged in terms of practical use.

[0018] In providing an explanation with reference to FIG. 1, yarn 2 that is drawn out from a wound yarn body 1 is wound with a bobbin frame 6 (bobbin frame circumference: 1.0 m) after passing through a snail guide 3 (Model A408067-R, Yuasa Yarn Guide Engineering Co., Ltd.), ring tensioner 4 (Model HRB6-12 Toyo Machine Works Co., Ltd.) and traverse guide 5 (Model A408132-R, Yuasa Yarn Guide Engineering Co., Ltd.) in that order.

[0019] The height from the floor on which the wound yarn body 1 is placed to the snail guide 3 was set at 800 mm, and the wound yarn body 1 was placed so that a vertical line extending from the center of the yarn guide hole of the snail guide 3 overlaps with the central axis of the wound yarn body 1. The height from the snail guide 3 to the yarn inlet hole of the ring tensioner 4 was set at 400 mm and the angle of the yarn 2 entering the yarn inlet hole of the ring tensioner 4 from the snail guide 3 was set at 90 degrees. The load applied with the ring tensioner 4 used a total of 6 rings weighing 1.2 g each. The location of the traverse guide 5 was a location at a horizontal distance from the yarn outlet hole of the ring tensioner 4 of 250 mm and 50 mm lower than the height of the yarn outlet hole of the ring tensioner 4. The location of the bobbin frame 6 was such that the height of the yarn guide hole of the traverse guide 5 and the center of the axis of rotation of the bobbin frame 6 are equal, and the distance from the traverse guide 5 to the center of the axis of rotation of the bobbin frame 6 was 533 mm. The oscillating width of the traverse guide 5 was set to 50 mm, traverse speed was 120 mm/min, winding speed was 120 m/min, and approximately 1000 m of yarn were wound onto the bobbin frame 6.

[0020] Although white powder adheres to the snail guide 3, the ring tensioner 4 and the traverse guide 5 when winding the yarn, since it is difficult to completely recover white powder from all of these components and since the adhered white powder ends up being dispersed in the surrounding area due to friction with the yarn, the amount of white powder adhered to the yarn was calculated based on the change in weight of the wound yarn using the following equation:

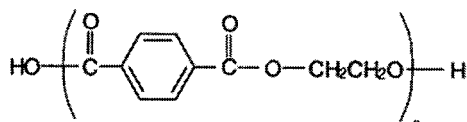
$$\text{Adhered amount of white powder (wt\%)} = (A - B - C)/C \times 100$$

(wherein A: weight (g) prior to rewinding onto the wound yarn body, B: weight (g) after rewinding onto the wound yarn body, and C: weight (g) of the rewound yarn).

[0021] The adhered amount of white powder is less than 0.3% by weight, preferably less than 0.2% by weight, and more preferably less than 0.1% by weight. If the adhered amount of white powder exceeds 0.3% by weight, unwinding becomes poor, adhesion of white powder to a knitting machine, weaving machine, winder or other guide or yarn path becomes severe, or the accumulation of white powder causes tension abnormalities and process problems.

[0022] The polyester fiber composing the wound yarn body of the present embodiment is characterized by the presence of a linear oligomer component having a carboxyl group on the terminal thereof (to also be referred to as a "terminal carboxylic acid linear oligomer component" in the present description) on the fiber surface. Moisture absorbency demonstrates repeated washing durability due to the presence of the terminal carboxylic acid linear oligomer component on the fiber surface. Here, an example of a terminal carboxylic acid linear oligomer component is represented by the following formula (1):

[Chem. 2]



(wherein $n = 3$ to 10).

[0023] A wound yarn body of a polyester fiber in which a terminal carboxylic acid linear oligomer component is present in this manner has superior water absorption performance.

[0024] The presence of the oligomer component can be confirmed by qualifying or quantifying according to the analytical methods described below.

[0025] Among these terminal carboxylic acid linear oligomer components, comparatively low molecular weight oligomer components can be analyzed by LC-MS (liquid chromatograph-mass spectrometry) by dissolving in THF. When a typical component is taken to be that in which $n = 4$, then the oligomer component in which $n=4$ present on the fiber surface can be measured according to the method indicated below.

[0026] A sample in the form of 100 mg of polyester yarn extracted from a wound yarn body was placed in a glass sample bottle having a volume of 20 mL (As One Laboran Pack Screw Tube Bottle 9-852-07 No. 5) followed by the addition of 3 mL of THF. After stirring for 6 hours at a rotating speed of about 800 rpm using a Yamato Magnetic Stirrer Model M-41, the sample was allowed to stand undisturbed for 4 days followed by extracting the sample by carrying out LC/MS on the THF solution and analyzing the components. When sampling the THF solution, 0.495 mL of solution were sampled while preventing the entrance of solids followed by the addition of 0.005 mL of internal standard in the form of methyl benzoate (1 mg/ml) for use as sample. The conditions of LC/MS analysis are shown in Table 1.

[Table 1]

5	LC	Apparatus	Waters, UPLC		
		Column	Imtakt, Cadenza CD-C18 (2 mm I.D. × 30 mm)		
		Column temperature	40°C		
		Detection	PDA 210-400 nm		
		Flow rate	0.2 mL/min		
		Mobile phase	A = water		
	10	Gradient	B = acetonitrile/THF (20/80)		
			Time (min)	A%	B%
			0	90	10
			10	0	100
			10.1	90	10
			20	90	10
15	MS	Injection volume	2 µL		
		Apparatus	Waters, Synapt G2		
		Ionization	ESI+, ESI-		
		Scan range	m/z 50-2000		

[0027] FIG. 2 indicates an example of the chart of a UV chromatogram (240 nm) of the THF solution. In addition, FIG. 3 indicates the estimated structures of characteristic peaks in the UV chromatogram of FIG. 2. In FIG. 2, a large number of the aforementioned terminal carboxylic acid linear oligomer components and cyclic oligomer components to be subsequently described were detected. Peak x in FIG. 2 is a peak derived from a linear oligomer component of a terminal carboxylic acid in which $n = 3$ (molecular weight: 786.24) shown in formula (1). This is estimated based on the detection of ions ($[M-H]^-$) having a mass number (m/z) of 785.17 in the ESI-mass spectrum of that peak (electrospray ionization, negative ion mass spectrum). Components derived from other peaks were estimated from the mass numbers of ions detected according to the ESI-mass spectra thereof in the same manner.

