Plant-based building materials may boost energy savings

September 24 2014, by Leslie Minton

Over a three-year period, University of North Texas researchers developed and tested structured insulated panel building materials made from kenaf, a plant in the hibiscus family that is similar to bamboo. Kenaf fibers are an attractive prospect because they offer the same strength to weight ratio as glass fibers. The kenaf materials, including composite panels, provide up to 20 percent energy savings, reduce energy consumption and reduce overall carbon footprint compared to fiberglass or steel and Styrofoam products, their studies show. Credit: University of North Texas

Scientists worldwide are turning to plants as a resource for biodegradable, renewable and environmentally friendly products and materials that can reduce landfill waste, help the environment and cause little to no damage to natural ecosystems.

Over a three-year period, University of North Texas researchers developed and tested structured insulated panel building materials made from kenaf, a plant in the hibiscus family that is similar to bamboo. Kenaf fibers are an attractive prospect because they offer the same strength to weight ratio as glass fibers.

The researchers found that the kenaf materials, including composite panels, provide up to 20 percent energy savings, reduce energy consumption and reduce overall carbon footprint, compared to fiberglass or steel and Styrofoam products.

The study to develop kenaf-based building materials was led by Nandika D'Souza, a professor in UNT's College of Engineering, with grant funding from the National Science Foundation. The building materials were tested at UNT's Zero Energy Laboratory in 2012. The laboratory is a testing ground for current and future sustainable materials and technologies.

A low-cost process to prepare kenaf for use as a building material was developed by UNT Associate Professor of Biology Brian Ayre and University of California Riverside Professor Michael Allen. The process involved using a microbial solution to extract and prepare plant fibers. Kenaf is soaked in the microbial solution, and the microbes dissolve everything but the essential plant fibers.

Researchers found that using the microbial solution minimized water absorption and created a 40-percent increase in mechanical properties over steam-processing the plant fibers, a common alternative used to

create other plant fiber products.

"The development of natural fiber alternatives to fiberglass, and plant-modified structural foam, offers a zero volatile compound option for home, automotive and consumer applications," D'Souza said.

"None of this would have been possible without the collaboration of our interdisciplinary team of plant biologists; construction engineers; and materials, mechanical and energy engineers and their collective recognition of, and contribution to, the intellectual value of this work," she said. "Plant biologists determined a new method to process grown fiber that materials and mechanical engineers determined had remarkable physical properties and architectures. Construction engineers enabled the building of the housing using the panels."

D'Souza and her research team have been studying kenaf as an alternative to glass and other synthetic fibers for years.

This work is a project in the Farmer-Academic-Industry Partnership for the Development of Sustainable, Energy Efficient, Multifunctional Bioproducts for the Built Environment. Hands-on activities with fourth to 12th-grade children through outreach camps, undergraduate and graduate student education and scholarship further broadened the project's impact.

The team also worked with industrial partners as part of the National Science Foundation's Partnership for Innovation program. Kengro, based in Mississippi, is a bioremediation and absorption product manufacturer, and Rubberlite, based in Virginia, is rubber and plastic manufacturer.

Kengro grew fibers over multiple acres to help scale up the project and Rubberlite provided a recycled tire-based structural foam for the panels that led to reduced energy consumption in the zero net energy model.

The research team's next step will be to use the materials in a zero net energy model home construction at UNT's Discovery Park campus.

Provided by National Science Foundation