

United States Patent Office

2,858,183

Patented Oct. 28, 1958

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2,858,183

HYDROGEN PEROXIDE BLEACHING OF COTTON FABRIC

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No Drawing. Application June 28, 1955
Serial No. 518,690

7 Claims. (Cl. 8-111)

This invention relates to a new and improved process for the continuous bleaching of cotton woven fabrics. More particularly it relates to a process of pre-treating such cotton goods whereby they may be treated with caustic and bleached with hydrogen peroxide in a single continuous storage stage.

In accordance with present commercially operated continuous bleaching processes using hydrogen peroxide bleaching solutions, gray woven cotton goods are first subjected to pre-treatment for removal of fabric sizes and finishes, then subjected to a relatively strong caustic soda solution, steamed and stored in a continuous storage system such as a J-box, saturated with a hydrogen peroxide bleaching solution, steamed and stored in a second J-box at a temperature of 200-212° F. and finally washed and dried.

Although such a process produces satisfactory bleached cotton, the investment in equipment and cost of steam, water and labor are high. Furthermore, physical damage frequently is caused by the necessity for pulling the goods through the two J-box system. Various proposals have been made in the past for overcoming these difficulties but no satisfactory process has been known for continuously bleaching cotton piece goods in a system employing a single J-box.

It is an object of this invention to provide an improved process for the treatment of such woven goods.

It is another object of this invention to provide a continuous process for the scouring and bleaching of such woven goods whereby one continuous storage stage, such as by use of a J-box, will be eliminated.

Other objects of the invention will appear hereinafter.

The objects of this invention may be accomplished, in general, by pre-treating unbleached woven cotton goods with an aqueous solution of a surface active wetting agent and a phosphate, rinsing the cotton goods, and then bleaching the same with an alkaline peroxide solution.

In general the first step, referred to hereinafter as the wet-out, may be carried out by immersing the woven cotton material in an aqueous solution of a surfactant and a phosphate for a short time so that the cotton is thoroughly wet with the solution. Usually about 1 to 30 minutes' immersion is suitable and about 1 to 3 minutes is effective to produce good results. A longer period of immersion may be utilized, if desired, especially if the woven materials being treated are heavy or tightly woven. Less than 1 minute may be satisfactory for light or loosely woven materials.

The temperature of the wet-out should be above room temperature for best results and it is preferred to operate at about 120 to 140° F. Temperatures higher than about 140° F. are satisfactory and excellent results have been obtained at 180° F. However, in most instances temperatures below 180° F. are satisfactory and more economical. At temperatures below about 120° F., difficulty may sometimes be encountered in reproducing results and brightness of the bleached cotton will be lower than obtained with the higher temperature wet-out.

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Generally, concentrations of surfactant or phosphate within the range of 0.1% to 1.0% are useful. Preferably about 0.3% to 0.5% is used for best results. Concentrations above 1% may be used but show little or no added advantage. Below about 0.3% a somewhat lower brightness will be obtained.

Anionic, cationic or nonionic surfactants may be used in the wet-out with equally good results. Typical examples of suitable surfactants are the alkoxyated aryl polyether alcohols, polyethylene oxide condensates, sodium alkyl sulfates, sodium hydrocarbon sulfonates, the stearamide of diethylene triamine, fatty alkylol amine condensates, substituted oxazoline, amino alkane sulfates of a fatty acid, sulfonated esters of dicarboxylic acid and alkyl aryl sulfonates.

The phosphates having utility in the process of this invention are the molecularly dehydrated salts of phosphoric acid, for example, sodium hexametaphosphate, sodium tripolyphosphate and sodium pyrophosphate.

It is essential in accordance with the present invention that the woven cotton from the wet-out step be rinsed. Preferably, for best results the rinse water is heated to about the same temperature as the wet-out. In any event it is essential, in order to obtain the full advantage of this invention, to rinse the cotton and the best results are obtained when this is done thoroughly with hot water, i. e., 120° F. to 180° F. Surprisingly, it has been discovered that although the surfactant and phosphate function to improve the bleaching, it is necessary in order to obtain fully satisfactory results that the cotton be thoroughly rinsed following the wet-out. It has been suggested, heretofore, to add a surfactant to a peroxide bleach solution; however, the results obtained by first wetting out in a solution containing a surfactant and a phosphate and then rinsing are far superior to such previously known processes.

