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The effects of mechanical sludge disintegration to enhance fullscale anaerobic digestion of municipal sludge

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Abstract

The main goal of the study was to evaluate the effects of mechanical sludge disintegration in enhancing full-scale anaerobic digestion of municipal sludge. Batch disintegration tests and lab dewatering tests were performed to determine the release of organic compounds and to assess the impact of disintegration of excess sludge before the fermentation process of mixed sludge on the dewaterability of post-fermented sludge, respectively. In the study, a disc disintegrator driven by a motor with a power of 30 kW, revolutions n=2950 rpm, was used. It was shown that increased amounts of organic compounds were released from the sludge along with an increase in energy consumed in the disintegration. A part of the organic compounds were volatile fatty acids (VFAs). The highest share of VFAs in the released organic compounds (COD:VFA in the range of 6.6÷8.2) was obtained by performing disintegration at an energy density of 140 kJ/L. It was also documented that the introduction of excess sludge disintegration prior to the fermentation tank resulted in a significant increase in biogas production (by an average of 33.9%) and in an increase in volatile total solids reduction in the fermented sludge (by an average of 22.7%). Such a surplus of produced biogas would allow to produce ca. 1600 kWh/d net electricity and 7.5 GJ/d (2080 kWh/d) of heat. Moreover, it was documented that the share of disintegrated waste activated sludge in the mixed sludge subjected to the fermentation process could favourably influence the efficiency of post-fermented sludge dewatering.

Key words: anaerobic digestion, mechanical disintegration, waste activated sludge, biogas production

1. Introduction

The legal requirements, which have become more stringent in recent times in terms of quality of effluent discharged into receivers (the need for highly effective removal of nitrogen and phosphorus from wastewater), in terms of how to deal with the waste sludge that appears in the process of wastewater treatment (a retreat from

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