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BLEACHING OF GROUNDWOOD

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Fig. 1.

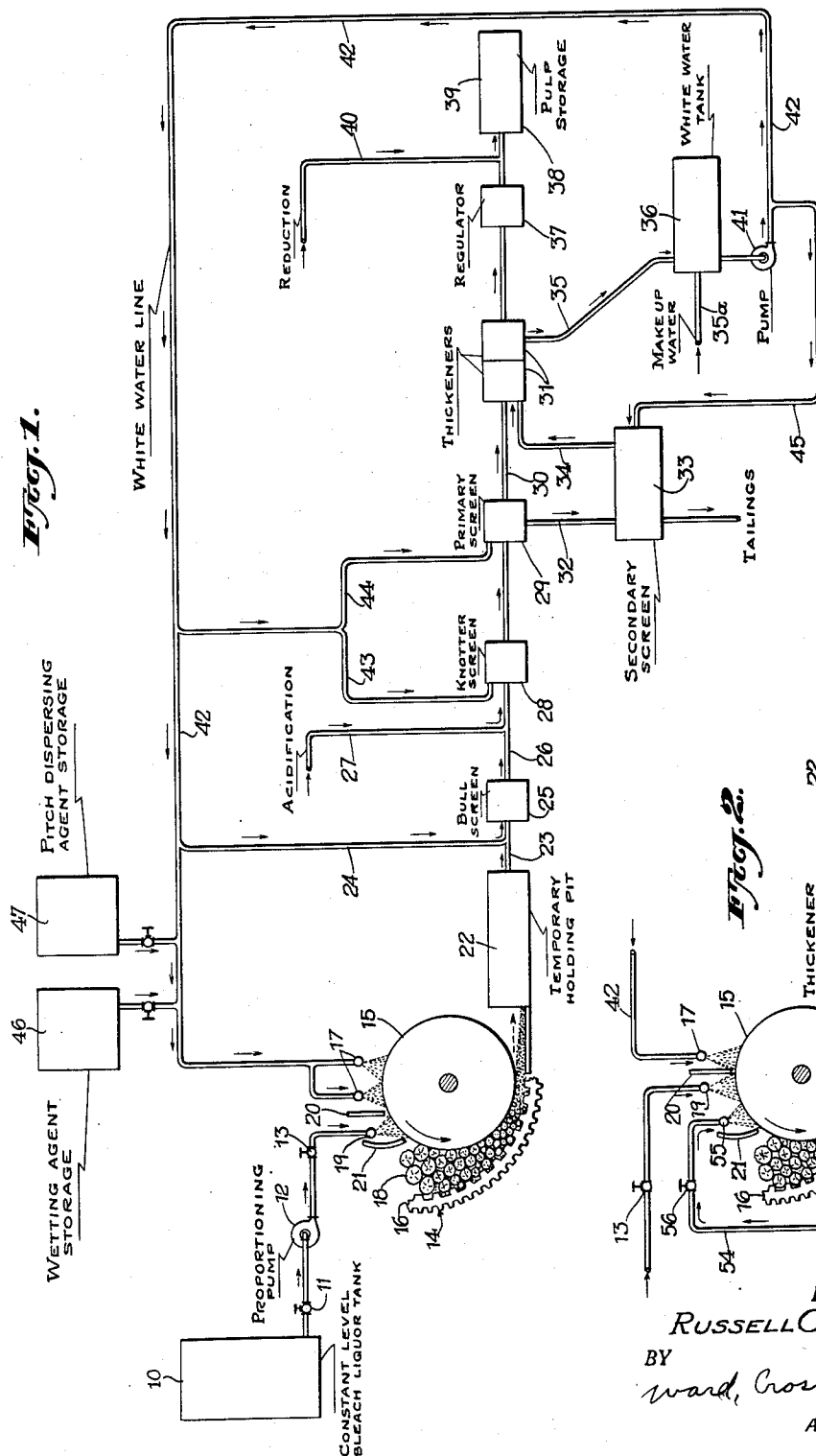
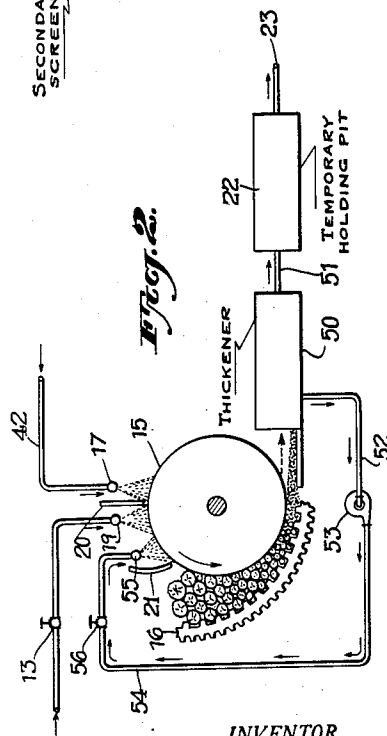


