MICROBIAL SYNGAS CONVERSION BY MESOPHILIC AND THERMOPHILIC ANAEROBIC MIXED-CULTURES

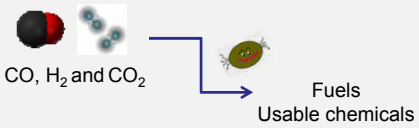
JOANA I. ALVES*
Supervisors: Madalena Alves, Diana Z. Sousa
* joana.alves@deb.uminho.pt

University of Minho
School of Engineering
Centre of Biological Engineering

FCT Fundação para a Ciência e a Tecn
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIO

Introduction

Synthesis gas (or syngas) can be produced from the gasification of a variety of recalcitrant or biodegradable waste materials. Syngas is a mixture composed of mainly H_2, CO and CO_2 that can be used in a biological process for the production of fuels or usable chemicals. The main goal of this work was to study the physiology and microbial composition of anaerobic cultures able to utilize syngas.



Methods

Enrichment cultures

Substrate (series M1, T1 and T2)

	CO	H_2	CO_2
Syngas from coal gasification	60%	30%	10%

Syngas was diluted with H_2/CO_2 (80:20 v/v) to provide CO concentrations ranging from 5% to 50% CO to the cultures.

Substrate (series T2)

CO diluted with N_2 to provide CO concentrations from 10% to 50% CO to the cultures.

Total pressure = 1.75 bar


37 °C — Mesophilic suspended sludge from a labscale bioreactor


55 °C — Thermophilic suspended slugde from a reactor treating organic municipal solid wastes

Monitoring

Gas composition (gas chromatography), soluble fermentation products (liquid chromatography)

Microbial growth (spectrophotometry, abs 600 nm)

Microbial communities (16S rRNA based PCR-DGGE, cloning and sequencing)

Results

Mesophilic enrichment series

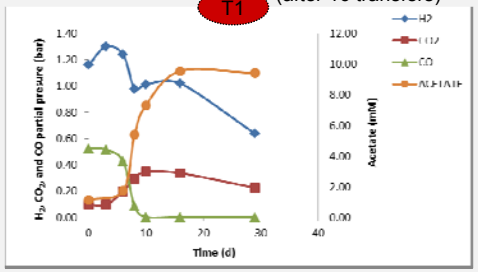
	M1
Substrate:	Syngas (3 transfers)
CO concentration:	5% to 10%

- After 2 transfers there were no growth, neither syngas or CO conversion.
- After 2 transfers the biomass also lost the ability to produce methane, that was being produced during 1st transfer.

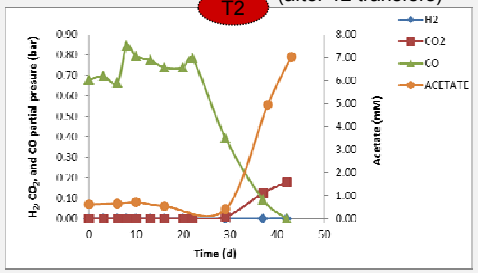
Thermophilic enrichment series

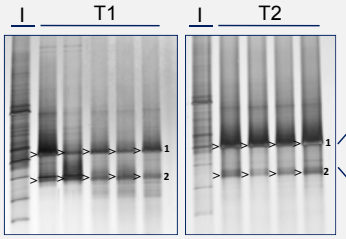
	T1	T2
Substrate:	Syngas (4 transfers) Syngas (12 transfers)	Syngas (4 transfers) CO (8 transfers)
CO concentration:	5% to 50%	5% to 50%

T1 (after 16 transfers)



T2 (after 12 transfers)





Desulfotomaculum s Hbr7 (99% identity)

Desulfotomaculum australicum str. AB33

Thermophilic anaerol bacterium K1L1 (96%

Thermoanaerobacte aotearoense (86%)

Conclusions

- Regarding CO consumption, the thermophilic suspend sludge offers potential advantages over the mesoph suspended sludge.
- CO degradation was faster on T1, probably because substrate used during the initial 4 transfers was the same during the entire experiment.
- The diversity of the microbial community present, decreas drastically from the inoculum sample, suggesting a f specialization of microbial community on this type of substrate

This work gave insight into the microbiology and physiology of syngas and carbon monoxide conversion by anaerobic mixed culture.

References

Basu R *et al.* (1993) Report for U.S. Department of Energy, 1-32
Henstra AM *et al.* (2007) *Current Opinion in Biotechnology*, 18(3 206.
Hussain A *et al.* (2011) *Appl Microbiol Biotechnol*, 90:827-836.
Oelgeschlager E and Rother M (2008) *Arch Microbiol*, 190:257-
Sipma J *et al.* (2006) Critical Reviews in Biotechnology, 26:41–6
Sokolova TG *et al.* (2009) FEMS MicrobiolEcol, 68:131-141.
Worden RM *et al.* (1997) American Chemical Society, 321-335.

Acknowledgements

The financial support from Fundação para a Ciência e Tecn (FCT) and European Social Fund (POPH-QREN) trough PhD SFRH/BD/48965/2008 given to Joana Alves is gra acknowledged.