

**ADNet Early Career Researcher Conference, Warwick University, June 29-30, 2015**

I would like my work to be considered for a platform presentation

## **The impact of plastic bag residues on Anaerobic Digestion performance**

Tanja Radu<sup>1</sup>, Richard Blanchard<sup>2</sup>, and Andrew Wheatley<sup>1</sup>

<sup>1</sup>School of Civil and Building Engineering, School of Electronic, <sup>2</sup>Electrical and Systems Engineering, Loughborough University

Keywords: food waste, bags and biodegradability

**Aim of the research:** To test the suitability of a plastic bag material for separate collection of food waste prior to AD. Toxicity, biodegradability and biogas production of the polymer was assessed by comparison with other feedstocks as controls. 10 litre digesters were used with and without pretreatment of the plastic.

**Short summary:** In this work we used 10 litre digesters to investigate the suitability of a polymer material for food waste collection plastic bags. The material needed to be robust, but also biodegradable. Digestion of the synthetic polymer was compared to natural polymers from maize and rice. Two controls were also used: cellulose (known for its high biodegradability) and sewage sludge (the most commonly used AD substrate). Parameters checked daily, included gas production and composition, CST and total and volatile solids of the digestate. Stability was assessed by Ripley's ratio, VFA, ammonia and pH. Digester loading was 1.36 g VS/l/day at 60 day HRT. The experiment was in two halves with sewage sludge feed in the middle, as an internal control to check activity. In a second experiment the material was pre-treated according to the Animal By-product Regulations (Regulation, 2011) heating to 70°C for 1hr. The results show the material was completely inert.

**Main results to be presented**

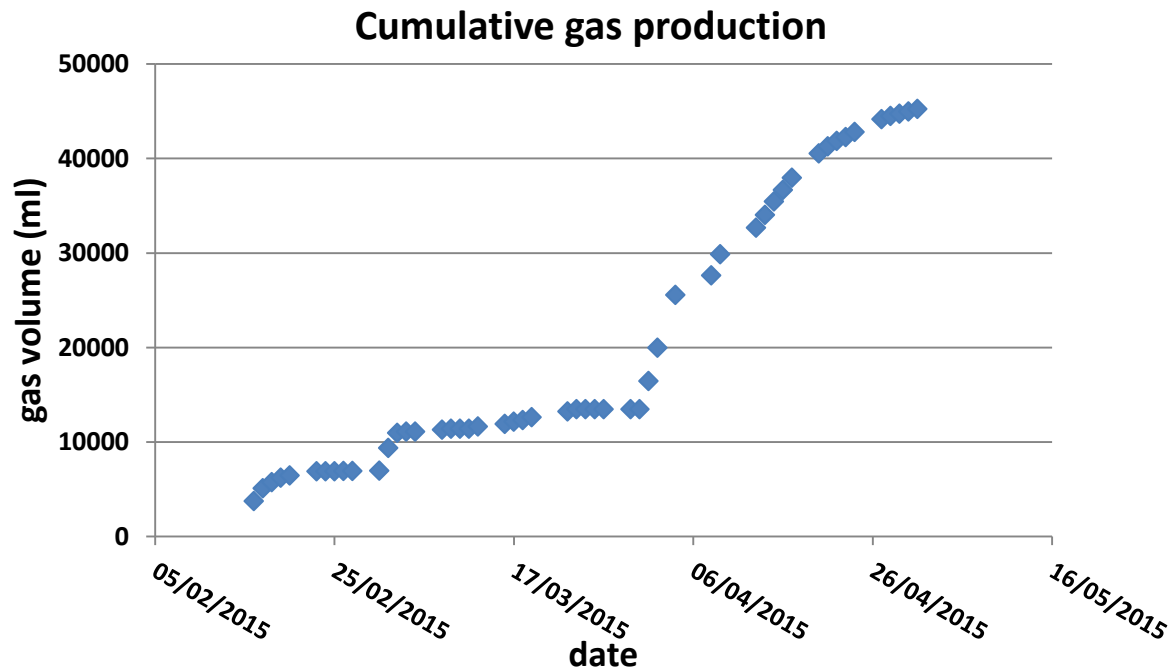


Figure 1. Gas production resulting for AD of synthetic polymer. Note: Sewage sludge added on 2/3/2015 and in period 30/3-21/4 2015.

