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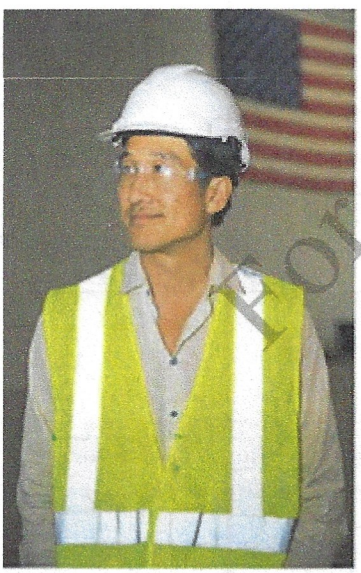
CHARLOTTE KESL FOR WSJ (3) An industrial robot that feeds boards into an assembly line is tested at InventWood's Frederick, Md., facility.



InventWood Chief Executive Alex Lau plans to initially market Superwood as siding.

Superwood may be able to replace plastic, aluminum and carbon fiber.

Bulletproof and Fire-Resistant. Could Superwood Replace Steel?

KEYWORDS |

CHRISTOPHER MIMS

Waste wood scraps, transformed at the molecular level, could become heavy-duty building materials

Frederick, Md.

Inside a cavernous warehouse, in the midst of a half-finished industrial park not far from a Civil War battleground, robot arms the size of Cadillac Escalades are rehearsing their moves for a tightly choreographed dance that will commence later this summer.

A strange new substance will begin rolling off the assembly line: soft wood transformed at the molecular level into something stronger than steel yet one-sixth the weight.

Its name is, maybe, a bit on the nose: Superwood.

Its maker, startup InventWood, says it could someday replace steel I-beams in the skeleton of a building, while being impact-resistant enough for bulletproof doors. It's also fire resistant—the outside carbonizes in a way that protects the inside, and it won't sag in a fire like steel. It would be a coup if the company can replace a good chunk of construction-grade steel and concrete with scrap wood that is otherwise unusable waste.

Superwood is also, I can attest, beautiful. The densification process deepens its color and brings out its natural grain. Alex Lau, InventWood's chief executive, handed me several of the oddly lustrous, improbably stiff boards as we toured the company's test lab and under-construction factory in central Maryland.

In my hands, Superwood feels like an otherworldly object—amazingly strong and light. I could easily snap an eighthof- an-inch-thick pine board in half (not to brag), but a sheet of Superwood with the same dimensions merely flexes slightly, no matter my effort. A foot-long stick, just a half-inch thick, was so rigid I couldn't bend it at all.

Sometime this summer, the world's first Superwood factory will go online. On my tour, I saw its beginnings, from a lab setup to a pilot system the size of a school gymnasium, then finally the gigantic factory floor, with machinery that towered over me. Soon, it will be churning out Superwood at an industrial scale, and the test of this new material's marketability will begin. The company says customers will be able to buy it for about the same price as high-end building facades, or tropical hardwood.

"Engineered" wood is big right now. The industry has long used scraps to make those familiar sheets of "oriented strand board" (better known as OSB), which differs from plywood but is still made with glued-together layers. Now researchers and engineers are evolving the concept.

Wood giant Weyerhaeuser just broke ground on a $500 million plant in Arkansas to create TimberStrand, which is made from scrap but can be stronger than conventional lumber. And Invent-Wood is drawing on the industry's expertise: The company's plant manager came from Weyerhaeuser.

Some builders are experimenting with cross-laminated timber— carefully layered wood planks—to replace smaller steel or concrete structural elements. This has led to things like wooden skyscrapers and the warm, inviting, $2 billion airport terminal in Portland, Ore.

This movement toward everlarger wooden buildings has depended on updating building codes and convincing people they won't go up in flames, says Caitlin Mueller, director of the Building Technology program at Massachusetts Institute of Technology. Properly designed, engineered wood buildings are quite safe in fires, she adds.

Traditional stick-built construction, with thin boards and ready access to oxygen, isn't. "You're basically making a little campfire," she says.

Liangbing Hu is the Willy Wonka of engineered wood. Now a professor at Yale, he previously served as director for the Center for Materials Innovation at the University of Maryland. There, he invented transparent wood, wood that could be molded like plastic, and wood that bounces like a rubber ball. All of his inventions involved messing with wood at the molecular level.

In 2018, Hu and his colleagues made waves among material scientists when they presented Superwood's enabling technology in a paper in Nature.

To create Superwood, they started by cooking and chemically treating the wood. Then they compressed it, so a typical board becomes 1/4 as thick. Hu found that the process pushed cellulose fibers closer together and collapsed the channels that make up a tree's circulatory system.

One challenge for Superwood: While it's much stiffer than regular wood, it's still not as stiff as steel or concrete, so buildings have to be designed not to flex too much, says Mueller.

After its initial buzz, most wrote off Superwood as a curiosity. Not Lau. He reached out to Hu and helped commercially launch InventWood in 2021. The startup nabbed a $20 million scale-up grant from the Energy Department the following year, and has also received $30 million in financing from a variety of investors.

Today, InventWood is bringing Superwood to market with a 90,000-square-foot manufacturing facility—and it's already planning a new facility three times as large.

In a recent tour of the nearly ready factory, I saw the entire process from start to finish. The company asked me not to reveal details about how it makes Superwood, because of their fear that companies overseas—Lau wouldn't say where, but it was obviously China—would copy their process.

Focusing on profitability, Invent-Wood will initially market Superwood as siding, which requires minimal certification, says Lau. It could also be used as decking—it has longevity and weather resistance similar to tropical hardwoods— as well as fencing and window mullions.

Establishing that Superwood can be used as structural elements in buildings requires certification by the company's partners, which include builders and architects. It also requires new building processes, since the stuff is strong enough to eliminate the steel joinery that is typical in engineered wood structures. Future buildings could be built with ancient techniques— think pegs made out of Superwood hammered into beams made from it, says Lau. Applications go beyond construction. Superwood is like carbon fiber, but less brittle, and carbon fiber is already used in everything from sports equipment and tennis shoes to race cars and airplanes. The last notable wooden airplane was the De Havilland Mosquito, in WWII, but in a future of eVTOLs, otherwise known as "flying cars," a material like Superwood could be in demand.

And who wouldn't want a laptop or smartphone made of deeply hued, extra-strong wood? Machining it requires new techniques, but those aren't out of the question, says Lau.

As my tour of InventWood's factory wound down, Lau gestured to the steel endoskeleton of his company's brand new space. Someday, he said, even this factory could be constructed from the same material it produces. For now, though, there is no shortage of partners lining up to test this new substance, and they take priority.