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METHOD FOR SIMULTANEOUSLY SCOURING AND BLEACHING TEXTILE FABRICS, PORTIONS OF WHICH ARE DYED WITH A SENSITIVE DYESTUFF

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ABSTRACT OF THE DISCLOSURE

Textile fabrics containing portions dyed with a sensitive dyestuff, such as a vat or a naphthol dye, are simultaneously scoured and bleached by saturating the fabric with a bleaching solution containing 0.7 to 3% hydrogen peroxide and sufficient alkali to bring the pH of the solution to 10.5 to 13, then heating the saturated fabric to a temperature of 180 to 220° F. for 0.5 to 4 minutes.

BACKGROUND OF THE INVENTION

The bleaching of textile fabrics containing portions dyed with a sensitive dyestuff has long been a problem. For example, cellulosic fabrics such as cotton, regenerated cellulose, and artificial silk containing portions thereof dyed with naphthol dyes have a marked tendency to stain and "mark-off" on the undyed portions of the fabrics and other goods into which they may come into contact when the goods are subjected to bleaching. The tendency of such dyed portions to stain and mark-off is aggravated by severe bleaching conditions, particularly high temperatures, high pH and extended bleaching times. Accordingly, mild bleaching conditions have invariably been considered essential. In the case of fabrics having portions dyed with a vat dye, they generally can be bleached with the more standard alkaline-peroxygen bleach solutions, but since in any successful bleaching operation scouring of the fabrics must also be achieved, it is generally considered necessary to subject the dyed fabric to a pre-scouring treatment in which relatively alkaline scouring solutions are employed. However, vat dyes are generally adversely affected by the usual alkaline scour treatment because the dyes become partially reduced thereby to a soluble form which can mark-off. Because of this, mills often omit such scouring treatment and use instead two peroxygen bleaching treatments. Mills also sometimes employ relatively uneconomic batch methods employing dye becks, etc., in order to protect certain sensitive dyes.

It has been proposed to bleach fabrics containing portions dyed with sensitive dyestuffs under mild conditions, e.g., temperatures no higher than about 160° F., pH values of from 6.5 to 10, as contrasted with the more severe bleaching conditions of temperatures of around 210° F. and of pH conditions exceeding pH 10 such as are commonly employed when bleaching undyed cotton fabrics, and bleaching times of from ½ to 8 or more hours have generally been necessary. Patents indicating such prior practices are Kauffmann U.S. Pat. 2,391,700 and Smolens U.S. Pat. 3,280,039. It has also been suggested (Prett et al., U.S. Pat. 3,227,655) that fabrics dyed with vat or naphthol dyes may be bleached with

peracetic acid solutions having a pH of 4.5 to 6 at temperatures of 60 to 90° C. However, the use of peracetic acid solutions is distinctly disadvantageous because peracetic acid is a highly noxious and potentially hazardous chemical which generally must be manufactured at the mill site by personnel inexperienced with its safe handling.

The method of the invention provides a continuous rapid single-stage method for simultaneously scouring and bleaching fabrics of the above type, thereby satisfying the requirements of a process which has long been desired and needed.

SUMMARY OF THE INVENTION

The method of the invention is a single-stage method for simultaneously scouring and bleaching textile fabrics having portions thereof dyed with a sensitive dyestuff, which process involves saturating the fabric, e.g., with 50 to 150% of its weight, with a bleaching solution comprising 0.7 to 3% hydrogen peroxide and sufficient alkali to bring the pH of the solution to 10.5 to 13, then heating the saturated fabric to a temperature of 180 to 220° F. for 0.5 to 4 minutes, following which treatment the fabric is washed and handled in the customary manner.

