SOIL RELEASE TREATMENT FOR MOISTURE WICKING SOCKS

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ABSTRACT
A treated garment, especially white socks, treated with a soil release composition and a process for treating the garment are disclosed. A majority of polyester yarns from profiled cross section high moisture wicking capacity filaments are disclosed in a garment and sock construction which optionally includes other polyester yarns, polyamide yarns, cotton yarns and spandex. The garments so constructed and treated are rendered resistant to soil re-depositing after repeated wearing and washing cycles.
SOIL RELEASE TREATMENT FOR MOISTURE WICKING SOCKS

FIELD OF THE INVENTION

[0001] The present invention relates to hosiery, and especially to socks, treated with a soil release composition. The treated socks are constructed from yarns comprising polyester and polyester blends with cotton and other fibers. More particularly the treated socks comprise yarns of high moisture wicking capacity further comprised of fine filaments of a cross-section which enables moisture movement.

BACKGROUND OF THE INVENTION

[0002] Compositions for the treatment of fabrics to prevent soil re-deposition properties are known. Such compositions are known from European Patent number EP1225269 B1 assigned to CIBA Specialty Chemicals. These compositions have been shown effective when used with cotton containing textiles of 30 to 100% in mixture with polyester or polyamide. Pure synthetic fibers of polyester or polyamide are also usually treated by such compositions. Here the benefit sought is one of enhanced retention of the white color over multiple washing cycles, along with hydrophilicity and stain release. Yarns of high moisture wicking capacity such as those sold under the COOLMAX® brand name (INVISTA S.A. r.l.), comprise fine polyester filaments with special cross-sections designed to achieve enhanced moisture movement properties. Such yarns are widely used in hosiery, especially socks. Often combined with other yarns such as cotton, along with portions of nylon and spandex, these yarns fill a niche in the manufacture of white athletic socks. A deficiency of fabrics comprising special cross section fibers is a dingy appearance, or less “white” appearance, over time after repeated home washings. This poor color appearance, lack of newness retention over time with numerous wearing and washings is noted by customers and provokes some return of goods to retail stores.

[0003] Due to the high retention of white appearance required for athletics socks after repeated consumer use, treatments to enhance the release of soil have been sought. Such treatments have been sought especially for apparel and for socks knit from yarns composed of polyester fiber having specialized cross-sections aimed at enhanced moisture movement. Socks of this type sold under the COOLMAX® brand name pass strict moisture management criteria to meet brand requirements. Potential added value for socks of this type could be derived from their enhanced maintenance of a white appearance.

[0004] Thus there is a need to develop an improved foot apparel product that meets both the high moisture management standards of the industry while improving color and newness retention.

SUMMARY OF THE INVENTION

[0005] The invention provides a treated garment comprising at least 50% polyester multifilament yarns. The multifilament yarns are comprised of filaments having a profiled individual filament cross section. The treated garment is given a treatment with a fluorine containing durable soil release composition. The treated garment is characterized by a wicking height at least 75 millimeters according to a vertical water wicking test method, a stain release rating of at least 3, as measured by AATCC (American Association of Textile Chemists and Colorists) Test Method 130-2000, and at least a 1.0 unit improvement in soil re-deposition according to the soil re-deposition test method provided herein. The treated garment may further comprise a balance of yarns selected from yarns comprising non-profiled individual filaments selected from natural cotton and synthetic polymer fibers: polyester, polyamide and spandex yarns. The treated garment may further comprise a sock or at least a pair of socks.

[0006] Further provided in accordance with the invention is a process for treating garments comprising at least 50% polyester multi-filament yarns comprised of filaments having a profiled individual filament cross section, and comprising the steps of: applying a fluorine containing durable soil release treatment in an aqueous exhaustion bath at greater than 5% based on weight of garments and less than 50 to 1 garments to bath ratio; dropping the treatment bath without an intervening rinse step; drying the garments in a tumble dryer or the equivalent of an automatic dryer; and curing garments while individually boarded at a temperature between 110° C. and 190° C. for time period of about 60 to about 90 seconds.

