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IMPARTING LUSTER TO COTTON FIBERS

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This invention relates to the production of a permanent, deep-seated, lustrous finish for woven cotton fabrics, which closely resembles in general appearance the finish resulting from full mercerization but which is free from disadvantages of such mercerization.

As is well known, mercerization is utilized to produce silk-like effects with cellulosic fibers and fabrics. This process, however, shrinks yarns so that the space between warp threads and between filling threads increases, resulting in a more open fabric with the appearance of cloth of a lower degree of quality, particularly when the mercerization is carried sufficiently far to ensure high luster. The fabric becomes thinner in both appearance and feel. The losses in appearance and handle are particularly noticeable and objectionable in the case of fabrics having a thread count less than about 144 x 76.

It is an object of this invention to produce in woven cotton fabrics a deep-seated luster which is permanent to washing. It is an object also to obtain improvements in appearance and handle. It is a further object to produce mercerized-like effects without the disadvantages usually resulting from mercerization. It is a still further object to provide a method of finishing which will enhance the value of mild mercerization.

The desired type of lustrous finish is obtained by a definite sequence of steps and well defined set of conditions. Fabric is impregnated with an aqueous, non-viscous, solution of a water-soluble carbamide-aldehyde reaction product. The concentration of this solution is critical in that concentrations lower than about 5% will not produce the desired permanent luster while concentrations above about 10% produce undesirable effects, such as embrittlement of the fibers, dusting, or superficial gloss. It is essential in impregnating fabric that the fibers be thoroughly wet through and yet that no excess of solution be left on the surface of the cloth. This is accomplished by a heavy nip or squeeze which leaves a take-up of solution between 70% and 45% of the dry weight of the fabric. The preferred retention of solution is about 60%. The fabric is then "moisture-conditioned." This may be accomplished according to one procedure by partially drying by any of the usual means, such as drying on a frame or tenter, over cans, in a loop drier, etc. and batching for a short time. In the preferred procedure the cloth is dried to a moisture content of 4 to 8% and then very lightly sprayed or moistened with water, 55

plaited, and left standing for several hours in order to ensure that a relatively small amount of moisture is thoroughly distributed throughout the fibers and that the fibers are in a plastic state. The cloth is then pressed and simultaneously rubbed between layers of fabric. In the next step the fabric is subjected to conditions which will cure or set the resin in the fibers. After this the cloth is wet-out, and finished as desired.

Cloth to be treated by the method just described may be taken directly from the loom or from any subsequent stage in the preparation of cloth. If the cloth is in the gray, it should be rendered absorbent by the use of a wetting agent. It is usually preferred to prepare the cloth for finishing by one or more of such operations as scouring, causticizing, mild mercerizing, boiling, bleaching, dyeing, etc. It is desirable, but not essential, that the cloth be dry before impregnation with a solution of the resin-forming material.

The carbamide-aldehyde or urea-formaldehyde type reaction product must be one which is readily soluble in water and is either an addition product or a condensation product in a low degree of polymerization. Such compounds as methylol urea or dimethylol urea are particularly suitable. There may also be reacted with the formaldehyde, in place of or in addition to urea, such reagents as thiourea, dicyandiamide, melamine, or other triazine, pyrimidine, or other methylol-forming carbamide. It is essential that the readily soluble reaction products which give non-viscous aqueous solutions be used in order to secure thorough penetration of the fabric and permeation of the fibers. There may be used, when desired, a small amount of a suitable wetting agent or penetrant to assist in this respect, this being particularly helpful in the case of gray goods or very heavy goods. There is applied with the urea-formaldehyde reaction product a small amount of a catalyst for curing this reaction product. The preferred catalysts are amine or ammonium salts, such as ammonium thiocyanate or ammonium phosphate, in an amount between one-half and about four per cent. of the weight of the urea-formaldehyde reaction product.

The optimum concentration of reaction product is determined by the type and construction of the fabric as well as by the amount of solution left in the goods. If the retention of solution is low, the concentration of reaction product can be in the upper range of the operative limits.

Higher concentrations than specified or excessive pick-up of solution give a surface glaze which is objectionable and unacceptable to the trade.

After impregnation the moisture content of the cloth must be reduced so as to be in suitable condition for the pressing between layers of fabric. The absolute water content is not the criterion here, for good results have been obtained with moisture contents varying between 8 and 20% water. The important consideration appears to be to have sufficient moisture present and to have this moisture evenly distributed through the fibers so that they are in a plastic state, which is suitable for the subsequent treatment of pressing and rubbing. During the stage of moisture-conditioning of the fabric, there must be avoided any condition which would cause migration of the resin to the surface of the fibers. Any step or series of steps which will fulfill these requirements may be used for the moisture-conditioning of the cloth.

The operation of simultaneously pressing and rubbing between layers of fabric may be performed in a number of ways, including decating (pressing between fabric-coated rollers), chasing, or pressing in a felting press. In the latter types of operation one layer of the fabric being treated is pressed and rubbed with other layers of the same fabric. All of these methods allow slippage of the woven surface over a fabric. The optimum degree of luster seems to develop when multiple layers are rubbed together under pressure. As many as 12 or 15 layers may be used to impart a high degree of luster.

This rubbing operation, however, leaves the fabric with an extremely shiny surface and a papery hand, which in extreme cases somewhat resembles oilcloth. This glazed effect is, however, overcome after the carbamide-aldehyde reaction product has been cured. Curing is accomplished, under conditions which are now well understood, in loop driers, closed tenters, conveyors, etc., at temperatures between 270° F. and 400° F. Baking at 280-290° F. for two to three minutes, for example, gives highly satisfactory results.

