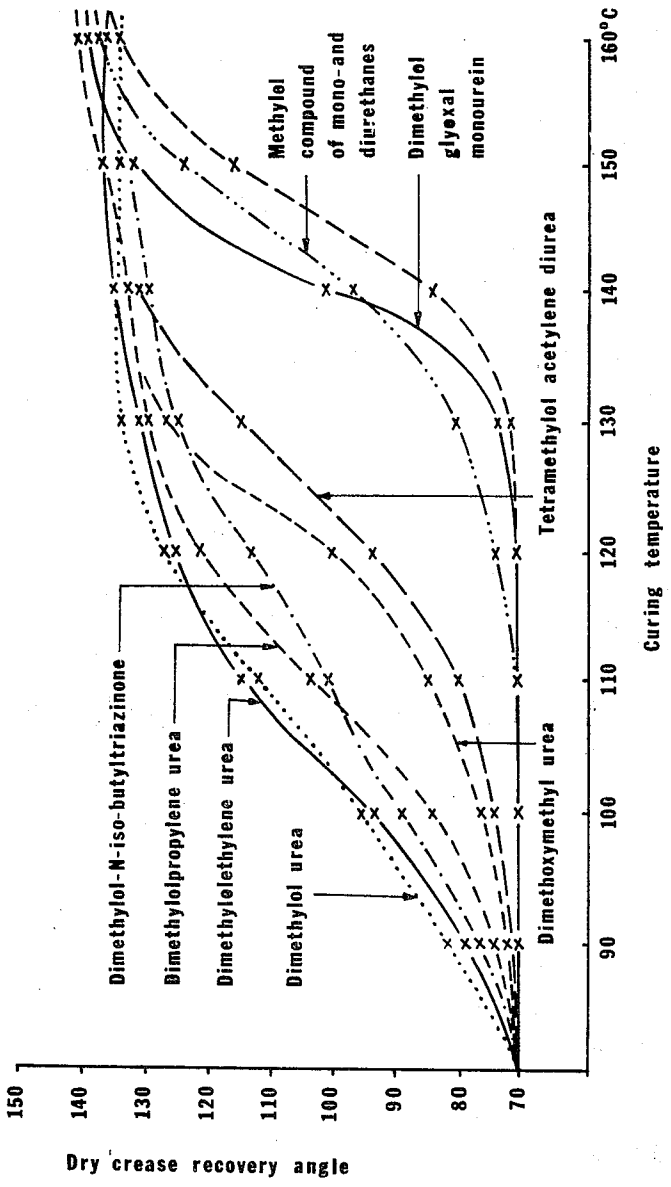
PROCESS FOR MANUFACTURING DURABLE PRESS GARMENTS

Filed April 8, 1968



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United States Patent Office 3,521,994
Patented July 28, 1970

3,521,994

PROCESS FOR MANUFACTURING DURABLE PRESS GARMENTS

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Filed Apr. 8, 1968, Ser. No. 719,481
Int. Cl. D06m 9/00
U.S. Cl. 8—115.7 2 Claims

ABSTRACT OF THE DISCLOSURE

A process for the preparation of durable press polyester fiber containing fabrics and the shaped articles produced therefrom, said process involving applying to said fabric aqueous solutions of nitrogen containing resin formers, precuring said resin formers by drying the resin treated fabric to substantially zero moisture regain while minimizing cross-linking, forming a creased garment from the fabric and subsequently or simultaneously fully curing the resin.

This invention relates to a process for the manufacture of durable press garments from cellulosic, thermoplastic fiber-blend fabrics, and more specifically, to polyester/cotton garments having an enhanced hand, improved abrasion resistance and improved crease retention.

Durabel press garments have recently achieved wide acceptance in the textile industry. In general, the durable press garments of the prior art are produced by one of several systems. Two of these systems are set forth in U.S. Pats. Nos. 2,974,432 and 3,268,915 which call for impregnating fabrics with aqueous solutions of compounds curable to thermal-setting resins, partially drying the fabrics under conditions to avoid water-insolubilization of the resins, formulating garments from the fabrics, pressing the garments to obtain the desired shape and creases and then subjecting the garment to the action of an oven operating at temperatures sufficient to cure the resins to water-insoluble state. In Pat. No. 2,974,432, the initial drying is enough to bring the water content of the treated fabric to from 2–8% above the natural water regain of the fabric while the value in Pat. No. 3,268,915 is 8–10%; to prevent loss of water in the fabric it was frequently the practice to wrap the fabric in polyethylene film until garments were to be made. Drying to bring the water content of the fabric to within not less than 2% of the natural water regain of the fabric will generally prevent substantial cross-linking or polymerization of textile resins. The need to package fabrics in moisture proof containers in order to maintain the noncross-linked and unpolymerized configuration is, of course expensive as well as cumbersome.

