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ANAEROBIC CO-DIGESTION OF OLEIC ACID AND WHEY PROTEIN: THE ROLE OF EMULSIFICATION

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Anaerobic digestion of FOG

- Fats, Oils and Grease (FOG) are preferred co-substrate for Anaerobic Digestion.
- High theoretical biomethane yield $(1m_3 CH_4 kg^{-1})$.
- FOG is a desirable substrate to enhance biomethane production.



Oleic acid

- Oleic acid is the most widespread unsaturated fatty acid in nature.
- It is suitable for biogas production.
- Is often responsible for process inhibition, due its high toxicity even at low concentrations.
- In this study, anaerobic co-digestion of oleic acid and whey protein was examined in continuous (batch-fed) stirred tank reactors.



Anaerobic Digesters Design &



igester type	CSTR
igester olume	2L
emperature	Mesophilic ~ 38 °C
ixing elocity	100 rpm
eeding type	Fed – batch (daily)
LSS	$10.2 \pm 2.5 \text{ g/L}$
H4-N	$2.5 \pm 0.2 \text{ g/L}$
icro- utrients	Eftaxias et al.

Preparation of proteinaceous solution

• 20gr/L whey protein• High shear 6000rpm



• Pre-heated at 75°C







Preparation of both mixtures

Emulsified mixture with oleic acid

 Mixing 5g/L of oleic acid when proteinaceous solution was performed. No emulsified mixture with oleic acid

 The proteinaceus solution and oleic acid were added separately into the digester

Waste Characteristics



Emulsified

10,0

No-emulsified 10,0 --OLR (g/Ld) -BPR (L/Ld) ---Foam ---Foam 9,0 8,0 7,0



Emulsified

No-emulsified



Parameter	Unit	Value
FOG	%	62.7
Protein	%	6.8
NVS	%	18.6



Emulsified



No-emulsified

Results – Maximum uptake rate for degrading LCFA

• Emulsified (km_fa = 6ka/kad)



• No-emulsified (km_fa = 1.41ka/kad)



m3.d-1

Conclusions

- ➢The results of this study demonstrate the importance of emulsification pre-treatment for high-rate anaerobic treatment of oleic acid based effluents.
- ➢Without emulsification procedure the anaerobic digestion of oleic acid was unstable, presenting high foaming incidents and severe accumulation.
- ➢Oleic acid solubility plays a critical role on the anaerobic digestion process.
- Maximum uptake rate for LCFA degrading microorganisms (km_fa) base on ADM1 modelling was 6 kg/kgd and 1.41 kg/kd for emulsified and non emulsified oleic acid respectively.

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Thank you