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

(11) Publication number: 0 087 537 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 82307031.3

(22) Date of filing: 22.12.82

(51) Int. Cl.[3]: D 06 N 3/14

(30) Priority: 22.02.82 JP 26149/82

(43) Date of publication of application: 07.09.83 Bulletin 83/36

(84) Designated Contracting States: DE GB IT

(71) Applicant: TORAY INDUSTRIES, INC.
2, Nihonbashi-Muromachi 2-chome Chuo-ku
Tokyo 103(JP)

(72) Inventor: Morioka, Atsumi
7-20, 3-chome Shimosakamoto
Otsu-shi Shiga-ken(JP)

(72) Inventor: Naka, Yasushi
4-2 Asahigaoka-cho
Hirakata-shi Osaka-fu(JP)

(72) Inventor: Uchida, Akira
1600-107 Minamisakura Kasu-machi
Kasu-gun Shiga-ken(JP)

(72) Inventor: Kawakami, Kiyoshi
57 Hiragaki-cho Karahashi
Minami-ku Kyoto-shi Kyoto-fu(JP)

(74) Representative: Ritter, Stephen David et al,
Mathys & Squire 10 Fleet Street
London EC4Y 1AY(GB)

(54) Moisture-permeable, water leak-preventive coated fabric.

(57) Provided is a moisture-permeable, water leak-preventive, coated fabric comprising a base fabric having on at least one surface thereof a microporous layer formed of a synthetic polymer consisting essentially of a polyurethane, the coated fabric having a water entry pressure of not lower than 700 mmH_2O/cm^2, a moisture permeability of not less than 4,000 $g/m^2 \cdot 24$ hrs. and a water leak resistance index at the back of the fabric after an artificial rainfall test of not less than 50.

EP 0 087 537 A2

MOISTURE-PERMEABLE, WATER LEAK-PREVENTIVE COATED FABRIC

BACKGROUND OF THE INVENTION

The present invention relates to a moisture-permeable, water leak-preventive coated fabric. More particularly, it is concerned with a moisture-permeable, water leak-preventive coated fabric having superior drapability and an excellent moisture permeability, a certain amount of air permeability and a durable water-proofness or water leak-preventiveness.

Various waterproof coated fabrics have heretofore been made public and practically used. For example, waterproof fabrics coated with a natural or synthetic rubber are practically used for raincoats and other waterproof clothing, tents, tarpaulins and other products. But all of them are less moisture-permeable; for example, waterproof clothes used as raincoats give an unpleasant feeling in wear due to stuffiness, and in the case of tents or the like there should be clear default of vapor being condensed on the interior surface thereof in their practical use. On the other hand, as a waterproof fabric emphasizing moisture permeability there is a fabric having a high woven density with a mere water repellent treatment applied thereto, but its water repellency is insufficient and its water-proofness is only temporary, and thus such fabric is inappropriate as a practical waterproof fabric for long term.

Furthermore, as a coated waterproof fabric having air- and moisture-permeability there has recently been proposed and practically used a fabric coated with a microporous polyurethane layer or a fabric coated with a porous layer obtained by using a synthetic resin or synthetic rubber with various foaming agents or the like added.

However, the former is not satisfactory in its water-proofness, and the latter is insufficient in its air- and moisture-permeability, and thus a further improvement has being desired.

The present inventors have previously developed a fabric coated with a microporous polyurethane layer having new structural characteristics superior not only in air- and moisture-permeability but also in water-proofness with a water entry pressure not lower than 700 mmH_2O/cm^2. But this fabric involves problems, for example, its surface water repellency is deteriorated due to its use for a long period of time or contamination, and its resistance to water washing is not satisfactory.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a new coated fabric.

It is another object of the present invention to provide a new coated fabric having not only air- and moisture-permeability but also water leak-preventiveness.

Other objects and effects of the present invention will become apparent from the following description.

The above-mentioned objects of the present invention can be attained by a coated fabric comprising a base fabric having on at least one surface thereof a microporous layer formed of a synthetic polymer consisting essentially of a polyurethane, said coated fabric having a water entry pressure of not lower than 700 mmH_2O/cm^2, a moisture-permeability of not less than 4,000 $g/m^2 \cdot 24$ hrs. and a water leak resistance index at the back of the fabric after an artificial rainfall test of not less than 50.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The coated fabric of the present invention has a structural characteristic such that it has a microporous layer formed of a synthetic polymer consisting essentially of a polyurethane, said layer having on its surface a large number of fine pores, also having in its interior relatively large-sized cavities communicating with those fine pores and further having a communication hole formed at least in part of the partition wall between adjacent cavities, wherein a water repellent agent adheres even to the wall surfaces of those cavities. The fine pores on the surface have an average diameter usually not larger than 5 microns, for example, not larger than 1 micron, and the inside cavities usually have a diameter not less than three times the diameter of the fine pores.

