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The effect of pre-treatment by ultrasound on anaerobic co-digestion of sewage sludge and bovine manure

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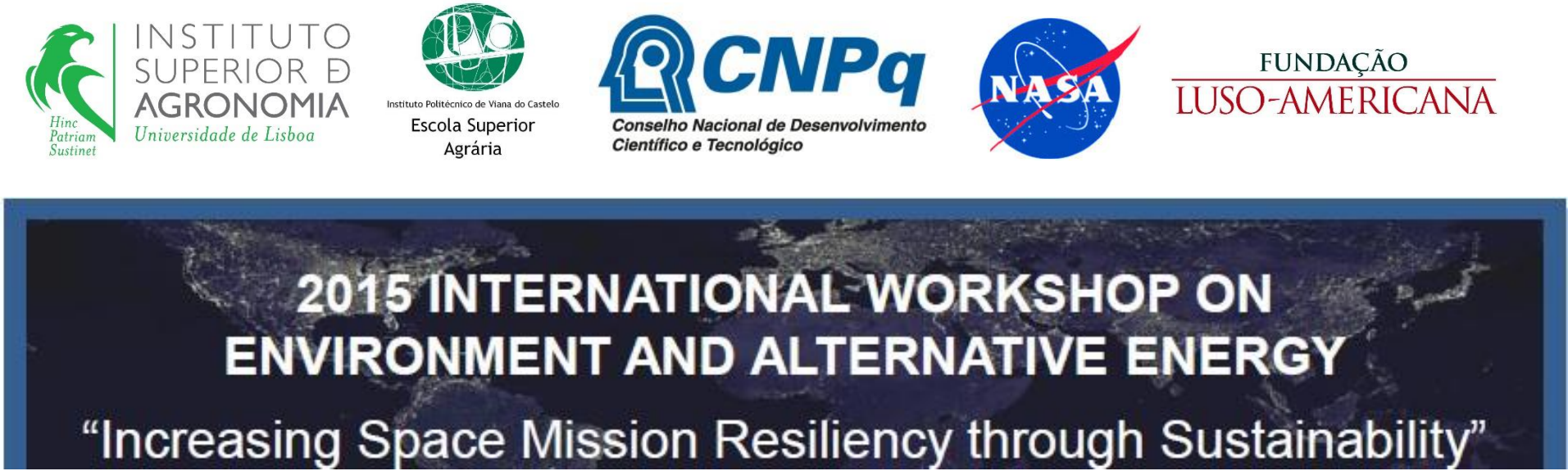
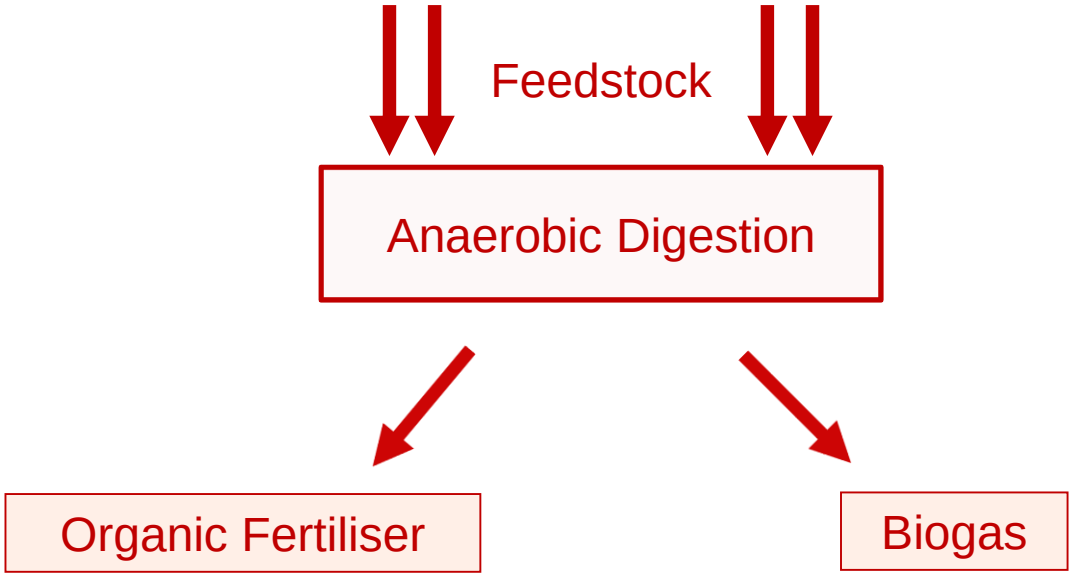


1. INTRODUCTION

Anaerobic Digestion or Biomethanation:

Economically and environmentally attractive microbially driven process that can be used to generate biogas from organic compounds .



