Impact of biodegradable plastic bags residues on anaerobic digestion [Poster]

Impact of biodegradable plastic bag residues on anaerobic digestion

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MOTIVATION:

- Plastic bags are an ideal material for the collection of wet wastes, but poor biodegradability
- Accumulations of plastic residues in the environment are an urgent and serious concern.
- AD is the most common process for the treatment and conversion of wet organic waste to energy.
- Biodegradable plastic would encourage the hygienic collection of household food waste for AD.
- Current practice: separation of bags from the food waste prior to digestion, a difficult operation causing loss of organic material and increased costs.
- Some of the plastic material inevitably ends up in the digesters and potentially on land

EXPERIMENTAL SUMMARY:

- Standard 10 litre vertically stirred bioreactors at 37°C,
- Plastic bags were used as a sole substrate and digesters performance was compared with the control digester fed by sewage sludge only.
- pre-treated at 70°C for 1hr, according to the Animal By-product Regulations.
- feeding 5 days per week, no feeding at weekends.
- The organic loading rate was 2.65 g VS/l/day.
- Monitoring: Cumulative gas production (on line), gas quality (manually by infra-red). Stability indicators (Ripley's Ratio, volatile fatty acids, pH and ammonia)

MATERIAL: Alcohol- and starch-based bag samples **used for production of biodegradable bags**

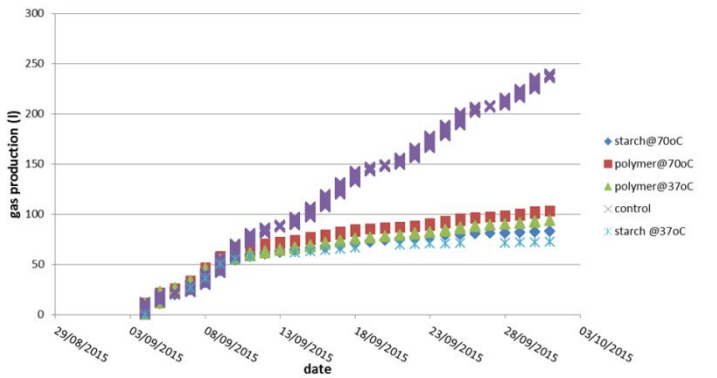

Figure 1. Biogas production for 5 digesters: control, starch bags, pre-treated starch bags, alcohol and pre-treated alcohol. Note that biogas production in all plastic bag-fed digesters is much lower than that in control digester, fed by sewage sludge only. Legend: "starch": starch based biodegradable material, "polymer": alcohol based biodegradable material, "control": sewage sludge fed digester

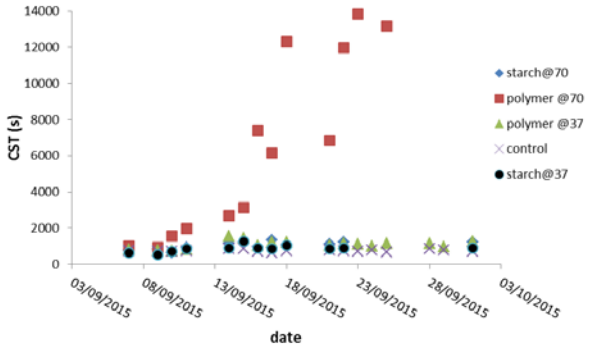

Figure 2 Capillary Suction Time (CST) for 5 digesters. Note the steady increase in digestate with heat pre-treated polymer based bags. This indicates increased viscosity of the digestate and potential increase in power consumption for digester mixing. The CST of the other digesters remains stable throughout the experiment. Pre-heating bags according to the Animal By-product Regulation to 70°C for 1hr did not have an effect on reactor performance.

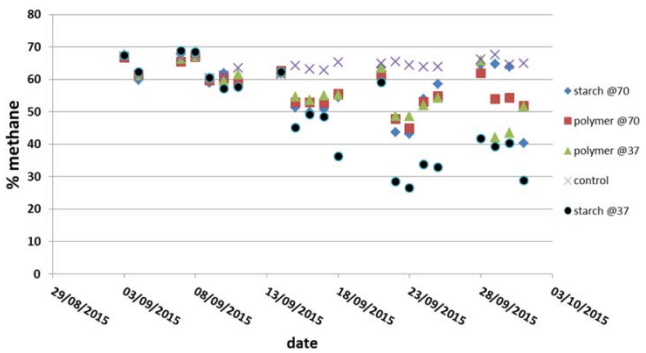

Figure 2. Gas quality-methane percentage in biogas. Note that for all samples methane percentage is lower than that in the control digester. Methane percentage is the lowest in the case of untreated starch based bags.

CONCLUSIONS:

- Poor biodegradability for both types of bags at both temperatures of pre-treatment
- Using bags as sole substrate, biogas production stalls and methane percentage in biogas decreases
- Stability indicators remain stable, indicating that material is inert rather than toxic to digestion.
- Alcohol polymer-based bags completely dissolved when treated at 70°C whereas the starch ones did not, and in this case only digester viscosity rapidly increased (CST)
- An increase in total solids in all test reactors was observed as the plastic accumulated. This may have implications for the mixing of the digesters, with an increase in torque on the stirrer blades, resulting in greater energy consumption.

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