

# SOY-BASED PAINTS AND COATINGS



**As one of the most readily available vegetable oils in the world, soybean oil continues to be a major ingredient in paints and coatings.**

## HISTORICAL USE OF SOYBEAN OIL

Soybean oil is the most readily available and one of the lowest-cost vegetable oils in the world today. For many years, soybean oil has been a major ingredient in making alkyd resins, which are dissolved in carrier solvents to make oil-based paints. While the production of alkyd resins, finished paints and coatings may involve proprietary formulations, the basic chemistry of converting a vegetable oil into an alkyd resin under heat and pressure is well understood.

With the growing popularity of latex, or waterborne paints, the market for alkyd resins made from soybean oil has declined, particularly in the area of architectural coatings. These low-odor, easy-cleanup products generally cost less but can lack the excellent film-forming and durability of alkyd paints.

At the same time, powder coatings and radiant-cured coatings have seen increased use in factory-applied coatings, replacing low-solids liquid systems. These new coatings – many of which cure through the input of energy in the form of heat, electron-beam, ultraviolet or other sources – contain no solvents.

## CURRENT RESEARCH OBJECTIVES

Research funded by the United Soybean Board (USB) has focused on several areas using soybean derivatives: creating stable, waterborne architectural coatings, stains, and sealers; finding high-performance, low-volatile-organic-compound (VOC) coatings for industrial applications; replacing petrochemical polyols with soy polyol coatings; and developing new 100-percent-solids powder coatings.

All projects currently funded by USB focus on the use of soybean oil chemically modified in some manner. Complementary work is being done to modify soybean oil for use in making new printing-ink formulations such as gravure printing. Funding to support research is made on a competitive basis, with strong preference given to research done with an identified commercial partner.

## OIL MODIFICATION

Soybean oil, as it is commercially available in an unrefined or refined, edible-grade state, is a fairly stable and slow-drying oil



used to provide the curing or drying characteristics provided by the binder part of the coating, or as a reactive diluent with other resins. USB-funded research has explored various means of chemically modifying the oil to enhance its reactivity under ambient conditions or with the input of energy in various

forms to cause the oil to copolymerize or cure to dry film. Some of these forms of modification have included epoxidation, alcoholysis or transesterification, direct esterification, metathesis, isomerization, monomer modification and various forms of polymerization, including heat bodying. The reactive linolenic-acid component of soybean oil, with its double bonds, is more useful than the more predominant oleic- and linoleic-acid components.

## ARCHITECTURAL USES

The majority of USB research projects have focused on developing soy-based compounds useful in making architectural paints, stains and sealers. Various methods of modifying soy are being examined, with expected differences in how soy oil will be used, from an additive in existing latex formulations to a completely novel polymer formulation based on soy oil.





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## RESIN PRODUCTS

Researchers at Eastern Michigan Coating Research Institute have demonstrated significant progress in alleviating yellowing deterioration in soy-based waterborne latex paints. Compared with 100 percent acrylic formulations, the new soy-based resin is equal or better in performance. In addition, no coalescing agent is needed, thereby reducing VOC levels. The new soy-based resin is more economical as a replacement for acrylics.

North Dakota State University has researchers working on soy/acrylate/sucrose resins for use in UV curable coatings as well as new soy/urethane/acrylate resins in thermoset coatings. Also, within UV-cured chemistry, Northampton Community College has developed a new soy/acrylic resin for use in UV-cured clear wood coatings.

Sherwin-Williams paint company has developed a new soy/polyester/acrylic water-dispersible hybrid paint with very low VOC content to be used in architectural and industrial coatings. The new coating takes advantage of soy oil as a more environmentally friendly substitute for traditional solvents/binders.

## NEW FORMULATIONS

New Century Coatings (NCC) has developed a line of soy methyl ester stains, sealers and architectural paints with excellent performance properties. These stains are user-friendly with deep penetration to extend the life of many different substrates. NCC has begun sales to concrete and wood coating retailers through Eco Pro-Cote, which has distributors nationwide. Soy-based roof coatings are currently being marketed by Green Products, Inc., and TKO Coating Inc. leading marketers of environmentally friendly coatings. The white-pigmented coating reflects heat and is superior to asphalt and waterborne emulsions in energy conservation, thereby earning an Energy Star Approval label. Green Products, Inc., also markets new metal and concrete coatings and caulks and adhesives that use soy-based-resin technology. In addition, a new soy-containing paint and mastic remover is available from Green Products.

Rust-Oleum Corporation has completed technology development for new soy-based waterborne clear polyurethane coatings for wood. The intent of the project is to provide a more environmentally friendly stain comparable in performance to oil/solvent-based stains.

PPG Corporation, as part of its new Green Chemistry platform, is developing new soy-based polyols to replace traditional petrochemical-based polyols for use in industrial coatings. A major farm implement

manufacturer has begun testing of new pigmented soy/polyester powder coatings developed by Battelle Corporation. Initial results look promising at both normal- and low-cured temperature conditions on metal substrates.

## INDUSTRIAL COATINGS AND INKS

Much of the research sponsored by USB to develop industrial coatings has equally good applications in printing inks. Starting with a modified oil, such as epoxidized, oxidized or alkali, refined soybean oil can enhance polymerization through the introduction of various energy sources and UV-sensitive monomers. These modified soy oils can be combined with acrylics to be used as effective ink pigment dispersants and wetting agents.

Researchers at Lehigh University have developed a soybean-oil-based, solventless, UV-EB-curable ink for lithography. The research is based on soybean oil and a hard resin in the presence of a cross-linking monomer cured by UV light. A proprietary photoinitiator is being used. Solvent recovery is not necessary because the system is solventless and less-expensive pigments can be used. A major resin manufacturer has expressed interest in trials with this new chemistry.

## SPECIAL-PURPOSE COATINGS

USB is supporting research with the Reichhold Corporation to develop a water-based soy alkyd latex emulsion for use in traffic paints. The traffic paint industry uses mostly acrylic resins in its formulations, and this new soy-based resin could be a significant replacement of these systems.

## ABOUT USB

USB is made up of 68 U.S. farmer-directors who oversee the investments of the soybean checkoff, a U.S. soybean research and promotion program, 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.

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



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