ARTIFICIAL RESIN GLUES FOR PLYWOOD

July 1939

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
FOREST PRODUCTS LABORATORY
Madison, Wisconsin
In Cooperation with the University of Wisconsin

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The term "artificial resins" was first used to describe synthetic chemical compounds that, in the intermediate phases of their production, resembled natural resins in general appearance. As new compounds were developed, however, the term came to include many products bearing little or no resemblance to natural resins, and at present it applies to a wide and heterogeneous group of products. Some of these have found wide practical application, while others are as yet mainly of theoretical interest.

Probably the best known artificial resins in manufacture and use are those produced by a condensation of phenol (carbolic acid) and formaldehyde, materials which have become available in increasing quantity with the development of modern chemical industry. Typical of such resins is the product sold under the name of Bakelite. Other synthetics having considerable commercial importance are urea-formaldehyde resins, glycerol-phthalic anhydride resins, polymerized vinyl esters, polymerized acrylic esters, cellulose esters, ketone resins, cumarone-indene resins, and sulphurphenol resins.

Of all these compounds only a few have thus far proved of practical value as woodworking adhesives, and those few belong to either the phenol-aldehyde or the urea-formaldehyde groups. The procedure in forming the phenol-aldehyde resins consists essentially in heating a mixture of phenol and formaldehyde, with or without the addition of small amounts of other chemicals called catalysts. The products of the condensation reaction are water and a resin-like mass that settles out. The water layer can be removed and the resin can, by further action of heat and pressure, be converted into a hard, insoluble substance. The specific properties of the resin are subject to control by the use of different catalysts and other modifications of the process. For the production of woodworking glues the reaction is stopped at an intermediate stage at which the resin may be applied to the surfaces to be glued. By application of heat and pressure in the gluing operation itself the reaction, somewhat resembling a fusion, is carried to completion.

With most of the phenol-aldehyde resins this final stage of the reaction will require, for best results, temperatures in the neighborhood of 300°F., pressures as great as can be applied without crushing the wood, and a pressing time of some 3 to 5 minutes after the glue layer has reached full temperature. Such requirements, however, may be modified even within a class of resins. One phenol-aldehyde resin glue, for example, may be spread and pressed at room temperatures. After the glue has taken an initial set the condensation reaction is completed by heating to about 150°F. for some hours.

In the final form the phenolic resin is insoluble in hot and cold water and, if the process is correctly controlled, it adheres well to wood surfaces. Thus a very water-resistant glue joint may be produced. Phenol-aldehyde glues may be used in the form of films, dry powders, or solutions,
all of which are readily available on the market. The powder is usually brought into solution or suspension before spreading on the wood.

The urea-formaldehyde artificial resin glues are of more recent development. At the present time (1939), they are on the market in the forms of dry powders and of solutions, but the film form is not available, at least from domestic sources. The urea-formaldehyde glues set at somewhat lower temperatures and at a somewhat more rapid rate than those of the phenol-aldehyde type. As in the case of the latter group, the temperature requirements may be modified within the group. Some of the urea-formaldehyde modifications on the market may be used entirely at room temperatures. When the gluing process is properly controlled the urea-formaldehyde joints are highly resistant to water at ordinary temperatures, but they will not withstand soaking in hot water.

For most present commercial glues of the phenol-aldehyde and the urea-formaldehyde types, heat is an essential agent in causing the final reaction. The process of gluing with synthetic resins lends itself, therefore, much better to plywood manufacture than to the gluing of thick stock, in which case the time required to bring the joint to the necessary temperature may be excessive from the standpoint of economy and quantity production.

The cost of the synthetic resin glues may be reduced by the use of "extenders" or "fillers" but unless the quantities added are very small this "extending" results in a sacrifice of the water resistance, mold resistance, and other desirable properties.

Theoretically, a wider range of glues with varying properties and gluing requirements may be possible through the selection of other types of artificial resins. For example, vinyl esters are "thermoplastic" and do not undergo a permanent chemical change under the action of heat alone. If they are to be used as glues, a press is required that can be heated and cooled while the product is under pressure. Films of vinyl esters and cellulose esters have appeared at least on foreign markets but they have not been used to any extent in the domestic plywood industry.

The use of artificial resins as woodworking glues is still in the developmental stage with new products and modifications appearing frequently. While service tests covering periods of 3 to 5 years have demonstrated a high degree or resistance to severe conditions of exposure, judgment of quality and usefulness of a resin glue must, for the present, be based on characteristics and properties of the individual compounds for no general statements can be made that apply with equal force to the entire field.

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