



(11) **EP 2 065 497 A1**

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

(43) Date of publication:
03.06.2009 Bulletin 2009/23

(21) Application number: **05795775.5**

(22) Date of filing: **17.10.2005**

(51) Int Cl.:
D04B 1/20 (2006.01) **A41B 1/00** (2006.01)
D03D 15/04 (2006.01) **D02G 3/04** (2006.01)
D04B 21/00 (2006.01) **D06M 15/53** (2006.01)
D06M 101/32 (2006.01) **D01F 8/12** (2006.01)

(86) International application number:
PCT/JP2005/019432

(87) International publication number:
WO 2006/043677 (27.04.2006 Gazette 2006/17)

(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: **19.10.2004 JP 2004304130**

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

(72) Inventors:
• **YASUI, Satoshi**
Osaka-shi, Osaka 541-0054 (JP)

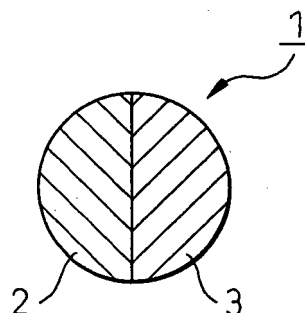
• **YAMAGUCHI, Takeshi**
Osaka-shi, Osaka 541-0054 (JP)
• **YOSHIMOTO, Masato**
Matsuyama-shi, Ehime 791-8041 (JP)
• **MORIOKA, Shigeru**
Matsuyama-shi, Ehime 791-8041 (JP)

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

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

(57) A woven or knitted fabric with a air space which is reversibly decreased by wetting with water compared to its dry state, comprises crimped filaments A whose percentage of crimp decreases upon wetting with water, and filaments B selected from among filaments with no crimps and crimped filaments which undergo substantially no change in percentage of crimp upon wetting with water, wherein the difference between the dry percentage of crimp $DC_f(\%)$ and the wet percentage of crimp (HC_f) ($DC_f - HC_f$) of a crimped filament A taken from the woven or knitted fabric is at least 10%, and the average value RA between the change in dimensions $RP(\%)$ of the woven or knitted fabric in the warp (or wale) direction when wet and when dry, and the change in dimensions $RF(\%)$ in the weft (or course) direction when wet and when dry ($=(RP-RF)/2$) (%) is at least 5%.

Fig.1



Description

FIELD OF THE INVENTION

[0001] The present invention relates to a crimped filament-containing woven or knitted fabric with a decreased air space upon wetting with water, to a process for producing it, and to textile products obtained therefrom. More specifically, the invention relates to a woven or knitted fabric with a decreased air space upon wetting with water and an increasing air space upon drying, as well as to a process for producing it and to textile products obtained therefrom.

BACKGROUND ART

[0002] Fabrics that undergo reversible change in air space by water wetting and drying are known as moisture-sensitive fabrics, and such moisture-sensitive fabrics having various structures have recently been proposed.

[0003] For example, Japanese Unexamined Patent Publication No. 2003-41462 (Patent document 1) discloses an air-permeable self-adjusting woven/knitted fabric comprising crimped conjugated fibers obtained by heat treatment of conjugated fibers made of a polyester resin component and a polyamide resin component bonded in a side-by-side fashion, to produce crimps. In this woven/knitted fabric, the percentage of crimp of the side-by-side crimped conjugated fibers is reduced by water wetting, thereby increasing the air space of the woven/knitted fabric and improving the air permeability.

[0004] When swimming wear or sportswear manufactured from ordinary woven/knitted fabrics made of synthetic or natural fibers is wetted with water, the light permeability often increases and causes the inner side to become visible, and therefore a solution to this problem has been desired. Demand also exists for provision of woven/knitted fabrics with reduced air space and improved waterproof properties in response to water wetting. Yet, woven and knitted fabrics that exhibit improved air permeability (increased air space) by water wetting have reduced waterproof properties in response to water wetting, and therefore cannot meet such demands.

[0005] Patent document 1: Japanese Unexamined Patent Publication No. 2003-41462

DISCLOSURE OF THE INVENTION

[0006] It is an object of the present invention to provide a crimped filament-containing woven or knitted fabric with a lower air space when wetted with water compared to its dry state, and an increased air space upon drying, as well as a process for producing it and to textile products obtained therefrom.

[0007] This object can be achieved by the woven/knitted fabric of the invention, the process for producing it and its textile products according to the invention.

[0008] The crimped filament-containing woven or knitted fabric of the invention is a woven or knitted fabric comprising crimped filaments A whose percentage of crimp decreases upon wetting with water, and filaments B composed of at least one type selected from among filaments with no crimps and crimped filaments which undergo substantially no change in percentage of crimp upon wetting with water, characterized in that the percentage of crimp $DC_f(\%)$ of a sample of dry crimped filaments A prepared by allowing a sample of the crimped filaments A taken from the woven or knitted fabric to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, and the percentage of crimp $HC_f(\%)$ of a sample of the water wetted crimped filaments A prepared by immersing a sample of the crimped filaments A in water at a temperature of 20°C for 2 hours, lifting it out from the water, sandwiching the sample between a pair of filter sheets within 60 seconds of lifting it, subjecting it to a pressure of 0.69 mN/m² for 5 seconds and lightly wiping the water from the sample, satisfies the following requirement (1):

$$(DC_f - HC_f) \geq 10 (\%) \quad (1),$$

and in that the length LPD (mm) in the warp (or wale) direction and the length LFD (mm) in the weft (or course) direction for a sample of the dry woven or knitted fabric prepared by taking a square sample with a 30 cm width in the warp (or wale) direction and a 30 cm length in the weft (or course) direction from the woven or knitted fabric and allowing it to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, and the length LPH (mm) in the warp (or wale) direction and the length LFH (mm) in the weft (or course) direction for a sample of the water wetted woven or knitted fabric prepared by immersing the woven or knitted fabric sample in water at a temperature of 20°C for 2 hours, lifting it out from the water, sandwiching the sample between a pair of filter sheets within 60 seconds of lifting it, subjecting it to a pressure of 0.69 mN/m² for 5 seconds and lightly wiping the water from the sample, are used in the following requirements (2) and (3):

$$RP(\%) = ((LPH - LPD) / LPD) \times 100 \quad (2)$$

$$RF(\%) = ((LFH - LFD) / LFD) \times 100, \quad (3)$$

to calculate the change in dimensions RP (%) representing the proportion of the difference between the length when wet (LPH) and the length when dry (LPD) with respect to the length when dry (LPD) for the warp (or wale) direction of the woven or knitted fabric, and the change in dimensions resizing factor RF (%) representing the proportion of the difference between the length when wet (LFH) and the length when dry (LFD) with respect to the length when dry (LFD) for the weft (or course) direction of the woven or knitted fabric, the average RA of which satisfies the following requirement (4):

$$RA(\%) = (RP + RF) / 2 \leq 5\%, \quad (4)$$

whereby the air space is reduced by wetting with water.

[0009] In the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, preferably the crimped filaments A are selected from among crimped conjugated fibers which differ from one another in terms of water-absorbing and self-extending properties, which are composed of a polyester resin component and a polyamide resin component bonded in a side-by-side fashion, and which have crimps formed by expression of their latent crimping performance.

[0010] Also, the polyester resin component in the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water is preferably composed of a modified polyethylene terephthalate resin comprising 5-sodiumsulfoisophthalic acid copolymerized in an amount of 2.0 to 4.5 mole percent based on the acid component content.

[0011] The crimped filaments A in the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water are preferably used in yarn twisted at the number of twists of 0 to 300 T/m.

[0012] The filaments B in the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water are preferably formed of a polyester resin.

