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DEFIBERING PRESOAKED LIGNO-CELLULOSE

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1 Claim. (Cl. 92—6)

1

The present invention relates to the manufacture of pulp for paper products, such as corrugated board, chip board, and the like. The conventional method of producing pulp from wood chips and other ligno-cellulose materials is by means of a process where the raw material is introduced into a large digester containing the cooking liquor. The digester is closed and heated either by direct steam or by having the liquor circulated from the digester to a heat exchanger outside the digester. The usual cooking process requires several hours before an acceptable pulp is obtained. One conventional method calls for the use of caustic soda alone or in combination with sodium sulfides, the latter being known as the "Kraft Process." The main chemical reaction during this process is the dissolution of the lignin in the wood by the caustic liquor. The delignification process takes considerable time, but not because the solution of the lignin itself by caustic soda is a lengthy process but because the penetration of the chemical liquor into the chips is slow and requires a considerable time to complete. Particularly is this true where chips of large dimensions are used and the penetration into the interior of the chips may take as long as two hours, even at elevated temperatures.

The Asplund Process as described in U. S. Patents No. 2,145,851 and No. 2,008,892 involves a non-chemical method of producing fibers from wood chips by a steaming of the raw material in order to heat it to a temperature at which the middle lamella binding the fibers together is markedly softened before it arrives at the grinding elements. The grinding thereupon takes place at this elevated temperature and as the middle lamella has lost most of its binding quality, the result is that the fibers may be readily separated mechanically and with minimum change to the individual fibers. The Asplund Process has found wide usage where free pulp is desired, as, for example, in the roofing-flooring and insulating and hardboard industries. For the purpose of making paper where high pliability and strength are required, it is necessary to remove part of the lignin in order to obtain a pulp that can be refined to such an extent that these requirements are fulfilled. For the purpose of making such pulps in which part of the lignin has been removed, and utilizing the Asplund Process, efforts have been made to introduce the chemical liquor into the high steam pressure chamber and cause the chemical reaction with the chips to take place at the same

2

time that the chips are introduced into the steam chamber. The time required to do this, however, has been up to a maximum of ten minutes. The pulp produced from the defibrator has been shown to possess certain strength qualities, making the pulp acceptable for certain paper products. Due to the comparatively short time in the preheater where the chemical solution is in contact with the chips, it is not possible for these chemical solutions to penetrate into the interior of the chips and react uniformly throughout the individual piece of chip. Moreover, as the chemical solution reaches the chips at the temperature prevailing in the steam atmosphere it is quickly heated to the same temperature by the steam and due to the elevated temperature the velocity of the reaction between the chemicals and the lignin of the wood will be extremely high. Therefore, most of the chemicals would be consumed on the outer part of the chips. The solution that penetrates into the interior of the chips, if any, would only be very weak. The chemical reaction in the inside of the chip, if reached by the chemical solution at all, is effective in a far less degree than at the outer surface. Therefore, the piece of chip arriving from the preheater to the grinding zone consists of a surface zone where the chemical solution has reacted with the lignin and transformed the same into water-soluble alkali lignin, while the interior zone is only to a minor degree affected or, in some cases, even entirely intact, only such chemical reaction having taken place as is caused by the heating of the wood.

It is obvious that if the chemicals can be equally distributed throughout the outer and inner portions of the wood a uniform delignification of the chips would be obtained, that is to say, if the chemicals are in an "in situ" position to the ligno-cellulose material. This cannot be accomplished in the short time that has been provided for during the arrangements tried out in combination with the "Asplund Defibrator." It is, therefore, necessary to extend this time to permit the complete penetration of the chemical solution. However, before the chemicals reach the interior of the wood the action of the high temperature has a certain destructive influence on the fiber produced unless the chemicals are present at the same time. This destructive influence of the elevated temperature seems to be connected with the breaking down or hydrolysis of the hemi-cellulose and also the cellulose in the wood and forming water soluble sugars from these wood constituents. As pro-

3

longed heating of the wood, moreover, causes the formation of acids, such as acetic and formic acids, of substantial quantities part of that portion of the alkali that does penetrate into the interior of the chip will be neutralized by these acids formed in this region. In this way the effect of the chemicals arriving in the interior of the wood will be still further reduced. The heating of an ordinary piece of chip takes from but thirty to forty seconds while the penetration of chemicals will take substantial time under the conditions in the defibrator preheater. It is well known that the chemical reaction between, for instance, caustic soda and the lignin in the wood is most rapid at temperatures of from 150° C. to 170° C., provided that the contact between the caustic soda solution and the lignin is complete, that is, the caustic soda solution is uniformly dispersed throughout the fibrillae of the ligno-cellulose materials.

