ANAEROBIC DIGESTION OF LIGNOCELLULOSIC BIOMASS PRE-TREATED BY SUB AND SUPERCRITICAL CONDITIONS

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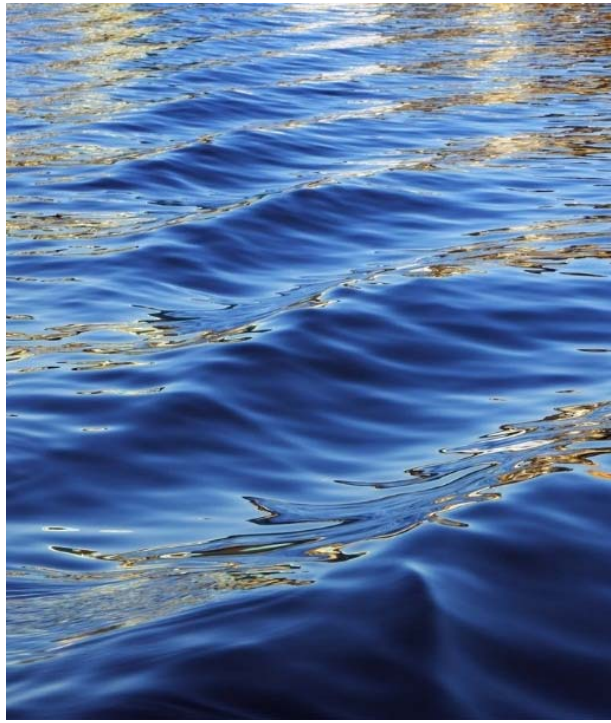


