



(11) **EP 1 801 274 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
27.06.2007 Bulletin 2007/26

(21) Application number: **05795767.2**

(22) Date of filing: **13.10.2005**

(51) Int Cl.:
D04B 1/20 (2006.01) **D03D 15/04** (2006.01)
A41B 17/00 (2006.01) **D04B 21/00** (2006.01)
D06C 7/00 (2006.01) **D01F 8/12** (2006.01)

(86) International application number:
PCT/JP2005/019245

(87) International publication number:
WO 2006/041200 (20.04.2006 Gazette 2006/16)

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**

(30) Priority: **15.10.2004 JP 2004301219**

(71) Applicant: **Teijin Fibers Limited**
Osaka-shi, Osaka 541-0054 (JP)

(72) Inventors:
• **YASUI, Satoshi**
c/o TEIJIN FIBERS LIMITED
Chuo-ku
Osaka-shi
Osaka
5410054 (JP)

• **YAMAGUCHI, Takeshi**
c/o TEIJIN FIBERS LIMITED
Osaka-shi
Osaka
5410054 (JP)
• **YOSHIMOTO, Masato**
TEIJIN FIBERS LIMITED
Matsuyama-shi
Ehime
7918041 (JP)
• **MORIOKA, Shigeru**
c/o TEIJIN FIBERS LIMITED
Matsuyama-shi
Ehime
7918041 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **WOVEN/KNIT FABRIC INCLUDING CRIMPED FIBER AND BECOMING RUGGED UPON HUMIDIFICATION, PROCESS FOR PRODUCING THE SAME, AND TEXTILE PRODUCT**

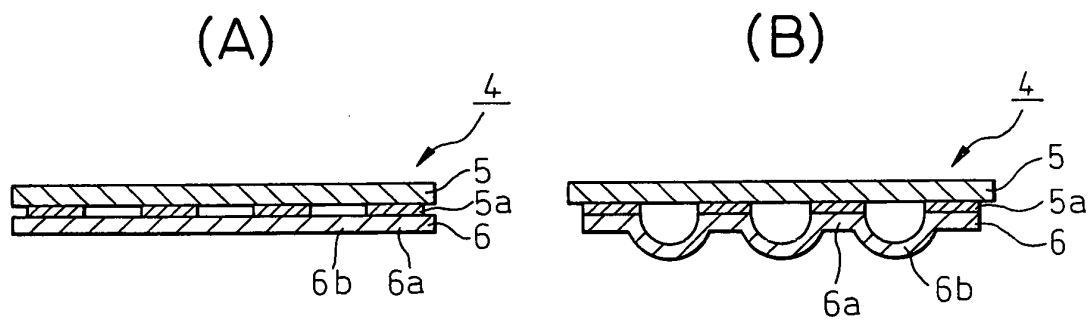
(57) A woven or knitted fabric, having a roughness which is manifested when wetted with water and disappears when dried, comprises crimped filaments A whose percentage of crimp decrease when wetted with water, and filaments B composed of non-crimped filaments and/or crimped filaments which undergo substantially no change in percentage of crimp when wetted with water, wherein the change of the roughness is 5% or more, determined in accordance with the following equation:

$$\text{Change in Roughness (\%)} = ((TW - TD) / TD) \times 100$$

in which TD: a thickness upon drying and TW: a thickness upon wetting with water, of the woven or knitted fabric.

EP 1 801 274 A1

Fig.4



Description

FIELD OF THE INVENTION

[0001] The present invention relates to a crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water, to a process for producing the same, and to textile products prepared therefrom. More particularly, the present invention relates to a woven or knitted fabric which comprises crimped filaments the percentage of crimp of which decreases upon wetting with water and filaments other than the crimped filaments, and has a performance such that the surface of the woven or knitted fabric manifests a roughness upon wetting with water and the roughness decreases or disappears upon drying, whereby clothes produced from the woven or knitted fabric do not cling or hardly cling to the skin even when wetted by perspiration, as well as to a process for producing the same and to textile products prepared therefrom.

BACKGROUND ART

[0002] When sportswear or underwear produced from woven or knitted fabrics comprising conventional fibers or natural fibers is worn, there is a known problem such that when the wearer sweats, the conventional fabrics are unpleasantly close and sticky on the skin due to the sweat.

[0003] Against vaporized sweat generated in the initial stage of perspiration, it has become common to employ clothes produced from fibers with high hygroscopicity as the constituent materials of clothes, or clothes formed from woven or knitted fabrics having a loose structure and a low density in order to increase the air permeability.

[0004] On the other hand, for liquid sweat generated during the middle and later stages of perspiration, there have been proposed multi-ply structured woven or knitted fabrics having a difference in density between the outside ply and inside ply (skin side) of the woven or knitted fabrics to allow sweat absorbed in the skin side ply to rapidly migrate to the outside ply (for example, see Patent Reference 1), and to use clothes formed from woven or knitted fabrics having a roughness formed on the skin side surface of woven or knitted fabrics to decrease the contact area between the skin and clothes and to decrease the degree of stickiness (for example, see Patent documents 2 and 3). However, in the former case, perspiration exceeding the saturated moisture absorption of the clothes results in residue of sweat on the skin side, causing the clothes to stick to the skin. In the latter case, where the surface roughness of the clothes is insufficient, perspiration in a large amount causes the clothes to stick to skin, and when the extent of roughness is increased in order to avoid the sticking, the air content of the woven or knitted fabric increases resulting in higher heat retention and thereby aiding perspiration, while the convexities of the roughness also rub against the skin producing an uncomfortable prickling feel, and are also abraded on the skin tending to create pilings.

[0005] It has therefore been desired to develop woven and knitted fabrics which can reduce such stickiness by reversibly manifesting roughness on the woven or knitted fabric surface when wetted with water.

[0006] Patent document 1: Japanese Unexamined Patent Publication No. 9-316757

[0007] Patent document 2: Japanese Unexamined Patent Publication No. 10-131000

[0008] Patent document 3: Japanese Unexamined Patent Publication No. 9-324313

DISCLOSURE OF THE INVENTION

[0009] An object of the present invention is to provide a woven or knitted fabric which manifests roughness on the surface when wetted with water in such a manner that the roughness is reduced or disappears upon drying, as well as a process for producing it and textile products obtained therefrom which do not become uncomfortable upon wetting by sweat produced by perspiration.

[0010] This object is achieved by the crimped filament-containing woven or knitted fabric of the present invention, the process for producing it and textile products therefrom.

[0011] The crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water, and comprises yarns comprising crimped filaments A the percentage of crimp of which decreases upon wetting with water, and yarns comprising filaments B comprising at least one type of filaments selected from non-crimped filaments and crimped filaments which undergo substantially no change in percentage of crimp upon wetting with water,

is characterized in that the change in roughness calculated by the equation:

$$\text{Change in Roughness (\%)} = ((TW - TD) / TD) \times 100$$

wherein TD represents a thickness of the woven or knitted fabric measured after standing it in an environment having a temperature of 20°C and a humidity of 65% RH for 24 hours and TW represents a largest thickness of the water-wetted portion of the woven or knitted fabric measured one minute after 1 ml of water has been dropped onto the woven or knitted fabric, is 5% or greater.

[0012] In the crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water, the crimped filaments A are preferably selected from crimped conjugate filaments comprising a polyester resin component and a polyamide resin component which components are different from one another in terms of water-absorption and self-elongation properties, and bonded to one another in a side-by-side structure, the conjugate filaments having crimps formed by revealing the latent crimpability of the conjugate filaments.

[0013] In the crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water, the polyester resin component preferably comprises a modified polyethylene terephthalate resin comprising 5-sodiumsulfisophthalic acid copolymerized in an amount of 2.0-4.5 molar percent based on the content of the acid component of the resin.

[0014] In the crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water, the yarn comprising the crimped filaments A is preferably twisted at the number of twist of 0-300 T/m.

[0015] In the crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water, the filaments B preferably comprises a polyester resin.

[0016] In the crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water, the fabric preferably at least one portion Y composed entirely of the crimped filaments A and at least one portion Z composed entirely of the filaments B, the Z portion being formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.

