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Abstract

Biogas for Future Electric and Gas Grids - BIOFEGG

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The European Commission's ambitious renewable energy goals, 20-20-20 objectives and Strategic Energy Technology Plan (SET Plan) request new technological and non-technological measures. Biogas is one of the promising energy sources that is not fully employed yet as a part of national gas and electric grids. BIOFEGG project develops and pilots new control methods for anaerobic digestion process and a novel biogas cleaning and upgrading method for siloxanes and terpenes. The project also demonstrates a recently developed innovative real-time monitoring system for the biogas quality. The connectivity of biogas plants to gas grids, biomethane filling stations and future electric generation systems are studied in the project considering both technical issues and non-technical issues like regulations, environmental aspects and financial framework. The project is coordinated by Kajaani University of Applied Sciences (KAMK) (FIN) with project partners from Austria, Sweden and Finland: Bioenergy and Sustainable Technologies GmbH (BEST) (AUT), Metener Oy (FIN), Mustankorkea Oy (FIN), Jahotec Oy (FIN), Luleå University of Technology (LTU) (SWE), Institute of Environmental Biotechnology - IFA Tulln, University of Natural Resources and Life Sciences (BOKU) (AUT), EVM Energie Versorgung Margarethen am Moos GmbH (EVM) (AUT). The project is part of the ERA-NET Bioenergy programme and is funded by Energimyndigheten in Sweden, The Austrian Research Promotion Agency in Austria and in Finland by Business Finland. Furthermore, industry participants are funding the Finnish research part of the project. The project duration is from 1/2018 until 12/2020. The project overview presentation presents the research results of the project so far.

The work at LTU aims at process optimization of the acidogenic fermentation, and there by removing siloxanes as much as possible from entering the biogas formation step. After an extensive literature review LTU designed several batch experiments to find operation conditions which maximize the solubilization of organic material before it enters the biogas reactor. The results indicate that 40% solubilization of the organic material in sewage sludge can be reached during 2 days. Optimal pH is in the range of 7-8 and the temperature range is 55-65 degrees Celsius. It was chosen to operate at pH 8 since it will limit the onset of methane formation in the reactor, and a temperature of 55 degrees since it will demand less heating.

KAMK is investigating the use of geopolymers for the adsorption of linear and cyclic siloxanes. Geopolymers are amorphous alumino-silicate materials, comparable to the crystalline zeolite analogue. The raw materials for the geopolymers are mainly sourced from industrial sidestreams, and the adsorbents are therefore economical to prepare and utilize. The geopolymer adsorbents were first tested in a laboratory setting and subsequently piloted at three biogas facilities utilizing varying feeds:

two in Finland and one in Austria. The siloxanes were determined by ND-IR spectrometer from Qualvista. The adsorption capacity of the tested geopolymers for siloxanes is in the area of tens of milligram per kg. The adsorbents can be regenerated by thermal decomposition of saturated geopolymers.

The aim for BEST is to investigate the effect of terpene containing substrates on the anaerobic digestion process and for BOKU to develop a method for the determination of the terpene concentration in the gas and liquid phase. The latest results of the batch experiments by BEST show, that the biogas potential is hardly influenced at low limonene concentrations (up to 1000 mg/kg) whereas the kinetics slowed down. At concentrations of 2000 mg/kg the biogas potential decreased by more than half.

Also, the semi-continuous experiments with orange peels as substrate proved to be problematic by causing instabilities in the anaerobic digestion process. However, it could be demonstrated that limonene could be detected in the gas phase even with very small quantities in the feed. The method developed by BOKU for the determination of terpenes has been extended by four more terpenes. Beside limonene and cymene, it is now possible to detect pinene, thujene, phellandrene and terpinene.

More information about the event, photos and presentation slides are available for download: https://nachhaltigwirtschaften.at/en/iea/events/2020/20200124-highlights-bioenergy-research.php