

Biobased Alternatives for Manufacturing Processes

Introduction

Significant economic opportunities exist for Ohio companies to adapt existing manufacturing processes to produce and/or use biobased materials and capture new markets for biobased products.

Ohio companies can achieve additional benefits by using these materials to reduce their operating costs and their environmental, safety and health costs. Use of biobased products often results in dramatic improvements in both environmental impact and worker exposure and safety. Many industries can benefit from the use of biobased products. Some examples include:

- metal finishing;
- molded plastic products;
- fabric industry;
- construction and renovation;
- chemical production and processing;
- metal casting industry;
- food processing;
- agricultural production and processing;
- energy production and transportation; and
- office, school and home maintenance.

The use of biobased products may reduce the generation of hazardous wastes, air emissions and other contaminants of regulatory concern.

What are biobased products? ¹

Biobased products have plant and/or animal materials as their main ingredients. They are made from a renewable resource and, with some exceptions, generally do not contain synthetics, toxins or environmentally damaging substances.

Using biobased products can save money, reduce reliance on fossil fuels such as petroleum, promote stewardship of our natural resources and reduce or eliminate the use of toxic substances.

Using biobased products can save money and reduce reliance on fossil fuels.

Examples of biobased products include:

- cleaning and solvent chemicals;
- lubricants, paints, inks, adhesives and other coatings;
- textiles, non-wovens and vapor barriers;
- wood furniture and wood by-products;
- paper and fiber composite products;
- composite wood extrusions and other construction materials;
- soil preparations;
- insecticides and fertilizers;
- foods, beverages and food supplements;
- leather goods;
- hormones and enzymes; and
- alternative fuels.

Why are biobased products better?

- Job creation - biobased products offer employment opportunities for production and processing of locally produced materials.
- Lower toxicity - biological materials generally are less toxic and are inherently biodegradable.
- Economically advantageous - biobased products can be grown and processed close to their point of use. Non-renewable resources must be extracted and shipped from wherever they are found (many times this is hundreds or thousands of miles from their point of use).
- Renewable raw materials - properly managed (grown, harvested and processed) materials can be a sustainable source of products and energy.

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What manufacturing materials can be replaced by biobased materials?

- Solvents
- Cleaners
- Lubricants
- Coolants
- Adhesives
- Resins
- Polymers
- Coatings
- Construction and Building Materials
- Chemical Feedstocks
- Fuels

Biobased material substitution case studies

*Switch to Biobased Lubricants Reduces Emissions, Costs at Alcoa*²

Through a collaborative research initiative with the U.S. Department of Agriculture (USDA), many Alcoa rolling mills around the world have switched to newly developed biobased lubricants that can reduce volatile organic compound (VOC) emissions by more than 25 percent, improve the work environment and potentially save more than \$4.4 million annually.

Biobased lubricants reduced VOC emissions by more than 25 percent!

Historically, Alcoa used petroleum-based lubricants during the rolling process to lubricate the aluminum and extract heat to maintain the shape of the coils.

Escalating oil costs and Alcoa's emission reduction goals spurred the company's scientists to either find or develop a lubricant substitute that came from a renewable source; was made through a process that was economical and nonpolluting; and met all industry and customer standards for safety and performance.

In 2008, Alcoa's Lancaster, Pennsylvania facility began using lubricants that were 100 percent vegetable-oil-based. Alcoa rolling mills in Texas and Australia are using biobased lubricants, which means they are more than 42 percent vegetable-oil-based. The goal is to move most of the company's 25 rolling mills to biobased lubricants.

If every mill makes the switch, the company can save several million dollars annually on lubrication costs. In addition, a life-cycle analysis showed a drop in VOC emis-

sions of more than 25 percent. The company also may receive significant carbon credits, especially in Europe.

*PureBond®: Formaldehyde-free Hardwood Plywood*³

Columbia Forest Products, in conjunction with Hercules Inc. and Dr. Kaichang Li of Oregon State University, has received a 2007 Presidential Green Chemistry Challenge Award from the U.S. EPA, for the development and commercialization of its PureBond® formaldehyde-free adhesive system for decorative plywood.