The coated fabric of the present invention having such characteristics is preferably produced in the following manner.

A coating solution prepared by adding water repellent agent, a nonionic surfactant and a polyisocyanate into a polar organic solvent solution with a polymer consisting essentially of a polyurethane dissolved therein is applied to a base fabric, which is then subjected to wet coagulation in a coagulating bath, and the resulting coated fabric is treated with a solution of a water repellent agent dissolved in an organic solvent, then dried and heat-treated.

As the polyurethane used in the preparation of the coating solution, there may be used a polyester type polyurethane elastomer, a polyether type polyurethane elastomer, or the like, with a concentration preferably in the range of 8 to 25% by weight. As to the polar organic solvent, essentially there may be used any polar organic solvent if only it can dissolve the polyurethane, and usually a known polar organic solvent is used such as dimethylformamide and dimethyl sulfoxide. As the water repellent agent, which is added as an essential component to the coating solution, one having affinity for the polyurethane is preferred, for example, a fluorine- or silicone-based water repellent agent. The concentration of the water repellent agent in the coating solution is preferably not less than 1.0% by weight and more preferably in the range of 2 to 10% by weight. As the polyisocyanate which is added as an essential component to the coating solution, there may be used an organic compound having two or more isocyanate groups such as a di- or triisocyanate; for example, it may be selected optionally from diisocyanates such as 2,4-(2,6-) tolylene diisocyanate, diphenylmethane 4,4'-diisocyanate, 1,4-naphthalene diisocyanate, isophorone diisocyanate and hexamethylene diisocyanate, and triisocyanates resulting from the addition reaction of 3 moles of these diisocyanates and 1 mole of compounds having three active hydrogens such as trimethylolpropane or glycerin. These polyisocyanates may also have their isocyanate groups in a free form or in a stabilized form with added phenol, etc. The polyisocyanate is added to the coating solution in an amount preferably ranging from 0.2 to 3% by weight. The polyisocyanate contributes to the improvement of adhesive property between the water repellent agent and the microporous polyurethane layer.

As the nonionic surfactant, which is preferably added to the coating solution, there may be used any of commercially available ones, but especially a nonionic surfactant comprising a block copolymer of polypropylene glycol and polyethylene glycol affords a good result. The nonionic surfactant functions to enhance the compatibility of the components in the coating solution and control the coagulating action in the coagulating operation. The concentration of the nonionic surfactant is preferably in the range of 1 to 8% by weight.

A pigment or the like may be added to the coating solution, if required.

The coating solution is applied to the base fabric uniformly in a desired thickness by means of a knife-over-roll coater or other conventional coating machine.

The coating solution may be applied directly to at least one face of the base fabric. In this connection, the base fabric is preferably pre-treated with a view to improving the moisture-permeability, handling of the fabric adhesive property between the microporous layer and the base fabric. For the pre-treatment there may be adopted a method wherein the face of the base fabric to be coated with the coating solution is heated and pressurized by calendering or some other suitable means thereby allowing the fibers to be transformed in section so as to become more narrowly spaced from each other; a method involving application of a water repellent agent to the base fabric; or a method wherein a synthetic polymer different from the polyurethane in the coating solution, especially one having a adhesive function,is applied to the base fabric partially in a dotted or linear form. For such partial application of the synthetic polymer, there may be adopted a known method such as the dotted coating roller system or the spray system. As the synthetic polymer, one having an adhesive force and being difficult to dissolve or insoluble in the polar organic solvent is preferred, and usually an acrylic polymer incorporating a crosslinking agent is employed. It is also preferable that a polyisocyanate is incorporated in the synthetic polymer. It is desirable that said synthetic polymer is applied to the base fabric in an area of 20 to 80% of the surface of the base fabric. Such a pre-treatment functions to suppress the permeation of the coating solution into the base fabric to about one-third or less of the thickness of the base fabric, whereby there is obtained a coated fabric having a drape handling of fabric, a high moisture- and air-permeability and a high peeling strength.

