Sweet success for pioneering hydrogen energy project

Coupling of Bio-H2 made by fermentation of confectionery waste to the operation of a PEM fuel cell used to drive an electrical device.

Bacteria that can munch through confectionery could be a valuable source of non-polluting energy in the years ahead, new research has shown. In a feasibility study funded by the Engineering and Physical Sciences Research Council, bioscientists at the University of Birmingham have demonstrated that these bacteria give off hydrogen gas as they consume high-sugar waste produced by the confectionery industry.

The hydrogen has been used to generate clean electricity via a fuel cell. Looking to the future, it could also be used to power the hydrogen-fuelled road vehicles of tomorrow. There is increasing recognition that, over the coming decades, hydrogen could provide a mainstream source of energy that is a safe, environmentally friendly alternative to fossil fuels.

This was a highly successful laboratory demonstration of bacterial hydrogen production using confectionery waste as a feedstock. The waste was supplied by Birmingham-based international confectionery and beverage company Cadbury Schweppes plc, a partner in the initiative. An economic assessment undertaken by another partner, C-Tech Innovation Ltd, showed that it should be practical to repeat the process on a larger scale.

As well as energy and environmental benefits, the technique could provide the confectionery industry (and potentially other foodstuff manufacturers) with a useful outlet for waste generated by their manufacturing processes. Much of this waste is currently disposed of in landfill sites.

In this project, diluted nougat and caramel waste was introduced into a 5 litre demonstration reactor (although other similar wastes could be used). The bacteria, which the researchers had identified as potentially having the right sugar-consuming, hydrogen-generating properties, were then added.

The bacteria consumed the sugar, producing hydrogen and organic acids; a second type of bacteria was

introduced into a second reactor to convert the organic acids into more hydrogen. The hydrogen produced was fed to a fuel cell, in which it was allowed to react with oxygen in the air to generate electricity. Carbon dioxide produced in the first reactor was captured and disposed of safely, preventing its release into the atmosphere.

Waste biomass left behind by the process was removed, coated with palladium and used as a catalyst in another project, funded by the Biotechnology and Biological Sciences Research Council (BBSRC), aimed at identifying ways of removing pollutants such as chromium (VI) and polychlorinated biphenyls (PCBs) from the environment. The reactors used by this parallel initiative also required hydrogen and this was supplied by the confectionery waste initiative too, further underlining the 'green' benefits offered by the new hydrogen production technique.

Professor Lynne Macaskie of the University of Birmingham's School of Biosciences led the research team. "Hydrogen offers huge potential as a carbon-free energy carrier," she comments. "Although only at its initial stages, we've demonstrated a hydrogen-producing, waste-reducing technology that, for example, might be scaled-up in 5-10 years' time for industrial electricity generation and waste treatment processes."

The team is now engaged in follow-up work which will produce a clearer picture of the overall potential for turning a wider range of high-sugar wastes into clean energy using the same basic technique.

See the new technology in action at http://bst.portlandpress.com/bst/033/bst0330076add.htm. This video clip shows gas from the reactor being fed to a fuel cell, producing electricity that enables the electric fan to turn.

Source: Engineering and Physical Sciences Research Council