5th International Conference on Sustainable Solid Waste Management

INTRODUCTION

Food Industry

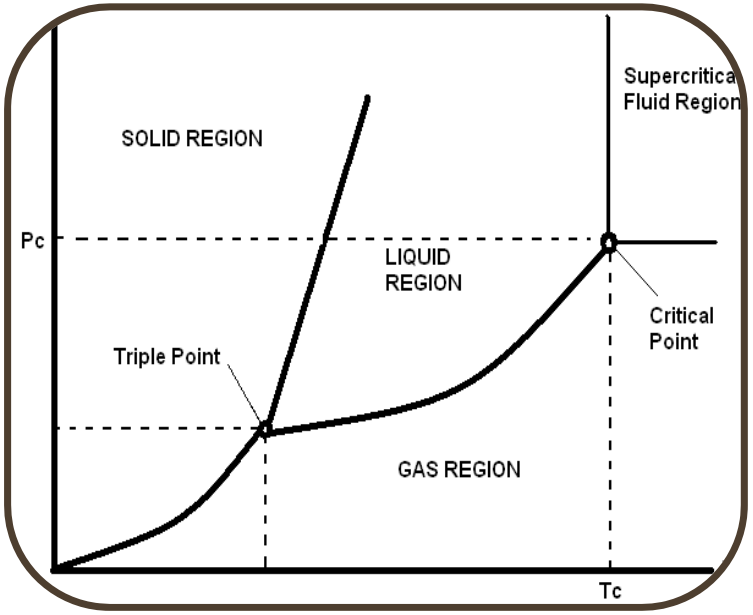
Sustainable energy system

AD = Stabilization + Biogas production

L Co-substrates & Additives ty

