PERMANENTLY CREASED AND PLEATED FABRICS AND PROCESS FOR PRODUCING SAME


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23 Claims. (Cl. 2—245)

The present invention relates to improved textile fabrics and improved methods of producing permanently creased and pleated fabrics and garments. More particularly, the present invention relates to the treatment of cellulose textile materials with polymerizable thermosetting resins and catalysts according to an improved method to produce stable, chemically treated textile materials that are particularly suitable and desirable for use in the manufacture of garments wherein creases and pleats are introduced and set in a permanent manner by subsequent processing.

Many attempts have been made in the past to develop processes for producing garments containing permanent creases and pleats. One of these methods is described by Warnock, U.S. Patent 2,974,432, whereby fabric is first impregnated with a solution of a mixture of polymerizable thermosetting resins, an organic acid type catalyst, and additives such as softeners and deodorants. The fabric is then partially dried and thereafter cut and sewn into a garment according to the desired style and design configuration. After the garments have been completed, the desired crease and/or pleats are formed in the garment according to the selected style and design. The garment is then placed in a garment setting oven for curing. The temperature in the oven for the curing step is sufficient to complete the polymerization reaction of the polymerizable thermosetting resins and serves to insolubilize the contained resin in situ, and thus to set the pleats and/or creases in the desired configuration in the garment in a permanent manner. Pleats and creases introduced into a garment in this manner are in general substantially unaffected by repeated launderings. In general, the foregoing sequence of operations for introducing permanent pleats and creases into a fabric is called deferred or delayed curing. Reference is made to U.S. Patent 2,974,432 where this process is described in further detail.

In actual practice, the efficiency of the deferred curing processes to produce the desired results depends by and large on the stability of the polymerizable material. That is, in order for the deferred curing operation to produce its optimum results, it is necessary that the polymerizable material used for the impregnation of the fabric remain in an unreacted state in the presence of the catalyst throughout the entire period following the initial application of the resin up to the final insolubilization of the curing reaction. Thus, while the impregnated fabric is stored, shipped and processed into the finished garments, there must be no opportunity for the resin to undergo further reaction. It is essential that the entire process avoid a premature reaction of the polymerizable material on the fabric prior to the final curing step. It is known in the art that the temperatures required to accelerate the polymerization and curing reaction of polymerizable thermosetting resins used for textile treatment is considerably above ambient temperature and that such reactions normally take place at elevated temperature. However, some reaction also takes place at moderate temperature and even at ambient temperature, particularly over a long period of time. Accordingly, since the fabrics treated with the polymerizable thermosetting resins and catalyst are frequently stored over a long period of time, the stability of such fabrics is severely limited, and this imposes considerable limitation on practicing processes such as described in U.S. 2,974,432 on a commercial scale.

For practical purposes, for most of the thermosetting resins presently available commercially, it is necessary to carry out all the processing steps including fabric treatment to garment curing in the shortest possible time span. It is often desirable that this time span be as short as a few days in certain instances. As a practical matter, the garment making operation; i.e., cutting, sewing, styling, etc. and including the subsequent curing operation is a distinct and separate industry from the fabric treatment industry. Generally, it is not feasible to carry out the operations outlined above beginning with the fabric impregnation to the final curing of the completed garment in a rapid sequence on a commercial scale. As a direct result of this a serious problem arises in connection with processes employed heretofore of effectively preventing the premature reaction of the resin deposited on the fabric while the resin impregnated fabric is stored, shipped or further processed.

Accordingly, it is an object of the present invention to provide an improved method for the production of permanently creased and pleated cellulose fabrics which avoids the short-comings and disadvantages of prior known methods and compositions.

It is a further object of the present invention to improve the stability of cellulose textile materials impregnated with polymerizable thermosetting resins and catalysts prior to the final curing and to avoid premature reaction of the polymerizable resin on the textile material.

It is a further object of the present invention to provide improved cellulose fabrics impregnated with polymerizable thermosetting resins and catalyst which resist the premature polymerization of the resin during the intermediate stages prior to the final curing step.

