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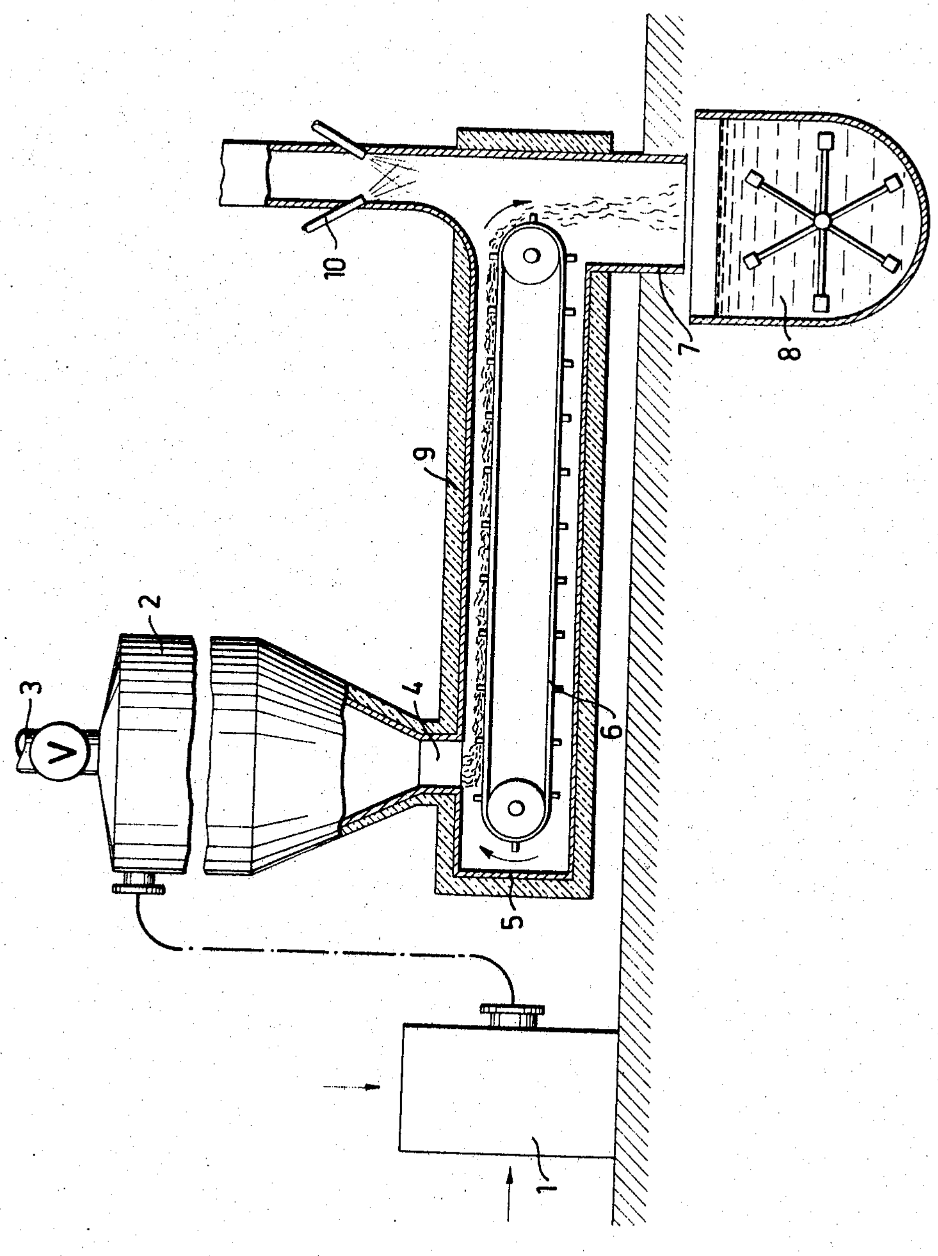

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METHOD OF IMPROVING THE DRAINAGE PROPERTIES OF HIGH BARK CONTENT WOOD PULP IN THE MAKING OF FIBERBOARD

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ABSTRACT OF THE DISCLOSURE

This invention provides a process for treating high bark-content pulp used in the manufacture of fiberboard from fibrous raw material to improve the drainage properties of the defibrated fibrous materials, by heat treating the defibrated fibers at a temperature of from about 60 to about 300° C. until the solids content of the fibrous material is within the range from about 30 to about 80 weight percent, and the drainage properties of the fibrous material after dilution with water for sheet formation are improved at least five defibrator seconds.

The present invention relates to a method of making fiberboard and other molded bodies from a bark-rich raw material and to an apparatus for carrying the method into practice.

