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METHOD OF PRODUCING LINEN-LIKE
EFFECTS ON TEXTILES

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1 Claim. (Cl. 117-64)

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This invention relates to the production of durable linen-like effects on fabrics composed of regenerated cellulose spun rayon or of mixtures of rayon and cotton from predominantly rayon to substantially 50% rayon and 50% cotton.

In carrying out the invention, we first prepare an aqueous solution of water soluble thermosetting resin forming materials insoluble in the completely polymerized state and apply the same to the fabric by impregnation, spraying or the like, after which excess solution is removed as by squeezing by passage of the fabric through nip rollers to obtain a solution pick-up of from substantially 70% to 90% by weight of the fabric in the natural dry state.

The fabric is then dried to dampness, i. e., to from substantially 10% to 15% moisture content over and above the natural combined moisture, by the application of heat in the usual manner. It is then quickly cooled to room temperature, say from 60° F. to 100° F.

We then pass the fabric through a chasing calender for the imparting of a mechanical finish.

As thus far described, the procedure is known, but heretofore the fabric has been run through the chasing calender until the resin-forming materials are completely polymerized to form a water insoluble resin. All chasing calenders depend upon pressure, heat and slippage for imparting a mechanical finish and the total pressure may vary from 20 to 40 or more tons on the fabric. For example, in a 30 ton chaser, 15 tons are applied to each ram which, calculated on the linear basis with bowls 60" wide, represents a pressure of 1/2 ton per inch on a 60" fabric. Although the bowls of a chasing calender are operated at the same peripheral speed, it is inevitable that there is also some friction, due to the slippage of fabric present at all times in the chaser.

In the known practice of running the fabric through the chaser until the resin-forming materials are completely polymerized, the pressure of the machine and the friction causes a flowing and a polishing of the surface deposits of polymerized material on the fibers. It follows therefore that the luster which is imparted to the fabric by the calender is enhanced or laid over with a high gloss due to the flowing and the polishing of the surface deposits of polymerized material on the fibers and yarns deformed by the pressure. Thus the resultant luster appears as a highly glossy surface luster, and in addition the fibers suffer a substantial reduction in flexibility and elasticity and are somewhat pressed and stuck to-

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gether and embedded in the resin material due to the pressure and the friction present during the polymerization. From this it follows that the fabric has stiffness imparted to it and suffers a substantial loss in hand or drape and also in feel. The crease-resisting properties of the fabric are low due to the sticking together by a hard brittle material and loss in flexibility and elasticity.

We aim to avoid the highly glossy surface luster and to obtain, in contradistinction, a luster which optically appears as though it were an interior or deep-seated, relatively subdued luster or glow, while at the same time the individuality, flexibility and elasticity of the fibers are substantially retained, in consequence of which the fabric not only substantially retains its original hand or drape but even has a superior drape and has a mellow feel. As will further appear, we also secure durability and resistance to washing, spotting and soiling, superior crease-resistance and resistance to fraying, with improved porosity or "breathing" properties and with substantial retention of tear strength.

In carrying out our improved process, as will further appear, we take advantage of the fact that a chasing calender may be operated at relatively low temperature with conditions such that for all practical purposes no appreciable polymerization of the resin-forming materials will occur on the chasing calender, providing the residence time within the chasing calender be sufficiently reduced. We then pass the fabric from the chaser to an oven where the temperature of the heated atmosphere and the residence time of the fabric is sufficiently high and long to bring about and complete polymerization of the resin-forming material to the water insoluble state, say from substantially 250° F. to substantially 350° F. and from substantially 8 minutes to substantially 2 minutes. Thus at the time of the imparting of the mechanical finish, i. e., the deformation and polishing of the fibers and yarns, there is no substantially polymerized material present and therefore there can be no flowing and polishing of polymerized material in the calender, in consequence of which the only luster or finish imparted is that which is imparted solely by the pressure and friction of the machine on the fibers and yarns themselves in the presence of free moisture and heat. At the time the resin-forming materials are polymerized, i. e., in the oven, there is no pressure on the fabric and therefore no flowing or polishing of surface deposits of resin and no sticking together of fibers. The luster imparted by the calender is thus seen through the

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surface deposits of resin and optically appears as though it were an interior deep-seated luster or glow of subdued character in contrast to the highly glossy resin surface luster hereinbefore described.

