

Anaerobic digestion of animal by-products: effect of substrate concentration

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Abstract

In this work, the anaerobic valorization of Category 2 Animal By-Products (ABP) to biogas is assessed. Category 2 ABP other than manure, digestive tract content and milk, usually called ‘bone flour’ and hereafter designated as Category 2 ABP* have been considered as a sustainable substrate for anaerobic digestion, due to their protein and grease content. Main characteristics of Category 2 ABP* are as follows: total solids (TS) = $916 \pm 1 \text{ mg g}^{-1}$ residue, volatile solids (VS) = $904 \pm 5 \text{ mg g}^{-1}$ TS, total Kjeldahl nitrogen (TNK) = $84 \pm 9 \text{ mg g}^{-1}$ TS, total phosphorus (TP) = $6.2 \pm 0.9 \text{ mg g}^{-1}$ TS, chemical oxygen demand (COD) = $1221 \pm 173 \text{ mg O}_2 \text{ g}^{-1}$ TS and oil/grease = $278 \pm 2 \text{ mg g}^{-1}$ TS. The ratio COD/N/P is 164 /8 /1. In this work, anaerobic biodegradability tests were performed by ‘multiple flask’ reactor method. Initial conditions of the experiment are: all flasks have the same content and it is assumed that the progress of hydrolysis, acidogenesis and methanogenesis is similar in all flasks. Sampling was based on the quantitative analysis of content of the flask withdrawn from the reactor system. [1]. Three concentrations of substrate were tested: 2, 5 and 10 % TS (dry weight of substrate per volume). To evaluate the performance of the reactors loaded with the three concentrations of substrate, methane and soluble COD were measured. The concentration of 2 % TS resulted in higher production of accumulated methane compared with the other concentrations. At 25th day of incubation soluble COD reached the same value for the three concentrations, approximately 450 - 500 mg g⁻¹VS_COD. After that period, the soluble COD concentration started to decrease for 2 % TS while it continued to increase for 5 and 10 % TS. These results suggest occurrence of methanogenic inhibition for the higher initial concentrations of substrate. The pH varied between 7.00 – 7.95 for 2 % TS, 6.76 – 7.70 for 5 % TS and 6.69 - 7.18 for 10 % TS. Inhibitory Volatile Fatty Acids (VFA) were not at the limiting concentrations for methanogenesis [2], however ammonia concentrations higher than 3700 mg NH₄⁺ L⁻¹ were observed for both, 5 and 10 % TS, and thus its inhibitory effects were observed [3].

References

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