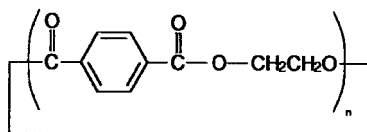
[0028] In the UV chromatogram, in cases in which a peak derived from the aforementioned terminal carboxylic acid linear oligomer component was not well-defined, the mass spectrogram of a mass number of 785 (vertical axis: detection intensity of specific mass number, horizontal axis: retention time) is displayed, and whether or not the oligomer was present was able to be determined according to whether or not a detection intensity peak of the mass number in the vicinity of the retention time estimated from the example of the UV spectrum (approx. 4.5 min. in FIG. 2) was present.

[0029] In formula (1), the amount of the terminal carboxylic acid linear oligomer in which $n = 3$ can be measured with the value of the peak area in the UV chromatogram, and that value can be converted to a concentration based on the ratio with the value of the peak area in the UV chromatogram of methyl benzoate added as internal standard. The location of peak c corresponding to the internal standard substance is estimated by detecting the ion of that mass number in an ESI-mass spectrum of that peak. In the case peak x in the UV chromatogram is not well-defined for reasons such as overlapping with other peaks, the area of peak z of the sample in question can be converted to the area of peak x by using the area of peak z in the mass chromatogram having a mass number of 785 as previously described and determining the intensity ratio between x and z by measuring a different sample in which both peak x and peak z are clearly detected under the same conditions. The intensity ratio with peak c can then be calculated by using the area of peak x of the sample in question determined in this manner.

[0030] The wound yarn body of the present embodiment is such that the amount of the terminal carboxylic acid linear oligomer in which $n=4$ shown in formula (1) is preferably equivalent to a concentration of 2 µg/ml to 15 µg/ml converted from the internal standard, and is more preferably equivalent to a concentration of 3 µg/ml to 10 µg/ml.

[0031] Although the terminal carboxylic acid oligomer contributes to water absorbency in this manner, a cyclic oligomer represented by, for example, the following formula (2):

[Chem. 3]



(wherein $n = 2$ to 10) does not exhibit water absorbency and conversely inhibits water absorbency. The amount of the cyclic oligomer represented by formula (2) can also be analyzed by LC-MS (liquid chromatography-mass spectroscopy) by dissolving in THF with respect to cyclic oligomers having a comparatively low molecular weight, and the concentration thereof as converted from the internal standard can be determined from the peak intensity ratio relative to the internal standard. When a typical component thereof is taken to be that in which $n = 3$, the amount of cyclic oligomer in which $n = 3$ is preferably equivalent to a concentration converted from the internal standard of $80 \mu\text{g/ml}$ or less and more preferably equivalent to $70 \mu\text{g/ml}$ or less.

[0032] More specifically, in the example of the chart of a UV chromatogram (240 nm) shown in FIG. 2, peak b is a peak of a cyclic oligomer component in which $n = 3$ shown in formula (2). Peak b can be confirmed to be derived the cyclic oligomer component (molecular weight: 576.13) as a result of an ion $[(M+\text{NH}_4)]^+$ having a mass number of 594.16 being detected in the ESI-mass spectrum of that peak (electrospray ionization, positive ion mass spectrum). In cases in which a peak derived from the aforementioned oligomer cannot be clearly defined in the UV chromatogram, the mass spectrogram of a mass number of 594.16 is displayed in the same manner as a terminal carboxylic acid linear oligomer in which $n = 4$, and whether or not the oligomer is present is able to be determined according to whether or not a detection intensity peak (peak w) of the mass number in the vicinity of the retention time estimated from the example of the UV spectrum (approx. 5.3 min. in FIG. 2) is present. The amount of this oligomer present can be measured with the value of the peak area in the UV chromatogram, and that value can be converted to a concentration based on the ratio with the value of the peak area of peak (peak c) in the UV chromatogram of the methyl benzoate added as internal standard.

[0033] Among terminal carboxylic acid linear oligomer components, comparatively high molecular weight oligomer components cannot be detected using the previously described method due to their poor solubility in THF. The wound yarn body of the present embodiment preferably retains a comparatively high molecular weight terminal carboxylic acid linear oligomer that is not extracted with THF on the surface of the polyester fiber composing the wound yarn body even after having extracted the aforementioned oligomer components that are soluble in THF. Since this terminal carboxylic acid linear oligomer demonstrates high adhesiveness with fiber and is resistance to elimination even after repeated washing, it is thought to demonstrate considerable effectiveness due to its water absorbency after repeated washing.

[0034] The wound yarn body of the present embodiment demonstrates water absorbency due to the presence of terminal carboxylic acid linear oligomers in which $n = 3$ to 10 in formula (1) that are soluble and insoluble in THF. There are no particular limitations on the method used to make these oligomers present, and although they may be imparted by a method such as coating a terminal carboxylic acid linear oligomer component on a fabric or mixed into an ester polymer, they are preferably imparted to the vicinity of the fiber surface by subjecting a specific polyester fiber to a specific alkali treatment.

[0035] The wound yarn body of the present embodiment is preferably characterized by containing polyester fiber containing 0.005% by weight to 1% by weight of elemental S (elemental sulfur). A water absorbency effect is obtained by carrying out a specific alkali treatment on polyester fiber containing 0.005% by weight to 1% by weight of elemental S, resulting in a line of yarn that exhibits hardly any change in that effect even after repeated washing. In the case the content of elemental S is less than 0.005% by weight, the effect of enhancing the durability of water absorbency after alkali treatment diminishes, while in the case the amount of elemental S contained in the polyester fiber is 1% by weight or more, fiber strength decreases making spinning difficult. The content of elemental S in the polyester fiber is more preferably 0.01% by weight to 0.8% by weight and even more preferably 0.015% by weight to 0.7% by weight. Furthermore, ICP-AES (inductively coupled plasma-optical emission spectrometry) is used as a method for quantifying elemental S. An example of a polyester fiber containing 0.005% by weight to 1% by weight of elemental S is a polyester fiber containing $0.5 \text{ mol}\%$ to $5 \text{ mol}\%$ of an ester-forming sulfonate compound.

[0036] Examples of ester-forming sulfonate compounds contained at $0.5 \text{ mol}\%$ to $5 \text{ mol}\%$ in a polyester fiber include sodium 5-sulfoisophthalate, potassium 5-sulfoisophthalate, sodium 4-sulfo-2,6-naphthalene dicarboxylic acid, sodium 2-sulfo-4-hydroxybenzoic acid, 3,5-dicarboxylic acid benzenesulfonic acid tetramethyl phosphonium salt, 3,5-dicarboxylic acid benzenesulfonic acid tetrabutyl phosphonium salt, 3,5-dicarboxylic acid benzenesulfonic acid tributylmethyl phosphonium salt, 2,6-dicarboxylic acid naphthalene-4-sulfonic acid tetrabutyl phosphonium salt, 2,6-dicarboxylic acid naphthalene-4-sulfonic acid tetramethyl phosphonium salt, 3,5-dicarboxylic acid benzenesulfonic acid ammonium salt

and ester derivatives such as methyl esters or dimethyl esters thereof. These ester derivatives such as methyl esters or dimethyl esters are used preferably from the viewpoints of obtaining superior polymer whiteness and polymerization rate. The polyester fiber preferably contains a metal sulfonate group-containing isophthalic acid component such as sodium 5-sulfoisophthalic acid or potassium 5-sulfoisophthalic acid, and among these, sodium dimethyl 5-sulfoisophthalate is particularly preferable.

