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(54) **Blended yarn having moisture conditioning.**

(57) A blended yarn comprises 20 to 50 percent by weight of a hygroscopic fiber and 50 to 80 percent by weight of a non-hygroscopic fiber, the yarn having a moisture-absorbing extent at the equilibrium of 15 percent or smaller at 20°c at a relative humidity of 65 % and that of 35 % at 29.5° at a relative humidity of 96 %. It is suitable for clothing having a moisture conditioning.

EP 0 255 697 A2

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Blended Yarn Having Moisture Conditioning

The present invention relates to a fibrous material for comfortable clothing. More particularly, it relates to blended yarn for clothing having the moisture conditioning function.

[Prior art and problems]

Synthetic fibers have come into general use on account of their outstanding characteristics; however, natural fibers finding more use for underwear than before as the demand for more comfortable clothing habits increases. A conceivable reason for this is that synthetic fibers are greatly poor in water-and moisture-absorption characteristics.

Heretofore, there have been proposed a large number of methods for imparting synthetic fibers water-and moisture-absorption characteristics. (Japanese Patent Laid-open Nos. 93121/1979 and 155770/1985) These methods, however, do not make synthetic fibers surpass natural fibers, and are not in practical use because any attempt to impart a moisture-absorption capacity greater than that of natural fibers aggravates the properties of synthetic fibers.

As to the moisture-conditioning, an animal fiber such as silk is best among natural fibers. It is not used in so many fields on account of its poor handling characteristics and poor economic efficiency.

As the result of studies on the change of humidity that takes place in clothing, the present inventors found that the humidity in clothing rises slowly if the clothing is worn after it has been dried such that the fibers having the greater moisture-absorption are dried nearly to the bone dry state. Therefore, one who wears such clothing feels less stuffy for a long time. On the other hand, it was also found that where fibers are modified so as to increase the amount of moisture absorption, the properties of fibers are aggravated to such an extent that the fibers are unsuitable for practical use.

In order to eliminate these disadvantages and to make maximum use of the moisture-absorption characteristics, the present inventors carried out a series of researches which led to the following findings. Carboxymethyl cellulose fiber and polyvinyl alcohol fiber strongly absorb moisture, but upon moisture absorption they become harsh and decrease in tenacity after drying. This disadvantage is eliminated if they are blended (by mixed spinning or mixed weaving) with non-moisture-absorbing fibers such as polyester fiber, polyethylene fiber, polypropylene fiber, polyvinyl chloride fiber, polyacrylic fiber, and nylon fiber. The amount of the non-moisture-absorbing fibers is more than 50 wt%, preferably 55-65 wt%. This blended fiber provides a greatly improved moisture-conditioning function.

Needless to say, the improvement of moisture-absorption is limited to such an extent that the fiber remains insoluble in water. This is greatly affected by the degree of substitution performed when the fiber is modified and also by the degree of polymerization of base fiber. The solubility of the fiber may be properly controlled by cross-linking and other means.

Thus the clothing which does not feel stuffy can be made when non-moisture-absorbing fibers are blended with carboxymethyl cellulose fiber or polyvinyl alcohol fiber which alone cannot be practically used because of its physical properties.

The present invention was completed on the basis of the above-mentioned findings.

Summary of the Invention

The present invention relates to blended yarn for clothing having the moisture conditioning function composing of at least two kinds of fibers, characterized in that the blended yarn contains 50-80 wt% of one or more than one kind of non-moisture-absorbing fiber and 20-50 wt% of moisture-absorbing fiber, and the equilibrium moisture absorption at a temperature of 20°C and an environmental relative humidity of 65% is lower than 15% based on the absolute dry weight and the equilibrium moisture absorption at a temperature of 29.5°C and an environmental relative humidity of 96% is lower than 35% based on the absolute dry weight.

It is defined in other words that a blended yarn of the invention comprises 20 to 50 percent by weight of a hygroscopic fiber and 50 to 80 percent by weight of a non-hygroscopic fiber, the yarn having a moisture-absorbing extent at the equilibrium of 15 percent or smaller at 20°c at a relative humidity of 65 % and that of 35 % at 29.5° at a relative humidity of 96 %.

The yarn preferably has a moisture-absorbing extent at the equilibrium of 5 % or smaller at 20°c at a relative humidity of 65 % and that of 35 % or smaller at 29.5°c at a relative humidity of 96 %. It is preferable that the non-hygroscopic fiber has a denier of 0.8 to 3.

