

Soy-Based Adhesives

The Products

Soy-protein-based wood adhesives have been used for centuries. Since World War II, they have been largely replaced by petroleum-based adhesives with superior performance and economics. Current research is focused on developing and commercializing three soy products:

- 1) A soy/phenol-resorcinol-formaldehyde (PRF) system for use in Oriented strand board (OSB) and plywood
- 2) A soy meal/flour formaldehyde-free glue to replace UF adhesives
- 3) A foaming glue for plywood

Market Size and Value

Markets for these products include applications in wood composite panels and new or emerging uses.

Long-Term Soybean Potential

Market Segment Million Bushels (4-5 years)

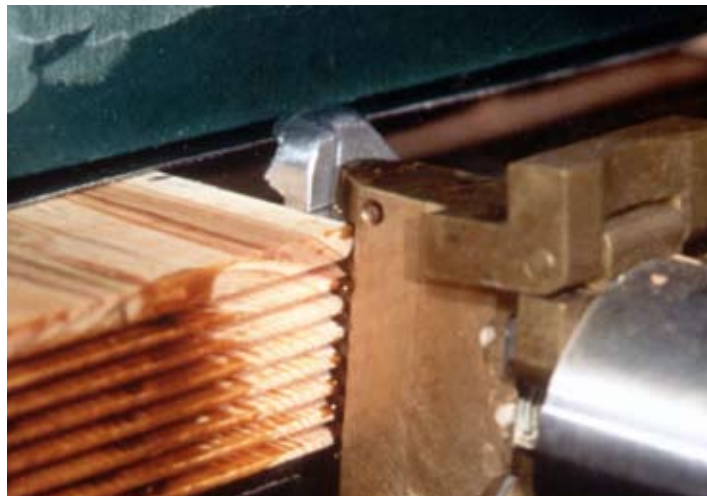
Wood Composite Panels:	
Particleboard	7.5
Medium density fiberboard	5.4
Plywood	1.2
Oriented strand board	4.5
Total Soy Bushels	18.6

Wood Panel Products

North American mills produce approximately 50 billion square feet of combined particleboard, medium-density fiberboard (MDF), plywood and OSB annually.

Particleboard and MDF are composed of low-value wood byproducts, such as sawdust bound with UF resins. The replacement adhesive, a soymeal/soy flour-based product, is expected to result in a product with formaldehyde-free glue and equal performance to UF resins. OSB is made of layered wood strands oriented at right angles to develop maximum strength and stability. OSB competes with plywood and has seen significant growth due to its lower price and competitive performance in many uses. Phenol formaldehyde (PF) and, to a lesser extent, diphenyl methane diisocyanate (MDI) are primary adhesives. Hydrolyzed soy proteins added to PF resins provide reduced costs and

reduced emissions. Ongoing research sponsored by the United Soybean Board (USB) is investigating the possibility of using PF soy-based products to completely eliminate formaldehyde emissions in the glue.



Panel products are a large market for softwood plywood, but has seen market share decline since the introduction of OSB. PF is the principal adhesive used to bind thin wood veneers together or over products such as MDF. A soy-based extender for PF resins is being currently pursued for use in softwood plywood.

USB-sponsored research has resulted in the commercialization of soy protein to replace blood meal in making foamed glues for plywood production. Foamed glues expand adhesive volume to realize equal bond performance with a 20 percent to 30 percent reduction in adhesive use.

A soy-based formaldehyde-free resin has recently been commercialized for use in manufacturing hardwood plywood for interior use. Under a licensing agreement from Oregon State University, Hercules began marketing the Pure Bond glue system to Columbia Forest Products and eventually granted Columbia Forest Products an agreement to sell the product in North America for decorative panel applications. USB-sponsored research is extending this new formaldehyde-free technology to provide an exterior grade resin for use in OSB and softwood plywood.

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Emerging Markets

There appear to be emerging and new markets for soy in heat-resistant adhesives, biobased composites and enzymatic processing for new soy hydrolyzates. Soy is being evaluated to determine if it will retard the softening of glue lines in structural engineered wood products like finger joints and I beams. If these new glues pass the appropriate fire-resistance tests, they will be qualified and preferred for use as heat-resistant adhesives to prolong the time a wood structure will collapse in a fire. Soy proteins are being developed to provide a renewable, plant-fiber-composite particleboard and medium-density fiberboard. These composites are touted to be a cost-competitive formaldehyde-free solution to traditional wood-composite particleboard and medium-density fiber board.

Iowa State is developing an enzymatic approach to making soy hydrolyzates that can be tailor-made for use with phenol formaldehyde resins in OSB and softwood plywood. The new approach is more environmentally friendly and less expensive than the traditional use of caustic and high temperature and pressure approaches.

State of the Art

Most USB-sponsored research has concentrated on either reducing formaldehyde emissions in UF produced wood composites or reducing the costs of using phenol in structural wood composites such as OSB and softwood plywood.



Relative Economics/Supplies

The major adhesive resins used for wood-composite panels contain phenol or urea, plus formaldehyde. Formaldehyde is made from methanol, which is made from natural gas. Phenol is derived from benzene and cumene, which are made from petroleum and propylene, which is made from natural gas in most of the world. Urea is a product of ammonia, which is primarily made from natural gas and carbon dioxide.

Formaldehyde pricing is dependent on methanol which has fluctuated greatly in the last few years because of shortages worldwide. Urea pricing is on the rise due to increased costs for ammonia. The rising costs for phenol are attributed to the rising cost for the base stock petroleum.

Soymeal/soy flour costs have remained flat for many years, but they recently increased due to increased demand for soy meal/flour. In spite of these recent price increases, soymeal/soy flour remains an inexpensive raw material for wood adhesives.

Advantages and the Path Forward

New soy adhesives promise both improved performance and economics to the wood products industry. They also should help to reduce emissions of formaldehyde.

USB is supporting research and testing to commercialize these products and ensure they meet industry standards. Working with industry partners, USB helps develop standard industry practices, an infrastructure to supply the products and acceptance of the resulting end products at all levels.

USB is made up of 68 farmer-directors who oversee the investments of the soybean checkoff on behalf of all U.S. soybean farmers. Checkoff funds are invested in the areas of animal utilization, human utilization, industrial utilization, industry relations, market access and supply. As stipulated in the Soybean Promotion, Research and Consumer Information Act, USDA's Agricultural Marketing Service has oversight responsibilities for USB and the soybean checkoff.

