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PROCESS FOR THE MANUFACTURE OF VEGETABLE FIBER PRODUCTS

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My invention relates to an improved process for the manufacture of vegetable fiber products of cellulose and lignin compacted or welded together under pressure accompanied by heat, and has for its object the treatment of the material in such a manner as to obtain a product of maximum rigidity and strength to resist flexure and other stresses, and to prevent or minimize any tendency which it may have to stick to the surface of the press platens or other molding surface.

The invention is in the nature of an improvement upon the process disclosed and broadly claimed in U. S. Patent No. 1,663,505, granted March 20, 1928.

The raw material used is one which contains lignin and cellulose, for example, wood chips obtained from saw mill waste, although other materials may be used provided they contain lignin in sufficient quantity to bind or weld the cellulose fibers together in compact relation when subjected to moisture, heat and pressure.

The raw material is first thoroughly disintegrated into fiber by any process in which at least the principal part of the lignin is retained, as, for example, the process disclosed and claimed in U. S. Patent No. 1,578,609, granted March 30, 1926, in accordance with which the fiber is obtained by subjecting the wood chips in a closed high pressure chamber to penetration by an elastic fluid such as steam at high pressure, and progressively discharging the same through a constricted outlet from said chamber while substantially maintaining the pressure in the pressure chamber, whereby the sudden expansion of the fluid is utilized for disintegrating the material.

The fiber thus obtained is recovered in a water bath and may be run through beaters or refiners if desired. Such fibers are of graduated fineness and well adapted to be felted together. The fiber pulp so obtained should preferably be sized with suitable material distributed substantially uniformly throughout to render the final product highly resistant to water and moisture. A suitable process for carrying out this step is disclosed and broadly claimed in U. S. Patent No. 1,784,993, granted Dec. 16, 1930, and consists briefly in subjecting the fiber to agitation in the water bath with melted petrolatum, paraffin or equivalent hydrocarbon at a temperature sufficiently high to prevent congealing of the hydrocarbon.

The pulp may be felted in any suitable apparatus, for example a machine of the Fourdrinier type by which a wet felted sheet, or "wet lap" is formed. In forming the wet lap sheet, it is important and highly desirable in order to obtain a product of maximum strength to resist flexure, that the fibers be well interlocked with each other in every direction. I have obtained such result by causing the pulp to be violently agitated just before it reaches the travelling screen of the Fourdrinier machine, so that at the very beginning of the formation of the sheet the fibers are in a very loose and widely separated condition. They settle with great rapidity and quickly build up on the screen a sheet several inches thick which may be reduced by loss of free water in the machine to a wet lap sheet having a thickness of about 1½ inches, for the production of a finished dried sheet having a thickness of ⅛ inch. Sheets of greater thickness may be produced by proportionately increasing the thickness of the wet lap.

The agitation should be as violent as possible, and of substantially uniform degree across the pulp stream, and the fibers should then be permitted to settle rapidly so as to interlock in every direction in the wet lap sheet, the voids between the longer or large pieces being filled by the finer ones, whereby "graining" or lines of weakness are avoided and great uniformity of density and strength of the finished product obtained.

The wet lap sheet having been thus formed is conveyed to a press in which it is subjected to high pressure, care being taken that the full pressure be applied to the wet lap sheet before the temperature of any part thereof rises above the temperature at which water vaporizes, viz., 212° F. at atmospheric pressure, and that full pressure be maintained until the sheet is dry. The tempera-

ture of the platens may be from 220° F. to 500° F., although somewhat higher temperatures may be employed if desired. The pressure to be employed may vary within wide limits. I have obtained very favorable results by using pressures ranging from 200 lbs. to 1000 lbs. or more per square inch.

