Anareobic Digestion Plant at Ludlow in Shropshire

The second visit on 31 July was to the Anareobic Digestion plant at Ludlow in Shropshire.

**Introduction**

Following the success of the pilot project Greenfinch were awarded a second DTI grant in 1998 to design, build and operate a demonstration digester to recycle kitchen waste from 1200 households in the Ludlow area of South Shropshire.

South Shropshire District Council funded the collection, which was carried out by Biffa using a 7.5 tonne vehicle.

Participating households were issued with a 15 litre bucket & lid and plastic bin liners. Kitchen waste was left on the kerbside for collection once per week.

The project period was from October 1999 to April 2001, during which time 300 tonnes of kitchen waste were recycled, producing 42,000 m³ of biogas.

A number of important conclusions were made from the project:

- The biogas plant was able to mechanically handle the kitchen waste
- The process worked well biologically
- The average amount of kitchen waste collected was 4.2kg per household per week
- The moisture content of the kitchen was 77%; i.e. the dry matter content was 23% of which 92% was volatile

80% of the volatile matter was transformed to biogas, giving a biogas production rate of 140 m³ per tonne with a calorific value of 22 MJ/m³.

The digestate production was 83% by weight of the kitchen waste and its dry matter content was 7%, ideal for re-use as a liquid fertiliser.

**What is anaerobic digestion?**

Anareobic digestion is the natural biological process that transforms biowaste to fertiliser and energy. In past centuries it was widely applied for the stabilisation of sewage sludge. Now it is used as a facility to meet the demands of a sustainable low carbon economy by enabling organic waste to be redirected from landfill, allowing it to be re-used safely as a fertiliser and by providing a valuable contribution to the production of renewable energy.
Biowaste suitable for anaerobic digestion includes:

- Source separated household and commercial kitchen waste
- Organic waste from food factories and retail outlets
- Slaughterhouse waste
- Agricultural waste

The energy produced from the process is in the form of biogas that is 60% methane and 40% carbon dioxide that can be converted into energy to produce electricity, heat or vehicle fuel. The naturally occurring bacteria break down the organic matter to produce the biogas and digestate. The process occurs in a sealed vessel that is mixed at a temperature of 37 degrees centigrade. All nutrients in the biowaste are retained in the digestate with the added benefit that they are made available as plant fertiliser without the need for further breakdown in the soil.

South Shropshire District Council took the decision to take in kitchen and garden waste from householders in partnership with Greenfinch Ltd who secured funding from the Defra new technology demonstration programme and Advantage West Midlands for the construction of an anaerobic digester plant, which is the first of its kind in the United Kingdom.

The plant is intended to redirect 5,000 tonnes per year of source separated kitchen and garden waste from landfill. South Shropshire householders are supplied with a separate bin specifically for kitchen and garden waste. The waste is delivered to an enclosed waste reception building; where a bio filter controls air emissions. Once the plant is fully operational it is intended the biogas is to be used by local businesses on the business park for heat and electricity and the pasteurised bio-fertiliser is to be offered to local farmers. Acceptance of biowaste by the plant started in January 2006.

**How does it work?**

Anaerobic digestion breaks down organic materials within an in-vessel or controlled environment. This is not a new process as this type of process occurs in landfill sites but at a much slower rate. Applying anaerobic digestion to certain types of waste such as kitchen and garden waste the process is speed up. Waste entering the plant is transported on a conveyor belt into a digester; where by-products are released such as: bio-gas made up of 60% methane (CH4) and 40% carbon dioxide (CO2), which can be burnt to generate heat or electricity. The bio liquid or liquid digestate can be used to improve soils as a conditioner or fertiliser. Fibre digestate can also be used, as a compost to apply to soil.
Anareobic digester has a two stage process:

The first stage is where acidification when micro-organisms release enzymes that convert organic compounds into fatty acids, hydrogen and acetic acid.

