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STUDY OF VFAS FORMATION DURING ANAEROBIC DIGESTION OF THERMALLY TREATED SLUDGE BY RESPIROMETRIC OXITOP® METHOD

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ABSTRACT

Volatile fatty acids (VFAs) are important intermediate compounds in the metabolic pathway of methane fermentation. Under balanced operation, the rate of production of VFAs is matched by their consumption rate; hence there is very little accumulation of these compounds. However, disturbances such as organic or hydraulic overload, presence of toxins and temperature fluctuations can cause imbalance in the process. This causes in turn microbial stress and results in a decrease of pH, leading to failure of the digester. Therefore, the concentrations of individual VFAs (acetic, propionic, butyric and valeric acid) can be considered as the best control parameters in the digester liquid phase.

We studied VFAs formation during anaerobic digestion of thermally treated (from +70 to 95°C) residual sludge - a pretreatment technique that uses stimulation activity of cell lysate (pre-acidification, self-digestion). Advantage is given to the acidogenic stage of anaerobic digestion, restricting the growth of methanogens. VFAs were determined by a computerized process analytical system based on capillary electrophoresis with UV detection. Ratios of individual organic acids were used to describe the performance of digester. Respirometric Oxitop® method, normally exploited for biodegradability tests and BOD_5 measurement was used for monitoring the digestion process. Depending on treatment temperature and sludge make-up (ratio of inoculum, treated and untreated sludges) three different VFAs formation profiles were observed:

- acetate was formed in two stages with maximums up to 10 mM on the day 10 and day 20, with abundant biogas and methane generation (balanced growth);
- large amounts of acetate were formed only at the beginning of digestion with moderate biogas and methane formation (overproduction of acetate);
- initial moderate VFAs formation, poor consumption of VFAs and biogas evolution (overproduction of propionate).

Propionate was not inhibitory to methanogenesis up to 20 mM; butyrate and valerate concentrations remained mostly below 7 mM.