DETAILLED DESCRIPTION OF THE INVENTION

[0007] According to one aspect of the invention, the applicants have found that a fluorine containing durable soil release composition applied as a final wet treatment on garments comprising a majority of profiled cross section filament yarns promotes the retention of garment whiteness and new appearance after extended wash cycles. An effective fluorine containing durable soil release composition for this treatment process is ZONYL® SRM (CIBA SPECIALTY CHEMICALS, Textile Effects, 3400 Westinghouse Boulevard, Charlotte, N.C. 28241, USA). The garments for which the inventive process is most effective comprise a high content of polyester multi-filament yarns. The balance of yarns with less than 100% polyester further comprise portions of cotton, polyamide (e.g. nylon 66 and nylon 6) yarns, polyester circular cross section filament yarns and spandex (e.g. Lycra® and Lycra® T400). A high content means greater than or equal to 50% and up to 100% polyester content. The filaments of these polyester yarns most effectively treated comprising profiled filaments. Herein, profiled filaments means having a non-circular cross-sectional shape as viewed normal to the long axis of the filament. One such profiled filament type is found in COOLMAX® yarns (INVISTA, S.A. r.l.; Three Little Falls Centre, 2801 Centerville Road, Wilmington, Del. 19808 USA). COOLMAX® yarns have a special cross-section which provides “4 channels” in each filament and are known for highly effective moisture wicking properties due to the presence of these channels. Fabrics of these yarns may take on a dingy appearance, or less “white” appearance, over time after repeated home washings. The processes herein and the products treated accordingly, by contrast, do not have this poor color appearance or lack of newness retention over time with numerous wearing and washings.

[0008] More generally, this invention provides a treated garment comprising at least 50% by polyester (from polyethylene terephthalate synthetic polymer) multifilament yarns. The multifilament yarns are comprised of filaments...
having a profiled individual filament cross section. The treated garment is given a treatment with the fluorine containing durable soil release composition, ZONYL® SRM. The treated garment is characterized by a wicking height at least 75 millimeters according to a vertical water wicking test method, a stain release rating of at least 3, as measured by AATCC Test Method 130-2000, and at least a 1.0 unit improvement in soil re-deposition according to the soil re-deposition test method provided herein. The treated garment may further comprise a balance of yarns selected from natural cotton yarns; non-profiled individual filament polyester, polyamide and spandex yarns. The treated garment may further comprise a sock or at least a pair of socks. More generally, the treatment herein is provided for socks which have a mostly white colored visual aesthetic.

The process, provided in accordance with the invention, treats garments comprising at least 50% polyester multi-filament yarns comprised of profiled individual filaments and comprises the steps of: applying a fluorine containing durable soil release treatment in an aqueous exhaustion bath at greater than 5% based on weight of garments and less than 50 to garments to bath ratio; dropping the treatment bath without an intervening rinse step; drying the garments in a tumble dryer or the equivalent of an automatic dryer; and curing garments while individually bored at a temperature between 110° C. and 190° C. for time period of about 60 to about 90 seconds. This process is effective in promoting whiteness retention after extended wash cycles. The whiteness retention property is demonstrated using a standard washing protocol and a synthetic standardize “dirt.” The test method measures the property of the treated fabrics to appear clean and not dingy without re-deposition of soil on the fabric from the wash water. The treated garments also meet a stain release requirement of at least 3 as measured by AATCC Test method 130-2000. The treated garments also meet a strict requirement for “whiteness” retention during the “boarding” or cure process and a strict moisture management standard. The moisture management standard is measured by a 125 mm (5 inch) water wicking height and 5 square centimeter spreading area known in the art for this category of hosiery sock product. Furthermore, the retention of the benefits of this fabric treatment is durable. Durable means the treatment benefit persists after extended wash cycles using standard stain release tests. Generally, these stain release tests are based on soil re-deposition, and the release of corn oil and mineral oil from the fabric of the garment.