Vegetable Crop Residues

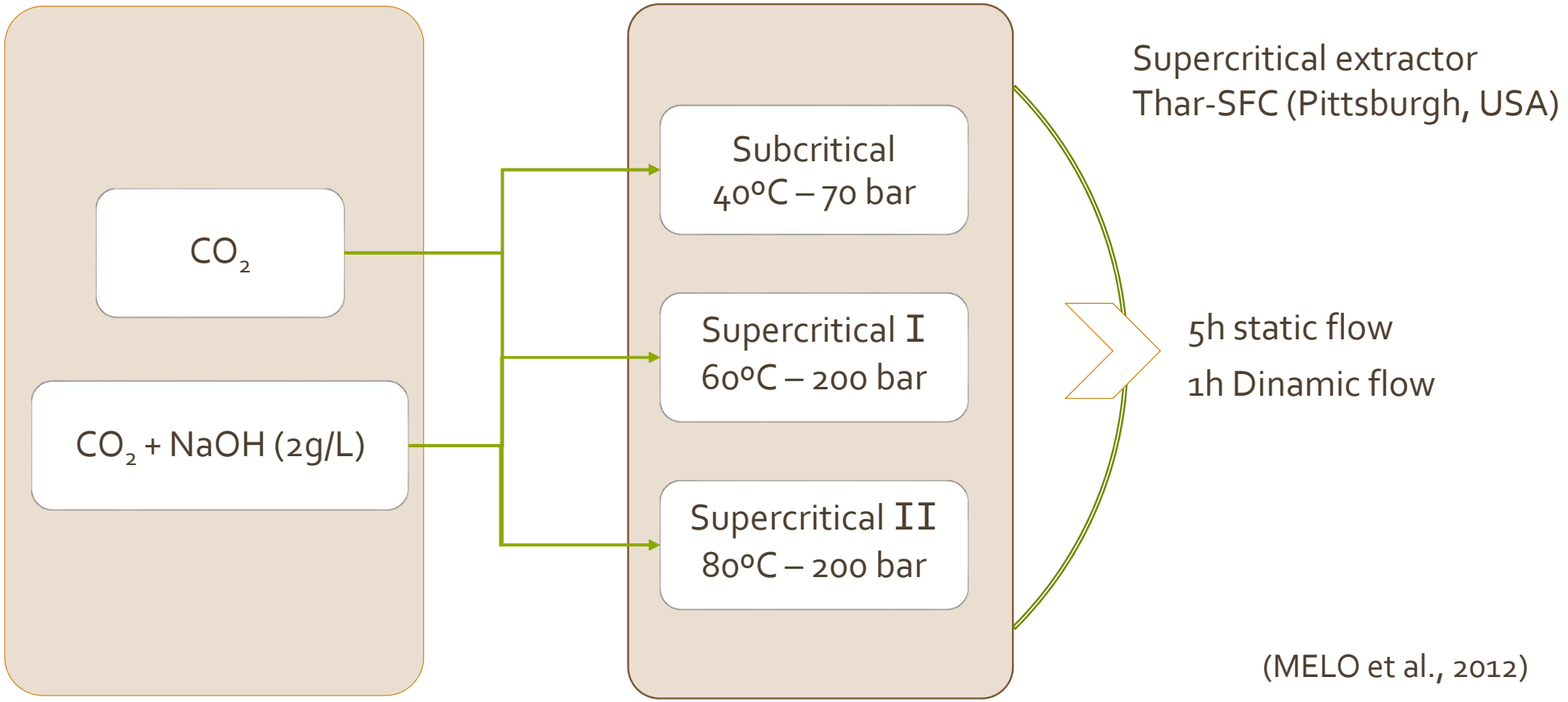
Sub/Supercritical Pre-treatment



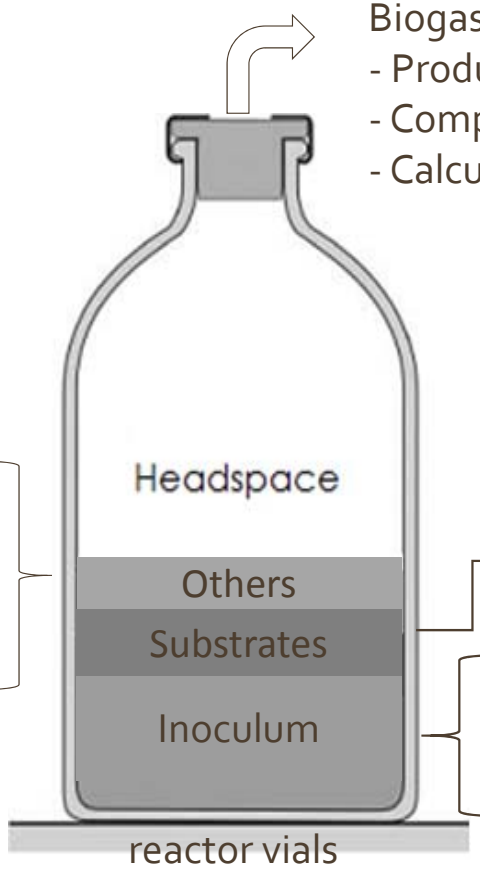
Sugarcane bagasse biodegradability and physicochemical characteristics