[0037] In addition, another example of polyester fiber containing 0.005% by weight to 1% by weight of elemental S is polyester fiber containing a non-ester-forming sulfonate compound. A non-ester-forming sulfonate compound refers to a polyester fiber containing a sulfonate compound without forming a polyester as a result of a sulfonate compound undergoing polycondensation by undergoing a direct esterification reaction with polyester, and examples thereof include polyester fiber obtained by a method consisting of mixing a master chip incorporating 0.5 mol% to 5 mol% of a sulfonate compound with a polyester chip in which an ordinary ethylene terephthalate component is 95 mol% or more, and polyester fiber obtained by adding 0.5 mol% to 5 mol% of a sulfonate compound.

[0038] Examples of a non-ester-forming sulfonate compound include alkaline metal salts of an alkyl sulfonic acid, and alkaline metal salts of an alkyl benzenesulfonic acid. Examples of alkaline metal salts of an alkyl sulfonic acid include sodium dodecyl sulfonate, sodium undecyl sulfonate and sodium tetradecyl sulfonate. In addition, examples of alkaline metal salts of an alkyl benzenesulfonic acid include sodium dodecyl benzenesulfonate, sodium undecyl benzenesulfonate and sodium tetradecyl benzenesulfonate. Sodium dodecyl benzenesulfonate is particularly preferable from the viewpoint of processing stability.

[0039] The total fineness of the water absorbent polyester fiber is preferably about 8 decitex (dtex) to about 167 dtex and more preferably about 22 dtex to about 110 dtex. Although there are no particular limitations on single yarn fineness, it is preferably about 0.5 dtex to about 2.5 dtex from the viewpoints of feel on the skin and texture.

[0040] The water absorbent polyester fiber may also contain a matting agent such as titanium dioxide, stabilizer such as phosphoric acid, ultraviolet absorber such as a hydroxybenzophenone derivative, crystallization nucleating agent such as talc, lubricant such as fumed silica, antioxidant such as a hindered phenol derivative, flame retardant, antistatic agent, pigment, fluorescent whitening agent, infrared absorber or antifoaming agent.

[0041] The water absorbent polyester fiber is preferably a false twisted yarn. Crimping of the false twisted yarn is preferably such that the crimp elongation rate is 30% to 150%. Furthermore, crimp elongation rate is measured under the conditions indicated below.

[0042] Length (A) is measured after 30 seconds by immobilizing the upper end of the crimped yarn and applying a load of 1.77×10^{-3} cN/dtex to the lower end. Next, the load of 1.77×10^{-3} cN/dtex is removed, a load of 0.088 cN/dtex is applied and length (B) is measured after 30 seconds followed by determining crimp elongation rate according to equation (3) indicated below.

$$\text{Crimp elongation rate (\%)} = [(B-A)/A] \times 100 \quad (3)$$

[0043] The wound yarn body of the present embodiment is preferably obtained by subjecting the water absorbent polyester fiber to alkali treatment while in the state of a wound yarn body. In addition, alkali treatment can be carried out using a cheese dyeing machine.

[0044] In the case of alkali treatment with a cheese dyeing machine, there is susceptibility to the occurrence of winding collapse in the case of winding crimp-less yarn around the cheese dyeing tube, and as a result of the occurrence of tightening attributable to heat shrinkage, liquid passage becomes poor and there is the risk of unevenness occurring in the reduction rate, thereby making this undesirable.

[0045] The wound yarn body of the present embodiment can be manufactured by a method that includes a step for carrying out alkali treatment on a polyester fiber containing 0.005% by weight to 1% by weight of elemental S at a reduction rate of 0.6% to 9% relative to the polyester fiber. In addition, a chelating agent is preferably used in combination in the step for carrying out alkali treatment, and an oligomer dispersant is further preferably used in combination during soaping and neutralization.

[0046] A linear oligomer can be formed when a polymer on the surface of the polyester fiber is subjected to alkali treatment (hydrolysis). Without being bound by a specific theory, it is presumed that a linear oligomer is formed by hydrolysis of a polymer on the surface of the polyester fiber on the fiber surface (while adhered to the fiber surface) without the immediate generation of a white powder component in the form of a cyclic oligomer due to alkali treatment (hydrolysis), and that the linear oligomer is converted to the cyclic oligomer by a dehydration-condensation reaction after being eliminated from the fiber surface. The cyclic oligomer observed on the fiber surface basically re-adheres to the fiber surface. When the cyclic oligomer is dissolved in a high-temperature aqueous alkaline solution, chelation is thought to occur to the effect of metal ions, and a chelating agent is used in combination during alkali reduction to prevent this. Despite this, cyclic oligomer present in the aqueous alkaline solution that remains by adhering to the fiber precipitates

as a result of having been lowered in temperature due to rinsing with normal temperature water during soaping, washing and neutralization, and ends up adhering to the fiber surface. Consequently, the combined use of an oligomer dispersant during soaping and neutralization removes the adhered oligomer.

[Reduction Rate]

[0047] The reduction rate of the polyester fiber as a condition of alkali treatment for demonstrating water absorbency is preferably 0.6% to 9%, more preferably 1% to 8%, and even more preferably 1.5% to 7%. Reduction rate can be calculated from the weight of the polyester fiber before and after alkali treatment. In the case the reduction rate is less than 0.6%, water absorbency attributable to alkali treatment is not demonstrated thereby making this undesirable, while if the reduction rate exceeds 9%, alkali reduction proceeds excessively resulting in inferior durability of water absorbency, thereby making this undesirable.

[0048] Polyester fiber containing 0.5 mol% to 5 mol% of an ester-forming sulfonate compound has a faster rate of alkali reduction in comparison with ordinary polyester fiber, thereby making this preferable since it is possible carry out treatment by adjusting the alkali to a lower concentration.

[Alkali Treatment Method]

[0049] A method consisting of forming a fabric by using a portion of a polyester fiber, obtained by carrying out alkali treatment by a method such as using a cheese dyeing machine so as to impart a reduction rate of 0.6% to 9% while in the state of a polyester fiber containing 0.005% by weight to 1% by weight of elemental S, is preferably used as an alkali treatment method.

