ABSTRACT: A process for simultaneously and preferentially depositing compositions on a particular side of two textile fabrics is described. The process involves impregnating two pieces of textile fabric with a composition in a liquid carrier, contacting the surfaces of the treated fabrics in contiguous relationship and heating the contacting fabrics to remove the liquid carrier whereby the composition becomes concentrated at or near the exposed surfaces of the two fabrics. The process can be repeated with the same or a different composition, and by exposing the remaining surface of each fabric on drying, depositing the second composition on these exposed surfaces. Thus, the invention provides a method for depositing two different compositions on two fabrics wherein each surface of the fabrics contains predominantly different compositions.
3,634,126

1 PROCESS FOR CONTROLLING LOCATION OF COMPOSITION IN FABRICS

BACKGROUND OF THE INVENTION

This invention relates to a process for simultaneously and preferentially depositing compositions on a particular surface of two textile fabrics, and more preferably, to a method for depositing compositions on a textile fabric wherein each surface of the fabric contains a different composition.

Fabrics for textile uses are prepared from a wide variety of materials in the forms of filaments and fibers. The materials utilized in the preparation of the fabric can be either natural substances such as cellulose fibers or keratinous fibers; synthetically produced fibers such as polyamides, polyesters, polyacrylonitriles, etc.; or blends of these various fibers. Although the properties of such fabrics can be determined and controlled to some degree by varying the amounts of the various fibers comprising a fabric, it has not been possible generally by such selection to prepare a fabric having all the desired properties, or the desired properties at a significant level. Examples of such properties include durable creases and pleats, soil release, abrasion resistance and, in general, acceptable wash-and-wear characteristics. In other words, after repeated washings and/or dry cleanings, the creases and pleats are either removed completely or are present to an unacceptable level, and/or the fabric has accumulated soil which either cannot be removed on washing or is redeposited in the washing cycle.

Many of these properties are improved by preparing fabrics from blends of natural and synthetic fibers. Unfortunately, the various fibers have different wearing characteristics and tend to abrade or degrade at different rates. For example, the abrasion resistance of cotton is less than the abrasion resistance of such synthetic fibers as polyester fibers. Accordingly, a fabric comprised of cotton and polyester fibers will abrade unevenly resulting in unusual color effects in dyed blended fabrics.

Another difficulty in preparing garments from fabrics containing, for example, cellulosic fibers, has been the weakening of the fibers at the angles of the creases or pleats during wearing and laundering. One solution to this problem has been to incorporate stronger fibers into the cellulosic fabrics as mentioned above. However, this does not provide a complete solution to the problem when it is necessary to utilize or one desires to utilize fabrics containing only cellulosic fibers.

Considerable research has been directed to the improvement of the properties of textile fabrics by treating the fabrics with monomers and polymers of thermosetting and thermoplastic resins, the monomers being converted in situ to the fully polymerized state through the use of catalysts. Attempts have also been made to improve the wear characteristics of fabrics by the use of such treatments as silicone, polyethylene, lubricants, softeners and plasticizers. Although these treatments are somewhat successful in improving many of the characteristics of the fabrics, such treatments may affect the aesthetic properties of the fabrics. Also, some treatments which have been suggested for improving the wear characteristics of, for example, durable-press fabrics, have not been acceptable because of the production of other undesirable side effects such as increased soil retention. Moreover, it has been found that treatments for improving certain properties of fabrics often suffer the disadvantage of producing fabrics having reduced wear life compared to untreated fabrics. The reduced wear life is observed in the form of lower tear resistance, lower flex strength and lower abrasion resistance. One possible cause of the low wear resistance of fabrics which have been given polymeric treatments is the reduction in fiber elongation and overall toughness of individual fibers caused by the presence of the polymers. Attempts to reduce the negative characteristics of the additive treatments by reducing the amount of additive applied to the fabric generally results in an overall reduction of the desirable properties. Consequently, there continues to be a need for a treatment or a process of treating textile fabrics to improve the properties of the textile fabrics in the absence of large amounts of additive.

Processes have been reported whereby compositions can be preferentially applied to a given surface of fabrics. Most of these techniques involve applying thickened compositions to one side of a fabric which are thereafter dried and cured quickly before the composition can penetrate the fabric. U.S. Pat. No. 3,445,277 describes such a process. It is also described in U.S. Pat. No. 3,445,277 to impregnate a fabric with a durable creaseproofing agent and a catalyst, and thereafter poison the creaseproofing agent on one side of the fabric so that on curing the treated fabric, the creaseproofing agent is fixed to only one side.

Flash drying treated fabrics at elevated temperatures such as on a can dryer is reported to cause migration of the chemicals to one side of the fabric. A modification of this technique is described in U.S. Pat. No. 3,141,810 wherein the impregnated fabric is placed on a cool glass plate and dried. Since drying occurs at the exposed face of the fabric, migration of the composition occurs to this face.

