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METHOD OF BLEACHING PULP OR PAPER WEBS

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This invention relates to the art of bleaching pulp and paper.

Among the objects of the invention are to provide an improved method of bleaching a web of pulp or paper to thereby increase the brightness or whiteness of the web; to provide a practical and economical bleaching method which will bring a web of pulp or paper to a color level not otherwise possible except by resorting to impractical and costly expedients; to provide an improved method of flash bleaching a web of pulp or paper; to provide a practical and economical method of increasing the brightness and whiteness of pulp by flash bleaching after the pulp has been bleached as much as practicable in the usual way; and to provide an improved method of overcoming two-sidedness of paper with respect to color. Other objects will hereinafter appear.

My method is particularly advantageous when it is used to effect final or flash bleaching. When the method is so practiced, the pulp is bleached as much as practicable in the usual and well known way. The pulp is then formed into a web, in accordance with the customary practice. This web might be a web of unbeaten pulp passing to the pulp drier and intended for subsequent use in furnishing the beater of a paper making machine, or it might be a wet or moist web of fibers formed on the paper making machine itself, or it might even be a web of dried paper, or so-called raw stock, that is to be coated in the coating mill. In any of these cases the web, after its formation is always subjected to a drying operation. In the case of the pulp web this would be accomplished by the usual pulp drier. In the case of the wet or moist web of fibers it would be accomplished by the usual driers following the Fourdrinier or other paper making section of the machine. In the case of the dry web of raw stock it would be the drying compartment through which the coated web passes to dry the coating. After the web has been formed, and before it has passed entirely through the drier, I apply a solution of hydrogen peroxide to one or both sides of the web and make use of the already available heat of the usual drier, or at least the last portion of it, to activate the hydrogen peroxide and render it effective in producing the desired final bleaching action.

The use of hydrogen peroxide as a bleaching agent in the textile industry is well known but so far as I am aware it has not been economically and practically used in the bleaching of pulp or paper, probably for the reason that it requires a high temperature to render it active. It does not become active to any appreciable extent until temperatures around 140° F. are reached. In the textile industry temperatures of 180° F. are commonly employed, and sometimes the bleach is used at the boiling temperature. If it were attempted to treat pulp slurry with hydrogen peroxide as a supplemental or separate bleaching step the treatment would be very costly in steam usage due to the high temperature that must be attained. Inasmuch as I apply the hydrogen peroxide solution to the pulp after it has been formed into a web, and make use of the heat that is already available in the customary web driers to render the hydrogen peroxide effective, no additional expense for the heat is required. Moreover, the hydrogen peroxide solution may be applied to one or both sides of the web by simple instrumentalities at small expense. By thus treating a web of pulp or paper with hydrogen peroxide solution and making use of the already available web drying heat to activate the hydrogen peroxide the brightness or whiteness of the web may be increased to an appreciable degree in a practical and economical manner.

If it were attempted in a pulp or paper mill, by changes in the usual method of bleaching the pulp in slurry form, to increase the normal brightness or whiteness of the pulp or paper web to a point where it would be commensurate with the brightness or whiteness attained by my method, the process would be costly, and perhaps expensive modifications of the bleaching plant and process would be necessary, or the amount of bleach per unit of pulp would have to be increased to a point where the quality of the pulp would be seriously degraded.

I have ascertained that hydrogen peroxide can be made use of to effect the desired final or flash bleaching of the web because it can be diluted to a sufficient extent to make its use practical and economical and to provide the solution in sufficient quantity so that it can be applied rapidly enough to penetrate the web and spread throughout its width, while at the same time the hydrogen peroxide will be present in the dilute solution in sufficient strength to bring about the required bleaching action. I have discovered that notwithstanding its dilution, the hydrogen peroxide solution, when applied to the web in proper quantity, will be activated by the normal heat of the driers and will produce the desired bleaching action within the time that it usually takes for the web to pass through the driers.

Satisfactory results have been obtained by practicing the invention as follows:

