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Bioconversion of carbon dioxide in biogas to methane

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Biogas produced from organic wastes contains energetically usable methane and unavoidable content of carbon dioxide. The exploitation of whole biogas energy is locally limited and utilization of natural gas transport system requires CO_2 removal or conversion to methane. Chemical methods of upgrading biogas to bio-methane have disadvantage in demand of high pressure and temperature. Biological conversion of CO_2 and hydrogen to methane is well known reaction and is carried out by hydrogenotrophic methanogenic bacteria. Reducing equivalents to biotransformation of carbon dioxide from biogas or other resources to bio-methane can be supplied by external hydrogen. The rapidly developing renewable energy carriers include electricity from wind and solar energy. Discontinuous electricity production combined with fluctuating utilization cause serious storage problems that can be solved by power-to-gas strategy representing production of storable hydrogen via electrolysis of water. Possibility of subsequent repowering of energy of hydrogen to the easily utilizable and transportable form is biological conversion with CO_2 to bio-methane. The aim of our project is to find the optimal conditions of the technology of biological reduction of CO_2 with H_2 in terms of process parameters and device type. Biomethanization of CO_2 can be applied directly to anaerobic digesters being fed with organic substrates, or in external bioreactors. Experiments started with hybrid anaerobic reactors (up-flow sludge bed reactor with packed bed in the upper part) fed with distillery slops as organic substrate and gaseous hydrogen was introduced to the bottom of reactor. The major bottleneck in the process is gas-liquid mass transfer of H_2 and the method of effective input of hydrogen into the system has to be optimized. The possibilities of an implementation of the technology to biogas plants will be suggested based on results of the project.

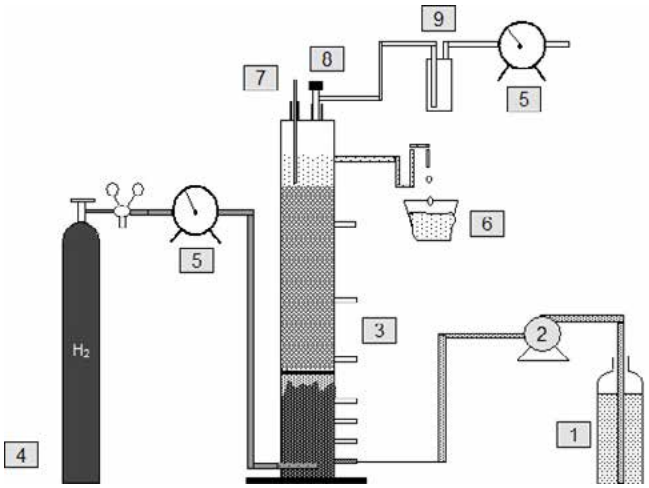

Figure 1: Scheme of experimental set of anaerobic hybrid reactor treating organic substrate and hydrogen. 1-substrate, 2-peristaltic pump, 3-hybrid anaerobic reactor with sampling ports, 4-source of hydrogen, 5-gas meter, 6-effluent, 7-thermometer, 8-sampling of biogas and 9-safety vessel.

Biography

Jana Zabranska is a member of the academic staff in Department of Water Technology and Environmental Engineering, Faculty of Technology of Environment Protection, University of Chemistry and Technology Prague. She is engaged in the field of "Anaerobic digestion, degradability and methane yield from different substrates". Currently, she is involved in the research of biogas production from agro-industrial wastes and biological removal of hydrogen-sulfide from biogas. She is a Supervisor of Master and Doctor degree students and has lectures on subjects "Anaerobic technology in environmental protection" and "Technology of biogas and bio-hydrogen production". She has Authored and Co-authored 273 scientific papers, three technological patents, six textbooks and two monographs. She is a member of International Water Association, Specialist Group of Anaerobic Digestion, Sludge Management; a member of Czech Biogas Association, Czech Water Association and; a member of the committee of the Czech Biotechnology Society.

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