

Developing the clean fuel of the future



A successful small trial of a hydrogen Microbial Electrolysis cell (MEC) reactor at a waste water treatment works on Tyneside has led Northumbrian Water to try to scale up this form of energy production to fully assess its viability.

Having pioneered making electricity using Advanced Anaerobic Digestion from sewage sludge, it is now leading the industry again on another sustainable alternative energy production as the first water company in the UK to take the lead on detailed studies of MEC potential.

Newcastle University and Northumbrian Water collaborated to install a pilot at Howdon sewage treatment works which was the first working MEC reactor fed on 'real' waste water in the world.

It successfully functioned to prove the concept producing over a litre of almost 100% pure hydrogen gas per day, for a year in varying temperatures.

Now a refined pilot plant is being installed for further trials at another Northumbrian Water waste water treatment works near Sedgfield, County Durham.

Waste water treatment at sewage works uses a lot of energy yet the latent energy stored in Northumbrian Water's works is more than four times the amount required for treatment.

The energy stored in UK waste water is equivalent to 5 billion oil barrels annually.

Capturing that energy is one of the most important challenges for the industry. Innovative energy-neutral technologies must be able to fit into existing infrastructure and be economically competitive for uptake and investment.

A solution may be through bioelectrochemical systems (BES) which make use of electrochemically-active microorganisms to treat waste water and produce electricity in microbial fuel cells (MFCs) or hydrogen in microbial electrolysis cells (MECs).

Electricity and hydrogen can be traded for economic return or used to offset costs and energy requirements in waste water treatment.

MECs offers a radical alternative to traditional waste water treatment and may, over the next decade, provide a much better way of treatment – and is a method which actually produces more energy than it consumes.

The MEC is a further development of the MFC which produces electricity which itself is like a biological battery but, unlike the batteries we know today, it doesn't run down or need to be recharged.

Microbes which power it are continually fed by a fuel – in the case of Northumbrian Water - by the sewage treatment works waste water.

The MEC is one step on from the MFC and instead of producing electricity it is designed to produce hydrogen which is a completely clean valuable fuel of the future.

Hydrogen-fed fuel cells could, for example, power future electric cars providing carbon free transport.

MECs require a 'top up' of energy for hydrogen generation. Hydrogen is perhaps worth almost ten times as much as electricity and the cost to produce a kilogram is approximately half its market value. This can be maximised when there is already infrastructure in place to capitalise on hydrogen production – like a waste water treatment works.

References:

Attempts have been made globally to scale BES with limited success. Cusick et al., (2011) published data on their 1m³ MEC at the Napa Wine Company, but much of the data from scale-up studies remains unpublished, such as Rabaey and Keller's 1m³ tubular MFC in Yatala, Queensland and Li's commercialisation of MFCs at the University of Connecticut.

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