The moisture-absorbing extent at the equilibrium, called also the equilibrium moisture absorption, is measured by determining an amount of the absorbed moisture in comparison with the completely dry state. The non-hygroscopic fiber is also called the non-moisture-absorbing fiber. The hygroscopic fiber is also called the moisture fiber.

The blended yarn used in the present invention includes the yarn constructed of filament fibers and the yarn constructed of staple fibers.

The moisture-absorbing fiber used in the present invention should preferably be one which has an equilibrium moisture absorption higher than 70% (based on the absolute dry weight) at a temperature of 29.5°C and an environmental relative humidity of 96%. Examples of this fiber include carboxymethyl cellulose fiber and polyvinyl alcohol fiber.

For cellulose fiber the desired degree of carboxymethylation varies depending on the degree of polymerization of cellulose. For example, in the case of cotton, the preferred degree of substitution of monochloroacetic acid is about 0.3. By contrast, in the case of viscose rayon, it is about 0.15 to 0.18. And in the case of polynosic rayon, which has a high molecular weight, it is about 0.19 to 0.22. With a degree of substitution higher than these limits, the resulting fiber is soluble. The solubility may be reduced by post-crosslinking, which is accomplished with aluminum ions in the simplest manner. No matter which method is used, the thus obtained carboxymethyl cellulose cannot be used alone for clothing because it becomes harsh as if it were starched, when it is wetted and then dried. To make matters worse, it decreases in tensile strength and shrinks, making the clothing dimensionally unstable.

The same is true of other fibers. Polyvinyl alcohol fiber, which varies in the degree of saponification depending on the average degree of polymerization, should preferably have a degree of saponification greater than 98 mol% if it is to have a desired degree of moisture absorption. This fiber also becomes harsh and decreases in strength as in carboxymethyl cellulose when it is used alone.

The non-moisture-absorbing fiber used in the present invention should preferably be one which has an equilibrium moisture absorption lower than 5% (based on the absolute dry weight) at a temperature of 20°C and an environmental relative humidity of 65%. Examples of this fiber include polyester fiber, polyethylene fiber, polypropylene fiber polyvinyl chloride fiber, polyacrylic fiber, and nylon fiber. Also included are those fibers which have minute linear grooves or pits formed on the surface by physical or chemical modification. Usually, fibers modified for moisture absorbtion has low strength and tend to become harsh when dried after moisture-or water-absorption because it has a high affinity for moisture-absorbing fiber.

In the present invention, the non-moisture-absorbing fiber should have a certain magnitude of strength so that is compensates for the weakness of the moisture-absorbing fiber. A tensile strength higher than 5.0 g/D (in dry state) is desirable. For good feel, the fiber should have a fineness lower than 3 denier, preferably 0.8 to 1.5 denier.

The blended fiber of the invention contains 50-80 wt% of non-moisture-absorbing fiber and 20-50 wt% of moisture-absorbing fiber. The equilibrium moisture absorption of the blended fiber at a temperature of 20°C and an environmental relative humidity of 65% is lower than 15% based on the absolute dry weight and the equilibrium moisture absorption of the blended fiber at a temperature of 29.5°C and an environmental relative humidity of 96% is lower than 35% based on the absolute dry weight. The one containing 55-65 wt% of non-moisture-absorbing fiber is desirable. The mixed blending of moisture-absorbing fiber and non-moisture-absorbing can be accomplished in the usual way. It is desirable that the fiber have as low a fineness as possible and the yarn have as low a count and as many twists as possible so that the high strength is achieved. Spun yarn of sheath-core structure (with the non-moisture-absorbing fiber outside) is desirable. Where the moisture-absorbing fiber is long fiber, a sheath-core structure is desirable in which the non-moisture-absorbing fiber is wound outside. (See Japanese Patent Laid-open No. 59745/1977.)

The desired yarn can be produced by two methods. The first method involves the ordinary spinning of previously provided moisture-absorbing fiber and non-moisture-absorbing fiber. The second method involves the modification of blended yarn of moisture-absorbing fiber and non-moisture-absorbing fiber wound on a cheese. The latter method may be desirable because yarn of high moisture absorption does not smoothly pass through the conventional apparatus on account of its physical properties.

The blended yarn of the present invention has increased friction because its hardness and surface properties are different from those of ordinary yarn. The problems may be solved by selecting a proper oil.

