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3,531,806

**PRODUCTION OF DURABLE SHAPED FABRIC
ARTICLES USING TWO-STAGE CURING**

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ABSTRACT OF THE DISCLOSURE

This invention relates to the production of durable shaped fabric articles using a two-stage curing procedure. More particularly, it concerns improvements in the manufacture of durable press garments having improved shape-holding qualities by the use of treating agent curing steps performed both before and after the permanent pressing or shaping of the garments.

FIELD OF THE INVENTION

The manufacture of shirts, trousers and other fabric articles that have been treated with resins or cross-linking agents so that the garments will durably retain the pleats, creases or other shapes pressed into them when they are formed has reached a high stage of development. In the earlier stages of this technology, garments having improved crease resistance and comparable finish effects were created by forming the garments out of fabrics previously treated with dimension stabilizing agents and subjected to suitable curing conditions in order to produce dimensionally stabilized fabrics. Such stabilized fabrics were then used in typical manner as other available textiles for fabrication into desired garments.

For the most part, such fabric treating operations have employed resin forming materials or substances capable of reacting with cellulose to produce cross-linking, which substances are reaction products of amino or amido organic compounds with aldehydes, particularly formaldehyde (see U.S. 2,235,141 and 3,060,061). More recently, improvements in the type of dimension stabilizing agent of the aminoplast type have been made in order to eliminate so-called "chlorine retention" problems (U.S. 3,041,199 and 3,058,849) as well as modifications in methods of curing these dimension stabilizing agents in order to produce improved results (U.S. 3,054,699 and 3,206,273). To a lesser extent, dimension stabilizing agents other than those within the category of aminoplast have been used in such operations (U.S. 2,782,090).

A recent development in this technology has involved modification in the application of the dimension stabilizing reagents relative to the formation of the garments and ultimate curing. In this so-called "delayed cure process" (U.S. 2,974,432), fabrics are treated with dimension stabilizing agents and catalysts in a finishing plant and then dried at low temperatures so that the treating agents remain in substantially uncured condition. Next, they are shipped to a garment maker where the fabrics are cut, sewn into garments and pressed at elevated temperature into a predetermined shape. Finally, the pressed garment is placed in an oven or other heated zone and cured for about 5 to 20 minutes at temperatures ranging from 150 to 180° C. With such operations, the garment is fixed into a desired shape that is highly wrinkle-resistant so when it is laundered and dried, it reverts to its original pressed configuration substantially free of wrinkles. So-called "wash-and-wear" garments of this type have met with widespread acceptance by housewives seeking to reduce the manual labor required to launder soiled garments.

In the "delayed cure processes," fabrics coming out of

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the textile treating mill or finishing plant are not dimensionally stable, and they have a tendency to shrink when the garment maker steam-presses them and places them in a curing oven. This problem has forced the garment maker to make troublesome modifications in his sizing of patterns in order to compensate for shrinkage. It has not been found possible to solve this shrinkage problem in the textile treating or finishing plant by precuring the resin to stabilize the fabric for this then defeats the whole purpose of the delayed cure concept for producing durable press garments. Accordingly, the textile trade has been seeking improvements in the production of durable press fabric articles to utilize the more desirable features from both of the basic types of operations which have evolved from this technology as described above.

OBJECTS

A principal object of this invention is the provision of new improvements in the production of durable shaped fabric articles. Further objects include the provision of:

(1) Improved methods for creation of durable pressed garments which eliminate shrinkage problems heretofore associated with the pressing of garments as one step in the manufacture of garments by the so-called "delayed cure process" of dimension stabilizing fabrics.

(2) New forms of fabric which are dimensionally stable and capable of cutting and forming into garments which will hold their size even during subsequent steam pressing although the fabric additionally possesses the property of being capable of being cured after the pressing to impart to it improved shape holding properties.

(3) New textile finishing operations using a combination of two-stage resin curing and multi-stage fabric treating and fabricating operations.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

GENERAL DESCRIPTION

These objects are accomplished according to the present invention by an improved method of production of durable press fabric articles which comprises in combination the steps of (a) impregnating a fabric with a liquid composition containing two separate dimension stabilizing agents, one of the agents being of relatively fast curing rate, and the other being of relatively slow curing rate, (b) drying and at least partially curing the fast curing dimension stabilizing agent contained in the impregnated fabric under such conditions that do not produce any appreciable curing of the slower acting dimension stabilizing agent, (c) cutting and forming the fabric produced by step (b) into an article, (d) pressing the formed article into a predetermined shape, and (e) subjecting the pressed article to conditions effective to substantially completely cure all of the dimension stabilizing agents contained in the fabric.

