

# Agricultural and industrial wastes co-digestion: batch versus semi-continuous anaerobic digestion yield and mass balance

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## Introduction

CIRSEE team, in partnership with AgroParisTech and SITA, had engaged two years ago a characterisation study of both agricultural and industrial wastes to evaluate their anaerobic digestion (AD) potential. To confirm the previous results obtained [1], a 2nd characterisation campaign was achieved last year comprising chemical and anaerobic biodegradability characterisations of several samples. AD yield and mass balance of three wastes mixtures were assessed both in batch and in semi-continuous feeding modes to evaluate relevance of simple batch tests over more laborious semi-continuous experiments.

## Material and Methods

### *Analysed materials and chemical characterisations*

Liquid cow manure and two different solid ones (cows and goats) were sampled at farm. Food and grease wastes were obtained from SITA industrial units. From them, three mixtures were constituted, one with agricultural wastes only (MIX1) and two with agricultural mixed with industrial wastes (MIX2 and 3). Digestate from a wastewater treatment plant sludge anaerobic digester had been used to inoculate both batch and semi-continuous digestion experiments. pH, total (TS) and volatile solid (VS) contents, total and ammonium nitrogen concentrations were analysed on each raw and incubated materials.

### *Batch anaerobic digestion*

Incubation tests were performed in one litre flasks on each considered material. Regular pressure measurements and micro-gas chromatography analysis allowed quantification of methane productions.

### *Semi-continuous anaerobic digestion*

Two lab scale anaerobic reactors of 10L were fed daily with the three mixtures successively over a 104 days period, at an organic loading rate of 2 kg VS/m<sup>3</sup>reactor/day. Biogas production was measured continuously using volumetric counters. Regularly,  $\mu$ GC analyses were performed on biogas samples and digestates were analysed for TS and VS content along with volatile fatty acids and ammonia nitrogen concentrations.

## Results and perspectives

The different wastes exhibited significant differences between their characteristics and notably concerning methane potentials, ranging from 200 to 960 L(CH<sub>4</sub>)/kgVS (obtained for cow solid manure and grease respectively). For the three wastes mixtures, MIX1, 2 and 3, methane potentials of 284, 586 and 619 L(CH<sub>4</sub>)/kgVS respectively were determined within 80 days of batch incubations. Those values were found in good agreement both with methane potentials calculated from mixtures components potentials and with methane potentials measured as mean values on the semi-continuous reactors. The higher deviation was observed on MIX 1 behaviours mainly because of the lower kinetic rate of agricultural wastes digestion. Batch tests gave thus quite relevant information on anaerobic biodegradability with regard to semi-continuous experiments. Pilot tests allowed additional parameters determination such as chemical characteristics of the digestate but long term experiments may be needed.

## References

[1] Rouez M., Martel J-L, Yapo J-F., Tristant D., De Franssu B., Villemin G., Lepine A., Agricultural and industrial wastes co-digestion : feedstock study and mass balance evaluation, in Orbit 2012 proceedings, Rennes, 2012

## Keywords

Agricultural and industrial wastes, anaerobic digestion, methane potential