Test Methods

Oil Repellency

Oil repellency ratings were determined according to Standard Test Method 118-2002 of the American Association of Textile Chemists and Colorists (AATCC). Oil repellency was tested by placing drops of hydrocarbon liquids of varying surface tension on the fabric, then visually determining the extent of surface wetting. This test determines how well finished fabrics resist oily stains and wetting by organic liquids. Generally, the higher the oil repellency rating, the better the finished fabric’s resistance to staining by oily substances. The standard test liquids are listed in Table 2.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Hydrocarbon</th>
<th>Surface Tension at 25° C. (77° F) (dyn/cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Refined Mineral Oil</td>
<td>31.0</td>
</tr>
<tr>
<td>2</td>
<td>Refined Mineral Oil/n-Hexadecane</td>
<td>29.2</td>
</tr>
<tr>
<td></td>
<td>(75/25 vol % at 21° C. (70° F)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>N-Hexadecane</td>
<td>27.3</td>
</tr>
<tr>
<td>4</td>
<td>n-Tetradecane</td>
<td>26.2</td>
</tr>
<tr>
<td>5</td>
<td>n-Dodecane</td>
<td>24.6</td>
</tr>
<tr>
<td>6</td>
<td>n-Decease</td>
<td>23.6</td>
</tr>
</tbody>
</table>

[0011] Different types of wetting may be encountered, depending on the fabric’s finish, fiber, or construction. With many fabrics, the endpoint rating is obvious because the fabric will completely resist wetting by one test liquid, but will allow immediate penetration by the next liquid. With some fabrics, however, endpoint determination can be difficult. These fabrics will show progressive wetting by several test liquids, as shown by a partial darkening of the fabric at the liquid/fabric interface. On black or dark fabrics, wetting can be detected by a loss of “sparkle” within the drop. For fabrics where the endpoint is difficult to determine, the endpoint is considered to be the test liquid that causes complete darkening at the interface within 30 seconds.

[0012] Fabric samples were placed face up on white blotting paper which rested on a flat horizontal surface. Drops of standard test liquid, beginning with the test liquid having a rating of 1, were applied to the test fabric in five locations. Each drop was approximately 5 mm in diameter or 0.05 milliliters in volume. The drops were observed for 30 seconds from an approximate angle of 45°. If at least three of the five drops were not observed to wet or penetrate the fabric and did not show wicking around the drops, the test was repeated on an adjacent site using the test liquid having a rating of 2. The procedure was continued until at least three of the five drops wet or showed wicking into the fabric within 30 seconds. The fabric’s AATCC oil repellency rating was determined to be the highest numbered liquid for which at least three of the five drops did not wet or wick into the fabric. Half point ratings may be given, for example 4.5 for a borderline pass on test liquid 5. An example of a borderline pass is where three or more of the five drops are rounded, however there is partial darkening of the specimen around the edge of the drop. In the United States, a commonly accepted level of oil repellency is a rating of 3.

Stain Release Rating

[0013] The AATCC stain release rating was determined according to Standard Test Method 130-2000 of the American Association of Textile Chemists and Colorists (AATCC). Fabric samples were placed flat on new AATCC Textile Blotting Paper on a smooth, horizontal surface. Five drops (0.2 milliliters total) of MAZOL®ED Corn Oil (ACH Food Companies Inc.) were placed on the fabric surface creating one single spot. A sheet of glassine paper was placed over the oil puddle, and a 2.27 kg (5 lb) weight was then placed directly over the glassine paper for 60 seconds. The weight and the glassine paper were removed, and the fabric sample was then washed for 12 minutes on normal wash cycle with high water level in a KENMORE® automatic using 100
grams of AATCC 1993 Standard Reference Detergent WOB. Wash temperature was 60° C. rinse temperature was cold. The total weight of the load was 4 lbs. After the final spin cycle, the entire load was placed in a KENMORE® automatic dryer and dried on high for 45-50 minutes.

[0014] Stain release ratings were determined by placing the stained, washed, and dried fabric flat in the center of a non-glare blacktop table with one edge of the table touching a Stain Release Replica (order number 08379, available from the AATCC). The fabric was viewed from a distance of approximately 76 cm (30 inches) and the residual stain was compared to the Stain Release Replica to the nearest 0.5 rating. Ratings are given from 1 (minimum) to 5 (maximum). In the United States, a commonly accepted level of stain release is a rating of 3.