For the manufacture of fiberboard by the conventional wet process, fibrous materials obtained by defibration of bark-containing wood chips are used to a large extent. In a known method, the raw material, sometimes after having been subjected to preheating by treatment with steam, is passed continuously through a grinding zone and is then sluiced or blown into a cyclone, where the relatively dry and hot stock is immediately precipitated by spraying with water. The defibrated raw material is usually subjected to screening and refining before it is sized and pumped to the sheet-forming machine. To obtain the desired strength properties, in particular for making semi-hard and porous board, a relatively extensive grinding or refining is required. This grinding results in lowered freeness, i.e. reduced drainage, which whether the manufacture relates to hard, semihard or porous board, is a great disadvantage on account of the concomitant lowered machine speed and the relatively low solids content after the sheet-forming machine. Even if the stocks used for making fiberboard are always considerably more easily dehydrated than the stocks used for making e.g. paper or paperboard, the drainage problem in the fiberboard manufacture is a very vital problem. This is related to the fact that the sheet weight of fiberboard is often more than 50 times that encountered when making paper. When a raw material which contains bark is to be used, the drainage problem is markedly increased. It was found that bark even in amounts of about 20 percent by weight result in such reduced drainage that it is impossible by good beating and low concentration in the sheet-formation to achieve optimum qualities of the final product as regards strength and surface smoothness at economically acceptable machine speeds, unless the sheet-forming machine is equipped with special means to increase the rate of water removal, e.g. extra suction boxes. At a bark content of about 30 to 40%, it can be considered definitely impossible to maintain normal machine speed, if the raw material has been subjected to good beating. In the latter case, there will be obtained in a freeness corresponding to about 50 defibrator seconds as compared to normally about 20 defibrator seconds at 10 to 15% bark content. "Defibrator seconds" refers to the draining capacity of the stock as measured in a freeness tester according to defibrator, in which a 10 liter sample of a stock suspension is allowed to run through a wire screen of special structure (see e.g. Pulp and Paper Manufacture, vol. 3, 1953, pages 606–609, "Manufacture and Testing of Paper and Board").

The present invention relates to a method of making fiberboard and other molded bodies from a raw material containing a high proportion of bark, in which the raw material, optionally after preheating in a preheater, is defibrated in a defibrating apparatus, to liberate the fibers, which method is free from the disadvantages referred to above. The method enables fiberboard to be manufactured from raw materials of up to 100% bark without essentially lowering the drainage capacity of the treated material and without reduction of the properties of the final product as regards strength and surface smoothness. The process comprises subjecting the fiber material obtained by defibration, prior to removal of water therefrom in a sheet-forming machine, at a solids content of at least 10% to a heat treatment at a temperature of 60 to 300° C. so that the solids content after said heat treatment is 30 to 80% and for a period of time such that the drainage properties of the treated fibrous material on dilution with water in a conventional way are considerably improved.

The fibrous raw material used for making fiberboard in accordance with this invention can be of either organic or inorganic origin and can be mixed with up to 100% bark. Suitable organic fibrous materials are lignocellulosic materials, such as, e.g. chips of various woods, such as pine, spruce, fir, birch or waste material from pulp manufacture or from sawmils, e.g. sawdust. Suitable inorganic fibrous materials which can be used in accordance with this invention, include e.g. asbestos.

The bark material used in this invention may be derived from bark of spruce, pine, fir, birch, aspen and other woods. The method is particularly advantageous in connection with spruce bark.

The amount of bark in the starting material will suitably be between 20 and 100% by weight. The invention is particularly advantageous for bark proportions exceeding 30% by weight and highly marked improvements as regards the drainage capacity of the treated raw materials are achieved when the proportion of bark exceeds 50% by weight.

The temperature at which the heat treatment in accordance with this invention is carried out, depends on the specific working conditions used in the fiberboard manufacture process and the desired properties of the final product and will usually be from about 60° C. to about 300° C. Preferably, the heat treatment will be carried out at a temperature of 70 to 250° C.

In most cases, temperatures within the range of 90 to 200° C. are to be preferred. The heat treatment can be carried out under normal pressure as well as elevated pressure. If the heat treatment is carried out under normal pressure, a temperature of 70 to 100° C. will suitably be used, and if the material is preheated prior to defibration, such preheating being generally achieved by heating with stream of 8 to 15 kg. per sq. cm. pressure, such a temperature is obtained in the material if it passed after defibration through a short conduit into a vessel communicating with the ambient atmosphere. If the heat treatment is carried out under elevated pressure, a temperature of 100 to 300° C. will generally be employed, and the device wherein the heat treatment is carried out will then be without continuous communication with the ambient atmosphere.