DETAILED DESCRIPTION AND PREFERRED EMBODIMENTS

The method of the invention is based upon the surprising discovery that textile fabrics containing portions dyed with a normally sensitive dyestuff can be simultaneously scoured and bleached satisfactorily in a very short time under conditions which have heretofore been considered too severe for use with such fabrics, and that such scouring and bleaching can be achieved under the conditions subsequently to be described without excessive staining of the undyed portions of the fabric occurring and with no significant color mark-off onto such undyed portions occurring. The method of the invention involves the use of bleaching solutions containing from 0.7 to 3%, preferably 1 to 2%, hydrogen peroxide (H_2O_2), and sufficient alkali to bring the pH of the solution to a value within the range pH 10.5 to 13, preferably 11 to 12.5. Effective bleaching is achieved by saturating the goods, e.g. with from about 50 to 150%, preferably 90 to 110%, of such solution, based upon the dry weight of the fabric, and then heating the saturated fabric to from 180 to 220° F., preferably 190 to 212° F., for 0.5 to 4 minutes. The time of heating will depend somewhat upon the extent of bleach desired, but mainly upon the composition of the bleaching solution and the temperature employed, the higher the peroxide concentration and the temperature the shorter being the time required.

The method of the invention is intended to produce effective scouring and bleaching in a time that will be sufficiently short so as not to involve or require the stacking or piling of fabrics into excessively large piles such that heavy masses of the fabric will be formed during the bleaching operation. For example, the accumulation of fabric masses such as may occur in textile bleaching operations using a J box may reach 5000 pounds or more in the stack within the J box, whereby the tendency for mark-off is greatly enhanced. Because of the short times involved in the present method and the rapid passage of fabric through the vessel in which the saturated fabric is heated,

no massive accumulation of fabric need be encountered. To effect the heating, a continuous length of the saturated fabric can simply be passed through a vessel, e.g., in serpentine fashion, where it will be contacted directly with an atmosphere of steam maintained at the desired temperature to which the fabric is to be heated. The design of the vessel and of the path of travel of the fabric therethrough should be such as to provide a residence time for the fabric therein of from 0.5 to 4 minutes. Shorter times are generally inadequate to provide the desired bleaching and scouring action while longer times are generally not necessary and would be rather impractical to provide without involving the accumulation of heavy masses of the fabric in order to achieve the longer times.

The hydrogen peroxide content of the bleach solution employed should generally be at least 0.7% by weight in order to achieve the desired bleaching and scouring effects in the time indicated. Hydrogen peroxide contents greater than about 3% are generally too costly.

The bleach solutions applied in accordance with the invention will have a pH of at least 10.5, but generally not exceeding about 13. Such pH values, which are substantially greater than those heretofore considered usable for bleaching fabrics dyed with particularly sensitive dyestuffs such as the naphthol dyes, are characteristic of the bleaching solutions of the invention and are essential to the obtainment of simultaneous rapid scouring and bleaching. Use of such highly alkaline bleach solutions avoids the necessity of pre-scouring and separately bleaching any of the fabrics of the above type containing portions dyed with sensitive dyestuffs and permits the simultaneous treatment of fabrics dyed with a vat dye and others dyed with a naphthol dyestuff in the presence of each other.

Alkalinities within the pH range 10.5 to 13, preferably 11 to 12.5, are obtained by adding to the peroxide bleaching solution in the required amount any of the alkaline materials commonly employed to provide such pH values in peroxide bleach solutions. Examples of such alkaline materials are soda ash, sodium silicate, alkali metal phosphates, ammonium hydroxide, and the like. The preferred alkaline materials are the alkali metal hydroxides such as sodium and potassium hydroxide, which materials may be employed alone, but preferably in combination with one or more of the previously mentioned alkaline materials. The bleaching solutions generally will contain from 0.3 to 2%, preferably 0.5 to 1.5%, caustic soda based upon the weight of the solution.

In addition to the above materials, the bleach solution may also contain other materials such as stabilizers for the hydrogen peroxide, wetting agents, and heavy metal impurity sequestering agents such as the well-known polycarboxyamino compounds and their water soluble salts, for example, ethylenediamine tetraacetic acid, diethylenetriamine pentaacetic acid, nitrilotriacetic acid, and their water soluble salts. The bleaching solutions will also preferably contain a peroxide stabilizer which is effective under alkaline conditions. Effective stabilizers are the water soluble salts of molecularly dehydrated phosphoric acid, examples of which are the sodium and potassium pyrophosphates, sodium hexametaphosphate and sodium tripolyphosphate. These will generally be used as concentrations of 0.2 to 2%. Sodium silicate, e.g., the 42° Bé. solution (approximate composition: 10% Na_2O, 25% SiO_2 and 65% H_2O) commonly employed in alkaline peroxide bleach solutions, is also effective, e.g., at concentrations of 0.5 to 3%. Combinations of such stabilizers may also be used. Particularly effective stabilizers are combinations of an alkali metal pyrophosphate and a soluble magnesium salt, e.g., sodium pyrophosphate and magnesium sulfate, disclosed in Campbell et al. U.S. Pat. 2,333,916.

