Bacteria Break Down Waste, Build Bioplastics

The same type of bacteria that help break down paper mill waste could also become an increasingly viable source of environmentally friendly biopolymers that can be used to make bioplastics, glues, and composite building materials.

WSU Professor ***Mike Wolcott*** has teamed with fellow WSU Professor and Agricultural Research Center scientist ***Jinwen Zhang,*** and other scientists and engineers at the WSU Wood Materials Engineering Laboratory, University of California-Davis, and the Idaho National Engineering Lab to focus on a class of naturally occurring bacteria that produce and store polyhydroxyalkanoates (PHAs) which are chain-like molecules, called polymers, that are found in plastics, glues, wood, plants, and even in mussel shells. "Polymers are what bind the fibers together in wood or plants or plastics," Wolcott explained. "Until now, the plastics we've been using have been petroleum based. We could reduce our dependence on international oil if we could make the way we produce PHAs more cost effective and find new uses for a less-pure version of them."

Firms in the U.S., China, and Brazil have commercially produced PHAs using fermentation techniques for many years. But, Wolcott said, the current process is expensive both financially and environmentally.

"Commercially produced PHAs are fairly expensive when used in their purest form," he said. "The bacteria feedstock is expensive because it is raised on glucose, and the chemicals used to extract the polymer from the bacteria are expensive and not very environmentally friendly."

Wolcott's research group is attacking both challenges. They are exploiting the fact that the same types of bacteria that are being grown commercially for PHAs are also used by paper mills in their water reuse sites to convert phosphates into phosphorous.

"The production of PHAs by those bacteria has been fairly low," he said. "One challenge is to find the right environmental conditions at the wastewater treatment site to enhance production—we are trying to get these guys as fat as possible. By regulating the treatment process, we can substantially increase the amount of PHAs produced, in addition to reducing the phosphates to a very low level."

Wolcott also has developed composite materials that can utilize a simple centrifuge process for extracting the PHAs into a crude form. This physical process is much less damaging to the environment and much less expensive than the chemical extraction process currently used. When used in building materials, the composites can provide a substantial market for the crude PHAs.

The result of the group's work? A more plentiful supply of crude PHAs.

Wolcott's team is also working on finding new uses for less-pure PHAs. He has received grants from both the National Science Foundation and the U.S. Department of Energy to pursue production of PHAs and new composite materials made with PHAs. Some of those materials include new building materials that potentially could replace wood or traditional plastics. "We are working with the Navy, for example, on new materials for docks, piers, and bridges," Wolcott said.