PureBond® has replaced traditional urea formaldehyde-based adhesives used in the manufacture of hardwood plywood, the decorative panels commonly used to make kitchen cabinets, casegoods and furniture.

Plant-based adhesive replaced 47 million pounds of urea formaldehyde, reducing hazardous air pollutants by 50-90 percent!

The PureBond formula, which consists primarily of soy flour, was invented by Dr. Li to mimic the protein that marine mussels secrete to attach themselves to rocks and other hard surfaces. Hercules adds to it a proprietary resin that gives plywood, and composites made with it, superior strength and water-resistance.

Columbia began converting to the formaldehyde-free system in 2005, and now all seven of its North American hardwood plywood mills produce PureBond plywood for distribution across the continent, at a price cost-neutral to conventional formaldehyde-based products. Conversion of the plants replaced 47 million pounds of urea formaldehyde, thereby reducing each mill's emissions of hazardous air pollutants by 50-90 percent.

*NOAA Operates Three, 100 Percent Biobased Ships*⁴

The National Oceanic and Atmospheric Administration (NOAA) operates a fleet of research vessels and small boats on the Great Lakes through its Great Lakes Environmental Research Laboratory (GLERL). GLERL's Green Ship Initiative has led the Nation by successfully converting all shipboard systems to biofuels and bio-lubricants. This effort produced the first federal vessel to run completely on non-petroleum products. The marine diesel-powered vessels in the Great Lakes are now fueled by B100 (100 percent) soy biodiesel.

The marine diesel-powered vessels are totally petroleum-free!

All other shipboard mechanical and hydraulic systems have been converted to bio-oils and lubricants (rapeseed and canola) to complete the objective of totally petroleum-free vessels.

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The B100 operational benefits include lower emissions, higher lubricity, cleaner injectors, and cost savings while also improving the work environment of the ship's crew and scientists.

The biodegradable vegetable oils used in crankcase, gear box and hydraulics offer an additional level of environmental protection in the event of a spill or accidental leak. The extensive application of bio-based products demonstrates cost-effective alternatives to the increasing demand on oil.

GLERL's Green Ship Initiative is based on field experience over a broad spectrum of engine, equipment and vessel designs and will be used to advance bio-product usage on other government and scientific vessels well into the future.

*Biobased Resin and Toner*⁵

Laser printers and copiers use more than 400 million pounds of toner each year in the United States. Traditional toners fuse so tightly to paper that they are difficult to remove from waste paper for recycling. They are also made from petroleum-based starting materials.

Biobased toner can save significant amounts of energy and allow more paper fiber to be recycled.

Battelle and its partners, Advanced Image Resources (AIR) and the Ohio Soybean Council, have developed a soy-based toner that performs as well as traditional ones, but is much easier to remove. The new toner technology can save significant amounts of energy and allow more paper fiber to be recycled.

Preliminary life-cycle analysis shows significant energy savings and reduced carbon dioxide (CO₂) emissions. It is estimated that a 25 percent market penetration of this technology could save 9.25 trillion Btu/yr and eliminate more than 360,000 tons of annual CO₂ emissions. The new toner is sold under the trade name BioRez®.

*Biolsoprene® product begins flowing from Genencor to Goodyear*⁶

Biolsoprene® product is based on a revolutionary technology providing an alternative to petrochemically derived isoprene, a key intermediate for synthetic rubber production.

Biolsoprene® product is derived from renewable raw materials, and represents a significant development within the biochemical and rubber industries. Aside from synthetic rubber for tire production, traditional isoprene is used for the production of a wide range of products, such as surgical gloves, golf balls and adhesives. Thus, the potential for Biolsoprene® product is substantial.

Biolsoprene® is an alternative to petrochemically derived isoprene, a key intermediate for synthetic rubber production.

"This is one more step toward a new era where biorefineries will take in biomass and turn out a number of valuable materials, from biofuels and other biochemicals to bioplastics," says Philippe Lavielle, Executive Vice President of Business Development at Genencor. "It signals that we're not just breaking boundaries in technology, but providing real-world alternatives and solutions to the biobased economy."

What incentives and programs are available for exploring manufacturing or use of biobased products?