Advantageously, the step of at least partially curing the fast acting agent without substantial effect upon the slow acting agent is conducted at a temperature between 90 to 120° C. for between about one to thirty minutes and the final stage of the operation in which all of the agents contained in the fabric are cured is conducted at a temperature between about 150 to 190° C. for between about five to twenty minutes.

Preferred results are obtained by using aqueous solutions of the mixture of the two dimension stabilizing

agents in order to impregnate the fabric. Such solutions advantageously comprise 5 to 50% by weight of the sum of the separate dimension stabilizing agents and may also contain an appropriate catalyst for the dimension stabilizing agents. Advantageously, the fabric is impregnated or otherwise treated with the aqueous solution so as to provide a finished and dried fabric containing an agent solids content of between about 5 to 50% by weight of the agent mixture based upon the dry weight of the unimpregnated fabric.

By way of example, dimension stabilizing agents of the fast curing category useable in carrying out the invention include the following classes of compounds: alkylol ureas, alkylol alkylene ureas, alkylol melamines, alkylol cyanurates, alkylol hydrazides, alkylol formamides, alkylol thioureas, and alkylol alkylene thioureas.

As to the dimension stabilizing agents of the slow curing category, the following general classes of such materials are exemplary for use in the invention: alkoxyalkyl urons, vinyl cycloalkylene dioxides, alkylol hydroxyalkylene ureas, glycidyl ethers of glycerol, alkoxyalkyl alkylene ureas, acrolein-formaldehyde resins, alkylol alkyl triazones, and alkoxyalkyl acetylene diureas.

EXAMPLES

A more complete understanding of the new methods and the resulting products of this invention may be had by reference to the following details of actual operations in accordance with the invention. In this example, as well as throughout the remaining specification and claims, all parts and percentages are by weight and all temperatures are in degrees centigrade unless otherwise specified.

A variety of dimension stabilizing agent pairs were used to treat sections of 7 oz. cotton twill fabric. This was accomplished by preparing aqueous solutions of each of the agent pairs containing 5% of each agent plus 1.5% zinc nitrate to serve as a curing catalyst. These solutions were padded onto the cotton fabric sections to give 100% pickup and then the fabric sections were dried only (95° C. for about five minutes in circulating air). A portion of each fabric section was laundered to see if any shrinkage resistance had been produced by one of the resin pair. The results obtained are reported in Table I.

TABLE I

Agent pair	Percent fabric shrinkage	
	Warp	Filling
1. Untreated fabric.....		
2. {Dimethylol ethylene urea (A).....}	4.1	2.0
{Vinyl cyclohexene dioxide (B).....}	1.7	1.0
3. {Dimethylol ethylene urea (A).....}		
{Glycerol diglycidyl ether (B).....}	1.4	1.3
4. {Dimethylol ethylene urea (A).....}		
{Bis methoxymethyl uron (B).....}	0.8	1.0
5. {Dimethylol melamine (A).....}		
{Dimethylol dihydroxyethylene urea (B).....}	1.7	1.6

After drying, the fabric sections were cut and sewed into trouser cuffs and steam pressed into proper shape. Following a final cure for 10 minutes at 320° F., the crease resistance values of the cuffs were tested and the values obtained for the pressed items are reported in Table II.

TABLE II

Agent pair	Crease resistance (W+F)	
	Dried only	Final cure
Number 1 Untreated.....	138	138
Number 2.....	131	240
Number 3.....	167	256
Number 4.....	153	251
Number 5.....	170	232

The above results demonstrate that the combination of slow cure and fast cure dimension stabilizing agents is able to stabilize the fabric against shrinkage without premature creaseproofing on simple drying, then later, in garment form, the agent pair can be high temperature

cured to produce shape setting and crease resistance in the final garment. This eliminates the problem of shrinking during pressing in delayed cure resin treated fabrics.

DISCUSSION OF DETAILS

As indicated above, there are a number of classes of compounds which are recognized by the textile trade as being dimension stabilizing agents of the fast-cure category. Specific compounds of this type that may advantageously be used in the new two-stage cure operations include: dimethylol urea, dimethylol ethylene urea, dimethylol melamine, trimethylol melamine, dimethylol propylene urea, sesquimethylol urea, dimethylol ethylene thiourea, dimethylol triazone, trimethylol cyanurate, and dimethylol hydrazide.

As to specific compounds of the slow-cure category, a list of those that may advantageously be used herein include: bismethoxymethyl uron, vinyl cyclohexene dioxide, dimethylol dihydroxyethylene urea, diglycidyl ether of glycerol, tetramethoxymethyl ethylene urea, acrolein-formaldehyde resin, dimethylol N-ethyl triazone, tetramethoxymethyl acetylene diurea, bis methoxymethyl ethylene urea, and dimethylol 4,5-bishydroxymonourein.

