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PROCESS OF MAKING A PLYWOOD PRODUCT

Robert M. Boehm, Laurel, Miss., assignor to Masonite Corporation, Laurel, Miss., a corporation of Delaware

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1

This invention relates to plywood made from natural wood veneers without use of the usual added bonding material between the plies.

Natural wood and its veneers are composed primarily of ligno-cellulose and consist principally of cellulose and lignin in which the cellulosic constituents are cemented together by the natural bonding material, lignin. The main object of the invention is to provide a plywood product in which the lignin of the wood veneers provides the bonding material between the plies, and the usual added interply bonding material is dispensed with. A further object of the invention is to prepare such a plywood product having the desirable properties of good density, low water absorption, and smooth and hardened surfaces. The invention embraces both the product and the process of its manufacture.

The above and related objects are attained in accordance with this invention by a procedure which consists in general terms of first subjecting the natural veneers to hydrolyzing conditions by exposure to steam at high temperature and corresponding high pressure to activate the lignin contained in the wood, then arranging the hydrolyzed veneers into a ply stack without added bonding material therebetween, and then applying heat and pressure to the stack to produce a plywood product in which some of the activated lignin serves to form a bond between the plies.

Veneers made from gum or pine wood have given good results but the veneer may be made from any species of wood which is suited for veneer making and provides veneers which will be hydrolyzed when subjected to steam at high temperature and corresponding high pressure. The wood veneers, which are thin sheets, as for example $1/32$ to $3/16$ inch or more in thickness, are subjected to hydrolyzing treatment with steam at high temperature and pressure to activate the lignin in the wood. This is preferably done in an autoclave. In the autoclave the veneers are preferably spaced apart by interposed spacer means, such as wire screens for example, so as to get thorough and uniform contact of the steam with the veneers. The steam will not only affect the veneer surfaces but will also penetrate substantially throughout the veneers and serves to activate the lignin in the body of the veneers. After the steam has been applied a sufficient length of time to obtain the necessary hydrolysis, it is shut off and the exhaust valve is opened to permit the steam to escape, and the treated veneers are removed. If desired, the hydrolyzed

2

wood veneers may be washed with water to remove acids and other soluble materials formed during the hydrolysis treatment.

The length of time and the temperature of the steam, used for hydrolyzing the veneers in the autoclave to obtain activation of the lignin, are somewhat interchangeable, longer time being required at relatively low steam temperatures and pressures, and shorter time at high steam temperature and pressure. A steam temperature of 200° C. (with pressure of about 200 p. s. i.) is about the minimum temperature at which the hydrolyzing treatment can be performed on the wood veneers within a reasonable time, about 15 to 20 minutes being required for heat treatment at this steam temperature. The steam temperature should not greatly exceed 285° C. (steam pressure about 1000 p. s. i.), since with higher temperatures than this the time of heat treatment becomes difficult to regulate. With steam at this temperature and pressure, the time of sustained application of the steam to the wood veneer required to obtain the necessary hydrolysis for activation of the lignin should not materially exceed about 15 seconds for gum and 20 seconds for pine, but the time of hydrolysis treatment can be somewhat longer when the steam pressure is brought up to the maximum and then released, as for example about 20 seconds for gum wood and about 35 seconds for pine.

In making plywood from such hydrolyzed veneers, added bonding material between the plies can be dispensed with because the lignin activated in the hydrolyzing treatment serves the function of bonding the plies together. To make the plywood, a number of the hydrolyzed wood veneers are arranged in a ply stack and the stack subjected to heat and pressure, preferably in a hot platen press, whereupon some of the lignin will flow sufficiently to form a bonding medium between adjacent plies of the stack. The stack is chilled while still under pressure to a point below the boiling point of water to thoroughly set the lignin and condense any steam which may be present, whereupon the pressure is released and the finished plywood product is removed from the press. When steam-heated press platens are used, the chilling can be carried out by replacing the steam in the platen passages with water.

The press platen temperature and the pressure required to consolidate the ply stacks of the hydrolyzed wood veneer sheets into a unitary plywood product depends to a considerable degree upon the type of veneer, the amount of heat treat-

ment given to the wood veneers during the hydrolyzing step, and upon the characteristics desired in the final plywood product. If the veneers are hydrolyzed in the autoclave at relatively high pressures and temperature, as for example hydrolyzed with steam at a temperature of 285° C. and pressure of 1000 p. s. i. as described above, the lignin will be activated to a relatively high degree, and under such conditions the platen temperature and pressure should not greatly exceed about 220° C. and 750 p. s. i. respectively in order to avoid excessive flow in the hot-pressing operation. However, if the veneers are hydrolyzed at relatively low steam temperature and pressure, the platen temperatures and pressures may be higher.

