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PROCESS OF MAKING PANEL BOARD

No Drawing.

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This invention relates to the manufacture of a hard fibrous sheet material and has for its object to provide a process simple in operation and more efficient in results than those heretofore proposed.

Fibrous materials such as wood, cotton, sugar cane bagasse, corn stalks, straw, and other fibrous plant growths of which the major constituent is cellulose have been in the past more or less extensively utilized for making paper, cardboard, fiber boards of various kinds, and the like. These raw materials just mentioned have been utilized singly and in various combinations with various fillers, binders, and the like for the manufacture of various articles from the thinnest of tissue papers and the like through a full range of products to and including hard, dense, stone-like articles.

Among the various products which have been produced from fibrous materials there has been included particularly a relatively hard, dense, and homogeneous board-like article which has great strength and rigidity and which will be designated as hard panel board. In the past great difficulty has been experienced in the manufacture of hard panel board in that the process has been difficult to control, and in fact the condition and character of the product cannot be prophesied. The strength of the product varied considerably, spotting of various degrees was evident, and other variations occurred. The spotting has apparently been of several varieties, generally described as burned spots and as stains. Neither the cause of these spots nor the method of their prevention has heretofore been discovered.

It is a purpose of this invention to provide a method or process for the manufacture of hard panel board and the control thereof, whereby there may be produced hard panel board of a uniform character and superior strength. A particular object of the invention is the control of the process whereby hard panel board may be produced without, or at least with a minimum of burned, stained, or spotted areas. Other and further objects of the invention will be apparent

from consideration of the following specification.

The general procedure for the manufacture of hard panel board is simple, comprising subdivision of the material into relatively small elements, the formation of the subdivided matter into sheets, and the compacting of the sheets while having a relatively high moisture content, with simultaneous drying of the sheets to form the hard, dense, homogeneous product desired. The purely mechanical steps of this process may follow the same general procedure as in the past, that is, the fibrous matter is first broken down into fiber bundles and fibers by any desired methods. The fibrous material may suddenly be released from confinement under high steam pressure; it may be crushed, as by passage through rolls similar to sugar mill rollers; it may be produced by digestion and refining as with a swing hammer shredder; or it may be subdivided by any other desired means.

In this first stage of the process special treatment may or may not be necessary, dependent upon the manner in which this initial step is accomplished. In this step of the treatment, however, it is desirable that the material be maintained in an alkaline condition. If the fibrous material is separated by the explosion process, sufficient alkali should be provided as by soaking the material to provide an initial alkalinity of about pH 8.2. Likewise, if the material is separated by a digestion and mechanical refining, the digestion should be initiated at a pH of about pH 8.2 or thereabouts, and even should the separation be by crushing, it is advantageous to use sufficient alkali in the liquid in which the material is soaked and worked to provide an alkalinity of about pH 8.2 at the start of the mechanical operations.

In this step of the process just described the proper pH can be best maintained by employing a highly buffered solution, that is, one in which there is present a considerable amount of buffer salts of relatively strong alkaline bases in combination with relatively weak acids or acid radicals. Complete maintenance of the alkalinity can not, of course, 100

be had in all cases, but the use of a highly buffered alkali absorbs to a large extent such organic acids as develop during the reduction of the material.

By employing a solution highly buffered by calcium and/or magnesium salts such as their carbonates, or by other buffer salts, the various acids, which develop when the fibrous material in a moist state is subjected to heat, are controlled; that is, actual acidity is absorbed by the action of the buffer and does not develop fully as would be the case were there no buffer salts present. The acids developed are not well recognized, but it is known that they tend to weaken the fiber and destroy portions thereof and, further, they act to restrain hydration of the fiber. Through control of the normally developed acids accomplished by the use of a buffered solution, as described, the fiber is not injured, and some preliminary hydration of the fiber is accomplished. The action of the buffered digestion liquor, particularly when the buffer salt is a calcium compound such as carbonate of calcium, apparently is to precipitate some of the solubles extracted from the raw material. At the same time the coloring matter extracted from the material is precipitated, or possibly it is absorbed by the other precipitate, although so far it has not been possible to discover the true action. This color removing effect may be obtained also by precipitation with other calcium salts, such as calcium chloride.