Wicking Test Method

[0015] The moisture wicking of the yarns of the invention is determined by known methods, such as a vertical wicking test or a horizontal wicking test. The vertical wicking test may be conducted by knitting the yarns into tubes, and then either scouring or treating the tubes with any desired agent and allowing the treated tubes to air dry. The tubes are then cut into 1 inch (25.4) wide strips about 8 inches (203 mm) long and suspended vertically above water with 3 inches (75 mm) in the water and 5 inches (125 mm) above the water. Observations of the height of the water being wicked up the strips are conducted visually at predetermined times, such as 1 minute, 5 minutes, 10 minutes, 20 minutes, and 30 minutes.

Individual Fluorine Percent on Weight of Fabric

[0016] The percent on weight of fabric for fluorine, represented as % w/w of F, is determined as follows. Fluorine on the fabric, represented here as F_{FAB} is measured by the well-known Wickbold torch method in parts per million (ppm). This value is then divided by the weight percent of fluorine in the fluorochromic, represented as F_{RC}, to obtain the fluorine percent on weight of fabric for that fluorochromic:

\[
\% \text{ w/w of } F = \frac{F_{FAB}}{F_{RC}}
\]

When more than one fluorochrome is used, the total fluorine percent on weight of fabric is obtained by summing the individual fluorine percent on weight of fabric values for all fluorochromes used.

Soil Re-Deposition Washing

[0017] Using a "Lab-Line" extraction mixer, prepare a 1% or 2% dispersed solution of DuPont Standard Dry Soil in 1 liter (L) of room temperature de-ionized (DI) water. Cut fabric samples 75 mm by 75 mm (3" by 3") and add soil solution to separatory funnel and place fabric samples in funnel, up to 6 samples per funnel. Agitate for 15 minutes at a speed setting of 20 cycles per minute. Drain soil solution into a 1 L beaker and discard. Rinse funnel with de-ionized (DI) water to remove residual soil on sides of funnel and drain. Add 30 g of TIDE® Free powder detergent. Agitate for 15 minutes at speed setting of 20 cycles per minute. Drain wash water into a 1 L beaker and discard. Add 1 L of 40° C DI water to the funnel and agitate for 10 minutes at speed setting of 20 cycles per minute. Drain rinse water and discard. Add 1 L of room temperature DI water and agitate for 10 minutes at speed setting of 20 cycles per minute. Drain rinse water and discard. Remove samples and squeeze to remove excess water. Air dry for a minimum of 8 hours or until dry. Rate samples according to the Gray Scale, AATCC Evaluation Procedure 2.

[0018] Procedure for dispersing "dry soil" in water. The dispersed DuPont Soil Solution was made using a Research Model 01 Szegvari Attritor System. An 80% water/20% DuPont Dry Soil solution was made. The procedure uses 2 lbs. of 2 mm zirconium silicate grinding media at an operating pressure of 40 psi and a shaft speed of 600 rpm for two hours.

**DuPont Standard Dry Soil**

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS Number</th>
<th>wt %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peat Moss</td>
<td>65997-15-1</td>
<td>38</td>
</tr>
<tr>
<td>Cement</td>
<td>1318-74-7</td>
<td>17</td>
</tr>
<tr>
<td>Kaolin Clay, Peerless</td>
<td>7631-86-9</td>
<td>17</td>
</tr>
<tr>
<td>Mineral Oil</td>
<td>8012-95-1</td>
<td>8.75</td>
</tr>
<tr>
<td>Carbon Black</td>
<td></td>
<td>5.75</td>
</tr>
<tr>
<td>Red Iron Oxide</td>
<td>1309-37-1</td>
<td>0.50</td>
</tr>
</tbody>
</table>

**DuPont Standard Dry Soil may be purchased from Textile Innovators Corporation, 101 Forest St., Winfield, NC 27983, USA (520-794-9703) - synthetic soil prepared according to AATCC method for carpet soil tests.