1. INTRODUCTION

Anaerobic Digestion or Biomethanation:

Parameters that affect the Anaerobic Digestion

pH, Temperature, Organic Loading Rate (OLR),

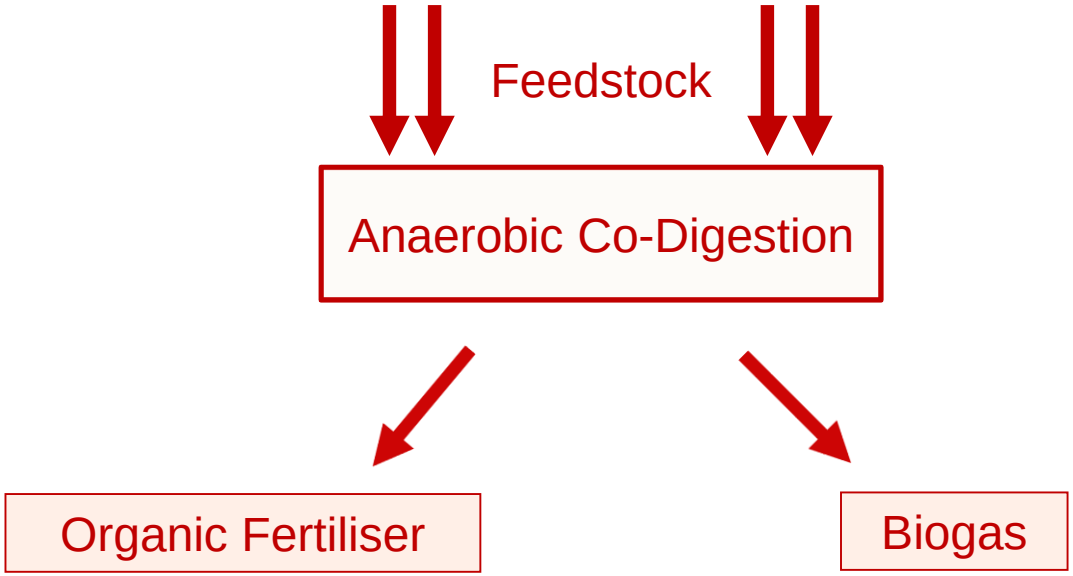
mixing, Hidraulic Retention Time (HRT), C/N ratio

All these parameters are important to the achievement of a stable degradation process and to produce a richer fertilizer and biogas.

1. INTRODUCTION

Anaerobic Co-Digestion or Biomethanation:

- Diferent feedstocks contribute with diferent C/N ratio;
- The mixture of different organic substrates com balance the C/N ratio in order to optimize the digestion process.



1. INTRODUCTION

Ultrasound Pre-treatment

The application of ultrasound pre-treatments aims to accelerate the hydrolysis of organic matter making it accessiblle for the biodegradation. Consequently, biogas production will be enhanced.

2. OBJECTIVES

Main objective :

To investigate the use of ultrasound pretreatment of the co-substrates on the anaerobic co-digestion of cattle manure and municipal sewage sludge, aiming to contribute to the development and optimization of an integrated solution for energetic valorization and treatment of agro-industrial wastes.

2. OBJECTIVES

Justification

- High pollution potential of agro-industrial wastes and wastewaters, specifically animal residues;
- Anaerobic municipal wastewater treatment plants in periodic idle mode because of an overdesigned capacity;
- The necessity to increase the biodegradability of co-substrates through the application of pre-treatments.

3.MATERIALS AND METHODS

Ultrasound Pre-treatment: Operation Condition

Figure 1 – Apllication of ultrasound pretreatment on co-substrates

- Samples of 500 mL;
- Temperature of 25ºC;
- Ultrasound frequency: 35khz
- Power Imput: 318 W
- Sonication time: 30 minutes
- Shaking every 10 minuts.

