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**EUROPEAN PATENT APPLICATION**

(43) Date of publication:

**03.05.2006 Bulletin 2006/18**

(21) Application number: **05255883.0**

(22) Date of filing: **22.09.2005**

(51) Int Cl.:

**D06M 10/02** <sup>(2006.01)</sup>

**D06M 11/76** <sup>(2006.01)</sup>

**D06M 15/643** <sup>(2006.01)</sup>

**C09K 3/18** <sup>(2006.01)</sup>

**D06M 11/38** <sup>(2006.01)</sup>

**D06M 13/08** <sup>(2006.01)</sup>

**D06M 15/256** <sup>(2006.01)</sup>

(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**

Designated Extension States:

**AL BA HR MK YU**

(30) Priority: **28.10.2004 CN 200410086246**

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(54) **Method of preparing fabrics having lotus leaf effect and fabrics having lotus leaf effect**

(57) The subject invention relates to a method of preparing fabrics having a lotus leaf effect (persistent stain-

proofing and waterproofing effect). The subject invention also relates to fabrics having a lotus leaf effect.

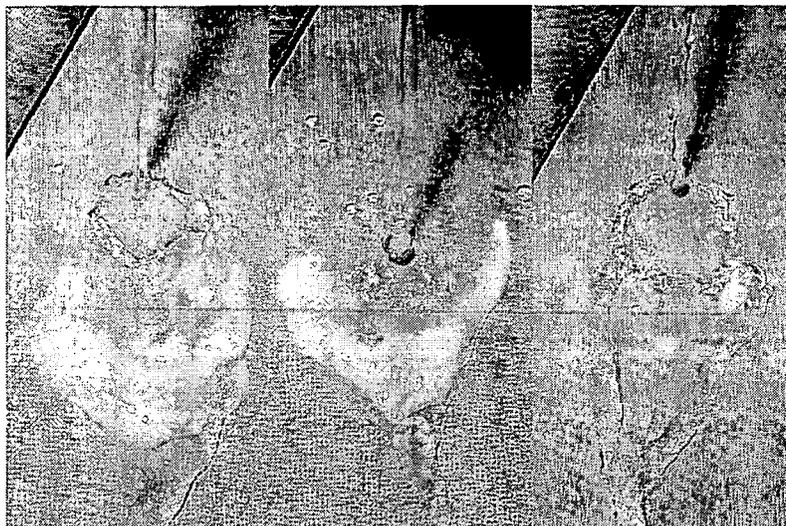


Figure 1

**Description**

**FIELD OF THE INVENTION**

5 [0001] The subject invention relates to a method for surface treatment of fabrics. Specifically, the subject invention relates to a method for preparing fabrics having a lotus leaf effect. The subject invention also relates to fabrics having a lotus leaf effect.

**BACKGROUND OF THE INVENTION**

10 [0002] In conventional waterproofing or stainproofing treatment, fabrics are simply immersed in or coated with reagent (s) to form a film thereon to achieve a waterproofing or stainproofing ability. However, the film obtained does not endure laundry. For example, the film can only be laundered in a washing machine (a water temperature of 40°C) for 25 times. The waterproofing or stainproofing ability is significantly reduced after 25 times.

15 [0003] Accordingly, a method for preparing fabrics having a lotus leaf effect for preventing stain or water droplet adhered thereon and fabrics having a lotus leaf effect are highly desired.

**SUMMARY OF THE INVENTION**

20 [0004] The object of the present invention is to provide a method for preparing fabrics having a lotus leaf effect.

[0005] Another object of the present invention is to provide fabrics having a lotus leaf effect.

**BRIEF DESCRIPTION OF DRAWING**

25 [0006]

Figure 1 represents consecutive photographs showing that stain applied to the fabric having been laundered for 100 times in a domestic washing machine can be easily removed by spraying water.

30 **DETAILED DESCRIPTION OF THE INVENTION**

[0007] By way of illustration and to provide a more complete appreciation of the present invention with many of the attendant advantages thereof, the following detailed description is given concerning a method for preparing fabrics having a lotus leaf effect and fabrics having a lotus leaf effect.

35 [0008] The present invention relates to a method for preparing a fabric having a lotus leaf effect, comprising, after a dyeing step and a drying step, a surface treatment of the fabric including a surface modification of the fabric and a treatment of the fabric with a hydrophobic reagent.

[0009] The fabrics for use in the subject invention include synthetic fabrics (for example, polyester, polyamide, and polyethylene), natural fabrics (for example, cotton and rayon), or interweaved fabrics of synthetic fabrics and natural fabrics (for example, nylon/cotton and polyester/cotton).

