Reformate from biogas used as fuel in a PEM Fuel Cell

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Abstract

Biogas is a renewable source that may be produced from many different raw materials such as industrial waste from wood and food industry, and sewage from wastewater treatment plants. Apart from traces of different impurities, the biogas also contains large amounts of methane and carbon dioxide and is a good feedstock for hydrogen production. By processing the biogas in a steam reformer a gas containing about 65-69% of hydrogen will be produced. However, the hydrogen is also accompanied with 26 – 29% of carbon dioxide and small amounts of impurities, mainly carbon monoxide and hydrogen sulfide.

The proton exchange membrane fuel cell (PEMFC) is seen as an attractive alternative for clean electricity production for transportation as well as for stationary power production. The PEMFCs possess advantageous features such as high efficiency, high power density and low emissions, making them competitive with e.g. the internal combustion engines in many applications. The best efficiency of the fuel cell is obtained when running the fuel cell on pure hydrogen and pure oxygen for the anode and cathode respectively.

In this project, olive mill wastes are digested to produce biogas that will in a later step be reformed to a hydrogen rich gas. That reformate gas will be used as anode gas in the PEM fuel cell producing electricity, and some heat, for the mill. For the cathode gas, air will be used. The aim of the present investigation is to study how the presence of different impurities will affect the performance of the fuel cell. Since the fuel cell will be placed in an agricultural area, not only impurities in the reformate used for the anode are of interest, but also possible contaminants such as ammonia or nitrogen oxides present in the air are investigated. Since the reformate will contain at least one third of carbon dioxide, known to be a problem when using Pt catalyst on the anode, also the influence of CO_2 on the anode is studied.