Category:Biogas

From Appropedia

(Redirected from Biogas digester)

Biomass residues can be converted into various forms, one of which is **biogas**.

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Intro

The aim of this conversion process is to improve the quality, specific energy content, transportability, etc., of the raw biomass source or to capture gases which are naturally produced as biomass is micro biologically degraded or when biomass is partially combusted. Biogas is a well-established fuel for cooking and lighting in a number of countries, whilst a major motivating factor in the development of liquid biofuels has been the drive to replace petroleum fuels. We will be looking at some of these fuels, their applications and the conversion technologies used to derive them.

Biogas is produced by means of a process known as anaerobic digestion. It is a process whereby organic matter is broken down by microbiological activity and, as the name suggests, it is a process which takes place in the absence of air. It is a phenomenon that occurs naturally at the bottom of ponds and marshes and gives rise to marsh gas or methane, which is a combustible gas.

There are two common man-made technologies for obtaining biogas, the first (which is more widespread) is the fermentation of human and/or animal waste in specially designed digesters. The second is a more recently developed technology for capturing methane from municipal waste landfill sites. The scale of simple biogas plants can vary from a small household system to large commercial plants of several thousand cubic metres.

The digestion of animal and human waste yields several benefits:

- the production of methane for use as a fuel.

- the waste is reduced to slurry which has a high nutrient content which makes an ideal fertiliser; in some cases this fertiliser is the main product from the digester and the biogas is merely a by-product.
- during the digestion process bacteria in the manure are killed, which is a great benefit to environmental health.

Two popular simple designs of digester have been developed; the Chinese fixed dome digester and the Indian floating cover biogas digester (shown in figures 1 & 2). The digestion process is the same in both digesters but the gas collection method is different in each. In the floating cover type, the water sealed cover of the digester is capable of rising as gas is produced and acting as a storage chamber, whereas the fixed dome type has a lower gas storage capacity and requires good sealing if gas leakage is to be prevented. Both have been designed for use with animal waste or dung.

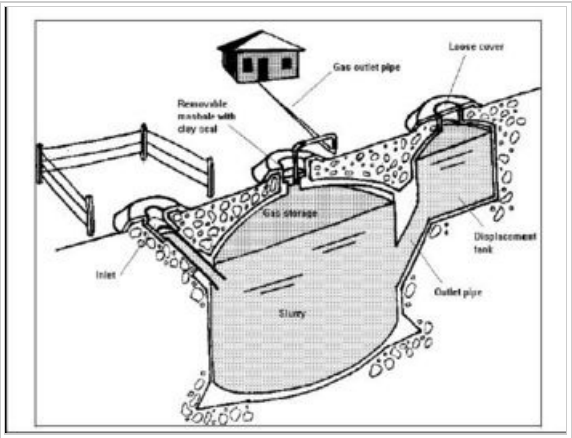

Figure 1. Fixed dome digester

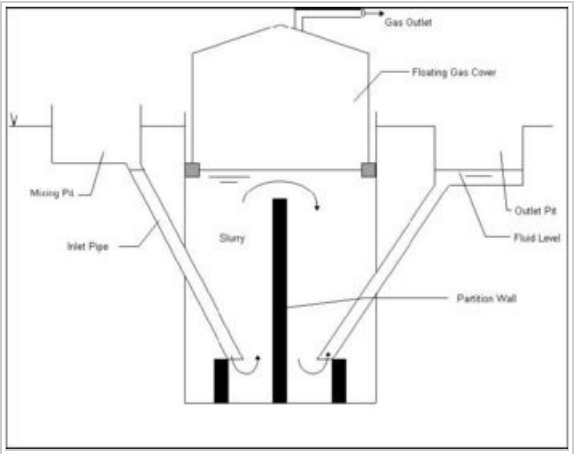

Figure 2. Floating cover digester

The waste is fed into the digester via the inlet pipe and undergoes digestion in the digestion chamber. The temperature of the process is quite critical - methane producing bacteria operate most efficiently at temperatures between 30 - 40°C or 50 - 60°C - and in colder climates heat may have to be added to the chamber to encourage the bacteria to carry out their function. The product is a combination of methane and carbon dioxide, typically in the ratio of 6:4. Digestion time ranges from a couple of weeks to a couple of months depending on the feedstock and the digestion temperature. The residual slurry is removed at the outlet and can be used as a fertilizer.

Biogas has a variety of applications. Table 1, below, shows some typical applications and

for one cubic meter of biogas. Small-scale biogas digesters usually provide fuel for domestic lighting and cooking.

Application	1 m^3 biogas equivalent
Lighting	equal to 60 -100 watt bulb for 6 hours
Cooking	can cook 3 meals for a family of 5 - 6
Fuel replacement	0.7 kg of petrol
Shaft power	can run a one horse power motor for 2 hours
Electricity generation	can generate 1.25 kilowatt hours of electricity

Table 1: some biogas equivalents (Source: adapted from Kristoferson, 1991.)

Some countries have initiated large-scale biogas programmes, Tanzania being an example. The Tanzanian model is based on integrated resource recovery from municipal and industrial waste for grid-based electricity and fertiliser production.

