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BLEACHING OF CELLULOSIC TEXTILES

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This invention relates to the treatment of cellulosic textiles. It relates more particularly to improvements in the treatment of such materials with a chlorite, sodium chlorite and calcium chlorite, for instance.

It has heretofore been proposed to treat cellulosic textiles, gray cloth, for instance, with an aqueous solution of a chlorite for the purpose of bleaching or otherwise removing impurities therefrom, and it is recognized that the chlorites are valuable agents for such purposes. It is known, however, that the chlorites are relatively inactive in neutral or alkaline solutions, but it has been found that the chlorites may be activated by an acid condition or by the presence of certain other materials.

Sodium hypochlorite has been found to be a particularly desirable agent for activating the chlorite and accelerating the bleaching of the textile. Sodium hypochlorite alone has previously been used in the bleaching of cellulosic textiles, but when so used has been found to attack the cellulosic fibers with a resultant tendering of the textile material. It has been found, however, that considerable proportions of sodium hypochlorite may be used in conjunction with sodium chlorite, for instance, without deleteriously affecting the textile. For example, cellulosic textiles have been satisfactorily bleached by treatment with an aqueous solution of sodium hypochlorite and sodium chlorite, in which the ratio of hypochlorite to chlorite, on the basis of available chlorine, was about 1½:1. Such operations have been carried out successfully by treating the textile in an aqueous bath of the hypochlorite-chlorite solution at temperatures ranging upwardly from about room temperature to somewhat less than 100° F.

It has been recognized as desirable further to increase the treating temperature in order to speed up the reaction; but it has been found that where the temperature of the bath is increased to about 100 to 110° F. or higher, the hypochlorite constituent of the solution is rapidly decomposed in the presence of the chlorite, resulting in the relatively rapid evolution of chlorine dioxide, and the exhaustion of the hypochlorite constituent, with a minimizing of any advantages which might otherwise be obtained by increasing the treating temperature.

My present invention provides means whereby cellulosic textiles may be treated with an aqueous solution of chlorite and hypochlorite at temperatures materially greater than heretofore found practical in such treatment, at a greatly

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increased bleaching rate and without the disadvantages heretofore experienced when attempting to operate at elevated temperatures.

In general, the process of my present invention comprises the impregnation of the textile to be treated with an aqueous solution of the chlorite and hypochlorite, and thereafter steaming the impregnated textile in the absence of surplus solution. I have found that under such conditions, the hypochlorite is not rapidly decomposed in the presence of the chlorite, the evolution of chlorine dioxide is substantially inhibited, and the textile is rapidly bleached without deleterious effects.

I recognize that it has previously been proposed to steam textiles while impregnated with solutions of various reagents. However, so far as I am aware, no one has heretofore proposed the subjecting of a textile impregnated with a hypochlorite-chlorite solution to the action of steam. The results obtained using this solution as a bath, in which the textile is submerged, when attempts were made to increase the operating temperature, have led to the belief that operation at high temperatures, such as that of steam or resulting from the steaming of the impregnated fabric, would be impractical.

I have made the surprising discovery that the full advantages of increased operating temperatures with respect to speeding up the bleaching reaction may be attained without the disadvantages previously noted, provided the textile is brought to this higher temperature by steaming the textile while wet with an amount of the solution such as is retained by the textile after immersion in and removal from a bath of the solution or such as results, for instance, from immersing the textile in the solution and removing excess solution therefrom, as by draining or passing between squeeze rolls.

Impregnation of the textile with the solution may be accomplished by immersion, padding, spraying, or other procedure which assures reasonably thorough wetting. Thereafter excess solution, if any, is drained or squeezed from the textile prior to the steaming.

The present invention has been found to be of particular utility where the textile so treated is to be subsequently dyed or printed, as the absorbency of the textile has been found to be surprisingly uniform and of a high order. The process is, of course, also useful in the bleaching of textiles where no dyeing is contemplated and particularly where good absorbency is desired.

Prior to the treatment of the textile with the

hypochlorite-chlorite solution, as just described, the textile is with advantage subjected to a scouring operation. This scouring may be by conventional methods, kiering, for instance. However, according to a particularly desirable aspect of the present invention, the textile, prior to treatment with the chlorite-hypochlorite solution, is subjected to a steaming treatment while impregnated with an aqueous solution of caustic soda.