The blended yarn produced as mentioned above can be made into clothing such as socks and underwear which are comfortable with less stuffy feeling.

[Effect of the invention]

As mentioned above, the blended yarn of the present invention is composed of two constituents: one absorbing less moisture under the condition of low relative humidity (say, at 20°C and 65 %RH), and the other absorbing more moisture under the condition of comparatively high relative humidity (say, at 29.5°C and 96 %RH). Therefore, it exhibits its moisture absorbing function when the temperature and humidity on the human skin increase, thereby alleviating the increase of humidity within clothing. It also releases moisture when the clothing is exposed to the external cool air which has a low vapor pressure, thereby keeping the comfortable condition within the clothing. Owing to this function, the blended yarn of the present invention can be made for underwear.

In addition, the clothing made of the blended yarn of the invention keeps its good state without moisture absorption during storage after washing and drying.

[Examples]

To further illustrate the invention, and not by way of limitation, the following examples are given. In the examples, "%" means "wt%".

Example 1

Blended yarn composed of 80% of polyester fiber (2 denier) and 20% of viscose rayon fiber (1.5 denier) was treated with monochloroacetic acid and sodium hydroxide at room temperature for 30 minutes for mercerization and subsequently at 60°C for 120 minutes for carboxymethylation. (The amount of monochloroacetic acid was three times that required to carboxymethylate 1 mol of cullulose (glucose unit) to a desired degree and the amount of sodium hydroxide was 2.2 times t that of monochloroacetic acid.) After carboxymethylation, the blended yarn was treated with acetic acid to neutralize excess sodium hydroxide, followed by rinsing. Finally, the blended yarn underwent oil treatment and hot air drying for 60 minutes. Thus there was obtained modified yarn having a degree of carboxymethylation of 0.2. The composition of the yarn before and after modification is shown in Table 1.

Example 2

Blended yarn composed of 65% of polyester fiber (2 denier) and 35% of viscose rayon fiber (1.5 denier) was carboxymethylated in the same manner as in Example 1. The degree of carboxymethylation was 0.13. The composition of the yarn before and after modification is shown in Table 1.

Example 3

Blended yarn composed of 65% of polyvinyl chloride fiber (2 denier) and 35% of viscose rayon fiber (1.5 denier) was carboxymethylated in the same manner as in Example 1. The degree of carboxymethylation was 0.13. The composition of the yarn before and after modification is shown in Table 1.

Example 4

Blended yarn composed of 55% of polyester fiber (2 denier) and 45% of viscose rayon fiber (1.5 denier) was carboxymethylated in the same manner as in Example 1. The degree of carboxymethylation was 0.09. The composition of the yarn before and after modification is shown in Table 1.

Comparative Example 1

Blended yarn composed of 50% of polyester fiber (2 denier) and 50% of viscose rayon fiber (1.5 denier) was carboxymethylated in the same manner as in Example 1. The degree of carboxymethylation was 0.09. The composition of the yarn before and after modification is shown in Table 1.

Comparative Example 2

Spun yarn was produced by blending 65% of polyester fiber (2 denier) and 35% of viscose rayon fiber (1.5 denier).

Example 5

Spun yarn was produced by blending 80% of polyester fiber (2 denier) and 20% of polyvinyl alcohol fiber having a degree of polymerization of 1700 and a degree of saponification of 99.0% (1.5 denier).

Example 6

Spun yarn was produced by blending 65% of polyester fiber (2 denier) and 35% of polyvinyl alcohol fiber having a degree of polymerization of 1700 and a degree of saponification of 99.9% (1.5 denier).

Example 7

Spun yarn was produced by blending 55% of polyester fiber (2 denier) and 45% of polyvinyl alcohol fiber having a degree of polymerization of 2000 and a degree of saponification of 99.9% (1.5 denier).

Example 8

Spun yarn was produced by blending 70% of polypropylene fiber (2 denier) and 30% of polyvinyl alcohol fiber having a degree of polymerization of 1700 and a degree of saponification of 99.9% (1.5 denier).

Comparative Example 3

Spun yarn was produced by blending 45% of polyester fiber (2 denier) and 55% of polyvinyl alcohol fiber having a degree of polymerization of 2000 and a degree of saponification of 99.9% (2 denier).

Comparative Example 4

Spun yarn was produced by blending 85% of polyester fiber (2 denier) and 15% of polyvinyl alcohol fiber having a degree of polymerization of 1700 and a degree of saponification of 99.0% (2 denier).

