



# Sticking with SOY

## New wood adhesive products for construction

**A**s “going green” takes the construction industry by storm, the inclusion of soy in more products is becoming increasingly prevalent — and wood adhesives are no exception. The United Soybean Board (USB) and soybean checkoff are committed to funding the research, development, and commercialization of new industrial uses for soybeans. USB focuses efforts on five target areas: adhesives, coatings and printing inks, lubricants, plastics, and solvents.

“The soybean checkoff helps fund projects to increase soybean demand through advancements in soy-based research and technology,” says Karen Fear, USB New Uses vice chair and a soybean farmer from Montpelier, IN. “Adhesives are an interesting market with a lot of potential.”

### ENVIRONMENTAL BENEFITS

A number of factors could lead to a future competitive advantage for soy in the adhesives market. In 2004, the International Agency for Cancer Research reclassified formaldehyde from a suspect carcinogen to a known carcinogen. This began a flurry of technical work on non-formaldehyde-containing resins to replace primarily urea formaldehyde (UF) in non-structural wood-composite-panel glues. There are now five soy-based glues for use in wood-composite panels. However, the future success of soy-based adhesives may rest upon the cost of soymeal/flour, petrochemical-based product pricing, technology development and regulatory/legislative issues.

Soy meal and soy flour are only beginning to penetrate the wood-composite-glue market. For the particleboard and medium-density-fiberboard markets, the greatest interest is having a formaldehyde-free resin to resolve the issue of formaldehyde emissions. This is needed to meet current and anticipated regulatory demands and green initiatives, such as the Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

Soy-based adhesives can be applied to green lumber and frozen lumber, enhancing the efficiency of the finger-jointing process. Finger-jointed studs are stronger and straighter than conventional lumber and will not warp (top left).

PRF/Soy 2000, a soy-based wood adhesive developed with funding from the soybean checkoff, is used to bind scrap-shorts of lumber in a process known as finger jointing. Using the PRF/Soy 2000 in finger jointing reduces the amount of energy needed in curing (top right).

Oriented strand board is made of layered wood strands placed at right angles to develop maximum strength and stability. Checkoff-funded research has led to the use of soy protein in the adhesive to bind these wood strands (bottom).



“Reducing formaldehyde emissions is one of the major factors in developing soy-based adhesives,” says Fear. “Soy adhesives don’t have an odor or cause any concerns with toxicity.”

Currently, soy-based formaldehyde-free glue systems are in use, representing about 70% of the glue potential in this segment. If soy-based resins capture a 20% market share in the wood-composite-resin business within five years after market introduction, the total soy meal and flour opportunity would be approximately 744 million pounds, or 18.6 million bushels of soybeans.

### POTENTIAL MARKETS

Soy adhesives are becoming more common in many areas of the construction industry as well. Structural panels refer to oriented strand board (OSB) and softwood plywood. The current formaldehyde-free soy-based resins are too high in viscosity for use in sprayable applications needed for making OSB. USB supports research to develop the proper viscosity for this application at Oregon State University, which was the original inventor of soy-based formaldehyde-free glues used in interior hardwood plywood. Developing soy-based glues that have a cost advantage will also be a primary driver for change in the marketplace.

In the OSB and structural plywood markets, formaldehyde emissions are less of a concern than reducing the cost of petrochemical resins such as phenol formaldehyde and melamines, which are associated with the high costs of natural gas and oil.

The most popular adhesive for particleboard has traditionally been urea formaldehyde. However, since formaldehyde has been classified as a known carcinogen, many mills are seeking to replace resins that emit formaldehyde. This creates an opportunity for soy-based resins capable of replacing formaldehyde-emitting resins.

Particleboard is a panel normally composed of discrete particles or pieces of wood in contrast to fibers, combined with an adhesive resin or another binder. The particles are bonded together under heat and pressure in a hot press and formed into a board. The most popular adhesive used for particleboard is UF, but there are soy-based resins capable of replacing UF. Costs to use soy-based resins vary from mill to mill.

Medium-density fiberboard (MDF) is composed of uniformly small particles and is of consistent density, ranging from 31 to 55 lbs./cu. ft. MDF is produced through the use of heat and pressure in a hot press.

E2e Materials, Ithaca, NY, is developing a new soy protein and renewable plant fibers composite particleboard and medium-density fiberboard. The composites are described as a cost-competitive, formaldehyde-free solution to traditional wood-composite particleboard and medium-density fiberboard. The proprietary technology claims a high strength-to-weight ratio, which can result in a 65% weight reduction without performance loss. Less material can equate into less energy required to produce particleboard and MDF.

### Current Soy-Based Resins

Current soy-based technology for use in wood-composite panels centers around several different systems developed to produce lower cost and/or more environmentally friendly systems. These include:

- **Foamed glue extruded systems.** This system is used in laminating plywood veneers, where soy flour is substituted for animal blood as a foaming agent for phenol formaldehyde resins.
- **Formaldehyde-free adhesives.** Soy meal or flour are used in formaldehyde-free adhesives to minimize formaldehyde emissions from wood-composite panels. In 2005, Columbia Forest Products announced the first use of formaldehyde-free glue when it converted from the use of urea-formaldehyde adhesives to a patented soy system. Other companies have developed low-formaldehyde or formaldehyde-free glue systems with soy to meet the challenges of regulatory and environmental issues.

### OPPORTUNITIES

Soy’s environmental benefits create a host of opportunities for soy-based adhesives. The state of California has announced two of the most stringent requirements for formaldehyde content in composite wood panels.

Based on California’s intentions, Hercules licensed soy-based formal-

dehyde-free technology from Oregon State University that will be used by Columbia Forest Products in its interior hardwood decorative paneling. All of Columbia Forest Products’ mills have converted to this new soy-based resin, which has resulted in new soy flour annual consumption. The Green Building Council — specifically the LEED program — promotes formaldehyde-free panels as being more environmentally friendly.

Many retailers are looking into soy-based products as well. Home Depot requires its wood-composite panel suppliers to provide products that meet European 1 requirements for reduced levels of formaldehyde. IKEA has proposed that its furniture have a maximum formaldehyde level of 0.07 ppm, which is lower than the phase 1 requirement proposed by the California Air Resources Board (CARB).

Heat-resistant adhesives (HRA) present another opportunity for soy. The USDA Forest Products Labs have done some preliminary work that indicates soy has limited thermal softening under heat, which suggests that soy has good heat resistance. The emerging market for this heat-resistant property would be primarily in engineered-wood products such as finger joints, I-beams and joists.

### ABOUT THE SOYBEAN CHECKOFF

Like many commodities producers, soybean farmers collectively invest a portion of their end-of-season profits to fund research and promotion efforts. This collective investment is called a checkoff.

The soybean checkoff is supported entirely by soybean farmers with individual contributions of 0.5% of the market price per bushel sold each season. The efforts of the checkoff are directed by the United Soybean Board, composed of 68 volunteer farmer-leaders nominated by their state-level checkoff organizations, called Qualified State Soybean Boards (QSSBs). The nominees are appointed by the U.S. Secretary of Agriculture.

For more information, visit [www.unitedsoybean.org](http://www.unitedsoybean.org).

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