June 16, 1953 W. L. SCOTT 2,642,359

PROCESS OF MAKING FIBERBOARD FROM GROUNDWOOD

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FIGURE 1

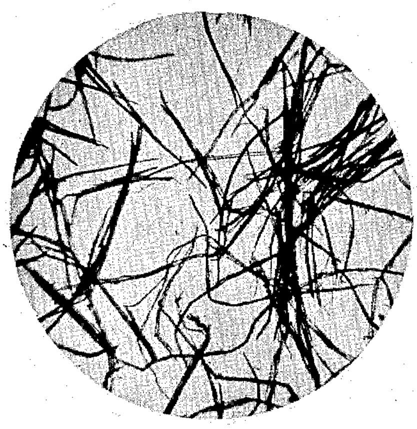

FIGURE 2

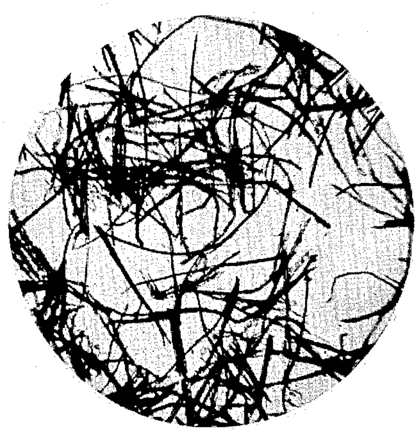

FIGURE 3

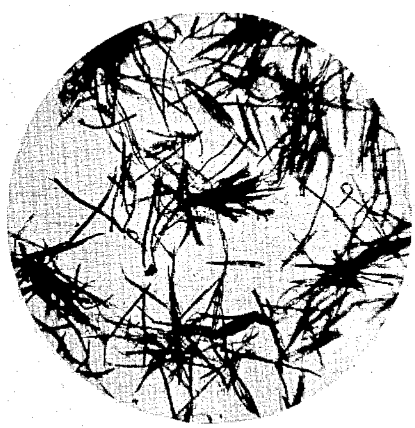

FIGURE 4

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PROCESS OF MAKING FIBERBOARD FROM GROUNDWOOD

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FIG. 5

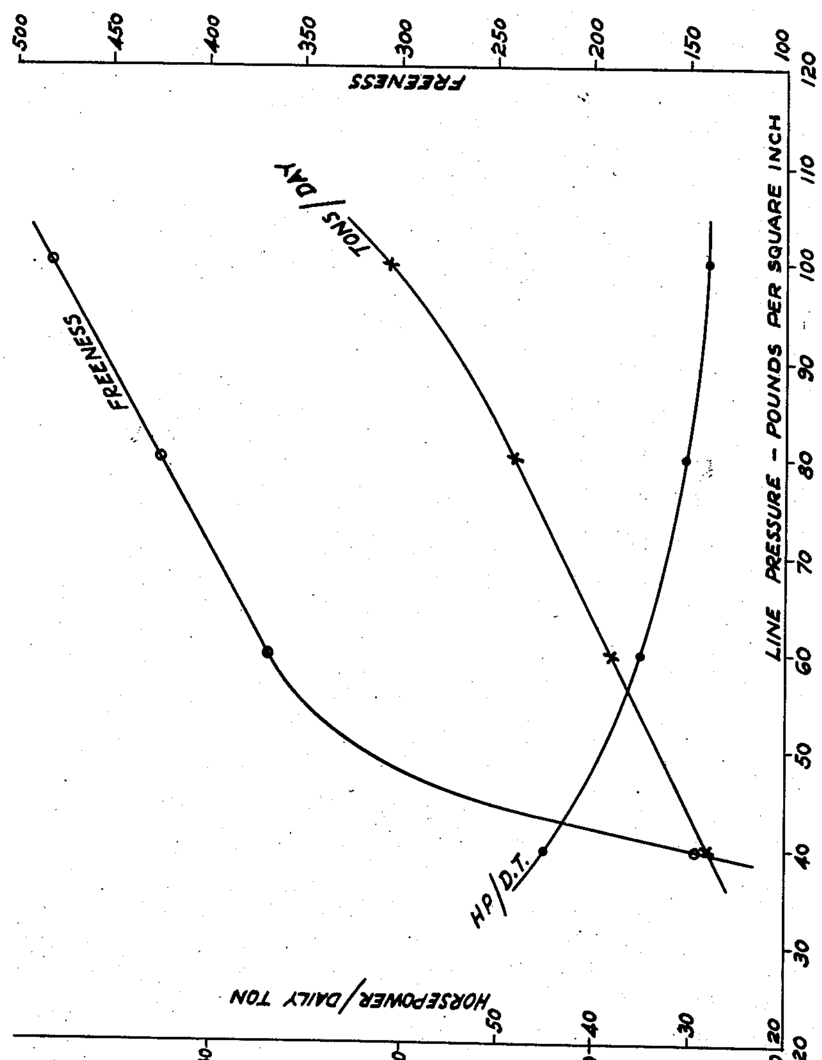
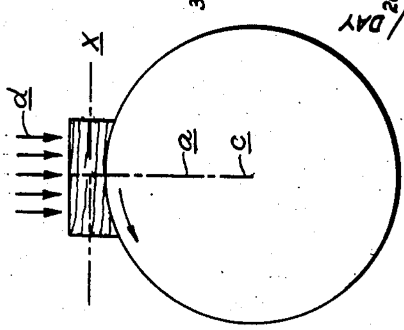