The period of time for carrying out the heat treatment shall be such that the drainage capacity of treated material, upon dilution with water in a conventional manner, is considerably improved. When high temperatures are employed, the minimum time in which the stock is to be heat treated to achieve a considerably improved drainage capacity, is shortened. If a temperature of 300° C. is used, a heat treatment period of at least 5 seconds is to be employed to achieve satisfactory results, while at 100° C. the corresponding minimum time is 60 seconds. At treatment temperatures of 70 and 100° C. which are preferably used for treatment at atmospheric pressure the heat treatment should be carried out for a time of at least 1 minute, preferably at least 3 minutes.

The heat treatment should, of course, not be carried out so that a considerable drying of the fibers results.

While it is possible to carry out the heat treatment with hot air as the heat transferring medium, steam is preferably used therefor. The defibrated bark-containing stock which is to be heat-treated according to this invention, usually has a solids content of 10 to 80%, preferably 35–50%, and if steam is used as the heat transfer medium, drying of the fibrous material in the heat treatment process is avoided. The procedure is often facilitated, however, if the solids content at the start of the heat treatment is considerably below 80% and may then be allowed to rise toward that level, but preferably not above 65%.

It is possible, if desired, to carry out the heat treatment in several steps, in which case treatments both at normal pressure and at elevated pressure and at varying temperatures are possible, the combination of temperature and time being always selected so as to result in the desired effect as regards the drainage properties of the stock. By such combination, it will be possible to obtain both a short treatment period, as is desirable from a practical point of view, and good possibilities of controlling the process.

At the end of the heat treatment, the solids content of treated fibrous material should be within the range of from 30 to 80%.

The process of this invention can be combined with a refining step, which can be carried out before or, if desired, after the heat treatment step without considerably reducing the improved d rainage properties of the fibrous material. However, since a refining treatment always results in some reduction of the drainage properties, it should preferably be made prior to the heat treament. It will, of course, also be possible to subject the material to a heat-treatment both before and after any refining step.

If the heat-treatment of this invention, especially for treating lignocellulosic fibrous materials having a relatively low proportion of bark therein, is carried out at a very high temperature and for a relatively long period of time, the treatment may result in some reduction of the strength properties of the final products, but on the other hand other advantages are gained, such as improved sheet formation and in some cases improved water-repellent properties of the final product. For products, where the strength properties are not of substantial importance, this may be of practical interest and may, per se, justify the utilization of the invention even for proportions of bark which with regard to drainage capacity might be acceptable even in conventional treatment.

The invention is illustrated by the following example which shows the application of the invention to the manufacture of hardboard. The invention is not limited to this example, however, but can be applied in all types of manufacture of fiberboard, plates and molded bodies from organic of inorganic fibrous materials containing a proportion of bark.

Example

Four raw material mixtures of lignocellulosic fibrous material containing from 0 to 100% by weight of spruce bark were defibrated in a defibrator after being preheated

with steam of 12 kg. per sq. cm. pressure and 190° C. temperature in two series of experiments.

In Series 1 the resulting fiber steam mixture which immediately after defibration had a temperature of 140° C. and a solids content of about 30%, was passed in the conventional manner through a conduit into a cyclone, into the top of which water was introduced at a temperature of about 60° C. to precipitate the steam and to dilute the stock. The residence time of the defibrated material in the conduit before the cyclone was about 1 second. After further dilution with water of about 40° C. to a solids content of 3% in a stock bin the stock was refined in a disc refiner. Thereupon, the refined stock was passed to a second stock bin, wherefrom it was further conveyed to the sheet-forming machine.

In Series 2, the mixture of fibers and steam leaving the defibrator was passed directly to a dry cyclone equipment in which the steam could leave from the top of the cyclone. The fibers were allowed to fall freely through the cyclone onto a conveyor belt arranged in a heat-insulated tunnel. At the end of the tunnel the material was dropped into a stock bin, wherein it was diluted to a solids content of about 5%. The residence time of the defibrated material during transport from the defibrator to the stock bin was about 50 minutes at a temperature of about 95° C. and at a solids content, prior to the dilution referred to, of about 50%. From the bin the material was passed to a disc refiner wherefrom the refined material passed to a second bin and then out to the sheet-forming machine.

In both series, hardboard was made in a conventional manner by hot pressing, heat hardening and conditioning. The dewatering properties of the fiber suspensions were determined prior to and after the refining step. The results are seen in the following table.