[0017] The crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water may comprise at least one portion Z composed entirely of the filaments B and at least one portion X composed of the filaments A and the filaments B, the Z portion being formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.

[0018] The crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water may comprise at least one portion X composed of the crimped filaments A and the filaments B and at least one portion Y composed entirely of the crimped filaments A, the X portion being formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.

[0019] The crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water, may comprise at least one portion X composed of the crimped filaments A and the filaments B, at least one portion Y composed entirely of the crimped filaments A and at least one portion Z composed entirely of the filament B, the Z portion being formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.

[0020] The crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water may have a multi-ply weave or knit structure with two or more plies, at least one ply of the multi-ply structure being composed of the crimped filaments A and the filaments B, while at least one other ply being composed entirely of the filaments B, and the ply containing the filaments A and B and the other ply containing the filaments B being partially bound with each other.

[0021] The crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water may have a multi-ply weave or knit structure with two or more plies, at least one ply of the multi-ply structure being composed of the crimped filaments A and filaments B, while at least one other ply being composed entirely of the crimped filaments A and B and the other ply containing the crimped filaments A being partially bound with each other.

[0022] The crimped filament-containing woven or knitted fabric of the present invention which manifests roughness upon wetting with water may have a multi-ply weave or knit structure with two or more plies, at least one ply of the multi-ply structure being composed entirely of the crimped filaments A, while at least one other ply being composed entirely of the crimped filaments B, and the crimped filaments A-containing ply and the filaments B-containing ply being partially bound with each other.

[0023] The process of the present invention for production of a crimped filament-containing woven or knitted fabric according to any one of claims 1 to 12 which manifests roughness upon wetting with water, is characterized by comprising a step of producing a precursor woven or knitted fabric from precursor filaments from which crimped filaments A which reveals crimps when a heat treatment is applied thereto, and the resultant crimps having a property such that the percentage of crimp decreases when wetted with water, and precursory filaments from which at least one type of filaments B selected from filaments which do not reveal crimps even when a heat treatment is applied thereto, and filaments which reveal crimps when a heat treatment is applied thereto but the percentage of crimp of the crimps essentially not decreasing when wetted with water, and a step of applying a heat treatment to the precursory woven or knitted fabric to produce a

woven or knitted fabric comprising the crimped filaments A and the filaments B.

[0024] In the process of the present invention for production of a crimped filament-containing woven or knitted fabric, the precursory filaments from which the crimped filaments A are preferably formed from non-crimped conjugate filaments comprising a polyester resin component and a polyamide resin component which components differ in water-absorption and self-elongation from each other and are bonded in a side-by-side structure.

[0025] The process of the present invention for production of a crimped filament-containing woven or knitted fabric the polyester resin component in the non-crimped conjugate filaments preferably comprises a polyester resin having an intrinsic viscosity of 0.30-0.43, and the polyamide resin component preferably comprise a polyamide resin having an intrinsic viscosity of 1.0-1.4.

[0026] The process of the present invention for production of a crimped filament-containing woven or knitted fabric, the non-crimped conjugate filaments preferably satisfy, after crimping treatment in boiling water was applied thereto, the following requirements:

- (1) a dry percentage of crimp DC after standing in an environment having a temperature of 20°C and a humidity of 65% RH for 24 hours, is in the range of 1.5 to 13%;
- (2) a percentage of crimp HC immediately after an immersion in water at a temperature of 20°C for 2 hours, is in the range of 0.5 to 7.0%; and
- (3) a difference between the dry percentage of crimp DC and wet percentage of crimp HC (DC-HC) is 0.5% or greater.

[0027] The textile product of the present invention includes the crimped filament-containing woven or knitted fabric of the present invention.

[0028] The textile product of the present invention is preferably selected from outerwear, sportswear and underwear clothes.

[0029] According to the present invention, it is possible to provide crimped filament-containing woven or knitted fabrics that manifest roughness on the surface upon wetting with water wherein the roughness is reduced or disappears upon drying, from crimped filaments A whose percentage of crimp decreases upon wetting with water and filaments B which undergo substantially no change in percentage of crimp upon wetting with water, as well as a process for producing them and textile products obtained therefrom.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

Fig. 1 is an explanatory view showing the cross-sectional profile of an embodiment of the crimped conjugate filament used in a woven or knitted fabric of the present invention.

Fig. 2 is an explanatory view showing the cross-sectional profile of another embodiment of a crimped conjugate filament used in a woven or knitted fabric of the present invention.

Fig. 3 is an explanatory view showing the cross-sectional profile of still another embodiment of a crimped conjugate filament used in a woven or knitted fabric of the invention.

Fig. 4(A) is an explanatory view showing the cross-sectional profile of an embodiment of a woven or knitted fabric of the present invention under dry condition, and Fig. 4(B) is an explanatory view showing the cross-sectional profile of the woven or knitted fabric under water-wetted condition.

Fig. 5 is a plane view showing the structure of another embodiment of a woven or knitted fabric of the present invention under dry condition.

Fig. 6(A) is an explanatory view showing the cross-sectional profile of still another embodiment of a woven or knitted fabric of the present invention under dry condition, and Fig. 6(B) is an explanatory view showing the cross-sectional profile of the woven or knitted fabric under water-wetted condition.

Fig. 7 is a plane view showing the structure of still another embodiment of a woven or knitted fabric of the present invention under dry condition.

BEST MODE FOR CARRYING OUT THE INVENTION

[0031] A woven or knitted fabric of the invention comprises crimped filaments A whose percentage of crimp decreases upon wetting with water, and filaments B composed of at least one type of filaments selected from non-crimped filaments and crimped filaments which undergo substantially no change in percentage of crimp upon wetting with water. When a crimped filament-containing woven or knitted fabric of the present invention is wetted with water (for example, when wetted by perspiration or falling rain), only the crimped filaments A exhibit a reduced percentage of crimp whereby the apparent lengths of the crimped filaments A increase to form roughness on the surface of the water-wetted woven or

knitted fabric, while drying produces an increase or restoration of the percentage of crimp of the crimped filaments A whereby the apparent lengths of the filaments are reduced or restored, and the roughness is reduced or disappears. In other words, the woven or knitted fabric of the present invention is able to reversibly undergo manifestation of roughness upon wetting with water and reduction or disappearance of the roughness upon drying.

[0032] The change in roughness calculated in accordance with the following equation from the thickness (TD) when dried and the thickness (TW) when wetted, of the woven or knitted fabric of the present invention is 5% or greater and preferably 10-100%.

$$\text{Change in Roughness (\%)} = ((TW - TD) / TD) \times 100$$

[0033] If the roughness change is less than 5%, manifestation of roughness in the woven or knitted fabric when wetted will be insufficient, making it impossible to sufficiently reduce the skin discomfort occurred when the fabric is worn.

[0034] The thickness TD when dried is the thickness after the woven or knitted fabric has stood for 24 hours in an environment at a temperature of 20°C at a humidity of 65% RH, and the thickness TW when wetted is the highest thickness of a portion of the woven or knitted fabric at which portion one ml of water has been dropped by using a dropper, one minute after the water dropping; these thicknesses TD and TW may be measured using, for example, a ultrahigh-precision laser displacement meter (Model LC-2400, product of Keyence).

[0035] It is important that in the crimped filament (A), the difference (DC-HC) between the percentage of crimp (DC) when dried and the percentage of crimp (HC) when wetted with water of the crimped filaments A is 0.5% or more, and such crimped filaments (A) are preferably conjugate filaments which are composed of two types of resin components, different from one another in terms of heat-shrinkage properties, for example, polyester resin component and a polyamide resin component, incorporated in a side-by-side structure, and have a crimped structure formed by expression of their latent crimping performance.