Figure 1. show the gas production surges in gas production (arrows) closely correspond to the sewage sludge additions. Additions of polymer as sole substrate gives the plateaus in gas production. Average gas production with sewage sludge was 2 litres of biogas per day, compared to 200ml with the polymer. The decrease in gas production was closely followed by a fall in biogas quality, with methane decreasing from initial 55-60% to 20-30%.

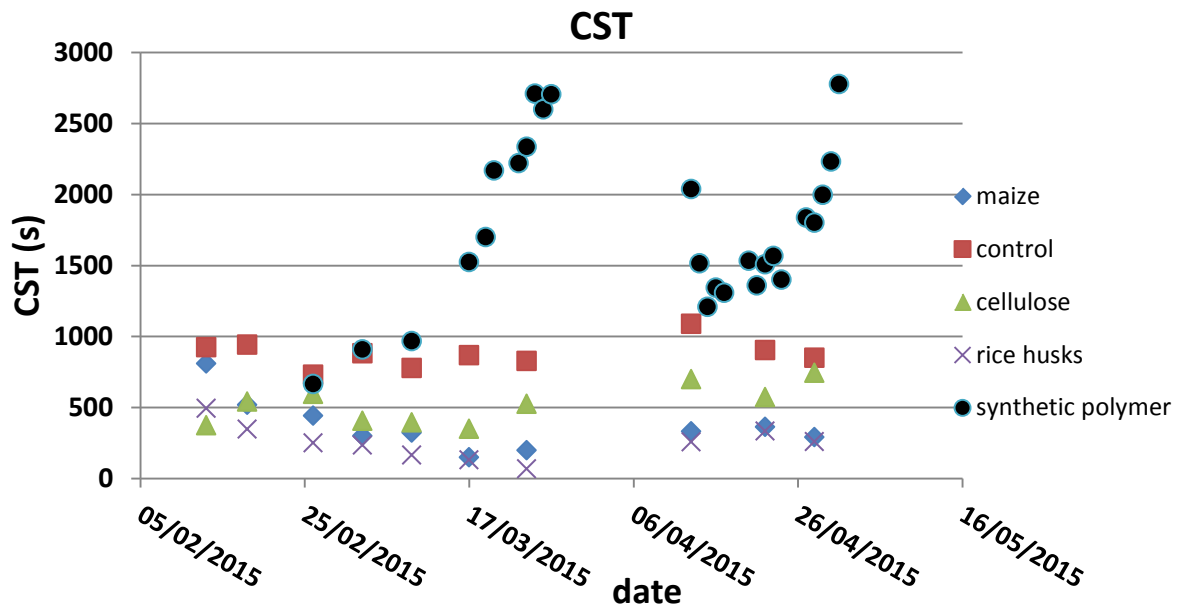


Figure 2. CST of the 5 reactors used in this experiment.

Figure 2 indicates effect of the polymer on the viscosity of the digestate. Introduction of the polymer causes a rapid increase in CST of the reactor. The CST of the other digesters remains stable throughout the experiment. Switching feedstock to sewage sludge lowers and stabilizes viscosity of the reactor. Repeating the experiment by introduction of the synthetic polymer as a feedstock reproduces the effect on CST. In the second phase of the experiment (from 22/04 on) the polymer was pre-heated according to the Animal By-product Regulation to 70°C for 1hr. This did not have an effect on reactor performance, neither gas production or quality (see Figure 1) nor the viscosity.

## References

Regulations (2011) (SI 2011/881) The Animal By-Products (Enforcement) (England)

**Conclusions:** It was concluded the material was not biodegradable but inert. The material was not toxic and digester activity rapidly recovered when fed a standard substrate. Digestion of the polymer material as sole substrate generated insignificant amounts of biogas which had a low methane content, much lower than the 55-60% methane achieved in other digesters. Following polymer introduction biogas production steadily decreased and stagnated as the easily biodegradable solids in the sludge were exhausted. All the digester stability indicators were normal throughout the experiment.

The CST results indicate a steady increase in viscosity of the digestate, with polymer addition, which will have an effect on the mixing, the torque and power needed to stir the reactor. The CST also rapidly decreased when sewage sludge was reintroduced. Pre-treatment of the polymers according to the Animal By-product Regulations, by heating at 70°C for 1hr had no effect on the digestibility of the plastic.