Fig. 2.



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BLEACHING OF GROUNDWOOD

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9 Claims. (Cl. 8—104)

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This invention relates to methods for bleaching and otherwise treating groundwood such as used for the manufacture of paper, paperboard and the like.

Heretofore in the manufacture of groundwood pulp, the general practice has been to take the pulp from the grindstones and after various diluting, screening and thickening steps, to pass the same into a pulp storage tank. From this tank, the pulp is either used in an unbleached state or passed through mixing apparatus for introducing bleach liquid, and then into bleaching tanks. Each batch of the pulp mixed with the bleaching liquor is required to stand in a bleaching tank for a period, for example of 6 to 8 hours, depending upon the temperature, which may usually range between 60 and 90° F., but in some cases possibly running as high as 110° F., although such a higher temperature is difficult to maintain with efficiency. While this bleaching process may be carried on more rapidly at elevated temperatures, it has heretofore been considered impractical or impossible to utilize a temperature above about 110° F., or 120° F. as an absolute maximum, because of the fact that the bleach liquors used for groundwood, such as peroxides, begin to break down at such temperatures and release oxygen gas. In addition to the undesirable time and temperature conditions, this method of bleaching groundwood also involves other serious disadvantages. For example, in a plant of any substantial size, very large capacity bleaching tanks are necessary, involving capital expenditures of many thousands of dollars. Furthermore, the pulp and bleaching liquor as stored in the tanks, tend to stratify, thus interfering with uniform bleaching action and interfering with the pumping of the mixture from the tanks. Furthermore, it is difficult to construct the necessary large bleaching tanks so as to avoid channeling effects and stagnant corner zones where the bleaching action will not proceed uniformly.

With the above described bleaching method carried out, say, at a temperature of about 90° F., and using an amount of bleaching material which will not involve a prohibitive expense, it is generally possible to increase the brightness of the stock by some 6 to 10 points as measured for example by the General Electric photoelectric cell reflectance meter. That is, if the unbleached groundwood pulp is initially such that a "hand sheet" may be made therefrom with a brightness of 58 points for example, in typical cases after bleaching by the above method the resulting hand sheets would have at best a brightness of 64 to

68 points. If this degree of brightness could be substantially improved, without going to a prohibitive expense for bleaching material, the use of such groundwood pulp might be greatly extended in connection with the manufacture of paper with higher brightness requirements. However, in practice, with the above described method it often proves difficult to secure a brightness improvement of more than about 6 points and the results obtainable are uncertain and have varied within rather wide limits. I have discovered that one of the causes of such variations and the difficulty of improving the brightness by such batch bleaching tank processes, arise from the fact that the initially stored unbleached stock drops in temperature and also sours and becomes affected by bacterial action, resulting in inefficient use of the bleaching agent because of the low temperature, and also because of the presence of what may be called peroxide-consuming bacteria.

The present invention provides a method for minimizing or eliminating the above-mentioned difficulties and at the same time makes possible a greatly improved bleached groundwood pulp product, in that the increase of brightness during the bleaching may be made, for example, nearly twice as great as with the formerly known groundwood bleaching methods, with the same or lesser amounts of bleach, and the process is carried out in such manner that the product is softened and improved in texture and uniformity.

According to the present invention, the bleaching liquor is applied preferably at or closely adjacent the point where the grinding of the wood takes place. At this point the pulp is subjected to the highest temperature which it reaches at any point during the process of pulp production. Due to friction, the surface of the grindstone at the point of abrasion of the wood may reach temperatures in the neighborhood of or possibly substantially in excess of 235° F. I have found that application of the bleach liquor at this point of high temperature not only does not injure or detract from the effectiveness of the bleaching agent, but unexpectedly the bleaching action is very rapid and efficient, and to a considerable degree takes place substantially instantaneously. However, for best results the bleaching action is allowed to continue for a relatively short controlled period, as the pulp passes to and through various treatment steps prior to the pulp storage, as will be hereinafter further explained.

