Our invention relates to a process for producing a hard, dense, strong water-resistant wall board and other products from lignocellulosic materials by the application of controlled heat and pressure for a relatively short length of time to a mixture of such lignocellulosic materials and added materials.

Various types of wall boards have been made by the application of heat and pressure to lignocellulosic materials obtained in a more or less fibrous form by other preliminary operations. These processes have had to use raw wood, rather than sawdust. These wall boards thus obtained, are inherently expensive because of the value of the wood and of the cost of the mechanical and chemical operations for reducing to a fibrous state.

We have now found that it is possible to use a number of chemical substances which can be added to the fibrous material as it comes as waste from other operations, for instance, to sawdust by a relatively simple mixing operation, and that the material can then be at once and without intermediate treatment, pressed at a suitable pressure and temperature to give a hard wall board at properties comparable to those obtained by more complicated methods of manufacture. It is, therefore, an object of this invention to make a wall board or similar board from waste wood substances which have had no chemical or mechanical treatment prior to the present operation.

It is a further object of this invention to make a hard, dense, strong wall board or similar board from waste wood substances which will have a considerable water resistance.

It is a further object of this invention to make such an article by handling only relatively dry materials without requiring such materials to be transformed into a slurry or aqueous suspension for the purpose of handling them in a wet state.

A further object of this invention is to allow the use of sawdust, shavings and other mill waste, directly as it comes from the saw or other wood forming machine, by means of a simple and readily operated process with a minimum of steps and equipment, so that these operations may be conducted by relatively small plants in isolated places and with a minimum of technical skill.

We have found that the agent suitable for this purpose of adding them to the lignocellulosic materials in their pulverulent or granular form is amorphous sulphur. The lignocellulosic materials used in our process may be wood from deciduous or coniferous trees. The size of the small wood particles may vary considerably so that the waste from different wood converting processes may be used. It is the preferred procedure to use particles having maximum thickness of not over \( \frac{1}{4} \) of an inch and frequently finer materials are preferable. Fibers containing the normal amount of moisture present in them without drying, and in fact materials containing from 5 to 30% water and up to as much as 50% water are suitable. These quantities of water are hardly appreciable since even the wet material, containing 50% water, acts as a gulverulent, granular material, as distinguished from the slurry used in other procedures where the wood component is in a water suspension, containing only 1 or 2% of fiber.

The preferred chemical material, sulphur, amounting to from 3 to 6% of the total weight of the wood, is mixed into the wood by means of a mixer. Any suitable device which gives a substantially uniform mixture of the chemical material with a cellulosic material may be used.

We have also found it desirable in certain cases to mix the sulphur and the wood and such other added agents, such as sodium hydroxide, under the addition of small amounts of water. The amount of sodium hydroxide used may vary preferably from 1 to 4% sodium hydroxide to the total weight of the mix. The amount of water which may be used may vary from 10 to 15% by weight of the total mix, and the preferred proportion of sulphur ranges from 3 to 6% of the total weight of the flour.

Having formed this mixture, it is necessary to press the mixture under suitable elevated temperatures. It is preferable to subject the mixture to pressures from 720 to 780 lbs. per square inch, at platen temperatures from 225 to 250° C.

In view of the fact that moisture will be discharged during the pressing operation, as well as due to the fact that some gases due to chemical action involved, will escape, it is necessary to make provision for the discharge of such gases and moisture. A suitable manner is to place the material between the platen of the press, where-in one platen is either smooth or has a smooth plate against it and the cellulosic material, and the other platen has one or more wire screens in contact therewith, so that the gases may work their way to the edge of the platen through and around the mesh of the wire screen, and thus find a means for escape. In cases where relatively thick boards or objects of other form, hav-
ing relatively thick sections are to be made, presses having platens which have screens on both platens, may be used so as to allow discharge of gases and moisture from both surfaces.

While the most convenient form of sulphur for use in this procedure is the amorphous type sulphur, sublimed sulphur commonly known as flowers of sulphur, the sulphur may also be used in any other suitable solid form or even dissolved in a suitable solvent.

While not necessary, in the process, the use of other additive agents, particularly the use of some forms of lignin obtained in other procedures, is desirable. For this purpose the lignin obtained from chemical processing of wood in the paper pulp industry, the lignin obtained by means of hydrolysis of wood cellulose in the production of fermentable sugars, and lignin obtained in other wood operations in a more or less crude and impure form is suitable for use as an additive agent.

The addition of waxes may increase the water resistant characteristics of the board obtained by means of the process herein set forth.

Having thus described our invention, what we claim and desire to secure by Letters Patent, is as follows:

1. The process for making a hard, strong, water resistant substantially dry product from lignocellulosic particles or fibers and lignin, comprising mixing therewith powdered sulfur from about 3 per cent to about 6 per cent of the weight of the lignocellulose and then subjecting the said mixture to a pressure of about 720 to 780 pounds per square inch and at a temperature of about 225° C. to about 250° C., whereby chemical bonding is effected between the said sulfur and the said lignocellulosic material to produce a uniform solid.

2. The process for making a hard, strong, water resistant substantially dry product from lignocellulosic particles or fibers and added lignin, comprising mixing therewith powdered sulfur from about 3 per cent to about 6 per cent of the weight of the lignocellulose and then subjecting the said mixture to a pressure of about 720 to 780 pounds per square inch and at a temperature of about 225° C. to about 250° C., whereby chemical bonding is effected between the said sulfur and the said lignocellulosic material to produce a uniform solid.

3. The process of making a hard, strong, water resistant, substantially dry product from lignocellulosic particles or fibers and lignin residue obtained from the hydrolysis of wood comprising mixing therewith powdered sulfur from about 3 per cent to about 6 per cent of the weight of the lignocellulose and then subjecting the said mixture to a pressure of from about 720 to about 780 pounds per square inch and at a temperature of about 225° C. to about 250° C., whereby chemical bonding is effected between the said sulfur and the said lignocellulosic material to produce a uniform solid.

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REFERENCES CITED

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

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re. 17,867</td>
<td>Darrin</td>
<td>Nov. 11, 1930</td>
</tr>
<tr>
<td>665,229</td>
<td>Kelly</td>
<td>Jan. 1, 1901</td>
</tr>
<tr>
<td>1,332,807</td>
<td>Ellis</td>
<td>Nov. 17, 1931</td>
</tr>
</tbody>
</table>

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Country</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>116,981</td>
<td>Germany</td>
<td>Dec. 29, 1900</td>
</tr>
</tbody>
</table>