FIG. 6.



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PROCESS OF MAKING FIBERBOARD FROM GROUNDWOOD

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7 Claims. (Cl. 92—1)

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This invention relates to a process of making fiberboard. More particularly, the invention relates to a process of making fiberboard from ground wood.

Fiberboard is widely used in the building industry. It is sold customarily in sheet form, with the sheets four feet wide by four to sixteen feet or more in length and about one-half inch thick. Such material commonly is used like building board for partitions, walls, and the like. The product must be structurally strong in order to permit handling in thin sheets of such large size. The material is also fabricated into tile and panel pieces which are often shiplapped and beveled on the edges and may have beading and other ornamentation in imitation of wood paneling cut into the face. These products commonly are used in churches, restaurants, offices, homes, and elsewhere as an exposed surface structure, generally being coated with paint at the factory. This type of product must not only be structurally strong to permit handling and convenient erection, but it must also have a smooth surface capable of being painted and must also be capable of being routed and otherwise cut to provide the joints, beads, etc. Fiberboard also is used as a plaster base instead of wood lath. For such service, the fiberboard is cut into pieces about four feet long by eighteen inches wide, is provided with an interlocking joint along the longitudinal edges at least, and is beveled along the four edges adjacent the face of the board to provide a plaster-receiving groove which when filled serves to reinforce the structure against cracking at the edges where adjacent sheets abut. Here, the product must be open and porous to receive and hold plaster well and must possess good edge strength to avoid damage to the shiplap or other joint during shipment, handling, and erection. One of the most common uses of fiberboard is as an insulation for heat or sound or both. In sound insulation work, the board is cut into tilelike pieces which generally are drilled with a multiplicity of small closely-spaced openings which extend into the body of the board from the exposed face. This service requires a light-density, open, porous board to provide the necessary natural openings within the body of the board to permit sound waves to enter. The product also must have a surface which will receive paint well and which will be capable of being drilled without tearing out at the surface, to provide a clean-cut attractive appearance. Where the product is used for

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heat insulation, and low heat transmission is a characteristic of all of the products referred to above, it must be open and porous and of light density. There are also other miscellaneous uses for fiberboard in the building and other trades and industries.

Most insulation board manufacturers produce and distribute the whole line of products referred to above, but for obvious economic reasons, they must make all of the products from the same basic stock, necessitating that the required physical characteristics for each of the products be incorporated into the others. This has placed a heavy burden upon the manufacturers of fiberboards, and they have resorted to many different techniques and raw materials in order to attain the desired result, often compromising on the physical qualities of the board in their efforts to make a base stock which will be acceptable for the many different finished products.