After the step of formation of the stock, and prior to the next general step, that of sheeting the stock, a very important step of the process occurs. At this point the stock is thoroughly washed, and the thoroughness of this washing is of great importance in producing the superior product of the process. In the washing step of the process the dissolved, absorbed, or precipitated coloring matter, gums, resins, dirt, and the like are thoroughly washed out of the material. The more thorough this washing, apparently, the more superior the final product, which results from the fact that in the final step of the process these undesired coloring matters, etc., tend to be locally precipitated to form stains and spots in the final product. Whereas the washing has been described as taking place between the step of initial preparation and the refining, it is to be understood that the washing can be done either at that point or between the step of refining and the next succeeding step, that of the formation of the prepared material into a sheet.

The next step in the process comprises mechanical refining and hydration of the fibrous material in a beater, swing hammer shredder, jordan, rod mill, or other appropriate refining engine, and the only particular feature herein to be observed is that the main-

tenance of the material in an alkaline condition is preferable.

It is to be understood that, for the manufacture of the product herein considered, the raw material is prepared by digestion and/or mechanical treatment so as to provide an intermediate fiber which is in reality not fiber, as such, as ordinarily referred to in the paper art, but which comprises more particularly relatively long, slim fiber bundles, with which is admixed some fiber as such, which fiber should comprise less than 50% of the total. This fiber relation is not absolutely essential, except as it is of advantage in the final step of the manufacture in that only in this way can such final step be accomplished in a commercially reasonable time.

After the raw material has been reduced to sheeting stock, as above described, it is formed, in any desired manner, into a sheet or wet lap, which may, for instance, be formed from a dilute suspension on a roll machine of the Oliver filter type. This sheet is carried into a preliminary press, which may be of the ordinary press roll type, whereby its water content is reduced to about 50% to 60% of the total. Throughout the operation of sheeting it is advisable that the water employed for diluting the stock be maintained at a pH of about pH 8.2, in order that the wet lap produced by this step of the process will have a pH of about pH 8.2. If desired, the necessary alkalinity may be imparted to the wet lap subsequent to its formation; the results by either maintaining the alkalinity or adding alkali have the same effect. It must be noted here that, while an alkalinity of pH 8.2 or thereabouts has been directed, the material must be highly buffered at pH 8.2 so that such alkalinity will not be too greatly changed in the final step, and that even higher alkalinity up to about pH 12 is advantageous, pH 8.2 being near the lower limit.

The final and last step of the method is the actual formation of the substance comprising a hard, dense, homogeneous board which might well be designated as reconstituted wood in that such boards have many characteristics comparable to those of wood boards. In this last step the sheeted material is dried by subjection to high temperature with simultaneous application of high pressure. For the final step a hydraulic press may be conveniently employed. The press is provided with heated platens between pairs of which are placed the wet sheets of the fibrous material. The platens are planar or may be shaped to form the final desired articles. The wet sheets are preferably placed between the pairs of platens with a smooth, burnished pan on one face and a screen on the other face. The burnished plate produces on one side of the finished product a smooth, glossy surface, whereas on the other

side of the product these will be screen marks with no gloss. The screen or some equivalent, as a pierced plate, is necessary in order that steam generated during the drying may escape, and unless a very smooth, glossy surface is desired, it is advisable that screens be employed on both sides, since in this way the final step can be more quickly accomplished.

