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### **Antifoaming effect of rapeseed oil and oleic acid in biogas reactors**

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Foaming is one of the major problems that occasionally occur in the biogas plants, affecting negatively the overall digestion process. Foam typically occurs in the main biogas reactor or in the pre-storage tank and results in adverse operational, economical and environmental impacts. So far, the foaming problem in manure based digesters, which is the main anaerobic digestion process applied in Denmark, has not been thoroughly investigated. Several studies reported that the most dominant factors contributing to foaming are the operational parameters of the digester (i.e. organic overload, temperature fluctuation, inadequate mixing), the feedstock composition and the presence of specific microorganisms. Methods for foam prevention and suppression are classified into four large groups; mechanical, physical, biological and chemical methods. Nevertheless, the complexity of the foam structure makes it difficult to apply a precise and efficient antifoam strategy. The aim of the present study was to evaluate the foam reduction efficiency and to investigate the influence on process performance of rapeseed oil and oleic acid in continuous mode manure-based biogas reactors, which were suffering by foaming incidents.

The experiment was carried out in six continuous stirred tank reactors (CSTR). The total and the working volume of each reactor was 2 and 1.5 L, respectively. Each reactor was continuously stirred using a magnetic stirrer. The operating temperature was maintained at  $54 \pm 1$  °C using thermal jackets. Each reactor was fed with a different mixed substrate, which was found to have an influence on foam formation in our previous study. Thus, the influent manure was supplemented with gelatine as a representative of proteins, Na-Oleate as a representative of lipids and glucose as a representative of carbohydrates. The hydraulic retention time (HRT) of all reactors was kept constant at 15 days. Once the daily foam volume production in the reactors was steady, a certain concentration of rapeseed oil or oleic acid was added to the feedstock bottle of each corresponding reactor in order to evaluate their antifoaming potential. The antifoam addition was done in three periods (period I, II, and III), with the antifoams (rapeseed oil and oleate) dosages of 0.05%, 0.1%, and 0.5% v/v-feed, respectively. During each period and once the reactor had a stable daily foam production, the foam reduction efficiency was calculated, and the addition of the antifoam was stopped until the foam production inside the reactor reached back to its initial level (i.e. before adding antifoam). The results obtained by the present study revealed both compounds were suitable as antifoam for manure digestion. Moreover, rapeseed oil was more efficient in foam suppression in the reactor fed with carbohydrates. The optimal dosage of antifoam agent should be dependent on the severity of foaming incident as the foam reduction efficiency of both compounds increased as their concentration in the reactor was higher.