While the method of the invention is designed to and does effect satisfactory scouring and bleaching in a single treatment, the method can, of course, be practiced to bleach fabrics which may have been previously subjected to a separate alkaline scouring treatment. Thus, fabrics in which the dyed portions have been dyed with a naphthol dye may be pre-scoured by the usual alkaline scour treatment commonly employed for scouring undyed fabrics, following which bleaching may be effected in accordance with the invention. However, in the case of vat dyed fabrics which generally cannot be subjected to the normal harsh pre-scouring treatment without being adversely affected thereby, they will generally be simultaneously scoured and bleached in accordance with the invention. The presence of the peroxide in the bleaching solutions employed protects the dyed portions of the fabric from being adversely affected by the high alkalinity of the solution.

The process of the invention can be practiced with the fabric in either open width or rope form and is carried out on a continuous basis whereby a continuous length of the fabric is continuously saturated with the bleach solution then continuously heated for the required time, e.g., by passing it through a steam box or steam-heated tubes to provide a residence time therein of 0.5 to 4 minutes, preferably 1 to 2 minutes.

The method of the invention is illustrated by the following examples in which all reagent concentrations expressed as percentages are by weight. In all the examples the fabric samples were saturated at room temperature, except when indicated otherwise, with 100% of the bleach liquor, based on the dry weight of the fabric, and then placed in a chamber of live steam at about 210° F. for the times indicated, following which they were rinsed at least three times with hot water.

The following abbreviations are used in some of the examples to designate certain constituents of the bleach solutions employed: DTPA designates a commercial diethylene-triaminepentaacetic acid sequesterant; DODS designates a commercial surfactant which is the sodium salt of dodecylated oxydibenzene sulfonate; and TSPP designates tetrasodium pyrophosphate decahydrate.

EXAMPLE 1

Separate portions of a tightly braided cotton-polyester shirt fabric containing red stripes formed of yarns dyed with a naphthol red dye and black stripes formed of yarns dyed with a black vat dye, woven into the fabric, were bleached using the bleaching solutions for Runs A, B and C whose compositions are indicated in the tabulation below. The fabric samples prior to the bleaching had been first given a mild scouring treatment involving saturating the fabric with an aqueous solution containing 0.83% TSPP and 0.5% soda ash, and then heating the saturated fabric at 150° F. for 60 minutes. The results are shown in the following tabulation:

Run	Bleach	Bleach conditions	Bleeding or markoff
A	0.7% H_2O_2, 1.25% sodium silicate, 0.25% $NaCHO_3$, 0.25% sulonated castor oil, 0.2% DTPA, 0.02% epsom salt, pH 10.2%.	1 hour at 210° F.	Considerable.
B	0.8% peracetic acid, 0.4% TSPP, pH 5.8 (NaOH).	30 minutes at 210° F.	Visible but less than in A.
C	1.4% H_2O_2, 0.9% NaOH, 2.0% sodium silicate, 0.05% epsom salt, 0.1% DTPA, 0.1% DODS, 0.5% TSPP, pH 11.4.	2 minutes at 210° F.	None visible.

The above data show that of the three bleaching runs, only Run C (in accordance with the invention) effected bleaching without bleeding of the naphthol red dye from the red or black pin stripes woven into the fabric.