MATERIALS & METHODS

Sub/Supercritical Pre-treatment



Biomethane Potential Tests



Biogas Analysis
- Production Amount (Pressure Transduction)
- Composition (Gas Chromatography)
- Calculation of methane volume.

20 mL of buffer
0,2 mL Macroelement solution*
0,1 mL Oligoelement solution*
Nitrogen x 3 min.

1.0 g. of raw/ pre-treated SCB

25 mL of Inoculum with SMA of 1.129 g .DQO / g.SSV.d.
Adapted with synthetic effluent of milk and celulose (3.2 g/L COD)

Adaptado de ANGELIDAKI et al. (2009)

*Zhender et al. (1980)

Estimation of kinetic parameters

- Methane production potential
- Methane production rate
- Duration of the lag phase

Modified Gompertz equation

$$P_{CH_4}(t) = P_{CH_4} exp\left\{-exp\left[\frac{k.e}{P_{CH_4}}(-t)+1\right]\right\}$$

(CHEN et al., 2006)

RESULTS & DISCUSSION

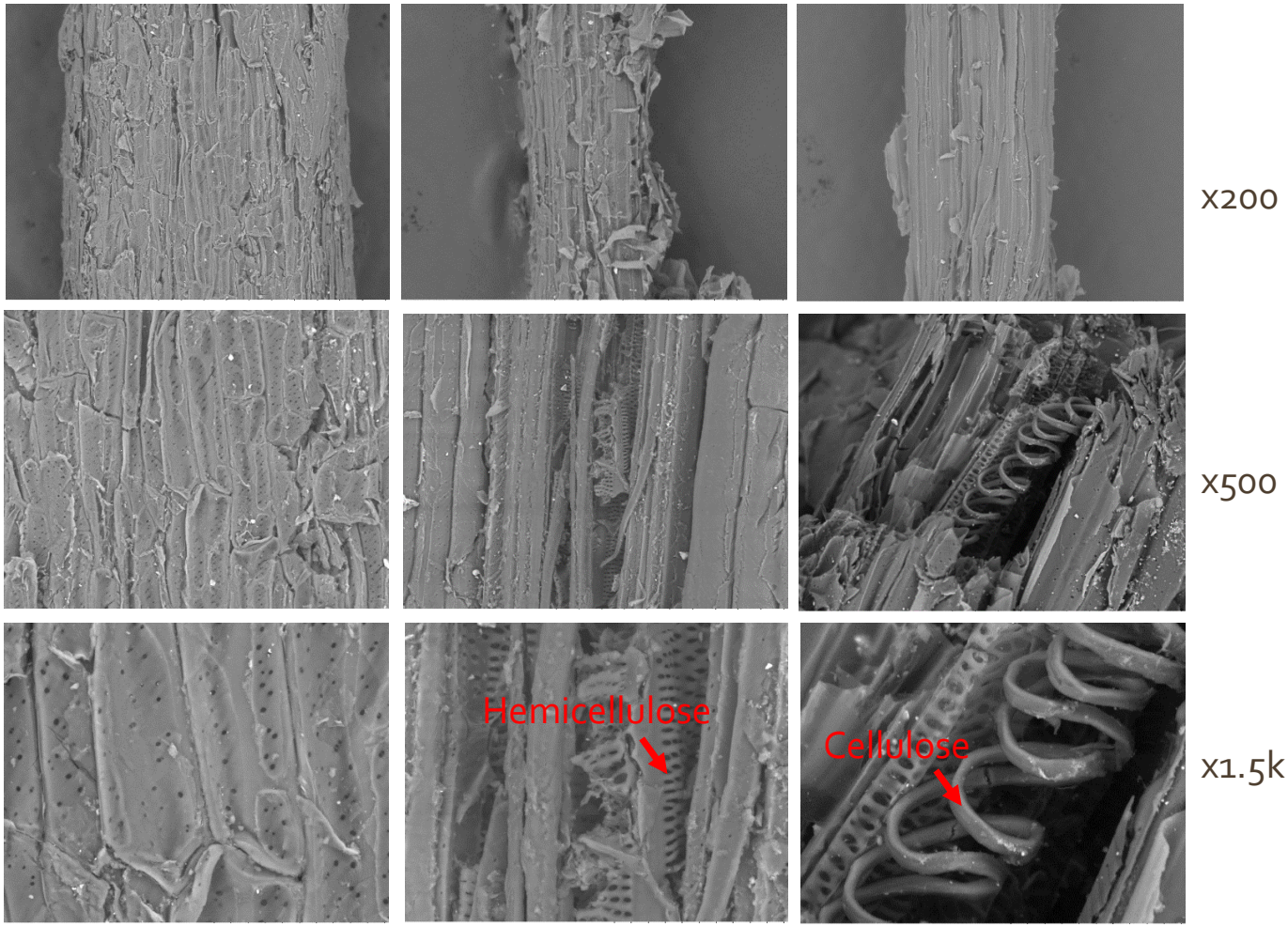
Characterization of SCB

NaOH

	T1 (Raw material)	T2 (40ºC+70bar)	T3 (60ºC+200bar)	T4 (80ºC+200bar)	T5 (40ºC+70bar)	T6 (60ºC+200bar)	T7 (80ºC+200bar)
Humidity (%)	4,8	4,3	4,6	3,6	3,9	4,7	5,5
Real ρ (g/cm3)	1,480±0,03	1,146±0,02	1,206±0,06	1,378±0,08	1,063±0,07	1,391±0,04	1,456±0,05
Aparent ρ (g/cm3)	0,056±0,001	0,068±0,003	0,061±0,003	0,063±0,003	0,049±0,002	0,061±0,001	0,060±0,002
Porosity (%)	96,219	94,042	94,962	95,422	95,423	95,647	95,891
Contact Angle	114,75±15,51	110,82±12,89	89,75±8,13	92,79±7,81	87,21±10,40	101,01±13,39	88,99±7,45
COD (g.COD/g)	0,857±0,083	0,948±0,200	0,903±0,025	1,025±0,004	0,833±0,052	0,966±0,260	0,935±0,051
TS (mg/g)	941,46±3,10	938,16±6,94	935,31±4,65	944,76±0,15	866,60±95,20	874,59±85,60	929,34±12,03
TFS (mg/g)	8,402±2,198	6,574±2,003	6,283±1,296	6,844±1,339	6,331±3,470	6,307±1,522	6,787±2,798
TVS (mg/g)	933,06±0,90	931,59±4,94	929,03±3,35	937,91±1,18	860,27±91,73	868,28±84,12	922,55±9,24