In U.S. Pat. No. 3,448,462 there is described a method for improving the abrasion resistance of garments by treating the fabric with an abrasion-resistant polymeric composition in a liquid carrier and thereafter drying one of the two faces of the impregnated fabric more rapidly than the other to effect migration. This uneven drying rate is accomplished by placing the impregnated fabric on a damp duck fabric conveyor and drying the fabric while on the conveyor. The exposed surface of the fabric dries more rapidly than the surface in contact with the dam duck. Accordingly, the polymeric compositions migrate to the exposed surface. These techniques for preferentially depositing compositions at the face of the fabric make it possible to improve the characteristics of the fabrics with less of the additive since the location of the additive can be controlled for maximum benefit. For example, for abrasion resistance, the polymeric additive should be at the surface where contact with abrasive forces occurs.

SUMMARY OF THE INVENTION

It has now been found that the backing fabric need not be limited to a fabric wet with water but that the backing can be a second fabric treated with a compositions which migrates at the same time. Thus, the process of this invention is a process for simultaneously and preferentially depositing compositions on a particular side of two textile fabrics. The process comprises impregnating two pieces of textile fabric with the composition in a liquid carrier, contacting one side of the treated fabric with one side of the second treated fabric and thereafter heating the two contacting fabrics to remove the liquid carrier whereby the composition becomes concentrated at or near the exposed surfaces of the two fabrics. In this manner, the properties of the fabrics can be improved, and the process provides a method for treating twice as much fabric at the same time. In a preferred embodiment, the above treated fabric is subjected to a second treatment of a composition in a liquid carrier and the procedure is repeated reversing the both fabrics as they come into contact and pass into the oven so that the second composition is concentrated on the opposite surface. In this manner, it is possible to locate those additives on the face of a fabric which are preferentially located on the face of the fabric such as abrasion-resistant additives, and it is possible to deposit other compositions on the back of the fabric to obtain the desired properties of the additive without detracting from the desired properties of the face. The process can be carried out on individual pieces of fabric or in a continuous manner.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a block or schematic diagram of one means for continuously treating two fabrics in accordance with the process of the invention.
DESCRIPTION OF THE PREFERRED EMBODIMENTS

As contrasted with many of the processes already known in the art, the process of this invention requires no particular method for applying the composition in the liquid carrier to the fabric. That is, it is unnecessary to increase the viscosity of the material so that it does not impregnate the fabric, nor is any other elaborate technique necessary for controlling the initial application of the composition. In fact, the invention contemplates thoroughly impregnating the fabric substrate with the composition in a liquid carrier as an initial step. Thus, the composition and the liquid carrier can be applied to the fabric substrate by any known method such as dipping, brushing, spraying, immerging, padding, coating, etc., and the concentration of the composition on the liquid carrier can be diluted as desirable and practical. Excess liquid can thereafter be removed by known techniques such as squeezing the wet fabric.

The compositions applied to the fabrics in accordance with the process of the invention may be either solid or liquid compositions which can be either soluble or insoluble in the liquid carrier. Examples of suitable compositions which are known for impregnating certain characteristics of textile fabrics include the aminoplast resins for improving the durable-press characteristics, acrylic polymers for abrasion resistance, various polymeric acid compositions for improving the soil-resistant and antistatic properties of fabrics and particularly, cellulosic-containing fabrics, lubricants, softeners, plasticizers, dyestuff, flame retardants, etc.

Inorganic materials can also be preferentially deposited on either surface of two fabrics, and these include, for example, hydrous stable metal oxides of such metals as aluminum, silica, titanium, etc. as described in U.S. Pat. No. 2,734,835 and water-insoluble basic aluminum salts such as those described by Pierce et al. in U.S. Pat. No. 3,089,778.

The liquid carrier can be any organic or inorganic liquid although the particular liquid carrier chosen cannot be one having a boiling point above the decomposition point of the composition being applied, nor must the liquid carrier react with the compositions. Thus, the liquid carrier is selected after considering the properties of the composition, Water is a particularly preferred liquid carrier in the process for water-insensitive compositions since the water is easily removed from fabrics at a reasonable temperature. More rapid drying is realized in some instances by dissolving or emulsifying the composition in an organic liquid medium such as the lower alkyl alcohols, methanol and ethanol.