EXAMPLE 2

Tightly braided samples of an enzyme desized cotton seersucker having alternating ⅛" red and white stripes were bleached in Runs A to F using the bleach solutions and the bleaching times at 210° F. indicated in the tabulation below. White threads of the bleached fabric were pulled out for observation of their pinkness in assessing

the extent of relative bleeding of the naphthol red dye with which the red stripes had been dyed. The results are shown in the following tabulation:

Run	Bleach solution	Time at 210° F.	Pinkness of white threads
A	1% NaOH, 0.5% TSPP	1 hour	
B	0.5% H_2O_2, 1.5% sodium silicate, 0.05% epsom salt, pH 10.3.	do	Almost as much as F.
C	1.4% H_2O_2, 1.5% NaOH, 2.0% sodium silicate, 0.05% epsom salt, 0.10% DTPA, 0.10% DODS, 0.5% TSPP, pH 11.8.	1 minute	Very slight, the best.
D	Same as in C	2 minutes	Sl. darker than C.
E	do	3 minutes	Darker than in D.
F	do	5 minutes	Darkest pink; very visible.
G	1.05% H_2O_2, 1.0% NaOH, pH 11.8.	2 minutes	In between C and D.

Looking at the bleached fabric samples as a whole, the pink coloration of the white stripes was quite apparent apparent for the fabrics bleached in Runs B and F, but was not apparent for the fabrics bleached in Runs C, D, E and G. Run A was a scouring run for preparing the fabric bleached in Run B.

The naphthol red color of the above fabric was found to have been deepened in shade to a red maroon after being bleached with those solutions having a high pH (Runs C–G), but treatment of the bleached samples with a 0.15% sodium hypochlorite solution (100% saturation) at 100° F. for 30 minutes restored the original color and removed slight traces of pink in the white stripes. Mills often use this treatment routinely as a final step in the wet processing of fabrics containing naphthol red dyed yarns to restore color shade.

EXAMPLE 3

Samples of an enzyme desized 78 x 78 cotton fabric (4 yds./lb.) were bleached in one-step operations in which the fabric was saturated with a bleach solution then heated with live steam for a given time, following which the whiteness of the bleached fabric was determined. The bleach solutions used, the bleaching conditions and the resulting fabric whitenesses are reported in the tabulation below. The whiteness values are blue reflectance percentages measured using a Hunter Reflectometer with a blue filter for which magnesium oxide gave a blue reflectance of 100%. The unbleached fabric had a whiteness of 57.9.

Run	Bleach Solution	Bleaching conditions	Whiteness
A	0.52% H_2O_2, 1.5% sodium silicate, 0.05% epsom salt, pH 10.4.	60 minutes at 210° F.	78.9
B	Same as solution in Run C of Example 2.	2 minutes at 210° F.	84.4
C	1.2% peracetic acid, 1.0% TSPP hydrate, pH 5.8 (NaOH).	20 minutes at 190° F.	79.1
D	3.7% perphthalic acid, 0.2% TSPP hydrate, pH 6.0 (NH_4OH).	2 minutes at 210° F.	75.9

The bleach solutions for Runs B, C and D were formulated at about equal cost. It will be seen that bleaching was much more effective in Run B (in which a bleaching solution and bleaching conditions in accordance with the invention were used) than in any of the other runs. The white portions of colored fabrics should generally be bleached to a whiteness of at least 82 to be acceptable. Since the white portions of virtually all colored fabrics will be no more difficult to bleach than the fabric used in the above bleaching runs, it will be evident from the above results that bleaching of colored fabrics in accordance with the invention will effect acceptable bleaching of the white portions of such fabrics.

EXAMPLE 4

Samples of a 1:1 cotton/polyester fabric having a red check pattern (½" checks) in which the red portions were dyed with a naphthol-disperse dye were bleached using various bleaching solutions under various conditions, the compositions of the bleaching solutions and the conditions being those shown in the tabulation below for Runs A to F. In Runs B to D, the fabric sample was saturated in liquor at 100° F. Another run (G) was carried out employing only water as the treating medium. The dye with which this fabric was dyed is especially sensitive and tends to run even in hot water. Following the bleaching, white threads were pulled and the relative pink colorations of clumps of the pulled white threads were rated numerically with a rating of 1 designating the least coloration. The results were as follows:

Run	Bleach formulation	Bleaching conditions	Relative coloration of white threads
A	0.5% H_2O_2, 1.5% sodium silicate, 0.05% epsom salt, pH 10.4.	60 minutes at 210° F.	[1] 7
B	Same as solution C of Example 2, but with 0.5% NaOH, pH 10.9.	2 minutes at 210° F.	2
C	As in B, but with 0.9% NaOH, pH 11.4.	1 minute at 210° F.	3
D	As in C	2 minutes at 210° F.	4
E	1.2% peracetic acid, 1.0% TSPP hydrate, pH 5.8 (NaOH).	15 minutes at 190° F.	5
F	3.4% perphthalic acid, 0.2% TSPP hydrate, pH 6.0 (NaOH).	2 minutes at 210° F.	5
G	Water	do	[2] 1

[1] Moderate pink.
[2] Slight pink.

