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Daily Commercial News
by ConstructConnect

Construction Corner: Could wood be the new Styrofoam?

Korky Koroluk April 6, 2018

It's only been a few weeks since we learned of plans to build a bridge in California using concrete that has been infused with nanocrystals from wood.

Research can be a slow process, at times even tedious. Publication of results often seems to be just as slow. That's why there is often a time lag between publication of papers dealing with any one particular topic.

And that's why I was surprised recently when another example of wood-based nanotechnology of interest to the construction industry popped up on my screen. This latest one is at least as intriguing as the first one was.

If you're interested in insulation, you may be surprised to learn that researchers have found that by stripping away all the filler material in wood, leaving just their fibres, the resulting "nanowood" material outperforms just about all existing insulation. Wood, it seems, might be the new Styrofoam.

A research team at the University of Maryland developed this new nanowood simply by exposing wood to three simple, cheap chemicals: sodium hydroxide, sodium sulfite and hydrogen peroxide. The team discovered these substances strip out the cell walls in wood (which are made up of lignin and hemicellulose), leaving behind just the skeletal nanofibres of cellulose.

It seems the unusual properties of the resulting nanowood can be attributed to the fact that these nanofibres are mostly parallel to one another. And the solid filler material in wood that will usually convey heat is gone, replaced by air. Poorly conducting air.

As well, the parallel alignment of fibres dissipates any heat that does penetrate. It can't become concentrated.

During lab tests, the research team found the substance's capacity to keep heat from penetrating from one side to the other is on par with Styrofoam, which is hundreds of times better at blocking heat than wool, glass or epoxy. The team also found that the nanowood is extremely strong, withstanding loads as high as 13 megapascals. That's the equivalent to almost 2,000 pounds per square inch.

The sample researchers tested was small — just 15 centimetres long and two centimetres thick — but they say it could be made in virtually any size or shape. Because the material is so versatile, it could be used to insulate a wide range of things, from entire buildings to very small computing components.

Since it is extremely light, it could be used where weight is important: aircraft engines, or cars, even spaceships.

And it's cheap.

Liangbing Hu, who led the research team, says just seven dollars' worth of chemicals would be enough to make a square metre of nanowood.

There is also an important ecological benefit because it's made from ordinary, recyclable wood. For its experiments, the team used American basswood, but Hu says any wood would do.

"Wood stores rather than emits carbon dioxide," he says.

Jeffrey Youngblood is a professor of materials engineering at Purdue University. He was involved in the research involving cellulosic nanocrystals for the concrete to be used in the California bridge this year. But his research interests are focused on the production of any industrially useful products derived from wood.

Referring to the work done at the University of Maryland by Hu and his team, Youngblood says it "really shows that nature has outperformed humankind, once again.

"We just have to unlock the secrets."

With proper treatment, he says, "wood can become stronger and more insulating than commonly used insulation, such as fibreglass for houses."

The research paper published by Hu and his team makes prominent mention of nanowood's biodegradability, its high mechanical strength and the ease of manufacture. In fact, Hu has already spun off a company called Inventwood to commercialize the product.

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