The following examples will illustrate the invention.

Example 1

Natural (i. e., unhydrolyzed) gum wood veneers, $\frac{1}{32}$ inch in thickness, were placed in an autoclave and subjected to a hydrolyzing treatment with steam raised to a pressure of 1000 p. s. i. (steam temperature about 285° C.) in 15 seconds, and then shut off and the autoclave exhaust valve opened. The hydrolyzed veneers in which the lignin had been activated were removed from the autoclave.

Thirty sheets of the hydrolyzed veneers, with the moisture content adjusted to about 5%, were arranged in a ply stack in a platen press, the grain of adjacent plies being arranged to cross each other, and subjected to a temperature of about 160° C. and a pressure of about 500 p. s. i. After the temperature of the board at the center reached about 160° C., it was held under this pressure for a period of 3 minutes. The press platens were then chilled to a temperature of about 55° C. while retaining the pressure on the ply stack. After chilling, the pressure was released and the finished plywood material removed from the platen press.

Example 2

This example was carried out in the same manner as in Example 1, except that the hydrolyzing treatment was performed with steam raised to a pressure of 600 p. s. i. (steam temperature about 225° C.) in 30 seconds.

Example 3

Natural gum veneers, $\frac{1}{32}$ inch in thickness, were placed in an autoclave and subjected to a hydrolyzing treatment with steam raised to a pressure of 1000 p. s. i. (steam temperature about 285° C.) in 25 seconds, whereupon the autoclave exhaust valve was opened and the veneers removed.

Fourteen sheets of the hydrolyzed veneers were arranged in a ply stack in a platen press. In this example the moisture content of the veneers going into the press was not adjusted, and the press was equipped with a wire screen placed beneath the ply stack to permit escape of moisture during the pressing operation. The ply stack was subjected to a temperature of about 200° C. and the pressure on the stack then raised to about 500 p. s. i. and then backed off to about 250 p. s. i. and so held for 15 minutes. The press platens were then chilled to a temperature of about 55° C. while still retaining the pressure on the ply stack. After chilling, the pressure was released and the finished plywood material removed from the platen press.

Example 4

Natural gum veneers, $\frac{1}{32}$ inch in thickness, were placed in an autoclave and subjected to a hydrolyzing treatment with steam raised to a pressure of 1000 p. s. i. (steam temperature about 285° C.) in 20 seconds, whereupon the steam was shut off and the autoclave exhaust valve opened. The hydrolyzed veneers in which the lignins had been activated were removed from the autoclave and washed with water at a temperature of about 80° C. to remove soluble acids and the like. The moisture content was then adjusted to about 5%.

Fourteen sheets of these veneers were arranged in a ply stack in a platen press and subjected to a temperature of about 220° C. and a pressure of about 160 p. s. i. which was released and raised again to 160 p. s. i. four times at 30-second intervals to breathe out moisture, after which the pressure was raised to about 750 p. s. i. and held for about 1½ minutes. The press platens were then chilled to a temperature of about 55° C. while still retaining the pressure on the ply stack. After chilling, the pressure was released and the finished plywood material removed.

Example 5

Pine veneers, $\frac{1}{16}$ inch in thickness, were placed in an autoclave and subjected to a hydrolyzing treatment with steam raised to a pressure of 1000 p. s. i. (steam temperature about 285° C.) in 35 seconds, whereupon the autoclave exhaust valve was opened. The hydrolyzed veneers, in which the lignins had been activated, were removed from the autoclave and air-dried to about 5% moisture content.

Four sheets of the air-dried hydrolyzed pine veneers were arranged in a ply stack in a platen press and subjected to a temperature of about 220° C. and a pressure of 125 p. s. i., which was released to breathe out moisture and raised again to 125 p. s. i. five times at 15-second intervals, after which the pressure was raised to about 750 p. s. i. and held for about 1 minute. The platen press was then chilled to a temperature of about 45° C. while still retaining the pressure on the ply stack. After chilling, the pressure was released and the finished plywood material removed from the platen press.