The wet sheet, after being placed between platens as described, is subjected to a temperature corresponding to between 30# to 80# steam pressure and is, at the same time, subjected to a pressure of from 300# to 700# per square inch as ordinarily satisfactory operating pressure. When the pressure is first applied, some water is initially squeezed out of the sheet, but the expressible water is quickly exhausted, and the fibrous material is then subjected to what might be termed a drying at high steam pressure. The water in the material is vaporized by the heat of the platens, and its escape from the body of the material is retarded by the mass of fiber intervening between its point of generation and its avenue of escape, around the strands of the screen, and consequently the fiber is high temperature steam cooked while drying. After a half hour more or less in the press, dependent on the thickness of the fiber lap, temperature of drying, pressure, etc., the substantially bone-dry finished board is formed and ready for removal from the press.

As previously stated, in the original fiber preparation or digestion the material is digested with water containing a relative high calcium and/or magnesium carbonate and/or chloride, which more or less precipitates the coloring matters of the fiber, and in the succeeding steps the precipitated coloring matter, together with dissolved gums, resins, dirt, and the like are washed out. Now, since the first steps of the fiber preparation only proceed as far as may be necessary in order to obtain the necessary amount of softening and separation of the fiber of the raw material into fiber bundles with an attendant amount of fiber as described, it generally occurs that all of the coloring matter, gums, resins, and the like, are not precipitated and extracted or washed out.

The residual coloring matter, gums, resins, and the like, remaining in the fiber, may be more or less dissolved in the water present in the wet sheet fed to the press in the final step of the process, or are probably dissolved on the initial application of heat and pressure in the press since, as stated, such sheet fed to the press has a water content of about 50%. In the final pressing operation the water in the sheet is, of course, heated by the hot platens, and this hot water dissolves from the fiber at least part of its residual coloring matter, gums, resins, and the like. The water

of the sheet under the conditions of pressing tends to collect or localize at any portion thereof which may be of less density, due to irregularity of formation, irregularity of the press plates or unequal pressure and, of course, matter which may be dissolved in the water is likewise collected or localized. When the board is finally dried out, these places, where the previously dissolved solids are now concentrated, produce spots having a color differing from that of the remainder of the board, thus producing seconds and even in some cases ruining the board, since the high content of solids at such points may cause local charring of the board.

By maintaining the sheet, fed to the press, in an alkaline condition and highly buffed, particularly with salts of calcium and magnesium, at an alkalinity of above pH 8.2, as has been described, any effect of acids formed in the final pressing and drying step which would tend to dissolve coloring matter and the like is absorbed by the buffer salts, and therefore there is no chance for these gums, resins, coloring matters, etc., to be concentrated at localized points to cause the undesirable spotting, staining, and the like. The use of the buffer salts of calcium and magnesium is particularly desirable, because the calcium and magnesium compounds formed appear best to maintain the coloring matters in a harmless condition through either their adsorption of such coloring matter or their tendency to cause precipitation thereof.

By carrying out the various steps of the process of manufacture as have been heretofore described, uniformly satisfactory, hard, dense, homogeneous, strong, and unblemished, reconstituted fiber boards may be made, which boards have a strength about 50% more than that of like boards made by approximate processes not embodying the particular invention described in this disclosure. The increased strength of the boards made by this process is partly attributed to the fact that since certain steps of the process, such as digestion and sheeting, are carried out under alkaline conditions, the material hydrated to a greater degree than would have been the case were such alkaline conditions not maintained.

The increased strength of the finished product appears to be brought about, not entirely due to the reasons just stated although they contribute, but the greater portion of this increase is due, apparently, to hydration of the fiber of the sheet while in the press subjected to the moisture, heat, and pressure and particularly to the condition of alkalinity, all as have been heretofore described. This hydration with heat, pressure, and moisture is in reality hydration due to action of high pressure steam. The moisture in the board is converted into steam by the heat of the platens, which steam, due to the high

pressure exerted by the platens and the limited escape thereof allowed along the wires of the screen, subjects the interior of the fiber mass to a treatment with high pressure steam which causes a considerable increased hydration of the fiber if alkaline.

