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## WOODWORKING GLUES OF NATURAL ORIGIN

Currently available woodworking glues may be conveniently divided into two main groups, namely, glues formulated from materials of natural origin and the synthetic resin glues, which are of more recent development and are the products of modern chemical industry. This technical note deals only with animal, vegetable, casein, soybean, and liquid glues. (See Technical Note No. 258 for information on resin glues.)

(1) Animal glues, also called hide glues or hot glues, are probably the oldest known type of wood glue and are prepared from the hides, bones, sinews, and hide fleshings of cattle. Most animal glues come in a dry form and are prepared for use by soaking in water, melted, and applied while hot. Liquid animal glues, ready to use at room temperature, are also available (see Technical Note F-2 on liquid glues). Animal glues are available in different grades; the higher grades are preferred for joint work, and the lower grades are suitable for veneering. Hot animal glues develop strength first by cooling and gelling and later by drying and are often preferred for hand spreading on irregularly shaped joints and for assembly work, as for furniture. The chief disadvantages of these glues are their relatively high cost, the importance of temperature control in their use, and the low water and moisture resistance of the joints.

(2) Vegetable (starch) glues are usually made from cassava starch. They are sold in powder form and may be mixed cold with water and alkali, but heat is commonly used in their preparation. These glues are relatively cheap, can be used cold, and remain in good working condition, free from decomposition, for many days. The normal vegetable glues prepared from powder are extremely viscous and are not practical to spread by hand. Special liquid starch glues, although easier to spread, are more expensive, and their other characteristics are not well established. Vegetable glues set relatively slowly, mainly by loss of water to the wood. In the past vegetable glues were widely used, particularly

for veneering because the time between spreading and pressing (assembly time) could be varied without affecting the quality of the joint. The use of vegetable glues is limited today because they lack water and moisture resistance, like the animal glues, and because they cause staining in thin veneer. These glues have not been used extensively for joint work.

(3) Casein glues are made from casein curd (protein) precipitated from milk either by natural souring or by the addition of acids or enzymes. Lime and other chemical ingredients are added to the casein to prepare the glue for use. Formulas are available for the user to compound his own glue from raw casein (Forest Products Laboratory Report No. D280), but it is generally more convenient to use prepared glues supplied in powder form, which require only the addition of water before use. The prepared glues are available in small retail packages. The many casein glues available include glues with long pot life but relatively low moisture resistance and glues with good moisture resistance but a definitely limited pot life. Casein glues have sufficient strength for either veneer or joint work. They are used cold (although they may be hot pressed) and when properly mixed can be spread with a brush. The moisture-resistant casein glues are intermediate in moisture resistance between vegetable and animal glues and synthetic resin glues. Disadvantages of casein glues are their tendency to stain veneers, the relatively short working life of some types, and the dulling effect of the glue lines on tools. Each of these limitations may be minimized separately by special formulations, but generally at the sacrifice of some other property.

(4) Soybean (vegetable protein) glues, which are similar in general composition, properties, and use characteristics to casein glues, are formulated from dried protein of soybeans. Soybean glues are cheaper and generally produce lower-strength joints than casein glues and are therefore mainly used at present for veneer gluing, primarily of the softwood species. Soybean glues are not normally suitable for hand work or small-scale operations. Their moisture resistance is similar to that of casein glues.

(5) Liquid glues include those glues of natural origin offered in ready-to-use form. Originally they were made from heads, skins, bones, and swimming bladders of fish, but more recently they are also prepared from animal-glue bases by special treatments. These liquid glues tend to vary considerably in quality from sample to sample, but the better glues produce joints comparable to those of hot animal glue. Liquid glues are more expensive than other nonresin glues and find their greatest use for small-scale operations, such as assembly or hobby work.

They are also used in place of hot animal glue if convenience of use is important. Liquid starch glues were previously mentioned. Certain synthetic resinglues are also supplied in ready-to-use liquid form. The most common type is the polyvinyl-resin emulsion glues. (See Technical Notes F-2 and 258).

(6) Blood albumin glues were formerly used for veneering but are now entirely replaced in the United States by the synthetic-resin glues.

The properties of woodworking glues of natural origin are summarized in the table.

# Summary of properties of woodworking glues of natural origin<sup>1</sup>

Property	Type of glue				
	Ani- mal	Vege- table (starch)	Casein	Vege- table pro- tein (soy- bean)	Liquid
Ready to use as received.....					x
Requires mixing for use.....	x	x	x	x	
Applied hot to wood.....	x				
Applied cold to wood.....		x	x	x	x
Can generally be spread by hand.....	x		x		x
Colorless or nearly colorless glue line.....	x	x	x	x	x
Tends to stain certain woods....		x	x	x	
Can be pressed at 75° F.; does not require curing at higher temperatures.....	x	x	x	x	x
Working life of 1 to 8 hours at 75° F.....			x	x	
Working life of over 8 hours at 75° F.....	(2)	x			x
Low moisture resistance.....	x	x			x
Medium moisture resistance..			x	x	
Can usually be purchased in retail stores.....	x		x		x
Good to high resistance to elevated temperatures.....	x	x	x	x	x
Relatively low cost.....		x		x	
Intermediate cost.....	x		x		x

<sup>1</sup>—These properties are based on average glues of each type. There are numerous exceptions for special glues of each type.

<sup>2</sup>—Applied hot at 140° to 150° F.