Fact Sheet
TILLAGE No. 11

Teagasc
Agriculture and Food Development Authority

Anaerobic Digestion

TILLAGE SPECIALISTS 2010

Introduction

Anaerobic Digestion (AD) is the conversion of feedstock (any organic non-woody material) by micro-organisms in the absence of oxygen into biogas and digestate. It is a natural process and is well understood by mankind having been harnessed for many years.

AD Process

Manure and other possible biomass feedstocks are inserted into a large, sealed airless container. In this oxygen free environment, bacteria will produce biogas. In most digesters the contents will be heated to accelerate the process.

The produced biogas can be used to generate heat or electricity or both. This last option of combined heat and power (CHP) is the most common. The electricity that is generated through the gas engine can be either supplied to the electricity grid or used for own consumption. The heat can be used for the digester with the surplus sold and used for heating residential or commercial buildings.

AD can be applied at a range of scales depending on the amount of biomass available. Systems can range from small farm based digesters to large centralised anaerobic digesters (CAD) supplied with feedstock's from several sources.

The microbial process of AD requires careful management to maximise its potential output. There are several design options which have different cost implications and return varying efficiencies including:

- Operation temperatures.
- Moisture levels.
- Continuous or batch system.
- Single, double or multiple digesters.
- Vertical or horizontal tank layout.

Biogas Composition

Component	Volume percentage
Methane (CH_4)	50 – 80%
Carbon dioxide (CO_2)	20 – 50%
Nitrogen (N_2)	<1%
Hydrogen (H_2)	<1%
Ammonia (NH_4)	<1%
Hydrogen sulphide (H_2S)	<1%

AD Feedstocks

- Slurries (Cattle/Poultry/Pigs).
- Domestic food waste (Brown Bin Waste).
- Food Processing Waste.
- Crops grown specifically for AD. (Wholecrop wheat/maize).
- Silage/Grass.

Biogas

The produced biogas consists of methane (CH_4) and Carbon dioxide (CO_2) together with minor quantities of nitrogen, hydrogen, ammonia and hydrogen sulphide. Biogas from feedstock's with high carbohydrate content, such as cattle manure has a relatively low methane content.

Potential benefits of AD to Different Groups

Farmers	Food Processors	Local Community	Environment	Government
Profit Support for livestock sector Nitrates directive Available nutrients Diversification Pathogen kill Weed seed kill	Food waste removal Cheap option Good image	Less smell Local renewable energy Local heat supply New jobs Cleaner environment	Less nitrate pollution No net GHG release Diverts landfill Diverts incineration Replaces manufactured N Carbon saving	Landfill directive Nitrates directive Renewable obligations Fuel security Biofuel obligation scheme Decentralised electricity

Potential Biogas from Manures

Feed	Biogas potential m^3/tonne	DM content
Cattle	19.69	8%
Pig	14.28	4%
Poultry	50 - 250	14 – 70%
FYM	49 - 66	20 – 27%

Potential Biogas from Crops

Feedstock	Biogas potential m^3/tonne	DM content
Grass	98 – 189 (Fresh-Silage)	19 - 37%
Maize silage	155	30%
Barley straw	383	80%
Chopped molasses	363	75%

Benefits of Digestate

Destruction of weed seeds

- Dependent on retention time, process temperature etc.

Avoidance of plant burns

- Burns caused by low density fatty acids – most fatty acids broke down in AD process.

Fertiliser improvement

- Mineralisation of organically bound nutrients – Total P vs Available P.

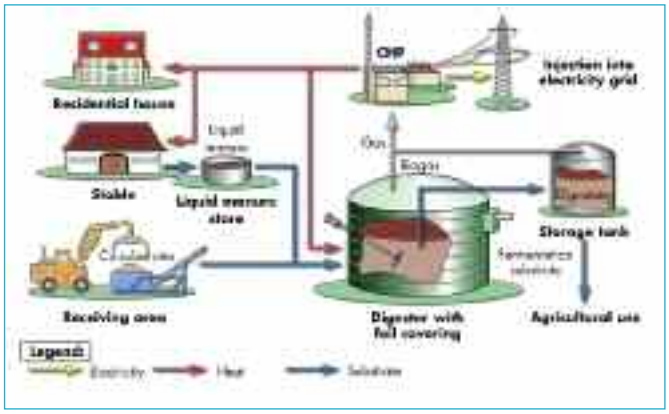
Economics

The economics will depend on the scale of the digester and the availability of feedstock's being digested. AD requires a high capital cost and payback will be determined by the price received for the renewable electricity produced. The REFIT tariff support mechanism is not expected to be favourable for digesting energy crops however with access to food wastes and the availability of a gate fee, certain projects may become viable with paybacks within 5 – 7 years.

Energy yield from $1m_3$ of Biogas

	Energy value
$1m_3$ biogas	23MJ
Electricity only	1.7 kWh
Heat only	2.5 kWh
CHP of biogas	1.7 kWh and 2 kWh

How AD Works



Source – FNR Germany

Summary

- Economics are variable depending on scale and mix of feedstock.
- Waste handling potential is also of interest to the food processing sector.
- Working with local 'waste' suppliers and heat/power users improves the economics significantly.
- Payback is dependant on a suitable REFIT tariff for the substrate being digested.

Further information:

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