The plywood material obtained from the above examples had the following characteristics:

	Example—				
	1	2	3	4	5
Caliper, inches	.383	.382	.197	.185	.10
Specific Gravity	1.32	1.34	1.09	1.42	1.29
MOR, p. s. i.	8,240	6,790	10,880	14,500	6,600
Per Cent Water Absorption, 24 hrs.	5.2	4.5	26.6	7.5	12.0
Per Cent Water Swelling, 24 hrs.	5.2	4.5	15.8	8.2	11.9
Per Cent Water Absorption, 48 hrs.	7.6	6.6	29.1	12.2	15.1
Per Cent Water Swelling, 48 hrs.	12.3	10.2	16.8	14.1	13.9

In following the procedure described, plywood products of relatively high density and low water absorption may be prepared without use of added bonding material between the plies of the product. The activated lignin of the wood veneers when set as described forms a good bond between the plies of the plywood product. Since the activation of the lignin extends to the interior of the veneers, improved bonding properties are

also obtained within the body of the plies. The finished plywood product has a glossy smooth surface which is relatively hard.

It is to be understood that the details described for illustration need not strictly be adhered to, and that the hydrolyzing and pressing conditions, the form of the pressing surfaces, and the like may be modified and suitable plywood products can be obtained. Modifications and variations within the scope of the claims are included in the invention.

I claim:

1. The process of making a plywood product from wood veneers which consists subjecting wood veneers to a hydrolysis treatment in the presence of steam having at least 200 pounds per square inch pressure so as to activate the natural bonding materials of the wood, followed by the procedure which comprises arranging a multiplicity of the veneers in a ply stack, subjecting the stack to heat and pressure to obtain flow of the activated natural bonding material between the plies, and chilling the stack while under pressure.

2. The process of making a plywood product from wood veneers which consists subjecting wood veneers to a hydrolysis treatment in the presence of steam at pressures within the range of 200 and 1000 pounds per square inch so as to activate the natural bonding materials of the wood, followed by the procedure which comprises washing the veneers with water to remove water solubles formed during the steam treatment, arranging a multiplicity of the veneers in a ply stack, subjecting the stack to heat and pressure to obtain flow of the activated natural bonding material between the plies, and chilling the stack while under pressure.

3. The process of making a plywood product from wood veneers which consists subjecting wood veneers to a hydrolysis treatment in the presence of steam at pressures between 200 and 1000 pounds per square inch so as to activate the natural bonding materials of the wood, followed by the procedure which comprises drying the veneers to substantially lower the moisture content, arranging a multiplicity of the veneers in a ply stack, subjecting the stack to heat and pressure to obtain flow of the activated bonding material between the plies, and chilling the stack while under pressure.

4. The process of making a plywood product from wood veneers which consists subjecting wood veneers to a hydrolysis treatment in the presence of steam under pressure to activate the natural bonding materials of the wood, followed by the procedure which comprises arranging a multiplicity of the veneers in a ply stack, subjecting the stack to heat and pressures within the range of 125 and 160 pounds per square inch to vaporize a substantial portion of the moisture content, releasing the pressure to allow escape of the vapors, subjecting the stack to heat and a pressure of at least 750 pounds per square inch to consolidate the stack, and chilling the stack while under pressure.

5. The process of making a plywood product as defined in claim 1, and wherein the hydrolysis treatment is made in the presence of steam within the range of 200 and 1000 pounds per square inch.

ROBERT M. BOEHM.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,125,973	Davidson	Jan. 26, 1915
1,677,963	Ford	July 24, 1928
1,932,255	Sherrard et al.	Oct. 24, 1933
1,973,571	Laucks	Sept. 11, 1934
2,019,056	Osgood et al.	Oct. 29, 1935
2,067,012	Loetscher	Jan. 5, 1937
2,080,077	Howard et al.	May 11, 1937
2,153,316	Sherrard et al.	Apr. 4, 1939
2,183,599	Welch	Dec. 19, 1939
2,190,909	Phillips et al.	Feb. 20, 1940
2,247,210	Schorger	June 24, 1941
2,298,017	Loughborough	Oct. 6, 1942
2,308,453	Potchen	Jan. 12, 1943
2,440,789	Van der Pyl	May 4, 1948
2,495,043	Willey et al.	Jan. 17, 1950