Specific mixtures of fast-cure agents (A) and slow-cure agents (B) advantageously useable in the invention include the following pairs:

- (1) dimethylol urea (A)
bis methoxymethyl uron (B)
- (2) dimethylol ethylene urea (A)
vinylcyclohexene dioxide (B)
- (3) dimethylol ethylene urea (A)
bis methoxymethyl uron (B)
- (4) dimethylol melamine (A)
dimethylol dihydroxyethylene urea (B)
- (5) dimethylol urea (A)
diglycidyl ether of glycerol (B)
- (6) trimethylol melamine (A)
tetramethoxymethyl ethylene urea (B)
- (7) dimethylol propylene urea (A)
acrolein-formaldehyde (B)
- (8) sesquimethylol urea (A)
dimethylol N-ethyl triazone (B)
- (9) dimethylol urea (A)
tetramethoxymethyl acetylene diurea (B)
- (10) dimethylol ethylene thiourea (A)
bis methoxymethyl ethylene urea (B)

Those skilled in the textile resin art will recognize other suitable pairs which may be used in this invention to produce improved permanent press cotton garments.

The amount of dimension stabilizing agent incorporated in the fabric in accordance with the invention will depend to some extent upon the specific agent used and upon the degree or amount of durable press effect desired in the final treated garment. As little as 1% and as great as 50% by weight of the treating agent based upon the dry weight of the fabric may be employed depending on the nature of the fabric or the amount or type of treating agent employed. With fabrics made from cellulosic fibers and particularly for garments such as shirts, trousers and light items of outer wear to which the intention is particularly applicable, a creaseproofing agent concentration between 3-30% is recommended and particularly 5-25%. Incorporation of this quantity of the treating agent in the fabric can be accomplished by any suitable fashion such as by brushing, spraying, roller coating or the like. Advantageously, the incorporation of the treating agent is accomplished by padding or immersion of the fabric in an aqueous treating bath containing the treating agent in a concentration of 5-50% by weight of the total weight of the solution to give a solution pickup by the fabric of 25-150% by weight of the total weight of the impregnated fabric.

The relative proportions of fast-cure agent to slow-cure

agent in the mixture used to impregnate the fabric may be varied and will depend to some extent upon the particular agents used. In the case of preferred pairs of agents, there may be synergistic result on the final durable press effect so that a given amount of the mixture will create a greater effect than the same amount of the individual components of the mixture. In general, proportions of between 4:1 and 1:4 and especially between 2:1 and 1:2 of pairs of one fast-cure and one slow-cure agent are preferred, but 3 or more component mixtures, e.g., 2 fast-cure and one slow-cure, may be used.

Following the application of the treating solution to the fabric, the wet textile is dried at a temperature between 15 to 120° C. and especially 50–100° C. in any suitable drying equipment such as hot air ovens, infrared chambers, heated rollers or the like. No special equipment is required for applying the treating solutions or for the drying operation but care should be exercised to prevent overheating so as not to produce any curing of the slow-cure agent. Established padding or impregnation procedures may be used, and these may be carried out in standard textile processing equipment. In these stages of operation, other finishing or treating agents such as sizing, softening, lubricating, mothproofing, water-proofing, coloring or the like may be accomplished.

The curing of the fast-cure agent in the textile finishing mill during the drying cycle while the fabric is still uncut is conducted in suitable ovens or other heating equipment at a temperature of 90–120° C. for between 1–30 minutes, the time generally being less the higher the temperature.

The curing of the slow-cure agent contained in the dried fabric is accomplished, as previously indicated, after the fabric has been cut and sewn or otherwise formed into a garment or other desired article. This is accomplished by exposing the completed article after it has been pressed into a desired shape. Such pressing is accomplished by the equipment and methods which are standard in the textile fabricating industry, e.g., steam pressing, electrically heated shapers or pressers or the like. Advantageously, the pressing is accomplished at a temperature of 150–200° C. for 0.1 to 20 minutes depending upon the weight of the fabric of which the garment is formed, the number of plies of fabric that are present in the area being pressed, and other factors well recognized in the textile trade. After this pressing or shaping operation, the garments are conveyed or otherwise handled so as to maintain them in wrinkle-free condition until they are placed in the chamber or other zone wherein they are cured at temperatures between 150–190° C.

The aqueous solution or other liquid compositions used to impregnate the fabric generally contain a catalyst to aid in the curing of the dimension stabilizing agents. A single catalyst or mixtures may be used, e.g., a mixture of one catalyst especially active with the fast-cure agent and another particularly suited for use with the slow-cure agent. As an alternative, vapor-phase application of catalyst as disclosed in my copending application, Ser. No. 559,384, filed June 22, 1966, may be employed.

