Fuel cell designed to produce hydrogen and clean waste water

Researchers from Pennsylvania State University (Penn State) (University Park, Pennsylvania) and Ion Power, Inc. (New Castle, Delaware) have developed an electrically assisted microbial fuel cell (MFC) that reportedly produces high yields of hydrogen from waste water while cleaning the waste water.

"While there is likely insufficient waste biomass to sustain a global hydrogen economy, this form of renewable energy production may help offset the substantial costs of wastewater treatment as well as provide a contribution to nations able to harness hydrogen as an energy source," says Penn State Professor of Environmental Engineering Bruce Logan. Logan developed the modified MFC along with Penn State postdoctoral researcher Hong Liu based on an idea by Ion Power President Stephen Grot.

The researchers claim that their process is unprecedented because it gives bacteria enough energy to produce four times as much hydrogen from biomass as they could with conventional fermentation alone. Bacteria in conventional fermentation can convert carbohydrates into only a small amount of hydrogen, which is accompanied by fermentation end products such as acetic acid (CH₃COOH) and butyric acid (CH₃CH₂CH₂COOH). Logan, Liu, and Grot overcome this "fermentation barrier" by adding approximately 0.25 V to the bacteria. The tiny amount of electricity converts the acetic acid into carbon dioxide (CO₂) and hydrogen, according to the researchers.

" Basically, we use the same microbial fuel cell we developed to clean waste water and produce electricity," says Logan. "However, to produce hydrogen, we keep oxygen out of the MFC and add a small amount of power into the system." He adds that, unlike conventional fermentation, the process is not limited to using only carbohydrate-based biomass for hydrogen production. "We can theoretically use our system to obtain high yields of hydrogen from any biodegradable, dissolved, organic matter—human, agricultural, or industrial waste water, for example—and simultaneously clean the waste water," he explains.

Logan is optimistic that the invention could ultimately offer wastewater treatment plant operators two primary benefits: having the ability to treat waste water without using oxygen and being able to make a profit selling the hydrogen. In the meantime, he and his colleagues will continue to develop the technology, which is presently in the laboratory prototype stage. "We are trying to improve hydrogen yields and find the best method for scaling up to larger systems," he concludes.

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