

1

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WRINKLE-RESISTANT COTTON FABRICS WITH IMPROVED MOISTURE ABSORPTION

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1 Claim

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A nonexclusive, irrevocable, royalty-free license in the invention herein described, throughout the world for all purposes of the United States Government, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

The treatment of cotton fabrics to give them wrinkle resistance and wash-wear or smooth drying properties is a common operation. These treatments usually consist of the application to the fabric of chemical agents that can react with themselves or the cellulose of cotton and fix the structure of the cotton fiber. The fabric is stabilized thereby in a smooth form, to which it will return after a deformation such as creasing or wrinkling. For these treatments, the most common agents now in use are the methylol amide compounds formed by the reaction of formaldehyde with polyfunctional organic amides. Some examples are dimethylol ethyleneurea, dimethylol ethyltriazone, trimethylol melamine, and the methylol ureas.

There are some disadvantages in these treatments, however. One disadvantage is that the moisture absorptivity of the cotton is reduced by the treatment. The relatively high moisture absorption normally present in cotton is often desirable. In cotton garments, it allows greater takeup and dissipation of body moisture, and contributes thereby to the comfort of the wearer, particularly in humid weather. This has been a marked advantage that cotton fabrics possessed in comparison with fabrics made from fibers with an inherently poor moisture absorption. The usual wrinkle resistance treatments, by reducing moisture absorptivity, gives a fabric that will make a less comfortable garment than untreated cotton fabric would make.

It is known that the loss of moisture absorptivity in these treatments can be prevented by conducting the treatment in a manner that allows the cotton to stay swollen throughout, for instance by conducting the treatment while the cotton remains wet with water. Treatments conducted in this manner, however, usually do not give the fabric much ability to resist wrinkling in the dry state, the condition in which it is normally used. In the few instances such treatments have given wrinkle resistance, the required procedure has proven troublesome and expensive.

The object of this invention is to provide a simple method of producing cotton fabrics with a high degree of wrinkle-resistance, and wash-wear properties, and with little or no reduction in moisture absorptivity. It has been found that this can be accomplished by using ordinary methylol amide finishing agents in the usual procedure but with a nonvolatile, water-soluble organic compound included in the treatment. The amount of this additive compound is adjusted to be sufficient to maintain enough swelling of the cotton fiber to give improved moisture absorption but not to be great enough to prevent the development of wrinkle resistance in the treated fabric when in the dry state. The compound used as the additive also must have low reactivity toward the methylol amide

2

finishing agent, or else the stabilizing action of the agent will be inhibited or entirely eliminated. Suitable compounds for use as additives in this invention are the polyethylene glycols and their monoalkyl or dialkyl ethers, such as: tetraethylene glycol dimethyl ether, triethylene glycol monoethyl ether, and polyethylene glycols with molecular weight greater than 200. The amount of the additive compound suitable for use will range from 3 to 15% of the treating solution, with 5.0 to 7.5% the preferred quantity.

Application of treatments with these additives to cotton fabric is by the same means commonly employed at present in wrinkle resistance treatments. In a typical treatment, a solution will be prepared containing 5 to 10% methylol amide, 0.3 to 3.0% catalyst to promote reaction of the methylol amide, 7 to 10% additive compound described in the invention, and the remainder water. Minor proportions of other agents may also be included, such as those to modify the feel or "hand" of the treated fabric. The cotton fabric is impregnated with the solution described by soaking and squeezing between pad rolls until the amount of solution retained is 50 to 100% of the dry fabric weight. The fabric is dried and heated briefly at an elevated temperature, 1 to 3 minutes at 140 to 160° C., to cause reaction of the methylol amide agent. In most instances it is preferable to wash the fabric after this treatment.

After such a treatment it is found that the cotton fabric has had a degree of wrinkle-resistance imparted to it that is only slightly less than that obtained without the use of the additive described in this invention. The moisture absorption of the fabric, however, is substantially higher than that of a fabric treated without the use of the additive. In fact, the moisture absorption of fabric treated by the process of this invention often approaches and sometimes exceeds that of the untreated fabric.

In the following examples the process and results of this invention are described in greater detail.

Example 1

Five solutions were prepared and used for the treatment of cotton print cloth. Each solution contained 10% dimethylol ethyleneurea, 0.5% zinc nitrate hexahydrate and an amount of tetraethylene glycol dimethyl ether ranging from 0 to 15% as additive. The solutions were applied to samples of the fabric, and the samples dried at 60° C. for 7 minutes, heated at 160° C. for 3 minutes, washed and dried. The fabrics were tested for moisture regain and crease recovery angle using methods described by the American Society for Testing Materials, "ASTM Standards on Textile Materials." Crease recovery angle is used as a measure of wrinkle resistance. The same crease recovery test was given to the fabrics while they were wet with water as a measure of their smooth drying properties. Results of the testing are shown in the following table.

Additive in soln. (percent)	Moisture re- gain (percent)	Crease recovery (degrees, W & F)	
		Dry	Wet
0.....	5.3	280	252
3.....	5.6	286	262
5.....	6.0	282	254
10.....	7.1	259	280
15.....	7.3	258	270
Untreated fabric.....	6.4	195	179

The tabulated data show that the use of 3 or 5% additive has no effect on the crease recovery produced by the treatment in dry fabric, but that moisture regain is increased. Even with 10% or 15% additive the crease recovery is considerably higher than that of untreated fabric, and the moisture regain is increased. Wet crease recovery increases with additive concentration up to 15%, the highest used.

Example 2

A series of solutions was prepared as in Example 1 except that triethylene glycol monoethyl ether was used as the additive. The solutions were applied to cotton fabric to obtain the results shown in the following table.

Additive in soln. (percent)	Moisture regain (percent)	Crease recovery (deg. W & F), dry
0-----	5.3	280
5-----	5.5	283
10-----	5.7	286
15-----	6.0	281

The results show that triethylene glycol monoethyl ether is also an effective additive.

Example 3

A solution was prepared containing 10% dimethylol ethylene-urea, 0.5% zinc nitrate hexahydrate, and 10% of a polyethylene glycol with an average molecular weight of 350. Application of this solution to cotton fabric followed by drying, heating, and an afterwash, produced a fabric with 275° crease recovery angle and 5.5% moisture regain. A similar solution, but without the polyethylene glycol, produced a fabric with 280° crease recovery angle and 5.3% moisture regain.

Example 4

A series of solutions was prepared containing 10% of different finishing agents and an appropriate amount of catalyst for the agent. A second series of solutions was prepared similarly but with 7.5% of tetraethylene glycol dimethyl ether as additive in each. Both series were applied to samples of cotton fabric, dried, heat cured, and washed. Test results on these fabric samples are shown in the following table.

Agent used	Moisture regain (percent)		Crease recovery angles ¹	
	Without additive	With additive	Without additive	With additive
Dimethylol ethyleneurea-----	5.7	6.9	279	256
Dimethylol ethyl carbamate-----	5.5	6.5	255	232
Dimethylol triazone-----	6.4	7.0	234	236
Polymethylol melamine-----	5.5	7.0	262	254
Untreated fabric-----	6.7	-----	184	-----

¹ Warp angle plus filling angle.

In each case, regardless of the active finishing agent used the inclusion of the tetraethylene glycol dimethyl ether in the solution caused an increase in the moisture absorption of the fabric while the crease recovery of the dry fabric remained much greater than that of the untreated fabric.

We claim:

1. In a process for treating cotton fabrics with nitrogen-containing resins, the improvement which consists of incorporating into the resin-treating formulation a quantity of from about 5.0% to about 7.5% of tetraethylene glycol dimethyl ether.

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