Volt-jolt harvests hydrogen from wastewater

Adrian Burton

US scientists report that applying a small voltage across the electrodes of a completely anaerobic microbial fuel cell (MFC) can increase the amount of hydrogen produced by its resident bacteria by up to 300% (Bio Sci Tech. DOI: 10.1216/BSM04-07-26). The finding brings the use of MFCs as a clean, economic energy source closer to reality and parallels the recent advances made in MFc electricity production (see "Dispatches" in Frontiers 2005; 4: 18).

MFCs use bacteria to break down wastewater organic material, and in doing so produce electrons as hydrogen that can be harvested at the appropriate electrode. "Hydrogen as a vehicle fuel on which many hopes are pinned", says study leader Bruce Logan (Professor of Environmental Engineering, Pennsylvania State University, State College, PA). "It could be produced from the hydrocarbons of water, but this requires large energy inputs. In MFCs, bacteria produce hydrogen cheaply from waste organic material such as sewage. So not only do we get an inexpensive fuel, we clean up the environment at the same time."

Until now, the problem in producing hydrogen this way has largely been the inability of fuel-cell bacteria to break down the "dead-end products" of fermentation, such as acetic and butyric acids - compounds still rich in hydrogen. "In this new, completely anaerobic system, we assist the bacteria to break down acetate by increasing the electrochemical potential they achieve with a 250 mV input across the electrodes", explains Logan. "This added potential helps the protons and electrons produced during metabolism to form hydrogen; making it energetically feasible for the microbes to break down acetate.

It developed on a large scale, this tiny input of electricity could be provided free by a single waste water, or even by a current-producing MFC.

What makes this technology attractive is that it takes ten times fewer energy terms than producing hydrogen by electrolysis and uses wastewater as a source of energy. "There is probably insufficient wastewater available to base a hydrogen economy on these systems", adds Logan, "but they may well produce enough to other water-treatment cases and provide a cost competitive supply of extra fuel."

"Provided the hydrogen is pure enough, this technology could be off great economic and social potential", comments Kenneth Babich (Researcher, Ghent University, Belgium). "Closed MFC-based technology creates opportunities for both small- and large-scale energy generation out of waste. Only the future will tell which energy source we will favor - electric or hydrogen gas."

Australia calls ships of the desert

Claire Miller

Pertinent thought is bringing wild camels in from the Australian desert, and into the firing line of wildlife authorities keen to curb rising numbers. Roger Wicks, South Australia's Executive Director of natural resource management (Adelaide), notes that the state's estimated 60,000 feral camels are doubling in number every 8 years, causing problems for humans and native wildlife. "They are putting huge grazing pressure on a pretty fragile environment, and they are taking the water, so they are competing with native animals", explains Wicks. "They come into the national parks and degrade the environment, taking off all the cover in country that wasn't designed to no camels at all."

South Australia's northwest is also home to two Aboriginal communities who live on the land, says Wicks. "They rely very much on rock holes for water, as do the wallabies and kangaroos, but the camels drink them dry. Then, if the camels are in poor condition and die in the holes, it can become quite messy. So it is not a good news story - the camels are a major problem for the Aboriginal out there."

Controlling numbers is difficult in Australia's vast outback, where locating herds is like searching for a needle in a haystack. However, the dry spell is driving the camels south into pastoral country in search of water, making them relatively easy to find, as up to 200 may cluster around livestock watering structures.

An aerial cull was initiated in May, while pastoralists are doing their bit by rounding up and slaughtering the camels for over- ers and meat markets and pet food. "We are always trying to keep the numbers down, but you have to take advantage of these sorts of times to be able to do it", explains Wicks. Although the aim is to reduce numbers by 10%, "if we get 3000, we will have done really well", he acknowledges.

Camels were originally imported into Australia in the 1800s to provide desert transport and communication, but were set free by their handlers following the arrival of powered vehicles in the early 1900s. It is estimated that approximately 500,000 feral camels now roam Australia's outback.

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