It is evident that the bleaching procedures of Runs B, C and D were more effective in preventing dye bleeding of this especially sensitive dye than were those of Runs A, E and F.

EXAMPLE 5

An enzyme desized braid of a cotton seersucker having alternating ⅛" white and blue stripes (vat dye) was saturated with a bleach solution of a composition the same as that of the solution used in Run C of Example 2 except that it contained 0.9% caustic soda and had a pH of 11.4, and then was bleached for 2 minutes at 210° F. The white backgrounds were well bleached and there was no visible dye mark-off. When this same fabric was scoured by saturating the same with a solution containing 1% caustic soda and 0.8% TSPP, followed by heating at 210° F. for 1 hour, severe mark-off of the blue dye onto the white stripes occurred. The marked-off dye was not removed by subsequently bleaching the fabric in an operation involving saturating the fabric with a bleaching solution containing 0.35% hydrogen peroxide, 1.5% sodium silicate and 0.05% epsom salt and then heating the fabric for 60 minutes at 210° F.

EXAMPLE 6

Samples of a braid of an all-cotton fabric having a ½" blue check pattern in which the blue portions were dyed with a blue copper phthalocyanine dye were bleached with four different kinds of bleaching solutions under the bleaching conditions indicated in the following tabulation. Following the bleaching, the coloration on white threads pulled from the bleached samples was noted. The results were as follows:

Run	Bleach formulation	Bleach conditions	Coloration on pulled white threads
A	0.5% H_2O_2, 1.5% sodium silicate, 0.05% epsom salt, pH 10.4.	212° F. for 60 minutes.	Slight, barely perceptible coloration.
B	Same as in Run C in Example 4.	212° F. for 2 minutes.	None.
C	1.2% peracetic acid, 1.0% TSPP hydrate, pH 5.8 (NaOH).	190° F. for 15 minutes.	Bright, distinct blue color.
D	1.05% H_2O_2, 1.0% NaOH, pH 11.8.	212° F. for 2 minutes.	None.

It will be seen from the above data that the bleaching solutions employed in Runs B and D prevented bleeding or mark-off of the blue dye, whereas the bleaching solutions employed in Runs A and C did not. The bleaching of the white backgrounds resulting in Runs B and D was excellent, and the bleached fabrics in those runs had a cleaner looking white background than did the fabrics in Run A or C.

EXAMPLE 7

Fabric, as described in Example 1, is continuously saturated to about 100% with a bleach solution having a composition as shown in Run C of Example 1. The saturated fabric is then simultaneously scoured and bleached, without significant dye bleeding or mark-off of the dyes onto the undyed portions of the fabric occurring, by passing it continuously through a steam chamber maintained at about 210° F. at a rate to give a residence time for the fabric therein of about two minutes.

We claim:

1. A method for simultaneously scouring and bleaching a textile fabric having portions thereof dyed with a sensitive dyestuff, which process comprises saturating said fabric with a 50 to 150%, based on the dry weight of the fabric, of a bleaching solution consisting essentially of 0.7 to 3% hydrogen peroxide by weight and sufficient alkali to provide a solution pH of 10.5 to 13, heating the saturated fabric to a temperature of from 180 to 220° F. for from 0.5 to 4 minutes, and washing the bleached fabric with water.

2. A method according to claim 1 wherein the bleaching solution contains 0.3 to 2% caustic soda by weight.

3. The method according to claim 1 wherein the temperature is 190 to 212° F.

4. The method according to claim 1 wherein the dyestuff is a naphthol dye.

5. The method according to claim 1 wherein the dyestuff is a vat dye.

6. The method according to claim 1 wherein the bleaching solution contains a peroxide stabilizer.

7. The method according to claim 1 wherein the bleaching solution is stabilized with a combination of tetrasodium pyrophosphate and magnesium sulfate.

References Cited

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