In practice, for reasons of economy and efficiency, it is necessary to press a plurality of sheets simultaneously in a single press. A press for this purpose may include as many as twenty-one horizontal steam-heated platens for the pressing of twenty sheets. A vertically movable ram may be arranged below the platens for applying the pressure. The platens (except the uppermost one which may be stationary) are free to move in a vertical direction in order to permit the pressure of the ram to be simultaneously applied to each of the sheets. Such a press is shown in my application Serial No. 151,809, filed November 30, 1926, issued as Patent No. 1,767,539, of June 24, 1930. In using a press of this kind, the twenty wet lap sheets are inserted simultaneously between the platens which are independently supported and spaced by a stepped support. As the ram rises, the bottom platen picks up the various platens in succession and does not apply substantial pressure to the sheets until the upward movement of the twenty movable platens is resisted by the uppermost or fixed platen.

It is highly desirable that the platens be maintained in heated condition, even while finished sheets are being removed and fresh wet lap sheets are being introduced, since it would be very uneconomical both of time and steam to cool the platens, by a suitable cooling medium, such as water, whenever the pressing of one set of sheets has been completed, at which time the temperature of the platens may be from 220° F. to 500° F. or more. On the other hand, it is essential to avoid heating any portion of the wet lap sheets above 212° F. prior to the application thereto of pressure sufficient to cause a compacting and consolidating of the material as it dries.

I have been able to overcome or reconcile these difficulties by so regulating the quantity of water in the wet lap and the speed of closing of the press that the wet lap will not be dried out sufficiently to cause the temperature of the material in contact with the platens to be raised above 212° F. during the closing of the press.

This result may be accomplished even in a press in which the wet lap rests directly upon a heated platen by forming the wet lap with a considerable water content and by closing the press so rapidly as to apply the full pressure in less than 1½ minutes after the wet lap sheets have been placed on the platens, the time of such closing being preferably from ½ to 1 minute. In practice I have obtained satisfactory results by forming the wet lap with a water content of from 50% to 60% of the dry weight of the fiber, although as little as 30% or considerably more than 60% may be used.

When the press is operated in such manner, the wet lap sheets will contain water which will be expressed in liquid form as the pressure reaches the material, which means that its temperature will not be above 212° F. but if the time is too greatly prolonged, or the original wet lap contains insufficient water, there will be no such expelling of free water which means that all expressible water has been converted into steam during the closing of the press and before full pressure has been applied, so that the temperature of the material will not be held at 212° F. but may be considerably higher, and the final product will be undesirably lacking in hardness and strength. Furthermore it will be more likely to stick to the platens.

It is possible to increase or prolong the time interval employed for the closing of the press while still avoiding the heating of the material above 212° F. before the application thereto of a pressure of 200 lbs. or more per square inch by providing the upper surfaces of the movable press platens with means for retarding the flow of heat therefrom, for example a layer of asbestos may be applied directly to the platen surface and a wire mesh screen above the asbestos. In addition to the provision of such means, the wet lap sheets may be placed upon steel surface plates outside of the press and conveyed thereby into the press, the surface plates resting upon the wire mesh screen and forming the pressing surface.

In order to prevent or minimize any tendency of the finished sheet to stick to the platen, I prefer to form such surface plate of steel or other metal of a thickness of about $\frac{3}{16}$" and provided on one or both surfaces with an electrodeposited coating of chromium, or the entire plate may be made of chromium or stainless steel. Such plate may be loosely inserted in the press, as described, with chromium side uppermost, the wet lap sheet resting thereon.

The use of a pressing surface of chromium, stainless steel, or the like is highly desirable for the hot pressing of a wet lap sheet made of felted fiber of lignin and cellulose such as wood exploded, as described, since a substantial portion of the wood sugar or caramelized products thereof, wood acids, and other water solubles of the original wood may be present which will increase the tendency of the wet lap to stick to the pressing surface.

Chromium is a particularly desirable material for the surfacing of the surface plate, since it provides a very smooth, dense and

hard surface, easy to clean and to maintain in such condition and not readily scratched or marred while being handled or cleaned. A steel plate with chromium surface is cheaper to manufacture than a solid chromium plate of equal thickness.

