A DRY-GLUE METHOD OF LAYING VENEERS

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A DRY GLUE-METHOD OF LAYING VENEERS

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The multitude of troubles incident to gluing with an adhesive which adds large quantities of water to the wood have stimulated the wish and hope on the part of many gluing operators of finding a dry-glue process of laying veneer. Most glue mixtures used in woodworking commonly contain around 200 percent of water, about twice as much water as dry glue, and before the joint can become strong most of this moisture must be absorbed by the wood plies adjacent the glue line. The absorption of the water by the thin plies causes them to expand, curl, and frequently to overlap, increases the moisture content of the dry wood so much that redrying is usually necessary, and subsequently may result in warping and face checking.

Various approaches have been made to the problem. One frequently suggested is to dissolve the glue in a liquid which does not swell the wood, or at least which reduces the amount of swelling. Unfortunately, the solvents other than water, which have been tried, either swell the wood more or less, are expensive, or are otherwise objectionable. Consequently, although adhesives with solvents other than water are available, this method of approach has not yet produced satisfactory results. A second method of attack is to use a form of dry glue which under the action of heat, pressure, or both adheres to the wood and makes a joint.

During the World War the problem arose of finding a satisfactory wing covering for airplanes. The use of plywood was suggested because of its mechanical properties. On account of the weight requirement, such plywood must of necessity be very thin. It was thought that 3-ply material with a total thickness of 1/30 to 1/40 inch might be satisfactory. Plywood manufacturers, accustomed to gluing veneer not thinner than about 1/30 inch, were unable to glue by ordinary gluing methods the type of plywood demanded.

Veneer as thin as 1/100 inch curls almost as soon as it is brought into contact with wet glue. The veneer also quickly expands to almost its maximum dimensions and overlaps are almost unavoidable. Furthermore, the glue penetrates entirely through the thin veneer in the gluing operation, causing the face plies to stick to each other, to the cauls, or to other contact surfaces. Consequently, the problem of gluing large sheets of very thin veneer, such as 1/100 inch in thickness, was presented to the Forest Products Laboratory by the Army and the Navy.

A Dry-Glue Process

To those engaged in the work it appeared that a dry-glue process offered the best possibilities of success. Work was, therefore, directed chiefly along that line and a process was developed and later patented in 1920 as U. S. Patent No. 1,336,262 by Sponsler, Dunlap, and Henning. It

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is entitled a "process of manufacturing plywood" and consists essentially of the following steps:

1. Preparation of a hygroscopic glue mixture,
2. Coating and drying of glue on a thin layer of veneer, tissue paper, or fabric, and
3. Interposing the layers of dry glue between plies of wood veneer and applying pressure and heat.

When application was made for a patent in 1919 it was learned that other efforts had been made along similar lines. English patent No.12,933 to L. F. Dobler, taken out in 1895, describes a method of combining paper, fabrics, cardboard, etc., with gutta-percha under the action of heat and pressure. In 1901 another English patent, No.17,327 to L. S. D. Freres, describes a method of mounting photographs with "a very thin layer of a gum resin or any other material which will melt and is capable, under the action of a hot iron or an elevation of temperature combined with pressure, of uniting the surfaces with which it is in contact." Later in 1912 U. S. Patent No.1,019,406 issued to L. H. Baekeland, covers a method of making a cardboard from paper or the like by combining them with dried layers of phenol-formaldehyde condensation products under the action of heat and pressure. About the same time that work was in progress at the Forest Products Laboratory application was filed for a patent by J. R. McClain covering a method of making compound lumber by combining layers of veneer with dried sheets of paper, fabric, etc., impregnated with one of the phenolic condensation products, such as bakelite, again using heat and pressure. U. S. Patent No.1,299,747, covering the process, was granted in 1919 and assigned to the Westinghouse Electric & Manufacturing Company.

The process developed at the Forest Products Laboratory for gluing thin plywood is similar in many respects to those described in other patents. It is different, however, in the kind of adhesive used and in its application to the manufacture of plywood.

Of the base materials used in woodworking glues blood albumin was selected because of its outstanding water-resistant properties which are of importance for aircraft plywood. Although casein was also tried it did not appear to possess the possibilities of blood albumin. After many trials the following formula was adopted:

Black dried blood albumin (90 percent solubility) 100 parts (by weight)
Water........................................... 190 parts (by weight)
Hydrated lime.................................. 1.5 parts (by weight)
Water........................................... 10 parts (by weight)
Sugar syrup.................................... 60 to 100 parts (by weight)

Except for the addition of sugar syrup, the formula is similar to other formulas used in mixing blood glues for plywood manufacture. The syrup is added to make the glue hygroscopic or capable of attracting and retaining moisture from the atmosphere sufficiently to permit adhesion to the wood. Corn syrup gave good results, but an invert sugar gave even more
satisfactory results. The quantity of syrup depends on the kind used. Glycerine may be used in place of the sugar syrup, but a smaller quantity of it is required.

The glue is prepared similarly to other blood glues. The dried blood and the larger amount of water are combined with as little stirring as possible. This may best be done by pouring the albumin slowly into the water. Cold water should be used, since warm or hot water may coagulate the albumin. The albumin should soak at least an hour and the mixture should then be stirred until it is uniform in consistency. Any undissolved material should be strained out by passing through a 30-mesh screen. The lime mixed with the smaller amount of water is next added with thorough stirring. The syrup is then stirred thoroughly into the mixture and the glue is ready for coating on veneer, paper, or fabric. To obtain good results the glue must be relatively thin and free from lumps of undissolved materials.

The preferred method of application is to spread the glue on thin paper or fabric and let it dry. When paper is used it should be thin and porous to assure thorough impregnation of the glue solution. Otherwise the paper may be a line of weakness in the plywood. On the other hand, the paper must be strong enough when wet to carry the weight of the glue. Cheese-cloth or other thin fabric may be used. A coarse-mesh cloth of strong fiber is best. The glue may be spread directly on the wood, but if applied to only one side of the veneer sheet, some warping and buckling will result. When used for such purposes as laying figured faces, the glue may be spread on the cross-banded cores and allowed to dry. The cores so prepared may then be stored until required for use. Just before gluing it is advisable to expose the coated cores to a damp atmosphere for about 30 minutes before laying the faces and pressing.

A machine used for coating the glue on both sides of a paper and drying was devised and built at the Forest Products Laboratory. The process was later tried out in a commercial paper-coating plant where an improved type of machine for the coating and drying was used. The process is similar to that used by paper-coating companies in the manufacture of gummed tape.

The Gluing Process

The gluing process is comparatively simple. Layers of the dry glue tissue or fabric are cut to the proper size and laid between the plies of the wood. The panels are then pressed in a hot platen press for a few minutes under high pressure. For soft, light woods pressures of 150 to 200 pounds per square inch can be safely used and for the harder, heavier species pressures as high as 400 to 500 pounds per square inch may be used. Inasmuch as no moisture is added in gluing, redrying is unnecessary.

Since the war-time demand was for a thin, water-resistant plywood, no attempt was made to apply the process to nonwater-resistant glues, such as the animal and vegetable glue, nor to the thicknesses of veneers used extensively in other fields. For more extensive commercial use it would
also be extremely desirable to have a dry glue which could be used in cold presses. Such a process would appear to have large possibilities for laying figured veneer in high-grade furniture panels where checking, crazing, and warping are serious defects. Thin veneers would not have to be dried to so low a moisture content as when gluing with a wet glue and redrying after gluing would be unnecessary.