In attaining the above objects, one feature of the present invention resides in the addition of a selected inorganic or organic agent to the textile treating solution, which agent functions to absorb moisture and results in an improvement in avoiding premature reaction of the polymerizable material.

It is a further feature of the present invention to have present on the chemically impregnated cellulose textile material a selected inorganic or organic agent for effectively avoiding reaction of the polymerizable thermosetting resins at the moderate temperature normally encountered in the shipping, storage and processing of the fabric.

A further feature of the present invention resides in making permanently creased and pleated cellulose garments, or portions or sections of such garments as, for example, a sleeve, a collar, a cuff, or a trouser leg, from cellulose textile materials which have been impregnated with a polymerizable thermosetting resin, a catalyst and a selected inorganic or organic agent which imparts stability of the treated textile material and prevents the premature reaction or curing of the polymerizable resin on the textile material.

The above objects and features as well as other objects, features and advantages of the present invention will become apparent from the following detailed description thereof.

According to the present invention, the stability to storage of cellulose textile materials, particularly cellulose fabrics treated with various thermosetting resins known to be useful for textile treatments and catalysts for these thermosetting resins can be greatly improved by having present on the treated textile material a selected neutral or substantially neutral compound which may be
organic or inorganic. These selected compounds, which will be more fully described hereinafter, are particularly effective in avoiding reaction of the polymerizable thermostetting resins at moderate temperatures such as are normally encountered in shipping, storage and processing of the treated cellulosic textile materials. As a result of the improvement of the present invention, permanently pleated and creased cellulosic garments can be obtained while avoiding the disadvantages and limitations inherent in the prior known processes.

A further advantage of the present invention resides in the fact that the selected compounds used in connection with the resin do not significantly alter the course of the reaction at elevated temperatures and hence do not in any way detract or diminish from the effectiveness of the overall delayed curing process. This is particularly important since the fabrics, finished garments or other articles of manufacture must be cured under elevated temperatures in commercial operation and it is desirable to avoid anything which would seriously deter or adversely affect the final curing step. An additional advantage of the present invention is that the added materials do not have any appreciable effect on the properties of the fabric after curing and do not deleteriously modify or impair the properties at which the fabric is to be used.

The inorganic and organic compounds employed according to the present invention function to absorb ambient water in the garment and fibers and inhibit premature reaction and polymerization of the polymerizable thermostetting resin which is present on the textile fabric. This result is accomplished without adversely affecting the fabric or final garment product.

In accordance with one feature of the present invention, one group of suitable agents are neutral or substantially or near neutral deliquescent inorganic salts including calcium halides, such as chlorides, bromides and iodides, cobaltous halides, manganese chloride, nickel halides, nickel nitrate and strontium halides. In general, the colorless, neutral deliquescent salts are preferred. Weakly acidic deliquescent salts such as the halides of calcium and nickel can also be employed but the conditions for their use are somewhat more critical. However, strongly acidic deliquescent salts are to be avoided.

In accordance with another feature of the invention, organic humectants, which are preferred, can be used as the selected agent for obtaining the improvement described above. Included as organic humectants are glycerol and polyethylene glycols of the formula:}

$$\text{HOCH}_2\text{CH(OCH}_2\text{CH}_2\text{)}_n\text{OH}$$

in which \(n\) has a value of 1 to 50. Of these polyethylene glycols, those in which \(n\) is greater than 1 are most preferred, because of their low vapor pressure.

In operation, the methods of the present invention are carried out by including the selected inorganic or organic agent with the polymerizing thermostetting resins and catalyst in the treating solution for impregnation of the textile material. For example, the agent can be added to the aqueous solution used to pad the textile fabric. The amount of additive employed can be varied within wide limits although, generally, amounts ranging from about 0.5% to about 20% by weight based on the weight of the treating solution can be used and amounts ranging from 1 to 5% are preferred.

The thermosetting resins which are known in the art and which lack satisfactory storage stability in the presence of catalysts when employed in the deferred curing processes include but are not limited to urea formaldehyde resins, dimethyl ethylene urea, dimethyl alkyl triazine, dimethyl hexahydropropylnitride, hexamethoxy methyl melamine, dimethyl ethyl carbamate and dimethoxyethyl uron.