Ohio BioProducts Innovation Center

The Ohio BioProducts Innovation Center (OBIC), a Third Frontier Wright Center of Innovation, is a research initiative that integrates academia and industry toward the development of renewable specialty chemicals, polymers/plastics and advanced materials. www.bioproducts.osu.edu/

Federal Green Purchasing

The U.S. Department of Agriculture (USDA) manages *BioPreferred*. Created by the 2002 and 2008 Farm Bill, *BioPreferred* includes a preferred procurement program for Federal agencies and their contractors, and a voluntary labeling program for the broad scale consumer marketing of biobased products.

Under the procurement program, *BioPreferred* designates items, or generic groupings of biobased products, that are required for purchase by Federal agencies and their contractors. As a part of this process, the minimum biobased content is specified and information on the technical, health and environmental characteristics of these products are made available on the *BioPreferred* website at www.biopreferred.gov/.

For more information about the benefits of producing and using biobased products, please see the online training module titled, *Utilizing Biobased Products to Enhance Economic and Environmental Performance*, at www.epa.ohio.gov/ocapp/p2/onlinep2training/onlinep2training.aspx or contact the Office of Compliance Assistance and Pollution Prevention at (800) 329-7518.

Biobased Alternatives for Manufacturing Processes

Vendors and directories of biobased products

**The information about the products named in this fact sheet is provided for convenience and is not an endorsement by Ohio EPA. Other similar products may result in similar benefits.*

Biobased USA
www.biobased.us/

BiobasedNews.com
www.biobasednews.com/

Eco Safety Products
www.ecosafetyproducts.com/

BioPreferred Catalog
www.catalog.biopreferred.gov

Building for Environmental and Economic Sustainability (BEES 4.0)
www.bfrl.nist.gov/oae/software/bees/

Soy Products Guide
www.soynewuses.org/ProductsGuide/Default.aspx

Environmentally Preferable Products
www.wbdg.org/design/env_preferable_products.php

References

¹ BiobasedNews.com website, www.biobased.org/

² Alcoa's biobased lubricant case study, www.alcoa.com/sustainability/en/case_studies/bio_based.asp

³ Columbia's PureBond® case study, www.columbiaforestproducts.com/PressReleases.aspx?id=6d77cd52-7647-4c92-9485-9a16d11ad4bb

⁴ NOAA's biobased ship case study, www.glerl.noaa.gov/pubs/brochures/GreenShip.pdf

⁵ BioRez®, Biobased Resin and Toner case study, www.epa.gov/gcc/pubs/pgcc/winners/gspa08.html

⁶ BioIsoprene®, biobased intermediate for synthetic rubber production case study, www.genencor.com/cms/connect/genencor/media_relations/news/frontpage/pressrelease_453_en.htm

U.S. EPA Presidential Green Chemistry Challenge
www.epa.gov/greenchemistry/pubs/pgcc/presgcc.html

Implications of Biobased Fuels and Chemicals for Midwest Manufacturing
<http://bioeconomy.wi.gov/docview.asp?docid=5196&locid=72>

Joint Service Pollution Prevention and Sustainability Technical Library, Green Procurement
www.p2sustainabilitylibrary.mil/

Biobased Products Best Practices Guide
www.soybiobased.org/resources/best-practices-guide-2nd-edition/

Pacific Northwest National Laboratory: Bio-based Product Research
www.pnl.gov/biobased/

National Renewable Energy Laboratory: Biomass Program
www.nrel.gov/programs/biomass.html

Argonne National Laboratory: Chemical and Bioprocess Development
www.es.anl.gov/energy_systems/research/process_technology/process_tech_chemical.html

Argonne National Laboratory: Separative Bioreactor
www.anl.gov/techtransfer/Available_Technologies/Biosciences/SeparativeBioreactor.html

Small Business Innovation Research: Biofuels and Biobased Products
www.csrees.usda.gov/fo/biofuelsandbiobasedproductssbir.cfm

Argonne National Laboratory: Ethyl Lactate Solvents
www.anl.gov/techtransfer/Available_Technologies/Environmental_Research/ethylactate.html

Soy Technologies, LLC
www.soytek.com/