By subjecting the unfinished textile to a caustic steaming, washing in hot or cold water, and then steaming the textile while impregnated with an aqueous solution of hypochlorite and chlorite and again washing, superior results have been obtained with respect to whiteness, excellent and uniform absorbency, susceptibility to dyeing and freedom from motes and the like.

Particularly desirable results are obtained by this two-step operation where a small proportion of a penetrant is added to the caustic solution used in the first stage of the treatment. Various penetrants effective in an alkaline environment may be used for this purpose, for instance a sodium alkyl aryl sulfonate. It is further desirable that the textile be impregnated or padded with the caustic solution, while the latter is hot, say at a temperature of about 180° F. to 200° F.

In previous attempts to scour textiles by steaming while impregnated with a caustic solution, it has been found necessary to subject the textile to repeated caustic steamings, including re-impregnation, in order to obtain satisfactory, uniform absorbency. When using the two-step operation of my present invention only one caustic steaming is usually required. This effects a substantial economy in finishing operations and appears to be due to the effecting of further substantial scouring action in the second, or bleaching stage of the process.

The washing of the textile following the caustic steaming, and also following the chlorite-hypochlorite steaming operation, may be carried out in any conventional manner using cold water. However, washing in hot water has been found to give improved results.

In carrying out the first step of the operation, the textile is immersed in, or otherwise wet with the caustic solution, preferably hot and containing a penetrant. About 0.1% of the penetrant is usually sufficient, although greater or even lesser amounts of the penetrants may be used, depending primarily upon the nature of the textile. After impregnation any surplus solution is preferably removed from the textile as by draining or mild squeezing between rollers.

The caustic impregnated cloth is then passed into contact with steam, either at full width or in rope form. For instance, the textile may be passed at full width through a steam chamber wherein it is subjected to an atmosphere of steam for a period of time sufficient to scour the textile, or the textile in rope form may be rapidly heated by a brief contact with steam and then stored in bulk in a chamber or pit where it is kept hot for the desired period without further introduction of steam.

Steaming time, concentration of the caustic solution, and temperature, are to a considerable extent interdependent. Particularly advantageous results are obtained when the concentration of the caustic solution is about 3% or greater by weight, say 3% to 7%, and the textile impregnated therewith is subjected to steam at atmospheric pressure for a period sufficient to permit the textile to assume approximately the temperature of the steam, and the hot textile is thereafter stored in a pit for about 1 hr. These operating conditions are, however, subject to considerable variation.

After the caustic steaming, the textile is washed and, preferably immediately, is subjected to the second stage, i. e., the hypochlorite-chlorite steaming operation. Instead of the caustic steaming, the textile may, in accordance with the broader aspect of this invention, as previously noted, be subjected to other conventional scouring operations, for instance, kiering, but in order to attain the full benefits of the present invention, the textile should be subjected to a caustic steaming and washing immediately preceding the herein described step of the process comprising the steaming, while impregnated with the hypochlorite-chlorite solution.

The steaming of the textile while impregnated with the hypochlorite-chlorite solution may likewise be carried out in any conventional steamer, either at full width or in rope form, in which the impregnated textile is subjected to the elevated temperature for a sufficient period to accomplish the desired extent of bleaching.

Particularly desirable results have been obtained in bleaching textile in rope form by passing the impregnated textile through a J-chute having perforations near the lower end of the long leg of the chute, said perforations being connected with a source of steam, as by a jacket welded onto the outside wall of the chute and enclosing the perforations. In this apparatus steam is injected into the J-chute through the perforations and the textile, as it passes through the J-chute, in the conventional manner, is gradually heated to approximately the steam temperature as it moves downwardly through the long leg of the chute toward the point of steam injection, and is thereafter subjected to the damp, high temperature environment until it has been withdrawn from the shorter leg of the J-chute.

In this operation, also, the concentration of the impregnating solution, temperature and time factor are interdependent, and each may be varied over a considerable range, suitable compensation being made with respect to the other conditions. Optimum operating conditions are also dependent upon the extent of bleaching required and the condition of the textile. Generally, satisfactory results have been obtained by maintaining the impregnated textile at an average temperature of about 140 to 160° F. for a period of about 1 hr., for instance while passing through a J-chute such as just described and injecting through the perforation into the J-chute atmospheric-pressure steam, the ratio of hypochlorite to chlorite in the impregnating solution being about 1.5 to 1, based on available chlorine, and said solution containing about 2.5 to 3 grams of available chlorine per liter.