Present status

Small-scale biogas production in rural areas is now a well-established technology, particularly in countries such as China and India. At the end of 1993, about five and a quarter million farmer households had biogas digesters, with an annual production of approximately 1.2 billion cubic metres of methane, as well as 3500 kW installed capacity

ofbiogas fueled electricity plant.

Dissemination

Kenya relies on imported petroleum to meet 75% of its commercial energy needs. In 1980, in an effort to reduce this high level of dependence on an externally controlled fuel source, the Kenyan government set up the Special Energy Programme (SEP). One aspect of the programme was the introduction and dissemination of biogas plant technology. After a poor start working with educational institutions, the programme turned to local artisans and commercial outlets working in the private sector. Hands-on training was given to masons and plumbers and private traders were encouraged to manufacture and stock appliances such as cookers and lights. By 1995, the number of plants installed in Kenya was estimated to be 880.

Scrubbing out unwanted gases

Carbon dioxide

Carbon dioxide (CO_2) is present in biogas. This reduces its performance as a fuel.[1]

The ways of dealing with this are:

- Accept the lower performance - it will still do the job, and you'll save a lot of hassle. This may be the best option for very small applications.
- Scrub the CO_2 with sulfur - e.g. see Biogas CO2 scrubbing project
- In future, separation technologies such as a plastic molecular sponge may become available.[2]

Hydrogen sulfide

Hydrogen sulfide[W] (H_2S, also called "rotten egg gas") is a common product of anaerobic digestion. It causes an unpleasant odor, and in high enough concentrations can be highly poisonous. (Note that it numbs the sense of smell long before it becomes fatal - so if you can smell it, it's not deadly yet.)

Hydrogen sulfide is corrosive and renders some steels brittle, meaning that if there is any significant quantity, it is important to remove it before the gas passes through any equipment, especially iron or steel equipment. (What about other materials? It's only very weakly acidic, so it's seems to not be the acidity that causes the problem with steel.

See Biogas H2S Scrubbing

Biomass gasification

Biomass gasification is a distinctly different process. *See Biomass gasification.*

References and resources

1. ↑ Is that the reason scrubbing is desirable?*suggested project.* That's just my best guess. --Chriswaterguy
2. ↑ Plastic 'Sponge' Could Help Biofuels Scrub CO2 From the Environment (http://www.wired.com/science/planetearth/news/2007/10/bio_plastic)

- Anonymous (Office of the Leading Group for the Propagation of Marshgas), A Chinese Biogas Manual (http://www.fastonline.org/CD3WD_40/JF/432/24-572.pdf) , 1981. A classic work on biogas production in China, showing construction of small-scale, underground digesters.
- Gunnerson C. G. and Stuckey D. C., Anaerobic Digestion - Principles and Practices for Biogas Systems (http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1999/11/19/00017 . World Bank Technical Paper No 49, The World Bank, 1986. A good overview.
- Gitonga, Stephen, Biogas Promotion in Kenya. Intermediate Technology Kenya, 1997.
- Fulford, David, Running a Biogas Programme: A Handbook (http://developmentbookshop.com/product_info.php?products_id=126) , Practical Action Publications, 1988 (being updated). Offering good information about the management of regional or country-wide biogas programs, and good technical information about the design of burners for biogas.
- House, David, The Complete Biogas Handbook (http://completebiogas.com/) , revised 2007. A very extensive work. There are several chapters available for download.

Interwiki links

- Wikipedia:Biogas

External links

- Video: Low cost biodigester installation on the Altiplano. Bolivia (http://www.youtube.com/watch?v=3Sl0XEN5Bgo)
- Video: Industrial Two-Stage Biogas Plant. Germany (http://www.youtube.com/watch?v=rYntOAAQZZ4)
- Bio Latrines in Kenyan Slums (http://www.afrigadget.com/2007/03/01/bio-latrines-in-kenyan-slums/) .
- Biofuel library (http://www.journeytoforever.org/biofuel_library.html)
- Biogas F.A.Q. (http://zorg-biogas.com/biblioteka/faq)
- Brief overview of biogas projects, mainly in India, China, Nepal and Africa (http://www.kingdombio.com/)
- Village Earth: Energy: Biogas (http://www.villageearth.org/pages/Appropriate_Technology/ATSourcebook/Energybi

Pages in category "Biogas"

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- A Chinese Biogas Manual
- Arcata Marsh digester

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- Biodigester Effluent Fertilizer Quality Testing with IRRI
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- Biodigester Effluent Water Quality Testing with IRRI
- Biodigester effluent fertilizer quality (IRRI)
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- Biogas Systems in India
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- Der Biokonverter der Arcata-Marsch

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- Economic analysis

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- Home biogas system (Philippine BioDigesters)
- Home biogas system (original)

I

- International Renewable Resources Institute-Mexico

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- Jean Pain system

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- Landfill gas

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- Making Biogas from Human Waste
- Methane

- Biogas Handbook

of a biogas digester

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- Floating drum biogas digestor

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- HSU Chiapas biodigester

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- Process for testing biodigester effluent fertilizer quality in lab with IRRI

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