Catalysts employed in connection with the foregoing resin finishes are well known in the art and are generally acidic in nature. Included for example are non-volatile acids, magnesium chloride, zinc chloride, zinc nitrate, aluminum chloride, salts of Lewis acids; e.g. zinc fluoroborate and the like.

In conventional operations when cellulosic fabrics are treated with the above resins and suitable catalysts, and partially dried without curing, their cure recovery values are essentially unchanged showing that very little or no crosslinking takes place. If the fabrics or garments manufactured from these treated textiles are then cured immediately or within a short period of time thereafter, cure recovery is greatly increased and creases and pleats can be set in a permanent manner as a result of the reaction taking place during the curing step. Such creases are termed by those skilled in the art as permanent creases and pleats and are retained after repeated launderings and washings.

On the other hand, if the fabrics or garments manufactured from them according to the conventional methods described above are stored or shipped prior to curing where the period or time duration between the initial impregnation and final curing is a relatively long period, it will be observed that the cure recovery of the fabric gradually increases as the storage period is prolonged. The increase in cure recovery values means that there is a reaction going on at the temperature at which the treated fabric is stored. As a result the ability of the fabric or garments manufactured from them to retain pleats or creases imparted at a later date and set by curing is substantially reduced and the desirable crease retention properties are correspondingly impaired.

The gradual increase in the cure recovery properties of a given fabric and with the corresponding decrease in the crease or pleat retention properties which can be assured by subsequently curing the textile material are evident even in a matter of hours when the impregnated fabrics are stored prior to curing at temperatures above 110 to 125°F. It will be readily apparent that this characteristic of impregnated textile materials is extremely disadvantageous since such temperatures are not uncommon in storage areas and in shipping vehicles during summer months. It is thus apparent that the treated fabrics intended to be used in a deferred curing process lose a considerable amount of their desirable properties and rapidly deteriorate under storage conditions.

By comparison the fabrics treated in accordance with the present invention wherein selected additives are present on the treated textile exhibit a substantially improved stability in storage and the cure recovery of the fabric remains unchanged for many weeks and excellent creases or pleat retention properties can be obtained by curing the treated fabrics even after prolonged storage.

In the examples which follow, the increase in the cure recovery of treated fabrics prior to curing and the decrease in the crease or pleat retention ratings after curing in the creased or pleated configuration and washing are taken as measures of storage stability of cellulosic fabrics treated with catalyzed thermostetting resins and intended for use in deferred curing processes.

As used herein, the expression "cellulosic textile material" is intended to include cellulosic polymers such as cotton, regenerated cellulose, linen and the like in the form of fiber, yarn and fabric, for example. Moreover, blends of cellulosic with other natural or synthetic fibers are also encompassed by the above expression.

The examples which follow are intended to be illustrative of the present invention and are not limiting thereof in any way.

The test methods employed to obtain the data reported in the examples are as follows:


Laundering—Home-type washing machine, full cycle, 140° F. Commercial synthetic detergent.

EXAMPLE I

Samples of an 8.0 oz. sq. yd. 100% cotton twill were impregnated with an aqueous solution (Solution A) containing 235 gms. of 50% aqueous solution of dimethyl ethyl carbamate, 84 gms. of 30% aqueous solution of magnesium chloride and 11 gms. of a 30% aqueous emulsion of polyethylene per liter. The impregnated fabric was passed through rubber squeeze rolls set to give a wet pick-up of 60%. The samples were then framed to the original dimensions and dried in a forced draft oven at 150°–160° F.

A second set of samples was impregnated in the same solution as described above, except that 33.5 gms. per liter of a polyethylene glycol (average molecular weight 600) were added to it (Solution B). The fabric samples were then processed as above.

A sample from each of the sets was creased along the warp, pressed in standard trouser leg press and cured in a forced draft oven at 325° F. for five minutes.

The other samples from each set were placed in an oven at 115°–120° F. for 200 and 400 hours, simulating accelerated storage conditions. At the end of each period of aging the fabric was creased, pressed and cured as described above.

All the creased and pressed samples were washed and tumble dried. The table below summarizes the performance results obtained.