Groundwood pulp as it leaves the grindstones is inherently somewhat acid, for example, having

a pH of about 4.8 to 5.6 in most systems, such acidity being due to the presence of the tannins and lignin acids of the wood. According to the present invention in its preferred form, a bleaching liquor is used of such amount and character as will impart a considerable alkalinity to the pulp grindings, for example, a pH of from about 9.5 to 10.7. Consequently, the grinding takes place under high temperature alkaline conditions which result in a substantial softening effect on the pulp, somewhat of the nature of mercerization, thereby improving its texture and quality for paper-making purposes. The pulp thus treated by an alkaline bleach at high temperature also has the quality of affording a more rapid drainage rate on the paper-making wire, enabling the paper machine to be operated at a more rapid rate.

As the pulp leaves the grindstone under normal grinding conditions, it is substantially sterile due to the temperature generated at the grindstone. But as the pulp passes through the various classification devices and chests and also as it becomes diluted by the addition of recirculated white water, it generally becomes, according to the prior practice, more and more infected with slime-forming bacteria, with the result that as it arrives at the storage chest prior to the bleaching tanks, it is in a condition fairly conducive to souring and bacteria formation, which, as above brought out, tends to seriously and irregularly interfere with the proper bleaching action. However, with the present invention, since the bleaching liquor in the form of peroxide is introduced at the point of highest sterility, viz., at the point of grinding, and since peroxide has a strong bactericidal action, the pulp remains substantially sterile throughout the pulp classification and thickening process, and there is accordingly no opportunity for bacteria action to interfere with the desired uniform and efficient bleaching action. The invention also readily lends itself to an arrangement of white water recirculation piping such that a substantial proportion of the bleaching ingredients may be recirculated in the water brought back to the grinders, thereby recovering with a minimum of expense, a considerable amount of the active bleaching agent.

Various further and more specific objects, features and advantages of the invention will clearly appear from the detailed description given below taken in connection with the accompanying drawing which forms a part of this specification and illustrates by way of example preferred arrangements of apparatus for carrying out the invention. The invention consists in such novel methods and combinations of features and method steps, as may be shown and described in connection with the equipment herein disclosed.

In the drawing, Fig. 1 comprises a schematic diagram or flow sheet for one form of groundwood mill equipped to carry out the invention; and Fig. 2 is a schematic diagram of an alternative and presently preferred embodiment of the invention.

The bleaching liquor may be contained, for example, in a constant level bleach liquor tank as indicated at 10. The ingredients of the bleach liquor may be mixed or otherwise prepared in a separate tank and the liquor transferred to the tank 10. From this tank the liquor may pass out through a shut-off valve as at 11 and through a suitable device such as a proportioning pump 12 for insuring the maintenance at a constant rate of flow to an adjustable throttling valve as at 13.

A pulp grinder is schematically indicated at 14. As here indicated, this grinder may preferably be of a continuous type such as the well-known Roberts grinder having a grindstone as at 15, a feed ring of known construction, portions of which are indicated at 16, and white water shower pipes as at 17. The wood being ground is indicated at 18 lodged between the grindstone and the feed ring 16. It will be understood that the invention may be similarly used with other types of wood grinders such for example as the various well-known types of so-called pocket grinders, for instance the Great Northern type, or with other types of continuous grinders as may be exemplified by the Waterous Magazine and Kamyr types, or chain feed types.

As shown in the drawing, the bleach liquor may be conducted from the throttle valve to a spray pipe as at 19, extending along in spaced relation to an element of the surface of the grindstone, and provided with suitably spaced apertures for projecting jets of the bleach liquor onto the surface of the grindstone just prior to its contact with the wood. In order to confine the sprays of the bleach liquor to the surface of the grindstone, baffles may be provided as at 20, 21 just preceding and succeeding the position of the spray pipe 19. With this arrangement it will be apparent that the bleach liquor is made available along with the white water at the point or points of abrasion of the wood, with the result that the bleaching and softening action on the pulp takes place at substantially the maximum temperature reached at the surface of the grindstone.

