

# Researchers use corn waste to generate electricity

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After the corn harvest, whether for cattle feed or corn on the cob, farmers usually leave the stalks and stems in the field, but now, a team of Penn State researchers thinks corn stover can be used not only to manufacture ethanol, but to generate electricity directly.

"People are looking at using cellulose to make ethanol," said Bruce E. Logan, the Kappe professor of environmental engineering. "You can make ethanol from exploded corn stover, but once you have the sugars, you can make electricity directly."

Logan's process uses a microbial fuel cell to convert organic material into electricity. Previous work has shown that these fuel cells can generate electricity from glucose and from municipal wastewater and that these cells also can directly generate hydrogen gas.

Corn stalks and leaves, amassing 250 million tons a year, make up a third of the total solid waste produced in the United States. Currently, 90 percent of corn stover is left unused in the field. Corn stover is about 70 percent cellulose or hemicellulose, complex carbohydrates that are locked in chains. A steam explosion process releases the organic sugars and other compounds in the corn waste and these compounds can be fed to microbial fuel cells.

The microbial fuel cells contain two electrodes and anaerobic bacteria -- bacteria that do not need oxygen -- that consume the sugars and other organic material and release electrons. These electrons travel to the

anode and flow in a wire to the cathode, producing electrical current. The water in the fuel cell donates positive hydrogen atoms that combine with the electrons and oxygen to form water.

The microbial fuel cells were inoculated with domestic wastewater and a nutrient medium containing glucose, the researchers report in the journal *Energy and Fuels*. Once established, the bacteria colonies were fed the sugary organic liquid obtained from steam exploding of corn stover.

The researchers, who include Logan, Yi Zuo, a Penn State graduate student in environmental engineering, and Pin-Ching Maness, a senior scientist with the National Renewable Energy Laboratory, report that "the conversion of organic matter to electricity, on the basis of biological oxygen demand removal, was relatively high with greater than 93 percent of the biological oxygen demand removed."

In essence, there is no organic matter left to cause problems when disposing of the remaining liquid because there is nothing left to oxidize. The process converts all the available energy to electricity. The electrical production is about one watt for every square meter of surface area at about 0.5 volts. A typical light bulb uses 60 watts. To increase wattage, the surface area needs to increase. To increase voltage, fuel cells can be linked in series.

"Producing electricity from steam-exploded corn stover adds to the energy diversity of our portfolio," said Logan. "Electricity can be used to pump water uphill for later use, directly run light, heat and equipment or electrolyze water to create hydrogen."

The Penn State researcher and colleagues also have used microbial fuel cells and wastewater to produce hydrogen gas directly.

Source: Penn State

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