After applying the coating solution to the base fabric thus pre-treated or not so treated, the fabric is immersed in a coagulating bath to allow coagulation to take place, then washed with water and dried to obtain a coated fabric. As the coagulating bath, there preferably is used water containing a small amount, say 1 to 10% by weight, of the polar organic solvent as a component of the coating solution. The coated fabric having the microporous layer thus obtained is then immersed in an organic solvent solution with a water repellent agent dissolved therein to allow the water repellent agent to fully permeate the interior of the fine pores, then dried and preferably heat-treated at a temperature of, for example, about 100° to 170°C.

As the water repellent agent used in the above treatment, a fluorine- or silicone-based water repellent agent is preferred, and as the organic solvent there may be used any organic solvent if only it can dissolve the water repellent agent without dissolving the polyurethane layer, for example, trichlene, perchlene, or a mixture consisting mainly thereof and partially containing toluene as a diluent. The concentration of the water repellent agent in the solution is not less than 0.05% by weight and preferably in the range of 0.5 to 5% by weight. In the case of treating the coated fabric with a mangle or the like, it is desirable to squeeze it to a pickup ratio of 20 to 100%, whereby a high water leak-preventiveness beyond expectation is imparted to the fabric. Although the reason therefor is not clear, it is presumed to be that in the case of using a water solvent type water repellent agent, said agent is difficult to permeate into the foamed interior of the microporous layer of the coated fabric of the invention at the time of the water repellent treatment because the microporous layer itself has somewhat water-repellent function, while the water repellent agent dissolved in the organic solvent according to the present invention is easy to permeate the foamed interior of the microporous layer of the coated fabric at the time of the water repellent treatment.

As the base fabric, there may be used, for example, a woven, non-woven or knitted fabric made of natural fibers such as cotton, silk or wool, chemical fibers such as cellulose, viscose rayon or cupra, synthetic fibers such as polyamide, polyester or acrylic fibers, or even filament yarn, spun yarn, blended spun yarn, or mixed fabric thereof.

According to the present invention described above, there is provided for the first time a moisture-permeable and water leak-preventive coated fabric having a water entry pressure of not lower than 700 mmH_2O/cm^2, a moisture-permeability of not less than 4,000 $g/m^2 \cdot 24$ hrs., a leak water amount on the back surface of said fabric after an artificial rainfall test of substantially zero c.c., a surface leak resistance value at the back of the fabric of not less than $5 \times 10^6 \Omega/5mm$ and a water leak resistance index of not less than 50. The leak water amount, the surface leak resistance value and the water leak resistance index as referred to herein are measured in the manner described below.

The artificial rainfall test will be described hereinunder with reference to the accompanying drawing.

Fig.1 is an illustrative view of the artificial rainfall test.

The artificial rainfall test used in the present invention comprises a rainfall test conducted for a period of 2 hours at the rain intensity of 550 m/hr according to JIS L-1092 (BUNDESMANN TEST).

As to the leak water amount, the volume (c.c.) of water leaked out to the back of the fabric after the artificial rainfall test mentioned above and collected in a beaker is measured and the value thus measured corresponds to the leak water amount. For measuring the water leak resistance index, first a circle 10 cm in diameter 2 is drawn on the back surface of the fabric 1 before the artificial rainfall test and a 7 x 7 cm square is drawn in said circle, which square is then subdivided into 49 squares each of which having 1 x 1 cm square. Then, after the artificial rainfall test, the surface leak resistance value in each of those subdivided squares is measured by using, for example, a multi-tester Model A-303TRD (a product of Sanwa Keiki Seisakusho) 3 while fixing its inter-detecting portion distance to 5 mm and contacting it with any desired point in each square to measure the electric resistance. In the present invention, the value $5 \times 10^6 \Omega/5mm$ is taken as a reference resistance value representative of a leak water-free state, and values above this reference value are judged to indicate the absence of leak water.

In this way, surface leak resistance values in the 49 squares are measured and the number of squares, n, indicating above

$5 \times 10^6 \Omega/5mm$ is calculated, then using the value n, the water leak resistance index is determined by the following equation:

$$\text{Water leak resistance index} = \frac{n}{49} \times 100$$

The present invention provides the coated fabric having a water leak resistance index of not less than 50, preferably not less than 80 .

EXAMPLE

Onto a nylon taffeta (warp and weft of 70 denier nylon filament yarn, warp density x weft density = 123 x 87) as a base fabric was partially applied a toluol solution (viscosity: 2,000 cP at 20°C) containing 15% by weight of an acrylic ester copolymer (butyl acrylate - acrylic acid copolymer) and 3% by weight of a trimethylol-propane - hexamethylene diisocyanate (molar ratio 1 : 3) adduct, by means of an engraved roller in a multiple dot form of 87 microns in depth and with a printing area of 50%, followed by drying.