The composition in the liquid carrier can be applied to the fabric in any for such as solution, dispersion, suspension or emulsion for preparing suspension, suspensions and emulsions of the particular compositions chosen will be readily apparent to those skilled in the art. As mentioned above, the process of this invention involves bringing together in contiguous relationship, tow wet fabrics which have been impregnated with the same or different compositions in a liquid carrier. Of course, when applying two different compositions, the composition or liquid carrier on one fabric must not react in any way with the composition or the liquid carrier on the second fabric when the two fabrics are brought into contact. It is essential to this invention that the two treated fabrics be maintained in contiguous relationship during the drying process, and the fabrics can be maintained in this position by any of the methods known in the textile art. For example, the fabrics may be superimposed on one another and pinned to a tenter frame. This method is particularly advantageous where the process is to be continuous. Where smaller pieces of fabric are being treated, they may be brought into contiguous relationship and maintained in this position utilizing a simple pin frame. Once the fabrics are dried, they may be removed from the pin frame or tenter frame. It can be observed from an inspection of the fabrics that the composition applied has migrated to the exposed surfaces of the two fabrics.

It has now been found that the process can be repeated, and a second composition preferentially deposited on the other face of the fabrics. This is accomplished by impregnating the fabric with a second composition, bringing the two fabrics together in contiguous relationship in such a manner that the previously exposed surfaces are the contiguous surfaces. In this manner, when the contiguous fabrics are dried and the second composition migrates to the exposed surface, the two surfaces of the resulting fabrics are coated with different compositions.

As mentioned previously, the process of this invention can be carried out either on short lengths of fabrics or on longer lengths of fabrics in a continuous manner. A schematic diagram of a continuous process in accordance with this invention is illustrated in the drawing. Fabrics 11 and 12 are advanced from rolls 10 and 13 respectively to work stations A and B respectively where the composition and liquid carrier are applied to the two fabrics. The compositions may be the same or different. From stations A and B the fabrics advance to station C where the fabrics are brought into contact such as by passing between the two rolls identified as 7. The contiguous fabrics advance to station D which is some form of a heating oven wherein the fabrics are dried. After emerging from station D, the fabrics advance to station E where the fabrics are separated and collected on makeup rolls 40 and 50. In the process outlined in the drawing, the drying is such that the composition in fabric 11 migrates to the surface which is away from fabric 12, and the composition in fabric 12 migrates to that surface which is away from fabric 11. In a preferred continuous process, the fabrics 11 and 12 are brought into contiguous relationship at station C and pinned on a tenter frame for advancement through station D. The tenter maintains the contiguous relationship throughout the advancement and sufficient tension on the fabrics to prevent distortion and wrinkling which could result in an uneven migration of the compositions to the exposed surface.

The abutting fabrics can be dried at station D with any conventional drying apparatus such as hot air ovens or infrared lamps or rays. Preferably, air-circulating means are provided for drying the fabrics. The temperature of the oven will vary depending on the nature of the fabric, the composition applied to the fabric and the liquid carrier. Generally, temperatures vary from about 60° C. to about 225° C. or higher are utilized. When water is the liquid carrier, a temperature of about 125° C. for a period of time of from about 1 to 5 minutes has been found to be sufficient. In those cases where the composition applied to the fabric can be further cross-linked and polymerized, the fabrics may be passed through a second heating station (not shown in the drawing) at higher temperatures to effect the cure. Such modifications will be readily apparent to those skilled in the art.

As mentioned previously, the two fabrics, after separation at station E, can be subjected to a second treatment in the same manner as before to preferentially deposit a second composition in the two fabrics. Generally, it will be desirable to deposit the second composition on the surface left uncoated by the previous treatment. Thus, the two separate fabrics from station E are passed through a second treating station and brought together again with the two sides which were in contact in the first treatment now the exposed sides of the two fabrics. Drying of these abutting fabrics causes the second composition to migrate to the exposed surfaces.

The following examples are presented for the purpose of illustration. Unless otherwise indicated, all parts and percentages are by weight.

EXAMPLE 1

Small samples of a fabric made from a blend of 65 percent polyethylene terephthalate and 35 percent wool fibers are padded to a 50 percent wet pickup with an aqueous emulsion prepared by mixing 200 parts of an acrylic polymer comprising 40 parts of ethylacrylate, 60 parts of butylacrylate and about 2 to 3 parts, based on the total weight of the acrylates,
of N-methylolacrylamide (available as an emulsion containing 46 percent solids from Rohm & Haas Company under the trade designation Rhoplex K-3), 12 parts of an acrylic copolymer of ethylacrylate:acrylic acid (70:30), 2 parts of a wetting agent and about 300 parts water. Two samples of the treated fabric are positioned so that they are back to back on a pin dryer and placed in a hot air oven maintained at a temperature of about 100° C. for 3 minutes. At the end of this period, the pin dryer is removed from the oven, and the fabric is removed from the pin dryer. An inspection of the two fabrics indicates that the acrylic polymer has migrated into the face of both fabrics.