Basically, it has been established that, in order to produce a board which will meet the minimum requirements for the various products listed above, the fiber furnish must include a combination of relatively long fibers and also short fibers or fines. The long fibers are necessary to impart structural strength and flexibility to the board, as well as give the required porosity for heat and sound insulation and plaster retention, and the short fibers or fines are essential in the binding of the long fibers together, the fines serving to weld the long fibers together at spaced points, producing a product having good structural strength. The long fibers also must be slender in order to provide a surface which is smooth and capable of being decorated and also must be of such nature that the product may be drilled, routed, and otherwise fabricated without leaving objectionable, unsightly, coarse fibers at the surface. The long slender fibers are also necessary to provide the requisite flexibility in the product to permit handling without breakage, particularly at the edges in shiplapped products, such as panels and tiles, plaster lath, and the like.

One of the most common expedients resorted to by fiberboard manufacturers in order to obtain the desired quantities of long fibers and fines in their furnish has been to form the long fibered portion of the stock by one method from a particular variety of wood or other fibrous material and form the short fibers and fines by a second process, using the same or another variety of fibrous raw material. For example, one large manufacturer of fiberboard employs bagasse fibers as the long fibered constituent of the furnish and uses ground pulpwood of the type used in paper manufacture for the fine, binder portion of the furnish. The two types of fibers are blended and a board produced therefrom.

It is an object of my invention to provide a method of making fiberboard utilizing ground wood possessing the requisite quantities of long slender fibers and fines to produce a fiberboard characterized by a good structural strength, low density, smooth surface, and machineability.

A further object of my invention is to provide a process of making fiberboard utilizing as the furnish wood fibers obtained from a single wood-grinding operation.

According to my process, I produce a fiberboard consisting essentially of matted fibers of wood by subjecting a bolt of wood to longitudinal grinding by pressing the bolt into engagement with the periphery of a rotating grinding surface with the direction of pressure application substantially parallel to a diameter of the grinding wheel which, if extended, would substantially bisect the bolt (within 20%) and would lie substantially normal to the longitudinal axis of the bolt (within 80° and 100°), or, stated in other words, a line drawn perpendicularly to the longitudinal axis of the wood will pass through the axis of the grinding wheel and substantially bisect the length of the bolt of wood and will lie substantially parallel to the direction of pressure application, thus to limit the angle effect between the wood and the grinding surface; and I grind in a single operation fiber including both a substantial portion of long fibers and a limited quantity of short binder fibers to form a furnish which, upon the removal of gross particles such as knots but while retaining substantially all of the ground material, will, upon laying and removal of water, produce a board having a low density and a high structural strength meeting the requirements set forth above for a fiberboard base product suitable for fabrication into the various products enumerated above.

The invention will be readily understood from a consideration of the following description of a preferred embodiment of the method with reference to the attached drawings in which:

Figures 1 to 4, inclusive, are reproductions of photomicrographs showing fibers of different classifications taken from a single grinding in the practice of the preferred method of this invention;

Figure 5 is a graph illustrating the results obtained by following certain conditions in the grinding step of my invention; and

Figure 6 is a diagrammatic view illustrating the disposition of a bolt of wood during grinding.

A product having the desired characteristics may be produced by utilizing bolts of loblolly pine approximately 21″ long and varying in diameter from about 3″ to 14″. The wood preferably is barked prior to grinding, and greenwood is preferred over deadwood. The grinding wheel or so-called "stone" may have a diameter of approximately 54″ and a width substantially greater than the diameter of the wood bolts to be ground. A wheel with a 34″ face may be used. A wheel such as an induced pore stone of 20 grit, cut with a coarse pattern, will give good results. The bolt is pressed into engagement with the periphery of the rotating grinding surface with the length of the bolt lying parallel to the direction of rotation

of the stone so as to effect longitudinal grinding. Pressure is applied to the bolt to bring it into engagement with the grinding surface under pressure. I have employed a line pressure of approximately 90 pounds per square inch on the ram which forces the bolt into engagement with the grinding surface. Such pressure provides a wood to stone contact pressure of about 45 pounds per square inch. The contact pressure may vary widely, but, in general, the contact pressure will be at least about 22½ pounds per square inch, preferably between about 22½ and about 50 pounds per square inch.

