Foodwaste as a co-substrate in a fed-batch anaerobic biowaste digester for constant biogas supply

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ABSTRACT

The use of foodwaste as a supplementary substrate for an anaerobic municipal biowaste digester during night times and as the sole substrate during weeks ends, when no biowaste suspension was available was studied in order to equilibrate biogas production. Assays were performed in semi-continuously fed laboratory reactors with real substrates, simulating practical feed conditions. Biogas production of biowaste or foodwaste reached 0.39 or 0.52 $m^3 \cdot kg^{-1}$ COD_{added}, with an average methane content of 62–66%, respectively. By foodwaste co-digestion during the night in a semi-continuously fed bioreactor, the total biogas production of the reactor increased by 21–37% compared to biogas production during biowaste-only-fed periods during the day and no feeding during the night. After three weeks of supplemenary foodwaste digestion during the nights and during week ends, the COD elimination efficiency of the reactor reached the same level as in biowaste-only-fed periods (51–65%). During co-digestion of foodwaste with biowaste, the volatile solids elimination efficiency was between 62–65%, which was insignificantly less compared to the volatile solids elimination during biowaste-only-fed periods (63–68%).

Key words | anaerobic digestion, biogas production, biowaste, co-digestion, foodwaste

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INTRODUCTION

As a consequence of an increasing population and increasing activities in urban areas, the solid waste volume from human activities is drastically increasing. In Europe, it is estimated that more than 3,000 million tons of waste are generated annually (European Environment Agency 2003). Out of this number, 60 million tons of recyclable organic waste are collected separately from households and food industries (Barth *et al.* 1998). According to The European Landfill Directive, the Member States are required to step-wise reduce the quantities of biodegradable municipal solid wastes going to landfills from 75 to 50 and to 35% of the total amount of biodegradable waste produced in 1995 (by weight), in periods of 5, 8 and 15 years after 2001, respectively (Luning *et al.* 2003). As other methods to reduce biodegradable waste, such as incineration, pyrolysis and gasification had only limited success, biological treatment (anaerobic digestion and aerobic composting) boosted considerably by the introduction of source-sorted collection of a non-toxic biodegradable fraction. Among the newly installed biological treatment systems in countries such as Spain and Germany, anaerobic treatment plants accounted approximately for 30–50% (de Baere 2006).

For treatment of source-sorted biowaste from cities such as Karlsruhe/Germany, anaerobic digestion with biogas production for steam and electricity supply has been installed in full-scale (Gallert & Winter 1997; Gallert *et al.* 2003). To maintain a permanent energy supply for the customers, biogas must be available at constant amounts 24 h a day. This can be reached by supplementary biogas sources, for instance from a sanitary landfill or by steam generation from incineration of waste wood, as realized in Karlsruhe. The combination of biogas from biowaste and biogas from sanitary landfills even works at closed

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