Project GREEEN

IMPACT

Addressing plant industry research and educational needs and sustaining Michigan's plant agriculture industry

Structural Biocomposites from Engineered Corn Straw Fibers and Novel Soy-based Resins

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Project length: 3 years (fiscal years 2000, 2001, 2002)

Biocomposites made entirely from plant and agricultural products can be as structurally strong as glass-reinforced composite materials and less expensive to produce. Products that could be manufactured from these biobased composites range from construction materials such as deck boards and ceiling tiles to interior components of automobiles. Using soybean oil and cellulose fiber from corn stalks to produce biobased composite materials for the manufacturing industry will benefit Michigan's soybean and corn producers and the state's economy. The potential market for biobased materials is growing annually. It is currently about 3 billion pounds per year and valued at $3 to $6 billion for material costs alone.

Objectives

- Modify corn stalks through the ammonia explosion process.
- Identify and characterize soy oil suitable for use in materials.
- Prepare bioplastics (polyurethane) from specially treated plant oil (corn or soy oil).
- Prepare bioplastic composites from corn stalk fiber and biobased soy oil polyurethane matrix.
- Prepare bioplastic composites from other natural fibers such as industrial hemp and jute and the biobased soy oil polyurethane matrix.

Challenges

There are plastic products on the market made from soy oil, but these materials are expensive. Successful rein forcement with biofibers could reduce energy require-ments, increase sustainability and reduce costs over glass-reinforced soy-based composites.

Conclusions

- Polyurethanes containing polyols can be produced from plant oils such as soybean oil. Incorporating corn fibers improves the rigidity of these materials by 150 to 300 percent depending on the fiber content.
- Polyurethanes with thermomechanical properties comparable to those of petroleum-based products can easily be produced. Both flexible and rigid materials can be produced.
- Corn stalk fibers can reinforce the polyurethane structure, increasing its stiffness and glass transition temperature. Using corn stalks improved thermal stability by more than 50 degrees C.
- A U.S. patent was filed in April 2003 for the tech-nology.

Industry impacts

- Soy-based products are renewable resources compared to petroleum-based products, and will be competitively priced with petroleum-based ones because the cost of the starting material is less expensive.
- Using corn fibers results in more energy-efficient an less expensive composite materials. Glass fiber is nearly four times as expensive as cellulose biofiber.
- The technology creates value-added market opportunities beyond food or feed products and may increase income for Michigan corn and soybean producers.
- Structural materials composed of corn and soy products will be more environmentally friendly than petroleum-based products.
- The Michigan durable goods industry will be able to produce sustainable materials as alternatives to petroleum-based materials used for transportation, housing, etc. These will provide additional sources of income.

The future

Researchers will investigate using cellulose fibers derived from native grasses for the structural fiber in composites. Land unable to support food production could support cultivation of perennial native grasses. Seed and fiber could be produced as high value supplemental alternative crops, and additional environmental benefits such as restoring soil structure and reducing pollution could be possible.

Funding partners

Project GREEEN awarded $50,000 to this project. The direct support leverage factor for this project was 0.

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For more information on this project, visit <http://www.greeen.msu.edu/July03FINAL/01-037.pdf>.