Between the upper surface of the wet lap sheet and the platen, I prefer to insert a wire mesh screen to permit escape of moisture from the wet lap sheet during the pressing operation. The use of such a screen is particularly desirable since it provides passages for the escape of water expressed from the material during the closing of the press, and prevents disruption of the edges of the wet lap sheet by streams of escaping water. In addition it permits escape of steam from the wet lap during the drying operation after the full pressure of the ram has been applied and all expressible water pressed out. Another advantage of the use of such screen is that it retards the flow of heat from the platen to the wet lap sheet during the closing of the press.

I claim:

1. In a process for the production of sheets of felted cellulose fiber united by lignin, forming a multiplicity of wet felted sheets of cellulose fiber containing a substantial proportion of lignin, placing them in a heated platen press which closes successively on different sheets, and closing said press at such speed that the sheet first closed upon does not become heated above 212° F. until after the press is fully closed.

2. A process of compacting a body of felted vegetable fiber which contains cellulose, lignin, water and water solubles, which consists in applying thereto a pressure of 200 lbs. or more per square inch by a pressing surface of material heated to a temperature of 220° F. or more and which does not corrode under the conditions of the process, said pressure being applied before the temperature of any part of the material is heated above 212° F.

3. A process of compacting a body of felted vegetable fiber which contains cellulose, lignin, water and water solubles, which consists in applying thereto a pressure of 200 lbs. or more per square inch by a pressing surface of chromium heated to a temperature of 220° F. or more, said pressure being applied before the temperature of any part of the material is heated above 212° F.

4. The process of compacting a body of felted fiber containing expressible water, cellulose and a substantial proportion of lignin which comprises the application thereto by press platens heated to at least 220° F. of pressure sufficient to compact and consolidate the material, for a time sufficient to compact, consolidate and dry the same, and in retarding the flow of heat from platen to material during the closing of the press sufficiently to prevent the development therein of a temperature substantially above 212° F. before the degree of pressure necessary for compacting and consolidating the material has been applied to the sheet.

5. In a process for the production of a sheet of compact ligno-cellulose material, forming a wet felted sheet of disintegrated fibers of such material, placing such preformed sheet upon a smooth metal surface plate, inserting such plate between the platens of a press, and pressing such sheet in contact with said surface plate.

6. A process of simultaneously compacting a series of sheets of felted fiber containing expressible water, cellulose and a substantial proportion of lignin, which consists in individually supporting said sheets upon superposed platens having a temperature of 220° F. or higher and applying a pressure of about 200 pounds per square inch or more to each of the superposed sheets before the platens have driven off from the sheets all water which is expressible at said pressure.

7. The process of simultaneously pressing and drying a number of bodies of felted fiber containing cellulose and a substantial proportion of lignin and of expressible water, which comprises heating platens to a temperature above that of boiling water, placing said bodies between such heated platens in a press, closing said press successively on different sheets, retarding the flow of heat from platen to body during the closing of the press to such an extent that upon the press being closed, liquid water is expressed from each such body, and completing the drying under pressure.

8. The process of claim 4 in which a surface plate separate from the platen is inserted between body and platen, and the body is pressed against such surface plate and the surface plate used to retard heat passage from platen to body.

9. A platen for hot press drying of fiber containing cellulose and lignin having a smooth surface of material containing a high proportion of chromium.

10. A platen for hot press drying of fiber containing cellulose and lignin having a smooth surface of chromium.

11. A face plate for a press platen for press drying of a body of exploded wood fiber, said press plate consisting principally of relatively soft sheet metal and having a smooth surface exposed to the fiber of hard dense chromium plated on the softer metal.

12. A process of compacting a body of fibrous vegetable material comprising cellulose, lignin, water and water solubles, which consists in applying a compacting pressure thereto by a surface which does not corrode under the conditions of the process and containing a high proportion of chromium and heated to a temperature of 220° F. or more,

said pressure being sufficient at the temperature employed to cause a coalescing or welding of the material and being applied before the temperature of any part of the material is heated above 212° F. and maintained until the material is substantially dry.

In testimony whereof, I have signed my name hereto.

WILLIAM H. MASON.