Though the maintenance of pH 8.2 has been particularly described herein in the description of the preferred process, it is to be understood that this figure is to be considered as preferred only. A reasonable variation from the preferred pH is allowable and may be necessary due to specific conditions, and it is a fact that the invention is operative at least to a reasonable degree from a pH of just above pH 7.0 to a pH of about pH 10.0, or even pH 11.0, so long as the alkalinity does not rise sufficiently to injure the fiber.

It is obvious that those skilled in the art may vary the steps and combinations of steps constituting this method within the scope of this invention without departing from the spirit thereof, and therefore it is not desired to be limited to the foregoing disclosure except as may be demanded by the claims.

What is claimed is:—

1. The process of producing a hard, dense, homogeneous, and strong board-like material from wood, straw, sugar cane bagasse, and the like, comprising the steps of the separation of the raw material into fiber bundles and fibers with subsequent washing, sheeting, and compacting of the previously separated matter, the compacting accomplished by the application of high pressure to the sheeted material with simultaneous subsection of the interior of the sheet to high pressure steam, the step of compacting initiated, through the addition of a buffer salt, under highly buffered alkaline conditions.

2. The process of producing a hard, dense, homogeneous, and strong board-like material from wood, straw, sugar cane bagasse, and the like, comprising the steps of the separation of the raw material into fiber bundles and fibers with subsequent washing, sheeting, and compacting of the previously separated matter, the compacting accomplished by the application of high pressure to the sheeted material with simultaneous subsection of the interior of the sheet to high pressure steam, the step of compacting initiated, through the addition of a buffer salt, under highly buffered alkaline conditions at a pH of about that expressed by pH 8.2.

3. The process of producing a hard, dense, homogeneous, and strong board-like material from wood, straw, sugar cane bagasse, and the like, comprising the steps of the separation of the raw material into fiber bundles and fibers with subsequent washing, sheeting, and compacting of the previously separated matter, the compacting accomplished by the application of high pressure to the sheeted

material with simultaneous subsection of the interior of the sheet to high pressure steam, the step of compacting initiated, through the addition of a buffer salt, under highly buffered alkaline conditions at a pH of about that expressed by pH 8.2, the alkaline buffer salt being a calcium compound.

4. The process of producing a board, dense, homogeneous, and strong board-like material from wood, straw, sugar cane bagasse, and the like, comprising the steps of the separation of the raw material into fiber bundles and fibers with subsequent washing, sheeting, and compacting of the previously separated matter, the compacting accomplished by the application of high pressure to the sheeted material with simultaneous subsection of the interior of the sheet to high pressure steam, the step of compacting initiated, through the addition of a buffer salt, under highly buffered alkaline conditions at a pH of about that expressed by pH 8.2, the alkaline buffer salt being such that calcium chloride is present during the final compacting and drying of the sheet.

5. The process of producing a reconstituted wood-like material by subjecting fibrous plant material having a moisture content of about 50% to a high degree of compression with the simultaneous application of heat of approximately 300° F., the material when initially subjected to the heat and pressure being in a highly chemically buffered condition.

6. The process of producing a reconstituted wood-like material by subjecting fibrous plant material having a moisture content of about 50% to a high degree of compression with the simultaneous application of heat of approximately 300° F., the material when initially subjected to the heat and pressure being in a highly chemically buffered condition and having an alkalinity of about pH 8.2.

7. The process of producing a reconstituted wood-like material by subjecting fibrous plant material having a moisture content of about 50% to a high degree of compression with the simultaneous application of heat of approximately 300° F., the material when initially subjected to the heat and pressure being in a highly chemically buffered condition through prior addition of a buffer salt and having an alkalinity of about pH 8.2 the buffer salt being a calcium compound.

8. The process of producing a reconstituted wood-like material by subjecting fibrous plant material having a moisture content of about 50% to a high degree of compression with the simultaneous application of heat of approximately 300° F., the material when initially subjected to the heat and pressure being in a highly chemically buffered condition wherein calcium chloride is present during the pressing.

