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RESIN IMPREGNATED TEXTILE FABRICS
AND PROCESS OF PRODUCING SAMEArnold Silver, Englewood, N. J., assignor to Betex
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5 Claims. (Cl. 117—11)

1

This invention relates to the finishing of textile fabrics so that they have a raised embossed design or a stamped pattern effect and are substantially permanently fast to washing and dry cleaning. By a "stamped pattern effect" is meant the effect produced when a resin impregnated web is passed between a pair of embossing rolls, one of which has raised portions and the other is smooth resulting in areas having a high gloss contrasting with duller areas. The high gloss areas are those areas which are contacted by the raised portions of the embossing roll; the duller areas are those which are not contacted by the raised portions on the embossing roll. Hence, it will be appreciated that a stamped pattern effect, as well as a raised embossed design, is produced by passing a resin impregnated fabric through a pair of embossing rolls, the particular effect or design produced depending upon the nature of the embossing rolls, as will be explained more fully hereinafter.

The treatment of cellulose and regenerated cellulose fabrics of the viscose or cuprammonium type with urea formaldehyde or melamine formaldehyde condensation products and followed by the passage of the resin impregnated fabric through a pair of embossing rolls has been proposed. While such treatment imparts to the fabric a crush or crease resistance fast to washing, it has been found objectionable for a number of reasons among which may be mentioned (1) the tensile strength of the fabric is deleteriously affected, (2) the fabric tends to develop an objectionable odor, and (3) the fabric at times has an undesirably soft hand, i. e., is soft to the touch. The term "hand" is used herein in the sense commonly employed in the textile art to mean the "feel" of the fabric.

It is an object of this invention to provide a process for finishing cotton and rayon fabrics imparting thereto a raised embossed design or stamped pattern effect, which process results in a fabric having a finish fast to washing and dry cleaning, which fabric will not develop objectionable odor and is of improved tensile strength.

Another object is to provide such fabric and process of producing same having a raised embossed design or stamped pattern effect, which fabric has a firm, or other desired hand, not materially affected by repeated washing and dry cleaning, and is of improved body and tensile strength.

Other objects and advantages of this invention will be apparent from the following detailed description thereof.

2

I have made the surprising discovery that by finishing cellulose or regenerated cellulose fabrics in accordance with the procedure which follows, fabrics result having raised embossed designs or stamped pattern effects, which fabrics are fast to washing and dry cleaning, of improved tensile strength and body, and of desired hand. The essential steps of procedure of this invention are

(1) impregnate the fabric with a solution of N-alkoxymethylpolyamide resin containing from 1% to 3% by weight of the resin in an aliphatic alcoholic solvent containing an acidic catalyst so that the fabric takes up from 60% to 100% of its weight, preferably about 85% by weight of the resin solution containing the catalyst;

(2) partially dry the thus impregnated fabric at a temperature not exceeding 250° F. for a period of time so as to leave in the impregnated web from 10% to 20%, preferably about 15%, based on the weight of the dry fabric, of moisture;

(3) pass the partially dried fabric containing the stated amount of moisture between a pair of embossing rolls at a temperature of 250° to 375° F., preferably 275° to 350° F., and

(4) cure the resin impregnated fabric at a temperature of 250° to 350° F., preferably 275° to 325° F., for from 4 to 15 minutes. This curing time, it will be understood, refers to the time required for the curing of each unit area of the fabric, i. e., the time during which each unit area of the fabric remains in the heated zone where the curing is effected.

If it is desired to produce a fabric having a relatively soft hand from 5% to 10% by weight of a mixture of heat hardenable carbamide aldehyde condensation product, such as urea formaldehyde and a heat hardenable aminotriazene aldehyde condensation product is incorporated in the resin solution. By varying the proportions of the resin constituents within the concentration limits noted fabrics of any desired hand may be produced. When employing the mixture of carbamide aldehyde and aminotriazene aldehyde condensation products an additional catalyst is incorporated in the resin solution to catalyze the curing of these resins. For example, diammonium phosphate may be added to the resin solution for this purpose.

