METHOD FOR INCREASING PILL RESISTANCE AND DENSITY OF BLENDED STAPLE POLYETHYLENE TEREPTHALATE AND CELLULOSE FABRICS BY APPLYING SPECIFIC CHEMICAL SHRINKING AGENTS FOR THE POLYETHYLENE TEREPTHALATE

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This invention relates to a finishing treatment for blended fabrics comprised of polyester fibers. More particularly, it relates to a process for increasing the weight per unit area of such fabrics.

Fabrics containing a high percentage of the polyester fibers of Whinfidd Patent No. 2,465,319, and particularly polyethylene terephthalate, resemble 100% woven fabrics more closely than do fabrics containing other commercial synthetic fibers. This fact, together with the excellent shape retention and lightness in weight possessed by the fabrics containing polyester fibers, has led to substantial commercial acceptance of such fabrics.

Because of the improved properties of fabrics containing polyester fibers, there has been a demand for such fabrics containing increased percentages of the polyester fibers. Heretofore, fabrics containing high percentages of polyester fibers have not been completely acceptable. Perhaps the most outstanding problem in connection with the fabrics containing high percentages of the polyester fibers is the tendency for such fabrics to form pills on the surface of the fabric. The increased tendency towards pill formation in these high polyester fiber fabrics apparently is caused by excessive polyester fibers on the surface of the fabric that become entangled into pills.

Not only has there been a demand for high polyester fiber fabrics with increased pill resistance, but also there has been a need for high polyester fiber fabrics of increased density wherein the polyester fibers are concentrated internally of the fabric. Such a fabric inherently will have high pill resistance as well as numerous other characteristics that make it ideal for many uses.

It is an object of this invention to produce high density fabrics containing substantial amounts of polyester fibers in conjunction with other fibers. It is a further object to produce such a fabric wherein the polyester fibers are concentrated internally of the fabric.

These objects are accomplished by selecting a fabric containing from 25—95% of polymeric polyethylene terephthalate fibers and shrinking the polymeric polyethylene terephthalate fibers an average of at least 18% of their initial lengths.

The shrinking step is accomplished in accordance with this invention by treating the fabric for at least two minutes with an aqueous liquor containing a certain type of shrinking agent. During the shrinking of the fibers the fabric is substantially free of tension. The liquor is maintained at a temperature from about 160° F. to its boiling temperature, ordinarily about 212° F., and preferably at about its boiling temperature.

The shrinking agent of my invention is phenol and phenols substituted in any position with hydrocarbon groups containing from 1—6 carbon atoms. Thus the shrinking agents employed can be ortho- or para-cresol, para- or meta-phenylphenol, ortho-, para- or meta-ethylphenol or the various xylenols.

While the phenols listed above give relatively high shrinkage of the fabrics under optimum conditions, by far the best shrinking agents, and by no means equivalents of those listed above, are meta-cresol and ortho-phenylphenol. These preferred shrinking agents give consistently excellent performance, producing the desired high density fabrics of outstanding quality.

In the shrinking treatment, the polyester fibers are shrunk substantially more than the other fibers present in the fabric. Consequently, the other fibers tend to loop and bunch up into the surface of the fabric while the polyester fibers become straightened out and concentrated internally of the fabric thereby being less available for pill formation.

As will be observed from the following examples, during the shrinking treatment the fabric shrinks substantially more warp-wise than it does fill-wise. It has been found that to produce a satisfactory fabric in accordance with this invention it is necessary that the fabric shrink at least 22% warp-wise, and preferably 25% or more, and at least 15% fill-wise, and preferably 18% or more, giving an overall average fabric shrinkage of at least about 18%. Obviously then the polyester fibers must shrink more than 18% of their initial lengths.

Using a shrinking liquor containing only meta-cresol as the shrinking agent, it has been found that the liquor must contain at least about 4% by weight of meta-cresol to give the required 18% average shrinkage. Alternatively the required amount of shrinking is obtained by treating the blended fabric with a liquor containing at least 1% of ortho-phenylphenol. Likewise, it has been found that the requisite shrinkage is obtained using aqueous liquors containing mixtures of meta-cresol and ortho-phenylphenol provided that the sum of the weight percentage of the ortho-phenylphenol and ¼ the weight percentage of the meta-cresol present in the liquor equals at least 1 percent.

Since no substantial increase in shrinkage is obtained by using a liquor containing in excess of about 7% of meta-cresol or about 4% ortho-phenylphenol, and since excessive amounts of these materials undesirably affect some fabrics, it is preferred to use liquors not in excess of these concentrations. Likewise when the treating liquor contains both these shrinking agents the percentage of ortho-phenylphenol plus ¼ the percentage of meta-cresol preferably does not exceed 6.75%.

To illustrate the practice of the present invention the following examples are given:

Example 1

A plain weave tropical geigie fabric made from a blend of 45% wool and 55% 3-denier polyethylene terephthalate staple fiber having a staple length of 2.5 inches was placed into a tumble washer containing a 5% by weight aqueous solution of m-cresol at a temperature of 200° F. The fabric was thusly washed with agitation in the tumble washer for 15 minutes.

After removal of the fabric from the tumble washer it was scoured in a 1% solution of ether-alcohol sulfate at 200° F. For 15 minutes and subsequently rinsed with water to remove m-cresol.

It was found that the fabric had shrunk 28% warp-wise and 20% fill-wise during this treatment. The fabric weight had increased from 4.8 oz./sq. yd. to 5.1 oz./sq. yd. with an increase in thickness from 0.019 inches to 0.024 inches.