Another system for the production of durable press garments is that system set forth in U.S. Pat. No. 3,341,955 wherein garments are prepared from fabrics comprising blends of fibers of which a preponderant amount are thermoplastic fibers, which fabrics have been treated with compounds capable of producing thermal-setting resins and the compounds fully or almost fully cured to resin state. The fabric, after having been formulated into a garment, is then pressed to obtain suitable creases using a hothead press which is operated at pressures of from 6,000 to 12,000 pounds per square inch at temperatures in the range of from 350° F. to 500° F., the temperature and time being sufficient to set the thermoplastic fibers of the fabric blend into a permanent crease and to reform the previously set resin into the new configuration.

While these prior art patented systems produced satisfactory durable press garments, textile finishers have shown a marked preference for N-methylol nitrogenous resin-

formers for use in impregnated apparel fabrics. The use of these resins results in greater abrasion resistance and higher tensile strength than when treated with other known textile resin-formers. Nitrogenous N-methylol resin formers, however, have a propensity to cross-link the cellulose components of the fabric rather than merely to polymerize. While cross-linking is beneficial, once the garment is in its final configuration; that is to say, once the garment has been creased and freed from wrinkles, this cross-linking propensity will, in the case of fabrics carrying partially cured resin, inhibit the formation of a sharp crease in a final curing operation. The inhibition is present regardless of whether this final cure operation is conducted in a hothead press or in a garment curing oven.

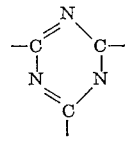
It is therefore an object of this invention to provide an improved process for the preparation of durable press garments having an improved crease retention and employing nitrogenous compound impregnated fabrics dried to substantially 0% moisture regain.

It is another object of this invention to provide durable press garments prepared from nitrogenous resin impregnated fabric the garments having enhanced and durable hand, improved abrasion resistance and improved crease retention.

In accordance with this invention, it has now been discovered that durable press garments of enhanced crease properties may be prepared by impregnating a fabric composed of a blend of at least about 20% and preferably at least about 35% by weight of thermoplastic fiber such as polyester and at least about 20% by weight of cellulosic fiber, e.g., cotton or rayon with a liquid containing one or more compounds capable of undergoing polymerization and also capable of cross-linking with the cellulosic fiber. Preferably, the nitrogenous compound is a compound which produces a substantial degree of polymerization of the additive as evidenced by the insolubilization of the resin former compound, e.g., water extraction of the fabric at this stage is incapable of removing from about 20 to 80% and preferably about 30 to 80% of the compound initially applied and the average degree of polymerization of the compound is in excess of about 30% and preferably in excess of about 60%. It should be understood that a minimal degree of cross-linking of the nitrogenous compound with cellulosic fibers will often take place and that cross-linking will also render the nitrogenous compound water insoluble. Where water is the liquid vehicle for applying the resin former compound, the drying is carried out to substantially 0% water which is, of course, less than the equilibrium or natural moisture regain valve of the fabric. The fabric is thereafter made up into an end use article such as a garment and then a crease is produced by either (a) pressing at temperatures sufficient to cure the compound to resin state, or (b) pressing at lower temperatures followed by oven baking to effect the cure; the cure is accomplished by totally insolubilizing the initially applied compound as by polymerizing it and/or linking it to the cross-linkabe fiber. Depending upon the temperatures selected, the thermoplastic fiber may be set or molded into the creased configuration but, even if not, it will be held creased by the polymerized resin or by the polymerized resin and the cross-linked fiber. Nitrogen containing resin-formers or additives which have been found to be suitable for use in this invention are N-methylol compounds selected from the group consisting of dimethylol cyclic ethylene-urea, dimethylol dihydroxy cyclic ethylene-urea, dimethylol propylene urea, dimethylol triazine, dimethylol uron, dimethylol methyl carbamate, dimethylol ethyl carbamate, dimethylol hydroxymethyl carbamate, dimethylol butanediol di-urethane, N-methylol N-acrylamide, and 2,5, dimethylol-3 hydroxy-4 dimethylol-acrylamide oxycyclic ethylene urea and com-

binations thereof to give the desired overall degree of polymerization and cross-linking.