[0013] The woven or knitted fabric, of the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, preferably has a multilayer woven or knitted structure with two or more layers, wherein at least one layer of the multilayer woven or knitted structure comprises the crimped filaments A at a content of 30 to 100 wt% of the total layer weight, and at least one other layer comprises the filaments B at a content of 30 to 100 wt% of the total layer weight.

[0014] The woven or knitted fabric, of the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, may be a knitted fabric with a tubular knitting structure, the composite loops of which tubular knitting structure are formed from the crimped filaments A and filaments B.

[0015] The woven or knitted fabric, of the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, may be a woven fabric with a weave structure, wherein either or both the warp and weft yarns may be composed of paralleled yarn comprising yarn made of the crimped filaments A and yarn made of the filaments B.

[0016] In the woven or knitted fabric, of the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, the yarns made of the crimped filaments A and the yarns made of the filaments B may be arranged alternately with every one yarn being in either or both the warp and weft directions or in either or both the course and wale directions.

[0017] In the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, preferably the yarns made of the crimped filaments A and the yarns made of the filaments B are combined with each other to form a core-in-sheath type composite yarn, wherein the core of the composite yarn is composed of the filament B yarns and the sheath is composed of the crimped filament A yarns.

[0018] In the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, preferably the filaments B are selected from among elastic fibers with a breaking elongation of 300% or greater.

[0019] The woven or knitted fabric, of the crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water, preferably has an air permeability upon wetting with water which is at least 20% lower than the air permeability upon drying.

[0020] The crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water is preferably a dyeing treatment applied fabric.

[0021] The crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water is also preferably a water absorption treatment applied fabric.

[0022] The crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water is also preferably a water repellent treatment applied fabric.

[0023] The process for production of the crimped filament-containing woven or knitted fabric of the invention is a process for production of a crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water, according to the present invention, the process being characterized by comprising a step of producing a precursor woven or knitted fabric from uncrimped fibers for formation of crimped filaments A which express crimping by heat treatment and wherein the crimps have a property such that the percentage of crimp decreases upon wetting with water, and fibers for formation of filaments B comprising at least one type selected from among fibers which do not express crimping by the heat treatment, and fibers which express crimping by the heat treatment but wherein the crimps have a property such that the percentage of crimp substantially does not decrease upon wetting with water, and a step wherein the precursor woven or knitted fabric is subjected to heat treatment to form a woven or knitted fabric containing the crimped filaments A and the filaments B.

[0024] In the process for production of the crimped filament-containing woven or knitted fabric of the invention, preferably the fibers for formation of the crimped filaments A are selected from among uncrimped conjugated fibers made of a polyester resin component and a polyamide resin component, which differ in their moisture-absorbing and self-elongating properties and are combined in a side-by-side structure.

[0025] In the process for production of the crimped filament-containing woven or knitted fabric of the invention, preferably the polyester resin component in the uncrimped fibers 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 to 1.4.

[0026] In the process for production of the crimped filament-containing woven or knitted fabric of the invention, preferably the uncrimped fibers have, after crimping treatment in boiling water,

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

(2) a wet percentage of crimp HC in the range of 0.5 to 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 greater.

[0027] A textile product of the invention includes a crimped filament-containing woven or knitted fabric of the invention which has a decreased air space upon wetting with water.

[0028] The textile product of the invention is preferably selected from among outer garments, sportswear and underwear.

[0029] A woven or knitted fabric of the invention has an air space which decreases by wetting with water and increases by drying, and therefore the visibility is not greater upon wetting, such as wetting caused by sweat, and the waterproof property of the woven or knitted fabric in rain, for example, is improved. A crimped filament-containing woven or knitted fabric of the invention is therefore useful for outer garments, sportswear and inner clothing materials.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

Fig. 1 is a cross-sectional view showing the structure of an example of a crimped filament whose percentage of crimp decreases upon wetting with water, in a woven or knitted fabric of the invention.

Fig. 2 is a cross-sectional view showing the structure of another example of a crimped filament whose percentage of crimp decreases upon wetting with water, in a woven or knitted fabric of the invention.

Fig. 3 is a cross-sectional view showing the structure of still another example of a crimped filament whose percentage of crimp decreases upon wetting with water, in a woven or knitted fabric of the invention.

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 selected from among filaments with no crimps and crimped filaments which undergo substantially no change in percentage of crimp upon wetting with water. When a woven or knitted fabric of the invention is wetted by, for example, sweat or rain, the crimped filaments A undergo a

decrease in percentage of crimp and their apparent lengths are extended. On the other hand, the filaments B undergo essentially no change in percentage of crimp due to wetting and therefore exhibit no change in apparent length, so that the woven or knitted fabric dimensions are virtually unaltered. Consequently, the air space of the woven or knitted fabric is reduced by the crimped filaments A whose apparent lengths have been increased. When the woven or knitted fabric is dried, however, there is virtually no change in the crimping or apparent lengths of the filaments B, while the crimped filaments A increase their percentage of crimp and exhibit a shortening of their apparent lengths, thereby increasing the air space of the woven or knitted fabric.

[0032] In order for a woven or knitted fabric of the invention to exhibit a decreased air space upon wetting with water, it is essential that the percentage of crimp $DC_f(\%)$ of a sample of dry crimped filaments A prepared by allowing a sample of the crimped filaments A taken from the woven or knitted fabric to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, and the percentage of crimp $HC_f(\%)$ of a sample of the water wetted crimped filaments A prepared by immersing a sample of the crimped filaments A in water at a temperature of 20°C for 2 hours, lifting it out from the water, sandwiching the sample between a pair of filter sheets within 60 seconds of lifting it, subjecting it to a pressure of 0.69 mN/m² for 5 seconds and lightly wiping the water from the sample, satisfy the following requirement (1):

$$(DC_f - HC_f) \geq 10 (\%) \quad (1),$$

and that when the length LPD (mm) in the warp (or wale) direction and the length LFD (mm) in the weft (or course) direction are measured for a sample of the dry woven or knitted fabric prepared by taking a square sample with a 30 cm width in the warp (or wale) direction and a 30 cm length in the weft (or course) direction from the woven or knitted fabric and allowing the woven or knitted fabric sample to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, and the length LPH (mm) in the warp (or wale) direction and the length LFH (mm) in the weft (or course) direction are measured for a sample of the water wetted woven or knitted fabric prepared by immersing the woven or knitted fabric sample in water at a temperature of 20°C for 2 hours, lifting it out from the water, sandwiching the sample between a pair of filter sheets within 60 seconds of lifting it, subjecting it to a pressure of 0.69 mN/m² for 5 seconds and lightly wiping the water from the sample, and the values for LPD, LFD, LPH and LFH are used in the following requirements (2) and (3):

$$RP (\%) = ((LPH - LPD) / LPD) \times 100 \quad (2)$$

$$RF (\%) = ((LFH - LFD) / LFD) \times 100, \quad (3)$$

to calculate the change in dimensions RP (%) representing the proportion of the difference between the length when wet (LPH) and the length when dry (LPD) with respect to the length when dry (LPD) for the warp (or wale) direction of the woven or knitted fabric, and the change in dimensions RF (%) representing the proportion of the difference between the length when wet (LFH) and the length when dry (LFD) with respect to the length when dry (LFD) for the weft (or course) direction of the woven (or knitted) fabric, the average RA thereof satisfies the following requirement (4):

$$RA (\%) = (RP + RF) / 2 \leq 5\%. \quad (4)$$

[0033] The value of $(DC_f - HC_f)$ is preferably 15 to 30%, and the RA value is preferably 1 to 3%. If the $(DC_f - HC_f)$ value is less than 10% and/or the RA value is larger than 5%, elongation of the woven or knitted fabric as a whole will absorb the extension in apparent lengths of the crimped filaments A by the reduction in percentage of crimp of the crimped filaments A when the woven or knitted fabric is wetted with water, thus preventing reduction in the air space of the woven or knitted fabric.