Numerous pieces of this treated tropical geigie fabric were dyed successfully and finished by conventional procedures. The fabric had excellent liveness, compressional resilience, wrinkle resistance, crease-recovery, elasticity and a greatly increased resistance to pilling.
Substantially the same product is obtained by following the same procedure but using a treating liquor containing 2.5% of m-cresol and 0.5% of o-phenylenediamine. Similarly, the improved product is obtained by replacing the treating liquor of this example with one containing no m-cresol and 1.0% of o-phenylenediamine. By using still higher concentrations of o-phenylenediamine up to about 4% by weight, even denser fabrics are made from this plain-weave tropical grège fabric.

**Example 2**

A fabric made from 85% of polyethylene terephthalate staple fiber and 15% cellulose acetate staple fiber, both of a staple length of 2.5 inches, was treated in accordance with the procedure of Example 1 but using an aqueous solution containing 6.3% by weight of m-cresol.

The thusly treated fabric and also a sample of the untreated fabric were then subjected to a standard pilling test wherein the surface of the fabric is subjected to controlled abrasion. It was found that the untreated fabric showed 12.7 pills per square inch whereas the treated fabric showed only 0.1 pill per square inch.

**Example 3**

Three two-yard samples of the fabric of Example 1 were treated in a tumble washer in accordance with the procedure of Example 1 but at varying m-cresol concentrations. This treatment was followed by a 30-minute scour at the boil with a 0.1% solution of an ethyl-alcohol sulfate with agitation. The following table shows the effect of these treatments. Under the heading “Shrinkage,” W stands for warp-wise and F for filling-wise.

<table>
<thead>
<tr>
<th>Concentration of m-cresol</th>
<th>Fabric Shrinkage</th>
</tr>
</thead>
<tbody>
<tr>
<td>4%</td>
<td>26.9% W 17.3% F</td>
</tr>
<tr>
<td>6%</td>
<td>28.8% W 21.9% F</td>
</tr>
</tbody>
</table>

**Example 4**

Three two-yard samples of the blended fabric of Example 1 were treated in a tumble washer in accordance with the procedure of Example 1 but at varying liquor temperatures. Following this treatment the samples were scoured in accordance with the procedure of Example 3. The following table shows the effect of this treatment:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Fabric Shrinkage</th>
</tr>
</thead>
<tbody>
<tr>
<td>65°F</td>
<td>11% W 9% F</td>
</tr>
<tr>
<td>100°F</td>
<td>28% W 15% F</td>
</tr>
<tr>
<td>212°F</td>
<td>28% W 15% F</td>
</tr>
</tbody>
</table>

Results similar to those of Examples 1 thru 3 are obtainable by including o-phenylenediamine in the treating liquor provided that the numerical sum of the weight percentage of the o-phenylenediamine plus ¼ the weight percentage of m-cresol present in the liquor falls within the range of 1 to 5.75%.

**Example 5**

Three samples of the polyester fiber-wool fabric of Example 1 were treated in a tumble washer in accordance with the procedure of Example 1 except that the shrink liquor contained varying amounts of o-phenylenediamine in place of the m-cresol of Example 1. This treatment was followed by a scour with an ether-alcohol sulfate solution to remove the treating liquor from the fabrics. The following table shows the effect of these treatments:

<table>
<thead>
<tr>
<th>Concentration of o-phenylenediamine</th>
<th>Fabric Shrinkage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0%</td>
<td>20% W 17% F</td>
</tr>
<tr>
<td>2.0%</td>
<td>20% W 22% F</td>
</tr>
<tr>
<td>3.0%</td>
<td>20% W 24% F</td>
</tr>
</tbody>
</table>

The process of this invention is applicable to all fabrics containing substantial amounts of polyester fibers in conjunction with other fibers, whether the fabric be woven, felted or otherwise fabricated. For example, this process is applicable to fabrics containing, besides polyester fibers, natural fibers such as wool, cotton, linen and the like, and synthetic fibers such as polycrylonitile fibers, polystyrene fibers, and the various rayon fibers. Of course, the fabric should not contain fibers that are substantially damaged by the shrinking agents.

The process can be applied at any stage in the conventional treatment of the fabric. If desired, the shrink treatment can be carried on simultaneously with the dyeing of the fabric. Preferably it is carried on prior to dyeing of the fabric since the treatment of dyed fabric in many instances causes bleeding off of dye.

I claim:

1. A method for increasing the pill resistance and density of a fabric made from a blend of staple textile fibers and containing from 25 to 95%, by weight, of polyethylene terephthalate staple fibers and from 5% to 75%, by weight, of a non-pilling cellulosic fiber, comprising the step of shrinking the polyethylene terephthalate fibers an average of at least 18% of their lengths so that the non-pilling staple fibers in the fabric, which shrink less than the polyethylene terephthalate fibers, bunch up into the surface of the fabric by treating said fabric for at least two minutes with an aqueous liquor containing from 0.4% by weight of ortho-phenylenediamine and from 0.75% by weight of meta-cresol, with the sum of the percentage of the ortho-phenylenediamine and the percentage of meta-cresol in the liquor equaling from 1 to 5.75%, said liquor being at a temperature of from about 160°F to its boiling temperature.

2. The method in accordance with claim 1 wherein the aqueous liquor contains from 4–7% by weight of meta-cresol.

3. The method in accordance with claim 1 wherein the aqueous liquor contains from 1–4% by weight of ortho-phenylenediamine.

4. The method in accordance with claim 1 wherein the aqueous liquor is at its boiling temperature.

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In the file of this patent

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