



Tropentag, October 9-11, 2007, Witzenhausen

“Utilisation of diversity in land use systems:
Sustainable and organic approaches to meet human needs”

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 pre-requisite for the production of acetic acid as it is the substrate for 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).

Results showed that the increasing loading of oDM per liter per day indicate an increase of biogas production but the substrate loading to methane transformation ratio was decreased accordingly. Increase in oDM loading through co-fermentation with slurry is not only a cost effective alternative to composting but also increased yields in biogas production, thus contributing in the production of regenerative energy and reduction of green house gas emissions. The use of enzyme in the anaerobic digestion stabilises the fermentation process although no effect could be found in maize and rye silage as co-substrates. No enzyme effect was found under experimental condition but a transient effect was noticed at higher loading only in grass as co-substrate.

Keywords: Co-substrates, co-fermentation, enzyme, methane