[0034] The percentage of crimp of the crimped filaments A in the woven or knitted fabric is measured by the following method.

[0035] A test woven or knitted fabric is allowed to stand for 24 hours in an atmosphere at a temperature of 20°C, 65% RH and then 30 cm x 30 cm strips are cut from the woven or knitted fabric in the same direction as the woven or knitted fabric (n=5). Crimped filaments A are removed from each of the strips and subjected to a load of 1.76 mN/dtex (200 mg/de) and the filament lengths L0f are measured, and then after 1 minute of releasing the load, a load of 0.0176 mN/dtex (2 mg/de) is applied and the filament lengths L1f are measured. Also, the filaments are immersed for 2 hours in water at a temperature of 20°C and then removed and the water is wiped off gently with filter paper, after which a load

of 1.76 mN/dtex (200 mg/de) is applied, the filament lengths L_{0f} are measured, and then after 1 minute of releasing the load, a load of 0.0176 mN/dtex (2 mg/de) is applied and the filament lengths L_{1f} are measured. The measured values are used in the following formulas to calculate the percentage of crimp when dry DCf(%), the percentage of crimp when wet HCf(%) and the difference in percentages of crimp when dry and when wet (DCf-HCf)(%). The average of the number n (5) is calculated.

$$\text{Dry percentage of crimp DCf(\%)} = ((L_{0f} - L_{1f}) / L_{0f}) \times 100$$

$$\text{Wet percentage of crimp HCf(\%)} = ((L_{0f}' - L_{1f}') / L_{0f}') \times 100$$

[0036] It is essential for the crimped filaments A taken from the woven or knitted fabric to be crimped filaments wherein the difference between the dry percentage of crimp DC(%) and wet percentage of crimp HC(%) (DC-HC) is at least 10%.

[0037] Such crimped filaments A are preferably selected from among crimped conjugated fibers which differ from one another in terms of water-absorbing and self-extending properties, are composed of a polyester resin component and a polyamide resin component bonded in a side-by-side fashion, and have crimps formed by expression of their latent crimping performance.

[0038] As polyester resin components to be used for the conjugated fibers there are preferred those having high adhesion with the aforementioned polyamide resin component, and for example, there are preferably used modified polyesters such as polyethylene terephthalate, polypropylene terephthalate or polybutylene terephthalate which are copolymerized with compounds which have an alkali or alkaline earth metal or phosphonium salt of sulfonic acid, and which have one or more functional groups with ester-forming capability. Particularly preferred among these are modified polyethylene terephthalate copolymerized with the aforementioned compounds because of their general purpose utility and low polymer cost. Examples of copolymerizing components in this case include 5-sodiumsulfoisophthalic acid and its ester derivatives, 5-phosphoniumisophthalic acid and its ester derivatives, sodium p-hydroxybenzenesulfonate, and the like. Preferred among these is 5-sodiumsulfoisophthalic acid. The copolymerization content is preferably in the range of 2.0 to 4.5 mole percent with respect to the moles of the acid component in the polyester resin. If the copolymerization content is less than 2.0 mole percent, excellent crimping performance is exhibited but peeling may occur at the bonding interface between the polyamide resin component and polyester resin component. Conversely, if the copolymerization content is greater than 4.5 mole percent, crystallization of the polyester resin component will be inhibited during stretching heat treatment, thus requiring a higher stretching heat treatment temperature level than usual, and potentially leading to numerous yarn breaks.

[0039] On the other hand, the polyamide resin component is not particularly restricted so long as it has an amide bond in the main chain, and as examples there may be mentioned nylon-4, nylon-6, nylon-66, nylon-46 and nylon-12. Among these nylon-6 and nylon-66 are particularly preferred from the viewpoint of general utility, polymer cost and reeling stability.

[0040] The polyester resin component and polyamide resin component may also contain publicly known additives such as pigments, delustering agents, anti-fouling agents, fluorescent brighteners, flame retardants, stabilizers, antistatic agents, light fastness agents, ultraviolet absorbers and the like.

[0041] There are no particular restrictions on the cross-sectional profile of side-by-side conjugated fibers for the crimped filaments A, and the bonding line between the polyester resin component and the polyamide resin component in the cross-sectional shape may be essentially straight linear or a completely straight line. Examples of cross-sectional shapes for the conjugated fibers are shown in Figs. 1 to 3. In Fig. 1, the conjugated fiber 1 has a circular cross-sectional profile and is composed of a polyester resin component 2 and polyamide resin component 3 bonded together, with an essentially straight linear bonding line. In Fig. 2, the conjugated fiber 1 has an oval cross-sectional profile and is composed of a polyester resin component 2 and polyamide resin component 3 bonded together, with an essentially straight linear bonding line. In Fig. 3, the conjugated fiber 1 has a circular cross-sectional shape and is composed of a polyester resin component 2 and polyamide resin component 3 bonded together, but the polyamide resin component 3 has a roughly circular cross-sectional profile and is situated in the polyester resin component also having a roughly circular cross-sectional profile, in a positional relationship approximating an eccentric core-in-sheath structure. However, a portion of the periphery of the polyamide resin component 3 is exposed and forms a part of the periphery of the conjugated fiber.

[0042] The cross-sectional profile of the conjugated fiber may be, instead of circular or oval, polygonal such as triangular or rectangular, or star-shaped or even hollow. However, the cross-sectional profile of the conjugated fiber is preferably circular in order to efficiently decrease the percentage of crimp upon wetting with water.

[0043] The weight ratio of the two resin components in the conjugated fibers for the crimped filaments A is not particularly restricted, but the weight ratio of the polyester resin component with respect to the polyamide resin component is preferably in the range of 30:70 to 70:30 and more preferably 40:60 to 60:40.

[0044] There are no particular restrictions on the individual filament thickness of the crimped filaments A or on the number of individual filaments of the crimped filaments A contained in the crimped filament yarn, but the individual filament thickness is preferably 1 to 10 dtex and more preferably 2 to 5 dtex. The number of individual filaments in the crimped filament A yarns is preferably 10 to 200 and more preferably 20 to 100.

[0045] Uncrimped side-by-side conjugated fibers composed of two different resin components as described above have a latent crimping property, and therefore express crimps when subjected to heat treatment such as, for example, high-temperature dyeing treatment. In such crimped conjugated fibers, preferably the polyamide resin component is situated on the inner portions of the crimps, while the polyester resin component is situated on the outer portions of the crimps. When crimped conjugated fibers having such a crimp structure are wetted with water, the polyamide resin component situated on the inner portions of the crimps are swelled by the water and expand while the polyester resin component situated on the outer portions of the crimps do not swell with water and their lengths are unchanged, such that the percentage of crimp of the conjugated fibers is reduced, and the apparent lengths increase. On the other hand, when the water-wetted crimped conjugated fibers are dried, the polyamide resin component shrinks while the polyester resin component undergoes no change in length, such that the percentage of crimp of the conjugated fibers increases and the apparent length of the crimped conjugated fibers is shortened.

[0046] The crimped filaments A are preferably in untwisted yarn or false twisted yarn with no more than 300 T/m twists, in order to facilitate reduction in the percentage of crimp and lengthening upon wetting with water. Untwisted filaments are especially preferred. With strong twisted yarn having strong twisting with greater than 300 T/m, the crimping is sometimes reduced upon wetting with water.

[0047] Also, yarn comprising the crimped filaments may be subjected to, for example, interlacing air treatment and/or false twisting treatment, and such treatment may cause interlacing of the individual filaments in the yarn at an interlacing number of about 20 to 60/m.

[0048] As long as the aforementioned conditions are satisfied, there are no particular other restrictions on the type of filaments B used in a woven or knitted fabric of the invention, i.e. the filaments which are uncrimped and 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 the dry percentage of crimp DC(%) when the filaments are dried under the conditions described above and the wet percentage of crimp HC(%) when they are wetted with water under the conditions described above (DC-HC) is less than 0.5(%) .

