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Lymperatou, A.; Gavala, H. N.; Skiadas, I. V.

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APPLICATION OF RESPONSE SURFACE METHODOLOGY FOR ASSESSING THE EFFECTS OF AQUEOUS AMMONIA SOAKING PARAMETERS ON THE METHANE YIELD OF SWINE MANURE FIBERS

A. LYMPERATOU[1], H.N. GAVALA[1], and I.V. SKIADAS[1,*]
[1] Department of Chemical and Biochemical Engineering, Technical University of Denmark, Søltofts Plads 229, 2800 Kgs. Lyngby, Denmark.
*Corresponding author: ivsk@kt.dtu.dk, tel+45 45252729

Abstract

Aqueous Ammonia Soaking (AAS) has proved to be very efficient in increasing the methane yield of both the raw [1] and digested [2] solid fraction of swine manure (fibers) when digested anaerobically. Nevertheless, the performance of this pretreatment may vary significantly depending on the specific conditions under which it is performed [3]. In this study the effects of variation of the most influencing AAS parameters on the methane yield of pretreated raw swine manure fibers were investigated, aiming at producing an empirical model for estimating the methane yield.

For this purpose Biochemical Methane Potential (BMP) tests of raw swine manure fibers, treated under different conditions, were conducted. The levels of the parameters of AAS (shown in Table 1) were chosen according to a Central Composite Design. The effects of the variation of the AAS-parameters on the CH_4 yield were assessed by Response Surface Methodology.

Table 1 Ranges of independent variables of AAS (Central Composite design)

Parameter	Coded factor levels				
	-a	-1	0	1	a
NH_3 concentration (% w/w)	0.9	7	16	25	31.1
Duration (hours)	4.8	28	62	96	119.2
Solid-to-liquid ratio (g/ml)	0.12	0.16	0.22	0.28	0.32

The range of increase of the CH_4 yield of the pretreated fibers after 17 days of digestion was 96-230% when compared to the CH_4 yield of non-treated fibers (control). The largest increase of CH_4 yield was observed when the fibers were treated with 7% w/w NH_3 (aq.) at a solid-to-liquid ratio of 0,16 g fibers/ml reagent and for 96 hours. The most significant effects were the main effect of duration of AAS, the interaction effect between NH_3 concentration and duration of AAS, and the quadratic effect of the solid-to-liquid ratio. An equation was obtained for predicting the CH_4 yield of the AAS-fibers as a function of the independent AAS parameters. Based on the above, low NH_3 concentrations and low solid-to-liquid ratios in combination to high durations of AAS are recommended for optimum CH_4 production. The model will be valuable for the techno-economic evaluation of different process configurations. Consecutively, it will be used for the design of a combined AAS and Anaerobic Digestion process for cost efficient CH_4 production from swine manure fibers.

References

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