The time factor may be varied by varying the rate at which the textile is passed through the steaming zone, that of the above-described J-chute, for instance, or by varying the length of the steaming zone. A satisfactory bleach is usually obtained in about ½ to about 1 hr., depending primarily upon the temperature employed.

This increased rate of bleaching is made possible by my surprising discovery that by following the procedure herein described, the temperature at which the bleaching is effected may exceed 100° F. without deleteriously affecting the

textile, without causing excessive evolution of chlorine dioxide and without causing such rapid depletion of the hypochlorite as to render the process impractical. According to our present process, the textile impregnated with the hypochlorite-chlorite solution may be heated to temperatures approaching that of steam at atmospheric pressure, i. e., 212° F. thus speeding up the bleaching reaction with beneficial results, with respect to economy in time and improved whiteness and absorbency of the textile.

The ratio of hypochlorite to chlorite and the available chlorine concentration and pH of the solution are also subject to considerable variation. The ratio of hypochlorite to chlorite may, with advantage, be varied within the range of about 0.51:1 to about 4:1, based on available chlorine, the optimum ratio depending largely upon other operating conditions and the results desired. Rapid and satisfactory bleaching has generally been obtained where the available chlorine concentration of the impregnating solution is about 2.5 to 3 grams per liter. The pH of the solution should not be less than 7 and is desirably within the range of about 9 to 11.

As previously noted, it is frequently desirable to subject the textile to a scouring operation prior to steaming the textile impregnated with the chlorite-hypochlorite solution. It will be understood that in carrying out such two-step operation, the textile may, if desired, be subjected to an intervening souring.

I claim:

1. In the bleaching of cellulosic textiles by treating the textile with an aqueous solution of a chlorite activated by the presence of a hypochlorite and having a pH not less than 7, the improvement which comprises effecting bleaching of the textile with said solution at a temperature in excess of 100° F. without appreciably diminishing activation of the chlorite by decomposition of the hypochlorite, said bleaching being effected by impregnating the textile with said solution and steaming the impregnated textile in the presence of only so much of the solution as is retained in the textile, for a period of time sufficient to effect the desired bleaching.

2. In the bleaching of cellulosic textiles by treating the textile with an aqueous solution of a chlorite activated by the presence of a hypochlorite and having a pH not less than 7, the improvement which comprises effecting bleaching of the textile with said solution at a temperature in excess of 100° F. without appreciably diminishing activation of the chlorite by decomposition of the hypochlorite, said bleaching being effected by impregnating the textile with said solution and steaming the impregnated textile in the presence of only so much of the solution as is retained in the textile, for a period of time sufficient to effect the desired bleaching, the ratio of the hypochlorite to chlorite in the solution being within the range of about 0.5:1 to about 4:1.

3. In the bleaching of cellulosic textiles by treating the textile with an aqueous solution of a chlorite activated by the presence of a hypochlorite and having a pH not less than 7, the improvement which comprises effecting bleaching of the textile with said solution at a temperature in excess of 100° F. without appreciably diminishing activation of the chlorite by decomposition of the hypochlorite, said bleaching being effected by impregnating the textile with said solution, heating the impregnated textile, in the presence of only so much of the solution as is retained in the textile, by contact with steam, and maintaining the textile at a temperature within the range of about 100° F. to about 212° F. for a period of time sufficient to effect the desired bleaching.

4. In the finishing of cellulosic textiles, the process which comprises impregnating the textile with an aqueous solution of caustic soda, steaming the impregnated textile, washing the textile and thereafter impregnating the textile with an aqueous solution of sodium chlorite activated by the presence of sodium hypochlorite and having a pH not less than 7, and effecting bleaching of the textile with said solution at a temperature in excess of 100° F. without appreciably diminishing activation of the chlorite by decomposition of the hypochlorite, said bleaching being effected by heating the impregnated textile, in the presence of only so much of the chlorite-hypochlorite solution as is retained in the textile, by contact with steam, and maintaining the textile at a temperature within the range of about 100° F. to about 212° F. for a period of time sufficient to effect the desired bleaching.

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