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CHEMICAL TREATMENT OF SURFACES IMPROVES JOINTS WITH CERTAIN WOODS AND GLUES

Most native American woods can be glued with most adhesives to produce joints as strong as the wood by the use of proper gluing conditions. However, certain species of high density or high extractive content are often not well glued even under good gluing practices.

In early tests at the Forest Products Laboratory, when wood surfaces were treated with chemical solutions before gluing, the quality of the joints was improved on several species with animal and casein glues. Treatment with a solution of caustic soda improved animal-glue joints on several wood species and the improvement was most marked under gluing conditions where starved joints normally occur. Caustic soda or lime water treatments also strengthened casein-glue joints in woods that ordinarily are joined with this glue with some difficulty.

The caustic soda solution consisted of 10 parts by weight of caustic soda and 90 parts of water. The treatment consisted of brushing the solution onto the surfaces to be joined. After about 10 minutes the surfaces were wiped with a cloth to remove any excess solution or dissolved material and allowed to dry before being glued.

Treatment of woods with caustic soda solution or lime water in order to improve their gluability with the newer synthetic resin glues has not been adequately investigated. However, it does not appear that such treatment would be advisable, particularly with urea- and resorcinol-resin glues as any residual alkali on the wood surface might be expected to alter the catalyst systems in these glues and thus affect their curing, strength development, and durability. Experiments have indicated that good joints can be obtained on most native American woods with these resin glues without chemical treatment of the wood by proper control of gluing conditions.

Tests of Animal-glue Joints

The results of the tests on treated wood joined with animal glue are indicated in table 1 in such a way as to show whether the treated joints gave higher or lower test results -- with respect to strength in shear and percentage of wood failure -- than joints glued without preliminary treatment under both good and starved-joint conditions.

The entire group of treated joints -- 13 species -- showed 51 percent greater average strength in shear than the untreated joints of the same species glued under starved-joint conditions, and 97 percent more wood failure.

In the case of the caustic-treated black walnut listed in table 1, although the strength values were less than those for untreated wood, the improvement in the starved-joint condition is indicated by the increase in the percentage of wood failure. With black walnut the lower strength of the treated joints was apparently due to poorer quality wood.

Tests of Casein-glue Joints

The results of tests of caustic-treated casein-glue joints are presented in table 2. This table is similar to table 1 except that starved joints do not enter the comparison of treated and untreated joints.

Tests on caustic-treated casein-glue joints in osage-orange gave striking results. Osage-orange contains a large amount of extractives and is one of the most difficult of all woods to join with casein glue. When this species was glued untreated, practically no adhesion at all occurred; the joints showed an average strength in shear of only 294 pounds per square inch and no wood failure. When it was treated with caustic soda, however, the average joint strength was over 3,000 pounds per square inch, and wood failure was 35 percent.

Lime water, ammonia, benzol, hydrochloric acid, and bleaching powder (chloride of lime) were other materials tested at the same time as the caustic soda. Hydrated lime (10 parts added to 90 parts of water) gave slightly better results than caustic soda when used as a surface treatment for hickory, red gum, and black cherry joined with casein glue. Of the other chemicals named above, some gave encouraging results on one or two species, but the results in general were not sufficiently consistent to warrant discussion in this note.

Table 1. --Effect of caustic soda on animal-glue joints

(Wood treated with caustic soda and glued under both good and starved-joint conditions)

Species of wood	Average strength	Average wood failure
	Lbs. per sq. in.	Percent
Basswood	++	+
Yellow birch	++	+
Black cherry	++	++
Red gum heart	++	+
Red gum sap	++	+
Sugar maple	++	++
Red oak	++	+
White oak	++	++
Osage-orange	+	+
Northern white pine	++	-
Southern yellow pine	++	+
Yellow poplar	++	++
Black walnut	-	++

\+ = More than value for untreated wood glued under starved-joint conditions.

++ = More than value for untreated wood glued under either starved-joint conditions or good gluing conditions.

\- = Less than value for untreated wood glued under either starved-joint or good gluing conditions.

Table 2. --Effect of caustic soda on casein-glue joints

(Wood treated with caustic soda and glued under normal conditions)

Species of wood	Average strength	Average wood failure
	Lbs. per sq. in.	Percent
Basswood	+	+
Red gum heart	+	-
Red gum sap	+	+
Hickory	+	+
Osage-orange	+	+
White oak	-	-
White pine	+	[1]
Redwood	+	+

[1] Difference insignificant.

+ = More than value for untreated wood glued under same conditions.
- = Less than value for untreated wood glued under same conditions.