[0049] The filaments B used for a woven or knitted fabric of the invention include filaments suitable for clothing, and may be polyesters such as polyethylene terephthalate, polytrimethylene terephthalate and polybutylene terephthalate, polyamides such as nylon-6 and nylon-66, polyolefins such as polyethylene and polypropylene, synthetic filaments formed from acrylic compounds, para- or meta-aramids and their modified synthetic resins, natural fibers, regenerated fibers, semi-synthetic fibers, polyurethane-based elastic fibers and polyether ester-based elastic fibers. Preferred among these are polyethylene terephthalate, polypropylene terephthalate and polybutylene terephthalate, as well as polyester filaments composed of modified polyesters obtained by copolymerization of these with copolymerizing components, because of their high dimensional stability when wet and their excellent compatibility with the crimped filaments A (combined filament properties, mixed knitting or mixed weaving properties and dyeing properties). There are also no particular restrictions on the individual filament thickness of the filaments B or on the number of individual filaments (number of filaments) in yarn comprising the filaments B, but for increased hygroscopicity of the woven or knitted fabric and further improved performance of air permeability when wet, the individual filament thickness is preferably 0.1 to 5 dtex (more preferably 0.5 to 2 dtex) and the number of filaments per yarn is preferably in the range of 20 to 200 and more preferably 30 to 100. The yarn comprising the filaments B can be subjected to interlacing air treatment and/or ordinary false twisting treatment. Such treatment may cause interlacing of the individual filaments in the yarn at an interlacing number of about 20 to 60/m.

[0050] 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 made of uncrimped filaments and/or filaments which undergo essentially no change in percentage of crimp upon wetting. Both may be used as separate yarns to form the woven or knitted fabric, or they may form the woven or knitted fabric as combined filament yarn such as air-mixed yarn, double twisted yarn, combined false twisted crimped yarn, paralleled yarn and the like.

[0051] There are no particular restrictions on the texture or number of layers for production of a woven or knitted fabric. For example, there may be suitably used a woven texture such as a plane weave, twill weave or satin weave, or a knitted texture such as a plain stitch, smooth knit, circular rib knit, seed stitch, plating stitch, Denbigh stitch, half knit or the like. However, there is no limitation to these. The layer structure for composing a woven or knitted fabric may be single-layer or multilayer with two or more layers.

[0052] Modes of woven or knitted fabrics include:

(1) woven or knitted fabrics having a multilayer woven or knitted structure of two or more layers wherein at least one of the layers of the multilayer woven or knitted structure comprises the crimped filaments A at a content of 30 to 100 wt% of the total weight of the layer, and at least one other layer comprises the filaments B at a content of 30 to 100 wt% of the total weight of the layer,

(2) knitted fabrics having a tubular knitting structure, with the composite loops of the tubular knitting structure formed from both the crimped filaments A and filaments B,

(3) woven fabrics having a woven texture, wherein either or both the warp and weft yarn is composed of paralleled yarn comprising yarn made of the crimped filaments A and yarn made of the filaments B.

(4) woven or knitted fabrics wherein the yarns made of the crimped filaments A and the yarns made of the filaments B are arranged alternately with every one yarn being in either or both the warp and weft directions or in either or both the course and wale directions.

(5) woven or knitted fabrics wherein the yarns made of the crimped filaments A and the yarns made of the filaments B are combined together to form a core-in-sheath type composite yarn, wherein the core of the conjugated yarn is composed of the filament B yarns and the sheath is composed of the crimped filament A yarns.

[0053] In the composite yarn having a core-in-sheath structure for mode (5) described above, it is important for the length LA of the sheath yarn made of the crimped filaments A and the length LB of the core yarn made of the filaments B to satisfy the relational expression: $LA > LB$. That is, if $LA \leq LB$, wetting of the obtained woven or knitted fabric will cause a reduced percentage of crimp for the crimped filaments A from which the sheath is formed, and when the apparent length is increased the filament B yarns from which the core is formed will also be elongated due to stretching by the elongated crimped filament A sheath yarn, eventually creating a change in dimensions in the woven or knitted fabric as a whole; thus, decrease in the percentage of crimp and increase in the apparent length of the crimped filaments A will not contribute to a reduced the air space of the woven or knitted fabric as a whole. The aforementioned relational expression $LA > LB$ can be satisfied by (1) a method wherein a high heat-shrinkage yarn with a boiling water shrinkage of 20% or greater is used as the core filament B yarns for production of composite yarn comprising the crimped filament A yarns for the sheath and the high heat-shrinkage filament B yarns for the core, a precursor woven or knitted fabric is produced from this composite yarn, and the precursor woven or knitted fabric is subjected to heat shrinkage treatment for heat shrinkage of the filament B yarns in order to achieve the expression $LA > LB$, and (2) a method wherein elastic filaments are used as the filament B yarns and these are mixed or paralleled with the crimped filaments A with the elastic filaments B in an elongated state to produce a precursor core-in-sheath composite yarn, after which the elongation is removed from the precursor composite yarn, elastic shrinkage is produced in the elastic filaments B to achieve the expression $LA > LB$, and a woven or knitted fabric is produced from the core-in-sheath composite yarn.

[0054] In a woven or knitted fabric of the invention, the lengths LA and LB of the core yarn and sheath yarn in the core-in-sheath composite yarn may be measured by the following method.

[0055] A test woven or knitted fabric is allowed to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, a sample with a 30 cm length in the warp (or wale) direction and a 30 cm width in the weft (or course) direction is taken from the woven or knitted fabric, and then a crimped filament A yarn and filament B yarn are taken from core-in-sheath composite yarn oriented in the same direction. The length LA of the crimped filament A yarn is measured under a load of 1.76 mN/dtex, and the length LB of the filament B yarn is measured under a load of 1.76 mN/dtex if it is a non-elastic filament yarn with a breaking elongation of up to 200%, or under a load of 0.0088 mN/dtex if it is an elastic filament yarn with a high breaking elongation exceeding 20%. The elastic filaments used as filaments B in a woven or knitted fabric of the invention preferably have a breaking elongation of 300% or greater.

[0056] The process for producing a woven or knitted fabric of the invention comprises a step of producing a precursor woven or knitted fabric from uncrimped fibers for formation of crimped filaments A which express crimping by heat treatment and wherein the crimps have a property such that the percentage of crimp decreases upon wetting with water, and fibers for formation of filaments B comprising at least one type selected from among fibers which do not express crimping by the heat treatment, and fibers which express crimping by the heat treatment but wherein the crimps have a property such that the percentage of crimp substantially does not decrease upon wetting with water, and a step wherein the precursor woven or knitted fabric is subjected to heat treatment to form a woven or knitted fabric containing the crimped filaments A and the filaments B.

[0057] In the process of the invention, preferably the fibers for formation of the crimped filaments A are selected from among uncrimped conjugated fibers made of a polyester resin component and a polyamide resin component, which differ in their moisture-absorbing and self-extending properties and are bonded in a side-by-side fashion. Also, preferably the polyester resin component of the uncrimped fibers 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 to 1.4. The intrinsic viscosity of the polyester resin component of the uncrimped fibers is more preferably 0.35 to 0.40 and the intrinsic viscosity of the polyamide resin is more preferably 1.2 to 1.4. The intrinsic viscosity of the polyester resin is measured at a temperature of 35°C with ortho-chlorophenol as the solvent, and the intrinsic viscosity of the polyamide resin is

measured at a temperature of 30°C with m-cresol as the solvent.