40 [0010] The object of the surface modification is to increase the roughness of the surface of fabrics to enhance the contacting area between reagents containing hydrophobic groups and the fabrics such that the reagents containing hydrophobic groups can bond to the fabrics. Any surface modification that can achieve the above object can be used for practicing the subject invention. The examples of the surface modification include a plasma treatment, a corona treatment, a chemical etching treatment or an adhesive treatment.

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**Plasma treatment**

50 [0011] The fabric is applied to a vacuum chamber (0.1 to 0.0001 torr) and suitable gas (for example air, oxygen, nitrogen, argon, carbon dioxide or their combination) is applied into the vacuum chamber. The surface of the fabric is subjected to a surface modification by introducing direct current, radio frequency or microwave excitation plasma of 50 to 1000 W for a period from 5 seconds to 600 seconds. Suitable fabrics for conducting the plasma treatment are synthetic fibers, for example, polyester, polyethylene and polyamide.

55 **Corona treatment**

[0012] The fabric is subjected to a surface modification with corona of 50 to 1000 W in atmosphere for a period from 5 seconds to 180 seconds. Suitable fabrics for conducting the corona treatment are synthetic fibers, for example polyester,

polyethylene and polyamide.

### Chemical etching treatment

5 **[0013]** Natural fibers are subjected to a chemical etching treatment using an acid. Synthetic fibers are subjected to a chemical etching treatment using a base, for example sodium hydroxide, sodium carbonate or sodium hydrogen carbonate. The above etching treatments reduce the amount of fiber ranging from 0.5% to 30%. Suitable fabrics for conducting the chemical etching treatment are synthetic fibers, for example polyester, and natural fibers, for example cotton.

### 10 Adhesive treatment

**[0014]** The fabrics are immersed in a specific adhesive agent, for example a polyisocyanate (10 to 100 g/l) and then dried. The polyisocyanate has a general formula of  $R-N=C=O$ , wherein R is  $C_5-C_{20}$ alkyl. Preferable examples of polyisocyanate include, but not limited to, polyhexylisocyanate, polyoctylisocyanate, polynonylisocyanate and polydodecanyl-  
15 isocyanate. Suitable fabrics for conducting the adhesive treatment are synthetic fabrics, for example polyester, and natural fabrics, for example cotton.

**[0015]** The fabrics which have been subjected to the surface modification are then treated by a hydrophobic reagent under a speed from 5 to 120 meter/min and at a temperature from 20°C to 170°C such that the hydrophobic reagent is intensely bonded onto the surface of the fabrics to result in a fabric having a lotus leaf effect.

20 **[0016]** Hydrophobic reagents are those commonly used in the textile field, for example silicone resins and fluorocarbons. Examples of fluorocarbons are compounds of the formula R-X, wherein R is  $C_1-C_{15}$  alkyl, X is  $(CF_2)_n$ , n is from 1 to 9. Preferable fluorocarbons are compounds of the formula R-X, wherein R is  $C_5-C_{12}$  alkyl, X is  $(CF_2)_n$ , n is from 2 to 7. More preferable fluorocarbons are compounds of the formula R-X, wherein R is  $C_7-C_{10}$  alkyl, X is  $(CF_2)_n$ , n is from 3 to 6.

25 **[0017]** The fabrics having been subjected to the above treatments have a surface similar to lotus leaf such that it is difficult for stain or water droplet to adhere thereonto. Due to surface modification of the fabrics, the hydrophobic reagent bonded to the fabrics can endure laundry and has persistent waterproofing and stainproofing abilities. In conventional waterproofing or stainproofing treatment, the fabrics are simply immersed in or coated with reagents to form a film thereon to achieve waterproofing or stainproofing ability. However, the film formed on the fabrics is destroyed therefrom  
30 after being laundered for 25 times such that the fabrics totally lose the original waterproofing and stainproofing abilities. Nevertheless, the fabrics treated by the method of the present invention still retain excellent waterproofing and stainproofing abilities (for example tested by the procedures under AATCC test method 22) after being laundered for numerous times (for example, for 100 times or being treated under the procedures of JIS L02173-103). In other words, the fabrics of the present invention have a lotus leaf effect.

35 **[0018]** The method of preparing fabrics having a lotus leaf effect comprises, after a dyeing step and a drying step, a surface treatment of fabrics including a surface modification of fabrics and a treatment of fabrics with hydrophobic reagents. The procedures of preparing the fabrics of the present invention comprise the steps of scouring, desizing, dyeing, drying, surface treatment, drying, maturing, post treatment. Optionally, the order of the steps can be adjusted or additional steps can be applied therebetween if the adjustment of order and the additional steps would not result in  
40 a negative influence on the waterproofing and stainproofing abilities of the fabrics.