[0036] Examples of preferred polyester resin components for the side-by-side type conjugate filaments include modified polyesters, for example, modified polyethylene terephthalate, polypropylene terephthalate or polybutylene terephthalate polymers which are copolymerized with compounds which have a group consisting an alkali or alkaline earth metal salt or phosphonium salt of sulfonic acid, and one or more functional groups with ester-forming property, for higher adhesion with the polyamide component. Particularly, modified polyethylene terephthalate copolymers containing the copolymerized aforementioned compounds, are preferred from the standpoint of common wide utility and low polymer price. Examples of copolymerization components in this case include 5-sodium sulfoisophthalic acid and its ester derivatives, 5-phosphonium isophthalic acid and its ester derivatives, sodium p-hydroxybenzenesulfonate, etc. Among them, 5-sodiumsulfoisophthalic acid is preferably employed. The copolymerization amount of the copolymerizing component is preferably in the range of 2.0-4.5 molar % with respect to the molar amount of the dicarboxylic acid component in the polyester resin component. If the copolymerization amount is less than 2.0 molar %, a separation may occur at the bonding interface between the polyamide component and polyester component, whereas the resultant conjugate filaments exhibit excellent crimping property. Conversely, if the copolymerization amount is more than 4.5 molar percent, crystallization of the polyester component will be inhibited during drawing and heat treatment, thus a higher draw and heat treatment temperature than usual becomes necessary, and this potentially leads to numerous breaks in the filaments.

[0037] There is no particular limitation to the polyamide resin component for the side-by-side type conjugate filaments, as long as it has an amide bond in the backbone chain, and the polyamide resin includes, for example, nylon-4, nylon-6, nylon-66, nylon-46 and nylon-12. Among them, nylon-6 and nylon-66 are particularly preferred from the viewpoint of common wide utility, low polymer price and high stability in filament production.

[0038] The polyester resin component and polyamide resin component may also contain publicly known additives, for example, pigments, delustering agents, stain-proofing agents, fluorescent brighteners, flame retardants, stabilizers, antistatic agents, light resisting agents, ultraviolet ray absorbers, etc.

[0039] The conjugate filament comprising two resin components different in heat shrinkage properties from each other (for example, polyester resin component and polyamide resin component) bonded in a side-by-side structure may have any cross-sectional profile and combining form. Figs. 1 to 3 show cross-sectional profiles of side-by-side type conjugate filaments to be used for the present invention. The conjugate filament 1 shown in Fig. 1 has a circular cross-sectional profile wherein the polyester resin component 2 and the polyamide resin component 3 are bonded in a side-by-side relationship. The conjugate filament shown in Fig. 2 has an oval cross-sectional profile wherein the polyester resin component 2 and the polyamide resin component 3 are bonded in a side-by-side relationship. The conjugate filament 1 shown in Fig. 3 also has a circular cross-sectional profile, but with the polyamide resin component 3 is located inside the polyester resin component 2 in a nearly core-in-sheath configuration. A portion of the polyamide resin component 3, however, is exposed on the outer periphery of the filament.

[0040] The cross-sectional profile of the side-by-side type conjugate filament may be, instead of circular or oval,

polygonal such as triangular or rectangular, flat or star-shaped or even hollow. Among them, a circular cross-sectional profile shown in Fig. 1 is preferred.

[0041] The mass ratio of the polyester resin component to polyamide resin component in the side-by-side type conjugate filament used for the invention is preferably in the range of 30:70 to 70:30 and more preferably 40:60 to 60:40.

[0042] The individual filament thickness of the crimped filaments A used for the invention is preferably 1 to 10 dtex and more preferably 2 to 5 dtex. When the crimped filaments A are used in a yarn or a filament bundle, the number of individual filaments is preferably 10 to 200 and more preferably 20-100 per yarn or bundle.

[0043] The conjugate filaments having two resin components different in heat shrinkage properties from each other and bonded in a side-by-side structure may have any desired cross-sectional profile or combining form. Figs. 1 to 3 show magnified cross-sectional views of side-by-side type conjugate filaments usable for the present invention. The conjugate filaments having the cross-sectional profiles shown in Figs. 1 and 2 are used in most cases, but a nearly eccentric core-in-sheath type such as shown in Fig. 3 may also be used. Alternatively, the profile may be triangular or rectangular, or a hollow may be formed within the cross-section. The circular cross-sectional profile shown in Fig. 1 is preferred among these profiles, but the oval cross-sectional profile as shown in Fig. 2 is also usable. The mass ratio of both components may be selected as desired, usually the mass ratio between the polyester resin component and polyamide resin component is 30:70 to 70:30 and more preferably 40:60 to 60:40.

[0044] There are no particular restrictions to the individual filament thickness and number of individual filaments (individual filament number) of the crimped filaments A. Preferably, the individual filament thickness is 1 to 10 dtex (more preferably 2 to 5 dtex) and the number of individual filaments is in the range of 10 to 200 (more preferably 20 to 100), per yarn.

[0045] The conjugate filaments composed of different resin components bonded to each other as described above usually have a latent crimping property, and therefore express latent crimping performance when subjected to heat treatment, for example, a high-temperature dyeing treatment which will be explained hereinafter. The crimp structure preferably has the polyamide resin component located in inner side of the crimped filament and the polyester resin component located in outer side of the crimped filament. The conjugate filament having the above-mentioned crimp structure can be easily produced by the production process as described below. If the crimped filaments A have the above-mentioned crimp structure, wetting with water causes the polyamide component located in the inner side to swell and elongate but causes virtually no change in length of the polyester component located in the outer side, and thus, the percentage of crimp of the conjugate filament decreases. As a result, the apparent lengths of the crimped filaments A increases. When dried, however, the polyamide component located in the inner side shrinks, while the polyester component on the outer side undergoes essentially no change in length and, thus, the percentage of crimp of the conjugate filament increases. Thus, the apparent length of the crimped filaments A is therefore shortened.

[0046] The crimped filaments A are preferably in the form of untwisted yarn or false twisted yarn with no more than 300 T/m twists, in order to facilitate decrease in the percentage of crimp upon wetting with water. Untwisted filament yarn are especially preferred. In case of a hard-twisted filament yarn having a hard twist, the percentage of crimp is sometimes hard to decrease upon wetting with water. Also, the crimped filament yarn may be one subjected to an air interlacing treatment and/or usual false twisting treatment at an interlace number of the individual filaments in the yarn of about 20 to 60 interlaces/m.

[0047] There are no particular restrictions to the type of filaments B which are non-crimped filaments or which have crimps that undergo essentially no change in percentage of crimp upon wetting with water. Here, the phrase "undergo essentially no change in percentage of crimp upon wetting with water" means that a difference (DC-HC) between the percentage of crimp DC(%) in dry and the percentage of crimp HC(%) in wet with water (DC-HC) is less than 0.5(%). The difference in percentage of crimp (DC-HC) is more preferably 0 to 0.4% and still more preferably 0 to 0.3%.

[0048] The filaments B may be selected from synthetic polymer filaments, for example, filaments of polyesters, for example, polyethylene terephthalate, polytrimethylene terephthalate and polybutylene terephthalate, polyamides, for example, nylon-6 and nylon-66, polyolefins, for example, polyethylene and polypropylene, acrylic compounds, para- or meta-aramids and modified synthetic resins thereof, natural filaments regenerated filaments semi-synthetic filaments, polyurethane-based elastic filaments and polyether ester-based elastic filament, as long as they are appropriate for clothes. Among them, polyester filaments, for example, filaments of polyethylene terephthalate, polypropylene terephthalate and polybutylene terephthalate, as well as polyester filaments composed of modified polyesters produced by copolymerization with copolymerizing components, as mentioned above, because the above-mentioned filaments exhibit a high dimensional stability even when wetted with water and satisfactory in filament-combining properties, mixed knitting or mixed weaving properties and dyeing properties compatibility with the crimped filaments A. There are also no special restrictions on the thickness of individual filaments for the filaments B or on the number of individual filaments per yarn or bundle when they are used in a yarn or a filament bundle. In order to increase the hygroscopicity of the resultant woven or knitted fabric and to accelerate the manifestation of roughness upon wetting with water, the thickness of the individual filament for the filaments B is preferably 0.1 to 5 dtex and more preferably 0.5 to 2 dtex, and the number of individual filaments for a filament B yarn or filament B bundle is preferably in the range of 20 to 200 filaments and more

preferably 30-100 filaments per yarn or bundle. The filament B-containing yarn or filament bundle can be subjected to an air interlacing treatment and/or conventional false twisting treatment, which may cause interlacing of the constituent individual filaments at about 20-60 interlaces/m.