[0050] In the case of carrying out alkali treatment using a cheese dyeing machine, it is necessary to wind the polyester fiber around the perforated tube used for cheese dyeing.

[0051] At that time, the wound amount of the polyester fiber containing 0.005% by weight to 1% by weight of elemental S is preferably 0.5 kg to 4 kg, more preferably 1 kg to 3.5 kg and even more preferably 2 kg to 3 kg. If the wound amount is less than 0.5 kg, productivity is inferior, thereby making this undesirable. If the wound amount exceeds 4 kg, liquid passage through the cheese dyeing machine becomes poor when carrying out alkali treatment, and in addition to increased susceptibility to variations, winding diameter also increases, thereby resulting in poor handling.

[Winding Density]

[0052] The winding density of the polyester fiber containing 0.005% by weight to 1% by weight of elemental S is preferably more than 0.1 g/cm³ to less than 1.2 g/cm³, more preferably more than 0.2 g/cm³ to less than 1.0 g/cm³, even more preferably more than 0.3 g/cm³ to less than 0.8 g/cm³, and particularly preferably more than 0.4 g/cm³ to less than 0.6 g/cm³. If winding density is 0.1 g/cm³ or less, the wound state collapses during alkali treatment with a cheese dyeing machine and defective unwinding occurs during knitting. In addition, if winding density is 1.2 g/cm³ or more, liquid passage during alkali treatment becomes poor thereby preventing uniform treatment and unevenness in water absorbency.

[Knit-Deknit]

[0053] Although knit-deknitting is an example of a technique consisting of first knitting a polyester containing 0.005% by weight to 1% by weight of elemental S into a knitted fabric by using knit-deknitting and subjecting to alkali treatment followed by rearranging to obtain a wound yarn body, crimps in the form of knit loops end up being imparted to the polyester fiber. Knit loops referred to here refer to crimps in the form of loops formed in the yarn when rearranging the knitted fabric after having immobilized stitches formed during knitting by heat treatment, and result in a peculiar texture when using this yarn to form a knitted fabric or woven fabric, thereby making this not very desirable.

[Hank Treatment]

[0054] Although an example of hank treatment is a technique consisting of forming the polyester fiber containing 0.005% by weight to 1% by weight of elemental S into a hank and subjecting to alkali treatment with a jet dyeing machine and the like followed by rewinding with a winder to obtain a wound yarn body, not only does this technique require labor and high costs in the hanking step and rewind step, but since the hanks also contain alkali treatment solution, crimps of the false twisted yarn end up stretching due to their own weight, thereby making this undesirable.

[Alkali Reduction Conditions]

[0055] Since unevenness occurs between the inner and outer layers in the case of carrying out alkali treatment with a cheese dyeing machine, long-term treatment at a low temperature is preferable, and in order to achieve a reduction rate of 0.6% to 9%, it is preferable to carry out treatment, for example, for 40 minutes to 100 minutes at a temperature of 90°C to 100°C and sodium hydroxide concentration of 0.1 g/L to 10 g/L, and more preferably for 50 minutes to 80 minutes at a temperature of 90°C to 95°C at a sodium hydroxide concentration of 5 g/L to 10 g/L.

[0056] Although neutralization with acid and washing are normally carried out following alkali treatment, in the case of alkali treatment with a cheese dyeing machine, the precipitated cyclic oligomer adheres to the inside of the cheese resulting in increased susceptibility to the occurrence of the problem of unwinding becoming poor when knitting or weaving using the wound yarn body as well as the problem of the cyclic oligomer adhering to the knitting machine, weaving machine, yarn path or guides in the form of a white powder. In order to solve these problems, it is necessary to not allow the oligomer causing the generation of the white powder to precipitate, not allow the white powder to adhere to the polyester fiber surface, and remove as much of the white powder as possible by enhancing washing following alkali treatment.

[0057] As was previously described, a cyclic oligomer in the form of a white powder is generated when the polyester fiber is hydrolyzed by alkali treatment. The cyclic oligomer is susceptible to the effects of metal ions present in the washing solution during alkali treatment, and since it more easily adheres to the fiber surface as a result of chelation, it is preferable to add a chelating agent. Although the chelating agent is not specified, examples of chelating agents include polycarboxylic acid, nitrotriacetic acid (NTA), ethylene diamine tetraacetic acid (EDTA), nitrilotrimethylene phosphonic acid, hydroxyethylidene diphosphonic acid (NTMP), phosphonic acid, glutamine diacetate, glutamic acid diacetic acid and salts thereof. The chelating agent is preferably added at 0.5 g/L to 2.0 g/L in an aqueous solution during alkali treatment.

[0058] Although cyclic oligomer present in an aqueous alkaline solution dissolves in the case of a high temperature, it precipitates in the case the solution temperature is lower than 90°C. On the basis thereof, precipitation and adhesion of the cyclic oligomer can be inhibited by draining the solution at a high temperature of 90°C to 95°C following alkali treatment.

[Soaping]

[0059] Since the alkaline solution remains in the wound yarn body after draining, it is necessary to carry out washing. Washing is preferably carried out by injecting water into the cheese dyeing machine following drainage, adding oligomer dispersant in the form of sodium hydrosulfite at 0.5 g/L to 2.0 g/L, and washing for 10 minutes at 80°C followed by washing at normal temperature after having washed twice for 10 minutes with warm water at 40°C to 60°C.

[0060] Although there are no particular limitations on the oligomer dispersant used, components such as amino-based ionic compounds, alkylene oxide adducts of fatty acids, polycyclic nonionic compounds, alkyl sulfonates, polyvalent alcohol fatty acid esters, alkylene oxide adducts of polyvalent alcohol fatty acids, aromatic polyester resins, carboxylates or polyaminocarboxylic acids can be used alone or in combination. An amphoteric surfactant is preferably used to prevent adhesion of oligomer and remove adhered oligomer. The oligomer dispersant is preferably added at 0.5 g/L to 3.0 g/L during soaping. If added at less than 0.5 g/L, the effects of preventing adhesion of oligomer and removal of oligomer become inferior and the adhered amount of white powder cannot be reduced. In addition, if the added amount of oligomer dispersant exceeds 3.0 g/L, although the adhered amount of white powder can be reduced, linear oligomer contributing to water absorbency also ends up being removed from the fiber surface, thereby resulting in poor water absorbency.

[Neutralization]

[0061] Oxalic acid or acetic acid is preferably used for the acid used in neutralization. Oligomer precipitation and adhesion can be inhibited when the treatment solution has become acidic by combining the use of an oligomer dispersant at that time.