Generally, acidic catalysts are preferred although alkaline or other types may be used in special cases. As to the former, any acid or acidic material known to be useful in catalyzing the curing of amino-aldehyde condensation products or reaction between an aldehydic compound and cellulose may be employed. Useable acidic catalyst materials include free acids, e.g., hydrochloric, sulfuric, pyrophosphoric, oxalic and chloroacetic acids; acidic salts, e.g., zinc nitrate, aluminum chloride, ammonium chloride and the like. A brief test with similar acidic materials will quickly reveal the effectiveness of the material for the contemplated operation.

The amount of catalyst used in the treating composition may be varied and will depend upon the precise material used. It is generally advantageous to use between

0.1 to 10% by weight of the total weight of the mixture fast-cure and slow-cure agents.

Although it is contemplated that the new methods of the invention could be used with any form of fabric made of organic fibers, the operations are particularly useful in connection with the cellulosic fabrics, e.g., fabrics composed of fibers of cellulosic origin including cotton, viscose rayon, linen or the like. Such fabrics may be formed wholly of fibers of cellulosic origin, but usually they are made of mixtures with other natural or synthetic fibers, e.g., nylon, polyester fabrics, acrylic fibers, modacrylic fibers, polyolefin fibers, and natural fibers such as mohair, wool, silk and the like.

Fabrics which have been treated and given partial curing in the uncut form, may be formed and shaped into many different items. Garments such as shirts, underwear, trousers, uniforms, aprons, hospital gowns, service jackets and such garments used for dress or service apparel constitute a principal class of items for manufacture using the invention. Other items such as household white goods, e.g., bed sheets, pillowcases, tablecloths, napkins, etc., as well as furnishings, e.g., curtains, shades, drapes and the like.

Having provided a description of the invention in such manner as to distinguish it from other inventions and from what is old, the scope of protection sought to be obtained by United States Letters Patent is defined by the following claims:

1. A method for the production of durable press cellulosic fabric articles which mitigates the shrinkage of the articles during processing by a delayed cure operation comprising in combination the steps:

(A) impregnating a cellulosic fabric with a liquid composition containing two separate dimension stabilizing agents, the first of said agents being appreciably faster in rate of curing than the second of said agents, said first agent being selected from the group consisting of: alkylol ureas, alkylol alkylene ureas, alkylol melamines, alkylol cyanurates, alkylol hydrazides, alkylol formamides, alkylol thioureas, alkylol alkylene thioureas; said second agent being selected from the group consisting of: alkoxyalkyl urons, vinyl cycloalkylene dioxides, alkylol hydroxyalkylene ureas, glycidyl ethers of glycerol, alkoxyalkyl alkylene ureas, acrolein-formaldehyde resins, alkylol alkyl triazones, alkoxyalkyl acetylene diureas,

(B) drying and at least partially curing the said first agent contained in the impregnated fabric at 90 to 120° C. for 1 to 30 minutes without any appreciable curing of said second agent,

(C) cutting and forming the fabric from step B into an article,

(D) pressing the formed article into a predetermined shape, and

(E) curing the pressed article at a temperature between about 150 to 190° C. for between about 5 to 20 minutes.

2. A method as claimed in claim 1 wherein said first agent is dimethylol urea and said second agent is bis-methoxymethyl uron.

3. A method as claimed in claim 1 wherein said first agent is dimethylol ethylene urea and said second agent is vinylcyclohexene dioxide.

4. A method as claimed in claim 1 wherein said first agent is dimethylol melamine and said second agent is dimethylol dihydroxyethylene urea.

5. A method as claimed in claim 1 wherein said first agent is dimethylol propylene urea and said second agent is acrolein-formaldehyde resin.

6. A method for the production of durable press garments in which shrinkage of the fabric after formation of the garment is minimal which comprises in combination the steps: (A) impregnating a cellulosic fabric with an aqueous solution of a dimension stabilizing agent mixture consisting essentially of 5 to 20% dimethylol ethylene

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urea, 5 to 20% bis-methoxymethyl uron, and 1 to 10% of an acidic aminoplast catalyst to impart to the fabric a solids content of 5 to 50% of said agent mixture based upon the dry weight of the unimpregnated fabric, (B) drying the impregnated fabric, (C) subjecting the dried fabric to a temperature between 90–120° C. for between 5 to 15 minutes to at least partially cure said dimethylol ethylene urea without appreciably curing said bis-methoxymethyl uron, (D) cutting and sewing the fabric from step B into garments, (E) pressing the garments at a temperature between 100–200° C. into a predetermined shape, and (F) subjecting the pressed garments from step D while in a substantially wrinkle-free condition to a temperature of between about 150 to 190° C. for between about 5 to 20 minutes sufficient to effectively cure said bis-methoxymethyl uron.

7. A method as claimed in claim 6 wherein the fabric

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issuing from step C is rolled into a roll for transport to step D.

8. A method as claimed in claim 1 wherein the fabric issuing from step B is rolled into a roll for transport to step C.

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