The blended yarn obtained in Examples 1 to 8 and Comparative Examples 1 to 4 was examined for strength and moisture absorption. Also, the moisture-absorbing fiber was examined for moisture absorption and harshness after drying. The results are shown in Table 1. For reference, the results of the examination of cotton, wool, and silk are also shown in Table 1.

The moisture-absorbing extent at the equilibrium was obtained by the following formula:

Moisture-absorbing extent at the equilibrium = $\frac{A - B}{B} \times 100$ (%)

where A : Equilibrium weight at a prescribed temperature and relative humidity, and

B : Absolute dry weight.

Table 1

Example No.	Moisture-absorbing fiber Type	Moisture-absorbing fiber Content, %	Non-moisture-absorbing fiber Type	Non-moisture-absorbing fiber Content, %	Yarn tenacity 40s g/s	Moisture absorption A	Moisture absorption B	Moisture absorption of moisture-absorbing fiber B	Harshness after drying
1	CM-RAY	22	PET	78	350	5	35	160	o
2	CM-RAY	38	PET	62	198	7	38	100	o
3	CM-RAY	35	PVC	65	168	6	37	100	o
4	CM-RAY	48	PET	52	172	8	38	80	o
(1)	CM-RAY	51	PET	49	145	10	36	80	x
(2)	RAY	35	PET	65	201	6	20	65	o
5	PVA	20	PET	80	360	3	36	180	o
6	PVA	35	PET	65	170	6	46	133	o
7	PVA	45	PET	55	182	5	36	80	o
8	PVA	30	PP	70	230	6	40	133	o
(3)	PVA	55	PET	45	138	6	40	72	x
(4)	PVA	15	PET	85	376	3	30	200	o
[1]	Cotton				160	8	28	28	o
[2]	Wool				-	16	36	36	o
[3]	Silk				-	13	40	40	o

( ) : Comparative Examples [ ] : Referential Examples
CM-RAY : carboxymethylated rayon fiber, RAY : rayon, PVA : polyvinyl alcohol fiber,
PET : polyester fiber, PVC : polyvinyl chloride fiber, PP : polypropylene fiber.
Moisture absorption A : equilibrium moisture absorption at 20°C and 65 %RH
Moisture absorption B : equilibrium moisture absorption at 29.5°C and 96 %RH

Example 9

Blended yarn composed of 65% of polyester fiber (2 denier) and 35% of viscose rayon fiber (1.5 denier) was carboxymethylated in the same manner as in Example 1. The degree of carboxymethylation was 0.14 (40S/1). Two single yarns were plied and knitted with Operon fiber (20%) made by Toray-Dupont into socks. For comparison, socks were knitted from plied yarn composed of 80% of two cotton yarns (40S) and 20% of Operon.

The socks samples were evaluated by 30 male panelists for 1 month (from middle of June to middle of July). The results are shown below.
The product of the invention is better: 22 panelists
Unable to say which is better: 5 panelists
The cotton socks are better: 3 panelists
Regarding stuffy feeling:
The product of the invention is better: 23 panelists
Unable to say which is better: 5 panelists
The cotton socks are better: 2 panelists

Claims

-1-A blended yarn which comprises 20 to 50 percent by weight of a hygroscopic fiber and 50 to 80 percent by weight of a non-hygroscopic fiber, the yarn having a moisture-absorbing extent at the equilibrium of 15 percent or smaller at 20°c at a relative humidity of 65 % and that of 35 % at 29.5° at a relative humidity of 96 %.

-2-A blended yarn as claimed in Claim 1, which has a moisture-absorbing extent at the equilibrium of 5 % or smaller at 20°c at a relative humidity of 65 % and that of 35 % or smaller at 29.5°c at a relative humidity of 96 %.

-3-A yarn as claimed in Claim 1, in which the non-hygroscopic fiber is made from polyester, polyethylene, polypropylene, polyvinyl chloride, polyacrylic acid or polyamide.

-4-A yarn as claimed in Claim 1, in which the hygroscopic fiber is made from carboxymethyl cellulose or polyvinyl alcohol.

-5-A yarn as claimed in Claim 1, in whcih the non-hygroscopic fiber has minute linear grooves or pits on the surface.

-6-A blended yarn as claimed in Claim 1, in which the non-hygroscopic fiber has a tensile strength of 5.0 g/D or larger in the dry state and a denier of 0.8 to 3.