Preferably, the nitrogen containing resin former is a water soluble nitrogenous resin free of nitrogen linked OH groups and more specifically a condensation product of a cyclic nitrogenous compound and a member selected from the group consisting of polyacetals of dialkylene and polyalkylene glycols. The cyclic nitrogenous compound is preferably a triazine characterized by the nucleus:



wherein at least one of the free valences is substituted by an amino group. Melamine, acetoguanamine and benzoguanamine are representative of this class of compound. In the preparation of these compounds, the acetal and aminotriazine are reacted under elevated temperatures, wherein the molar ratio of aminotriazine to polyalkylene glycolic within the range of 1 to 4.5 and 1 to 15, condensation product containing per molecule at least two polyoxyalkylene radicals derived from said polyalkylene glycol and at least two alkylidene radicals derived from said aldehyde.

The resin former should be present in quantities sufficient to produce an add-on from about 1.5% to about 20% and preferably about 2 to 10% based on the dry weight of the fabric. The catalyst is present in quantities of from 5% to 25% based on 100% resin. Catalysts which have been found to be suitable for curing the aforementioned resins are acid or latent acid catalysts which fall into one of the five general categories: (1) mineral acids; (2) organic acids; (3) ammonium salts; (4) amine salts; and (5) metal salts. The preferred catalysts are catalysts in the latent acid group which are combined as ammonium, amine and metal salts. Specific catalysts which have been found to be suitable for purposes of this invention are zirconium acetate, calcium acetate, manganese acetate, zinc nitrate, zinc chloride, magnesium chloride, ammonium sulfate, ammonium chloride, pyridinium chloride, or combinations thereof, although in general best controlled results are achieved with polyvalent metal salts of weak acids such as acetates, borates, citrates, etc. The resin-former and catalysts must be selected so as not to produce undesirable color effects which might occur with certain dyes.

It should be understood that the weak acid catalysts have a tendency to produce more polymerization and less cross-linking and are therefore desired. However, different resin-formers have different curing characteristics. By "cuing characteristics" is meant the temperature and time function of a cross-linking chemical; this function characterizes the course of a cross-linking process up to achievement of its maximum effect. The variations in cross-linking characteristics may be readily seen from the drawing wherein:

The figure is a schematic representation of several plots of dry crease recovery angle versus curing temperature for a variety of resin-formers. The dry crease recovery angle is a gauge of the degree of cross-linking in a fabric containing a particular resin. When the fabric is heated at low temperatures as during drying or even in an already dried fabric, the resin cures by polymerization and the fabric will exhibit a dry crease recovery angle of about 70°. If heating is carried out at a slightly higher temperature, the value for the dry crease recovery angle may not change significantly. However, for each particular resin-former a threshold temperature will be reached where a substantial increase is realized in the dry crease recovery angle, evidencing degrees of surface polymerization and/or cross-linking. The exact take-off point for each curve depends upon the chemical identity of the resin-former. The dry crease recovery angles will even-

tually level off near 150° since the theoretical maximum is 180°. As can be learned from the figure, if the drying temperature is properly selected, the resin-former can be polymerized to a controlled degree while cross-linking is kept to a predetermined low value.

In general, the process of the invention is conducted as follows:

(a) Fabric is scoured and, if so desired, dyed. The fabric, once dyed, should be hydrophilic, that is, it must have a good and uniform moisture pickup, which means that it contains no interfering chemical auxiliary products used for the lubrication of the fiber (antistatic), is free of all chemical products used for warp sizing, and has a neutral pH.

(b) The fabric is then padded with an aqueous solution, comprising N-methylol resin-formers, catalysts and, optionally, wetting agents, softeners, hand builders and deodorants.

(c) The fabric is then squeezed in such a way as to retain about 60% of the aqueous impregnating solution, it being understood of course, that this percentage may vary in accordance with the weight of the fabric and the percentage of the synthetic fiber blend. The squeezing operation must, however, be uniform along the width of the fabric.

(d) The fabric thus padded with the aqueous impregnating solution is dried in a tenter frame under conditions of time and temperature to bring the fabric to a temperature of 120° C. The fabric, after being fully dried (0% water) is withdrawn from the tenter frame, cooled and rolled, in order to stop the polymerization process of the resin and to avoid wrinkles and creases.

