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It Pays To Convert Food Processing Wastewater to Energy Source

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University Park, Pa. - In laboratory tests, Penn State environmental engineers have shown that wastewater from a Pennsylvania confectioner, apple processor, and potato chip maker can produce hydrogen gas worth $80,000 a year or more.

Steven Van Ginkel, doctoral candidate, and Dr. Sang-Eun Oh, postdoctoral researcher in environmental engineering, conducted the tests.

"In addition to hydrogen, which can be used as a fuel and industrial feedstock, methane, the main component of natural gas, can be generated from the wastewaters," he notes. "Over 10 billion BTUs of energy from methane could be produced every year at a single one of these food processing plants."

Van Ginkel adds, "By extracting hydrogen and methane from their wastewaters, these plants can also reap significant savings by not needing to aerate. Aeration makes up 20 to 80 percent of wastewater treatment costs."

The researchers presented the Penn State team's findings in a poster, "Turning Pennsylvania's Waste Into Energy," today (Feb. 5) at Penn State's Hydrogen Day, a special event for industry and government representatives. His co-authors are Dr. Oh and Dr. Bruce Logan, director of the Penn State Hydrogen Energy Center and the Kappe professor of environmental engineering.

In the tests, Van Ginkel and Oh added hydrogen-producing bacteria to samples of wastewater from the Pennsylvania food processors. The bacteria were obtained from ordinary soil collected at Penn State and then heat-treated to kill all bacteria except those that produce spores. Spores are a dormant, heat-resistant, bacterial form adapted to survive in unfavorable environments, but able to begin growing again in favorable conditions.

"The spores contain bacteria that can produce hydrogen and once they are introduced into the wastewater, they eat the food in the water and produce hydrogen in a normal fermentation process, "Van Ginkel says.

Keeping the wastewater slightly acid helps to prevent any methane-producing bacteria from growing and consuming hydrogen.

After only a day of fermentation in oxygen-free or anaerobic conditions, the hydrogen-producing bacteria fill the headspace in the fermentation flasks with biogas containing 60 percent hydrogen and 40 percent carbon dioxide.

In the second stage of the process, the acidity in the wastewater is changed and methane-producing bacteria added. The bacteria eat the leftovers, grow and generate methane.

The solid material or sludge left over from fermentation is only one- fourth to one-fifth the volume from typical aerobic treatment processes.

Van Ginkel says, "Using this continuous fermentation process, we can strip nearly all of the energy out of the wastewater in forms that people can use now. While this approach has high capital costs at the outset, our calculations show that it could pay off well both environmentally and financially for some food processors in the long run."

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