EXAMPLES

[0019] In an example of the invention sock samples were knitted using the following construction details: 80% COOLMAX® (Type 729W) and 20% plating yarn consisting of 120 denier LYCRA® (902C) double covered with 70 denier 34 filament nylon 66 plus 40 denier 13 filament nylon 66 in the sock top, and 18 denier LYCRA® air jet covered with 2 plies of 70 denier 68 filament nylon 66 in the foot of the sock.

[0020] In an comparative example, sock samples were knitted using the following construction details: 65% COOLMAX® (Type 729W) in a 50/50 cotton blend and 37% plating yarns of 18 denier LYCRA® spandex air jet covered with 2 plies of with 2 plies of 70 denier 68 filament nylon 66 filament yarn.

[0021] All invention example socks were finished according to the following protocol: first a pre-scor for 15 minutes at 70° C. with 0.5 gram/liter Merol HS(C)1 (from Stepan Co.), 22 West Frontage Road, Northfield, Ill. 60063; 0.5 g/l trisodium phosphate and 0.5 g/l Lubit 64 (Lanxess Corp. 111 RIDC Park West, Pittsburgh, Pa.); next a water rinse (2 times); add water to 40/1 liquor ratio; add ZONYL® SRM based on a minimum of 5% (up to 10%) by weight of goods (garment weight); adjust pH to 5.5 with acetic acid; heat the bath to 43° C. and hold 20 minutes with agitation; drop bath; do not rinse garments and then tumble dry. Using standard boarding techniques the garments are individually boarded at 160° C. for between 90 seconds to assure product cure on the garment.

[0022] All comparative example socks were finished according to the following protocol: first a pre-scor for 15 minutes at 70° C. with 0.5 gram/liter Merol HS(C)1, 0.5 g/l trisodium phosphate and 0.5 g/l Lubit 64; add PEARL-MALOSE™ 3%; adjust pH to 6.0 with acetic acid; heat the bath to 60° C. and hold 10 minutes with agitation; drop bath; do not rinse garments and then tumble dry. Using standard boarding techniques the garments are individually boarded at 140° C. for 60 seconds.
Both comparative and invention example socks met the moisture wicking specifications for vertical rise of water, at least 75 mm.

The soiling ratings are given in the following tables 1 and 2. The Gray Scale ratings indicate relative “dinginess” of a white sock. In both cases where the invention examples were treated with ZONYL® SRM and challenged with a soil test of either 1% or 2% soiling, the invention examples were superior to the comparative examples.

### TABLE 1

<table>
<thead>
<tr>
<th>80% COOLMAX® socks</th>
<th>Gray Scale Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparative Example</td>
<td>3.5</td>
</tr>
<tr>
<td>Treated with 5% ZONYL® SRM</td>
<td>4.5</td>
</tr>
<tr>
<td>Treated with 10% ZONYL® SRM</td>
<td>4.5</td>
</tr>
</tbody>
</table>

### TABLE 2

<table>
<thead>
<tr>
<th>80% COOLMAX® socks</th>
<th>Gray Scale Rating</th>
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<td>4.5</td>
</tr>
<tr>
<td>Treated with 10% ZONYL® SRM</td>
<td>4.5</td>
</tr>
</tbody>
</table>

1. A treated garment comprising at least 50% polyester yarns, wherein the yarns are comprised of filaments having a profiled individual filament cross section, and wherein the garment is treated with a fluorine containing durable soil release composition, and wherein the treated garment has a wicking height at least 75 millimeters and a soil re-deposition rating of at least 3.

2. The treated garment of claim 1 comprising a balance of yarns selected from yarns comprising non-profiled individual filaments selected from natural cotton and synthetic polymer fibers: polyester, polyamide and spandex yarns.

3. The treated garment of claim 1, comprising a sock.

4. A process treating garments comprising at least 50% polyester multi-filament yarns comprised of filaments having a profiled individual filament cross section, and comprising the steps of:

   - applying a fluorine containing durable soil release treatment in an aqueous exhaustion bath at greater than 5% based on weight of garments and less than 50 to 1 garments to bath ratio;
   - dropping the bath without rinsing;
   - drying the garments in a tumble dryer; and
   - curing the boarded garments individually at a temperature between 110° C. and 190° C. for time period of about 60 to about 90 seconds.

* * * * *