Commercial hydrogen peroxide known as "100 volume" concentration, which contains roughly 30% of H_2O_2 by weight was mixed with sodium silicate in the volume ratio of about ½ part sodium silicate to 1 part "100 volume" hydrogen peroxide. The mixture was then diluted by making up 1½ gallons of the mixture to approximately 50 gallons of the dilute solution so that the concentration of the hydrogen peroxide in the dilute solution was a fraction of 1% H_2O_2. This dilute solution was sprayed uniformly across the upper surface of a web of previously bleached soda pulp before the web passed through the pulp drier. Application of the solution was made at the rate of about .00008 gallon of 100 volume H_2O_2 per square foot of pulp web. The pulp drier that was employed produced approximately 40 tons per day (air-dry) running at 95 feet per minute with a 25 x 38–500 basis weight of 235 pounds. The solution applied to the web amounted to approximately 1% of 100 volume H_2O_2 on the oven dried weight of the fibrous material. The already available heat of the pulp drier (ranging from about 210–230° F.) was utilized to activate the hydrogen peroxide. By thus practicing the invention the whiteness or brightness of the web was increased from 3% to 5% notwithstanding the fact that the pulp from which the web was formed had been previously fully bleached in the usual manner. Dilution of the hydrogen peroxide solution to the extent above indicated and its application at the rate above specified caused the solution to penetrate the web throughout its entire width and at the same time the hydrogen peroxide was present in sufficient strength to bring about the required bleaching action at the temperature of the driers and within the time it took for the web to pass over the driers. Of course the quantity of hydrogen peroxide solution applied to the web and the extent to which the solution is diluted may be varied depending upon the degree of bleaching sought to be obtained. The sodium silicate maintained the pH of the bleaching solution at about 10 and served to stabilize the hydrogen peroxide and accelerate its action. The invention is not limited to the use of a stabilizer but it is advisable to use one. Other substances than sodium silicate may be used, but I have found the use of sodium silicate to be particularly advantageous because it performs two functions, i. e., it serves as a stabilizer and also maintains the bleaching solution at the proper alkalinity thus making it unnecessary to use two separate ingredients for these purposes. Moreover, in performing its stabilizing function it has been found to be particularly advantageous in preventing the initial application of the heat from suddenly dissociating the H_2O_2 solution and too quickly bringing to an end its bleaching action.

The hydrogen peroxide solution may be applied to the web by any suitable means such as a spray pipe, applicator rollers, or the like. It may be applied to either one or both surfaces of the web, and at any appropriate place so long as the web will thereafter be subjected to the heat of at least a portion of the driers for a long enough period to produce the desired bleaching action. When a web of pulp is treated in accordance with the invention the hydrogen peroxide solution is preferably applied to the upper surface of the web either just ahead of the last wet press, or between the last wet press and the first drier of the pulp drying machine. The quantity applied, and the strength of the solution will, of course, be governed by the bleaching action desired as the pulp goes over the driers.

The method may also be applied to a web of paper formed on a paper making machine. The hydrogen peroxide solution may be applied by any suitable means to one or both surfaces of the web just ahead of the last wet press, or between the last wet press and the first drier, or it may be applied within the drier section, or at any other appropriate place so long as the application is far enough from the dry end to give ample time for the hydrogen peroxide to react under the influence of the heat.

My improved bleaching method may be used to overcome two-sidedness of paper so far as color is concerned. The hydrogen peroxide solution may be applied by any suitable means to the wire side of the web of paper (or to whichever side is to be brightened), the application being preferably just ahead of the last wet press, or between the last wet press and the first drier, as at the smoothing press, or within the drier section but far enough from the dry end to give sufficient time for the hydrogen peroxide to react. By applying the hydrogen peroxide solution in the proper quantity and at the proper strength, depending upon the amount of bleaching required at the darker side of the web, two-sidedness with respect to color may be eliminated. If desired the hydrogen peroxide solution may be applied to both sides of the web of paper thereby raising the color level of the whole sheet and at the same time eliminating two-sidedness.

If desired the hydrogen peroxide solution may be incorporated as one ingredient in a coating suspension consisting of the usual ingredients of pigments and adhesives. The suspension containing the hydrogen peroxide may be applied to the surface of a paper web either in the wet or moist condition as on the paper making machine, in which case the driers following the forming wire furnish the heat to render the hydrogen peroxide active, or it may be applied to the dried web as in standard coating mill practice in which case the heat usually employed to dry the coated paper renders the hydrogen peroxide active.

It will now be seen that the hydrogen peroxide solution may be used in a practical and economical manner to obtain a final or flash bleach by applying the solution to pulp that has already been bleached as much as practicable, and by applying the solution to the pulp after it has been formed into a web. The web may be either a web of pulp passing to or through the usual pulp driers, or it may be a web of wet or moist paper passing to or through the usual paper driers, or it may be a web of dried paper that is being coated in the coating mill and passing to or through the coating driers. In any case, no additional expense is entailed to provide the heat for rendering the hydrogen peroxide effective because the heat used for this purpose is that which is already available. I have found that the heat thus made use of is sufficient, within the time it takes for the web to pass through the driers, to activate the hydrogen peroxide and make it effective in producing the desired final or flash bleaching of the web. The hydrogen peroxide has no degrading influence on the pulp and leaves no detrimental residual chemical compounds in the web.

My process can be practiced without large

capital investment. Moreover, it is very flexible and the whiteness or brightness can be controlled as a machine operating variable. The bleaching action can be made to take place uniformly throughout the thickness of the web by applying the solution to both sides of the web or in sufficient quantity to one side of the web, or the bleaching action may be confined to that portion only of the pulp which requires to be flash bleached to a higher whiteness and brightness. The bleaching action may be a superficial one at one or both sides of the web to improve the whiteness or brightness of only the surface portion of the web. This not only saves the expense that would be involved if the entire mass of pulp were bleached, but it also makes it possible to secure in a paper sheet a material brightening and whitening action substantially on the surface where it is most desired.

