Successful Pilot-Scale Biological Methanation

Imminent Breakthrough for Power-to-Gas Technology

Success of the German energy turnaround will be critically dependent upon the development of intelligent practical solutions for energy conversion and storage. The most promising approach to long-term storage of excess power generated by wind turbines and solar installations is provided by power-to-gas technology, in which electricity is converted into the gaseous fuel methane. With financial support from the federal state of Rhineland-Palatinate and the EU, PFI and Mainz University have jointly developed a novel biological power-to-gas process and successfully tested it on an engineering lab scale.

Biological methanation is an innovative solution for long-term storage of excess power generated by wind turbines and photovoltaic installations, whose output is typically subject to wide daily and seasonal fluctuations. Compared to the alternative Sabatier process for industrial scale methanation (conversion of carbon dioxide and hydrogen into methane over a nickel catalyst at a temperature of 300 °C and a pressure of 10 bar) the new process offers considerable advantages: First of all it attains a higher efficiency of conversion of hydrogen and CO_2 into methane and secondly the microorganisms used are largely insensitive to impurities present in the feed gases. Hence it permits direct reaction of electrolytically generated hydrogen with unpurified crude gas from biogas plants to form biomethane.

In order to develop the process for practical application, it was first necessary to develop a suitable bioreactor and then to optimise the microorganisms used with regard to conversion rate and productivity. Intense research and development work on a laboratory and pilot scale by PFI and its partner organisations provided the scientific and technical basis for this work.

The performance of the microorganisms has been demonstrated in a PFI pilot research reactor. The research reactor with a height of four metres and a packed bed volume of about 300 litres has been in operation since 2013 and is used to test the applicability of the laboratory results on an industrial scale (Fig. 1).

Use of optimised strains of methanogenic bacteria with high growth and conversion rates and a specially developed fermentation process hugely increased the rate of degradation and methane productivity. Thus the reactor processes 1450 litres per hour of the input gasses hydrogen and carbon dioxide per cubic metre of packed bed. That corresponds to a methane production rate of about 280 litres per hour. An innovative process design prevents breakthrough of the input gases and yields a product gas containing over 97 percent methane. The next step, construction of pilot plant, is already in progress. The plant is due to come on stream in 2015 and is located in the Pirmasens-Winzeln Energy Park. The projected gas grid feed-in rate is up to 440,000 m^3 of biomethane per annum. Pirmasens Municipal Utilities and Pfalzgas GmbH have expressed interest in application and marketing of this innovative technology once the pilot plant is in successful operation.

This cooperative research project of PFI and the Johannes Gutenberg University Mainz was funded by the federal state («Land») Rhineland-Palatinate and the European Union within the European Regional Development Fund (**E**uropäischer **F**onds für **r**egionale **E**ntwicklung - EFRE). We wish to take this opportunity express our gratitude for this funding.

Wachstum durch Innovation – EFRE
RheinlandPfalz

PFI Germany

Member of PFI Group

Any questions? Please contact:

Dipl.-Ing. (FH) Benjamin Pacan
Technical Development, Research Plants, Project Management
Tel: +49 - (0)6331 - 24 90 - 840
E-Mail: mailto:benjamin.pacan@pfi-germany.de

Figure 1: Trickle flow reactor for biogenic methane production in the PFI engineering lab