9. The process of producing a hard, dense, homogeneous, and strong reconstituted board-like material from ligneous raw materials, such as wood or plant growth, wherein the raw material is initially treated to soften it sufficiently for the succeeding steps, the raw material after the initial treatment separated into fiber bundles, refined and thoroughly washed, and then formed into a sheet having a moisture content of about 50%, the final step comprising compression of the wet sheet at a pressure of between 250# and 700# per square inch, with simultaneous application of heat of about 300° F., the sheet dried while subjected to such heat and pressure, the digestion and final compression carried on under alkaline conditions, initially highly buffered through the introduction of a buffer salt maintaining a pH of between 7.0 and pH 11.0.

10. The process of producing a hard, dense, homogeneous and strong, reconstituted board-like material from ligneous raw materials, such as wood or plant growth, wherein the raw material is initially treated to soften it sufficiently for the succeeding steps, the raw material after the initial treatment separated into fiber bundles, refined and thoroughly washed, and then formed into a sheet having a moisture content of about 50%, the final step comprising compression of the wet sheet at a pressure of between 250# and 700# per square inch, with simultaneous application of heat of about 300° F., the sheet dried while subjected to such heat and pressure, the digestion and final compression carried on under alkaline conditions, initially through the introduction of a buffer salt highly buffered, the alkalinity being expressed by a pH of about pH 8.2.

11. The process of producing a hard, dense, homogeneous and strong, reconstituted board-like material from raw material, such as wood or plant growth, wherein the raw material is initially prepared in the presence of an alkali and buffer salt, is subsequently refined into fiber bundles and thoroughly washed, then sheeted, and with substantially 50% water content is compressed under a pressure of from 250# to 700# per square inch, simultaneously being dried by the application of heat during the pressing and drying stage, there being present in the sheet an alkali and an alkaline buffer salt during said compression the pH maintained between pH 7.0 and pH 11.0.

12. The process of producing a hard, dense, homogeneous and strong, reconstituted board-like material, such as wood or plant growth, wherein the raw material is digested in an alkaline digestion liquor containing a buffer salt, an alkaline buffer salt, is subsequently refined into fiber bundles and thoroughly washed, then sheeted, and with substantially 50% water content is compressed

under a pressure of from 250# to 700# per square inch, simultaneously being dried by the application of heat during the pressing and drying stage, there being present in the sheet an alkaline buffer salt during said compression.

13. The process of producing a hard, dense, homogeneous and strong, reconstituted board-like material from raw material, such as wood or plant growth, wherein the raw material is initially prepared in the presence of an alkali and a buffer salt containing a calcium compound, is subsequently refined into fiber bundles and thoroughly washed, then sheeted, and with substantially 50% water content is compressed under a pressure of from 250# to 700# per square inch, simultaneously being dried by the application of heat during the pressing and drying stage, there being present in the sheet an alkali and a calcium buffer compound maintaining an alkalinity between pH 7.0 and pH 11.0 during said compression.

14. The process of producing a hard, dense, homogeneous, and strong board-like material from wood, straw, sugar cane bagasse, and the like, comprising the steps of the separation of the raw material into fiber bundles and fibers with subsequent sheeting and compacting of the previously separated matter, the compacting accomplished by the application of high pressure to the sheeted material with simultaneous subjection of the interior of the sheet to high pressure steam, the step of compacting of the sheet initiated under alkaline conditions at a pH of about that expressed by pH 8.0, the sheet dried to substantial bone dryness prior to the release of the pressure of compression.

15. A panel board comprising a dense, homogeneous, board-like material produced from bagasse which has been softened, separated into fiber bundles and sheeted; alkali and a buffer in the sheeted material at a pH of about pH 8.0, the elements of the sheeted material compacted and bonded through subjection internally to steam under pressure while the sheet is subjected to compression, the sheet subsequently while still subjected to the compression dried to substantial bone dryness.

In testimony whereof we affix our signatures.

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