A second mixture is prepared comprising 18 percent dihydroxy dimethyol ethylene urea (50 percent solution available under the trade designation Permafresg 183 from the Sun Chemical Company), 3.2 percent zinc nitrate hexahydrate, 0.2 percent of ethoxylated nonyl phenyl and 3 percent of a polyethylene softener. The two fabrics treated above are immersed in this emulsion, pinned face to face on a pin dryer and dried at a temperature of about 110° C. for 3 minutes. The polyethylene teraphthalate/cotton fabrics treated in this manner are observed to have the durable-press resin concentrated on the back of the fabric. Thus, the fabrics prepared in this example have the abrasion-resistant acrylic coating on the face of the fabric and the durable-press resins on the back surface of the fabric. Such fabrics are found to exhibit excellent abrasion resistance and durable press characteristics.

EXAMPLE 2

An acrylic emulsion is prepared containing 6 percent of an acrylic polymer emulsion commercially available from National Starch Company under the trade designation Resyn 254445 which is essentially a butyl acrylate polymer emulsion containing a small amount of acrylonitrile (about 5 percent) and N-methylol acrylamide (about 2-3 percent). A second mixture is prepared comprising 10 percent of a 50 percent dihydroxy dimethyol ethylene urea solution, 1.8 percent of a 50 percent zinc nitrate hexahydrate solution, 0.1 percent wetting agent and 3.5 percent of cyanate HP, a commercial fatty acid ester softener available from American Cyanamid Co. Samples of fabric made from 65 percent polyethylene teraphthalate and 35 percent viscose rayon are treated with the above solution in accordance with the following procedures.

PROCEDURE 1

Two pieces of fabric are treated with the first emulsion to a 70 percent wet pickup and dried at a temperature of about 110° C. on a pin frame back to back so that the polymer migrates to the face of the two fabrics. The treated fabrics are then immersed in the second mixture and dried at a temperature of about 110° C. on a pin frame face to face whereby the resin migrates to the back of the two fabrics.

PROCEDURE 2

Samples of the fabric are immersed in the second mixture to provide a 70 percent wet pickup and two pieces of the wet fabric are placed on a pin frame face to face whereupon the frame is placed in an oven at a temperature of 110° C. for about 3 minutes. The resin is observed to migrate in back of the fabrics.

PROCEDURE 3

Procedure 2 is repeated except that ordinary drying techniques are utilized. That is, a single treated sample is placed on the pin frame and dried at a temperature of about 110° C. for 3 minutes. No migration is observed.

The above treated samples are then pressed on a hot head press using a cycle of 5 seconds steam, 5 seconds bake and 5 seconds vacuum and baked for 15 minutes at a temperature of about 163° C. The fabrics exhibited good fabric smoothness and crease retention but only the fabrics treated in accordance with procedures 1 and 2 exhibited satisfactory abrasion resistance on the fabric face. The abrasion resistance of the fabrics is determined according to the test procedure known as the CSI Frosting Test. Details of this test are reported in "The Proceedings of the American Association of Textile Chemists and Colorists," American Dyestuff Reporter, Nov. 22, 1965, page 48. The frostiness rating is determined by comparison with a set of standards having a numerical range of from 1 to 5 with 1 representing severe frosting due to abrasion and 5 representing negligible frosting. The results of this test are reported in the following table.

<table>
<thead>
<tr>
<th>Fabric Treatment Procedure</th>
<th>CSI Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.3</td>
</tr>
<tr>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>3</td>
<td>2.0</td>
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</table>

The above results demonstrate that the process of the invention provides desirable improvement to fabrics and in particular, that abrasion-resistant polymers (acrylics) are not needed if the durable-press resin (the ureas) are connected on the back of the fabric rather than distributed throughout the fabric. That which is claimed is:

1. The process for preferentially depositing compositions on both sides of two textile fabrics which comprises:
   a. impregnating two pieces of textile fabric with a first composition in a liquid carrier,
   b. contacting one side of one treated fabric with one side of the second treated fabric in a contiguous relationship,
   c. heating the contacting fabrics to remove the liquid carrier whereby the first composition becomes concentrated at or near the exposed surfaces of the two fabrics,
   d. separating the two fabrics,
   e. impregnating the fabrics with a second composition in a liquid carrier,
   f. contacting the two fabrics in contiguous relationship so that the sides of the two fabrics which were in contact with each other in steps (b) and (c) are now the exposed surfaces, and
   g. heating the contacting fabrics to remove the liquid carrier whereby the second composition becomes concentrated at or near the exposed surfaces of the two fabrics.

2. The process of claim 1 wherein the first composition applied to the two fabrics is different for each fabric.

3. The process of claim 1 wherein the first composition is a polymeric composition.

4. The process of claim 1 wherein the composition is an acrylic polymer and the carrier is water.

5. The process of claim 4 wherein the composition is an amination resin.

6. The process of claim 1 wherein a slight uniform tension is applied to the edges of the contacting fabrics.

7. The process of claim 1 wherein the first and second compositions are different compositions.