**[0019]** The steps of the method of the invention are described as follows.

### Scouring & desizing

45 **[0020]** A griegie is scoured and desized under suitable conditions. For example, a griegie having 400 to 600 yards/piece is scoured and desized for removing oil and impurities thereon. The griegie can be scoured and desized at a temperature, for example from 70°C to 110°C, preferably from 80°C to 110°C, and at a speed from 50 to 60 meters/min.

### Dyeing

50 **[0021]** The griegie after being desized is dyed with suitable dyes, for example, acid dyes, disperse dyes, cationic dyes, reactive dyes, indanthrene dyes and direct dyes, together with suitable dyeing auxiliaries in, for example, an air flow dyeing machine, a jigger dyeing machine, a winch dyeing machine, a beam dyeing machine, a jet dyeing machine, a rapid dyeing machine or a continuous dipping & padding dyeing machine under, for example, a temperature of 40°C to  
55 170°C.

**Drying**

[0022] The griegie coming from the dyeing step is dried at a temperature from 50°C to 210°C and a speed from 5 to 80 meters/min.

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**Surface treatment**

[0023] The griegie coming from the drying step is subjected to a surface treatment. The griegie is treated by a surface modification selected from plasma treatment, corona treatment, chemical etching treatment or adhesive treatment depending on the species of the fabrics. The griegie is then treated by a hydrophobic reagent at a temperature from 20°C to 170°C and a speed from 5 to 120 meters/min.

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**Drying**

[0024] The griegie coming from the surface treatment step is dried at a temperature from 50°C to 210°C and a speed from 5 to 80 meters/min.

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**Maturing**

[0025] The griegie coming from the drying step is applied into an oven at a temperature from 90°C to 170°C and a speed from 5 to 90 meters/min such that the griegie is matured to a fabric which is more secured.

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**Final treatment**

[0026] The fabric can be optionally subjected to a final treatment, for example softening, cold-hot calendering, coating, lamination, and special waterproofing. For example, the fabric can be delivered to a tank containing a softening agent to conduct the softening treatment. Then, the fabric is delivered to a machine at a suitable speed (for example 35 to 55 meter/min), a suitable height (60 to 100 mm, for example 80 mm), a suitable angle (45° to 135°, for example, 90°), a suitable temperature (110°C to 130°C, for example 120°C) to conduct the waterproofing treatment. The fabric is then stored for a suitable period of time to effect crosslinking. The fabric can be optionally subjected to a final setting to obtain the final product.

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**Test of persistent waterproofing (waterstaining) ability**

(1) Testing method: AATCC test method 22

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[0027] AATCC test method 22 is directed to a method for testing water-repellency of fabrics.

(2) Testing device: AATCC-22 tester

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(3) Testing procedures

[0028] A fabric having a lotus leaf effect prepared by the present invention is laundered in a domestic washing machine under the procedures of JIS L02173-103, dried, and cut into a test specimen of 18 x 18 cm. The specimen is conditioned at 65±2% relative humidity and 21±1°C for a minimum of 4 hours before testing. The specimen is then fastened securely in a metal hoop so that it presents a smooth, wrinkle-free surface. The hoop is placed in a position that it presents an angle of 45° with the stand of the tester. A funnel is positioned 15.2 cm above the center of the specimen. An amount of 250 ml of distilled water at 27±1°C is poured into the funnel and is allowed to be sprayed onto the test specimen for 25 to 30 seconds.

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**Ratings for testing**

**[0029]**

100: No sticking or wetting on upper surface of fabric

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90: Slight random sticking or wetting on upper surface of fabric

80: Wetting on upper surface of fabric at spraying points

70: Partial wetting on whole upper surface of fabric

5 50: Complete wetting on whole upper surface of fabric

**[0030]** The following example is provided to further explain the invention from which the artisans can further appreciate the invention. However, the example should not be considered as a limitation to the scope of the invention.

10 **Example**

**[0031]** A griegie of  $450 \pm 50$  yards/piece is subjected to a scouring treatment and desizing treatment at a temperature of about  $90^{\circ}\text{C}$  and at a speed of 50 meters/min. Then, the griegie is dyed and dried at a temperature of about  $110^{\circ}\text{C}$  and is treated by radio frequency of 500W in a vacuum chamber for 250 seconds to effect surface modification. After that, 15 the griegie is treated by a fluorocarbon compound having a formula of R-X wherein R is  $\text{C}_{10}$  alkyl and X is  $(\text{CF}_2)_3$  at a speed of 20 meters/min and at a temperature of  $60^{\circ}\text{C}$  and is then dried at a temperature of  $110^{\circ}\text{C}$ . Finally, the griegie is matured at a temperature of  $160^{\circ}\text{C}$  to form a fabric having a lotus leaf effect.