[0058] In the aforementioned production process, an intrinsic viscosity of the polyester resin component higher than 0.43 yields a conjugated fiber with physical properties similar to fiber composed of a polyester resin component alone, and can prevent reduction in the air space when the woven or knitted fabric is wetted with water. Also, an intrinsic viscosity of the polyester resin component of less than 0.30 excessively reduces the viscosity of the molten polyester resin component during the melt spinning step, resulting in insufficient fiber formability, increased generation of fluff in the obtained conjugated fibers, and inadequate quality and production efficiency for the conjugated fibers.

[0059] The spinneret used to produce the side-by-side conjugated filaments A may be one as shown in Fig. 1 of Japanese Unexamined Patent Publication No. 2000-144518. The extrusion openings for the high viscosity resin component and the extrusion openings for the low viscosity resin component in this spinneret are separated, in a design wherein the cross-sectional area of the extrusion openings for the high viscosity resin is increased to lower the extrusion rate. This type of spinneret is used for passage of the molten polyester resin component through the high viscosity resin extrusion openings and passage of the molten polyamide resin component through the low viscosity resin extrusion openings, joining the two types of melt flows in a side-by-side fashion and cooling them to solidification. In this melt spinning step, the weight ratio of the polyester resin component with respect to the polyamide resin component is preferably 30:70 to 70:30, and more preferably 40:60 to 60:40.

[0060] For production of the aforementioned side-by-side conjugated fibers, the unstretched fiber yarns (bundled) produced in the melt spinning step may be first wound up and then supplied to a stretching step (separate stretching), or the melt spun unstretched filament yarns (unbundled) may be supplied directly to a stretching heat treatment step without winding up (direct stretching). The stretching step may be carried out under ordinary conditions. For example, in a direct stretching system, the spinning step is carried out at a spinning speed of 1000 to 3500 m/min, and the obtained unstretched fiber yarn is immediately stretched at a desired draw ratio at a temperature of 100 to 150°C and wound up. The draw ratio is appropriately set so that the finally obtained conjugated fiber has a breaking elongation of preferably 10 to 60% and more preferably 20 to 45%, and a tensile strength of preferably 3.0 to 4.7 cN/dtex and more preferably 3.0 to 4.0 cN/dtex.

[0061] The uncrimped fibers of the conjugated fibers for the crimped filament A obtained by the production process of the invention preferably have, after crimping treatment in boiling water,

- (1) a dry percentage of crimp DC in the range of 1.5 to 13% after standing for 24 hours in an environment at a temperature of 20°C, 65% RH,
- (2) a wet percentage of crimp HC in the range of 0.5 to 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 greater.

[0062] The dry percentage of crimp DC and wet percentage of crimp HC are measured by the following methods.

[0063] A wind-up frame with a circumference of 1.125 m is used for rewinding 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 skein, the small skein is twisted into a double ring and placed in boiling water while subjected to an initial load of 49/2500 mN x 20 x 9 x total tex (2 mg x 20 x total denier) for 30 minutes' of treatment, after which it is dried for 30 minutes with a drier at 100°C and then placed in dry heat at 160°C while subjected to the initial load for 5 minutes of treatment. The initial load is removed after the dry heat treatment, and after standing for at least 24 hours in an environment at a temperature of 20°C, 65% RH, the initial load and 98/50 mN x 20 x 9 x total tex (0.2 gf x 20 x total denier) double load are applied, the skein length L0 is measured, the double load alone is immediately removed, and the skein length L1 one minute after removing the load is measured. The skein is then immersed for 2 hours in water at a temperature of 20°C while under the initial load, and after removal and lightly wiping off the water with filter paper, it is subjected to the initial load and the double load, the skein length L0' is measured, the double load alone is immediately removed, and the skein length L1' one minute after removing the load is measured. These measured values are inserted into the following formula to calculate the dry percentage of crimp (DC), wet percentage of crimp (HC) and the difference in dry and wet percentage of crimps (DC-HC).

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

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

[0064] When the dry percentage of crimp of the conjugated fiber is smaller than 1.5%, the change in percentage of

crimp when wet is reduced, and therefore the change in air permeability of the woven or knitted fabric may be smaller. Conversely, when the dry percentage of crimp of the conjugated fiber is greater than 13%, crimping is strong enough to inhibit change in crimping when wet, and the change in air permeability of the woven or knitted fabric may likewise be smaller. If the difference in percentage of crimp of the conjugated fiber when dry and when wet (DC-HC) is less than 0.5%, the change in air permeability of the woven or knitted fabric may be excessively small.

[0065] In the process for production of a woven or knitted fabric of the invention, the aforementioned uncrimped conjugated fibers, and the filaments B which are uncrimped with a hot water shrinkage of 20% or greater or crimped with a percentage of crimp which is essentially unchanged upon wetting, are used to weave or knit a precursor woven or knitted fabric, which is then subjected to dyeing wherein the heat of dyeing produces crimps in the conjugated fibers to produce a woven or knitted fabric containing crimped filaments A. When a core-in-sheath type composite yarn is obtained using the crimped conjugated filament A yarn and the filament B yarn, it is important for the length LA of the crimped filament A yarn to be larger than the length LB of the filament B yarn in the composite yarn.

[0066] There are no special restrictions on the woven or knitted texture of a woven or knitted fabric according to the invention.

[0067] In the production process of the invention, 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 from 5 to 40 minutes as the keep time at the top temperature. Dyeing of the woven or knitted fabric under these conditions will allow the uncrimped conjugated fibers to express crimping by the heat shrinkage difference between the polyester resin component and the polyamide resin component. The polyester resin component and polyamide resin component may be selected from among the aforementioned polymers to yield a crimped structure with the polyamide component situated on the inner sides of the crimps.

[0068] The woven or knitted fabric which has been dyed is usually subjected to final dry heat setting. The temperature of the final dry heat setting is preferably 120 to 200°C and more preferably 140 to 180°C, and the 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 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 conjugated fibers during dyeing will be reduced and the fibers may harden and produce a hard feel to the cloth.

[0069] In the woven or knitted fabric obtained in this manner, the air permeability upon wetting is preferably at least 20% lower than when dry, and more preferably 30 to 100%. The air permeability is a property representative of the air space of the woven or knitted fabric, and a lower air permeability of the woven or knitted fabric means a smaller air space. The air permeability is the value (ml/cm²/s) measured according to JIS L 1096 1998, 6.27.1, A (Fragile-Type Air Permeability Tester Method).

[0070] "Dry" in this case is the state of the sample after standing for 24 hours in an environment at 20°C, 65% RH, while "wet" is the state of the sample after immersion for 2 hours in water at 20°C, sandwiching it between a pair of filter sheets, subjecting it to a pressure of 490 N/m² for one minute and lightly wiping the water off; the air permeability is measured for each (n=5) and the average is calculated.

[0071] The woven or knitted fabric of the invention is preferably subjected to hygroscopic treatment and/or water repellent treatment, depending on the purpose and intended use. For example, it is preferably subjected to hygroscopic treatment when the purpose is improving the anti-visibility property of sportswear and underwear caused by sweat. Hygroscopic treatment of the woven or knitted fabric is preferred because it increases the diffusion rate of sweat and prevents a sticky feel, while also increasing the rate of change in crimping of the crimped filaments A whose percentage of crimp decreases upon wetting, and increasing the response speed for improved anti-visibility. Also, water repellent treatment is preferred when the purpose is improving the waterproof properties of windbreakers or ski and snowboard wear in rain. Water repellent treatment is preferred because it increases the initial waterproofness while lowering the air space of the woven or knitted fabric by absorption of moisture and water by the crimped filaments A whose percentage of crimp decreases upon wetting, during periods when the water repellent coating of the woven or knitted fabric surface repels rain, thereby improving the waterproof properties.

[0072] The agent used for the hygroscopic treatment is preferably polyethylene glycol or a derivative thereof, or polyethylene terephthalate-polyethylene glycol copolymer, adhered at 0.25 to 0.50 wt% with respect to the weight of the woven or knitted fabric. The method for hygroscopic treatment may be, for example, a bath treatment method in which the hygroscopic agent is mixed with the dyeing solution during dyeing, or a coating method such as a method of dipping the woven or knitted fabric in a hygroscopic treatment solution before the final dry heat setting and squeezing it with a mangle, a gravure coating method or a screen printing method.

