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Thermal disintegration as a process supporting sewage sludge utilization

Abstract
Highly effective methods of biological and chemical wastewater treatment applied in Poland resulted in an increased amount of generated sewage sludge, which pose serious problem related to its utilization. The purpose of this studies was to determine the impact of the thermal disintegration process (in low temperatures < 100°C) on the biodegradation of excess sludge, and then on the methane fermentation process. It was found that the method of thermal disintegration under the aforementioned conditions allows to achieve a very high degree of the excess sludge disintegration (> 70%) already at a temperature of 45°C. At the same time, the concentration of volatile fatty acids (VFAs) increases more than 55 times, which can significantly shorten the fermentation process.

Keywords: sewage sludge, thermal disintegration, methane fermentation, biogas production.

1. Introduction

In recent years, highly effective methods of biological and chemical wastewater treatment have been implemented in Poland. These methods are particularly aimed at increased nutrients removal and organic substance reduction in order to meet the requirements of the Water Framework Directive (2000/60/EC). Unfortunately, it resulted in an increased amount of generated sewage sludge, and the sludge management itself is currently one of the most difficult tasks faced by exploiters of waste water treatment plants (WWTPs). Modernization of sludge management (economically and environmentally justified) and final management of sewage sludge is one of the most difficult, and at the same time the most expensive element of WWTP exploitation, which accounts for 50–70% of operating costs. Therefore, the search for new, economically rational and highly efficient solutions in the sludge economy is extremely important.

One of the methods intensifying the treatment of sewage sludge is the disintegration. For many years the most commonly mechanical and ultrasounds disintegration of extensive sludge was utilized in WWTPs. However, the most effective are thermal disintegration methods (low and high temperature), which significantly affect the increase of sludge biodegradability (Zheng, Graff, Fillos, & Rinard, 1998). Accordingly in this study, the purpose of laboratory tests was to determine the impact of the thermal

disintegration process (in low temperatures < 100°C) on the biodegradation of excess sludge, and then on the methane fermentation process.

2. Description of preliminary studies

The research was carried out in a laboratory scale thermal disintegrator developed by the Gdansk University of Technology scientific team (Fig. 1). Preliminary studies were carried out over 48 hours in the temperatures ranged between 45 and 52°C and mixing frequency range from 20 to 35 Hz. During all experiments small amounts of oxygen was added to remove free ammonia and hydrogen sulphide.

Fig. 1. Thermal disintegrator in laboratory scale

3. Preliminary results

Based on results obtained it was concluded that the method of thermal disintegration under the aforementioned conditions allows to achieve a very high degree of the excess sludge disintegration (> 70%) already at a temperature of 45°C. At the same time, the concentration of volatile fatty acids (VFAs) increases more than 55 times, which will favourably shorten the hydrolytic fermentation phase and accelerate and intensify the processes taking place in subsequent phases of anaerobic stabilization.

Preliminary results indicate a significant improvement of the excess sewage sludge biodegradability prior to their final management. Moreover, disintegrated sewage usage indicates also the possibility of improving the energy balance on WWTP connected with sewage sludge fermentation.

References

Zheng, J., Graff, R.A., Fillos, J., Rinard, I. (1998). Incorporation of rapid thermal conditioning into a wastewater treatment plant. *Fuel Processing Technology, 56*, 183–200.

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