3.MATERIALS AND METHODS

Anaerobic Sequencing Batch Reactor (ASBR): Experimental Installation

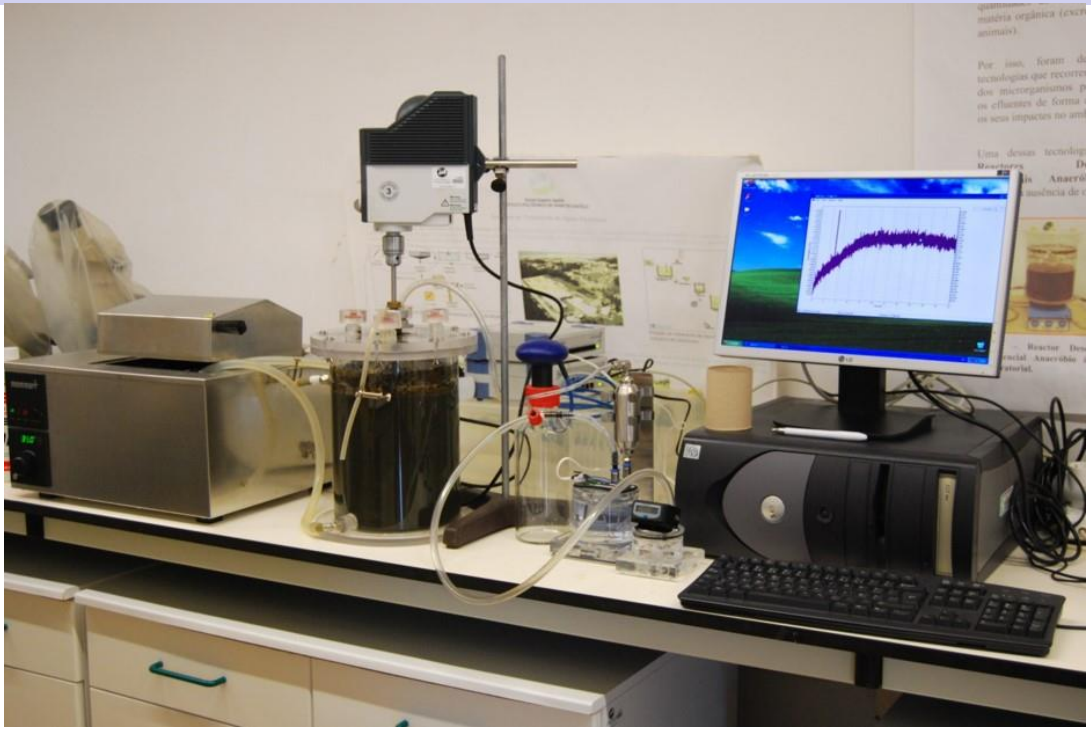


Figure 2 – Experimental installation

3.MATERIALS AND METHODS

Anaerobic Sequencing Batch Reactor: Operation conditions

ASBR 1 : No Ultrasound

- Temperature: 30 º C
- Shaking: 120 rpm
- Total HRT: 35 days

ASBR 2 : Ultrasound

- Temperature : 30 º C
- Shaking: 120 rpm
- Total HRT: 28 days

ACoD Assays: Parameters monitorization

pH, COD (total and dissolved), Solids (total solids, total volatile solids, total suspended solids, volatile suspended solids), nitrogen

4 OPERATIONAL RESULTS

Chemical Characterization of the experiments

Table 1 – Chemical characterization of the mixtures with and without pre-treatment

REACTOR	tCOD (gO2/L)	sCOD (gO2/L)	TS (g/L)	VTS (g/L)
ASBR 1 (no ultrasound)	35000±0	2160±130	22,7±1,13	16,8±0,77
ASBR 2 (ultrasound)	42667±3695	3093±185	24,6±0,35	19,44±0,36

