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Foaming in manure based digesters: Effect of overloading and foam suppression using antifoam agents

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Summary

Anaerobic digestion foaming is one of the major problems that occasionally occur in full-scale biogas plants, affecting negatively the overall digestion process. The foam is typically created either in the main biogas reactor or/and in the pre-storage tank and the entrapped solids in the foam cause severe operational problems, such as blockage of mixing devices and collapse of pumps. Furthermore, the foaming problem is linked with economic consequences for biogas plants, due to income losses derived from the reduced biogas production, extra labour work and additional maintenance costs. Moreover, foaming presents adverse environmental impacts owing to the overflowing of the pre-storage or digester tanks. So far, there has never been thoroughly investigation of foaming problem in manure-based digesters, which is the main anaerobic digestion system applied in Denmark. The purpose of the present study was to investigate the effect of organic loading rate on foam formation and also to evaluate the antifoam efficiency of different chemical compounds on foam suppression.

Thus, the impact of organic loading rate on anaerobic digestion foaming was studied in a continuous mode experiment. A continuous stirred tank reactor, operating under thermophilic conditions (55 ^{o}C) was fed with cattle manure. In order to investigate the effect of organic overloading on foam formation, a stepwise increase of the organic loading rate was performed by the addition of glucose in the feeding substrate. Biogas production, methane content in biogas, pH, VFA concentration and the volume of foam formed in the reactor were monitored and recorded in daily basis.

The investigation of possible solutions to counteract foam formation was achieved through the evaluation of the antifoam efficiency of five commercial and non-commercial chemical compounds. The antifoam agents were tested on samples derived from a reactor that was facing foaming problems due to organic overload. The antifoam potential was determined by the aeration method and was defined using three parameters: foaming tendency, normalised foaming tendency and foam stability

The results obtained from the above experiments showed that the organic loading rate had a significant impact on foam formation. Finally, it was observed that using specific chemical defoamers, the foaming propensity of the substrate was minimized. However, the efficiency of the defoamers varied significantly, revealing that their chemical composition affected differently the foam mechanism.

Keywords: foaming; anaerobic digestion; antifoam agents, organic overloading.