[0049] A woven or knitted fabric of the invention comprises the aforementioned crimped filaments A whose percentage of crimp decreases upon wetting with water, and filaments B comprising non-crimped filaments and/or crimped filaments which undergo essentially no change in percentage of crimp upon wetting with water.

[0050] There are no particular restrictions on the weave or knit structures or number of plies as of the woven or knitted fabric. Suitable weave or knit structures include weave structures a plane weave, twill weave or satin weave, and a knit structures such as a plain knit smooth knit, circular rib knit, seed knit, plating stitch, Denbigh stitch, half knit, etc, but there is no limitation to these. The fabric may be a single-ply fabric or a multi-ply fabric having two or more plies.

[0051] The reason of manifesting the roughness in the woven or knitted fabric when wetted with water is that the woven or knitted fabric is composed of portions which undergoes a dimensional change (expansion) when wetted with water and portions which undergoes little or no dimensional change even when wetted with water whereby, when wetted with water, the former portions changes in dimensions, and the latter portions exhibit little or no change in dimensions. Therefore, when wetted with water, the former portions form convexities and thereby manifest a roughness in the fabric. Consequently, for effective manifestation of roughness upon wetting with water, it is important to appropriately arrange the crimped filaments A and the filaments B.

[0052] A preferred mode for arrangement of the crimped filaments A and filaments B in a woven or knitted fabric of the present invention will be explained below.

[0053] First, according to mode (1), the woven or knitted fabric comprises one or more portions (Y portions) composed entirely of the crimped filaments A and one or more portions (Z portions) composed entirely of the filaments B, wherein the Z portions are formed continuous in either or both the warp and weft directions or in either or both the wale and course directions.

[0054] In this structure, as the Y portions have, when wetted with water, a greater degree of dimensional change than that of the Z portions, and the Z portions in the woven or knitted fabric are formed continuous in either or both the warp and weft directions or in either or both the wale and course directions, so that dimensional change of the woven or knitted fabric as a whole is inhibited, and the Y portions form convexities to manifest roughness.

[0055] In Fig. 6(A), the woven or knitted fabric 7 comprises Y portions 8 having a large dimensional change upon wetting with water and Z portion 9 having little or no dimensional change upon wetting with water, and in the dry state, the Y portions 8 and Z portions 9 form a flat surface but upon wetting with water, each Y portions 8 extends outward from one side surface of the woven or knitted fabric 7 to form convexities, as shown in Fig. 6(B), thus producing roughness on the surface of the woven or knitted fabric 7.

[0056] The pattern in which the Z portions are continuous in either or both the warp and weft directions or in either or both the wale and course directions is not particularly restricted, and examples include a border pattern, stripe pattern or lattice pattern, a diamond pattern as shown schematically in Fig. 7, or a checkered pattern.

[0057] There is no particular restriction on the area ratio of the Z portions to Y portions, but for increased dimensional stability of the woven or knitted fabric, the ratio Z portion area:Y portion area is preferably 10:90 to 90:10 and more preferably 20:80 to 80:20.

[0058] In the woven or knitted fabric 7 as shown in Fig. 7, the Y portions 8 are separated from each other by Z portions 9. While there is no particular restriction on the area of each Y portion 8, it is preferably in the range of 0.01 to 4.0 cm² and more preferably 0.1 to 1.0 cm². This is preferred from the viewpoint of preventing sticking between clothing and skin during periods of perspiration. The width of the Z portions 9 is preferably in the range of 0.5-100 mm.

[0059] According to mode (2) of the woven or knitted fabric of the present invention, the fabric comprises one or more portions (Z portions) composed entirely of the filaments B and one or more portions (X portions) composed of the filaments A and the filaments B, wherein the Z portions are formed continuous in either or both the warp and weft directions or in either or both the wale and course directions.

[0060] In this structure, as the X portions have a greater degree of dimensional change when wetted with water than that of the Z portions, and the Z portions of the woven or knitted fabric are formed continuously in either or both the warp and weft directions or in either or both the wale and course directions, the dimensional change of the woven or knitted fabric as a whole is inhibited, and the X portions form convexities to manifest roughness. The pattern in which the Z portions are formed continuously and the area ratio of both portions may be similar to that of mode (1).

[0061] According to mode (3) of the woven or knitted fabric of the present invention, the fabric comprises one or more portions (X portions) composed of the filaments A and the filaments B and one or more portions (Y portions) composed entirely of the crimped filaments A, wherein the X portions of the woven or knitted fabric are formed continuous in either or both the warp and weft directions or in either or both the wale and course directions.

[0062] In this structure, as the Y portions have a greater degree of dimensional change when wetted with water than that of the X portions, and the X portions of the woven or knitted fabric is formed continuous in either or both the warp and weft directions or in either or both the wale and course directions, the dimensional change of the woven or knitted

fabric as a whole is inhibited, and the Y portions form convexities to manifest roughness. The pattern in which the X portions are formed continuous and the area ratio of both portions may be similar to mode (1).

[0063] According to mode (4) of the woven or knitted fabric of the invention, the fabric comprises one or more portions (X portions) composed of the filaments A and the filaments B, one or more portions (Y portions) composed entirely of the crimped filaments A and one or more portions (Z portions) composed entirely of the filaments B, wherein the Z portions of the woven or knitted fabric are formed continuous in either or both the warp and weft directions or in either or both the wale and course directions.

[0064] In the above-mentioned mode (4) of the structure, as the Z portions have, when wetted with water, the least degree of dimensional change compared to the other portions (X portions and Y portions), and the Z portions of the woven or knitted fabric are formed continuous in either or both the warp and weft directions, the dimensional change of the woven or knitted fabric as a whole is inhibited, and the other portions (X portion and Y portion) form convexities to manifest roughness. The pattern in which the Z portions are continuous and the area ratio of Z portions to the total of the other portions may be similar to mode (1).

[0065] According to mode (5) of the woven or knitted fabric of the invention, the fabric has a multi-ply woven or knitted structure having two or more plies wherein at one or more plies (X plies) of the multi-ply structure is composed of the crimped filaments A and the filaments B while one or more of the other plies (Z plies) is composed entirely of the filaments B, and the former plies and latter plies are partially bound together.

[0066] In this structure, the X plies have a greater degree of dimensional change when wetted with water than that of the Z plies, and the portions of the X plies which are not bound with the Z plies form convexities to manifest roughness.

[0067] In Fig. 4(A), the woven or knitted fabric 4 is a multi-ply fabric comprising an X ply 6 and a Z ply 5, and a bonding ply 5a through which the plies 5 and 6 are partially bound together. When the multi-ply woven or knitted fabric is wetted with water, as shown in Fig. 4(B), the X ply 6 extends between the bound sections to form convexities 6a, but the portions 6b where the X ply 6 is bound through the binding ply 5a cannot extend. As a result, roughness is formed on one side of the woven or knitted fabric.

[0068] When, as shown in Fig. 5, the lattice section 6b in the X ply 6 of the woven or knitted fabric is bound with the Z ply (not shown in Fig. 5) through the binding ply (also not shown), the section 6a which is not bound extends outward upon wetting with water, to cause a plurality of rectangular convexities to be separately distributed from each other, thereby creating roughness on one side of the multi-ply woven or knitted fabric. Alternatively, the sections which are not bound may be formed in a lattice form and the bound sections may form a plurality of regions spaced from each other.

[0069] According to mode (6) of the woven or knitted fabric of the present invention, the fabric has a multi-ply woven or knitted structure with two or more plies wherein one or more plies (X plies) of the multi-ply structure are composed of the crimped filaments A and the filaments B while one or more other plies (Y plies) are composed entirely of the crimped filaments A, and the X plies and Y plies are partially bound together.

[0070] In this structure, the Y plies have a greater degree of dimensional change when wetted with water, than that of the X ply, and the portions of the Y plies which are not bound with the X plies form convexities to manifest roughness.