TABLE

Pretreatment of stock	Series 1				Series 2			
	Bark, percent							
	0	15	60	100	0	15	60	100
Freeness (drainage time), defibrator, seconds:								
Before refining	12	14	40	150	11	12	14	30
After refining	20	22	120	800	22	22	30	58
Properties of final hardboard bending strength:								
Kg. per sq. cm	500	450	380	240	400	425	420	300
Water absorption, percent	19	20	25	30	17	19	22	27

It is apparent from the above table, that the material treated in accordance with this invention shows a markedly improved drainage capacity as compared to the material treated in the conventional manner. As regards the strength properties, all of the products treated in accordance with this invention showed sufficiently good properties to satisfy the requirements of "U.S. Commercial Standard TS–5593A, Service Hardboard" and except for slightly too low strength at 100% bark, British Standard 1142:1961 for standard hardboard was also satisfied. Said standards require a bending strength of at least 210 and 380 kg. per sq. cm., respectively. In addition to the data set forth in the preceding table, it was found that the hardboard prepared according to this invention irrespective to the proportion of bark of the starting material had a considerably more smooth surface than that prepared by the conventional method.

In yet another series of experiments, Series 3, the heat treatment was carried out by a slightly modified procedure, using the raw material containing 60% spruce bark referred to above. In principle the same equipment was used as in Series 2, but in the lower portion of the cyclone referred to hot air of 300° C. was injected through upwardly directed slots, whereby the residence time in the cyclone was lengthened due to the retarded speed, so that even in this stage a relatively efficient heat treatment of the fibrous material was obtained thereby. The material was subjected for a time of about 10 seconds to a temperature of about 200° C., wherein on account of the short residence time the solids content was increased from about 35% to about 50%, only. In the same way as in Series 2, the fibrous material was then conveyed through a heat-insulated tunnel, and it was found that if the residence time therein was reduced to 60 seconds at 80 to 100° C., the same results as regards drainage capacity as well as board properties were obtained as in Series 2 (see Table 1, 60% bark).

In a further series of experiments (Series 4), attempts were made to reduce the heat treatment time further, using the same raw material mixture as in Series 3. After the fiber material was separated from steam in a cyclone in the same way as in Series 2, it was fed into a pressure vessel where it was heated with superheated steam at a pressure of 5 kg. per sq. cm. and a temperature of 250° C. After removal from the pressure vessel the solids content of the fibrous material was 50 to 60%. From the pressure vessel, the material was passed directly to a stock bin, where it was diluted with water to 5%, whereupon it was refined in a disc refiner and passed to the sheet-making machine. It was found that a heat-treatment time of about 15 seconds under these conditions gave the same result as regards drainage properties as were obtained in Series 3.

A suitable equipment for carrying the method of this invention into practice is shown diagrammatically on the accompanying drawings. The defibrating apparatus wherein the raw material is defibrated in a well-known manner in the presence of steam, is shown at **1**. The defibrated raw material is blown as a suspension in steam into a cyclone **2** which has an upper outlet **3** for release of steam, if needed, and a lower material outlet **4**. The fibrous material precipitated in the cyclone **2** drops through the outlet **4** into a conveyor casing **5** and onto a conveyor belt **6** arranged therein, said belt conveying the material towards the casing outlet **7** through which it falls down into a stock bin **8** where it is diluted to a suitable consistency to be fed to the sheet-forming machine. The speed of the conveyor **6** is controlled so that the material has a suitable residence time in the casing **5** to undergo the desired heat treatment. The casing **5** has a heat insulation **9** to limit the temperature reduction of the material during the conveyance. The steam liberated from the material can suitably be precipitated as liquid by injecting water through the nozzles **10**.

We claim:

1. In the method for making fiberboard and other molded fiber materials from a fibrous raw material containing at least 20% by weight of bark, which comprises defibrating the fibrous raw material to liberate the fibers, then adding water to dilute the fibrous material to a consistency desired for sheet formation in a sheet-forming machine, and forming a fiberboard sheet therefrom, the improvement which comprises heating, before addition of water, the defibrated fibrous material having a solids content of at least 10% at a temperature in the range from about 60 to about 300° C. until (1) the solids content of the fibrous material is increased, if necessary, to within the range from about 30 to 80 weight percent and (2) the drainage properties of the fibrous material, after dilution with water for sheet formation, are improved at least 5 defibrator seconds.

2. A method as in claim **1** in which the raw material is lignocellulosic and contains at least 30% by weight of bark.

3. A method as in claim **1** in which the bark material is conifer bark.

4. A mehod as in claim **1** in which the heat treatment is carried out at a temperature of 70 to 250° C.

5. A method as in claim **1** in which the heat treatment is carried out at normal pressure and a temperature of 70 to 100° C.

6. A method as in claim **1**, in which the heat treatment is carried out under elevated pressure and at a temperature of 100 to 300° C.

7. A method as in claim **1**, in which steam is used as the heating medium.

8. A method as in claim **1**, in which the material is refined before the heat treatment.

9. A method as in claim **1** iln which the bark material is pine bark.

10. A method as in claim **1** in which the fibrous material is refined after the heat treatment.

11. A method as in claim **1** including the step of preheating the fibrous raw material prior to defibration thereof.

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