It is apparent that samples treated with Solution B still maintained their excellent properties after aging at 115°–120° F. for 400 hours.

EXAMPLE II

Samples of an 8.0 oz./sq. yd. 100% cotton twill were processed as in Example I except that the impregnating mixtures were: Solution A—an aqueous solution containing 200 gms. of a 50% aqueous solution of N,N-dimethyl methyl urea, 40 gms. of a 30% aqueous solution of zinc nitrate and 11 gms. of a 30% aqueous emulsion of polyethylene per liter; Solution B—as above, except that 33.5 gms. per liter of a polyethylene glycol (molecular weight 600) were added.

The performance results for this treated fabric, creased, cured and tested as shown in Example I, were:

EXAMPLE III

Samples of an 8.0 oz./sq. yd. 100% cotton twill were processed as in Example I, except that the impregnating mixtures were: Solution A—an aqueous solution containing 22.2 gms. of a 45% aqueous solution of dimethyl dihydroxy ethylene urea, 33.5 gms. of a 30% aqueous solution of zinc nitrate and 11 gms. of a 30% aqueous emulsion of polyethylene per liter; Solution B—as above, except that 33.5 gms. per liter of a polyethylene glycol (molecular weight 600) were added.

Performance results for this treated fabric, creased, cured and tested as per Example I, were:

EXAMPLE IV

Samples of an 8.0 oz./sq. yd. cotton twill were processed as in Example I, except that the impregnating mixtures were: Solution A—an aqueous solution containing 200 gms. of a 50% aqueous solution of dimethyl ethylene urea, 40 gms. of a 30% aqueous solution of magnesium chloride and 11 gms. of a 30% aqueous emulsion of polyethylene per liter; Solution B—as above, except that 33.5 gms. per liter of calcium chloride were added.

The performance results for this treated fabric, creased, cured and tested as per Example I, were:

EXAMPLE V

80 x 80 cotton print cloth fabric samples were impregnated with aqueous solutions of N,N-dimethyl methylimidazolium (MMI); Solution A contained 100 gms. of a 50% DMMU aqueous solution and 13.5 gms. of 30% zinc nitrate solution; Solution B contained 100 gms. of a 50% DMMU aqueous solution, 20 gms. of 30% zinc nitrate and 20 gms. glycerine. The impregnated samples were passed through rubber squeeze rolls set to give a wet pick-up of 100%. The samples were then framed and dried in a forced draft oven at 150°–160° F.

A sample from each of the sets was cured in a forced draft oven at 325° F. for 5 minutes. The other samples from each set were placed in an oven at 115°–120° F. for 200 and 400 hours. At the end of each period of aging the fabric was cured as described above. All the samples were tested for dry crease recovery before and after the curing step.
EXAMPLE VI

100% rayon challis samples were impregnated with aqueous solutions of dimethyl ethylene urea (DMEU), Solution A contained 100 gms. of a 50% DMEU and 20 gms. of a 30% aqueous solution of magnesium chloride and 17 gms. of a 50% aqueous emulsion of polyethylene per liter. Solution B, as above, except that 17 gms. per liter of a polyethylene glycol (molecular weight 600) were added. The impregnated samples were passed through rubber squeeze rollers to give a wet pickup of 120%. The samples were then framed and dried in a forced draft oven at 150°-160°F. A sample of each set was hand pleated (3 1/4" pleat width), pressed to flatten the pleat and sharpen the crease, then cured at 325°F. for 3 minutes in a forced draft oven.

The other samples from each set were placed in an oven at 115°-120°F. for 150 hours and 300 hours. At the end of each period of aging, the fabric was hand pleated (3 1/4" pleat width), pressed to flatten the pleat, sharpen the crease, then cured at 340°F. for 3 minutes in a forced draft oven.

The pleated and cured samples were rated for crease and pleat retention after laundering and tumble drying.