4 OPERATIONAL RESULTS

Chemical characterization of the experiments

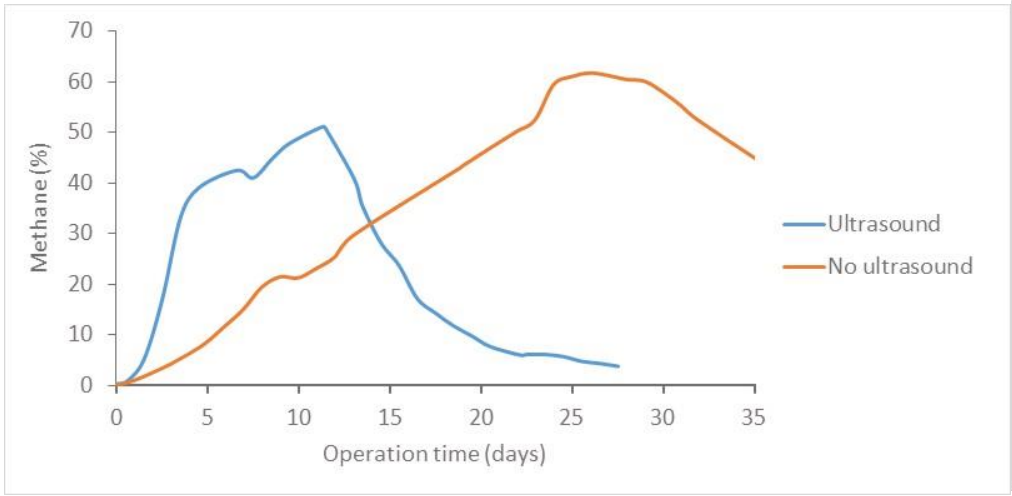


Figure 3 – Profile of methane yield

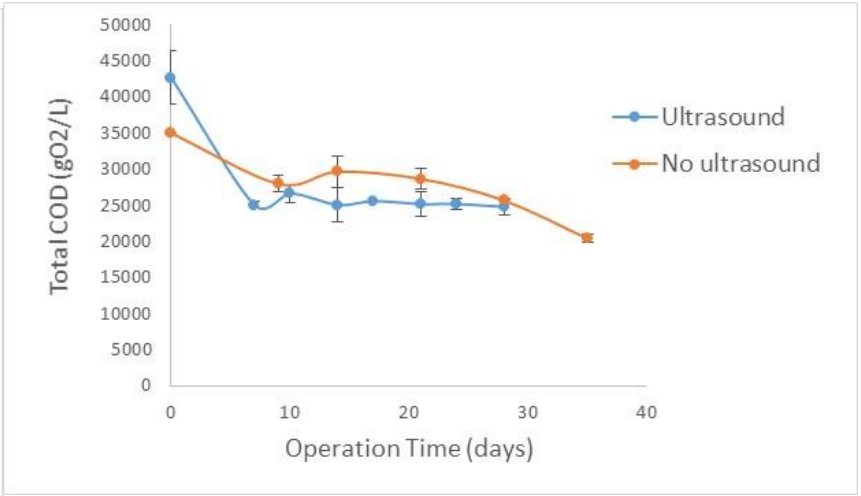


Figure 4 – Profile of Total COD

4 OPERATIONAL RESULTS

Chemical Characterization of the experiments

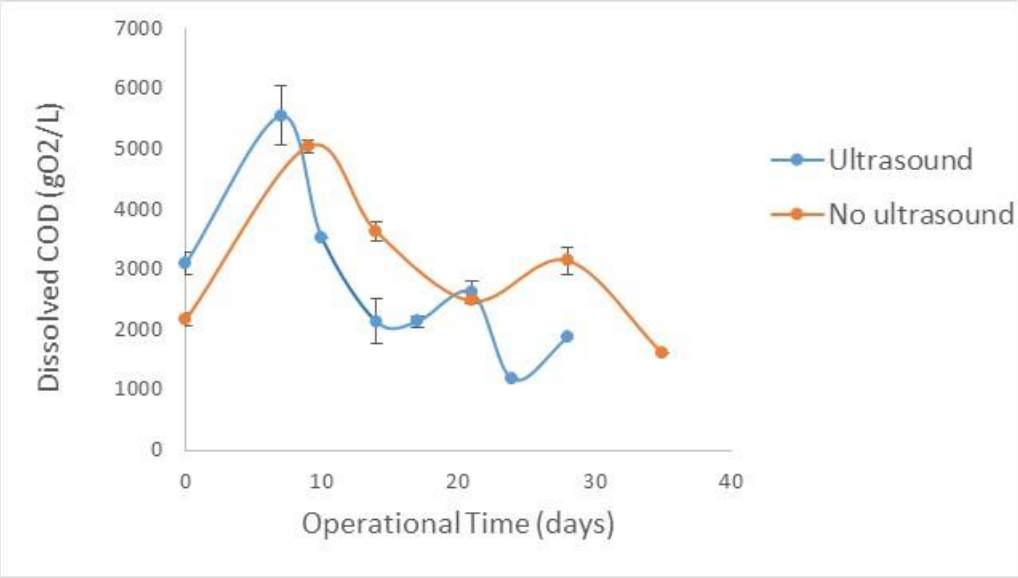


Figure 5– Profile of Dissolved COD

4 OPERATIONAL RESULTS

Table 2 – Removal efficiency, biodegradation rate and HRT calculated for ASBR 1 and ASBR 2..

Reactors	Removal Efficiency in terms of total COD (%)	Biodegradation rate (gO2/gSSV.d)	HRT to reach maximum methane yield rate (days)
ASBR 1 (no ultrasound)	31	0,06	25
ASBR 2 (ultrasound)	42	0,13	11

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4. CONCLUSIONS

● The application of ultrasound pre-treatment to the substrates enhances organic matter biodegradation rates, the removal efficiency in terms of total COD and reduce the hydraulic retention time necessary to achieve the maximum rate of methane production.

● The present study pointed out to the advantages of: *i)* the use of ultrasound pre-treatment to optimize the anaerobic co-digestion process; *ii)* to provide the energy recovery of agro-industrial wastes and contribute to increased energy self-sufficiency of anaerobic digestion systems*; iii)* adoption of an integrated strategy towards sustainable management and valorisation of dairy effluents and other agroindustrial organic wastes, as a contribution to regional development.

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Thank you for your attention!!

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