[0071] According to mode (7) of the woven or knitted fabric of the invention, the fabric has a multi-ply woven or knitted structure with two or more plies wherein one or more plies (Y plies) are composed entirely of the crimped filaments A while one or more other plies (Z plies) are composed entirely of the filaments B, and the Y plies and Z plies are partially bound together.

[0072] In this structure, the Y plies have a greater degree of dimensional change when wetted with water than that of the Z plies, and the portions of the Y plies which are not bound with the Z plies form convexities to manifest roughness.

[0073] The woven or knitted fabric of the invention may be easily produced by the production process described below.

[0074] The process of the present invention for producing a crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water, is characterized by comprising a step of producing a precursor woven or knitted fabric from precursor filaments from which crimped filaments A which reveals crimps when a heat treatment is applied thereto, and the resultant crimps having a property such that the percentage of crimp decreases when wetted with water, and precursory filaments from which at least one type of filaments B selected from filaments which do not reveal crimps even when a heat treatment is applied thereto, and filaments which reveal crimps when a heat treatment is applied thereto but the percentage of crimp of the crimps essentially not decreasing when wetted with water, and a step of applying a heat treatment to the precursory woven or knitted fabric to produce a woven or knitted fabric comprising the crimped filaments A and the filaments B.

[0075] In the process of the present invention, preferably the filaments, from which the crimped filaments A are formed, are selected from non-crimped conjugate filaments comprising a polyester resin component and a polyamide resin component, which are different in water-absorption and self-elongation from each other and are bonded in a side-by-side structure, and preferably the polyester resin component of the non-crimped filaments includes a polyester resin with an intrinsic viscosity of 0.30 to 0.43, and the polyamide resin component includes a polyamide resin with an intrinsic viscosity of 1.0-1.4.

[0076] In an embodiment of the process of the present invention, a polyester having an intrinsic viscosity of 0.30 to

0.43 (measured at 35°C in ortho-chlorophenol as the solvent) and a polyamide having an intrinsic viscosity of 1.0-1.4 (measured at 30°C in m-cresol as the solvent) are melt-spun into a side-by-side type composite filament structure. In this case, a polyester component having an intrinsic viscosity of 0.43 or less is particularly preferred. If the polyester component has an intrinsic viscosity of greater than 0.43, the polyester exhibits an increased viscosity and thus the properties of the composite filament will approach those of the polyester alone and it may not be possible to obtain a woven or knitted fabric which achieves the object of the invention. Conversely, if the polyester component has an intrinsic viscosity of less than 0.30, the resultant polyester component melt may exhibit too low a viscosity, and the filament-forming property of the melt decreases and generation of fluffs is promoted, and the quality and productivity of the conjugate filaments are reduced.

[0077] The spinneret used for the melt spinning may be one as shown in Fig. 1 of Japanese Unexamined Patent Publication No. 2000-144518, wherein the extrusion openings for the high viscosity component and low viscosity component are separated from each other, and the linear extrusion rate of the high viscosity component is low (the cross-sectional area of the extrusions openings is designed small). Preferably, the molten polyester resin component is passed through the extrusion openings for the high viscosity component, while the molten polyamide resin component is passed through the extrusion openings for the low viscosity component, and the two components are joined together while cooling them to solidification. For this step, as mentioned above, the mass ratio of the polyester component to the polyamide component is preferably 30:70 to 70:30, and more preferably 40:60 to 60:40.

[0078] After the melt composite melt spinning, there may be employed a separate drawing system wherein drawing is carried out after winding up the melt-spun filaments, or a direct drawing system wherein a draw-heat treatment is carried out without winding up the melt-spun filaments. The spinning and drawing steps may be performed under conventional conditions. For example, in a direct drawing system, the spinning step is carried out at a spinning speed of about 1000 to 3500 m/min, and followed by immediate drawing step at a temperature of 100 to 150°C and then winding up step. The draw ratio is appropriately set so that the finally obtained conjugate filaments have a elongation at break of preferably 10 to 60% (more preferably 20 to 45%), and a tensile strength of preferably about 3.0 to 4.7 cN/dtex.

[0079] For the process of the present invention, the non-crimped conjugate filaments preferably have, after crimping treatment in boiling water,

(1) a dry percentage of crimp DC in the range of 1.5-13% after standing for 24 hours in an environment at a temperature of 20°C, at a humidity of 65% RH,

(2) a water-wet percentage of crimp HC in the range of 0.5-7.0% immediately after immersion in water at a temperature of 20°C for 2 hours, and

(3) a difference between the dry percentage of crimp DC and wet percentage of crimp HC (DC-HC) of 0.5% or more. The dry percentage of crimp DC is more preferably 2 to 6%, the wet percentage of crimp HC is more preferably 1 to 3%, and the difference between the dry percentage of crimp DC and wet percentage of crimp HC (DC-HC) is more preferably 1 to 5%.

[0080] The dry percentage of crimp DC and wet percentage of crimp HC are measured by the following measurement methods.

[0081] A wind-up frame with a circumference of 1.125 m is used for rewinding a filament yarn under a load of 49/50 mN x 9x total tex (0.1 gf x total denier) at a fixed speed for 10 winds to produce a small hank, the small hank is twisted to form into a double ring and immersed in boiling water while applying an initial load of 49/2500 mN x 20 x 9 x total dtex (2 mg x 20 x total denier) for 30 minutes, then dried in a drier at 100°C for 30 minutes and then placed in dryer at 160°C for 5 minutes while maintaining the initial load to heat-treat the hank. The initial load is removed from the hank after the dry heat treatment was completed, and then the hank is left to stand in an environment at a temperature of 20°C at a humidity of 65% RH for at least 24 hours, then the initial load and an additional load of 98/50 mN x 20 x 9 x total tex (0.2 gf x 20 x total denier) are applied to the hank, then the length L0 of the hank is measured, the additional load alone is immediately removed, and one minute after removing the load the length L1 of the hank is measured. The hank is then immersed in water at a temperature of 20°C for 2 hours while applying the initial load thereto, and after taking up from water, the hank is sandwiched between a pair of filter sheets (30 cm x 30 cm size), a pressure of 0.69 mN/cm² (70 mgf/cm²) was applied to the filter sheets for 5 seconds to lightly wipe off of water, then the initial load and the additional load are applied to the hank, the length L0' of the hank is measured, the additional load alone is immediately removed from the hank, and one minute after removing the load the length L1' of the hank is measured. These measured values are inserted into the following equations calculate the dry percentage of crimp DC(%), wet percentage of crimp HC(%) and the difference (DC-HC) percentage of crimps between dry and wet. The average value for 5 measurements was calculated.

$$\text{Dry percentage of crimp DC(\%)} = ((L_0 - L_1) / L_0) \times 100$$

$$\text{Wet percentage of crimp HC(\%)} = ((L_0' - L_1') / L_0') \times 100$$

[0082] In the crimped conjugate filaments A used for the present invention, if the dry percentage of crimp DC is smaller than 1.5%, the change in percentage of crimp upon wetting with water is small, and thus a roughness may not be manifested. Conversely, if the dry percentage of crimp DC is more than 13%, crimping may be too strong, thereby inhibiting change of the crimps upon wetting with water, and also potentially preventing manifestation of roughness. If the difference (DC-HC) between the dry percentage of crimp DC and wet percentage of crimp HC is less than 0.5%, roughness may not be manifested even when wetted with water.

[0083] After producing a woven or knitted fabric simultaneously from the conjugate filaments as mentioned above and the filaments B which are either non-crimped or have crimps which undergo substantially no change in percentage of crimp even upon wetting with water, the fabric may be subjected to a dyeing treatment, whereby the heat of dyeing expresses latent crimping of the conjugate filaments (to produce the crimped filaments).

[0084] There are no special restrictions on the weaving or knittin structure of the woven or knitted fabric, and any of the aforementioned types may be selected as appropriate.

[0085] The temperature for the dyeing treatment is preferably 100 to 140°C and more preferably 110 to 135°C, and the dyeing time is preferably in the range of 5 to 40 minutes as the highest temperature duration time. Dyeing of the woven or knitted fabric under these conditions will allow the conjugate filaments to express crimping due to the difference in heat shrinkage between the polyester component and the polyamide component. The polyester component and polyamide component may be selected from the aforementioned polymers to form the crimped structure in which the polyamide component is located in the inner sides of the crimps.