[0073] On the other hand, the water repellent treatment is preferably carried out until the water repellency of the woven or knitted fabric after water repellent treatment is at least level 4 according to JIS L 1092 6.2 (Spray Test). An example is a method wherein a commercially available fluorine-based water repellent (for example, Asahi Guard LS-317 by Asahi Glass Co., Ltd.) is used as the water repellent, if necessary with mixture of a melamine resin and a catalyst, to prepare a treatment agent with a water repellent agent content of about 3 to 15 wt%, and this treatment agent is used for treatment

of the surface of the fabric at a pickup rate of about 50 to 90%. The method for treatment of the surface of the fabric with the water repellent agent may be a pad method, spray method or the like, but a pad method is most preferred from the standpoint of penetration of the treatment agent to the interior of the fabric. The pickup rate is the weight ratio (%) of the treatment agent with respect to the weight of the fabric (before applying the treatment agent).

[0074] When a woven or knitted fabric of the invention is wetted by sweat or rain, the crimped filaments A extend due to reduction in the amount of their own crimps. Meanwhile, the filaments B do not extend even when wetted and therefore maintain a fixed dimension of the woven or knitted fabric, resulting in a lower air space of the woven or knitted fabric and improved anti-visibility and waterproof properties of the woven or knitted fabric.

[0075] In addition to the treatments described above, ordinary methods may be employed to subject the woven or knitted fabric of the invention to piling treatment, ultraviolet blocking, or various treatments which confer the functions of antibacterial agents, deodorants, insecticides, luminous agents, retroreflective agents, minus ion-generating agents and the like.

[0076] A crimped filament-containing woven or knitted fabric with a reduced air space upon wetting with water according to the invention may be used for production of various types of textile products. Such textile products include outer garments, sportswear, and underwear.

EXAMPLES

[0077] The present invention will now be explained in greater detail through the following examples, with the understanding that the invention is not limited in any way to the examples. The following measurements were conducted for the examples and comparative examples.

(1) Intrinsic viscosity of polyester

[0078] This was measured at 35°C using ortho-chlorophenol as the solvent.

(2) Intrinsic viscosity of polyamide

[0079] This was measured at 30°C using m-cresol as the solvent.

(3) Tensile strength and breaking elongation

[0080] A fiber sample was allowed to stand a day and a night in a steady temperature and humidity chamber kept in an atmosphere at 25°C, 60% RH, and then a sample length of 100 mm was set in a Tensilon tester by Shimadzu Laboratories Co., Ltd. and pulled at a rate of 200 mm/min, upon which the tensile strength at breakage (cN/dtex) and the elongation (%) were measured. The average value of n=5 was calculated.

(4) Boiling water shrinkage

[0081] The boiling water shrinkage (hot water shrinkage) (%) was measured by the method specified according to JIS L 1013 1998, 7.15. The average value of n=3 was calculated.

(5) Percentage of crimp of conjugated fiber

[0082] A wind-up frame with a circumference of 1.125 m was used for rewinding 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 skein, the small skein was twisted into a double ring and placed in boiling water while subjected to an initial load of 49/2500 mN x 20 x 9 x total tex (2 mg x 20 x total denier) for 30 minutes of treatment, after which it was dried for 30 minutes with a drier at 100°C and then placed in dry heat at 160°C while subjected to the initial load for 5 minutes of treatment. The initial load was removed after the dry heat treatment, and after standing for at least 24 hours in an environment at a temperature of 20°C, 65% RH, the initial load and the 98/50 mN x 20 x 9 x total tex (0.2 gf x 20 x total denier) double load were applied, the skein length L0 was measured, the double load alone was immediately removed, and the skein length L1 one minute after removing the load was measured. The skein was then immersed for 2 hours in water at a temperature of 20°C while under the initial load, and after removal and lightly wiping off the water with filter paper, it was subjected to the initial load and the double load, the skein length L0' was measured, the double load alone was immediately removed, and the skein length L1' one minute after removing the load was measured. These measured values were inserted into the following formula to calculate the dry percentage of crimp (DC), wet percentage of crimp (HC) and the difference in dry and wet percentages of crimp (DC-HC). The average value of n=5 was calculated.

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

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

(6) Percentage of crimp of crimped conjugated fibers in woven or knitted fabric

[0083] The woven or knitted fabric was allowed to stand for 24 hours in an atmosphere at a temperature of 20°C, 65% RH and then test strips with a length of 30 cm in the warp (or wale) direction and a width of 30 cm in the weft (or course) direction were taken from the woven or knitted fabric (n=5). Crimped filaments A were removed from each of the test strips and subjected to a load of 1.76 mN/dtex (200 mg/de) and the filament lengths L_{0f} were measured, and then after 1 minute of releasing the load, a load of 0.0176 mN/dtex (2 mg/de) was applied and the filament lengths L_{1f} were measured. Also, the filaments were immersed for 2 hours in water at a temperature of 20°C, removed and then placed between a pair of filter sheets at a pressure of 0.69 mN/m² for 5 seconds and the water was wiped off gently, after which a load of 1.76 mN/dtex (200 mg/de) was applied, the filament lengths L_{0f}' were measured, and then after 1 minute of releasing the load, a load of 0.0176 mN/dtex (2 mg/de) was applied and the filament lengths L_{1f}' were measured. The measured values were used in the following formulas to calculate the percentage of crimp when dry DC_f(%), the percentage of crimp when wet HC_f(%) and the difference in percentages of crimp when dry and when wet (DC_f-HC_f)(%). The average of n=5 was calculated.

$$\text{Dry percentage of crimp DC}_f(\%) = ((L_{0f} - L_{1f}) / L_{0f}) \times 100$$

$$\text{Wet percentage of crimp HC}_f(\%) = ((L_{0f}' - L_{1f}') / L_{0f}') \times 100$$

(7) Air permeability

[0084] The air permeability was measured by the following method as a property representing the air space of the woven or knitted fabric. The air permeability when dry (cc/cm²/s) and the air permeability when wet (cc/cm²/s) were measured for a woven or knitted fabric sample according to JIS L 1096 1998, 6.27.1, A (Fragile-Type Air Permeability Tester Method). "Dry" was the state of the sample after standing for 24 hours in an environment at 20°C, 65% RH, while "wet" was the state of the sample after immersion for 2 hours in water at 20°C, sandwiching it between a pair of filter sheets, subjecting it to a pressure of 490 N/m² for one minute and lightly wiping the water off; the air permeability was measured for each (n=5) and the average was calculated. The change in air permeability was calculated by the following equation.

$$\text{Change in air permeability (\%)} = ((\text{air permeability when dry}) - (\text{air permeability when wet})) / (\text{air permeability when dry}) \times 100$$

(8) Change in dimensions RA of sample

[0085] The change in dimensions RA of a sample of the woven or knitted fabric was calculated in accordance with the following equations. The average was calculated for n=5.

$$RA(\%) = (RP + RF) / 2$$

$$RP(\%) = ((LPH-LPD)/LPD) \times 100$$

$$RF(\%) = ((LFH-LFD)/LFD) \times 100$$

[0086] Here, LPH, LPD, LFH and LFD respectively represent the lengths upon wetting with water and the lengths upon drying in the warp (or wale) direction and the weft (or course) directions of the sample, where the sample was in a square form with a 30 cm length in the warp (or wale) direction and a 30 cm width in the weft (or course) direction from the woven or knitted fabric. LPH: a wet length of the sample in the warp (or wale) direction (mm), LPD: a dry length of the sample in the warp (or wale) direction (mm), LFH: a wet length of the sample in the weft (or course) direction (mm), LFD: a dry length of the sample in the weft (or course) direction, "wet": a state of the sample after immersion in water at 20°C for 2 hours, immediately sandwiching it between a pair of filter sheets, subjecting it to a pressure of 0.69 mN/m² for 5 seconds and lightly wiping the water off, "dry": a state of the sample after standing for 24 hours in an environment at 20°C, at 65% RH.