It is important to limit the angle effect between the bolt of wood being ground and the grinding surface, and, preferably, the bolt is pressed into engagement with the periphery of the rotating grinding surface with the direction of pressure application substantially parallel to a diameter of the grinding wheel which, if extended, would substantially bisect the bolt and would lie substantially normal to the longitudinal axis of the bolt. Since it is not possible economically to cut the bolts to a precise length, by substantial bisection I mean to include practice in which the extended diameter would pass within 20% of the actual center of the bolt. While the angle of attack between the bolt and the peripheral grinding surface should be such that the extended diameter will lie normal to the longitudinal axis of the bolt, satisfactory results will be achieved if this angle is 10° above or below normal, namely, between 80° to 100°. The log should be of a length less than the diameter of the grinding stone in order that the whole of the log may be ground progressively.

The grinding action has been illustrated diagrammatically in Figure 6 where the longitudinal axis of the wood blank has been indicated x and the axis of the grinding wheel has been indicated c. It will be observed that the direction of the grain of the bolt is substantially parallel to the longitudinal axis x of the wood and substantially normal to the axis of rotation c of the grinding wheel and that line a which is perpendicular to the line x, representing the longitudinal axis of the wood, and passes through the axis of rotation c of the grinding wheel substantially bisects the length of the bolt and lies substantially parallel to the direction of pressure application which has been indicated by the arrows d.

The grinding stone preferably is bathed by the application of sprays of water to the surface of the stone at spaced points along its path of rotation. For some types of woods, it may be advantageous to apply steam in the pit in which the wheel rotates or admix steam with the water showers, but for most types of wood, this is not necessary. It also may be advantageous in certain instances to pretreat the bolts of wood by soaking them in dilute caustic or other materials which tend to facilitate the grinding operation.

As the grinding operation proceeds, the wheel travels inwardly with the grain of the wood and then curves outwardly against the grain of the wood, and if the bolt is disposed in the center of the grinding pocket, the inward and outward grinding will each constitute about one-half of the total. This longitudinal grinding, when the angle effect is thus controlled, results in the production of a substantial quantity of long slender fibers and a limited quantity of short binder fibers. As the wheel travels against the grain, it produces fibers which are predominantly long, and a major portion of the fine fibers are produced as the wheel travels with the grain. Since the wheel is cutting both with and against the grain simultaneously, longs and fines are formed in a single grinding operation. The nature of the fibers depends to a considerable extent upon the type of wood employed, but proper quantities of the desired fibers in the required relationship of longs to fines can be secured with the woods commonly employed in fiberboard manufacture by controlling the angle effect, the pressure applied to the bolt, the grit of the grinding stone employed, the pattern on the stone, and the other factors which have been mentioned.

In the typical example referred to, a fiberboard furnish was produced containing about 70% of long slender fibers, 10 to 65 mesh (all screens referred to are standard Bauer-McNett classifier screens), and about 30% of fines, the ratio of fines to longs being approximately 1:2.3.

These fibers are shown in Figures 1 to 4 of the drawing, magnified to nine diameters. It will be observed from Figure 1, which shows a typical group of fibers retained on a 10-mesh screen, that the fibers are long and slender. It is the fibers which are retained on the 10-mesh screen which impart the strength-giving characteristics to the finished product, although all of the fibers between 10 and 65 mesh are considered as longs. Figure 2 shows typical fibers which were retained on the 20-mesh screen; Figure 3, the typical fibers retained on a 35-mesh screen; and Figure 4, typical fibers retained on a 65-mesh screen. It will be noted that in all of these instances, the fibers are relatively slender with respect to their length.

The fiber obtained in the typical example was found to have a freeness of about 475, utilizing a five-gram sample and conducting the freeness test in accordance with the standard Canadian system of freeness testing. For best operating results and in order to produce a board having the requisite physical qualities, the freeness preferably should be in the range between 300 and 500.