[0086] The woven or knitted fabric which has been dyed is usually subjected to final dry heat setting. The temperature of the final dry setting is preferably 120 to 200°C and more preferably 140 to 180°C, and the final setting time is preferably in the range of 1 to 3 minutes. If the temperature for the final dry heat setting is below 120°C, wrinkles created in the fabric during the dyeing will tend to remain, and the dimensional stability of the finished product may be impaired. Conversely, if the temperature for the final dry heat setting is higher than 200°C, crimping of the conjugate filaments created during dyeing will be decreased and the filaments may stiffen and produce too stiff a hand of the fabric.

[0087] In the woven or knitted fabric produced by the process of the present invention, wetting of the woven or knitted fabric by perspiration or rain causes a decrease in degree of crimping of the crimped filaments A themselves, and an increase in their apparent lengths. On the other hand, the filaments B do not elongate even when wetted with water, and therefore the dimensions of the woven or knitted fabric as a whole are fixed. The result is that wetting with water causes the portions of the fabric containing the crimped filaments A to form convexities, thereby manifesting roughness. This manifestation of roughness can also reduce sticking of the fabric to the skin when wetted with water. As a goal for reducing stickiness, the sticking force is preferably no greater than 980 mN (100 grf). To determine the sticking force, a piece of a fabric having a length of 15 cm and a width of 6 cm is placed on a metal roller having a diameter of 8 cm, and one end of the piece is attached to a stress-strain gauge while a clip having a weight of 98 mN (10 grf) is attached at the other end of the fabric piece, as shown in Fig. 1 of Japanese Unexamined Patent Publication HEI No. 9-195172. Next, the metal roller is rotated at a peripheral speed of 7 cm/sec while injecting 0.5 cm³ of water by using a syringe into between the metal roller and the fabric piece, and the tension applied to the fabric piece is measured by using the stress-strain gauge, while recording the measured maximum tension value as the sticking force.

[0088] Conventional methods may be employed to subject the woven or knitted fabric of the invention to water absorption treatment, water repellent treatment, rising treatment, and another various treatments for ultraviolet ray blocking, and imparting the functions of antibacterial agents, deodorants, insecticides, luminous agents, retroreflective agents, minus ion-generating agents, etc, to the fabric.

[0089] A crimped filament-containing woven or knitted fabric according to the present invention may be used for production of various types of textile products.

[0090] Textile products according to the present invention include outerwear sportswear, and underwear materials.

EXAMPLES

[0091] The present invention will be explained in detail through the following examples which are in no way limitative on the scope of the invention.

[0092] The following measurements were conducted for the examples and comparative examples.

1. Intrinsic viscosity of polyester

[0093] This was measured in ortho-chlorophenol as the solvent at 35°C.

2. Intrinsic viscosity of polyamide

[0094] This was measured in m-cresol as the solvent, at 30°C.

3. Tensile strength and elongation at break

[0095] A sample of filaments was allowed to stand in a constant temperature constant humidity room kept at a temperature of atmosphere 25°C, at a humidity of 60% RH, for 24 hours and then the sample having a length of 100 mm was set in a tester (trademark: Tensilon, made by Shimadzu Laboratories Co., Ltd.), and elongated at a rate of 200 mm/min, upon which the strength at breakage (cN/dtex) and the elongation (%) at break were measured. The average value of the data (n=5) was calculated.

4. Shrinkage in boiling water

[0096] The shrinkage (%) in boiling water was measured by the method specified according to JIS L 1013-1998, 7.15. The average value of the data (n=3) was calculated.

5. Percentage of crimp of conjugate filaments

[0097] A wind-up frame having a circumference of 1.125 m was used for rewinding filaments under a load of 49/50 mN x 9 x total tex (0.1 gf x total denier) at a fixed speed for 10 winds to produce a small hank, and the small hank was twisted into a double ring and immersed in boiling water while applying an initial load of 49/2500 mN x 20 x 9 x total tex (2 mg x 20 x total denier) to the hank for 30 minutes, the hank was dried in a drier at 100°C for 30 minutes and then placed in dry heater at 160°C for 5 minutes while maintaining the initial load on the hank. The initial load was removed after the dry heat treatment was completed, and the hank was left to stand in an environment at a temperature of 20°C at a humidity of 65% RH, for 24 hours or more the initial load and an additional load of 98/50 mN x 20 x 9 x total tex (0.2 gf x 20 x total denier) were applied to the hank, the length L0 of the hank was measured, the additional load alone was immediately removed, and one minute after removing the load the length L1 of the hank was measured. The hank was then immersed in water at a temperature of 20°C for 2 hours while maintaining the initial load, removed from water and lightly wiped off water with a filter paper, then the initial load and the additional load were applied to the hank, the length L0' of the hank was measured, the additional load alone was immediately removed and, one minute after removing the load, the length L1' of the hank was measured. These measured data were inserted into the following equations to calculate the dry percentage of crimp (DC), wet percentage of crimp (HC) and the difference (DC-HC) between the dry and wet percentages of crimp. The average value of the data (n=5) was calculated.

$$\text{Dry percentage of crimp DC (\%)} = ((L0 - L1) / L0) \times 100$$

$$\text{Wet percentage of crimp HC (\%)} = ((L0' - L1') / L0') \times 100$$

6. Sticking force

[0098] A test piece of a woven or knitted fabric having with a length of 15 cm and a width of 6 cm was placed on a surface-polished metal roller having a diameter of 8 cm, and one end of the test piece was attached to a stress-strain gauge while a clip having a weight of 98 mN (10 grf) was attached at the other end of the test piece, as shown in Fig. 1 of Japanese Unexamined Patent Publication No. 9-195172. Next, the metal roller was rotated at a peripheral speed of 7 cm/sec while gently injecting 0.5 ml of water with a syringe into between the metal roller and the test piece, and the tension created on the test piece was measured with the stress-strain gauge, and the measured maximum value of the

tention was recoated as the sticking force. The average value of 5 measurement data (n) was determined. A high average value represents an increased sticking force.

7. Roughness change

[0099] A woven or knitted fabric was left to stand in an environment at a temperature of 20°C, at a humidity of 65% RH (n=5) for 24 hours, and then cut into 5 pieces (n=5) each having 30 cm x 30 cm dimensions. The dry thickness (TD) of the test pieces of the woven or knitted fabric was measured in an environment of a temperature of 20°C, and a humidity of 65% RH by using an ultrahigh-precision laser displacement gauge (Model LC-2400, product of Keyence). Next, one ml of water was dropped onto the test pieces with a dropper and one minute after dropping water the water-wetted maximum thickness (TW) at the water-dropped portion of the test pieces was measured using a ultrahigh-precision laser displacement gauge (Model LC-2400, product of Keyence). The roughness change was calculated in accordance with the following equation. The average of five measurement data (n=5) was determined.

$$\text{Roughness change (\%)} = ((\text{TW} - \text{TD}) / \text{TD}) \times 100$$

Example 1

[0100] Nylon-6 with an intrinsic viscosity $[\eta]$ of 1.3 and modified polyethylene terephthalate copolymerized with 2.6 molar percent of 5-sodiumsulfoisophthalic acid, having an intrinsic viscosity $[\eta]$ of 0.39, were melted at 270°C and 290°C, respectively. The same type of side-by-side conjugate filament spinneret as that shown in Fig. 1 of Japanese Unexamined Patent Publication No. 2000-144518 was used for extrusion of the resins each at an extrusion rate of 12.7 g/min, to form a side-by-side conjugate filaments having a cross-sectional profile of the individual filaments as shown in Fig. 1, and the extruded conjugate filaments were cooled to solidify and an oiling agent was applied to the filaments. The filaments were preheated with a preheating roller at a speed of 1,000 m/min at a temperature of 60°C, and then draw-heat treated between the preheating roller and a heating roller heated to a temperature of 150°C, at a speed of 3050 m/min, then finally wound up to obtain an 84 dtex/24 filaments conjugate filament bundle. The tensile strength of the obtained conjugate filaments was 3.4 cN/dtex, and the elongation at break of the filaments was 40%. The conjugate filaments bundle was treated in boiling water to express the crimping, then the percentage of crimp was measured. The dry percentage of crimp DC was 3.3%, the wet percentage of crimp HC was 1.6% and the difference (DC-HC) between the dry percentage of crimp DC and wet percentage of crimp HC was 1.7%.

