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PROCESS OF BLEACHING PULP

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This invention relates to an improved process of bleaching chemical wood pulp and particularly kraft (or "sulfate") pulp, and to kraft pulps so bleached.

The difficulties of bleaching kraft pulp to a fine white color without serious loss of strength are well known, and investigators have, from time to time, proposed a variety of processes for solving this problem. The use of chlorites has, under certain circumstances, proved helpful for this purpose; however, their use has not always given consistent results, especially in the production of the highest quality of bleached or "super-bleached" kraft pulp.

One object of the present invention is to provide a process of bleaching wood pulp, particularly kraft pulp, whereby consistently to produce a very bright product without substantially impairing the strength characteristics of the pulp. Another object is to provide a process by which kraft pulp may be bleached to a higher brightness, without material strength loss, than by hitherto-known methods employing chlorites. A further inventive object is the provision of a super-bleached kraft pulp having a brightness of 80 or better and having substantially unimpaired strength characteristics.

It is the common experience of those engaged in the bleaching of kraft pulp that it is comparatively easy to obtain by multi-stage bleaching operations a bleached kraft pulp of good color and strength; but that to continue the bleaching and purifying process (either as a part of the same operations or in additional steps), whereby to obtain pulp of the highest quality in which the brightness of a so-called "super-bleached pulp" is combined with the substantially unimpaired strength characteristics of the semi-bleached kraft pulp, presents serious difficulties. Specifically, it is comparatively easy to produce a kraft pulp having a brightness of 75 to 78 and with high mullen and tear values, whereas it is difficult to carry forward the bleaching to the production of a pulp having a brightness of 80 to 84 without seriously damaging the strength of the product. It is precisely this brighter material which is in considerable demand for the manufacture of the better grades of printing, bond, ledger, and like papers.

In the manufacture of bleached kraft pulp, the wood (commonly pine) is digested, under pressure, with a solution containing sodium sulfide and sodium hydroxide, then washed and subjected to a more or less elaborate bleaching process. The bleaching process commonly consists of alternate chlorine, or hypochlorite, and caustic alkali treatments with or without intermediate washings. Sometimes a final treatment with sodium chlorite is given. As many as six to ten or more separate steps may be involved in the process. Finally, the fully bleached pulp is either pumped in slush form to an adjacent paper mill or it is dried and shipped in dry sheets, rolls or bales to the paper mill for use directly in the manufacture of paper.

We have discovered that if a pulp-drying step is interposed in the process just prior to the final chlorite treatment, the resulting pulp has greatly enhanced value. That is to say, the bleached or semi-bleached pulp, which has undergone a multi-stage bleaching operation with chlorine, caustic soda and hypochlorite in any suitable sequence, is dried, advantageously, by mechanically removing as much of the water as possible and then evaporating the remaining water to give a substantially dry pulp, and thereafter is resuspended and given a final chlorite treatment. Whereas in the absence of an interposed drying step chlorite-treated slush pulp may have a brightness of 75 to 78, the same pulp when dried preliminary to treatment with chlorite will have a brightness of 80 to 84 and will possess substantially the same strength properties as are possessed by the conventionally treated pulp.

The reason for this improved result is not known with any degree of certainty. It has been suggested that kraft (and soda) cooking liquors, unlike sulfite liquors, are selective in their action on the ligneous portions of the wood, in that they very rapidly remove intercellular lignin but do not attack the cell wall lignin to any great extent until the intercellular lignin has been nearly completely removed. It may be that in the drying of the bleached or semi-bleached pulp there occurs a surface concentration of the non-celluosic materials through evaporation, making these constituents more accessible to the bleaching chemical. Or, the heat or dehydrating effects present in the drying operation may, in some way not at present clearly understood, render the non-cellulosic materials specifically more reactive to the chlorite. Regardless of the scientific explanation of the phenomenon, the improved process of the present invention does provide a simple procedure for the attainment of that degree of super-bleaching and strength which is so sought for.

In carrying out the process it is not necessary that the bleached or semi-bleached pulp be completely dried in the drying step. Satisfactory results may be obtained when the drying is so carried out as to leave as much as fifty per cent moisture in the pulp; however, we prefer to dry to such an extent as to give a pulp which is from seventy to one hundred per cent air dry (i. e., sixty-three to ninety per cent bone dry).

The bleached, or semi-bleached, and dried pulp, in sheet, roll or shredded form, thereafter is fed into a vessel provided with means for disintegrating the material. A beater or pulping

engine is recommended for this purpose. The chlorite, which may be a chlorite of sodium, potassium, calcium, or other alkali metal or alkaline earth metal, may already be present in the water in the beater; or, it may be added in dry form, or as a solution, to the pulp before or after the latter is disintegrated.

The following examples will illustrate the process. Unbleached southern pine kraft pulp was washed free from spent digestion liquors and treated with chlorine water. The quantity of chlorine water used was equal to about 3.7% (available chlorine) by weight based on the dry weight of the pulp. The pulp was at a consistency of about 3.3%; the temperature of treatment was 90° F., and the treatment continued for 60 minutes. The pulp was then filtered and washed. It was next extracted with a solution of sodium hydroxide, in amount equal to 0.9% NaOH based on the dry weight of the pulp, for 35 minutes, at 78° F., at a pulp consistency of 10%. It was then filtered and washed, after which it was treated with calcium hypochlorite solution at 75° F., at a pulp consistency of 10%. The amount of hypochlorite used was equivalent to 0.5% available chlorine based on the dry weight of the pulp. Sodium hydroxide in the amount of 0.4% based on the pulp was added in this step.