My invention overcomes these difficulties by the introduction of chips which have been treated with chemicals prior to the introduction to the defibrator so that the chemical solution is evenly distributed throughout the chips. I accomplish this by having the chips soaked in the chemical solution prior to introduction to the defibrator. This can be done in many ways, one of which is to have the chips pass through a tank containing the chemical solution for a short time. The chips are carried from the tank to a bin where the chips are maintained at room temperature and the liquor picked up by the chips through the passage in the tank penetrates into the interior of the chips. The time required for this absorption into the chips takes substantial time, from four to twenty-four hours or even more. It is, however, obvious that the size of the raw material subjected to this soaking and absorption process determines to a large extent the time required to provide for complete penetration. The time for the soaking and absorption steps, according to my invention, is, therefore, regulated to accommodate the size of the raw material as well as the moisture content of the same. The chips can also be kept in a tank containing a chemical solution until the interior of the chips is completely penetrated by the solution, and then removed from the tank; or the chemical solution sprayed on the chips, say, on a conveyor belt. The chips can also be treated with a chemical solution while stored in a bin. In this case the solution of the chemical is sprayed upon the chips and the solution travels through the bin wetting the chips during its passage and is gradually absorbed into the interior of the chips. It is also possible to carry out the absorption process in several steps, that is, to first apply a certain amount of the chemical solution and keep the material in a bin for some time during which the solution is absorbed to some extent into the chips, and to then follow with another soaking step and another absorption period.

By providing the chips with such an extended period of absorption, the chemicals will be present throughout the piece of wood, and as the raw material is introduced into the defibrator the chemical reaction between the chemicals and the lignin will increase in velocity as the temperature of the raw material is raised. As the temperature at the surface of the material is raised to the steam temperature practically instantaneously due to the condensation of steam, the surface reaction is increased in velocity at a very high rate immediately. The temperature of the interior of the raw material increases rapidly, due to heat

4

conduction, and the chemical reaction velocity likewise goes up with the temperature increase.

I also accomplish another advantage inasmuch as the storage in the bin where the absorption of the surface liquor is being carried out also provides a certain delignification, although very slow, at the regular room temperature. As the raw material in its presoaked form is brought to the defibrator feed arrangement—whether a plunger or screw feed—a certain amount of liquid would be squeezed out if the total amount of liquid carried by the chips is in excess of what can be squeezed out by these mechanical means. The squeezed out liquor will carry with it a certain amount of such parts of the wood as have been dissolved by the chemicals during the absorption period.

In the Asplund defibrator the temperatures used range from 150° C. to 170° C. Immediately upon introduction into the preheater the rising temperature of the wood will cause an immediate increase in the delignification process which not only acts upon the surface of the chips but throughout the entire piece of the wood chip and to the same extent that the temperature of the wood is raised. As this chemical reaction makes rapid progress I can carry out an adequate delignification in the preheaters of the "Asplund Defibrator," as described in U. S. Patents No. 2,145,851 and No. 2,008,892 as well as described in the literature covering the "Asplund Defibrator." No changes in the design and volume of the preheater are required for a production of pulp of the same quantity as for non-chemical pulping. The pulp that I obtain, according to my invention, is uniformly delignified and, therefore, has better characteristics than otherwise would be possible. By varying the soaking time, the strength of the liquor, as well as the temperature of the liquor, I can get various amounts of chemical in the chips, and by means of the steam process in the defibrator obtain a predetermined delignification of the wood fibers to such purposes as are required to suit the type of product to be made from the fiber obtained.

After the discharge of this pulp from the defibrator, I take the fiber through a washing system, which may be of a conventional design. This washing of the fiber with water will dissolve the alkali lignin, and the washed pulp can be refined and its strength increased to the extent that it can be used for paper products such as corrugating board.

Although I have referred to caustic soda in the above description of my invention, the chemical soaking can be carried out using other chemicals which can react with the constituents of the wood. Such chemicals are other alkalis, such as potassium hydroxide, calcium hydroxide, and others, as well as sulphides of sodium, potassium, calcium, and others. Furthermore, I can also use acids, such as sulphite, sulphuric and hydrochloric acids, and others, as well as salts, such as sodium sulphite, and other salt or combination of salts or acids or alkalis having the effect of dissolving such constituents of the wood that can render the produced pulp suitable for paper-making purposes.

I can also carry out the soaking in more than one step and use different types of chemical solutions in each step at varying temperatures, concentrations and soaking time to achieve the best results in quality of the pulp produced, as well as regulating the yield of such pulp made.

The size of wood chips used, or more generally

speaking, the size of the individual piece of raw material to be used, as well as the moisture content of the same, have to be considered to regulate the concentration of the chemicals to be used as well as the length of the soaking time to obtain the desired results.

Although I have referred to wood chips in explaining and describing my invention, it is understood that I can use all types of ligno-cellulose raw materials for the purpose of my invention. The raw material should preferably be chipped or cut up to facilitate the soaking and absorption of the chemicals, but it is understood that such material as straw and other materials of like kind do not require such a complete chipping into small size as is required for such material as wood.

What I claim is:

The improvement in the method of producing pulp from ligno-cellulose material which consists in soaking the ligno-cellulose material in chipped form in an aqueous solution of inorganic digesting reagents, maintaining the material at substantially room temperature for approximately 4 to 28 hours and sufficient for the chemical to penetrate the interior of the chips without the employment of penetration-facilitating measures, thereafter introducing the chips into a steam atmosphere having a temperature of approximately 150-170° C. and at which the middle lamella of the material is markedly softened, and substantially immediately defibrating the chips while in said atmosphere and at the last-mentioned temperature.

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