

UNITED STATES PATENT OFFICE

2,126,809

METHOD OF TREATING COTTON

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No Drawing. Application July 15, 1935,
Serial No. 31,443

4 Claims. (Cl. 8—20)

My invention is an improved method and composition for the treatment of fibers, and involves primarily the application of discoveries made by me of hitherto unknown characteristics produced in certain fibers by the chemical and physical effects thereon of ammonia.

I have discovered that the uncoiling of the axial spiral twist of the flat ribbon-like fibers or cells of cotton renders them more readily susceptible to the action of caustic and such uncoiled fibers may be given, without tension, all the characteristics of mercerization under tension, by brief immersion in caustic of mercerizing strength. I have further found that partial effects of mercerization may be imparted to such uncoiled fibers by treatment thereof with caustic of less than mercerizing strength. The effect of the caustic in swelling, strengthening and lusterizing uncoiled fibers varies with the strength of caustic and duration of immersion therein of the fibers, as contrasted with the abrupt change in the effect on normal coiled fibers when treated, under tension, with caustic of mercerizing strength instead of with more dilute caustic.

I have further found that uncoiling of the axial spiral twist of the flat ribbon-like fibers of cotton, with their natural, water repellent waxes and gums adhering thereto, may be effected by treatment thereof with ammonia, either in the presence or absence of other degumming agents, and that such ammonia treatment further effectively degums the fibers and prevents the conversion thereof into oxycellulose by the concurrent or subsequent treatment of such fibers with caustic.

Such of my discoveries as are applicable to a particular type of fiber may be utilized as concurrent steps or consecutive steps in the treatment of such fiber, and, when the steps are utilized consecutively, the sequence in which such steps are used are susceptible of considerable variation.

When the steps are utilized concurrently some or all of the reagents employed may be advantageously mixed together before wetting, or in solution.

The fibers may be treated in their raw or unspun state or in the form of bats, slivers, yarns, or in fabricated form such, as woven, knitted or felted fabrics.

In the treatment of fibers, the ammonia is preferably utilized as a dilute aqueous solution, which may be diluted from the aqua-ammonia of commerce or formed by the introduction of anhydrous gas liberated from ammonium salts by reaction of caustic.

Where the ammoniacal treatment is given in an open vessel, jig or the like, the temperature of the bath is preferably kept at about 140° F. to avoid excessive loss of ammonia, but when the treatment is given in certain forms of enclosed kiers it may be necessary to operate at a temperature of approximately 228° and a pressure of from 10 to 15 pounds to secure adequate circulation of the solution through the goods.

The ammoniacal effect on cotton fiber is apparent not only by the visible uncoiling and untwisting of the fiber, but is further evidenced by the fact that ammoniacally treated cotton fiber, after thoroughly washing and drying, becomes negatively charged with electricity upon rubbing on glass and will also respond to such dyes as are commonly used with nitrogen containing fibers.

The characteristic features of my invention will further appear from the following illustrative examples, but it will be understood that such examples are by way of illustration only and that the details of methods embodying the presence of my invention may be widely varied.

In a preferred commercial treatment, in accordance with my invention, of a broadcloth woven from American peeler cotton and of a weight of say four yards to the pound, the fabric, after the usual singeing and de-starching treatment, may be kier boiled for approximately ten hours in a dilute ammoniacal solution containing about six percent by weight of NH_4OH based on the weight of the goods, or this may be represented as using a twelve percent solution of a twenty-six percent Bé. aqua ammonia based on the weight of the goods. The kier may be operated either as a closed or as an open system, but when operated as an open system the temperature should be such as to avoid excessive loss of ammonia by evaporation, and the loss of ammonia may be further minimized by covering the kier. A suitable, but by no means necessary, temperature for a kier operated on a closed system is approximately 228° whereas a suitable, but by no means necessary, temperature for a kier operated on an open system is approximately 140° F.

The duration of the kier boil is largely dependent upon the efficiency of the circulation of the kier and the weight of the fabric, but should be continued until the fibers are uncoiled and to a large degree untwisted and the goods are well bottomed.

