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WOOD VENEER GLUE

Russell G. Peterson, Tacoma, Wash., assignor to George H. Osgood, Tacoma, Wash.

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This invention relates to glues which are particularly adapted for use in gluing sheets of wood veneer together in the manufacture of multi-ply panel boards. They are also adapted for making multi-ply paper board of card board, and other uses may be found for them.

Certain glue problems arise in this industry due to the manner of manufacture. According to one method of manufacture the ply which is to be the middle ply, say in a completed three-ply panel, is run between rolls to which the glue is fed and these rolls transfer it to both sides of the ply. The outside plies are then placed face to face against the middle ply, generally with the grain of the outside plies running crosswise of the grain of the middle one. In some instances the assemblies, each assembly consisting of three or any other desired number of plies with the glue between them, are stacked up until the stack is sufficiently high, whereupon it is subjected as a whole to pressure in a suitable press.

The assemblies must be under pressure at the time the glue sets in order to produce a good, strong bond between the plies. The glue must, accordingly, not set too soon, that it before the pressure is applied, but it should set soon thereafter. Each glue formula has its own setting characteristics and this gives rise to certain problems. Various types of artificial resins are known and it has been proposed to use some of these as glues in this and the paper board industry, but they have offered difficulties due principally to their speeds of hardening. Hardening of such artificial resins amounts to setting of the glues consisting of or including them. It is known that the time of hardening of artificial resins can be controlled or varied to some extent by the application of various degrees of heat or by incorporating so-called catalyzers into the resins before they harden.

I have discovered that an acid-containing cellulosic flour, such as wood flour, finely ground oat hulls, finely ground wheat straw, finely ground bagasse fiber waste, etc., when impregnated with or mixed with sodium nitrate and then added to artificial resins of various kinds speeds up or catalyzes the hardening reaction and thus the setting of artificial resin glues, and that it results in the glue bond being much stronger than any other glue composition that I have ever tested, both by the wet and the dry test, the resulting glue being applicable by rolls.

The cellulosic flour may be mixed with the sodium nitrate salt in the dry state, but I prefer to impregnate the cellulosic flour with a solution of sodium nitrate so as to have about one (1) part of sodium nitrate to two to ten (2 to 10) parts of cellulosic flour, and I then introduce this combination into the artificial resin just before the resin is to be used as an adhesive. I prefer to have the cellulosic flour ground to a fine mesh, such as one hundred fifty (150) mesh or finer, as this makes a smoother, nicer looking adhesive, but coarser flour, for example, of fifty or sixty (50 or 60) mesh, acts equally as well but the resulting liquid glue has a grainy, coarse look when compared with the glue made with the finer ground cellulosic material. I prefer to use wood flour for the cellulosic material, but other materials which are slightly acid in their natural state may be used. The woods I prefer are pine, fir and spruce.

I am not prepared to say just why this combination results in such an extremely strong glue, but I have tried a great number of other salts and the sodium nitrate (or its equivalent, potassium nitrate) is the only salt that gives this very satisfactory combination. I have tried a great number of cellulosic materials, such as ground oat hulls, wheat bran, etc., and they do not increase the strength of the glue alone, but when mixed with sodium nitrate, the result is startling, and the increase in strength is immeasurably higher than when sodium nitrate alone is used as the hardening agent, so it seems that there must be some chemical reaction with the resin that takes place when both the cellulosic material and sodium nitrate are present in combination. As stated before, other salts have been tried, but this combination, according to my tests, gives the best, most consistent and strongest results. In the case of such wood flours as have a hardening action of their own, the combination with sodium nitrate gives a satisfactory result that can not be obtained with any amount of either material alone and still have a commercially workable glue.

Where a hot press is available, this composition is particularly desirable for pressing therein, and it is particularly adapted to take the place of a hot pressed resin glue where a hot press is not available, for with this composition a panel that is comparable to a hot pressed resin panel may be produced by the common process of pressing without the application of heat known as cold pressing.