If so-called pocket types of grinders are used, provision is preferably made for shutting off the bleach liquor spray during intervals when the grinder pockets are being refilled with wood.

From the grindstone the groundwood may be allowed to flow into the usual grindstone pit structures, the construction of which may depend upon the type of grinder used. The pulp may then, for example, flow into a temporary holding pit as at 22, into which pulp from other grinders may also flow. This pit should be of such proportions or length as to afford any further necessary element of time substantially to complete the bleaching efficiently.

From this holding pit the pulp may flow through a conduit 23 into which diluting white water may be introduced as through pipe 24. The diluted pulp may then be passed through a so-called bull screen as at 25 for removing coarse chips and thence out through a conduit 26.

With the particular arrangement of apparatus shown, up to this point the bleaching action has taken place under alkaline conditions, and up to this point the metal parts of the apparatus and conduits through which the mixture passes may be readily formed of iron and thus will not be attacked by the alkaline solution. Since the screening and thickening apparatus subsequent to this point in most groundwood mills may involve parts of copper or other metals which would be attacked by an alkaline solution, it is desirable at this point to acidify the pulp and bleach mixture. For this purpose a suitable acid solution may be introduced as through conduit 27, of a character and amount sufficient to acidify the mixture, for example, to a pH of from 6.5 to 7, so that metal parts of the succeeding apparatus will not be attacked and yet the bleaching action, if desired, may continue.

The acidified mixture may now be caused to flow through a knotted screen as at 28 and thence

through the usual so-called primary screen as at 29, from which the accepted flow may pass through conduit 30 to suitable thickening apparatus as at 31. Rejects from the primary screen may be passed through conduit 32 to a so-called secondary screen as at 33 from which the accepted stock may pass through conduit 34 to the thickeners 31. White water from the thickeners may pass through conduit 35 to a white water tank as at 36, having a make-up fresh water inlet 35a. From the thickeners the stock may be passed through a so-called regulator as at 37 of any well-known form for controlling the consistency of the mixture. From the regulator the mixture may pass through a conduit as at 38 to a pulp storage tank as at 39. Just prior to its admission to the storage tank it may be treated to reduce any residue of bleaching agents therein, by the introduction of a suitable reducing agent through a conduit 40 connected into the conduit 38.

It will be understood that the pulp mixture may be allowed to flow by gravity between various of the above units of the apparatus and in some cases subjected to pumping as may be desired, depending upon the layout of the particular plant.

White water may be drawn from tank 36 as by a pump 41 and forced through a white water line as at 42, back to the above-mentioned white water sprays 17 at the grindstone. Branches from this white water line as at 24, 43 and 44 may be used to dilute the stock prior to the several screening steps. Another white water pipe as at 45 may extend from the pump 41 to the secondary screen 33.

In the event the screening and thickener apparatus is so constructed as to include no catalytic metals, for example if stainless steel is used in general instead of copper, bronze or brass, then the acidifying step may be omitted at 27 and the pulp mixture kept in an alkaline state until just prior to its passage into the pulp storage tank. In that event the acidification and reduction may both take place at 40. This possibility has advantages in that the white water which will then pass to the white water tank and back through white water line 42 to the grinders, will be alkaline and accordingly a somewhat smaller quantity of fresh chemicals is needed in the bleach liquor at the grindstone. That is, with this return of alkaline white water, the fresh bleached liquor introduced at the grinder is more efficiently augmented than would be the case with an acid white water return, since in the grinding and bleaching process an alkaline condition is desirable and a return of acid white water would require an increase in the alkaline chemicals sufficient to offset the returned acid.

Various advantages of the invention may be realized with the use of a variety of different kinds of bleach liquor applied to the grindstone. But as above indicated, an alkaline bleaching liquor is preferred, and particularly an alkaline peroxide mixture. An example of bleaching liquor, which is preferred at present and which has given highly satisfactory results with the arrangement of apparatus such as above described, comprises the following:

"Solozone" (a Du Pont sodium peroxide product)	2.0
Sulphuric acid, (66° Bé.)	1.6
Sodium silicate (41.5° Bé.)	7.5
Epsom salt	0.025

Per cent 70

The above percentage figures may be taken as denoting pounds of chemicals per 100 pounds of air-dry pulp. The above chemicals may be mixed with a suitable amount of water for convenient introduction through the grinder spray pipe 19. For example, to produce 1000 gallons of the bleaching liquor, about 950 gallons of water may be used.

