Sulphur-free biogas for fuel cells

Fuel cells can convert methane from biogas into electricity with a high utilisation rate. However, it requires removing all the sulphur compounds in the gas. Researchers are working in the laboratory on a promising chemical technology that can help solve the problem.

Fuel cells can be used to advantage to transform methane from biogas and natural gas into electricity. They are extremely effective and convert energy with a utilisation rate of up to 85 per cent or more if surplus heat is included in the equation.

This makes the technology interesting in cases where there is a desire to produce electricity from gas and fuel cells can thereby be used for such a purpose in areas with no access to the electricity grid.

The major challenge with gas and particularly with biogas is that they contain small amounts of sulphur which can destroy the fuel cell catalyst within a short space of time.

"Sulphur compounds in the gas react with the surface of the fuel cell catalyst where the methane is converted into hydrogen, and this very quickly destroys the fuel cell. In fact, this is currently the greatest barrier to converting gas into electricity," says Associate Professor Anders Feilberg.

Together with his research colleagues, he has created the first promising results with a chemical pretreatment of gas which can remove more than 99 per cent of sulphur compounds in the laboratory. However, the technology is still immature, and there is a way to go before the researchers can carry out full-scale experiments.

Chemistry can make gas cleaner

The principle is that the gas is fed through a reactor with a fluid containing iron compounds, and these react with the sulphur molecules prior to being sent on to the fuel cell. It all takes place in a stable and fully controlled process and it appears at this stage – in the laboratory – to act as a brilliant alternative to the microbial cleaning methods used today.

"Our aim is to increase and control the purity of the gas before it's sent through further desulphurisation and on to the fuel cell," says Associate Professor Feilberg.

The initial laboratory studies indicate that the chemical pretreatment method has the potential to increase the quality of the desulphurisation, making it a cleaner gas that is ultimately converted into electricity.

Simple measurements can predict sulphur accumulation

However, the problem with sulphur in fuel cells is not solved by a better cleaning technology alone. The desulphurisation products currently available on the market will still have a limited duration of action, and damaging sulphur compounds will sooner or later get into the fuel cell.

"The problem today is that we can't say in advance when the desulphurisation product stops working. All we know is that it will eventually break down, and sulphur molecules will penetrate and destroy the fuel cell by deactivating its catalyst. If we could measure the sulphur compounds – even in very small amounts – and if we could do it in a continuous process, then we'd also be able to very precisely predict when it's time to change the purifier," says Associate Professor Feilberg.

The researchers are now working on the first prototype of a measuring instrument that can monitor in real time how the effect of the desulphurisation product wears off. The technology will be perfected and ultimately commercialised in the coming years.