The second stage is the biogas is scrubbed so it is fit to be used in the generation of electricity, while the liquid solid digestates are used as soil enhancers or disposed of according to their quality. The sustainability of the digestates depends on a number of factors such as it level of contamination and how biodegradable the incoming waste stream or feedstock. Garden and kitchen waste separated at the first point of disposal i.e. at home or kerbside provides the best feedstock.

Advantages of Anaerobic Digestion:

- Can process a range of different types of BMW (biodegradable municipal waste) – meaning it can complement composting systems, catching biodegradable waste that can’t be processed through windrow composting e.g. cooked kitchen waste and animal by-products
- It can be used to stabilise waste, after mechanical separation as part of an MBT (mechanical biological treatment) type plant before it goes to landfill
- It produces useful by-products which can easily be captured e.g. the production of biogas can be combusted when the anaerobic digestion plant is used with a combined heat and power plant, to provide electricity to power the AD (anaerobic digestion) process or be added to the national grid as a source energy to heat homes
- Fibre and liquid digestates can provide soil improvers and fertilisers

Disadvantages:

- If the feedstock is poor the anaerobic digestion cannot process the waste into soil enhancers, further techniques such as composting may be needed, resulting in increased expenditure – therefore the onus is householders to separate their waste properly
- If anaerobic digestion does not completely biodegrade the waste, the digestate may not meet government standards, therefore will not help local authorities meet their landfill allowance trading scheme targets.
- Anareobic digestion plants create a lot of waste water containing nitrite that needs further processing before it can be disposed into sewage systems – although some water may be re-circulated during Anaerobic digestion, particularly when the feedstock is dry.
Adoption of anaerobic digestion in other countries within Europe

Denmark

Anaerobic digestion is a type of facility most favoured by European countries for many years. Denmark initiated a financial subsidy program for anaerobic digestion systems about 20 years ago. 15 years before there was a strong interest in such subsidies in the United States. Denmark's subsidy program resulted in the construction of 20 centralised biogas plants and a few on farm ones. The most sophisticated designs and construction technology were used that were available at the time. The Danish subsidy ended in the 1990s with no new plants built since. In Denmark the law prohibited land filling of organic matters, which motivated the Danish towards the approach of biogas systems.

In Denmark the income from biogas plants is equally split between electricity sales, heat sales and tipping fees received for organic waste. Danish consumers pay around 20 cents per kilowatts for electricity from biogas plants. Combustion heat from Danish engine-generator sets is sold to residents and businesses in towns where distributed heating systems are a common place.

Germany

In Germany, source separation of organic residues from households, gardens and parks is one of the main measures in waste management. The number of anaerobic digestion plants is between 500 and 800 that use agricultural waste such as manure with only a few co-digest biowaste plants. In order to save landfill capacity and to meet the requirements of the TA Siedlungsabfall more and more plants are built in Germany to reduce the organic content in the residual waste with pre-treatment composting or digestion technologies.

Observations

The plant is still at infancy stage where the building remains unfinished to accept visitors. Greenfinch are facing problems such as, the waste brought to the plant is of poor quality in that South Shropshire residents are failing to separate residual waste from kitchen and garden waste. The Council have issued residents with 240 capacity bins to replace the clear bin sacks for kitchen and garden has exacerbated the problem. There is no sorting of waste when it is delivered to the plant, which means the waste is transferred along a conveyor belt, passed into the pre-treatment chamber where it is mixed with chemicals into a thick sludge like soup before transferral in to the anaerobic digestion chamber.
The plant is failing to achieve the 5,000 tones per year kitchen and garden waste from landfill target that has been set. Shropshire District Council is aware of the problem and has put enforcement penalties in place; however, these are very rarely followed through. The low-level production rates means low-grade fertilisers are produced that are sold onto local farmers within the area. It also means that the system is constantly clogged up with foreign particles that cause parts to the system to be renewed more frequently. However, all this said there it is unlikely that this type of facility would not be suitable for Luton.