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Anaerobic digestion of pressed off leachate from the organic fraction of municipal solid waste

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ABSTRACT

A highly polluted liquid ("press water") was obtained from the pressing facility for the organic fraction of municipal solid waste in a composting plant. Methane productivity of the squeezed-off leachate was investigated in batch assays. To assess the technical feasibility of "press water" as a substrate for anaerobic digestion, a laboratory-scale glass column reactor was operated semi-continuously at 37 °C.

A high methane productivity of 270 m^{-3} CH_4 ton^{-1} COD_{added} or 490 m^{-3} CH_4 ton^{-1} VS_{added} was achieved in the batch experiment. The semi-continuously run laboratory-scale reactor was initially operated at an organic loading rate of 10.7 kg COD m^{-3} d^{-1}. The loading was increased to finally 27.7 kg COD m^{-3} d^{-1}, corresponding to a reduction of the hydraulic retention time from initially 20 to finally 7.7 days. During the digestion, a stable elimination of organic material (measured as COD elimination) of approximately 60% was achieved. Linearly with the increment of the OLR, the volumetric methane production of the reactor increased from 2.6 m^3 $m^{-3}_{reactor}$ d^{-1} to 7.1 m^3 $m^{-3}_{reactor}$ d^{-1}.

The results indicated that "press water" from the organic fraction of municipal solid waste was a suitable substrate for anaerobic digestion which gave a high biogas yield even at very high loading rates.

1. Introduction

The introduction of the European Landfill Directive (EC, 1999) has stimulated European Union Member States to develop sustainable solid waste management strategies, including collection, pretreatment and final treatment methods. According to the European Landfill Directive, it is compulsory for the member states to reduce the amount of biodegradable solid waste that is deposited on sanitary landfills. The target is that by the year 2020 only less than 35% of the total biodegradable solid waste that was produced in 1995 will be deposited on sanitary landfills.

Separation of municipal waste into a recyclable fraction, residual waste fraction and a source-sorted organic fraction (OFMSW) is a common practice of waste management in German cities in order to meet the obligations of the Landfill Directive. In 2006 around 8.45 million tons of OFMSW were collected. These organic wastes consisted of 4.15 million tons of source-sorted organic household residues and 4.3 million tons of compostable solid wastes from gardens and parks (Statistisches Bundesamt, 2008a). There exist 1742 biological treatment plants and 45 mechanical–biological treatment plants throughout Germany, including composting plants and anaerobic digesters (Statistisches Bundesamt, 2008b). Germany is categorized as an advanced composting country since it has installed a wide range of composting plants from simple windrow systems to highly sophisticated technical processes. Several technologies and methodologies have been applied in order to optimize the composting process and to improve the quality of compost. Already in 1995 around 28% of the composting plants in Germany were categorized as technically advanced (Gruneklee, 1997). In 2006, a total number of 485 OFMSW treatment plants participated in the State Commission for Delivery Terms and Quality Assurance (Ger.: RAL-*Reichsausschuß für Lieferbedingungen und Gütesicherung*) of compost, fermentation products and humus (Ger.: *RAL-Gütesicherungen für Kompost, Gärprodukte und AS-Humus*). These plants altogether treated 7.8 million tons of biodegradable waste. The majority of this amount (approx. 5.9 million tons) was treated in composting plants and generated compost predominantly from source-sorted OFMSW as well as garden and park wastes (BGK, 2007).

One important parameter of OFMSW for a successful composting process is its moisture content since the microbial decomposition of organic matter mainly occurs in the thin liquid film around the surface of the particles (Krogmann and Körner, 2000). To support growth and activity of microorganisms that are involved in the composting process, OFMSW should have a moisture content within the range of 40–60%. A moisture content below 40% will

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