The pulp resulting from these operations (hereinafter called "original" pulp) was then dried on a usual type of pulp drier to a moisture content equivalent to 80% air dry (i. e., 72% bone dry).

Thereafter two thousand three hundred and thirty-five pounds of the dried pulp was added to a breaker beater which contained water at 115° F. and 8.5 pounds of sodium chlorite (130% available chlorine). The consistency of the mixture in the beater was 5.0%. Two pounds of caustic soda was then added to give a pH of 8.9. An additional two pounds of caustic soda was added during the bleaching to maintain an alkaline condition. Shortly after the pulp had been furnished into the beater, a solution of calcium hypochlorite containing twelve pounds available chlorine was gradually added. After one and a half hours in the beater the pulp was dropped to a chest and recirculated for about two more hours and then washed. A comparison of the original pulp with the "final" pulp (i. e., the product resulting from the drying and the final treatment with chlorite) is given below:

Beating time, in minutes	Mullen		Tear	
	Original	Final	Original	Final
0	83	69	670	632
25	118	119	787	772
50	167	157	687	639
75	194	198	560	523
100	223	240	475	468
125	238	234	418	381

Brightness	
Original	Final
69.1	80.8

In another test, unbleached kraft pulp was bleached by a multistage bleaching process involving chlorine and hypochlorite and caustic soda treatments similar to that described in the preceding example. This "original" pulp had a brightness of 69.1. The pulp was then dried to a condition of 90% air dry (81% bone dry). Thereafter, twenty-six hundred pounds of the dried pulp was charged into a pulping engine which contained eight pounds of 85% sodium chlorite dissolved in sufficient water to give a consistency of 4.6% after the pulp had been added thereto. The temperature of the mix was raised to 160° F., and the pH was adjusted to 3.7 by the addition of sulfuric acid (36.5 pounds). After three hours the brightness of the pulp was 80.6. A comparison of the mullen and tear values of the pulp before and after the drying and the acid chlorite treatment is given in the following table:

Time, minutes	Mullen		Tear	
	Original	Final	Original	Final
0	62	66	648	638
25	104	102	866	867
50	145	140	695	659
75	159	171	545	540
100	187	191	468	482
125	204	210	384	385

Applying the same acid chlorite treatment to the pulp but omitting the step of drying the pulp before the acid chlorite treatment gave a pulp having a maximum brightness of 76.

It will be noted that in the chlorite superbleaching treatment in one instance, under alkaline conditions, calcium hypochlorite was added and in another instance the chlorite was employed at raised temperature with adjustment of the pH to acid conditions. The addition of the hypochlorite or the acidification of the chlorite solution serves to activate the chlorite.

We claim:

1. Process of bleaching kraft pulp, which comprises subjecting raw kraft pulp to a multi-stage bleaching operation, removing water from the resulting at least partially bleached pulp by mechanical means and by evaporation, to a condition of at least 70% air dry thereafter disintegrating the dried pulp in water, and bleaching it with a composition containing a chlorite and an activator therefor to a brightness of at least 80.

2. Process of bleaching kraft pulp, which comprises bleaching kraft pulp in a multi-stage bleaching operation, drying the bleached pulp to a condition of at least 70% air dry by a drying procedure involving evaporation of water therefrom by means of heat, thereafter disintegrating the dried pulp in water, and treating the resulting suspension of disintegrated pulp with a chlorite in an acid medium to bleach the pulp to a brightness of at least 80.

3. Process of bleaching kraft pulp, which comprises subjecting kraft pulp to a multi-stage bleaching operation, drying the bleached pulp to a condition of at least 70% air dry by a process including the evaporation of water from the pulp by means of heat, thereafter disintegrating the dried pulp in water, and further bleaching the pulp to a brightness of at least 80 by subjecting the same to treatment with a mixture of a chlorite and a hypochlorite in an alkaline medium.

4. Process of bleaching pine kraft pulp, which comprises subjecting raw pine kraft pulp to a multi-stage bleaching operation including treatment of the pulp with chlorine, caustic soda, and hypochlorite in separate stages, washing said

bleached pulp, drying the pulp to a condition of at least 70% air dry by evaporating water from the pulp by means of heat, and thereafter superbleaching the pulp to a brightness of from 80 to 85 without substantial loss in strength characteristics by disintegrating the pulp in water and treating the disintegrated pulp with a composition containing a chlorite and an activator therefor.

5. The process of claim 4, in which the superbleaching with a chlorite is carried out in an acid medium.

6. The process of claim 4, in which the superbleaching operation is carried out in an alkaline medium in the presence of a chlorite and a hypochlorite.

7. Process of superbleaching kraft pulp to a brightness in excess of 80 without substantially decreasing the mullen and tear values thereof, which comprises disintegrating in water bleached kraft pulp which has been heat dried to a condition of at least 70% air dry and subjecting the resulting pulp suspension to the action of a composition containing a chlorite and an activator therefor.

8. Process of superbleaching kraft pulp to a brightness in excess of 80 without substantially decreasing the mullen and tear values thereof, which comprises disintegrating in water a bleached kraft pulp which has been dried to at least 70% air dry condition by a procedure involving evaporation of water from the pulp by means of heat and treating the resulting pulp suspension with a chlorite while maintaining the suspension at a pH value below 7.

9. Process of superbleaching kraft pulp to a brightness in excess of 80 without substantially decreasing the mullen and tear values thereof, which comprises disintegrating in water bleached kraft pulp which has been dried by evaporating water from the pulp by means of heat to a condition of at least 70% air dry and subjecting the resulting pulp suspension to the conjoint action of a chlorite and of a hypochlorite while maintaining the suspension at a pH value in excess of 7.

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