[0062] Although there are no particular limitations on the oligomer dispersant used during neutralization, an amphoteric surfactant is used preferably since adhesion of oligomer is prevented under alkaline or acidic conditions.

[Cheese Dyeing]

[0063] The wound yarn body of the present embodiment may be dyed. In the case of using in the form of dyed yarn, cheese dyeing may be carried out directly after having carried out alkali treatment with a cheese dyeing machine.

[Finishing Agent]

[0064] Although softening treatment for softening texture or oiling treatment for improving yarn unwinding and knitting organization may be carried out in the bath, it is not preferable to use that which impairs water absorbency such as a cationic softening agent or silicon oil.

[Rewinding]

[0065] In addition, the wound yarn body of the present embodiment may be rewound with a winder after having undergone alkali treatment with a cheese dyeing machine to obtain a wound yarn body.

EXAMPLES

[0066] The following provides a detailed explanation of the present invention using examples thereof. The present invention is naturally not limited to these examples.

[0067] Furthermore, wound yarn bodies obtained in the examples were evaluated using the methods indicated below.

(1) Adhered Amount of White Powder

[0068] The previously described method was used to evaluate the adhered amount of white powder.

(2) Quantification of Terminal Carboxylic Acid Linear Oligomer in which $n=4$

[0069] The previously described method was used for evaluation.

(3) Water Absorbency

[0070] Yarn was drawn out from the wound yarn body, a tubular knitted fabric was fabricated and the resulting tubular knitted fabric was scoured and dried in accordance with ordinary methods followed by measuring water absorbency of the resulting tubular knitted fabric using the falling-drop method of JIS L1907:2010 after washing 30 times according to Method 103 C of JIS L0217:1995. In the present description, the resulting water absorbency was taken to be the water absorbency of the "water absorbent polyester fiber".

(4) Washing Treatment

[0071] Yarn was drawn out from the wound yarn body, a tubular knitted fabric was fabricated and the resulting tubular knitted fabric was scoured and dried in accordance with ordinary methods followed carrying out washing treatment using a weakly alkaline detergent (trade name: Attack, Kao Corp.) in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995.

(5) Industrial Washing Treatment

[0072] Yarn was drawn out from the wound yarn body, a tubular knitted fabric was fabricated and the resulting tubular knitted fabric was scoured and dried in accordance with ordinary methods followed by carrying out washing treatment on the resulting tubular knitted fabric using 0.8% owf soap, 0.8% hydrogen peroxide and 0.8% sodium silicate as detergent under conditions of the F-2 medium temperature washer method of JIS L1096:2010 8.39.5b) 2.2.2) on the assumption of an industrial washing test.

(6) Presence of Absence of Knit Loops

[0073] Yarn was drawn out from the wound yarn body and the state of the yarn was observed in the state of not applying a load. The presence of loop-shaped crimps originating in the knitted fabric was confirmed at that time.

[EXAMPLE 1]

[0074] 84 dtex/36 f polyester false twisted yarn having a round cross-section (elemental S content: 0.14% by weight) and containing 2 mol% sodium dimethyl 5-sulfoisophthalate was wound around a perforated tube for cheese dyeing at a winding density of 0.5 g/cm³ and wound amount of 3.0 kg.

[0075] The tube wound with the yarn was placed in a cheese dyeing machine and subjected to alkali treatment for 60 minutes at a liquid temperature of 95°C with an aqueous alkaline solution using 10 g/L of sodium hydroxide and 2 g/L of chelating agent in the form of Marpon A-47 (Matsumoto Yushi-Seiyaku Co., Ltd.) while raising the temperature of the aqueous alkaline solution under conditions of 2°C/min.

[0076] After draining immediately after alkali treatment at a liquid temperature of 95°C, water was injected and soaping was carried out for 15 minutes at a liquid temperature of 80°C using 1 g/L of sodium hydrosulfite and 2 g/L of oligomer dispersant in the form of Mahon PS-K7 (Matsumoto Yushi-Seiyaku Co., Ltd. incorporating amphoteric surfactant) followed by draining and washing twice with hot water for 3 minute at a water temperature of 60°C.

[0077] After washing with hot water, draining and re-supplying with water, neutralization was carried out using acetic acid after using 1 g/L of oligomer dispersant in the form of Mahon PS-K7 followed by washing.

[0078] After draining, the tube wound with the yarn was removed from the cheese dyeing machine and dehydrated with a centrifugal dehydrator followed by drying with a cheese dryer to obtain a wound yarn body.

[0079] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was less than 1 second, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 2 seconds. The adhered amount of white powder was 0.10% by weight.

[EXAMPLE 2]

[0080] A wound yarn body was obtained by carrying out treatment using the same method as Example 1 with the exception of using 1 g/L of a chelating agent in the form of Marpon A-47 during alkali treatment, using 1 g/L of an oligomer dispersant in the form of Marpon PS-K7 during soaping, and using 0.5 g/L of an oligomer dispersant in the form of Marpon PS-K7 during neutralization. The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was less than 1 second, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 2 seconds. The adhered amount of white powder was 0.23% by weight.

[EXAMPLE 3]

[0081] A wound yarn body was obtained by carrying out treatment using the same method as Example 1 with the exception of using 2 g/L of oligomer dispersant in the form of Marpon PS-K7 during neutralization.

[0082] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was 4 seconds, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 15 seconds. The adhered amount of white powder was 0.05% by weight.

[COMPARATIVE EXAMPLE 1]

[0083] 84 dtex/36 f polyester false twisted yarn having a round cross-section (elemental S content: 0.14% by weight) and containing 2 mol% sodium dimethyl 5-sulfoisophthalate was wound around a perforated tube for cheese dyeing at a winding density of 0.5 g/cm³ and wound amount of 3.0 kg.

[0084] Alkali treatment was carried out for 60 minutes at a liquid temperature of 95°C with an aqueous alkaline solution using 10 g/L of sodium hydroxide while raising the temperature of the aqueous alkaline solution under conditions of 2°C/min.

[0085] After draining immediately after alkali treatment at a liquid temperature of 95°C, soaping was carried out for 15 minutes at a liquid temperature of 80°C followed by draining and washing twice with hot water for 3 minute at a water temperature of 60°C.

[0086] After washing with hot water, draining and re-supplying with water, neutralization was carried out using acetic acid followed by washing.

[0087] After draining, the tube wound with the yarn was removed from the cheese dyeing machine and dehydrated with a centrifugal dehydrator followed by drying with a cheese dryer to obtain a wound yarn body.

[0088] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was 15 seconds, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 15 seconds. The adhered amount of white powder was 0.73% by weight.