As the N-alkoxymethylpolyamide, N-methoxymethyl polyhexamethylene adipamide, or N-ethoxymethyl polyhexamethylene adipamide, may be used. These compounds and other N-alkoxymethylpolyamides may be prepared as dis-

closed in United States Patents 2,430,910, 2,430,923 and 2,430,860. The preferred N-alkoxymethylpolyamide resins are those produced by E. I. du Pont de Nemours & Co. and sold under the following trade designations:

Type 8 DV 55 Nylon Resin
Type 8 DV 45 Nylon Resin

The N-alkoxymethylpolyamide resin is dissolved in a solvent, such as an aliphatic alcohol, e. g., methanol, ethanol or isopropynol desirably containing up to 45% of water, preferably from 15% to 40% water. An isopropyl alcohol water mixture containing from 15% to 40% water is preferred, because of its low toxicity and cost. To this solution containing the N-alkoxymethylpolyamide resin is added an acid catalyst, such as an organic acid, e. g., acetic, tartaric, citric or maleic acid. Instead of an acid catalyst, a salt catalyst, such as ammonium citrate, which decomposes to form citric acid may be employed. The amount of acid catalyst added is such as to give the solution of the uncured resin a pH of not more than 6, preferably about 4. From 1/2% to 5%, preferably from 1% to 3%, of acid catalyst based on the weight of the N-alkoxymethylpolyamide resin is used. To the resultant resin solution any of the known textile softeners may be added, if desired. The use of a resin solution for impregnating the fabric containing only the N-alkoxymethylpolyamide as the resin constituent results in a fabric having a firm hand, particularly if an amount of resin near the upper portion of the above noted range of 1% to 3% is employed.

If it is desired to produce a fabric having a softer hand, from 5% to 10% by weight of heat hardenable carbamide aldehyde condensation products, such as urea formaldehyde, dimethylol urea, etc. is employed in admixture with a heat hardenable aminotriazene aldehyde condensation product, such as melamine formaldehyde condensation products and heat hardenable condensation products of other aminotriazenes, such as melam and 2 chloro-4, 6-diamino-1, 3,5-triazene, etc. Aldehydes in addition to formaldehyde which may be used are acetaldehyde, benzaldehyde, etc.

A preferred resin solution which has been found to give excellent results is as follows: 4% by weight of urea formaldehyde (sold under the trade name Rhonite R₄), 4% dimethyl trimethylol melamine (sold under the trade name Aerotex M-3), 1.1% N-alkoxymethylpolyamide (sold under the trade name Type 8 DV 55 Nylon Resin). This mixture is dissolved in a solvent comprising 60% isopropyl alcohol and 40% water. To this solution is added 1% of citric acid and .5% of diammonium phosphate.

The impregnation of the fabric is carried out by immersing a continuously moving web of the fabric in a bath of the resin solution containing the catalyst and moving the immersed web through the bath at a rate so that after removal from the bath and passage between a pair of press rolls to remove excess solution, the web contains from 60% to 100%, preferably about 85%, of its weight of resin solution. The fabric thus introduced into the resin solution may be a dyed cotton or rayon fabric, or a fabric devoid of dyestuffs. If the fabric is wet it is subjected to a drying treatment before introduction into the resin solution. The thus impregnated web is passed through a drier of any suitable type to remove the alcohol solvent and part of the water.

The drying is controlled so that the web leaving the drier and entering the embossing rolls contains from 10% to 20%, preferably 15%, moisture. To accomplish this result the drying is carried out at a temperature below 250° F., preferably from 200° to 250° F., the time of passage of the impregnated web through the drier being so controlled as to leave the required amount of moisture in the web. In order to obtain the desired finish it is important to effect the drying as hereinabove described to leave in the web from 10% to 20% moisture.

The partially dried resin impregnated web containing from 10% to 20%, preferably about 15% by weight of moisture is passed between a pair of embossing rolls. In the production of a raised embossed design, one of the embossing rolls is a metal roll, e. g., steel, having the raised design thereon and the other, the platen roll which is usually the bottom roll, is made of paper. The embossing rolls before use to emboss the fabric are operated to cause the raised portion to form mating indentations in the platen roll producing what might well be termed accurately mated male and female dies. The embossed web leaving the embossing rolls is cured as hereinabove described.

In the production of a fabric having a stamped pattern effect, a pair of steel, copper or other hard surfaced rolls is used, one of which rolls has raised portions in conformity with the desired design and the other of which is a smooth metal on other smooth hard surfaced platen roll. The impregnated web after partial drying as hereinabove described and before curing is passed between the rolls. In the areas where the raised design contacts the impregnated web a densification or coalescence of the resin takes place which upon subsequent curing, as hereinabove described, produces permanent contrast between the areas thus densified and the remaining areas.

The embossing roll is heated to a temperature of 250° to 375° F., preferably 275° to 350° F. For best results, when embossing a web impregnated with a resin solution in which the resin constituent is an N-alkoxymethylpolyamide resin the temperature of the embossing roll should be within the range of 250° to 350° F. When the web is impregnated with the mixture of resins hereinabove described the temperature of the embossing roll should desirably be within the range of 300° to 375° F.

