Cornfields could play a role in recycling old electronics

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Credit: Ames Laboratory

A new biochemical leaching process has been developed that uses corn stover as feedstock, and recovers valuable rare earth metals from electronic waste.

It's nothing new to Iowans that corn and its byproducts can be used for high-tech applications ranging from bioplastics to ethanol. Using corn stover for what is essentially a mining process may seem like a stretch even for Iowa – the world's biggest producer of corn—but the new process does indeed use stover as a key ingredient. The research was directed by the U.S. Department of Energy's Critical Materials Institute (CMI) headquartered at the Ames Laboratory on the Iowa State University campus, and carried out by scientists at Idaho and Lawrence Livermore National Laboratories, and Purdue University.

David Reed, Yoshiko Fujita, and Vicki Thompson hail from Idaho National Laboratory's Biological and Chemical Processing Department, and are researchers for the Critical Materials Institute. They are part of a CMI team whose work is devoted to finding a way to tackle a growing environmental and manufacturing supply problem—the ever-increasing amount of electronic waste, like discarded cell phones and hard drives, and the potential for recovering and recycling high demand rare-earth metals to be used again in manufacturing.

Hydrometallurgy is a liquid chemical process used to extract metals from ores, recycled, or residual materials. But traditional leaching methods already in use by the mining industry are not a great choice for recycle and recovery methods for a number of reasons, said Thompson, who is a Distinguished Staff Engineer at INL.

"They typically are sulfuric acid-based which is an environmental hazard, and use heat and pressure, which makes them costly," she said. "From both an environmental and economic perspective, we needed to find a more efficient process."

They found it by capitalizing on the abilities of a strain of Gluconobacter bacteria, an acid producing microbe.

"They have evolved over billions of years," said Thompson. "They weren't meant for this work but they do a darn good job." The resulting organic acids are one of the active ingredients in dissolving and extracting the rare earth metals from waste materials. But the bacteria are hungry little things, and as their name implies, they like the sweet stuff—glucose, or sugar.

"They thrive in sugar-rich environment. They like simple sugars that are easy to eat, easy to break down, just like we like Twinkies and donuts," said Reed, the principal investigator heading up the research. "But refined glucose accounts for 44 percent of the expense of this recovery method, so we started looking for lower cost alternatives."

Fujita, who is the lead scientist for CMI's environmental sustainability research efforts, said the group turned to investigating agricultural waste streams like potato peels and apple processing water (local to the scientists and plentiful in Idaho) and corn stover (local to CMI headquarters in Iowa) to convert into the basic sugars needed to feed the metal mining bacteria. Corn stover was the winner, being relatively easy to convert to usable sugars, and cost competitive for larger scale commercialization.

"CMI knows that it needs to invent solutions to critical materials challenges that are economically and environmentally sustainable," said CMI director Alex King. "In this case, meeting those national goals can also benefit Iowa's farmers."

Provided by Ames Laboratory