When the ammoniacal treatment is completed, the goods are well washed in the kier. There is then introduced into the kier an aqueous solution

containing approximately 1% of sodium perborate, based on the weight of the goods.

This solution is circulated and the temperature gradually increased by steps, first to 140° F. at which it is maintained for approximately three-quarters of an hour, and thereafter to 160° F. at which the temperature is maintained until complete bleach is effected.

The goods are again thoroughly washed in the kier, then washed in a continuous rope washer, soured in a continuous rope washer, rewashed in a continuous rope washer, and then passed through a mercerizing bath of caustic soda at a temperature not exceeding 100° F., and preferably not less than 70° F., at a strength of caustic of from 40° Twaddell to 56° Twaddell. The mercerization may be effected in a continuous rope washer or a usual type of fabric pre-shrinking machine, since the full mercerizing effect is secured by my improvements without the necessity for tension, although, if desired, the usual mercerizing machine applying tension may be used.

By this treatment, fabric woven from American peeler cotton may be given the lustre, sheen, coverage and strength and the general appearance of a fabric woven from much higher grade cotton and mercerized by previous processes.

Any other oxidizing agent suitable for use in a kier, such, for instance, as sodium peroxide or hydrogen peroxide, or a mixture thereof, may be substituted for the sodium perborate in the foregoing illustration.

Where complete mercerization is not required, certain of the advantages of my invention may be obtained by treatment with caustic of less than mercerizing strength, which will improve the cover, handle and feel and effect the pre-shrinking of the fabric. This treatment with caustic of less than mercerizing strength may be effected as a separate step substituted for the mercerizing step, or may be effected by introducing caustic in low concentration into the ammonia kier boil. When used in the kier boil, the caustic is preferably used in an amount approximating 1½% by weight of the ammoniacal solution. When the fibers are uncoiled as a result of the ammoniacal treatment, the action of dilute caustic thereon progressively improves the strength, cover and handle of the goods with increases in the caustic concentration and when the caustic concentration is increased progressively above 18° Twaddell the lustre is gradually increased until the full luster of mercerization is attained at mercerizing strength of the caustic. Under special conditions it may be desirable to give the

ammoniacal and cold caustic treatments without the oxidizing treatment, or a combined ammoniacal and hot caustic treatment may be given to degum and uncoil the fibers and to improve the coverage of the fabric.

In some instances it is preferable that the ammoniacal treatment, the oxidizing treatment and the cold caustic treatment should be performed as separate and distinct steps consecutively or indispersed with other standard treating operations.

Unspun fibers may be treated similarly to the treatment given woven fabrics, and spun fibers may be subjected to the several steps concurrently or sequentially; preferably by forcing the solutions or combined solution through yarn packages by the use of a package machine of the Franklin type or the Overmeyer type. When mercerization of yarns in packages is effected in accordance with my process, by circulating caustic of mercerizing strength through yarn packages after the ammoniacal treatment of such packages, the yarn is given the same lustre and strength that is given to yarn by usual mercerization of a warp rope under tension. Such result is effected without substantial tension or contraction of the yarn sufficiently to prevent circulation of the liquid through the package.

By effecting mercerization in accordance with my invention without tension, there is avoided the stretching of yarns up to or beyond their elastic limits such as occurs in ordinary mercerization and fabrics may be produced in which the increase in lustre and strength due to mercerization is in the same proportion for both the weft yarns and the warp yarns.

Having described my invention, I claim:

1. The method of treating cotton fibers containing natural waxes or gums which includes subjecting such fibers to the action of hot aqueous ammonia until the axial spiral twist of the flat ribbon-like cells of such fibers uncoil and the gums or waxes are softened.

2. In the treatment of cotton fibers as set forth in claim 1, the step which consists in subjecting the uncoiled fibers to the action of caustic.

3. In the treatment of cotton fibers as set forth in claim 1, the step which consists in subjecting the uncoiled fibers to the action of caustic of less mercerizing strength.

4. In the treatment of cotton fibers as set forth in claim 1, the step which consists of subjecting the uncoiled fibers to the action of caustic without tension.

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