(9) Measurement of yarn length

[0087] The woven or knitted fabric was allowed to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, and then a strip of 30 cm (in the warp (or wale) direction) x 30 cm (in the weft (or course) direction) was cut out (n=5). Next, a conjugated filament (A) yarn and filament (B) yarn were taken from each strip, a load of 0.0088 mN/dtex was applied in the case of an elastic filament or a load of 1.76 mN/dtex in the case of a non-elastic filament, and the length LA of the conjugated filament A yarn and the length LB of the other filament B yarn were measured. The average of n=5 was calculated.

Example 1

[0088] Nylon-6 with an intrinsic viscosity $[\eta]$ of 1.3 and modified polyethylene terephthalate copolymerized with 2.6 mole percent 5-sodiumsulfoisophthalic acid, having an intrinsic viscosity $[\eta]$ of 0.39, were melted at 270°C and 290°C, respectively, and the conjugated fiber spinneret shown in Fig. 1 of Japanese Unexamined Patent Publication No. 2000-144518 (wherein the spinning hole is a spinning nozzle hole composed of two arc-shaped slits A and B situated essentially on the same circumference at a spacing (d), and where the area SA of the arc-shaped slit A, the slit width A₁, the area SB of the arc-shaped slit B, the slit width B₁ and the area SC defined by the inner perimeters of the arc-shaped slits A and B simultaneously satisfy the following inequalities [1] to [4]:

- [1] $B_1 < A_1$
- [2] $1.1 \leq SA/SB \leq 1.8$
- [3] $0.4 \leq (SA+SB)/SC \leq 10.0$
- [4] $d/A_1 \leq 3.0$

was used for extrusion of the polyethylene terephthalate from slit A and the nylon-6 from slit B, at an extrusion rate of 12.7 g/min each, followed by cooling to solidification and lubricant application to form a side-by-side undrawn conjugated fiber having the cross-sectional profile shown in Fig. 1. The filament was preheated with a preheating roller at a speed of 1000 m/min and a temperature of 60°C, and then subjected to drawing heat treatment between the preheating roller and a heating roller heated to a temperature of 150°C at a speed of 3050 m/min (drawing factor: 3.05), and wound up to obtain an 86 dtex/24 fil uncrimped conjugated fiber.

[0089] The breaking tensile strength of the obtained drawn conjugated fiber was 3.4 cN/dtex, and the breaking elongation was 40%. When the percentage of crimp was measured after boiling water treatment of the conjugated fiber, the dry percentage of crimp DC was 3.3%, the wet percentage of crimp HC was 1.6% and the difference between the dry percentage of crimp DC and wet percentage of crimp HC (DC-HC) was 1.7%.

[0090] The conjugated fiber yarns (without boiling water treatment and without crimping or twisting) were arranged in full set on the front reed of a 36 gauge tricot knitting machine, while uncrimped polyethylene terephthalate multifilament yarns (33 dtex/12 fil) with a boiling water shrinkage of 20% were arranged in full set on the back reed of the tricot knitting machine, for knitting a tricot stitched fabric in a knitting structure front 10-23, and back 12-10, with a 110/2.54 cm machine course.

[0091] The tricot stitched fabric was dyed under conditions with a maximum temperature of 130°C and a maximum temperature keep time of 15 minutes, for manifestation of the latent crimping property of the conjugated fibers, thereby

producing a crimped conjugated fiber yarn-containing tricot knitted fabric; this was then subjected to padding treatment using a treatment solution containing 8 wt% of a fluorine resin-based water repellent (ASAHIGUARD™ AG710, product of Asahi Glass Co., Ltd.), and then dried at a temperature of 100°C and subjected to final dry setting at 160°C for 1 minute.

[0092] The performance of the obtained tricot stitched fabric was as follows.

LPH: 305 mm

LPD: 300 mm

LFH: 311 mm

RP : 1.7%

RF : 3.7%

RA : 2.7%

Dry air permeability: 14 ml/cm²/s

Wet air permeability: 10 ml/cm²/s

Variation in air permeability: 40%

The knitted fabric had a reduced air space upon water wetting and therefore a lower air permeability, and was therefore satisfactory.

[0093] The yarn length (LA) of a conjugated fiber yarn (crimped filament A yarn) taken from the knitted fabric was 2700 mm, and the yarn length (LB) of a filament B was 1890 mm, and therefore LA was longer than LB. Also, the dry percentage of crimp DC_f of the crimped conjugated filament A taken from the knitted fabric was 7%, the wet percentage of crimp HC_f was 52%, and the dry-wet percentage of crimp difference (DC_f-HC_f) was 18%.

Comparative Example 1

[0094] The uncrimped conjugated fibers used in Example 1 were arranged in full set on the front reed and back reed of a 28 gauge tricot knitting machine, for knitting a tricot stitched fabric in a knitting structure of front 10-23 and back 12-10, with a 60/2.54 cm of courses on machine. Dyeing and final dry heat setting were also carried out on the resultant fabric in the same manner as Example 1.

[0095] The obtained knitted fabric was unsatisfactory, with LPH: 315 mm, LPD: 300 mm, LFH: 330 mm, LFD: 300 mm, RP: 5.0%, RF: 10.0%, RA: 7.5%, dry air permeability: 140 cc/cm²/s, wet air permeability: 250 cc/cm²/s and air permeability variation: -79%, i.e. a large increase in air permeability when wet. Also, for a conjugated fiber taken from the fabric, the dry percentage of crimp DC_f was 62%, the wet percentage of crimp HC_f was 38% and the difference in the dry and wet percentages of crimp (DC_f-HC_f) was 22%.

INDUSTRIAL APPLICABILITY

[0096] According to the present invention, it is possible to obtain woven and knitted fabrics with improved anti-visibility and waterproof properties by efficient reduction in the air space in a wet state as compared to a dry state. The woven and knitted fabrics may be used for outer garments, sportswear and underwear provide effects of inhibited visibility by sweat and improved waterproofness in rain, and therefore their industrial value is very high.

Claims

1. A woven or knitted fabric comprising crimped filaments A whose percentage of crimp decreases upon wetting with water, and filaments B composed of at least one type selected from among filaments with no crimps and crimped filaments which undergo substantially no change in percentage of crimp upon wetting with water, **characterized in that** the percentage of crimp DC_f(%) of a sample of dry crimped filaments A prepared by allowing a sample of said crimped filaments A taken from said woven or knitted fabric to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, and the percentage of crimp HC_f(%) of a sample of the water wetted crimped filaments A prepared by immersing a sample of said crimped filaments A in water at a temperature of 20°C for 2 hours, lifting it out from the water, sandwiching said sample between a pair of filter sheets within 60 seconds of lifting it, subjecting it to a pressure of 0.69 mN/m² for 5 seconds and lightly wiping the water from the sample, satisfy the following requirement (1):

$$(DC_f - HC_f) \geq 10 (\%) \quad (1),$$

and **in that** the length LPD (mm) in the warp (or wale) direction and the length LFD (mm) in the weft (or course)

direction for a sample of the dry woven or knitted fabric prepared by taking a square sample with a 30 cm width in the warp (or wale) direction and a 30 cm length in the weft (or course) direction from the woven or knitted fabric and allowing it to stand for 24 hours in an environment at a temperature of 20°C, 65% RH, and the length LPH (mm) in the warp (or wale) direction and the length LFH (mm) in the weft (or course) direction for a sample of the water wetted woven or knitted fabric prepared by immersing said woven or knitted fabric sample in water at a temperature of 20°C for 2 hours, lifting it out from the water, sandwiching said sample between a pair of filter sheets within 60 seconds of lifting it, subjecting it to a pressure of 0.69 mN/m² for 5 seconds and lightly wiping the water from said sample, are used in the following requirements (2) and (3):

$$RP(\%) = ((LPH - LPD) / LPD) \times 100 \quad (2)$$

$$RF(\%) = ((LFH - LFD) / LFD) \times 100, \quad (3)$$

to calculate the change in dimensions RP (%) representing the proportion of the difference between the length when wet (LPH) and the length when dry (LPD) with respect to the length when dry (LPD) for the warp (or wale) direction of said woven or knitted fabric, and the change in dimensions RF (%) representing the proportion of the difference between the length when wet (LFH) and the length when dry (LFD) with respect to the length when dry (LFD) for the weft (or course) direction of said woven or knitted fabric, the average RA of which satisfies the following requirement (4):

$$RA(\%) = (RP + RF) / 2 \leq 5\%, \quad (4)$$

whereby the air space is reduced upon wetting with water.

2. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein said crimped filaments A are selected from among crimped conjugated fibers which differ from one another in terms of water-absorbing and self-extending properties, are composed of a polyester resin component and a polyamide resin component bonded in a side-by-side fashion, and have crimps formed by expression of their latent crimping performance.
3. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 2, wherein said polyester resin component is composed of a modified polyethylene terephthalate resin comprising 5-sodiumsulfoisophthalic acid copolymerized in an amount of 2.0 to 4.5 mole percent based on the acid component content.
4. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein said crimped filaments A are included in yarn twisted at the number of twists of 0 to 300 T/m.
5. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein said filaments B are formed of a polyester resin.
6. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein said woven or knitted fabric has a multilayer woven or knitted structure with two or more layers, wherein at least one layer of said multilayer woven or knitted structure comprises said crimped filaments A at a content of 30 to 100 wt% of the total layer weight, and at least one other layer comprises said filaments B at a content of 30 to 100 wt% of the total layer weight.
7. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein said woven or knitted fabric is a knitted fabric with a tubular knitting structure, the composite loops of which tubular knitting structure are formed from said crimped filaments A and filaments B.
8. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein said woven or knitted fabric is a woven fabric with a weave structure, wherein either

or both of the warp and weft yarns are composed of both paralleled yarns comprising yarn made of said crimped filaments A and yarns made of said filaments B.

9. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein the yarns made of said crimped filaments A and the yarns made of said filaments B are arranged alternately with every one yarn being in either or both the warp and weft direction or in either or both the course and wale directions.
10. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein the yarns made of said crimped filaments A and the yarns made of said filaments B are combined with each other to form a core-in-sheath type composite yarn, the core of said composite yarn being composed of said filament B yarns and the sheath being composed of said crimped filament A yarns.
11. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein said filaments B are selected from among elastic fibers with a breaking elongation of 300% or greater.
12. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, wherein the woven or knitted fabric has an air permeability upon wetting with water which is at least 20% lower than the air permeability upon drying.
13. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, which is a dyeing treatment applied fabric.
14. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, which is a water absorption treatment applied fabric.
15. A crimped filament-containing woven or knitted fabric which has a decreased air space upon wetting with water according to claim 1, which is a water repellent treatment applied fabric.
16. A process for production of a crimped filament-containing woven or knitted fabric having a decreased air space upon wetting with water, according to any one of claims 1 to 15, the process being **characterized by** comprising a step of producing a precursor woven or knitted fabric from uncrimped fibers for formation of crimped filaments A which express crimping by heat treatment and wherein the crimps have a property such that the percentage of crimp decreases upon wetting with water, and fibers for formation of filaments B comprising at least one type selected from among fibers which do not express crimping by said heat treatment, and fibers which express crimping by said heat treatment but wherein the crimps have a property such that the percentage of crimp substantially does not decrease upon wetting with water, and a step wherein the precursor woven or knitted fabric is subjected to heat treatment to form a woven or knitted fabric containing the crimped filaments A and the filaments B.
17. A process for production of a crimped filament-containing woven or knitted fabric according to claim 16, wherein the fibers for formation of said crimped filaments A are selected from among uncrimped conjugated fibers made of a polyester resin component and a polyamide resin component, which differ in their moisture-absorbing and self-elongating properties and are combined in a side-by-side structure.
18. A process for production of a crimped filament-containing woven or knitted fabric according to-claim 16, wherein the polyester resin component in said uncrimped fibers includes a polyester resin with an intrinsic viscosity of 0.30 to 0.43, and said polyamide resin component includes a polyamide resin with an intrinsic viscosity of 1.0 to 1.4.
19. A process for production of a crimped filament-containing woven or knitted fabric according to claim 17, wherein said uncrimped fibers have, after crimping treatment in boiling water,
 - (1) a dry percentage of crimp DC in the range of 1.5 to 13% after standing for 24 hours in an environment at a temperature of 20°C, 65% RH,
 - (2) a wet percentage of crimp HC in the range of 0.5 to 7.0% immediately after immersion in water at a temperature of 20°C for 2 hours, and
 - (3) a difference between said dry percentage of crimp DC and wet percentage of crimp HC (DC-HC) of 0.5%

or greater.

20. A textile product including a crimped filament-containing woven or knitted fabric with a decreased air space upon wetting with water according to any one of claims 1 to 15.

21. A textile product according to claim 21 which is selected from among outerwear, sportswear and underwear.

5

10

15

20

25

30

35

40

45

50

55

Fig.1

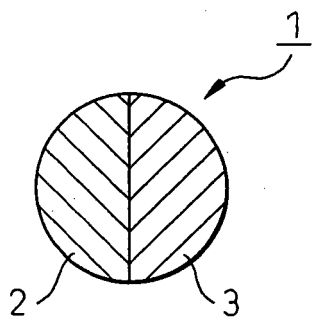


Fig.2

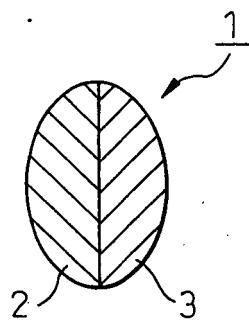
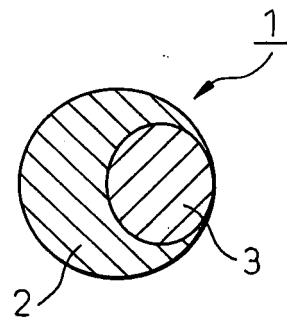


Fig.3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/019432

A. CLASSIFICATION OF SUBJECT MATTER

D04B1/20 (2006.01), **A41B1/00** (2006.01), **D03D15/04** (2006.01), **D02G3/04** (2006.01), **D04B21/00** (2006.01), **D06M15/53** (2006.01), **D06M101/32** (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), **A41B1/00** (2006.01), **D03D15/04** (2006.01), **D02G3/04** (2006.01), **D04B21/00** (2006.01), **D06M15/53** (2006.01), **D06M101/32** (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	JP 62-162043 A (Teijin Ltd.), 17 July, 1987 (17.07.87), Claims; page 2, lower left column; page 4, upper left column (Family: none)	1-21
X	JP 60-252756 A (Teijin Ltd.), 13 December, 1985 (13.12.85), Claims; examples (Family: none)	1-21
X	JP 60-252746 A (Teijin Ltd.), 13 December, 1985 (13.12.85), Claims; examples (Family: none)	1-21

☒ 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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/019432

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2003-41462 A (Teijin Ltd.), 13 February, 2003 (13.02.03), Claims; Par. No. [0022]; example 1 (Family: none)	1-21

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 2003041462 A [0003] [0005]
- JP 2000144518 A [0059] [0088]