(e) The fabric is then formulated into a garment and pressed on a hothead press to fully cure the resin, or alternatively, pressed at a lower temperature, and then subjected to a curing operation in a garment curing oven.

A better understanding of the invention may be had from the following specific examples. It should be understood, however, that the examples are given merely for purposes of illustrations, and should not be considered as limiting the spirit or scope of this invention.

EXAMPLE I

A 10.4-ounce per square yard 50% cotton, 50% polyester fabric having 153 ends per inch in the warp and 52 picks per inch in the fill, the warp yarns being 13.1 cotton count with 18 turns per inch Z twist is prepared. The fabric is immersed in a pad bath containing per liter:

100 grams dihydroxy dimethylolethylene urea
25 grams zinc acetate, and
2 grams of a nonionic wetting agent.

The fabric after obtaining a 70% by weight wet pickup is run full width into the nip of a pair of squeeze rolls and then into a tenter frame. The tenter frame which feeds the fabric into a plurality of compartments is operated as follows:

Compartment:	Air temperature, ° C.
1	160
2	160
3	140
4	140
5	120
6	120

The fabric leaving compartment 6, having a 0% moisture content, is passed over a water-cooled drum to terminate curing and collected; upon standing under normal temperature and humidity conditions for a long time, normal moisture regain conditions are approached. If this fabric is water extracted about 48% of the dihydroxydimethylolethylene urea can be removed, the balance having been insolubilized. The insolubilization is believed to be primarily due to polymerization.

The fabric is then cut and formulated into a pair of trousers and the trousers pressed on a Hoffman press at a temperature of about 165° C. for 14 seconds. The garment is then passed into a hot air curing oven operated at a temperature of 165° C. for a period of 15 minutes, whereby the unreacted resin is given a final cure. The trousers are found to have an improved hand, controlled shrinkage and superior crease retention even after a plurality of machine launderings.

Alternatively, similar results can be achieved if the pressing is carried out with a hothead press followed by an oven cure at the same temperatures. Generally similar results can be achieved by omitting the oven cure and using only hothead pressing at about 180° C. or higher, at pressures of from 6000 to 12,000 pounds per square inch. Even though the lower temperature pressings make it desirable to oven cure while the higher temperature pressing does not, the lower temperature pressing is preferred since it avoids the negative effect on certain dyes which sometimes follows the use of higher temperatures.

EXAMPLE II

A 10-ounce per square yarn 65% polyester, 35% cotton fabric having 120 ends per inch in the warp and 51 picks per inch in the fill, the warp yarns being 13.8 cotton count with 16 turns per inch Z-twist and the fill yarns being 10.5 cotton count having 12 turns per inch Z-twist, is prepared. The open width fabric is padded through a bath having the following composition per liter:

100 grams dimethylol propylene urea
100 grams dimethylol hydroxymethyl carbamate
25 grams zinc chloride, and
2 grams nonionic wetting agent

The fabric after obtaining a 70% by weight wet pick-up is fed into a tenter frame operating under drying conditions the same as those set forth in Example I. The dry fabric is then cut and formulated into a pair of trousers. The trousers are then pressed in a so-called hothead or electric topper press at a pressure of about 9000 pounds per square inch and at a temperature of 230° C. for a period of about 15 seconds, the temperature being sufficient to both mold the polyester and to cure any residual unreacted components of the resin coating. The final product is found to exhibit an improved hand and to have superior crease retention after a plurality of machine launderings.

EXAMPLE III

A 65% polyester, 35% cotton fabric having a weight of 1.15 linear yards per pound and having 111 warp ends per inch and 52 fill ends per inch, the fill yarns having a cotton count of 10 in the singles yarns, and the warp ends having a cotton count of 12 in the singles yarns is prepared. The open width fabric is padded through a bath having the following composition per liter:

50 grams of Quaker Reactant 40 (amino triazine modified polyacetal manufactured by Quaker Chemical Products Corp., Conshohocken, Pa.)
5 grams magnesium chloride hexahydrate, and
2 grams nonionic wetting agent

The fabric after obtaining a 75% by weight wet pick-up is run full width into the nip of a pair of squeeze rolls and then into a tenter frame. The tenter frame which feeds the fabric into a plurality of compartments is operated as set forth in Example I. The fabric, after having been reduced to 0% moisture content is then cut and formulated into a pair of trousers according to the procedure as set forth in Example I. The trousers, after being subjected to dry cleaning tests were found to exhibit superior crease retention, the superiority of crease retention being determined according to the standards set forth in AATCC test 88.C–1964 T which corresponds to U.S.A. Standards Institute Test L14, 173–1964. While the aforementioned tests are devised for rating permanent creases in garments subjected to home launderings, the standards employed therein have been found to be equally applicable to giving crease ratings to garments subjected to dry cleaning tests. As previously mentioned as a result of conducting these tests, the garment prepared according to the procedure set forth in Example III is found to exhibit superior crease retention.

