Explanatory Note: Research into optimising anaerobic digestion processes

What is Anaerobic Digestion

To reduce the greenhouse gas impacts of waste management[1], and meet our obligations under the EU Landfill Directive[2], it is crucial to divert biodegradable wastes, including food waste, from landfill.

Anaerobic digestion (AD) produces renewable energy through the biodegradation of organic matter in the absence of oxygen to produce biogas (a mixture of predominantly carbon dioxide and methane) which is captured to be used as a renewable energy source. Biogas can be used to generate heat and power, or as a transport fuel – either locally or injected into the gas grid. The process also produces a digestate that, provided it is of an appropriate quality, can be applied to land as a soil conditioner and/or to add crop-available nutrients. A wide range of biodegradable wastes have potential to be anaerobically digested.

Research on optimising inputs and outputs from anaerobic digestion processes (WR0212)

This research project aimed to provide a better understanding of some factors influencing the anaerobic stabilisation of biodegradable waste, in order to develop operating protocols to prevent low methane yield and process instability.

In particular the research addressed whether processes could be improved by co-digestion of food waste with other organic materials (including other wastes). Suitable mixtures of biodegradable materials and wastes for stable and efficient anaerobic degradation were identified, as were conditions for optimal digestion. Digestion with co-substrates was found to be useful method of balancing the carbon to nitrogen ratio of the feedstock, providing essential elements and improving the overall efficiency of the digestion process.

The project identified a need for further research into food waste-only digestion (where co-substrates are not used), in order to prevent potential process problems due to increased levels of ammonia and the build-up of volatile fatty acids.

Further Research: Optimising processes for the stable operation of food waste digestion (WR1208)

This research project will investigate both:

1. the addition of trace elements to digesters operating on food waste only. Deficiencies in trace elements can affect digestion performance because they can allow the microbial activity that the process relies upon to be more sensitive to ammonia toxicity; and
2. methods of reducing the overall ammonia load in food waste digesters.

Emerging early findings from the follow-up research (funded by Defra & WRAP), are promising. These show that careful supplementation with trace elements (based upon the trace element content of the feedstock) is enabling stable digestion, even at high ammonia levels. This indicates that the operational challenge observed with 'food waste only' digestion arose from a deficiency in key nutrients that resulted in the inhibition of methane production at high ammonia levels. Different mixtures of trace metals are being trialled to determine an optimum mix of supplements to ensure the biogas benefits of food waste digestion are fully realised.

Our use of this research

The work will form part of the evidence base to develop our policies on managing the treatment of biodegradable wastes, in particular food waste, and on energy from waste. Our research also contributes to the emerging portfolio of information which provides the detailed technical data to support AD processes.

Energy from waste is integral to our desire to manage waste in the most carbon and environmentally friendly way and to produce renewable energy. A cross-government energy from waste project jointly led by Defra and DECC will facilitate the development of the most environmentally and economically viable energy from waste options, providing further clarity on the important role of AD.

Related research

Details of other Government-funded research into anaerobic digestion are set out in the Anaerobic Digestion Implementation Plan.

[1] In landfill sites biodegradable waste is converted to methane, a potent greenhouse gas.

[2] The EU Landfill Directive requires the UK by 2020 to cut the volume of biodegradable municipal waste sent to landfill to 35% of that produced in 1995.