When this procedure is followed on spun rayon fabric or fabrics made of mixtures of cotton and rayon, of suitable relative percentage weight and construction, the result is to produce a pleasing finish which is very much like linen in appearance and which has the properties hereinbefore recited as being the objective of this invention.

For the resin-forming materials we may use any of the acid catalyzable resin-forming materials known in the textile art for the production of crease-proofing finishes and chintz finishes or the like, such, for example, as urea-formaldehyde, thiourea-formaldehyde, dicyandiamide-formaldehyde, mixtures thereof, melamine-formaldehyde, mixtures of melamine-formaldehyde and urea-formaldehyde or thiourea-formaldehyde or dicyandiamide-formaldehyde and the like. These should be employed in unreacted form or in partially reacted water soluble form.

For the catalyst we prefer a delayed action type of catalyst such, for example, as has a pH of from substantially 6 to substantially 8 in solution and on the dried mechanically treated cloth but which will develop the proper acid conditions for polymerization when the fabric is cured at the temperature and times described above. As examples of this type of catalyst we mention as preferred carbazide hydrochloride, and equivalents which may be substituted therefor, with good results, such as phenyl biguanide hydrochloride, monoguanyl urea phosphate, di-monoethanolamine hydrogen phosphate, octadecyloxymethyl pyridinium chloride and such commercial products as "Catalyst AC," an organic nitrogen chloride. We may also use that type of acid catalyst which, while having some appreciable acidity in solution, develops marked acidity at elevated temperatures. We here mention diammonium hydrogen phosphate, ammonium sulfate, ammonium lactate and ammonium citrate.

The concentration of resin-forming materials in the solution may vary from 5% to 20% by weight of the solution and the catalyst should be employed in minor amount. A softener is unnecessary but is desirable in the case of mixtures of rayon and cotton and if employed, may be used in amounts from about 1% to as high as 4% by weight of solution; and the catalyst in amounts from about 3 to about 5% by weight of resin forming material.

The factors which contribute to the avoidance of any appreciable polymerization on the glazer are (1) low acidity in solution; (2) low temperature drying; (3) after cooling; (4) the low temperature of the heated bowls which ensures that the temperature of the fabric in the chaser shall never achieve substantially 175° F. and preferably a temperature which is much lower, say, for example, from 100° F. to 150° F.; (5) the cooling of the fabric as it passes from the nips over the idler rolls and back to the nips; (6) the presence of free moisture, and (7) the catalyst of the character hereinbefore described. The rate of polymerization under these conditions is so slow that polymerization cannot proceed to any appreciable extent. We prefer to run the heated bowls of the calender at a temperature of from substantially 250° F. to 300° F. and to correlate the residence time of the fabric in the calender therewith so as to ensure that the temperature of the fabric in

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the calender will not rise above 175° F. A simple test of whether proper conditions are present is to wash a sample of the fabric after it has left the calender. If there is no finish left after the water washing, there has been no polymerization of the resin-forming materials in the chaser for the purposes of this invention. If, on the other hand, any of the finish remains, then there has been an objectionable extent of polymerization on the chasing calender.

Example I

460.0 lbs. methylol urea-formaldehyde resin (50%)
20.0 lbs. Aerotex #801 (dimethylol urea formaldehyde resin 100% solid)
25.0 lbs. Sapamine KW (yellow aqueous opalescent dispersion of a cationic active quaternary ammonium salt)
20.0 lbs. catalyst A. C.
1.0 lb. ammonium hydroxide (28%)
Water to make 150 gallons.

A spun rayon fabric, 40'', 46/40, 3.50 yds./lb., was impregnated with the above solution and squeezed until an 80% pick-up of solution was obtained based on the weight of the fabric. The cloth was then carefully dried until approximately 10% of excess moisture was left on the cloth and then immediately cooled to 60° F.