[0101] The non-crimped composite filament bundle (without boiling water treatment and without crimping or twisting) and a conventional 84 dtex/72 filaments polyethylene terephthalate multifilament yarn (filament B) having a shrinkage in boiling water of 8% were fed to a 28 gauge double circular knitting machine, for knitting of a circular knitted fabric with the knitting structure shown in Table 1.

Table 1 Knitting structure

[illegible]

[Notes:]

C: Cylinder side

D: Dial side

o: Dial side knit

```
x: Cylinder side knit
```

¥: Cylinder side tack

a: Non-crimped conjugate filament yarn

b: Polyester multifilament yarn

[0102] The circular knitted fabric was dyed under conditions of a temperature of 130°C and a top temperature keeping time of 15 minutes, for expression of the latent crimping property of the non-crimped conjugate filament yarn, to produce the crimped filaments A. In the dyeing step, a hygroscopic agent (polyethylene terephthalate-polyethylene glycol copolymer) was contained in an amount of 2 ml/liter with respect to the dyeing solution for treatment in the same bath as the dyeing bath, to apply a hygroscopic treatment to the knitted fabric. The circular knit fabric was subjected to final dry heat setting at a temperature of 160°C for 1 minute.

[0103] The cross-section of the circular knit fabric in the thickness direction is shown in Fig. 4. In Fig. 4, a ply (Z ply) was composed entirely of the filaments B, while the other ply (Y ply) was composed entirely of the crimped filaments A, and the Z ply and Y ply were partially tacked by the polyester filament B yarn.

[0104] In the view of the Y ply side surface of the knitted fabric as shown in Fig. 5, the Y ply was tacked in a lattice formed portion to the Z ply and when wetted with water, the non-tacked rectangular portions b of the Y ply form convexities

to thereby manifest roughness.

[0105] In this knitted fabric, the roughness change between wet and dry states was 15% and the sticking force was 784 mN (80 gf), and the low degree of stickiness when wetted with water was satisfactory from a practical standpoint.

Example 2

[0106] Using a 28 gauge tricot knitting machine, the same conjugated filament (filament A) as used in Example 1 was full-set on a back reeds, while the same polyethylene terephthalate multifilament yarn (filament B) as used in Example 1 was set on the middle reeds at 2 in-10 out, and the same polyethylene terephthalate multifilament yarn (filament B) as used in Example 1 was also set on the front reeds at 10 out-2 in, for knitting a tricot knit with a structure of back: 10-12, middle: 10-12-23-34-45-43-32-21, front: 45-43-32-21-10-12-23-34, with knitting conditions on the machine of 60 courses/2.54 cm. The knitted fabric was then subjected to dye finishing in the same manner as in Example 1.

[0107] For this knitted fabric, the dry cross-section in the thickness direction comprised sections composed entirely of the crimped filaments A (Y sections) and sections composed of the crimped filaments A and filaments B (X sections), as shown in Fig. 6(A).

[0108] As can be seen in Fig. 7, the fabric surface had X sections 9 in a continuous lattice diamond pattern extending over the fabric and, when wetted with water, the rectangular sections (Y sections) 8 surrounded by the lattice pattern formed convexities thus manifesting roughness.

[0109] In this knit fabric, the roughness change between wet and dry states was 25% and the sticking force was 686 mN (70 gf), and therefore the low degree of stickiness when wetted with water was satisfactory from a practical standpoint.

Comparative Example 1

[0110] A dyed (and water absorbing agent treated) circular knit fabric was produced in the same manner as Example 1, except that, the same conjugate filaments as used in Example 1 were employed instead of the polyethylene terephthalate multifilament yarn (filaments B).

[0111] In this knit fabric, the roughness change between wet and dry states was 2% and the sticking force was 1470 mN (150 gf), and therefore the high degree of stickiness when wetted with water was unsatisfactory from a practical standpoint.

INDUSTRIAL APPLICABILITY

[0112] According to the present invention, it is possible to produce woven and knitted fabrics which reversibly manifest roughness on their surfaces when wetted with water, while having reduced roughness when dry, as well as textile products such as outerwear, sportswear underwear produced from the woven or knitted fabrics. Wearing such textile products can reduce sticking between skin and clothing during periods of perspiration.

Claims

1. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water, and comprises yarns comprising crimped filaments A the percentage of crimp of which decreases upon wetting with water, and yarns comprising filaments B comprising at least one type of filaments selected from non-crimped filaments and crimped filaments which undergo substantially no change in percentage of crimp upon wetting with water, **characterized in that** the change in roughness calculated by the equation:

$$\text{change in Roughness (\%)} = ((\text{TW}-\text{TD})/\text{TD}) \times 100$$

wherein TD represents a thickness of the woven or knitted fabric measured after standing it in an environment having a temperature of 20°C and a humidity of 65% RH for 24 hours and TW represents a largest thickness of the water-wetted portion of the woven or knitted fabric measured one minute after 1 ml of water has been dropped onto the woven or knitted fabric, is 5% or greater.

2. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, wherein the crimped filaments A are selected from crimped conjugate filaments comprising a polyester resin component and a polyamide resin component which components are different from one another in terms of

water-absorption and self-elongation properties, and bonded to one another in a side-by-side structure, the conjugate filaments having crimps formed by revealing the latent crimpability of the conjugate filaments.

- 5 3. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 2, wherein the polyester resin component comprises a modified polyethylene terephthalate resin comprising 5-sodiumsolfisophthalic acid copolymerized in an amount of 2.0-4.5 molar percent based on the content of the acid component of the resin.
- 10 4. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, wherein the yarn comprising the crimped filaments A is twisted at the number of twist of 0-300 T/m.
- 15 5. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, wherein the filaments B comprise a polyester resin.
- 20 6. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, comprising at least one portion Y composed entirely of the crimped filaments A at least one portion Z composed entirely of the filaments B, wherein the Z portion being formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.
- 25 7. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, comprising at least one portion Z composed entirely of the filaments B and at least one portion X composed of the filaments A and the filaments B, the Z portion being formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.
- 30 8. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, comprising at least one portion X composed of the crimped filaments A and the filaments B and at least one portion Y composed entirely of the crimped filaments A, wherein the X portion is formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.
- 35 9. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, comprising at least one portion X composed of the crimped filaments A and the filaments B, at least one portion Y composed entirely of the crimped filaments A and at least one portion Z composed entirely of the filament B, wherein the Z portion is formed continuously in either or both the warp and weft directions or in either or both the course and wale directions of the woven or knitted fabric.
- 40 10. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, having a multi-ply weave or knit structure with two or more plies, wherein at least one ply of the multi-ply structure is composed of the crimped filaments A and the filaments B, while at least one other ply is composed entirely of the filaments B, and the ply containing the filaments A and B and the other ply containing the filaments B are partially bound with each other.
- 45 11. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, having a multi-ply weave or knit structure with two or more plies, wherein at least one ply of the multi-ply structure is composed of the crimped filaments A and filaments B, while at least one other ply is composed entirely of the crimped filaments A and B and the other ply containing the crimped filaments A are partially bound with each other.
- 50 12. A crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water according to claim 1, having a multi-ply weave or knit structure with two or more plies, wherein at least one ply of the multi-ply structure is composed entirely of the crimped filaments A, while at least one other ply is composed entirely of the crimped filaments B, and the crimped filaments A-containing ply and the filaments B-containing ply are partially bound with each other.
- 55 13. A process for production of a crimped filament-containing woven or knitted fabric which manifests roughness upon wetting with water, according to any one of claims 1 to 12, **characterized by** comprising a step of producing a precursor woven or knitted fabric from precursor filaments from which crimped filaments A which reveals crimps when a heat treatment is applied thereto, and the resultant crimps having a property such that the percentage of crimp decreases when wetted with water, and precursory filaments from which at least one type of filaments B

selected from filaments which do not reveal crimps even when a heat treatment is applied thereto, and filaments which reveal crimps when a heat treatment is applied thereto but the percentage of crimp of the crimps essentially not decreasing when wetted with water, and a step of applying a heat treatment to the precursory woven or knitted fabric to produce a woven or knitted fabric comprising the crimped filaments A and the filaments B.

