MARKET OPPORTUNITY SUMMARY

SOY-BASED ADHESIVES

Soy delivers lower cost, lower VOCs and higher profits to the wood products industry.

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 focuses on developing and commercializing two soy products to re-establish their use as a wood adhesive:

1. A soy/phenol formaldehyde (PF) system for use in oriented strand board (OSB) and plywood.
2. A soy meal/flour formaldehyde-free adhesive to replace urea formaldehyde (UF) adhesives in hardwood plywood, engineered wood and particleboard.

MARKET SIZE AND VALUE

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

Long-Term Soybean Potential
Market Segment Million Bushels (4-5 years)

Particleboard:	7.5
Medium density fiberboard (MDF):	5.4
Plywood:	1.2
Oriented strand board (OSB):	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 formed into panels using UF resins. The replacement adhesive, a soy meal/flour-based product, does not contain formaldehyde (NAF); therefore, it does not contribute to formaldehyde emissions. OSB is made of layered wood strands oriented 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, diphenylmethane diisocynate (MDI) are primary adhesives for OSB applications that require more demanding performance characteristics. Hydrolyzed soy proteins added to PF resins provide reduced costs without degrading performance. Ongoing research sponsored by the United Soybean Board (USB) investigates the optimization of hybrid PF-soy adhesives in phenol products and the replacement of UF with soy-based alternatives to completely eliminate formaldehyde emissions from adhesive in interior applications.

Panel products are a large market for plywood, but it has seen market share decline since the introduction of OSB. PF is the principal adhesive used to bind thin wood veneers together or bind them over a core board, such as MDF.

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 been commercialized for use in manufacturing hardwood plywood for interior use. Under a licensing agreement from Oregon State University, Hercules began marketing the PureBond® plywood panels 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 plywood, which is being developed by Applied Protein Systems.

EMERGING MARKETS

There appear to be emerging and new markets for soy in non-wood adhesives, biobased composites and enzymatic processing for new soy hydrolysate. Soy adhesives do perform very well in high-heat testing of structural engineered wood products like finger joints and I-beams. These adhesives have

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been shown to possess superior heat resistance, which prolongs the structural integrity of the wood structure in a fire.

Soy proteins are being developed as a binder to provide a renewable, plant-fiber-composite particleboard and medium-density fiberboard. These composites could be a cost-competitive, formaldehyde-free solution to traditional wood-composite particleboard and medium-density fiberboard.

Similar protein technologies are being utilized in non-wood adhesives at Heartland Resource Technologies for full or partial replacement of latex adhesives such as polyvinyl acetates.

Iowa State University has developed an enzymatic approach to making soy hydrolysates 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, high-temperature and high-pressure approaches.

New applications have been found in the construction adhesives and sealants market. Several polyols manufacturers have introduced products that were developed to replace petrochemical polyols with soy-based alternatives in urethane adhesives. The soy component has been shown to offer improved adhesion to a wide variety of substrates. Soy oil adhesive technology developed by Niemann Labs is used in asphalt and built-up roof applications, replacing VOC and adding bio-content.

Most recently, pressure-sensitive adhesives (PSA) have been formulated using modified soy oil. This work is being funded at Kansas State University's Center for Biobased Polymers by Design in the Department of Grain Science and Industry.

STATE OF THE ART

Most USB-sponsored wood 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.

USB funding has been used to replace petrochemical components in non-wood adhesives, which reduces volatile organic compounds while increasing biobased content.

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 as a result of shortages worldwide. Urea pricing rose due to increased costs for ammonia but then dropped significantly during the economic situation early in 2009. The costs for phenol are attributed to the cost for the base stock petroleum, which has followed the same trends as urea.

Soy meal/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, soy meal/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 have also proved to be excellent alternatives to urea-based products for interior applications where legislation now restricts 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.

ABOUT USB

The 69 farmer-directors of USB oversee the investments of the soy checkoff to maximize profit opportunities for all U.S. soybean farmers. These volunteers invest and leverage checkoff funds to increase the value of U.S. soy meal and oil, to ensure U.S. soybean farmers and their customers have the freedom and infrastructure to operate, and to meet the needs of U.S. soy's customers. As stipulated in the federal Soybean Promotion, Research and Consumer Information Act, the USDA Agricultural Marketing Service has oversight responsibilities for USB and the soy checkoff.

FOR MORE INFORMATION, VISIT: SOYNEWUSES.ORG

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