Following the rinse with water the woven cotton is bleached with an alkaline peroxide, preferably in the damp condition. The cotton is treated with sufficient bleach solution to become thoroughly wet and will in most cases contain bleach solution in an amount equal to about 50% to 150% of the weight of cotton. Where a rapid bleach is desired, the cotton containing bleach solution is heated, for example, by steaming to temperatures of about 160° to 212° F. or higher if desired and then maintained at the elevated temperature, while preventing evaporation, until the desired degree of bleaching is obtained. In a typical continuous peroxide bleaching system the cotton may be steamed to raise the temperature of the goods to about 205° to 212° F. and then stored in an insulated J-box for between 30 minutes and 1½ hours. At the end of the bleaching period, the goods are rinsed in water until essentially free of bleach solution.

The usual well-known stabilizers and alkalies for peroxide bleaching may be used, for example, sodium silicate, caustic soda, borax and sodium pyrophosphate.

The preferred percompound for the bleaching step is hydrogen peroxide. However, if desired, other known equivalents for hydrogen peroxide may be used, for example, sodium peroxide, sodium perborate and the like.

Generally, when bleaching gray woven cotton the concentration of hydrogen peroxide employed will be within the range of about 0.5% to 2.0% (100% H₂O₂ basis).

Sodium silicate is the preferred stabilizer in the bleaching step of this invention and, for optimum results, sodium silicate should be used in amounts greater than those commonly utilized in bleaching woven cotton goods. It is preferred to use about 2% to 3% sodium silicate (the 42° Bé. silicate regularly used in the textile bleaching trade). Higher concentrations may be used but show no advantage. Less than about 2% silicate may be used but improved results are obtained with 2% or more.

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The preferred alkali in the bleach solution is sodium hydroxide and about 0.1% to 0.8% sodium hydroxide may be used. However, it is preferred to use about 0.2 to 0.6% for best results. Bleach solutions containing only sodium silicate and sodium hydroxide in addition to the hydrogen peroxide bleaching agent are entirely satisfactory in practicing the invention. Alternatively, a bleach solution containing borax in addition to the above has been found useful particularly when silicate concentrations in the lower portion of the preferred range are used. A bleach solution containing about 0.3 to 1.0% borax (as the decahydrate) has been found to provide excellent bleaching with good stability of the peroxide solution.

Throughout this specification the concentrations given are based on the weight of solution.

The following examples illustrate the invention:

Example 1

Samples of gray cotton sheeting weighting 25 g. each were immersed in 1 liter of solution containing 0.5% sodium hexametaphosphate and 0.5% of the anionic, cationic and nonionic surfactants listed below. After 3 minutes immersion at 140° F. the samples were removed from the solution and rinsed thoroughly; twice with water at 140° F. and three times with water at room temperature. Each sample was then squeezed out, and immersed in a bleach solution consisting of 1.05% H₂O₂, 3.0% sodium silicate (42° Bé.) and 0.5% NaOH. After being thoroughly wet-out with the bleach solution, excess solution was removed so that the cotton sample contained 100% by weight, i. e., a solution-to-cotton ratio of 1:1. The samples were heated to 210° to 212° F. and maintained at that temperature during 1 hour while preventing evaporation. The samples were then rinsed thoroughly, centrifuged and ironed. Brightness was then determined with a Hunter multipurpose reflectometer.

Surfactant	Brightness
(a) "Duponol" ME (sodium alkyl sulfate).....	91.8
(b) "Alkanol" WXN (sodium hydrocarbon sulfonate).....	91.8
(c) Triton X-100 (alkoxylated aryl polyether alcohol).....	91.7
(d) Alrosol C (fatty alkylol amine condensate).....	91.7
(e) Alkatarge (substituted oxazoline).....	91.8
(f) Sulfonated castor oil+hexahydronaphthalene.....	91.5
(g) None.....	90.5
(h) "Duponol" ME (only).....	91.0

Example 2

The procedure of Example 1 was repeated except the wet-out solution contained 0.5% "Duponol" ME and the phosphates listed below:

Phosphate	Brightness
Sodium hexametaphosphate.....	91.8
Sodium tripolyphosphate.....	91.6
Sodium pyrophosphate.....	91.8
Sodium hexametaphosphate (only).....	91.1

Example 3

The procedure of Example 1 was followed but the wet-out contained 0.5% "Duponol" ME and 0.5% sodium hexametaphosphate; the bleach solution 1.05% H₂O₂, 3.0% sodium silicate, 0.6% NaOH and 0.5% borax.

Wet-out temperature—70–80° F.