(1) The fabrics of the present invention and the conventional fabrics are tested according to the procedures and 20 test method mentioned above for their waterproofing ability prior to laundry ( $L_0$ ), laundry for 25 times ( $L_{25}$ ) and laundry for 100 times ( $L_{100}$ ). The results of the test are listed as follows:

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Rating Fabrics	laundry number		
	$L_0$	$L_{25}$	$L_{100}$
Fabrics of the invention	100	90	80
Conventional fabrics	100	80	50

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35 The result of the table shows that the fabrics of the present invention obtain a high score of 80 while the conventional fabric obtain a scope of as low as 50.

(2) Easy testing method for stainproofing

40 The fabric after laundry for 100 times (water temperature at  $40^{\circ}\text{C}$ ) is stained by mustard, catchup or honey. The stain on the fabric is easily removed by water spraying as shown in Figure 1.

**[0032]** The present invention may, of course, be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the present invention. The present embodiments are, therefore, 45 to be considered in all respects as an illustration and are not restrictive.

**Claims**

1. A method of preparing a fabric having a lotus leaf effect, comprising subjecting a fabric to a surface modification and treating the fabric with a hydrophobic reagent.
  2. A method according to claim 1, wherein the surface modification and treating of the fabric with a hydrophobic reagent occur after a dyeing step and a drying step.
  3. A method according to claim 1 or claim 2, wherein said surface modification comprises a plasma treatment, a corona treatment, a chemical etching treatment or an adhesive treatment.
  4. A method according to claim 3, wherein an adhesive used in the adhesive treatment is a polyisocyanate of a general
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formula of  $R-N=C=O$ , wherein R is  $C_5-C_{20}$  alkyl.

5 **5.** A method according to claim 4, wherein said polyisocyanate is polyhexylisocyanate, polyoctylisocyanate, polynonylisocyanate or polydodecanylisocyanate.

**6.** A method according to any one of claims 1 to 5, wherein said hydrophobic reagent comprises a silicone resin and a fluorocarbon.

10 **7.** A method according to claim 6, wherein said fluorocarbon is a compound of formula  $R-X$ , wherein R is  $C_1-C_{15}$  alkyl, X is  $(CF_2)_n$ , n is from 1 to 9.

**8.** A method according to claim 7, wherein said fluorocarbon is a compound of formula  $R-X$ , wherein R is  $C_7-C_{10}$  alkyl, X is  $(CF_2)_n$ , n is from 3 to 6.

15 **9.** A method according to any preceding claim, wherein said fabric is laundered according to procedures of JIS L02173-103 and tested according to AATCC test method 22 and retains excellent waterproofing and stainproofing abilities.

20 **10.** A fabric obtainable by a method according to any one of claims 1 to 9.

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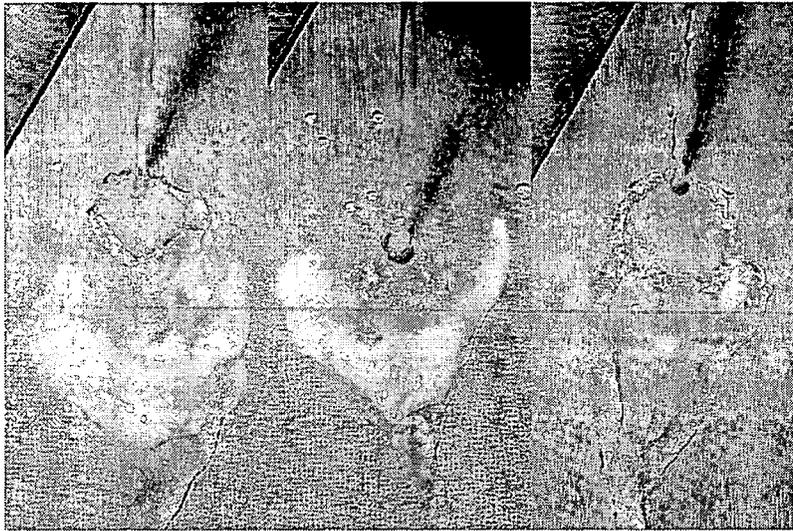


Figure 1



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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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