For purposes of simplification of the procedure, various additives have not been included in the examples; however, it should be understood that any of the well-known additives commonly employed in permanent press garments may also be included in the baths employed in the process of this invention. Additives which may be included are hand builders, softeners and soil release agents. The hand builders are emulsions or dispersions of polymers prepared from vinyl monomers or combinations of two or more of the following monomeric components: vinyl acetate, vinyl acrylate, methyl acrylate, ethyl acrylate, methacrylic acid, methyl methacrylate, acrylonitrile, ethylhexyl acrylate or any combinations of the foregoing. Three-dimensional polymer structures are frequently obtained having the characteristic advantage of other polymerizing or cross-linking polymers. The softeners may be compounds such as polyethylene and polypropylene dispersed in a suitable medium such as for instance, an epoxy soybean oil medium. As noted previously, the resin-former to fabric ratio may be as varied as desired, e.g., about 1.5 to 20% and preferably 2 to 10% of resin-former on fabric weight; with 50–50 cellulosic-polyester blends an add-on of 8% is preferred when the cellulosic is cotton and 10% when it is rayon.

It is theorized that the acetate catalyst cause predominantly homopolymerization of the N-methylol compounds rather than cause the agent to react to a high degree with the cellulosic components of the fabric. It is well known that strong acid catalysts such as an amine hydrochloride or zinc nitrate are needed to promote extensive reaction with cellulose within a few minutes at 160° C. Free N-H groups, made available through loss of formaldehyde from N-methylol groups, could react with N-methylol groups under the mildly acidic conditions to form homopolymers in the fiber. The cellulosic hydroxyl groups are less reactive than an amino group with N-methylol finishing agent. The relatively few instances of reaction between the N-methylol compound and cellulose would effectively graft the nitrogenous polymer to cellulose. The residual N-methylol groups on the polymer can, however, undergo a cross-linking reaction with cellulose when activated later at elevated temperatures.

While various embodiments of the invention have been described, modifications may be made therein without departing from the spirit and scope of this invention and it is intended that such obvious modifications be embraced by the claims which follow.

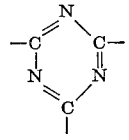
Having thus disclosed the invention, what is claimed is:

1. In a process for the production of a durable press garment comprised of at least 35 percent (by weight) of polyester and at least 20 percent (by weight) of a cellulosic comprising the steps of sequentially: scouring fabric; applying to said scoured fabric an aqueous solution of nitrogen-containing resin-former capable of being linked to the cellulosic fiber and of undergoing polymerization; making said fabric into a garment; and curing said garment, whereby said resin-former becomes totally insolubilized; the improvement which comprises the steps of sequentially:

(a) applying to said fabric the product of the process of reacting:

(1) an alhylene glycol and an aldehyde, thereby forming a polyacetal; and, thereafter,

(2) reacting the polyacetal thus formed with a triazine of the formula



wherein:

(i) at least one of the free valences of the triazine is substituted by an amino group,

(ii) from about 4.5 to about 15 moles of said glycol are reacted per mole of triazine, and

(iii) the product of said process contains at least two polyoxyalkylene radicals derived from said glycol and at least two alkylidene radicals derived from said aldehyde,

said product being so applied to the fabric that from about 1.5 to about 20 weight percent of the dried fabric is comprised of it;

(b) drying said fabric in a tenter frame until no water is present therein and from about 20 to about 80 percent of said product initially applied to said fabric cannot be water-extracted from the fabric; and

(c) cooling and rolling said fabric.

2. The process of claim 1, wherein:

(a) said triazine is selected from the group consisting of melamine, acetoguanamine, and benzoquanamine,

(b) said dried fabric is comprised of from about 2 to about 10 weight percent of said product, and

(c) said fabric is dried until from about 30 to about 80 percent of said product initially applied cannot be water-extracted from the fabric and the final temperature of the fabric is about 120 degrees centigrade.

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U.S. Cl. X.R.

8—115.5, 116.2