[COMPARATIVE EXAMPLE 2]

[0089] A wound yarn body was obtained by carrying out treatment using the same method as Comparative Example 1 with the exception of using 2 g/L of oligomer dispersant in the form of Marpon A-47 during soaping.

[0090] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was less than 1 second, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 2 seconds. The adhered amount of white powder was 0.64% by weight.

[COMPARATIVE EXAMPLE 3]

[0091] A wound yarn body was obtained by carrying out treatment using the same method as Comparative Example 1 with the exception of using 2 g/L of oligomer dispersant in the form of Marpon A-47 during soaping and using 1 g/L of oligomer dispersant in the form of Marpon PS-K7 during neutralization.

[0092] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was less than 1 second, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 2 seconds. The adhered amount of white powder was 0.52% by weight.

[COMPARATIVE EXAMPLE 4]

[0093] A wound yarn body was obtained by carrying out treatment using the same method as Comparative Example 1 with the exception of using 2 g/L of oligomer dispersant in the form of Marpon A-47 during alkali treatment.

[0094] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was less than 1 second, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 2 seconds. The adhered amount of white powder was 0.47% by weight.

[COMPARATIVE EXAMPLE 5]

[0095] A wound yarn body was obtained by carrying out treatment using the same method as Example 1 with the exception of setting the draining temperature following alkali reduction to 70°C.

[0096] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was 6 seconds, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 13 seconds. The adhered amount of white powder was 0.82% by weight.

[COMPARATIVE EXAMPLE 6]

[0097] A wound yarn body was obtained by carrying out treatment using the same method as Example 1 with the exception of using 6 g/L of oligomer dispersant in the form of Marpon PS-K7 during neutralization.

[0098] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was 7 seconds, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 15 seconds. The adhered amount of white powder was 0.03% by weight.

[COMPARATIVE EXAMPLE 7]

[0099] A wound yarn body was obtained by carrying out treatment using the same method as Example 1 with the exception of using 6 g/L of oligomer dispersant in the form of Marpon PS-K7 during soaping.

[0100] The reduction rate of the water absorbent polyester yarn of the resulting wound yarn body was 6.0%, water absorbency after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was 8 seconds, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 15 seconds. The adhered amount of white powder was 0.03% by weight.

[COMPARATIVE EXAMPLE 8]

[0101] A wound yarn body was obtained by carrying out treatment using the same method as Example 1 with the

exception of using 84 dtex/36 f polyester false twisted yarn having a round cross-section and composed of regular polyester not containing sulfonic acid.

[0102] Water absorbency of the water absorbent polyester fiber of the resulting wound yarn body after washing 30 times in accordance with Method 103 C of Attached Table 1 of JIS L0217:1995 was 180 seconds or more, and water absorbency after washing 30 times in accordance with the F-2 medium temperature washer method of JIS L1096:2010 was 180 seconds or more. The adhered amount of white powder was 0.02% by weight.

[0103] The manufacturing conditions, properties and other data relating to the polyester wound yarn bodies obtained in the aforementioned Examples 1 to 3 and Comparative Examples 1 to 8 are summarized in the following Table 2.

[Table 2]

	Elemental S content	Wind- ing density	Wound amount	Alkali reduction					Drain- ing	Soaping			Neutraliza- tion	Water absorb- ency		Ad- hered amount of white powder	Concentra- tion of ter- minal car- boxylic acid linear oli- gomer (n=4) con- verted from internal standard	Pres- ence of knit loops?
				NaOH con- centration	Chelating agent con- centration	Temp	Time	Reduc- tion rate		Temp	Oligomer dispersant concentra- tion	Temp		After wash- ing 30 times	After in- dustrial wash- ing 30 times			
	wt%	g/cm ³	kg	g/L	g/L	°C	Min	%	°C	g/L	g/L	°C	g/L	Sec	Sec	wt%		
Ex.1	0.14	0.5	3.0	10	2	95	60	6	95	2	2	80	1	<1	2	0.10	4.1	No
Ex.2	0.14	0.5	3.0	10	1	95	60	6	95	1	1	80	0.5	<1	2	0.23	4.3	No
Ex.3	0.14	0.5	3.0	10	2	95	60	6	95	2	2	80	2	4	4	0.05	3.1	No
Comp . Ex.1	0.14	0.5	3.0	10	Absent	95	60	6	95	Absent	Absent	80	Absent	2	4	0.73	6.0	No
Comp . Ex.2	0.14	0.5	3.0	10	Absent	95	60	6	95	2	2	80	Absent	<1	2	0.64	4.2	No
Comp . Ex.3	0.14	0.5	3.0	10	Absent	95	60	6	95	2	2	80	1	<1	2	0.52	3.6	No
Comp . Ex.4	0.14	0.5	3.0	10	2	95	60	6	95	Absent	Absent	80	Absent	<1	2	0.47	4.8	No
Comp . Ex.5	0.14	0.5	3.0	10	2	95	60	6	70	2	2	80	1	6	13	0.82	4.4	No
Comp . Ex.6	0.14	0.5	3.0	10	2	95	60	6	95	2	2	80	6	7	13	0.04	2.3	No
Comp . Ex.7	0.14	0.5	3.0	10	2	95	60	6	95	6	6	80	1	8	15	0.03	2.1	No
Comp . Ex.8	0	0.5	3.0	10	2	95	60	1.5	95	2	2	80	1	180 or more	180 or more	0.02	0.0	No

INDUSTRIAL APPLICABILITY

[0104] The wound yarn body of a water absorbent polyester fiber of the present invention absorbs water semi-permanently even in the case of not subjecting to water absorption processing without generating white powder in the wound yarn rewinding step and knitting step, is able to rapidly absorb perspiration when worn, demonstrates superior comfort, and has a favorable soft feel on the skin, thereby enabling it to be preferably used in innerwear, sportswear and the like.

REFERENCE SIGNS LIST

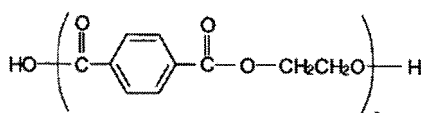
[0105]

- 1 Wound yarn body
- 2 Yarn
- 3 Snail guide
- 4 Ring tensioner
- 5 Traverse guide
- 6 Bobbin frame

Claims

1. A wound yarn body of a water absorbent polyester fiber having water absorbency as determined by the falling-drop method of JIS L1907:2010 after washing 30 times according to Method 103 C of JIS L0217:1995 of 5 seconds or less; wherein the adhered amount of a white powder containing a cyclic oligomer that is a decomposition product of the polyester that composes the water absorbent polyester fiber is less than 0.3% by weight.
2. The wound yarn body according to claim 1, wherein the water absorbent polyester fiber contains 0.005% by weight to 1% by weight of elemental S and 95 mol% or more of the repeating units of the polyester is ethylene terephthalate.
3. The wound yarn body according to claim 1 or 2, wherein a terminal carboxylic acid linear oligomer component represented by the following formula (1):

[Chem. 1]



(wherein n is an integer of 3 to 10) is present on the surface of the water absorbent polyester fiber, and among the terminal carboxylic acid linear oligomer components, the terminal carboxylic acid linear oligomer component in which n = 4 is contained in an amount equivalent to the concentration as internal standard of 2 µg/ml to 15 µg/ml.