After the embossing treatment the web is passed through a curing zone, e. g., a drying oven where it is subjected to curing at a temperature of 250° to 350° F., preferably 275° to 325° F., for from 4 to 15 minutes. In general, when curing a web impregnated with a resin solution containing only an N-alkoxymethylpolyamide resin the temperature of the curing should be within the range of 250° to 325° F.; when curing a web impregnated with the mixture of resins hereinabove described the temperature of the curing should be within the range of 300° to 350° F. The higher the temperature of curing within the above temperature range for a fabric containing a given amount of resin, the shorter the time of cure. Also the time of cure within the above range of from 4 to 15 minutes will vary depending upon the resin content of the fabric subjected to curing, i. e., fabrics containing larger amounts of resin within the above disclosed ranges should either be cured for a longer period of time when the temperature of curing is the

same, or, if cured for the same period of time, should be cured at a higher temperature within the temperature range above noted.

After curing the fabric is framed to the desired finished width and wound into rolls for storage or shipment.

The following examples are illustrative of the invention; it will be understood the invention is not limited to these examples.

EXAMPLE I

A bath of uncured polyamide resin solution is produced by dissolving Type 8 DV 55 Nylon Resin in a solvent consisting of 70% isopropyl alcohol and 30% water at a temperature of about 122° F. to produce a solution having a concentration of 2% by weight of resin. To this solution 2% of citric acid based on the weight of the resin is added as a polymerization catalyst. Cotton fabric is continuously passed through this bath, the fabric being immersed therein and upon leaving the bath is passed between a pair of squeeze rolls which remove the excess resin solution. The fabric thus takes up approximately 85% of its weight of resin solution. This impregnated fabric is then passed through a drying zone maintained at a temperature of 180° F., the rate of travel of the fabric web being such that the web leaves the drying zone containing from 10% to 15% moisture. The partially impregnated fabric is then passed between a pair of male and female embossing rolls, the male roll being a steel roll and the female roll a paper roll. The male roll is at a temperature of 275° F. The fabric is passed between these rolls at a rate of about 15 yards per minute. The embossed fabric web is then passed through a drying oven at a temperature of 275° F. in which oven the fabric remains for 8 minutes.

There is thus produced a resin impregnated cotton fabric having an embossed design, which fabric is exceptionally fast to washing and dry cleaning, does not develop odor on standing, has a firm hand, and is of greatly improved tensile strength, as is evident from the test data on tensile strength given in the table which follows the examples.

EXAMPLE II

This example differs from Example I in that the resin solution through which the cotton fabric is passed contains approximately 1% Type 8 DV 55 Nylon Resin, rather than 2% as in Example I. The procedure is otherwise the same as hereinabove disclosed in connection with Example I. The resultant fabric had a somewhat softer hand. Like the fabric produced in Example I it is exceptionally fast to washing and dry cleaning, does not develop odor on standing and is of improved tensile strength as compared with embossed impregnated fabrics produced prior to this invention, as is evident from the test data on tensile strength given in the table which follows the examples.

EXAMPLE III

This example differs from Example I chiefly in the resin solution with which the resin is impregnated. In Example III the resin solution is produced by dissolving in a solvent consisting of 70% isopropyl alcohol and 30% water, 1% Type 8 DV 55 Nylon Resin, 4% urea formaldehyde resin sold under the trade name Rhonite R₁, 4% dimethyl trimethylol melamine which is a resin sold under the trade name Aerotex M-3 and a catalyst consisting of a mixture of about

1% citric acid and .5% diammonium phosphate. After impregnation of the web with this resin solution so that the web picks up 85% of its weight of resin solution, the impregnated web is subjected to the same further treatment as in Example I, except that the embossing roll is heated to a temperature of 325° F. and the curing temperature is 325° F. The resultant fabric surprisingly does not develop objectionable odor on standing, and this notwithstanding the presence of urea formaldehyde and melamine resins present in the resin solution with which the fabric is impregnated. Further, the embossed fabric is exceptionally fast to washing and dry cleaning; repeated washing and dry cleaning does not materially affect the pattern produced by the embossing. The fabric has a firm hand which is not materially affected by repeated washing and dry cleaning.

The fabrics of the above examples were subjected to standard tensile strength tests to determine the warp and weft tensile strength. Five samples of each fabric employed for each warp and weft test were thus tested and the average of the tensile strength data of the five samples taken as the value of the warp or weft tensile strength of the fabric in question. Warp and weft tensile values for the fabrics produced in the above three examples are given in the table which follows. Also given in this table are the warp and weft tensile values for (1) the standard, which is the same cotton base fabric not impregnated with resin and not subjected to an embossing treatment, and (2) an embossed fabric produced under the same embossing pressure, which fabric, however, is impregnated with a resin solution containing 8% urea formaldehyde resin (Rhonite R₁), 5% of dimethyl trimethylol melamine (Aerotex M-3), and .5% of diammonium phosphate catalyst. The tensile values given for this fabric (identified in the table as comparative sample) are truly representative of the tensile values of embossed resin impregnated fabrics produced prior to my invention and are given for purposes of comparison.