The artificial resin made from formaldehyde and urea is cheap enough for it to be used as a glue in the above mentioned industries, and since the invention is particularly adapted there-

to and it is at present the preferred material, I will describe it with particular relation to such artificial resin or condensation product, although it is applicable to other artificial resins as well and may be used in the same manner therewith. Cellulosic flour in combination with sodium nitrate not only hastens the setting and increases the strength of the resulting glue bond, but it makes it possible to decrease the glue costs as much as fifty percent (50%) and still have products of the desired quality. This decrease in cost is due to the low cost of the wood flour and to the increased body or volume of the glue resulting from the addition of the wood flour which is a comparatively very light weight material. For example, the addition of an amount of cellulosic flour in combination with sodium nitrate equal to fifteen percent (15%) of the weight of the artificial resin increases the volume about thirty-five percent (35%), thus reducing the cost of the glue about one-third (⅓), and at the same time resulting in a stronger bond and the possibility of a better method of manufacture.

In this connection it is to be noted that the volume of glue applied per unit area to the work is fixed and can not be arbitrarily changed in commercial practice. There should always be enough glue to contact the maximum possible surface of every wood fiber and to get into as many pores as possible and as far into them as possible. No matter how great an adhesive strength a glue may have, too little of it will, for example, by contacting only some of the fibers, put more strain on those to which it adheres simply because the strains are assumed by a less area. If too much glue is present between the plies, the excess will be squeezed out on pressing. The minimum and maximum volumes of glue to be used are thus fixed by conditions independent of the particular glue formula. My invention permits of the use of less artificial resin by substituting cheap cellulosic flour in combination with sodium nitrate for some of the resin while increasing the strength of the resulting glue bond.

The increased strength seems to be due at least in part, to the fact that the combination of the resin with the cellulosic flour in combination with sodium nitrate has a better power of penetrating into the wood pores than the resin alone, and this gives a better and stronger mechanical hold on the wood, the cellulosic flour in combination with sodium nitrate appearing to modify the resin also in this respect.

The preferred formula that I use is as follows:

	Pounds
Urea resin (partially condensed)	150
Combined wood flour and sodium nitrate (20 lbs. wood flour and 5 lbs. sodium nitrate)	25

The above materials are mixed together and spread on veneer and put under pressure as is customary in commercial practice.

Another formula is as follows:

	Pounds
Urea resin (partially condensed)	150
Combined wood flour and sodium nitrate (30 lbs. wood flour and 9 lbs. sodium nitrate)	45
Water	45

The water is added to dilute the mix so that it will not be too heavy on the rolls when being spread and also to reduce the cost. It does not materially reduce the glue strength but does reduce the cost some by adding volume.

The above formulae are the preferred but we have made several hundred others and all were found highly satisfactory.

The process I have used to gain the best results has been to apply the fluid glue comprising the artificial resin and the cellulosic flour in combination with sodium nitrate to the sheet veneer and press under heat, although I have determined that a very strong panel having very high water resistance and high wood failure can be made by pressing without the application of heat, and in each case the assemblies should be under pressure when the glue sets. A still different manner of using the new glues is to press the assemblies without the application of heat until the glue sets to such a degree that the panel will hold together, and then run the assembly through a device to which a small amount of heat is applied for a short period, such as through a veneer drier or hot plate press to apply a small amount of heat to further harden the glue.

As a specific example, I may state that I may make the partially condensed artificial resin as follows.

I mix together—

Urea	pounds	25
A 40% by volume solution of formaldehyde in water	pounds	62
Hexamethylenetetramine	grams	72
and		
Borax	do	25

For the proportions given, I use urea of commercial fertilizer grade. This grade of material contains a small amount of impurities, but I prefer it for economical reasons. Pure material can be substituted for the commercial, and then a slight adjustment in the amount should be made for the impurities for best results. The mixed materials are heated together, best in a jacketed pot having a suitable condenser, the heating being continued for about twenty minutes after the mass begins to boil. The reaction product hardens without any other treatment within a period varying from several days to several weeks, probably due to a more or less slow continuation of the condensation reaction.

