Fact Sheet – Anaerobic Digestion (farm residues)

Anaerobic digestion (AD) processes organic materials in the absence of air to produce what is known as biogas, which is a mixture of methane (CH_4) and carbon dioxide (CO_2) as well as some other trace gases. The methane fraction of this gas can be burnt in specifically designed combined heat and power (CHP) engines to generate renewable power in the form of both heat and electricity. The electricity can be used to power plant equipment or be exported to the national grid, while the heat produced can be used to heat digester tanks to the optimum temperature for the biological system or can supply local residences or neighbouring industrial processes.

AD has been used to process sewage sludges in the UK since the 19th century. In the natural environment it is also the process that can break down organic material in pools and marshes to produce marsh gas and in waste landfills to produce landfill gas. AD is a well-established technology in Germany, where there are over 7,000 plants, mostly fed on purpose grown crops which receive state subsidies. In comparison in the UK the technology is in relative infancy with about 100 operational plants. In terms of land take, the average size of an AD plant (500kw) is in the region of 2 hectares.

In addition to biogas, a nutrient rich substance known as digestate is produced as a by-product of the process which can be used as a soil fertiliser. Digestate can either be applied directly to land as a complete product or be separated into components: a liquor which is nitrogen rich and a phosphate rich fibrous soil conditioner. Digestates differ from untreated slurries because they have more a readily available nitrogen content and a lower pathogen load. Digestate can therefore be used as a replacement or partial replacement for synthetic fertilisers. However, it should be borne in mind that the fertilising properties of digestates will differ depending on the composition of the feedstocks used.

A number of feedstocks are suitable for farm-based AD including animal slurries and manures, poultry litter, crops and crop residues. There is a distinction to be made between farm-based AD and waste AD, which as the name implies uses biowastes such as food wastes, sewage sludges, waste oils and slaughterhouse wastes, many of which contain animal by-products. The digestate from such biowastes requires to be treated to stringent BSI PAS 110 standards before it can be used as a soil conditioner. The digestate produced from farm-based AD does not require to meet these standards.

The anaerobic digestion process takes place in a sealed tank called a digester or bioreactor. In the absence of oxygen and under the application of heat, anaerobic bacteria digest the organic matter in the feedstock and produce biogas. There are two basic AD processes, which take place in different temperature ranges. Mesophilic digestion takes place between 20°C and 40°C and can take up to a month or two to complete. Thermophilic digestion takes place between 50°C and 65°C and is faster than the mesophilic process. However, the bacteria involved in the thermophilic process are more sensitive and care needs to be taken not to shock-load and kill these organisms by suddenly introducing too much of a new feedstock, especially those rich in fats and sugars.

FAQs

Q: **What are the benefits of on-farm AD?**
A: The major advantage of on-farm AD is that feedstocks for the plant are often readily available; for example the cattle slurries generated on a dairy farm. In such a situation, a digester provides a waste treatment method to act as part of a farm's slurry management system, while also providing additional slurry storage. The digestate by-product is a valuable fertiliser with increased nutrient availability when compared to undigested slurries and its use can reduce reliance on chemical fertilisers and result in cost savings. In addition, subsidies such as the Feed-in Tariffs and the Renewable Heat Incentive as well as sales of electricity to the grid help AD to become a profitable enterprise.

Q: **What are the capital investment costs?**
A: Initial capital development costs for AD are relatively high, but depend on the scale and complexity of the plan; as a rough rule of thumb, a cost of £4,000 to £7,000 per kW of capacity could be allowed, excluding the cost of grid connection. For example, a plant run solely on the slurries produced by 600 dairy cattle might be sized at 80kW and could therefore cost in the region of £560,000, excluding any grid connection costs.

Q: **What are the likely payback periods?**
A: For a correctly designed plant running at full capacity, simple payback periods for AD could be as low as 5 years if both FIT and RHI payments are registered for and claimed and if the majority of the heat and electricity generated by the plant can be used locally. Income is also received from selling any excess electricity to the national grid, or selling any excess heat for local use such as district heating or an industrial process. A payback period of 10 years is more common.

Q: **Will planning permission be required?**
A: Yes, planning consent is likely to be required for all anaerobic digestion plant installations, and it is advisable to consult with the local planning authority at an early stage in the projects development. The planning requirements for AD plants will vary depending on the size of the installation. Smaller on-farm AD plants often form part of on-site waste management and will therefore be treated as an agricultural application, whereas larger AD plants which are designed specifically for energy generation and import feedstocks will be more similar to an industrial process and therefore more supporting information and assessments will be required. Depending on the feedstocks being used in the plant, environmental permits may also be required.

Q: **Will I need a waste management licence or similar?**
A: Possibly, depending on waste types and the size of the digester. If only energy crops are used as the feedstock, nothing is required. If slurry/manure is used as the feedstock (with or without energy crops), a Paragraph 51 exemption must be registered with SEPA (provided you are not adding more than 100 tonnes/day to the digester). If other waste types are used, e.g. spoiled crops not grown specifically for the AD plant, green waste, food waste, etc, then a Waste Management Licence or PPC Permit would be required – this is dependent on waste types and quantities.

Q: **Where can I find a list of AD suppliers and installers?**
A: http://adbiogas.co.uk/member-directory/
http://www.biogas-info.co.uk/index.php/who-to-contact-qa.html

Because AD is an emerging technology in the UK with high capital costs, it is important to get good independent advice in order to be sure of making a sound investment.

Q: **Are AD plants easy to operate and what is their expected lifespan?**
A: Modern digesters are highly automated; from pumping slurries or other feedstocks into the plant to the timing of electricity generation to match demand. A simple daily inspection of the equipment should take no more than 15 minutes and there should be little for the operator to do. With a good maintenance regime an AD plant could reasonably be expected to have a lifespan in the region of 25 years.

Q: **How long does it take to build a plant?**
A: Construction of an AD plant is dependent on the size of the project but can normally be expected to take approximately 6 to 9 months.