In the above example of bleaching liquid, sulphuric acid (or other suitable acid) is used essentially to neutralize what would otherwise be an excessive alkalinity of the sodium peroxide. The sodium silicate in the mixture has the properties of a detergent and a penetrant, and also acts as a buffer to the bleaching solution and aids in maintaining the pH in the desired range. It also forms a protective coating on the surface of the metals of the apparatus, thereby inhibiting corrosion thereof. It further acts with a stabilizing action on the peroxide solution. The Epsom salt may be used in the mixture for the purpose of converting to a non-catalytic state the metallic elements found in the raw water used to make up the bleach solution. Tests thus far have indicated that the optimum pH of the pulp slurry, immediately after it is mixed with the bleaching solution, is from about 10.3 to 10.6, this pH being obtainable when pulp with a pH of about 4.8 is treated with the solution prepared in accordance with the above percentages.

Other bleaching agents which may be used comprise hydrogen peroxide, although this will ordinarily involve a greater expense for an equivalent quantity. In the above specified bleaching formula, the sodium silicate percentage may vary from about 5 to 10% or above, with good results, although about 7.5% is preferred for economy, even though slightly better results may be obtained with 10%. Silicates other than sodium silicate may of course be used providing suitable modifications are made in the proportions of the other chemicals in the bleaching solution.

In case the water in the white water return line is alkaline, it will be understood that the preferred percentages of the above-described bleaching formula should be modified to take into account the increased alkalinity which the white water contributes to the pulp slurry.

Temperature measurements made within one-quarter inch of the surface, inside of the stone of grinders used for producing groundwood, have indicated temperatures at that point in excess of 235° and as high as 250° F. Consequently, it is assumed that the temperature at the point of abrasion of the wood may in the usual case be somewhat higher than this value. In any event, the temperature is such that steam is given off and it is believed that at the point of abrasion superheated steam is present. It is apparent therefore that the temperature at the moment of the initial bleaching action, in accordance with this invention, will ordinarily be at least 212° F., or perhaps in most cases substantially higher, while subsequent temperatures in the grinder pit and the temporary holding pit may gradually decline, for example to about 160°-180° F. in the grinder pit to about 140° toward the outlet of the temporary holding pit. After passing through the bull screen, the temperature may for convenience in pumping be allowed to drop to 90° or below.

As above indicated, a greater part of the bleaching action takes place during the short time that the pulp slurry is in contact with the grindstone surface. However, for best results the bleaching

action should be allowed to continue, but for only a relatively short period as compared with the time heretofore required for bleaching by the batch tank method. The period during which the bleaching action is allowed to continue in the temporary holding pit 22 or equivalent structure, may for example be from 15 minutes to 2 hours. The time of travel of the pulp from this pit through the bull screen to the point of acidification as indicated on the drawing, will not ordinarily amount to more than about a minute. With the equipment as shown in the drawings, the acidification may be accomplished by introducing a solution of dilute sulphuric acid through the conduit 27. The amount and concentration of this dilute acid should be such as to overcome the alkalinity of the pulp slurry and establish therein as above stated, a pH of from about 6.6 to 7. On the other hand, if the acidification is effected subsequent to the thickeners, the amount of acid introduced should be sufficient to bring the pH of the pulp slurry down to a range of about 5.4 to 6, so that the pulp will not become yellow on standing, but will permanently retain a white color.

The pulp slurry ordinarily passes from the bull screen through the succeeding screening and thickening steps to the pulp storage tank, all within a matter of several minutes. The bleaching action is preferably terminated by the introduction of the reducing agent through the conduit 40 just prior to the pulp storage. This reducing agent may, for example, comprise a solution of calcium bisulphite, sodium sulphite, sodium metabisulphite, or any of the other common reducing compounds customarily used for reducing peroxide bleaching agents. The amount of the reducing agent used should preferably be just sufficient to reduce the residual peroxide present, leaving the pulp in a slightly acid condition.

At the various stages in the system shown on the drawing, the pulp may be maintained of a consistency comparable to the consistencies customarily maintained at corresponding points when the pulp is to be bleached by the older storage tank process. For example, as the pulp leaves the grinder, in case a Roberts type grinder is used, it may contain from $2\frac{1}{2}$ to 3% of fiber and is diluted successively through the screening operations to about 0.4% as it enters the primary screen. In the thickeners it may be thickened to about 12% and then somewhat diluted by the regulator for subsequent storage.