The fiberboard industry has followed generally the practices of the pulp industry with respect to grinding of wood, the pulp industry being infinitely older than the fiberboard industry. Common practice in the pulp industry is to grind wood across the grain, thus producing a short fibered furnish having a low freeness value. This type of stock is suitable for admixture with long fibered stock but will not alone produce a fiberboard having the desired physical characteristics. The fiberboard industry has attempted to obtain a long fibered stock utilizing a cross-grinding process with a coarse grit stone and a coarse pattern, but the result has been the formation of fibers which are relatively large in diameter with respect to their length and such a product is not desirable, for long slender fibers are required in order to provide the structural strength, flexibility, and smooth paint-receiving surface necessary for a general utility fiberboard base material. On the other hand, longitudinal grinding has been attempted by the paper industry, but its efforts, being directed toward the production of a fine fibered stock which will present a finished surface which will receive printing ink well, have been fruitless primarily because of the high horse power requirements and concomitantly high cost of longitudinally grinding a pulp suitable for paper manufacture. The process also

failed to produce a furnish acceptable for use in paper manufacture.

I have found that the horse power requirements may be maintained well within the limits of the conventional cross grinding used in the fiberboard industry if the wood to stone contact pressure, angle effect, and the grit and pattern of the stone are taken into proper consideration in the production of a furnish having a substantial portion of long slender fibers and a limited proportion of fines.

This is illustrated in the chart shown in Figure 5 where an induced pore stone of approximately 20 grit and of a coarse pattern was used in the longitudinal grinding of barked green loblolly pine, the wheel being 42″ in diameter and 20″ wide. It will be noted that the horse power per daily ton with a line pressure of 90 pounds was about 28, which is wholly comparable with the horse power per daily ton expended in cross grinding of loblolly pine. The line pressure was equivalent to approximately twice the wood to stone contact pressure. It will also be noted that output in tons per day rose with increases in line pressure, and that with a line pressure of 90 pounds per square inch, the tons per day produced were in the neighborhood of 15. Referring to the freeness curve, it will be noted that with line pressures as low as 50 pounds, it was possible to produce a furnish having a freeness of 300 or greater, and that with the line pressure at 90 pounds, a freeness of about 450 was obtained.

In the preferred example, the ratio of fines to long slender fibers was in the order of 1:2.3, considering the 10- to 65-mesh fibers, that is those greater than 65 mesh in size, as longs and those passing through the 65-mesh screen as fines. The ratio of fines to longs should, for best results, fall between 2:1 and 1:3 (at least $33^1/_3$% and not more than 75% of 10- to 65-mesh fibers) with a ratio of 1:2.3 (30% fines and 70% longs) being considered ideal. Since the fibers which are retained on the 10-mesh screen are the longest and impart desirable physical characteristics to the board, as mentioned above, it is preferred to have at least 7% of such fibers in the furnish. There should be some intermediate sized fibers, that is, those which will be retained on the 20-, 35-, and 65-mesh screens; and, thus, I prefer to have not more than 20% of 10-mesh fibers in the furnish, although more may be present for certain types of products. This depends to some extent upon the length of the fibers in this 10- to 65-mesh classification. I prefer to have at least 20% of such 10 mesh fibers longer than .3″. As previously mentioned, the long fibers should also be slender, and exceptionally good results are obtained when the long fibers have an average diameter less than .010″.

The fibers obtained by longitudinal grinding, as discussed above, are quite different in character from fibers obtained by the conventional cross-grinding practice followed by the fiberboard industry. This is particularly true of the length and diameter characteristics of the long fiber fraction which is obtained by practice in accordance with the present method. The following tables show typical fiber length and diameter measurements made on fibers produced in accordance with the preferred practice. In each instance, random specimens of fibers taken from the various classifications were placed on slides, and actual measurements were made microscopically.

Table A

[Based on fibers retained on 10-mes h screen.]