Then, a coating solution prepared by dissolving 20 parts by weight of a polyester type polyurethane elastomer, 4 parts by weight of a fluorine-based water repellent agent and 4 parts by weight of a pore controller in 72 parts by weight of dimethylformamide was applied to the above-treated base fabric in an amount of 150 g/m^2 (wet) by means of a knife-over-roll coater. Then, the base fabric was immersed in a water bath containing 5% by weight of dimethyl-formamide, allowed to coagulate, washed with water and then dried to obtain a coated fabric having fine pores.

The coated fabric was immersed in a trichlene solution containing 0.5% by weight of a fluorine-based water repellent agent,

0087537

then squeezed by a mangle to a pickup of 80%, then dried and heat-treated at 150°C for 10 minutes to give a water leak-preventive, moisture-permeable coated fabric having the characteristics shown in Table 1.

By way of comparison, the coated fabric having fine pores produced in the same process as described above except immersing into trichlene with water repellent agent was immersed in a water dispersion containing 0.5% by weight of a fluorine-based water repellent agent, then in the same manner as above, squeezed, dried and heat-treated at 150°C for 10 minutes. Characteristics of the coated fabric thus treated are shown in Table 1 as Comparative Example A.

For further comparison, a coated fabric having fine pores was obtained in the same way as in the above Example except that in place of the polyurethane coating solution used in the above Example there was employed a coating solution prepared by dissolving 20 parts by weight of a polyester type polyurethane elastomer and 4 parts by weight of a pore controller in 76 parts by weight of dimethylformamide without using the fluorine-based water repellent agent. The coated fabric was then immersed in a water dispersion containing 0.5% by weight of a silicone-based water repellent agent, then squeezed by a mangle to a pickup of 50%, followed by drying and subsequent heat treatment at 140°C for 10 minutes. Characteristics of the coated fabric thus treated are shown in Table 1 as Comparative Example B.

For a still further comparison, with respect to the commercial products of C and D companies comprising nylon taffeta coated with a polyurethane to form a microporous layer and said to have moisture-permeability and water-proofness, their characteristics were checked, the results of which are set out in Table 1.

Table 1

Performance \ Sample	Present Invention	Comparative Examples A	Comparative Examples B	Commercial Products C Co.	Commercial Products D Co.
Water entry pressure ($mm\ H_2O/cm^2$)	1800	1800	1800	1900	2100
Water repellency (dot)					
Base fabric surface	100	100	90	90	90
Resin surface	100	90	70	80	80
Moisture permeability ($g/m^2 \cdot 24$ hrs.)	4500	4300	3900	3000	4000
Leak water amount (c.c.)					
Before washing	0	0	5	7	11
After washing	0	2	*	*	*
Water leak resistance index					
Before washing	100	40	10	0	0
After washing	80	20	*	*	*

Note) The physical properties other than water leak-related properties were measured according to the following methods:

Water entry pressure	JIS L-1092 (method A)
Water repellency	JIS L-1092
Moisture permeability	JIS Z-0208
Washing test	JIS L-0217 (103) (after repeating three times)

* : Since the fabric before washing allowed too much

water to leak, the measurement after washing was omitted.

WHAT IS CLAIMED IS:

1. A moisture-permeable, water leak-preventive, coated fabric comprising a base fabric having on at least one surface thereof a microporous layer formed of a synthetic polymer consisting essentially of a polyurethane, said coated fabric having a water entry pressure of not lower than 700 mmH_2O/cm^2, a moisture permeability of not less than 4,000 $g/m^2 \cdot 24$ hrs. and a water leak resistance index at the back of said fabric after an artificial rainfall test of not less than 50.

2. A moisture-permeable, water leak-preventive, coated fabric according to claim 1, characterized in that a leak water amount on the back surface of said fabric after said artificial rainfall test is substantially zero cubic centimeter.

3. A moisture-permeable, water leak-preventive, coated fabric according to claim 1, wherein said water leak resistance index at the back of said fabric after said artificial rainfall test is not less than 80.

4. A method of producing a moisture-permeable, water leak-preventive, coated fabric, which comprises applying a coating solution to at least one face of a base fabric, said coating solution comprising a solution in a polar organic solvent of a polyurethane, a water repellent agent, a nonionic surfactant and a polyisocyanate, subjecting said fabric to wet coagulation in a coagulating bath, treating the resulting coated fabric with a solution of a water repellent agent in an organic solvent, followed by drying and heat treatment.

FIG. 1