4. The wound yarn body according to any of claims 1 to 3, wherein the wound amount of the water absorbent polyester fiber is 0.5 kg to 4 kg per single wound yarn body.
5. The wound yarn body according to any of claims 1 to 4, wherein the water absorbent polyester fiber is a false twisted yarn.
6. The wound yarn body according to any of claims 1 to 5, wherein the water absorbent polyester fiber does not have needle loop-shaped crimps.
7. A method for manufacturing the wound yarn body according to any of claims 2 to 6, comprising a step for carrying out alkali reduction on the polyester fiber containing 0.005% by weight to 1% by weight of elemental S at a reduction rate of 0.6% to 9% with respect to the polyester fiber.

8. The method according to claim 7, wherein a chelating agent is used in combination in the step for carrying out alkali reduction and an oligomer dispersant is further used in combination during soaping and neutralization.

5

10

15

20

25

30

35

40

45

50

55

FIG. 1

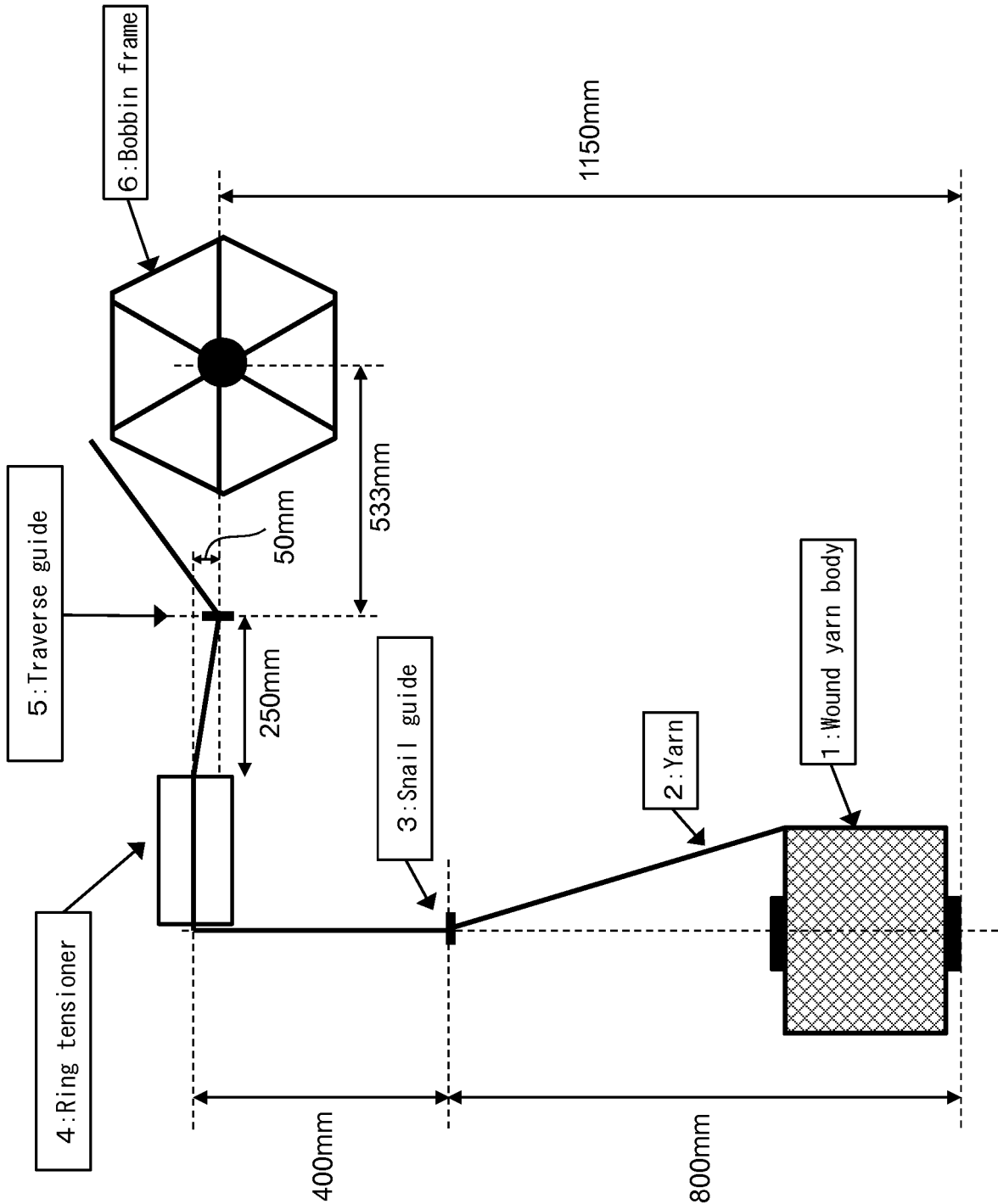


FIG. 2

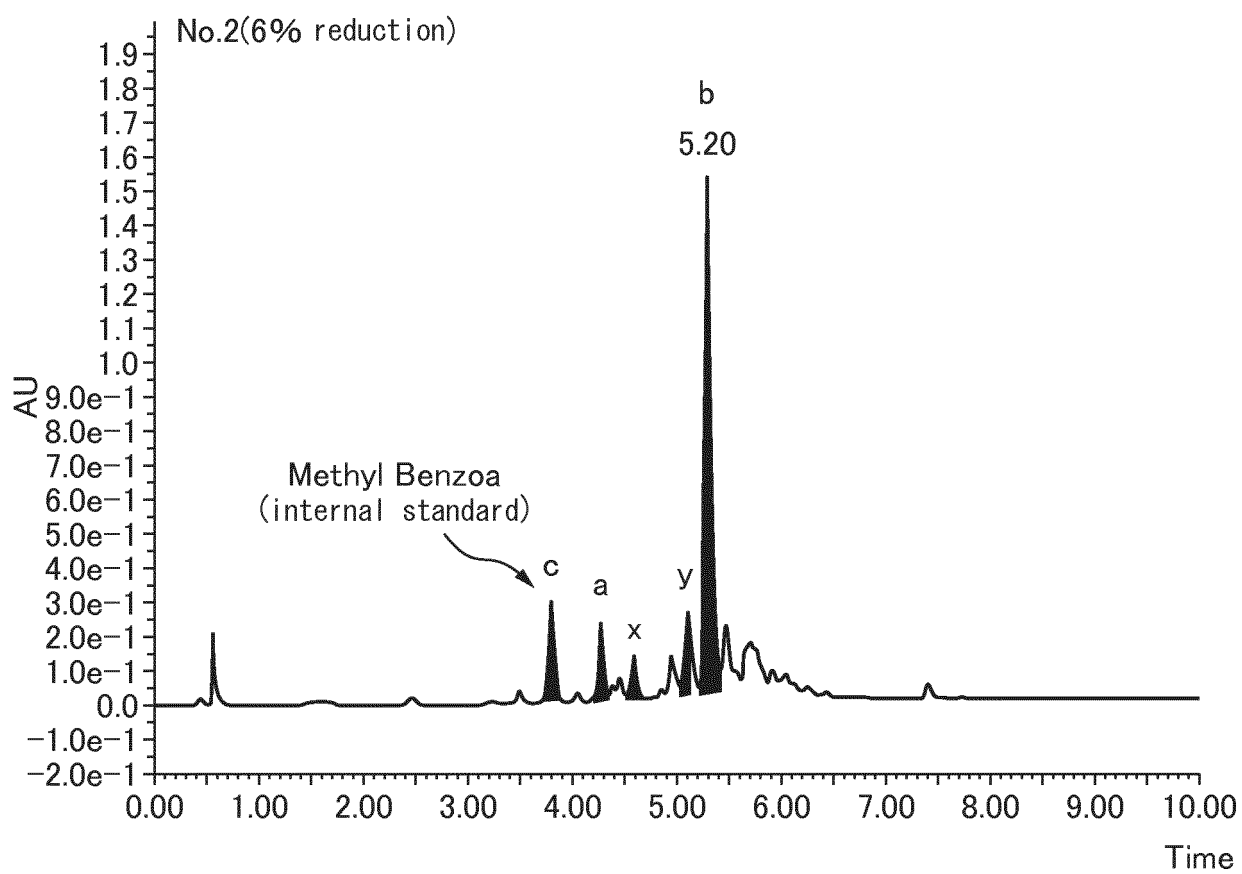
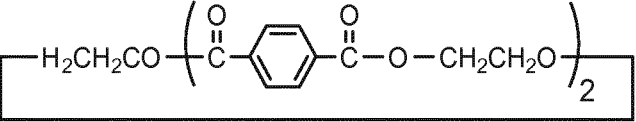
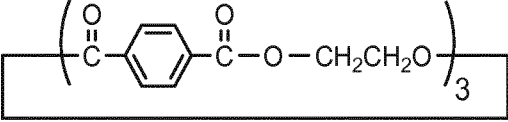
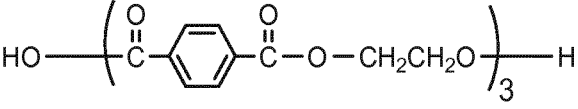
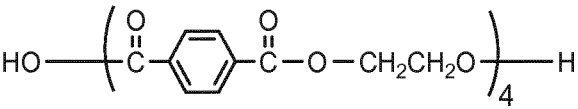


FIG. 3

Estimated
molecular weight

Peak	Detected ion (m/z)		Estimated structure
a	429.12 $[M+H]^+$	428.11	
b	594.16 $[M+NH_4]^+$	576.13	
x	785.17 $[M-H]^-$	786.18	
y	977.21 $[M-H]^-$	978.22	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/089171

A. CLASSIFICATION OF SUBJECT MATTER

D06M11/00(2006.01)i, D06M101/32(2006.01)n

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06M10/00-11/84, D06M16/00, D06M19/00-23/18

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017

Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2015/076412 A1 (Asahi Kasei Fibers Corp.), 28 May 2015 (28.05.2015), 0030 to 0031, 0041; claims & US 2016/0376730 A1 0070 to 0073, 0086 to 0087; claims & EP 3075899 A1 & JP 6095798 B2	1-8
A	JP 63-190073 A (Dai-Ichi Kogyo Seiyaku Co., Ltd.), 05 August 1988 (05.08.1988), claims; page 2, upper left column to upper right column; examples (Family: none)	1-8

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
09 March 2017 (09.03.17)Date of mailing of the international search report
04 April 2017 (04.04.17)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/089171

