US scientists have developed a fuel cell that uses the pollution from abandoned metal and coal mines to generate electricity. Bruce Logan, collaborating with Shaoan Cheng and Brian Dempsey, all from The Pennsylvania State University, combined previous work to devise new ways of combating the problem of Acid Mine Drainage (AMD) - acidic water draining from abandoned mines.

**Logan's previous work** focused on developing microbial fuel cells to harness the energy from chemical reactions controlled by bacteria. The team realised that Logan’s fuel cell design could also use this acidic waste. However, with AMD the bacteria are not used in the microbial fuel cell. Instead, the new cell generates energy from a chemical reaction that occurs naturally when the polluted water comes into contact with oxygen.

AMD is a serious environmental problem that threatens the health of plants and animals as well as the safety of drinking-water supplies. It is expensive and difficult to combat, with large quantities of chemicals often being used to neutralise the acid. This fuel cell is able to combat AMD whilst providing a source of power at the same time.

As well as being acidic, AMD contains iron. When exposed to oxygen, this iron reacts releasing energy that can be used to generate electricity. Electricity generated using Logan’s fuel cell could, for example, power a device to pump water out of a mine.

The overall reaction is analogous to reactions that power the human body, in which oxygen combines with sugar to produce energy. In the fuel cell, the AMD water is separated from the oxygenated water by a membrane, and half of the overall reaction occurs at each of the electrodes. The oxygen is used up by one electrode, while the iron is converted into iron oxides at the other electrode. In addition to the electricity that is generated, the iron oxides can be used as colourants for paints or other products or as sorbents for other environmental pollutants.

In this research, the investigators used a solution similar to AMD, and showed that the device efficiently removed dissolved iron from the solution while also producing electricity at power levels similar to conventional microbial fuel cells. The researchers say they will be able to improve the efficiency of the fuel cell in the future.

The prototype fuel cell is very small – around the size of a teacup – and much larger reactors would be needed for practical applications. But with the model working effectively, Logan predicts that the project could be commercialised within a few years.


**Contact:** blogan@psu.edu

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