### Table: Crape Retention Ratings

<table>
<thead>
<tr>
<th>Aging Time</th>
<th>Cr. Ret. Ratings</th>
<th>Pleat Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Ldg. Dry</td>
<td>2 Ldg. Dry</td>
</tr>
<tr>
<td>Fabric Impregnated with Sol. A...</td>
<td>5.0</td>
<td>4.5-4.8</td>
</tr>
<tr>
<td>Fabric Impregnated with Sol. B...</td>
<td>5.0</td>
<td>4.5-4.8</td>
</tr>
<tr>
<td>Fabric Impregnated with Sol. A...</td>
<td>150 hrs</td>
<td>4.0</td>
</tr>
<tr>
<td>Fabric Impregnated with Sol. B...</td>
<td>150 hrs</td>
<td>4.0</td>
</tr>
<tr>
<td>Fabric Impregnated with Sol. A...</td>
<td>900 hrs</td>
<td>2.0-3.0</td>
</tr>
<tr>
<td>Fabric Impregnated with Sol. B...</td>
<td>900 hrs</td>
<td>2.0-3.0</td>
</tr>
</tbody>
</table>

EXAMPLE VII

Samples of 80 x 80 cotton print cloth were treated with a solution containing 50 gms. per liter of dimethyl ethylene urea and 5 gms. per liter of zinc nitrate hydrate (Solution A) to give a wet pickup of 100%. The samples were framed to the original dimensions and dried at 90°-95°F. A second set of samples was treated with the same solution as described above, except that 30 gms. per liter of a polyethylene glycol of average molecular weight 1000 were added (Solution B). The crease recovery of the fabric was measured immediately, and at intervals thereafter, the samples being stored at 70°F. and 65% RH during this period.

The following crease recovery (W-F) results were obtained.

<table>
<thead>
<tr>
<th>Storage Time</th>
<th>Fabric Treated With—</th>
<th>Solution A</th>
<th>Solution B</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>140</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td>One Week</td>
<td>200</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td>Two Weeks</td>
<td>207</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td>Three Weeks</td>
<td>225</td>
<td>163</td>
<td></td>
</tr>
<tr>
<td>Six Weeks</td>
<td>237</td>
<td>168</td>
<td></td>
</tr>
</tbody>
</table>

The foregoing examples show the striking advantage afforded by the present invention wherein the stability of cellulosic textile materials impregnated with polymerizable materials and catalyst can be enormously increased so that the treated fabrics can be stored over a prolonged period of time and then shipped to the garment manufacturer who then cuts and sews the fabric to make the garment following any desired style and design configuration and after the garment is completed, imparts the creases and/or pleats as indicated by the styling desired and then sets the creases and pleats by heating the garment to cure and thus insolubilize the resin on the fabric. The ease and pleat retention properties obtained according to the methods of the present invention are outstanding and compare favorably with those obtained by immediately curing the impregnated cellulosic fabrics without storing them. The present invention is thus a valuable improvement for textile manufacturers enabling a far greater flexibility in storage and inventory requirements thus permitting a more satisfactory and desirable commercial operation and which avoids the disadvantages and deleterious effects which have been exhibited in the prior methods of deferred curing.

What is claimed is:

1. In a method for the production of permanently creased and pleated cellulosic garments wherein a cellulosic textile fabric is impregnated with a polymerizable thermosetting resin and an acid catalyst for said polymerizable thermosetting resin, partially dried without reaching the polymerizable thermosetting resin, then cut and sewn into a garment or garment section according to any desired style and wherein the desired creases, folds, and pleats are introduced after completion of the garment or garment section and set by curing the completed article to insolubilize the resin, the improvement comprising having present on the fabric an effective amount of a substantially neutral deliquescent inorganic salt which is a member selected from the group consisting of calcium halides, cobaltous halides, manganous chloride, nickel halides, nickel nitrate and strontium halides to thereby avoid a premature reaction of the polymerizable thermosetting resin on the textile fabric prior to the final curing step.

2. In a method for the production of permanently creased and pleated cellulosic garments wherein a cellulosic textile fabric is impregnated with a polymerizable thermosetting resin and an acid catalyst for said thermosetting resin, partially dried without reaching the polymerizable thermosetting resin, then cut and sewn into a garment or garment section according to any desired style and wherein the desired creases, folds, and pleats are introduced after completion of the garment and set by curing the completed garment to insolubilize the resin, the improvement comprising having present in the fabric an effective amount of an organic humectant to thereby avoid a premature reaction of the polymerizable thermosetting resin on the textile fabric prior to the final curing step.

