New wood-plastic composites to boost industry, help use waste products

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Wood science researchers in the College of Forestry at Oregon State University have developed new wood-plastic composites that are stronger and less expensive than any similar products now available – a major breakthrough for this growing industry.

Wood-plastic composites, often used for such things as outdoor decking, are one of the fastest growing components of the wood composites industry. Some projections have suggested that these products, which were used for less than 1 percent of decking in the mid-1990s, may capture 20 percent of that market by 2010.

"Composite products made from wood and plastic are highly desirable for their low maintenance and ability to resist rot," said Kaichang Li, an associate professor in the OSU Department of Wood Science and Engineering. "But their use has been limited because of high cost and low strength, a result of inadequate adhesion between the wood fibers and plastic."

Fundamentally, Li said, this is because wood and plastic are like oil and water, and do not mix well. Wood is hydrophilic – it absorbs water – and plastic is hydrophobic, repelling it. A "compatibilizer," typically a polymer that bridges the interface between the wood and plastic in these products, improves stress transfer and increases their strength and stiffness.

The new wood-plastic composites use superior compatibilizers

developed in Li's laboratory, and an innovative technology for mixing wood and thermoplastics such as nylons, in which the melting temperature of the plastic is higher than the wood degradation temperature.

With this approach, the new wood-plastic composites can use very inexpensive plastics such as those found in old carpet fibers – about 4.4 billion pounds of which are now wasted every year, going into landfills where they are extremely slow to biodegrade and pose a significant waste disposal problem.

They could also open the door for improved utilization of low-grade woody biomass from needed thinning of Oregon forests, which is increasingly being done to improve forest health and prevent catastrophic wildfire. A better "value added" use for that wood fiber could be important, experts say.

The technology may prompt a major expansion of the wood-plastic composite industry into new types of products and uses, experts say. In particular, such products may help further replace wood treated with chemical preservatives, some of which have already been banned due to health and environmental concerns.

"This new material is far superior to anything currently available in the wood-plastic composite market," Li said. "It should become an important new product and an industry with the potential for rapid growth."

So far, the research on the new product has only been done at a laboratory scale. Findings have been published in the Journal of Applied Polymer Science and other professional publications.

Scientists now want to duplicate the findings at something much closer

to an industrial scale, which they will be able to do with the contribution to OSU of a $180,000 extruder from ENTEK, a Lebanon, Ore., firm that manufactures extruders for bio-based composites.

A local startup company in Corvallis, Sustainable Industries Group, LLC, is also supporting the research. And the Oregon Nanoscience and Microtechnologies Institute has provided support to get the new equipment installed, which also has the capability to produce nanocomposite materials.

The new wood-plastic composites are just the latest advance with new adhesives and materials from Li's research programs. In the past few years, his research also began a revolution in wood adhesives. Inspired by the way mussels on the ocean shore cling to rocks despite pounding waves, Li found their secret – an unusual adhesive that could be mimicked by modifications of abundant and inexpensive soy protein. The modified soy protein can be used as an adhesive for production of plywood, particleboard and other wood composite panels, without giving off the carcinogenic formaldehyde fumes common with traditional wood adhesives.

That patented adhesive has already been commercially used for production of wood composite panels by Columbia Forest Products, the largest producer of decorative interior panels in the nation. All plywood plants of Columbia Forest Products have been converted to using the new technology in face of rapidly rising demand.

And one of the latest innovations, still in early research phases, is cellulose crystals from wood for use in rubber products. Products such as tires now often use silica in their manufacturing processes, which can create waste disposal concerns. The use of wood – a renewable material – might address that problem and some day have the nation driving on tires made at least partially out of trees.

Source: Oregon State University