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Application of physicochemical pre-treatments for enhanced biogas yield from wastewater sludge

Zoltán Jákói ; Sándor Beszédes ; Cecilia Hodúr

University of Szeged, Faculty of Engineering, Department of Biosystem Engineering

In our experimental work we applied different variations of physicochemical pre-treatment methods to meat industry-originated wastewater sludge samples in order to investigate how they affect the kinetics of biogas production and the overall biogas yield. For the experiments, 100 cm³ of sludge samples were being treated by microwave irradiation (P=250 W, total irradiated energy = 93,6 kJ), alkaline treatment (2 cm³ of NaOH) and the combination of these two. The following mesophilic anaerobic digestion process was carried out in a temperature-controlled laboratory incubator (35°C, 24 days); the gas pressure was measured via OxiTop-C manometric measuring heads. The biogas-yield was calculated by the modified ideal gas law. Our results revealed that each of the pre-treatment methods could increase the overall biogas yield compared to the control samples; by using standalone MW irradiation, standalone NaOH treatment and combined (MW+NaOH) treatment the increment in the yield was 2.1-fold, 1.22-fold, and 2.48-fold, respectively. It has also been revealed that the microwave irradiation affected the kinetics of the biogas production as well; even though in the first 10-13 days the measurable yield was lower than those obtained for the control samples, in the last 11-14 days a precipitous increment could be observed, both during the standalone MW and the combined MW+NaOH treatments. When comparing the effectiveness of the pre-treatment methods in regards of the overall produced biogas volume, it can be shown that the standalone NaOH treatment falls short to the standalone MW irradiation (cf. 22.84 cm³ vs 38.97 cm³). However, when applying them in combination, the maximum reachable biogas yield exceeds the former two (46.42 cm³), therefore it can be stated that the effects of alkaline treatment and MW irradiation are additive.