When pulp or paper is treated in accordance with my invention the opacity of the paper is increased and there is a very material increase in the permanence of the color with respect to the usual fading factors such as heat, light, alkali and time, thus permanently maintaining in the sheet the improvement in color produced by my method.

I claim:

1. In the manufacture of a web of pulp or paper in which the web is dried by being passed through a heat drier, the improvement which comprises preparing a solution of hydrogen peroxide and applying the solution thus prepared to at least one side of the web at a point in advance of the dry end of the drier whereby the heat of at least a portion of the drier is utilized to render the hydrogen peroxide active to bleach the web.

2. In the manufacture of a web of pulp or paper in which the web is dried by being passed through a heat drier, the improvement which comprises preparing a solution of hydrogen peroxide applying the solution thus prepared to at least one side of the web and uniformly across its width at a point in advance of the dry end of the drier whereby the heat of at least a portion of the drier is utilized to render the hydrogen peroxide active to bleach the web.

3. The method of flash bleaching a pulp or paper web which comprises forming a web from previously bleached pulp or fiber, passing the web through a heat drier to dry the same, preparing a solution of hydrogen peroxide and applying the solution thus prepared to at least one side of the web at a point in advance of the dry end of the drier whereby the heat of at least a portion of the drier is utilized to render the hydrogen peroxide active to bleach the web.

4. The method of bleaching a pulp or paper web which comprises preparing a solution of hydrogen peroxide and applying the solution thus prepared to at least one side of the web and thereafter subjecting the web to heat to render the hydrogen peroxide active to bleach the web.

5. The method of flash bleaching a pulp or paper web which comprises forming a web from previously bleached pulp or fiber, preparing a solution of hydrogen peroxide and applying the solution thus prepared to at least one side of the web, and thereafter subjecting the web to heat to render the hydrogen peroxide active to bleach the web.

6. The method of bleaching a pulp or paper web which comprises preparing a solution of hydrogen peroxide and applying the solution thus prepared to at least one side of the web and thereafter subjecting the web to heat at a temperature of at least 140° F.

7. The method of overcoming two-sidedness of paper with respect to color which comprises preparing a solution of hydrogen peroxide and applying the solution thus prepared to that side of a paper web whose whiteness or brightness is to be improved to substantially match the whiteness or brightness of the other side of the web, and thereafter subjecting the web to heat to render the hydrogen peroxide active to bleach the side of the web to which the solution has been applied.

8. The method of bleaching which comprises coating a paper web with a coating comprising a mixture of pigment, adhesive and hydrogen peroxide solution, and thereafter subjecting the coated paper to heat to dry the coating and to render the hydrogen peroxide active to produce a bleaching action.

9. In the manufacture of a web of pulp or paper in which the web is dried by being passed through a heat drier, the improvement which comprises preparing a solution of hydrogen peroxide containing sodium silicate and applying the solution thus prepared to at least one side of the web at a point in advance of the dry end of the drier whereby the heat of at least a portion of the drier is utilized to render the hydrogen peroxide active to bleach the web.

10. The method of flash bleaching a pulp or paper web which comprises forming a web from previously bleached pulp or fiber, preparing a solution of hydrogen peroxide and applying to at least one side of the web the solution thus prepared at such a rate per square foot of web that approximately 1% of 100 volume H_2O_2 will be applied based on the oven dried weight of the fibrous constituents of the web, and thereafter subjecting the web to heat to render the hydrogen peroxide active to bleach the web.

11. The method of flash bleaching a pulp or paper web which comprises forming a web from previously bleached pulp or fiber, preparing a solution of hydrogen peroxide in which the concentration of the hydrogen peroxide is approximately a fraction of 1% H_2O_2, applying the solution thus prepared to at least one side of the web at such a rate per square foot of web that approximately 1% of 100 volume H_2O_2 will be applied based on the oven dried weight of the fibrous constituents of the web and thereafter subjecting the web to heat to render the hydrogen peroxide active to bleach the web.

12. In the manufacture of a web of pulp or paper in which the web is dried by being passed through a heat drier at a temperature of at least 140° F., the improvement which comprises preparing a solution of hydrogen peroxide in which the concentration of the hydrogen peroxide is approximately a fraction of 1% H_2O_2, and applying the solution thus prepared to at least one side of the web at such a rate per square foot of web that approximately 1% of 100 volume H_2O_2 will be applied based on the oven dried weight of the fibrous constituents of the web, the solution being applied at a point in advance of the dry end of the drier whereby the heat of at least a portion of the drier is utilized to render the hydrogen peroxide active to bleach the web.