5 14. A process for the production of a crimped filament-containing woven or knitted fabric according to claim 13, wherein the precursory filaments from which the crimped filaments A are formed from non-crimped conjugate filaments comprising a polyester resin component and a polyamide resin component which components differ in water-absorption and self-elongation from each other and are bonded in a side-by-side structure.

10 15. A process for production of a crimped filament-containing woven or knitted fabric according to claim 14, wherein the polyester resin component in the non-crimped conjugate filaments comprises a polyester resin having an intrinsic viscosity of 0.30-0.43, and the polyamide resin component comprise a polyamide resin having an intrinsic viscosity of 1.0-1.4.

15 16. A process for production of a crimped filament-containing woven or knitted fabric according to claim 13, wherein the non-crimped conjugate filaments satisfy, after a crimping treatment in boiling water was applied thereto, the requirements:

- 20 (1) a dry percentage of crimp DC after standing in an environment having a temperature of 20°C and a humidity of 65% RH for 24 hours, is in the range of 1.5 to 13%;
 (2) a percentage of crimp HC immediately after an immersion in water at a temperature of 20°C for 2 hours, is in the range of 0.5 to 7.0%; and
 25 (3) a difference between the dry percentage of crimp DC and wet percentage of crimp HC (DC-HC) is 0.5% or greater.

17. A textile product which includes the crimped filament-containing-woven or knitted fabric according to any one of claims 1 to 12.

30 18. A textile product according to claims 17, selected from outerwear, sportswear and underwear clothes.

Fig.1

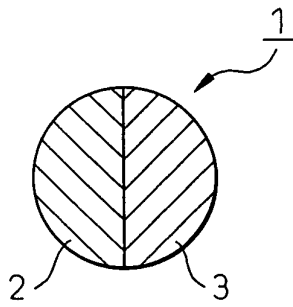


Fig.2

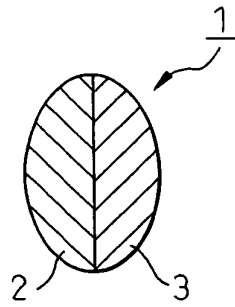


Fig.3

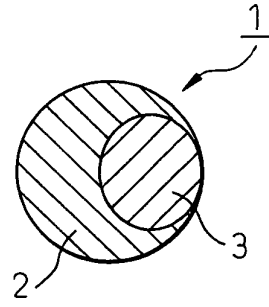
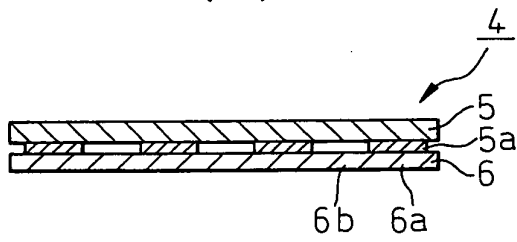


Fig.4

(A)



(B)

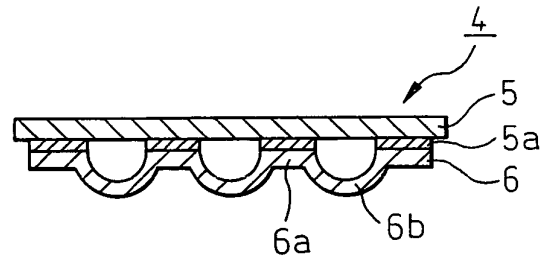


Fig.5

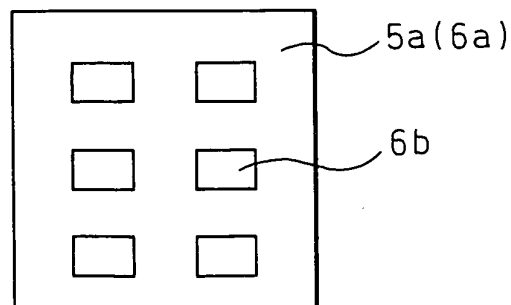


Fig.6

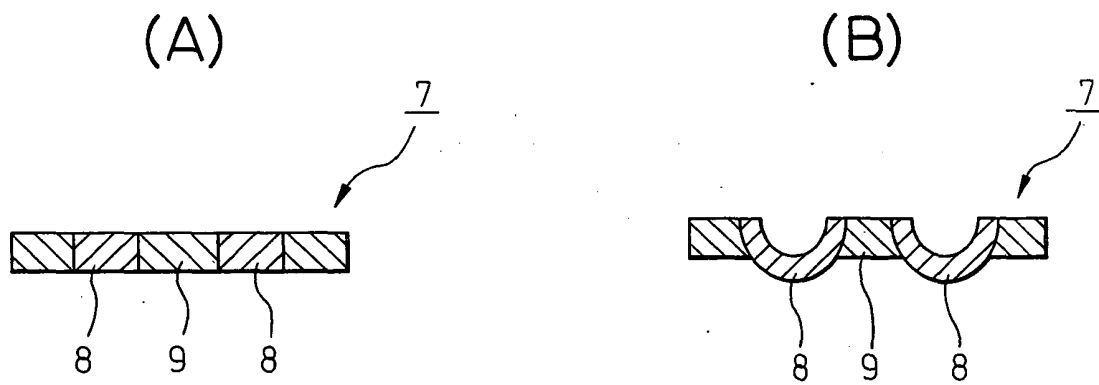
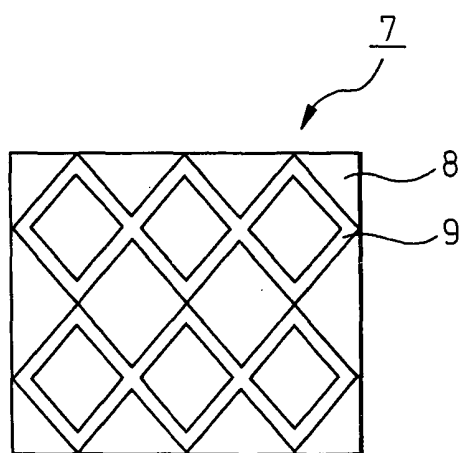


Fig.7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/019245

A. CLASSIFICATION OF SUBJECT MATTER D04B1/20 (2006.01), D03D15/04 (2006.01), A41B17/00 (2006.01), D04B21/00 (2006.01), D06C7/00 (2006.01), D01F8/12 (2006.01)		
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) D04B1/20 (2006.01), D03D15/04 (2006.01), A41B17/00 (2006.01), D04B21/00 (2006.01), D06C7/00 (2006.01), D01F8/12 (2006.01)		
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 1996-2006 Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006		
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.
X Y	JP 62-162043 A (Teijin Ltd.), 17 July, 1987 (17.07.87), Claims; page 3, lower right column to page 4, upper left column; page 4, lower right column, Table 1 (Family: none)	1-9, 13-18 10-12
X Y	JP 60-252756 A (Teijin Ltd.), 13 December, 1985 (13.12.85), Claims; page 3, lower right column; page 4, lower left column, Table 1; examples (Family: none)	1-9, 13-18 10-12
☒ 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 06 January, 2006 (06.01.06)		Date of mailing of the international search report 17 January, 2006 (17.01.06)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/019245

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 60-252746 A (Teijin Ltd.), 13 December, 1985 (13.12.85), Claims; page 3, upper left column; page 4, upper left column, Table 1; examples (Family: none)	1-9, 13-18 10-12
Y	JP 8-218253 A (Mitsubishi Rayon Co., Ltd.), 27 August, 1996 (27.08.96), Claims; Par. No. [0010] (Family: none)	10-12

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

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 9316757 A [0006]
- JP 10131000 A [0007]
- JP 9324313 A [0008]
- JP 2000144518 A [0077] [0100]
- JP 9195172 A [0087] [0098]