The degree of improvement of the brightness of the pulp obtainable with the invention will vary according to the proper timing and continuance of the bleaching action subsequent to the grinder and also vary depending upon whether or not the white water is returned in an acid or alkaline state. Various tests have been made of the invention, using the equipment as shown on the drawing and the above-described preferred bleaching liquor. In these tests a groundwood pulp was used which, when unbleached, gave a brightness of about 54.9 to 58.2. When pulp of this type was bleached according to the older batch tank methods, the improvement in brightness was within a range of about 6 to 10 points—and generally substantially less than 10 points (unless resort is had to the use of large amounts of bleach at prohibitive expense). On the other hand, by following the method of the present invention, using the same initial type of groundwood pulp, the brightness was improved as much as 14 points, consistent results as high or higher

than this being readily obtainable. This same pulp when acidified and reduced immediately upon leaving the grinder pit, showed a brightness improvement of over 10 points, thus showing that a greater part of the bleaching action takes place almost immediately at the grinder. Pulp from this same pulp sample, upon standing three hours, was then acidified and reduced, with a resultant brightness of 72.5, the initial or unbleached pulp having a brightness of 54.9.

In the drawing, tanks are shown at 46 and 47 with conduits respectively connected through suitable valves into the white water return line 42. These tanks may be used for introducing various reagents into the returned white water for acting upon the pulp in cooperation with the bleaching agent or independently thereof as described and claimed in application Ser. No. 586,808, filed April 5, 1945, of which this application comprises a continuation in part.

With the embodiment of the invention shown in Fig. 2, the pulp after receiving bleaching treatment at the grindstone 15, is preferably conducted for example, with a consistency of about $1\frac{1}{2}$ to 3% into a thickener 50 wherein the consistency of the pulp may be increased for example, to about 7–15% before it passes through a conduit 51 to the temporary holding pit 22. The white water removed from the pulp at the thickener 50 may be conducted as through conduit 52 to a pump 53, which causes this liquid to be recirculated back through conduit 54 to a spray outlet 55 at the grindstone and adjacent the spray 19 of initially introduced bleaching liquor. As in the case of the supply means for the original bleach liquor, suitable apparatus may be included if desired in the return line 54 to control the rate of flow.

It will be apparent that this recirculated white water will contain considerable incompletely exhausted bleaching material and because of this fact, one may operate this embodiment of the invention so as to increase the concentration of the bleaching liquor at the grindstone to give a further improvement of several points, in the brightness of the pulp product, or, alternatively, one may use for economy an original supply of bleaching liquor of lower concentration and still obtain results comparable to those hereinabove described. For example, one may use an original bleaching formula containing 1.2% of sodium peroxide instead of the 2.0% noted in the formula hereinabove given, and by making suitable corresponding adjustments in the necessary amounts of sodium silicate and sulphuric acid (the Epsom salt may remain the same), a brightness equivalent to that obtainable with the process hereinabove described may be obtained, with a saving of some 40% of the peroxide required.

Except for the features above referred to, it will be understood that the embodiment of Fig. 2 may be the same or similar to that of Fig. 1.

This alternative method of the recycling bleaching liquor from a point shortly after the pulp leaves the grindstone, has further important advantages. It will be apparent that a lower concentration of chemicals may be caused to flow with the pulp slurry as it passes through the knoter screens, primary screens, secondary screens, etc., thus subjecting these parts of the equipment to less corrosive action. Furthermore, the total alkalinity of the pulp slurry is somewhat decreased at the point of acidification, whether the acidification step is taken prior to certain of the screens or just prior to pulp stor-

age. Consequently, the amount of acid required for acidification is less. In cases where acidification is advisable prior to the knotters screens on account of the presence of metals in certain units of the system which may be attacked by alkaline solutions, it will be apparent that this shorter recycling method enables the return of a greater portion of the white water to the grindstone in an alkaline state, thus facilitating the maintenance of the desired substantially alkaline conditions at the point of "flash" bleaching.

While the invention has been described in detail with respect to particular preferred examples, it will be understood by those skilled in the art after understanding the invention, that various changes and further modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. Method for forming and bleaching ground-wood, which comprises abrading wood under conditions causing generation of substantial heat by friction at the point of abrasion, and applying substantially at such point a bleaching agent selected from the group consisting of alkaline solutions of hydrogen peroxide and solutions of alkali metal peroxides.