Morphology

Scan electron microscopy

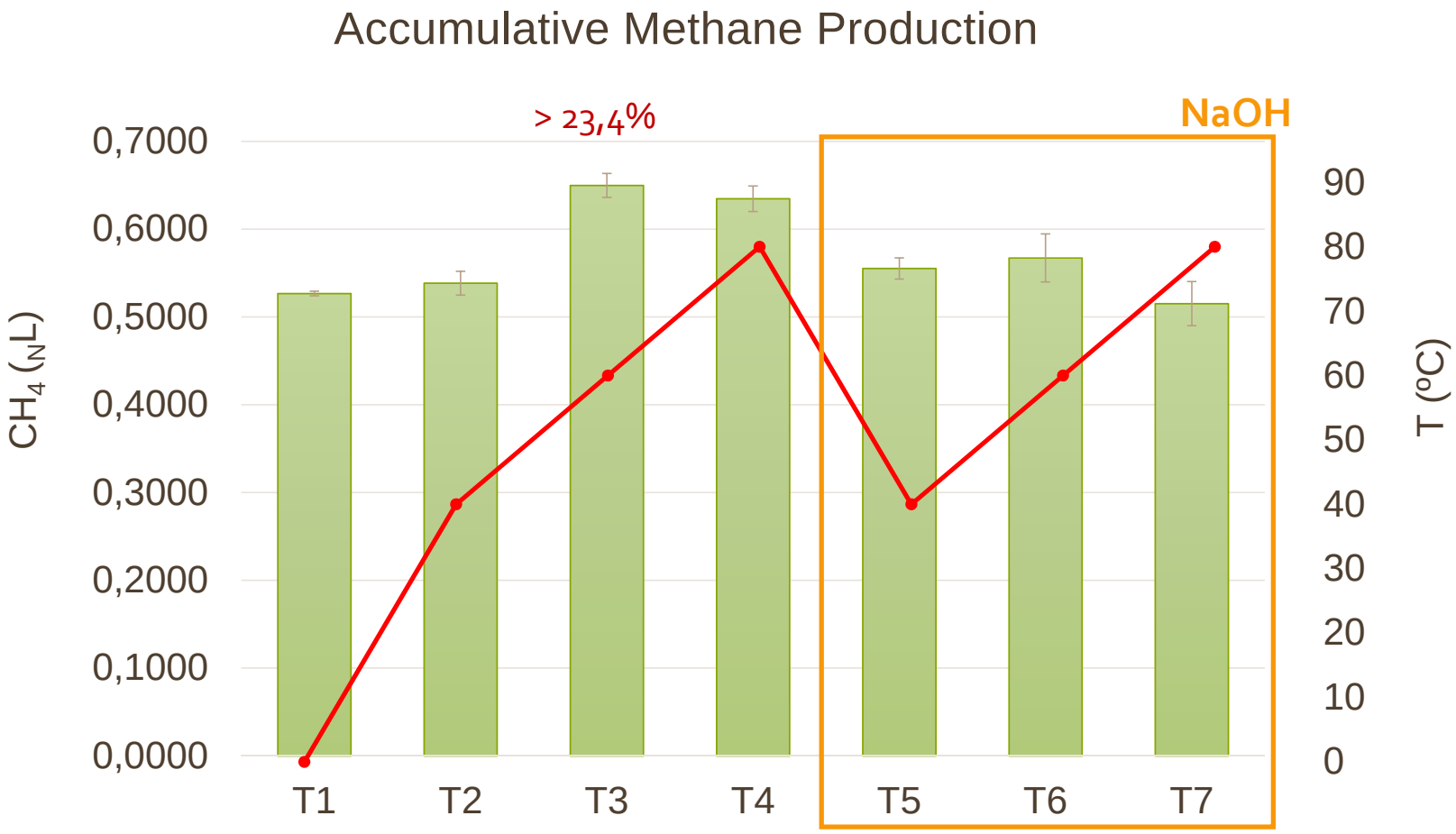


Characterization of SCB

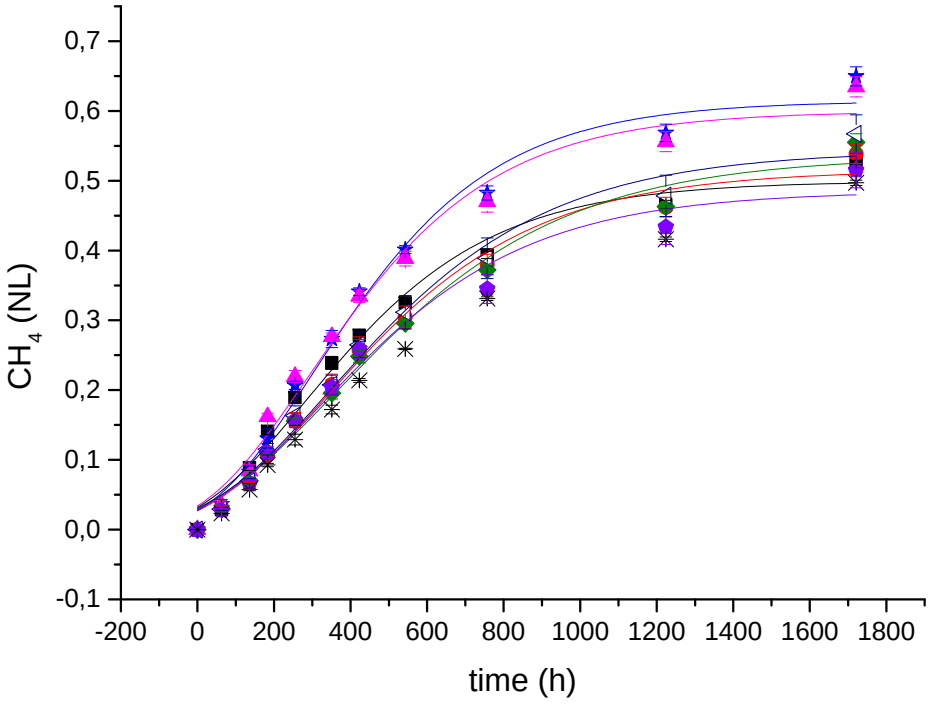
NaOH

Compound	T1 (Raw material)	T2 (40ºC+70bar)	T3 (60ºC+200bar)	T4 (80ºC+200bar)	T5 (40ºC+70bar)	T6 (60ºC+200bar)	T7 (80ºC+200bar)
Acid Lignin (%)	10,53	10,11	9,68	12,14	**15,73**	**12,54**	**13,80**
Cellulose (%)	49,81	50,26	50,42	49,52	49,14	50,23	49,37
Hemicellulose (%)	25,71	25,62	27,22	29,44	**28,09**	**28,68**	**29,63**

BMP of sugarcane bagasse.



BMP Kinetic Parameters



Branco (*), T1 (■), T2 g (●), T3 (▲), T4 (▼), T5 (♦), T6 (◄), T7 (►)

	Pmáx ($_N$L)	λ (h)	k ($_N$L/h)	R^2	Yp/S*
T1	0.499±0.020	281.51±20.68	$6.59x10^{-4}$	0.980	0.615
T2	0.515±0.018	335.02±20.18	$6,11x10^{-4}$	0.986	0.568
T3	0.615±0.020	303.78±16.88	$8.43x10^{-4}$	0.987	0.720
T4	0.600±0.023	291.30±20.63	$7.99x10^{-4}$	0.980	0.620
T5	0.536±0.023	361.93±25.50	$5.69x10^{-4}$	0.983	0.666
T6	0.543±0.022	346.87±23.62	$6.13x10^{-4}$	0.983	0.587
T7	0.485±0.025	323.57±31.06	$5.75x10^{-4}$	0.974	0.551

NaOH

* Prod. CH_4 relativa à quantidade de substrato

Conclusions

- Pre-treatments with sub and supercritical fluids have the potential to reduce structural obstacles of composition and increase the biodegradability of lignocellulosic materials.
- Methanogenic production of the anaerobic digestion of sugarcane bagasse was increased in all cases in which the material was pretreated with sub and supercritical CO_2, with exception of the cases in which NaOH was used as polarity modifier in combination with high temperatures.
- More research its necessary to increase the effectiveness of this pre-treatment by evaluating with greater amplitude variables of temperature, pressure, time and addition of co-solvents.
- An economic analysis it's necessary to determine the cost/benefit balance, which can be improved if lignin recovery it's added.

Thank you for your attention.

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Special Acknowledgments:

Universidade de São Paulo FZEA USP LBA FZEA USP CAPES CNPq