The general appearance and handle of the cured fabric at this point is still undesirable. It must, therefore, be treated for removal of the glazed appearance and for improvement in handle. It has been found that the objectionable properties are easily overcome by any process in which the goods are wet again. The most direct procedure is to wet the cured fabric and finish it in any desired manner, for example by passing it through a mangle, and frame-drying it in the usual way. If desired, finishing agents such as softeners (sulfonated oils, sulfonated tallow, sulfated alcohols, long-chained quaternary ammonium compounds, etc.) and sizes (starches, polyvinyl alcohol, water-soluble cellulose ethers, etc.) may be applied in the bath when the fabric is wet-out. There may also be used other finishing processes such as shrinkage by "Sanforizing."

In the final wetting of the fabric the surface effects which resemble those from usual calendaring disappear. The shine or glaze is eliminated and the yarns return to their normal positions in the cloth. Distorted effects from rubbing and the papery hand often produced also disappear. The finished fabric possesses a deep-seated luster resembling that obtained in full mercerizing. The luster is wash-fast.

Example 1

A dyed broadcloth, of 37" width, 128 x 68 construction, 4.00 yards per lb., was taken after the usual operations of scouring and drying and impregnated on a two-roll rubber mangle with dip with an aqueous solution containing 72 lbs. of dimethylol urea and 2 lbs. 14 ozs. of diammonium phosphate in 100 gals. of water with a retention of 60%. The wet cloth was dried on a frame operating at 320° F. and plaited to cool. It was then sprinkled with water, plaited, and left standing for three hours. At this point the cloth had a moisture-content of 11-12%. The moisture-conditioned cloth was chased twice with six ends and passed at once through a drier at 340° F. where it was heated for about 40 seconds. After swinging to cool, the cloth was wet-out with a solution containing 0.75% sulfonated teaseed oil, dried, and shrunk on a Sanforizing machine.

Example 2

A piece-dyed cotton and spun rayon twill, of 40" width, 2.50 yards per lb., was taken after drying and impregnated on a three-roll hydraulic mangle with two dips in a solution containing 60 lbs. of methylol urea and 2 lbs. of ammonium thiocyanate in 100 gals. of water at 90° F. The retention of solution was 55%. The twill was frame-dried at 260° F. and batched cool. The cloth was dampened over a water-spray, again batched, and allowed to stand for two hours. Rubbing and pressing were then accomplished by chasing eight ends once. Curing was performed in a loop drier operating at 280° F. At this point the ribs of the twill were completely flat, destroying the appearance of a twill weave. In prior finishing processes ribbed constructions, such as twills, have never been pressed, nor has it been possible to offer lustrous finishes in ribbed constructions because of this damaging effect to the appearance of the cloth. But when ribbed fabric finished as described was wet-out through a mangle, the flattened surface yarns resumed their normal shape and showed a deep-seated luster between the ribs of the fabric. The final fabric was extremely silky in appearance, resulting from the blending of the matte surface of the ribs and the lustrous inner yarns.

The process herein described may be used for imparting a desirable luster to cotton fibers in practically any woven cloth. The cloth may be a mixed fabric containing other fibers, such as linen, rayon particularly spun rayon, a small amount of wool, etc., or the cloth may be composed entirely of cotton. The process may be used alone to impart a lustrous finish or it may be used in conjunction with causticizing or mild mercerization, in which case full mercerization is avoided, and the advantages of both processes secured.

We claim:

1. A process for imparting to cotton fibers in woven cloth a permanent, deep-seated luster which comprises impregnating the cloth with a non-viscous, aqueous solution containing between about 5% and about 10% of a water-soluble carbamide-aldehyde reaction product with a retention of the impregnating solution between 70% and 45% of the dry weight of the cloth, moisture-conditioning the impregnated cloth to a water-content between 8% and 20%, simultaneously rubbing and pressing the conditioned cloth between layers of fabric, curing the carbamide-

aldehyde product in the cloth, and wetting the cloth after curing.

2. A process for imparting to woven cotton fabric a permanent, deep-seated luster which comprises impregnating the fabric with a non-viscous, aqueous solution containing between about 5% and about 10% of a water-soluble urea-formaldehyde reaction product with a retention between 70% and 45% of the impregnating solution based on the dry weight of the fabric, moisture-conditioning the impregnated fabric to a water-content between 8% and 20%, simultaneously rubbing and pressing the conditioned fabric between layers of cloth, heat-curing the urea-formaldehyde reaction product in the fabric, wetting, and finishing the cured fabric.

3. A process for imparting to woven cotton fabric a permanent, deep-seated luster which comprises impregnating the fabric in a form ready for finishing with a non-viscous, aqueous, solution containing between about 5% and about 10% of a dimethylol urea and a small amount of a catalyst for curing this product with a retention of the impregnating solution of

about 60% based on the dry weight of the fabric, moisture-conditioning the impregnated fabric to a water-content between 8% and 20%, simultaneously rubbing and pressing the conditioned fabric between layers of the fabric by chasing, heat-curing the dimethylol urea in the fabric, wetting and finishing the cured fabric.

4. A process for imparting to woven cotton fabric a permanent, deep-seated luster which comprises impregnating the fabric with a non-viscous, aqueous solution containing between about 5% and about 10% of a water-soluble urea-formaldehyde reaction product so as to leave between 70 and 45 parts of the solution in 100 parts of the fabric, drying the impregnated fabric to a low moisture-content, restoring the moisture-content to between 8% and 20% throughout the fabric, simultaneously rubbing and pressing the fabric between layers of cloth, heat-curing the urea-formaldehyde reaction product in the fabric, wetting-out and then drying the fabric.

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