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[73] Assignee **The United States of America as represented by the Secretary of Agriculture**

[54] **DURABLE-PRESS ALL-COTTON FABRICS THROUGH TREATED FIBER BLENDING WITH UNTREATED FIBER**
1 Claim, No Drawings

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[50] **Field of Search** 8/116.3, 116

[56] **References Cited**

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ABSTRACT: Raw stock and lint cotton in various stages of machine processing, through roving, were submitted to demoisturizing, irradiation with gamma rays, graft-polymer deposition, blending with untreated similar cotton, constructed into a fabric, and finally cross-linked with chemical reagents. These "all-cotton" fabrics have good durable press properties which can compare favorably against cotton-synthetic blends, generally blended on a yarn to yarn basis.

DURABLE-PRESS ALL-COTTON FABRICS THROUGH TREATED FIBER BLENDING WITH UNTREATED FIBER

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.

This invention relates to a multistep method of producing "all-cotton" fabrics having properties comparable to the cotton-synthetic blended fabrics so well accepted in consumer categories currently. Specifically, this invention refers to a method of producing durable-press all-cotton fabrics by a multistep process wherein (1) the macromolecular properties of cotton fibers are selectively and permanently changed by a free radical initiated graft copolymerization step, (2) the modified grafted cotton fibers are blended with like or unlike unmodified cotton fibers and spun into yarns to construct woven or knitted fabrics, and (3) the blended all-cotton fabric, containing a selected ratio of modified to unmodified cotton fibers, is chemically cross-linked in the fabric form to yield textile products with higher wash-wear ratings than fabrics woven from the natural cotton fibers. Abrasion resistance is improved also.

The method of this invention has as its objective the modification of both the chemical and physical structures of cotton fibers then mechanically blending or mixing these modified fibers with selected untreated cotton fibers. The all-cotton fabrics thus blended contain fibers which retain their normal reactivity towards cross-linking agents and fibers which are less reactive toward cross-linking agents than the unmodified fibers but which do impart improved durable-press properties, particularly abrasion and wrinkle resistance and wash-wear ratings, to the final all-cotton blended fabric. The natural properties of the cotton fabric are conserved to a maximum extend, and new, durable-press properties are imparted to the resulting all-cotton textile products.

Currently, in the preparation of durable-press textile products, manmade fibers or yarns (for example, polyester) are blended with cotton fibers or yarns to form a fabric that is subsequently treated with a cross-linking reagent. Cotton is included in most blends to add comfort to textile garments and because of its chemical reactivity toward finishing agents. The presence of the manmade fibers probably aids in retention of durable-press properties such as, for example, appearance of the garments after washing and drying without ironing. In the currently accepted blends cotton usually comprises only about 35 percent of the finished fabric. The manufacture of durabe-press all-cotton products made from natural cotton fibers is currently limited due to these facts. When cotton is finished with chemicals which impart high wrinkle recovery angles substantial losses are noted in other areas of evaluation of the finished products. These prior art all-cotton products suffer large, undesirable decreases in the natural properties of cotton (unmodified) textile products. For example, overall wash-wear performance ratings, which include abrasion resistance, tearing strength, and appearance decrease substantially in the products of the current blends. These products of the blends of the instant invention do not suffer these decreases.

The instant invention defines a distinct improvement in selectively and permanently changing the morphological and physical properties of cotton fibers. Long-lived free radicals are produced on the cellulose molecule, preferably by exposing the cotton fibers in a field of ionizing gamma radiation. The effect can be accomplished by other manner of irradiation, of course. Then, vinyl monomers and preferred solvents are selected and graft copolymerization reactions with the irradiated cotton carried out, to form poly(vinyl)-cotton cellulose copolymers. These are modified cotton fibers.

The selection of the solvents for the vinyl monomers, particularly as relates to their effects on the morphology of the cotton fibers can determine to a certain extent where the grafted copolymer is located within the fibrous structure. The formation of cotton cellulose graft copolymer-modified cotton fibers does not significantly change the moisture regain properties of the modified cotton fibers (based on the cellulosic content of the fibers). This is important in making textile products with a high degree of comfort, particularly as relates to moisture control and transfer. These and other physical properties were changed in the modified cotton as evidenced by the fabrics produced therefrom. The fabrics in many instances have demonstrated improved abrasion resistance and shape retention and recovery properties.

By the method of this invention—the blending of modified cotton fibers with unmodified cotton fibers to form fabrics and cross-linking these—durable-press all-cotton textile products which retain the excellent natural properties of cotton to a maximum extent are provided. These have higher wash-wear performance ratings than the fabrics made from unmodified fibers.

The following examples are provided to illustrate the invention and are not to be construed as limits to the invention in any manner whatsoever.