2. In the production and bleaching of ground-wood pulp, the method which comprises abrading the wood under conditions causing generation of substantial heat by friction at the point of abrasion, and applying a bleaching agent to the pulp before dilution for screening and while the pulp still retains the greater part of the heat absorbed thereby during the abrading action, said bleaching agent being selected from the group consisting of alkaline solutions of hydrogen peroxide, and solutions of alkali metal peroxides.

3. In the manufacture of groundwood, the method which comprises subjecting wood pulp grindings while still hot due to friction occurring during grinding thereof, to the action of an alkali metal peroxide bleaching solution containing alkali metal silicate as a buffer and stabilizer of the peroxide solution and also sufficient acid for controlling the pH of the pulp slurry within a range of about 9.5 to 10.7, then increasing the consistency of the slurry and returning removed white water containing unspent bleaching solution back into the hot grindings, allowing the thickened slurry to temporarily remain in the presence of residual bleaching solution, thereafter diluting, screening and further thickening the slurry, and returning white water recovered in the latter thickening step back to the hot grindings.

4. In the manufacture of bleached groundwood, the method which comprises subjecting wood pulp grindings while still retaining the greater part of the heat supplied thereto by the friction occurring during grinding thereof, to the action of an alkaline bleaching solution chosen from the group consisting of alkaline hydrogen peroxide solutions and alkali metal peroxide solutions, and such that the pH of the pulp slurry will be within a range of about 9.5 to 10.7, and thereafter increasing the consistency of the slurry and returning removed white water containing unspent bleaching solution back into the hot grindings and allowing the thickened pulp slurry to tem-

porarily remain in the presence of residual bleaching solution.

5. In the manufacture of bleached ground-wood, the method which comprises subjecting wood pulp grindings while still hot due to friction occurring during grinding thereof, to the action of a bleaching solution chosen from the group consisting of alkaline hydrogen peroxide solutions and alkali metal peroxide solutions, then increasing the consistency of the pulp slurry and returning removed white water containing unspent bleaching solution back into the hot grindings, allowing the thickened slurry to temporarily remain in the presence of some of the residual solution, thereafter diluting, screening and further thickening the pulp slurry, and returning white water recovered from the latter thickening step back to the hot grindings, and acidifying the slurry after said thickening.

6. In the manufacture of bleached ground-wood, the method which comprises subjecting the pulp grindings while still retaining the greater part of the heat supplied thereto by the grinding friction, to the action of a sodium peroxide bleaching solution containing sufficient alkali metal silicate for controlling the pH of the pulp slurry above 9.

7. In the production and bleaching of ground-wood pulp, the method which comprises abrading logs of wood to directly form therefrom a finely divided fibrous pulp under conditions causing generation of substantial heat by friction at the point of abrasion, applying a bleaching agent to the pulp while the pulp still retains a large part of the heat acquired during the abrading action, said bleaching agent being chosen from the group consisting of alkaline hydrogen peroxide solutions and alkali metal peroxide solutions then increasing the consistency of the resulting slurry before same is substantially diluted for screening, and returning resulting removed white water containing unspent bleaching solution back into the hot grindings.

8. In the production of groundwood pulp, the method steps which comprise abrading wood under conditions causing sufficient generation of heat by friction to impart a substantially sterile condition to the pulp, subjecting the resulting pulp grindings while still substantially sterile and hot due to such friction to the action of a solution of sodium peroxide bleaching agent, thereafter diluting, screening and thickening the resulting pulp slurry, said bleaching solution being sufficient in amount to maintain the slurry in a substantially sterile condition free of slime-forming bacteria throughout such steps of diluting, screening and thickening, and thereafter neutralizing such bleaching agent in the slurry.

9. In the production of groundwood pulp, the method steps which comprise abrading wood under conditions causing substantial generation of heat by friction, subjecting the resulting pulp grindings while hot due to such friction to the action of a bleaching agent, said agent being chosen from the group consisting of alkaline hydrogen peroxide solutions and alkali metal peroxide solutions thereafter diluting, screening and thickening the resulting pulp slurry, and acidifying the slurry to substantially a neutral pH prior to the primary screening step.

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