TABLE

Tensile strength pounds per treating load

	Example I	Example II	Example III	Standard	Comparative Sample
Warp..	49	50.8	52.8	52.8	37.6
Weft..	59.4	50.8	59.4	58.8	40.4

It will be noted that, relative to the standard, the embossed comparative sample shows a 30% loss in warp tensile strength and a 31% loss in the weft tensile strength. Example I on the same basis of comparison shows no loss in warp tensile strength and shows an increase in the weft tensile strength. Example II shows a loss of only .38% in the warp tensile strength and of 1.36% in the weft tensile strength. Example III shows a loss of only .72% in the warp tensile strength and shows an increase in the weft tensile strength.

By "washing" as used herein is meant the usual washing in water, water and soap, and water and synthetic detergents to which fabrics are commonly subjected at home and in laundries. By "dry cleaning" is meant the usual treatment with hydrocarbon solvents to which fabrics are subjected in effecting the cleaning thereof. The expression "cellulosic" as used in

the claims is intended to mean fabrics made chiefly from cotton fibres, such as the well known cotton fabrics, or regenerated cellulose fibres, such as viscose or cuprammonium types of rayon.

Since certain changes in carrying out the above process and certain modifications in the fabric which embody this invention may be made without departing from the scope of this invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense. For example, instead of applying the uncured resin solution to the fabric by immersing the fabric in a bath of the solution and passing it through this bath, the resin solution may be sprayed on to the fabric or otherwise applied thereto.

What is claimed is:

1. A process for producing embossed resin impregnated cellulosic fabrics having a finish fast to washing and dry cleaning, which process comprises applying to the fabric a solution of N-alkoxymethylpolyamide resin containing from 1% to 3% by weight of the resin in an aliphatic alcohol solvent containing an acidic catalyst so that the fabric absorbs from 60% to 100% of its weight of said solution, partially drying the thus impregnated fabric at a temperature not exceeding 250° F. to produce a resin impregnated fabric containing from 10% to 20% liquid based on the dry weight of the fabric, embossing the partially dried fabric at a temperature of 250° to 375° F., and curing the embossed resin impregnated fabric at a temperature of 250° to 350° F. for from 4 to 15 minutes.

2. A process as defined in claim 1, in which the fabric is impregnated with a solution containing in addition to the 1% to 3% N-alkoxymethylpolyamide from 5% to 10% by weight of a mixture of resins consisting of a heat hardenable carbamide aldehyde condensation product and a heat hardenable aminotriazene aldehyde condensation product dissolved in an aliphatic alcohol solvent containing not more than 45% by weight of water.

3. Embossed resin impregnated cellulosic fabric produced by the process of claim 1.

4. A process for producing embossed resin impregnated cellulosic fabrics having a finish fast to washing, which process comprises continuously passing a web of the cellulosic fabric through a bath of a solution of N-alkoxymethylpolyamide resin containing from about 1% to about 3% by weight of the resin, an aliphatic alcohol solvent and from about 0.5% to about 5% by weight

based on the weight of the N-alkoxymethylpolyamide resin of an acid catalyst from the group consisting of acetic, tartaric, citric and maleic acids, the web being thus caused to pick up from about 60% to about 100% of its weight of said resin solution, continuously passing the thus impregnated fabric through a drying zone to reduce the liquid content of said fabric to from about 10% to about 20% of the dry weight of the fabric, continuously passing the thus dried fabric between a pair of embossing rolls one of which is heated to a temperature of from about 250° to about 375° F., and continuously passing the web from said embossing rolls through a curing zone maintained at a temperature of from about 250° to about 350° F. at a rate such that each unit area of the web remains within said zone for from about 4 to about 15 minutes.

5. A process as defined in claim 4, in which the bath through which the fabric is passed contains from about 1% to about 3% by weight of N-alkoxymethylpolyamide resin, from about 0.5% to about 5% by weight based on the weight of the N-alkoxymethylpolyamide resin of an acid catalyst from the group consisting of acetic, tartaric, citric and maleic acids, from about 15% to about 40% by weight of water, the rest of the solvent being an aliphatic alcohol, from about 5% to about 10% by weight of a mixture of resins consisting of a heat hardenable carbamide condensation product and a heat hardenable aminotriazene aldehyde condensation product and a small amount of diammonium phosphate.

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