Revalorization of sewage sludge and other organic wastes by co-digestion

Foncillas, Clara Fernando; Estevez, Maria M. ; Varrone, Cristiano; Uellendahl, Hinrich

DOI (link to publication from Publisher):
10.13140/RG.2.2.29741.64481

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Foncillas, C. F., Estevez, M. M., Varrone, C., & Uellendahl, H. (2019). *Revalorization of sewage sludge and other organic wastes by co-digestion*. Poster presented at Proceeding of 7th international conference on sustainable solid waste management, Heraklion 2019.. https://doi.org/10.13140/RG.2.2.29741.64481

Revalorization of sewage sludge and other organic wastes by co-digestion

Poster · June 2019

DOI: 10.13140/RG.2.2.29741.64481

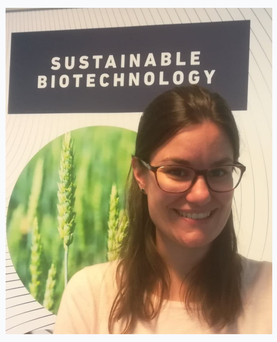
4 authors, including:

Clara Fernando Foncillas
Aalborg University
2 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Cristiano Varrone
Aalborg University
169 PUBLICATIONS **856** CITATIONS
SEE PROFILE

Maria M. Estevez
Aquateam COWI - Norwegian Water Technology Center
15 PUBLICATIONS **206** CITATIONS
SEE PROFILE

Revalorization of sewage sludge and other organic wastes by co-digestion



C. Fernando-Foncillas[1], M. M. Estevez[2], C. Varrone[1] and H. Uellendhal[3]

[1] Section of Sustainable Biotechnology, Aalborg University Copenhagen, A.C. Meyers Vænge 15, 2450 Copenhagen, Denmark (E-mail: cff@bio.aau.dk)
[2] Aquateam COWI, Karvesvingen 2, 0579 Oslo, Norway
[3] Faculty of mechanical and Process Engineering and Maritime Technologies, Flensburg University of Applied Sciences, Kanzleistr. 91-93, Flensburg, Germany

Introduction

Sewage sludge is digested anaerobically after wastewater treatment for the production of biogas, but this is not always a very economically feasible process. Combination with other organic wastes in co-digestion can improve the efficiency of the process due to a synergistic effect [1]. Co-digestion can overcome problems related to single substrate digestion such as the lack of micronutrients or imbalanced C/N ratio. Sewage sludge has been successfully co-digested with different organic wastes such as food waste [2].

In addition to biogas, sewage sludge can be converted in other value-added products such as organic acids, intermediate products of the anaerobic digestion. The focus of this project is to achieve higher valorization of sewage sludge through addition of different organic wastes for the production of biogas and other intermediate products, as presented in **Figure 1**.