Fiber Length, Inches	Longitudinal Grinding, Percent
0–.05	0.4
.05–.10	3.3
.10–.15	22.7
.15–.20	20.2
.20–.25	15.7
.25–.30	13.2
.30–.35	7.4
.35–.40	3.7
.40–.45	2.9
.45–.50	2.5
.50–.55	1.3
.55–.60	1.7
.60–.65	1.3
Over .65	3.7

Number of fibers measured—242.

Table B

[Based on fibers retained on 20-mesh screen.]

Fiber Length, Inches	Longitudinal Grinding, Percent
0–.02	0.0
.02–.04	1.7
.04–.06	8.8
.06–.08	28.5
.08–.10	20.6
.10–.12	20.6
.12–.14	12.8
.14–.16	4.1
.16–.18	1.3
.18–.20	0.8
Over .20	0.8

Number of fibers measured—242.

Table C

[Based on fibers retained on 35-mesh screen.]

Fiber Length, Inches	Longitudinal Grinding, Percent
0–.01	0.0
.01–.02	0.0
.02–.03	3.0
.03–.04	11.0
.04–.05	22.0
.05–.06	22.0
.06–.07	19.0
.07–.08	15.0
.08–.09	3.0
.09–.10	4.0
Over .10	1.0

Number of fibers measured—100.

Table D

[Based on fibers retained on 65-mesh screen.]

Fiber Length, Inches	Longitudinal Grinding, Percent
0–.01	0.0
.01–.02	4.0
.02–.03	34.0
.03–.04	28.0
.04–.05	25.0
.05–.06	9.0
.06–.07	0.0

Number of fibers measured—100.

From the foregoing tables, it will be observed that by longitudinal grinding under the controlled conditions expressed, a substantially large long fiber fraction is produced. Table A, for example, shows that 24.5% by count of the fibers retained on a 10-mesh screen had an average length greater than 0.3″, and practically all of the fibers were longer than 0.10″. A substantial quantity were over ½″ long, and 3.7% were over 0.65″ long.

Not only is a furnish produced having a substantial quantity of long fibers, but the long fibers are slender. This is illustrated by the following tables which show the actual measured diameters of random specimens of fibers.

Table E

[Based on fibers retained on 10-mesh screen.]

Fiber Diameter, Inches	Longitudinal Grinding, Percent
0–.005	36.8
.005–.010	17.3
.010–.015	13.6
.015–.020	8.6
.020–.025	6.8
.025–.030	6.4
.030–.035	4.6
.035–.040	2.3
Over .040	3.6

Number of fibers measured—220.
Average diameter—.014″.

Table F

[Based on fibers retained on 20-mesh screen.]

Fiber Diameter, Inches	Longitudinal Grinding, Percent
0–.001	0.0
.001–.002	36.0
.002–.003	45.0
.003–.005	10.6
.005–.007	2.7
.007–.009	4.1
Over .009	1.6

Number of fibers measured—122.
Average diameter—.003″.

Table G

[Based on fibers retained on 35-mesh screen.]

Fiber Diameter, Inches	Longitudinal Grinding, Percent
0–.001	9.0
.001–.002	74.0
.002–.003	15.0
.003–.004	2.0
Over .004	0.0

Number of fibers measured—100.
Average diameter—.0017″.

Table H

[Based on fibers retained on 65-mesh screen.]

Fiber Diameter, Inches	Longitudinal Grinding, Percent
0–.001	18.0
.001–.002	73.0
.002–.003	9.0
.003–.004	0.0
Over .004	0.0

Number of fibers measured—165.
Average diameter—.0014″.

It will be noted from examination of Table E that over 50% by actual measurement of the 10-mesh fibers had a diameter less than .010″, and the average diameter was .014″. When it is considered that the 10-mesh fibers constitute substantially all of the fibers in the furnish over 0.3″ long, it will be clear that even the longest fibers in the furnish are extremely slender. All the shorter fibers have an even smaller average diameter, the average of all of the fibers in the 10- to 65-mesh classification being .005″. The long slender nature of all the fibers is visually indicated in Figures 1 to 4 where the fibers are illustrated at a magnification of nine diameters.