3. In a method for the production of permanently creased and pleated cellulosic garments which comprises the steps of impregnating a cellulosic fabric with a polymerizable thermosetting resin and a catalyst, partially drying the fabric without substantially reacting the thermosetting resin, cutting and sewing the fabric into a garment or garment section according to any style or configuration, introducing at least one crease or fold into the garment after the completion of the garment, and heating the garment to cure the completed garment thereby insolubilizing the resin and permanently setting the crease or fold in the garment, the improvement comprising having in the fabric an effective amount of a substantially neutral inorganic deliquescent agent which is a member selected from the group consisting of calcium halides, cobaltous halides, manganous chloride, nickel halides, nickel nitrate and strontium halides to thereby avoid premature reaction of the polymerizable thermosetting resin on the textile fabric prior to the final curing step.

4. In a method for the production of permanently creased and pleated cellulosic garments which comprises the steps of impregnating a cellulosic fabric with a polymerizable thermosetting resin and a catalyst, partially drying the fabric without substantially reacting the thermosetting resin, cutting and sewing the fabric into a garment or garment section according to any style or configuration, and then curing the completed article at a temperature in the range of 150°-175°F. and 65% relative humidity for a period of time sufficient to insolubilize the resin on the fabric.
tion, introducing at least one crease or fold into the garment after the completion of the garment, and heating the garment to cure the completed garment thereby insolubilizing the resin and permanently setting the crease or fold in the garment, the improvement comprising having present in the fabric an effective amount of an organic humectant to thereby avoid premature reaction of the polymerizable thermosetting resin on the textile fabric prior to the final curing step.

5. In the method as set forth in claim 1 wherein the inorganic salt is calcium chloride.

6. In the method as set forth in claim 2 wherein the organic humectant is glycerol.

7. In the method as set forth in claim 2 wherein the organic humectant is a polyethylene glycol represented by the structural formula:

\[
\text{HOCH}_2\text{CH}_2\left(\text{OCH}_3\text{CH}_2\right)_n\text{OH}
\]

in which \(n\) has a value of 1 to 50.

8. In the method as set forth in claim 2 wherein the organic humectant is a polyethylene glycol with a molecular weight of about 600.

9. In the method as set forth in claim 2 wherein the polyethylene glycol has a molecular weight of about 1000.

10. A cellulosic textile fabric impregnated with a polymerizable thermosetting resin, a catalyst for the polymerizable thermosetting resin and a substantially neutral deliquescent inorganic salt which is a member selected from the group consisting of calcium halides, cobaltous halides, manganous chloride, nickel halides, nickel nitrate and strontium halides to thereby avoid premature reaction of the polymerizable thermosetting resin on the textile fabric prior to the final curing step.

11. A cellulosic textile fabric impregnated with a polymerizable thermosetting resin, a catalyst for the polymerizable thermosetting resin and an organic humectant to thereby avoid premature reaction of the polymerizable thermosetting resin on the textile fabric prior to the final curing step.

12. In a method for the production of cellulosic fabrics which are suitable for use in making permanently creased and pleated garments and wherein the fabric is impregnated with a polymerizable thermosetting resin and a catalyst and thereafter partially dried without substantial reaction of the polymerizable resin in which fabric is then suitable for shipping and storage and processing by the manufacturer of the garment, the improvement comprising having present in the fabric an effective amount of a substantially neutral deliquescent inorganic salt selected from the group consisting of calcium halides, cobaltous halides, manganous chloride, nickel halides, nickel nitrate and strontium halides to thereby avoid premature reaction of the polymerizable thermosetting resin on the fabric prior to the final curing step.

13. In a method for the production of cellulosic fabrics which are suitable for use in making permanently creased and pleated garments and wherein the fabric is impregnated with a polymerizable thermosetting resin and a catalyst and thereafter partially dried without substantial reaction of the polymerizable resin and which fabric is then suitable for shipping and storage and processing by the manufacturer of the garment, the improvement comprising having present in the fabric an effective amount of an organic humectant to thereby avoid premature re-

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