Task 1.2 – Evaluation of post-digestion under high organic loading rate

Subtask 1.2.1 - Batch screening of post-digestion vs. recirculation

Objective

Lab-scale batch biomethane potential (BMP) assays are employed to compare the potential of post-digestion vs. recirculation of (N-stripped) digestate in terms of residual biogas/bio-methane output. The project's objective is to obtain min. 10 - 20% higher biogas yield.

Set-up

The standardised reactors (Figure 1) are operated acc. to Holliger et al (2016)[1], in biological triplicates. Raw digestate (RD) from a full-scale digester (i.e., reference material) and air-stripped RD from *Task 2.1* is used. The effect of the reduced N-content and increased bio-available organic fractions by applying different stripping conditions is tested.	 Figure 1: BMP assay set-up, top view

Lab-scale stripping conditions
- pH 8
- 70°C
- G/L 1000
- Air flow: 8L/min
	Batch BMP-test @ 37°C, total V = 1L, biogas measurement via gravimetric quantification of the water displacement
	- References
	  ○ Recirculation of non-stripped digestate (+fresh dairy manure)
	  ○ Post-digestion of non-stripped digestate
	- Recirculation: 10-50% of the fresh substrate as surplus
	- Post-digestion of stripped digestate

The influent and effluent streams are characterized. Although high OLRs cannot be tested in batch assays, they give valuable insights in the influence of stripping on digestate degradability and post-AD vs. recirculation.

[1] DOI: 10.2166/wst.2016.336

Results

The influent streams (i.e., fresh manure, raw digestate and stripped digestate) are characterized for pH, TAC, FOS, (V)TS, TC, soluble TOC, TN and TAN. The results of these analyses are shown depicted in Table 1. The N-removal and disintegration efficiency of almost 90% give a "go" to initiate the BMP assays.

Table 1: characterisation of the fresh manure and the digestate before and after stripping

Parameter	Fresh manure	Digestate	Stripped digestate	*Difference due to stripping*
pH (-)	6,42	7,64	8,75	
TAC (g/L)	6,39 ± 0,09	13,7 ± 0,07	7,03 ± 0,02	
FOS (g/L)	8,17 ± 0,13	3,18 ± 0,47	3,40 ± 0,34	
TS (g/kg)	83,34 ± 3,02	56,16 ± 0,21	73,72 ± 0,50	*+ 31%*
VS (% of TS)	84,4 ± 0,59	75,22 ± 0,14	73,87 ± 0,63	
TC (g C/kg)	32,91 ± 1,76	19,71 ± 1,07	25,87 ± 1,92	
Soluble TOC (g/L)	8,84	4,62	8,63	*+ 87%*
TN (g N/kg)	4,95 ± 0,04	3,97 ± 0,10	1,98 ± 0,08	
TAN (g/kg)	**2,86 ± 0,05**	2,92 ± 0,09	0,32 ± 0,03	*- 89%*
C/N	6,65	4,96	13,02	

The BMP assays show hardly any difference in biogas (methane) yield for the recirculation of the stripped digestate compared to the non-stripped digestate. Recirculating 10, 25 and 50% stripped digestate results in an extra biogas production of 0, 3 and 9%, respectively.
Post-digestion of stripped digestate results in significantly higher methane yield (+ 88%) compared to the non-stripped digestate.

Table 2: batch digestion – evaluation post-digestion vs. recirculation

Description	mL biogas/g VS_{fed}	% CH_4
Post-AD, no stripping	103 ± 16	54 ± 2,2
Post-AD, with stripping	**195 ± 15**	53 ± 1,5
RR10%, no stripping	290 ± 9,0	55 ± 0,13
RR10%, with stripping	288 ± 7,9	54 ± 0,90
RR25%, no stripping	269 ± 10	54 ± 0,51
RR25%, with stripping	276 ± 9,4	53 ± 0,95
RR50%, no stripping	243 ± 18	53 ± 1,3
RR50%, with stripping	266 ± 13	53 ± 1,6

BioDEN

A biorefinery approach to exploit digestate as key feedstock in the energy – nutrient nexus

Conclusions

The targeted additional biogas production (10 -20%) is not achieved when recirculating stripped digestate to the anaerobic digester. In post-digestion, on the other hand, an 88% increase in biogas production was observed.

Contact: Prof. Lise Appels lise.appels@kuleuven.be

More information about the project: check out the project website.

Project partners: Biogas-E, KU Leuven, Ghent University, Marmara University, VCM, OSTIM

With the support of:

cornet

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

TÜBİTAK