In the manufacture of fiberboard from the ground wood obtained in the manner described above, the fibers as delivered from the grinder are first sieved to remove gross particles, such as knots or the like, and following this, a second screening operation is effected to remove any shives and other coarse material. This is effected by passing the stock first over a ⅝" mesh screen and then over a ¼" mesh screen. Substantially all of the ground material is used in the furnish, the knots and other gross particles and shives constituting but a minor amount of the total ground wood. A water slurry is then formed of the desired consistency, and the furnish thus prepared is laid with the aid of a suitable machine, such as a Fourdrinier or cylinder machine, and water is removed. The board is then run through a drier and upon completion of such operation is ready for subsequent fabrication into insulating boards, acoustical tile, insulating lath, decorative panels, planks, or the like.

Boards manufactured from the furnish produced in accordance with the typical example had a tensile strength of 175 pounds per square inch and a density of 1.5 pounds per board foot. For most fiberboard uses, such density and tensile strength are satisfactory. Products having a density between .75 and 1.7 may be produced utilizing the present method. The tensile strength will, of course, vary with the density.

For certain products, it may be desirable to incorporate into the ground wood slurry a size, such as rosin or wax, which is customarily added to the slurry and then precipitated on the fibers by the use of alum. The quantity of size employed will generally be in the neighborhood of ½% to 1½% by weight of the weight of the board.

In the typical example, I have referred to the use of a 20-grit stone with a coarse pattern. Other stones may be employed. For best results, the stone should have an average grit not finer than 27, i. e., at least as coarse as 27, and, preferably, a 20- to 24-grit open structure grinding stone, cut with a coarse pattern, should be employed.

Loblolly pine is a particularly good wood for fiberboard manufacture and has been referred to in my preferred example. Other woods may be used singly or in combination, such as willow, cottonwood, aspen, longleaf pine, short-leaf pine, slash pine, jack pine, hemlock, fir, and the like. In many areas, wood available on the open market to fiberboard manufacturers includes a mixture of two or more of the above species.

While I have illustrated and described my invention with particular reference to a preferred embodiment thereof, it is to be understood that the same is not limited thereto and otherwise may be embodied and practiced within the scope of the following claims.

I claim:

1. In a process of making fiberboard consisting essentially of a mat of fibers of wood, the steps which comprise producing in a single grinding operation fibers of such coarseness that from 7% to 20% will be retained on a 10 mesh screen and the ratio of total short fiber to total long fiber greater than 65 mesh in size will be between 2 to 1 and 1 to 3 by subjecting pieces of wood to longitudinal grinding by pressing the wood against the curved peripheral grinding surface of a rotating grinding stone the diameter of which is greater than the length of the pieces of wood and the average grit of which is at least as coarse as 27, with the direction of the grain of the wood lying substantially normal to the axis of rotation of the grinding stone, and with a line drawn perpendicularly to the longitudinal axis of the wood and passing through the axis of the grinding stone substantially bisecting the length of the pieces of wood and lying substantially parallel to the direction of pressure application, said relationship being maintained substantially throughout the grinding operation, removing any gross particles such as knots but retaining substantially all of the ground material, and forming a fiberboard directly from an aqueous slurry the fiber fraction of which consists substantially wholly of the fibers so formed.

2. In a process of making fiberboard consisting essentially of a mat of fibers of wood, the steps which comprise producing in a single grinding operation fibers of such coarseness that from 7% to 20% will be retained on a 10 mesh screen and the ratio of total short fiber to total long fiber greater than 65 mesh in size will be between 2 to 1 and 1 to 3 by subjecting pieces of wood to longitudinal grinding by pressing the wood against the curved peripheral grinding surface of a rotating grinding stone the diameter of which is greater than the length of the pieces of wood and the average grit of which is at least as coarse as 27, with the direction of the grain of the wood lying substantially normal to the axis of rotation of the grinding stone, and with a line drawn perpendicularly to the longitudinal axis of the wood and passing through the axis of the grinding stone substantially bisecting the length of the pieces of wood and lying substantially parallel to the direction of pressure application, said relationship being maintained substantially throughout the grinding operation, removing any gross particles such as knots but retaining substantially all of the ground material, and forming a fiberboard having a density between about .75 and about 1.7 pounds per board foot directly from an aqueous slurry the fiber fraction of which consists substantially wholly of the fibers so formed.

