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Volatile Fatty Acids - Alkaline Buffer Capacity Ratio Applied to Monitorize Biogas
Plants in West Region of Romania

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Abstract: In anaerobic digestion processes for biogas production, the importance of correct and efficient feeding of the digester is an essential condition to reduce losses and to fully exploit the methanogenic potential of the raw material. In many cases, due to the desire to increase biogas production, digesters are fed with materials with increased amounts of organic substances, which leads to the accumulation of volatile fatty acids and implicitly to a decrease in pH. This acidity inhibit methanogenic bacteria, and biogas production decreases or even stops. In monitoring anaerobic digestion processes, an important parameter is the FOS/TAC ratio, which represents the ratio between the concentration of volatile fatty acids (FOS, from Ger. Fluchtige Organische Sauren) and the alkaline buffer capacity (TAC, from Ger. Totales Anorganisches Carbonat). The optimal FOS/TAC ratio should be between 0.3-0.4. In this study, the FOS/TAC ratio and the pH of the digestate from three biogas plants in the Western area of Romania were analyzed and the correlation between the operating stage of the biogas plants and the analyzed parameters was established. The results obtained allowed to issue recommendations for improving the anaerobic digestion process of the raw material and optimizing biogas production.

Introduction

Anaerobic digestion offers an ecological and efficient alternative solution for the disposal of toxic waste and the production of energy. Our team contributed to correct feeding in one biogas plants where the biological process was unbalanced due to technical problems. Other two biogas plants are in start up stage. The correct feeding of a digester is essential, and a very important fist step is represented by FOS/TAC ratio.

Materials and methods

In order to be able to check for incorrect feeding of the digesters, we applied the Normand titration method, for FOS/TAC ratio and pH monitorization.

FOS/TAC ratios	Background suggestion	Countermeasure
>0,6	Very expenssive biomass input	Stop addig biomass
0,5-0,6	Excessive biomass input	Add less biomass
0,4-0,5	The plant is overflowing	Monitor the plant more closely
0,3-0,4	Biogas production at its peak	Keep biomass input constant
0,2-0,3	The biomass input is to low	Gradually increase biomass intake
<0,2	The biomass input is far too low	Rapid increase in biomass input

Tabel 1. Report of Deula Nienburg Research Center with references to FOS/TAC ratio

Conclusions and recommendations

High FOS/TAC ratio is correlated to acidity (low pH) caused by inadequate feeding (high TAC). In start-up phase of the anaerobic digestion, low FOS/TAC ratio is correlated to neutral-low alkaline pH, determined by low conentration of organic acids. As recommendations, mixture recipe for feeding the digesters after reaching the neutral pH and the maximum FOS/TAC value of 0.4, have been established according to the materials available on the farm.

Results and discussions

In all three biogas plants, pH value is correlated to the FOS/TAC ratio (table 2). In biogas plant C, the highest FOS/TAC ratio indicate inadequate feeding, correlated to acidification (pH 5).

Biogas plant	Stage	pH	FOS	TAC	FOS/TAC
A	1	7,83	8175	1087	0.13
A	2	7,72	8500	1004	0.12
B	1	8,05	10100	1834	0.18
B	2	8.02	9526	1810	0.19
C	1	5	50500	170	296
C	2	7.86	7333	1760	0.24

Tabel 2. FOS/TAC ratio correlated to pH in 3 biogas pants

Cow manure will constitute the main substrate with important microorganic input. Ensiled biomass available as substrate with high energy input can constitute an energy feedstock to produce high quantity of biogas and green energy. To increase economics of the process, it is recommended to feed the digester with residual raw materials, available at zero costs in the area of the biogas plant operator.