Brightness—91.0

Wet-out temperature 140° F.; brightness—91.8

Example 4

The procedure of Example 1 was followed using a wet-out solution containing 0.5% sodium hexametaphosphate and 0.5% "Duponol" ME for 3 minutes at 140° F. The bleach solution contained 1.05% H₂O₂, 2.0% sodium silicate, 0.6% NaOH and 0.5% borax. One sample was

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rinsed at 140° F. following the wet-out; a second sample at 65° F.

Rinse temperature 140° F.; brightness—92.1

Rinse temperature 65° F.; brightness—91.4

Example 5

The procedure of Example 1 was followed using the wet-out composition of Example 4 and a bleach solution containing 1.05% H₂O₂, 3.0% sodium silicate, 0.8% NaOH and 0.5% borax. One sample was rinsed thoroughly following the wet-out. Brightness of the bleached sample was 92.2. A second sample was treated in the same way otherwise but was not rinsed following the wet-out. Brightness of the bleached unrinsed sample was 91.3.

Example 6

A 25 g. sample of gray woven cotton was immersed directly in a bleach solution containing 1.05% H₂O₂, 3.0% silicate, 0.5% NaOH and 0.5% "Duponol" ME. The cotton was then squeezed out and bleached as in Example 1. Brightness of the bleached sample was 89.6.

Example 7

The procedure of Example 1 (a) was followed except that a series (A) of samples of gray woven cotton was bleached using bleach solutions of varying NaOH concentration. A second series (B) of samples was wet-out in water only at 140° F. prior to bleaching with a bleach solution containing 1.05% H₂O₂ and 1.0% sodium silicate.

Percent NaOH	Brightness		Absorbencies for Series B (sec.)
	A	B	
0.0.....		84.1	60
0.2.....	91.7	88.9	4
0.4.....	92.2	89.4	2
0.6.....	91.8	88.7	3
0.8.....	91.4	83.6	6
0.9.....		78.4	23

Absorbency of the bleached samples of series (A) was 1.5 to 2.0 seconds as determined by the AATCC drop test.

Example 8

The procedure of Example 1 was followed except that the cotton sample was wet-out in a solution containing 1% olive oil soap instead of sodium alkyl sulfate surfactant. Brightness of the bleached sample was 91.4.

In all of the above examples using the process of the present invention, the bleached samples were mote-free or had a mote count of not more than 1 per square foot and an absorbency less than 2 seconds.

A major advantage of the process of this invention is that it provides a practical process for bleaching gray woven cotton goods without the necessity for extensive pretreatments. It is surprising that the combination disclosed herein produces bleached cotton of high brightness, free of motes and having excellent absorbency in view of the fact that previously known commercial operations required high temperature treatment with strong caustic solutions to obtain satisfactory bleaching.

Although the particular combination described herein has primary utility in bleaching gray woven cotton it may be used in bleaching woven cotton previously subjected to various treatments, for example, enzyme desizing, acid souring, mercerizing or a combination thereof. However, it may be necessary for optimum results to adjust the alkalinity of the bleach formula.

Since it is obvious that many changes and modifications can be made in the above described details without departing from the nature and spirit of the invention it is to be understood that this invention is not to be limited to said details except as set forth in the appended claims.

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I claim:

1. The process of bleaching woven cotton fabric which comprises wetting-out said fabric in an aqueous solution containing 0.1% to 1% of a surface active wetting agent and 0.1% to 1% of molecularly dehydrated salt of a phosphoric acid for a minimum period of about one minute, rinsing the fabric with water until said wetting-out solution is substantially removed from said fabric, incorporating in said fabric between 50% and 150% by weight of an alkaline peroxide bleaching solution, heating said fabric to a temperature of 160° F. to 212° F., maintaining said fabric at such temperature for a period of 30 minutes to 90 minutes, and rinsing said fabric in water to remove the bleaching solution therefrom.
2. The process of claim 1 in which the phosphate is sodium hexametaphosphate.
3. The process of claim 1 in which the fabric containing the bleach solution is heated to a temperature between 205° F. and 212° F.
4. The process of claim 1 in which the alkaline peroxide bleaching solution contains between .5% and 2.0% H_2O_2 , between 2% and 3% sodium silicate (42° Bé.), between 0.1% and 0.8% sodium hydroxide and between 0.3% and 1% borax.

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5. The process of claim 1 in which the wetting-out solution has a temperature between 120° F. and 180° F.

6. The process of claim 1 in which the rinsing water for rinsing the wetting-out solution has a temperature between 120° F. and 180° F.

7. The process of claim 1 in which both the wetting-out solution and the rinsing water for removal of the wetting-out solution have a temperature between 120° F. and 180° F.

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