The moist sized fabric was then chase calendered once in a 5-bowl calender using 40 tons total pressure and 250° F. on the steel bowls. The fabric was then cured in a hot oven using 350° F. temperature and 2 minute time. The fabric was then washed and dried. The finished fabric had a soft full crease-resistant hand and a deep-seated mellow luster of linen-like appearance.

Example II

40.0 lbs. Aerotex M-3 (dimethyl-trimethylol melamine-formaldehyde resin) 80%
10.0 lbs. methylol urea-formaldehyde resin 50%
10.0 lbs. Rhonite 313 (dimethylol urea-formaldehyde resin 50% solid)
10.0 lbs. Triton K-60 (tetra alkyl quaternary ammonium chloride)
6.0 lbs. carbazide hydrochloride
1.0 lb. ammonium hydroxide (28%)
Water to make 100 gallons.

A spun rayon fabric of the said construction was sized, dried, and cooled as described in Example I. The fabric was then passed through a 5-bowl chasing calender using 300° F. and 30 ton pressure and then cured in an oven 8 minutes at 250° F. This was followed by washing and drying.

The resulting fabric had the characteristics described in Example I.

Example III

140.0 lbs. Resloom HP (di and trimethylol melamine-formaldehyde resin)
3.0 lbs. di-monoethanolamine hydrogen phosphate
1.0 lb. ammonium hydroxide (28%)
Water to make 100 gallons.

A spun rayon fabric was impregnated with the above solution and then squeezed until a 70% pick-up was obtained. The fabric was then carefully dried in a tenter frame until approximately 12% of excess moisture remained in the cloth and then cooled.

This fabric was then passed twice through a 5-bowl chasing calender operating at 250° F. and

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30 ton pressure, and then cured 3 minutes at 300° F. The cloth was finally washed and dried.

The resulting fabric had a deep luster and a flexible linen-like finish and good crease-resistance.

Example IV

80.0 lbs. Aerotex M-3 (dimethyl trimethylol melamine resin 80%)

60.0 lbs. Aerotex #450 (dimethylol urea-formaldehyde resin) 50%

10.0 lbs. Ahcovel G s-di[1-(2-palmitamidoethyl)] urea monoacetate

10.0 lbs. diammonium hydrogen phosphate

1.0 lb. ammonium hydroxide (28%)

Water to make 100 gallons.

A 45'', 39/32, 2.25 yds./lb. spun rayon (75%) cotton (25%) fabric was sized, dried, cooled and chase calendered as described in Example I. The fabric was then cured at 300° F. for 3 minutes and then washed and dried.

A linen-like fabric with deep-seated luster and good crease-resistance was obtained.

We claim:

The process of imparting a linen-like finish to fabrics consisting of at least 50% spun rayon and the remainder cotton, which comprises impregnating the fabric with an aqueous solution of a water-soluble thermosetting textile resin of the acid-catalyzable aldehyde type, together with an acid-providing catalyst, the resin-forming materials being present in proportions ranging from substantially 5% to 20% by weight of the solution, the catalyst being present in minor amount, and the solution pick-up being from sub-

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stantially 70% to substantially 90% by weight of the fabric in the dry state; drying the fabric with heat to substantially 10% to substantially 15% free moisture by weight of the dry fabric; immediately cooling the heated fabric substantially to room temperature; subsequently passing the fabric through a chasing calender heated to a temperature of from substantially 250° F. to substantially 300° F. with a plurality of thicknesses of fabric in each nip of the calender, while controlling the speed of the fabric in proportion to calender temperature so as to heat the fabric to a temperature of at least 100° F., but not above about 200° F., whereby to avoid substantial setting of the resin; passing the fabric to an oven having an atmosphere of from substantially 250° F. to substantially 350° F. for a residence time of from substantially eight minutes at the lower temperature to substantially two minutes at the higher temperature to set the resin; and washing and drying the fabric.

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