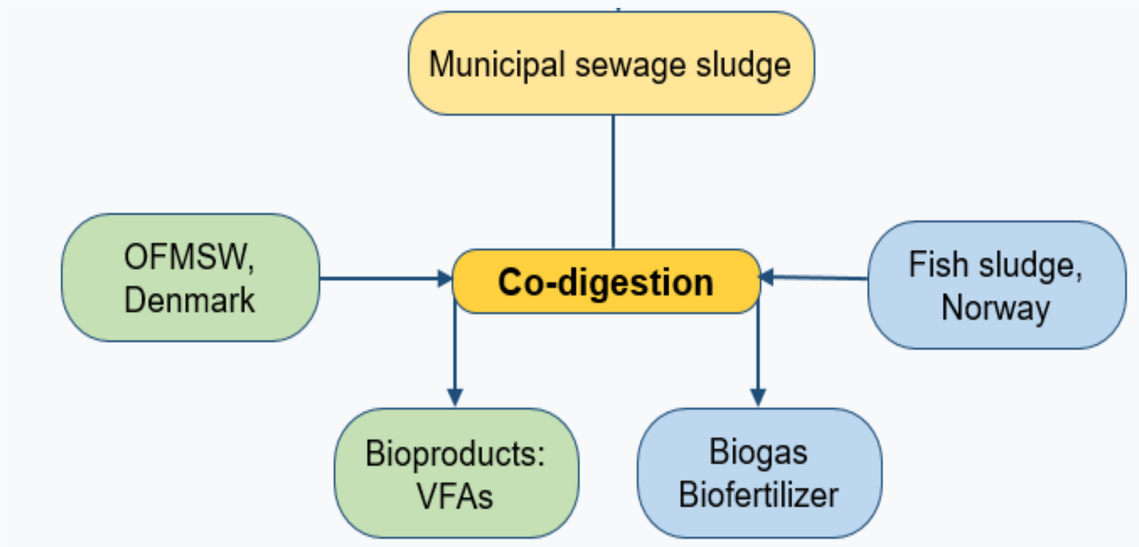


Figure 1: Diagram of the project idea

For that purpose, a representative organic waste of each country is used: fish sludge in Norway and organic fraction of municipal solid waste (OFMSW) in Denmark. The first step in this research was to study the chemical characterization of these organic wastes in order to optimize their use as substrates. Then, some batch tests were performed in order to study methane and biofertilizer production in Norway, and volatile fatty acids (VFAs) production in Denmark.

Results & Discussion

Table 1. Characteristics of sewage sludge, OFMSW and fish sludge

		COD g/kg	TS %	VS %	pH	Total N g/kg	Total P g/kg
Denmark	**Primary sludge**	44.1	3.3	2.8	5.8	1.1	1.0
	Secondary Sludge	24.6	2.6	1.9	6.4	1.5	2.3
	OFMSW	181.2	14.5	12.9	4.8	3.6	2.6
Norway	**Fish sludge A**	n.a.	13.4	12.3	5.6	7.6	1.3
	Fish sludge B	n.a.	10.4	9.2	4.7	5.1	0.9
	Sewage sludge	84.0	8.1	6.6	5.8	2.0	1.0

Samples of organic wastes and sewage sludge were collected in Denmark and Norway to study their chemical composition, which may vary depending on the region and time of collection. **Table 1** summarizes the chemical composition of the collected samples. The TS and VS content are lower in sewage samples from Denmark than from Norway, while the organic wastes have a similar TS and VS content.

Results from batch test experiments for VFA production are presented **in Figure 2**. Samples of sewage sludge and OFMSW were studied alone and in combination with and without inoculum. A maximum of about 0.18 g-COD/g-COD was obtained from co-digestion of both substrates and inoculum, with a higher increasing trend than all the other combinations.

Figure 3 presents the methane yield from different combinations of fish sludge and sewage sludge at thermophilic conditions. Co-digestion of both substrates gave a general positive effect, reaching up to 42% more methane than sewage sludge alone.