3. In a process of making a fiberboard consisting essentially of a mat of fibers of wood, the steps which comprise producing in a single grinding operation fibers of such coarseness that from 7% to 20% will be retained on a 10 mesh screen, at least 20% by count of such 10 mesh fibers being longer than .3 inch, and the ratio of total short fiber to total long fiber greater than 65 mesh in size will be between 2 to 1 and 1 to 3 by subjecting pieces of wood to longitudinal grinding by pressing the wood against the curved peripheral grinding surface of a rotating grinding stone the diameter of which is greater than the length of the pieces of wood and the average grit of which is at least as coarse as 27, with the direction of the grain of the wood lying substantially normal to the axis of rotation of the grinding stone, and with a line drawn perpendicularly to the longitudinal axis of the wood and passing through the axis of the grinding stone substantially bisecting the length of the pieces of wood and lying substantially parallel to the direction of pressure application, said relationship being maintained substantially throughout the grinding operation, removing

any gross particles such as knots but retaining substantially all of the ground material, and forming a fiberboard directly from an aqueous slurry the fiber fraction of which consists substantially wholly of the fibers so formed.

4. In the process of claim 3 the modification wherein the fibers greater than 65 mesh in size have an average diameter less than .010 inch.

5. In the process of claim 1 the modification wherein the contact pressure between the wood and the grinding stone is at least 22½ pounds per square inch, and wherein the grinding stone has an average grit between about 20 and about 24.

6. In a process of making fiberboard consisting essentially of a mat of fibers of wood, the steps which comprise producing in a single grinding operation fibers of such coarseness that from 7% to 20% will be retained on a 10 mesh screen, the ratio of total short fiber to total long fiber greater than 65 mesh in size in the stock so formed will be between 2 to 1 and 1 to 3, and the stock will have a freeness between about 300 and about 500 as herein defined, by subjecting pieces of wood selected from the group consisting of loblolly pine, willow, cottonwood, aspen, long-leaf pine, short-leaf pine, slash pine, jack pine, hemlock and fir to longitudinal grinding by pressing the wood against the curved peripheral grinding surface of a rotating grinding stone the diameter of which is greater than the length of the pieces of wood and the average grit of which is at least as coarse as 27, the contact pressure between the wood and the grinding stone being between about 22½ pounds and about 50 pounds per square inch, with the direction of the grain of the wood lying substantially normal to the axis of rotation of the grinding stone, and with a line drawn perpendicularly to the longitudinal axis of the wood and passing through the axis of the grinding stone substantially bisecting the length of the pieces of wood and lying substantially parallel to the direction of pressure application, said relationship being maintained substantially throughout the grinding operation, thereby simultaneously to grind said pieces of wood in both an inward and outward direction with and against the grain of the wood, removing any gross particles such as knots but retaining substantially all of the ground material, and forming a fiberboard having a density between about .75 and 1.7 pounds per board foot directly from an aqueous slurry the fiber fraction of which consists substantially wholly of the fibers so formed.

7. A process of grinding wood for producing fibers for making fibrous products, the steps comprising pressing the wood against the curved peripheral grinding surface of a rotating grinding stone, the diameter of which is greater than the length of the pieces of wood and the average grit of which is at least as coarse as 27, with the direction of the grain of the wood lying substantially normal to the axis of rotation of the grinding stone, and with a line drawn perpendicularly to the longitudinal axis of the wood and passing through the axis of the grinding stone substantially bisecting the length of the pieces of wood and lying substantially parallel to the direction of pressure application, and maintaining said relationship substantially throughout the grinding operation to produce in a single longitudinal grinding operation fibers of such coarseness that from 7% to 20% will be retained on a 10-mesh screen and the ratio of total short fiber to total long fiber greater than 65 mesh in size will be between 2:1 and 1:3.

WYLMER L. SCOTT.

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