Example 1

A quantity of raw stock cotton fibers were demoisturized to less than 2 percent moisture in a vacuum oven at 50° C., sealed in a nitrogen atmosphere in a thin metal container, and irradiated to a dosage of 1 megarad by cobalt-60 gamma-radiation. About 4 days later, the radiation-activated cotton fibers were immersed in a solution substantially 70 percent styrene and 30 percent methanol at 25° C. in the absence of oxygen for 22 hours to give 29 percent add-on of poly(styrene). Then 4 pounds of untreated cotton fibers were blended with 1 pound of the modified cotton fibers and spun and woven into textile fabric suitable for making trousers (3/1 twill, 9 ounces per square yard, 88 ends by 44 picks; filling yarn, 11/1 count, 3.50 twist multiplier; and warp yarn 11/1 count, 4.25 twist multiplier). Then the blended fabric was washed and dried in air and treated with cross-linking agent, dimethylol dihydroxyethylene urea (DMDHEU), in the usual manner to give an add-on of 7–9 percent and dried in an air oven. Then simulated trouser cuffs were made from two panels of twill, 18 inches long warp, 10 inches wide fill; seamed along length with ½ inch free edging with hem 2½ inches wide on one end; then folded to form cuff 1½ inches wide. The trouser cuffs were pressed on a hothead steam press, then cured in a forced draft oven at 160° C. for 12 minutes. Then the trouser cuffs were evaluated after washing and drying cycles by the American Association of Textile Chemists and Colorists Test Method No. 124 and rated for appearance on a scale from 1 to 5. After 30 wash-dry cycles the blended all-cotton fabric rated 4.7, almost perfect. A control fabric made from natural cotton fibers only rated 4.1.

EXAMPLE 2

A quantity of purified cotton fibers was treated by the method of example 1 except that after 3 days the radiation-activated cotton was immersed in a solution substantially 70 percent styrene and 30 percent methanol, at 25° C. in the absence of oxygen for 1 hour. This yielded an 18 percent add-on of poly(styrene).

A second quantity of purified cotton fibers was radiation-activated and after 7 days was immersed in the above-mentioned solution at the same temperature and in the absence of oxygen, but for 35 minutes. This yielded a 12 percent add-on of poly(styrene).

One pound of each of the above-treated cotton was blended with 3 pounds of untreated cotton, that is, a ratio of 1:1:3 was employed in blending the cotton with a respective 18 percent poly(styrene): 12 percent poly(styrene): 0 percent poly(styrene) content. This gave a blended cotton with about the same average content of poly(styrene) as in example 1. Then, by the method of example 1, a twill fabric was woven and tested in the same manner. After 30 wash-dry cycles the blended all-cotton fabric rated 4.6 while the untreated control fabric rated 4.1.

Example 3

A quantity of raw stock (using the method of example 1) was radiation-activated, then, after 5 days, immersed in a solution containing 15 percent methyl methacrylate, 40 percent water, and 45 percent methanol at 25° C. in the absence of oxygen for 10 minutes to give 53 percent add-on of poly(methyl methacrylate). Then 4 pounds of unmodified cotton fibers were blended with 1 pound of these modified cotton fibers. Twill fabric was woven and tested, by the method of example 1. After 30 wash-dry cycles, the blended all-cotton fabric rated 4.3, while the control fabric rated 4.1.

Example 4

A quantity of purified cotton fibers (using the method of example 1) was radiation-activated, then after 3 days immersed in a solution containing 70 percent styrene and 30 percent methanol at 25° C. in the absence of oxygen for 1 hour to give 29 percent add-on of poly(styrene). Then 4 pounds of purified cotton fibers were blended with 1 pound of the modified cotton fibers. By the method of example 1, twill fabric was woven and tested. After 30 wash-dry cycles the blended all-cotton fabric rated 4.4. A control fabric rated 4.1.

We claim:

1. A method of producing all-cotton fabrics having "durable-press" properties, comprising:

a. demoisturizing cotton fiber selected from the group consisting of raw stock and processed stock lint to about 2 percent moisture content.

b. irradiating the demoisturized fibers with ionizing gamma radiation to a dosage of about 1 megarad to introduce free radical sites in the cellulosic molecule of said fibers,

c. immersing the irradiated fibers in a solution containing about from 15 percent to 70 percent of vinyl monomer selected from the group consisting of:

styrene, and

methylmethacrylate;

about from 30 percent to 45 percent methanol; and about from 0 percent to 40 percent water for a period of time sufficient to allow a graft copolymer to form within the structure of the fibers at room temperatures,

d. washing the graft copolymerized fibers with water then drying,

e. blending the dried, graft copolymerized fibers with about four times their weight of untreated cotton,

f. spinning the blended fibers,

g. constructing a fabric from the spun fibers and

h. cross-linking the cellulosic structure of the fabric through reaction with a cross-linking agent.

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