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Influence of Enzyme Addition and Substrate Loading on the Efficiency of Biogas Production

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Abstract

Biogas from the fermentation of slurry is often used for the local supply of energy in developing countries. Fossil energy sources are substituted and therefore greenhouse gas emissions are reduced. Harvesting residues or energy crops can be added to fermentation in order to increase gas yields but the fermentation process might be limited by the hydrolysis of cellulose and hemicellulose, which is a prerequisite for the production of acetic acid as the substrate of methanogenic bacteria. It is discussed, whether the addition of enzymes to biogas digestors can increase the biogas yield. In our experiment enzymes are tested which can also be produced on local level in developing countries.

12 anaerobic digestors ($V=8$ l) are continuously fed with different co-substrates (maize silage, rye silage and grass silage). To each of the substrates either active or inactivated enzymes are added with 2 repetitions per treatment. Substrates and enzymes are added daily and fermentation residues are removed. The substrate loading is successively increased in order to determine the effect of substrate availability on the efficiency of enzyme addition. Gas production and gas quality is determined daily and frequently samples are taken for determination of residue parameters (e.g. COD, buffer capacity, VFA).

First results with a loading of $1\text{g ODM l}^{-1}\text{ d}^{-1}$ indicate an increase of biogas production from maize by enzyme addition. Data to be presented will include higher loading rates, gas production from rye and grass as co-substrates and information on the effect of substrate loading on the stability of the fermentation process.

Keywords: Anaerobic digestion, co-digestion, energy crops, greenhouse gas emissions, slurry