

# TECHNICAL NOTE NUMBER 207

FOREST PRODUCTS LABORATORY  
MADISON, WISCONSIN

UNITED STATES FOREST SERVICE  
OREGON STATE JULY 1929  
AGRICULTURAL COLLEGE

## GLUES FOR USE WITH WOOD

JAN 2 1936

LIBRARY

The glues that are adapted for gluing wood may conveniently be divided into five classes, as follows:

1. Animal glues, which are made chiefly from the hides, bones, sinews, and hide fleshings of cattle. These glues come in dry form and must be mixed with water and melted.

2. Casein glues and vegetable-protein glues, which have similar properties and characteristics. Casein glues are made from the curd of soured milk, lime, and other chemical ingredients. Vegetable-protein glues are made from soy bean meal, peanut, and other high protein-containing meals. Both glues are sold in prepared form, requiring only the addition of the separate ingredients to the water.

3. Vegetable (starch) glues, which are usually made from cassava starch. They are sold in powdered form and may be mixed cold with water and alkali, but heat is commonly used in their preparation.

4. Blood-albumin glues, which are made from soluble blood albumin, a product recovered from the blood of animals. These glues must be mixed from the separate ingredients just before use, since they deteriorate rapidly on standing.

5. Liquid glues, which are commonly made from the heads, skins, bones, and swimming bladders of fish. Some liquid glues are made from animal glue and from other materials. They come in prepared form ready for immediate use.

*Properties and characteristics of different classes of woodworking glues*

Property or characteristic	Animal glues	Liquid glues	Vegetable (starch) glues	Casain glues <sup>1</sup>	Blood-albumin glues
Mixing and application.....	Soaked in water and method applied warm by hand or mechanical spreaders.	Requires no mixing; applied warm or cold, usually by hand.	Mix with water and alkali with or without heat; applied cold by mechanical spreaders.	Mixed cold with water; applied cold by hand or mechanical spreaders.	Mixed cold with water; applied cold by hand or mechanical spreaders.
Tendency to foam.....	Usually slight; sometimes pronounced.	Of little practical importance.	Very slight; some air usually incorporated in mixing.	Very slight to medium.	Slight to pronounced.
Temperature requirements	Ordinarily sufficient for gluing wood, and room.	Some times necessary to warm glue.	Used at ordinary room temperatures.	Used at ordinary room temperatures.	Heat usually required to set glue; cold-press formula an exception.
Spreading capacity: <sup>2</sup> Extremes reported: <sup>3</sup> Common range: <sup>4</sup> Working line..... Consistency.....	20 to 55..... 25 to 35..... A line or less..... Variable from thin to very thick with temperature changes.	No date..... Several hours to many days. Variable from thin to medium.	33 to 120..... 42 to 60..... Many days..... Normally thick.	30 to 80..... 35 to 55..... Few hours to several days. Thick to medium.....	30 to 100..... Several hours to a few days. Variable, thin to thick depending on formula.
Rate of setting.....	Rapid.....	Rapid to medium.....	Slow to rapid.....	Rapid.....	Very rapid with heat; otherwise slower.
Strength: <sup>5</sup> Water resistance..... Tendency to stain wood.....	Very high to low..... Low..... None to very slight.....	High to very low..... Low..... None to very slight.....	Very high to medium..... Low..... Slight to marked with some woods.....	Very high to medium..... Low to high..... Marked with some woods.....	Very high..... Medium to low..... Very high, except that the dark glue may show through the veneer..... Slight.....
Dulling effect on tools: <sup>6</sup>	Moderate.....	Moderate.....	Moderate.....	Moderate to pronounced.....	Slight.....

<sup>1</sup> Glues made from vegetable proteins, such as soy-bean and peanut meal, resemble casain glues in general properties and characteristics.  
<sup>2</sup> Expressed in square feet of single pine line per pound of dry glue for veneer work.  
<sup>3</sup> Expressed in square feet of single pine line per pound of dry glue for veneer work.  
<sup>4</sup> Animal and casain glues are likely to deteriorate seriously if kept liquid more than one day.  
<sup>5</sup> Based chiefly on joint strength tests.  
<sup>6</sup> The water resistance of animal glues may be increased by chemical treatment.

Vegetable glues are the cheapest glues, normally ranging in price from about 4 to 11 cents per pound. Casein and vegetable-protein glues may vary in price from 6 to 24 cents, different grades of animal glue from 12 to 30 cents, and dried blood albumin, suitable for making glue, from 16 to 38 cents per pound.

Animal glue, frequently referred to as "hot glue," possesses great strength, particularly in the higher grades; it flows freely, and does not stain wood. So far no glue has been found by the woodworking industry to be as suitable for hand spreading on irregularly shaped joints, although a cheaper glue would be desirable. The price of animal glue and the importance of temperature control in its use are the chief factors that limit its utility. The fact that it is not highly water resistant is occasionally a drawback. It may, however, be treated to make it more water resistant.

Casein and vegetable-protein glues have been used commercially for a much shorter time than animal glue, and their possibilities and limitations are not so well known. Casein glue has sufficient strength for either veneer or joint work. It is used cold (although it may also be hot pressed), and when properly mixed it can be spread with a brush. The property most featured is its high water resistance, which makes it suitable for gluing articles to be used under moist conditions. Not all casein glues are water resistant, however; some are made to compete with vegetable glue and claim no great water resistance. Among the disadvantages of casein glues are a tendency to stain thin veneer and a relatively short working life of some kinds. It is claimed that staining has been overcome to a certain extent in some casein glues. The water-resistant casein glues are somewhat harder on tools than animal and vegetable glues. Possibly this objection can be overcome by altering the ingredients in the glue or by using different steel in the tools. While vegetable-protein glues are similar to casein glues in properties and characteristics, some of them do not give quite as high joint strengths.

Vegetable glues have found wide use in recent years because they are cheap, can be used cold, and remain in good working condition free from decomposition for many days. They are extremely viscous, and it is not practicable to spread them by hand. Their use is limited because they lack water resistance and usually cause staining in thin fancy veneer. They set relatively slowly and for this reason are not extensively used for joint work. Vegetable glues have been studied and developed almost entirely by private initiative, and there has been much litigation over patent rights.

Blood-albumin glue has shown notably high resistance to moisture, especially in the boiling test. This makes it particularly suitable for gluing plywood which is later to be softened in hot water and molded—a use which, however, has been small. The chief drawback to the use of blood glues has been the necessity for hot-pressing. A water-resistant blood glue may be made which can be cold-pressed, but its usefulness is limited by its low to moderate strength.

Liquid glues are similar in properties to animal glue. Some brands are equal in strength to good joint glues, but others are weak and unreliable. Their great advantage is that they come in prepared form, ready for immediate use, making them particularly suitable for patch work and small gluing jobs. Factors that limit their use are high price, lack of water resistance, and the difficulty in distinguishing between good and poor brands.

Generally speaking, present vegetable, blood albumin, and vegetable-protein glues are veneer glues, while animal and casein glues are used for both veneer and joint work. As between animal and casein glue for joint work, if freedom from staining is important animal glue is preferable; if water resistance is of importance then a casein glue should be selected. Because of the necessity of heat in the preparation and use of animal glue, the casein cold glue will probably be favored if both glues are otherwise equally well adapted.