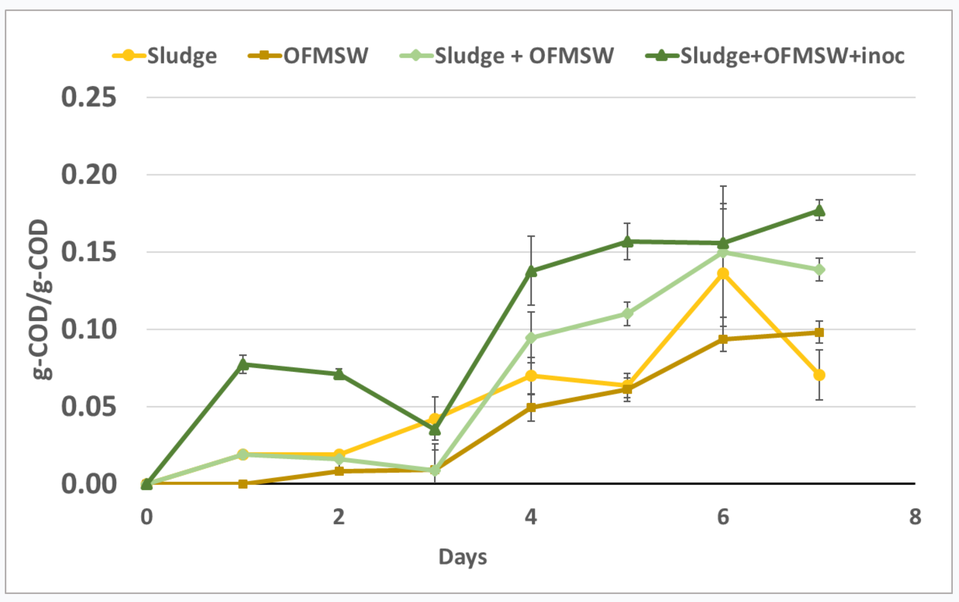


Figure 2: VFA yield from co-digestion of sewage sludge and OFMSW

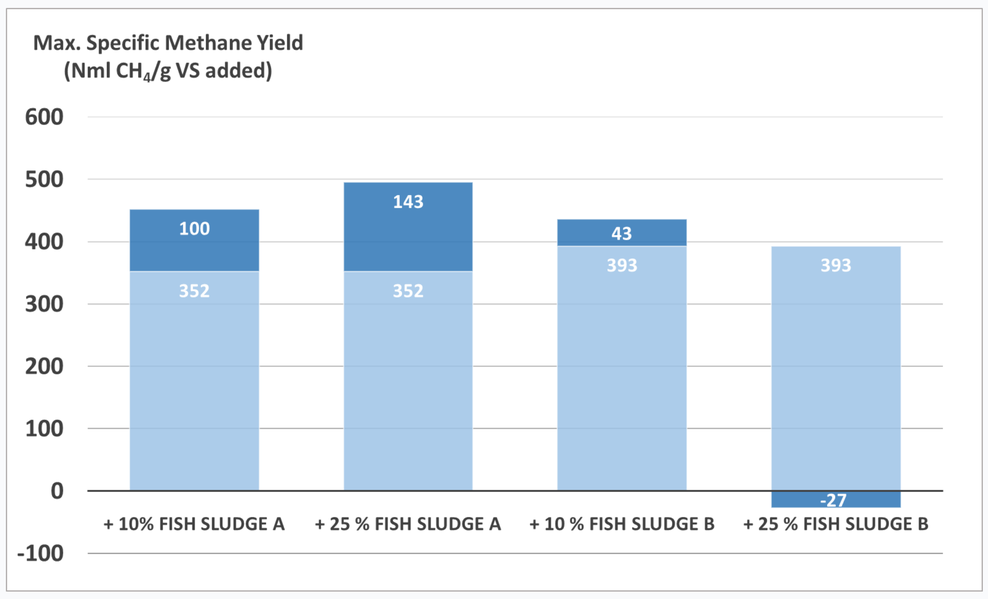


Figure 3: Biogas yield from co-digestion of sewage sludge and fish sludge

Conclusions

A representative organic waste from both Denmark and Norway was studied for revalorization of sewage sludge by co-digestion. Chemical composition of the samples, which may vary depending on region and time of collection, was studied since it can affect the co-digestion process and its outcome. Experiments to produce VFAs from sewage sludge and OFMSW, and biogas from sewage sludge and fish sludge were performed showing a general increasing trend when co-digesting the substrates. Co-digestion is then a promising approach in order to optimize feasibility of sludge treatment in wastewater treatment plants.

Acknowledgements

This study was carried out with funding from COWI Foundation, Project A092762-001 Wastewater and Organic Waste Treatment Facilities – Net Green Energy, Nutrients and Bioproducts Producers.

AALBORG UNIVERSITY
COPENHAGEN

aquateam | COWI

COWIfonden

References

[1] Xie, S., Wickham, R. and Nghiem, L.D. 2017. “Synergistic effect from anaerobic co-digestion of sewage sludge and organic wastes” *International Biodeterioration & Biodegradation* 116: 191-197

[2] Koch, K., Plabst, M., Schmidt, A., Helmreich, B. and Drewes, J. E. 2016. “Co-digestion of food waste in a municipal wastewater treatment plant: Comparison of batch tests and full-scale experiences” *Waste Management* 47: 28-33