The resulting product is liquid. I prefer to mix the wood flour and nitrate salt, preferably pre-combined, therewith at the plant where the glue is to be used, since it is necessary to ship and maintain the liquid partial condensation product separate until it is to be used, as the combination stays fluid only for from two (2) to twenty-four (24) hours, depending on the amount of wood flour introduced.

The above specific example of making the condensation product explains my preferred method of making it. My invention is not limited thereto because it is applicable to other condensation products, for example, an artificial resinous condensation product of a material of the class including urea, thiourea, phenol, their homologues and substitution products, with an aldehyde-like material of the class including formaldehyde, hexamethylenetetramine, their homologues and substitution products. Such types of condensation products are known and some are purchasable on the market. My invention includes, in its broader phase, the addition of the wood flour and sodium nitrate to previously prepared partial condensation products referred to above.

Certain details referred to for the purpose of describing the invention may be varied without departing from the spirit of the invention.

I claim:

1. A glue having a consistency adapting it to be mechanically applied by rolls and comprising the combination of an artificial-resin partial condensation product and cellulosic flour in combination with a nitric acid salt of a member of the class consisting of sodium and potassium.

2. A glue having a consistency adapting it to be mechanically applied by rolls and comprising the combination of an artificial-resin partial condensation product and acid-containing cellulosic flour in combination with a nitric acid salt of a member of the class consisting of sodium and potassium.

3. A glue having a consistency adapting it to be mechanically applied by rolls and comprising the combination of an artificial-resin partial condensation product and wood flour in combination with a nitric acid salt of a member of the class consisting of sodium and potassium.

4. A glue having a consistency adapting it to be mechanically applied by rolls and comprising the combination of an artificial-resin partial condensation product and flour of pine wood in combination with a nitric acid salt of a member of the class consisting of sodium and potassium.

5. A glue having a consistency adapting it to be mechanically applied by rolls and comprising the combination of an artificial-resin partial condensation product and flour of fir wood in combination with a nitric acid salt of a member of the class consisting of sodium and potassium.

6. A glue having a consistency adapting it to be mechanically applied by rolls and comprising the combination of an artificial-resin partial condensation product and flour of spruce wood in combination with a nitric acid salt of a member of the class consisting of sodium and potassium.

7. A glue having a consistency adapting it to be mechanically applied by rolls and comprising the combination of: a partial condensation product made by condensing a material of the class consisting of urea, thiourea, and phenol, their homologues and substitution products, with a material of the class consisting of an aldehyde and hexamethylenetetramine; and acid-containing cellulosic flour in combination with a nitric acid salt of a member of the class consisting of sodium and potassium.

8. The method of improving an artificial-resin partial condensation product glue, which consists essentially in adding an acid-containing cellulosic flour and a nitric acid salt of a member of the class consisting of sodium and potassium thereto.

9. An artificial-resin partial condensation product glue improved by the addition of acid-containing cellulosic flour and a nitric acid salt of a member of the class consisting of sodium and potassium.

10. A glue comprising an artificial-resin partial condensation product of urea with formaldehyde and hexamethylenetetramine, and acid-containing cellulosic flour and a nitrate of a member of the class consisting of sodium and potassium.

11. A glue comprising an artificial-resin partial condensation product of urea with formaldehyde and hexamethylenetetramine, and wood flour and a nitrate of a member of the class consisting of sodium and potassium.

12. An artificial-resin partial condensation product glue improved by the addition of acid-containing cellulosic flour impregnated with a nitrate of a member of the class consisting of sodium and potassium.

13. An artificial-resin partial condensation product glue improved by the addition of wood flour impregnated with a nitrate of a member of the class consisting of sodium and potassium.

14. An artificial-resin partial condensation product glue improved by the addition of flour of wood of the class consisting of pine, fir and spruce, said flour being impregnated with a member of the class consisting of sodium nitrate and potassium nitrate.

RUSSELL G. PETERSON.