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-525650 A (Clariant International Ltd.), 17 July 2008 (17.07.2008), 0015 to 0019 & WO 2006/067199 A1 pages 4 to 5 & US 2008/0148497 A1 & EP 1674608 A1	1-8
A	WO 2013/168599 A1 (Matsumoto Yushi-Seiyaku Co., Ltd.), 14 November 2013 (14.11.2013), claims; 0052; examples & JP 2013-168599 A	1-8
<u>E, X</u> <u>E, A</u>	JP 2017-008425 A (Asahi Kasei Corp.), 12 January 2017 (12.01.2017), entire text (Family: none)	<u>1-7</u> <u>8</u>

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/089171

Object to be covered by this search:

Claim 1 contains the wording "a yarn roll of water-absorbing polyester fibers having a water absorption of 5 seconds or less". In regard to this wording, the description (paragraph [0050]) indicates that a definition of a water absorption test is as follows. The yarn is unreeled from the yarn roll and a cylindrical knitted fabric is produced therefrom; the obtained cylindrical knitted fabric is scoured and dried by an ordinary method; and the obtained cylindrical knitted fabric is examined for water absorption using a specific standard testing method, thereby determining the water absorption "of the water-absorbing polyester fibers". However, there are no limitations on the knitting structure, basis weight, thickness, etc. of the cylindrical knitted fabric obtained from the yarn unreeled from the yarn roll. Therefore, the cylindrical knitted fabric has not been sufficiently specified, and any cylindrical knitted fabric can be involved. It means that the results of the water absorption test which were obtained using such cylindrical knitted fabric have no clear technical meaning. It is hence considered that a meaningful search for the whole range of the invention in claims 1-8 is impossible.

Claim 1 is not regarded as a subject matter to be excluded from the international search. However, as a result of an examination concerning "examination for subject matters to be excluded from the international search", the subject matter to be searched for was limited, with respect to the wording "a yarn roll of water-absorbing polyester fibers having a water absorption of 5 seconds or less" in claim 1, by limiting "the water-absorbing polyester fibers" to ones which satisfied all of the requirements given in claims 2 and 7-8, as a part for which a meaningful search could be made.

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2005200799 A [0008]
- JP 2014101598 A [0008]
- JP 2014101599 A [0008]
- WO 2015076412 A [0008]