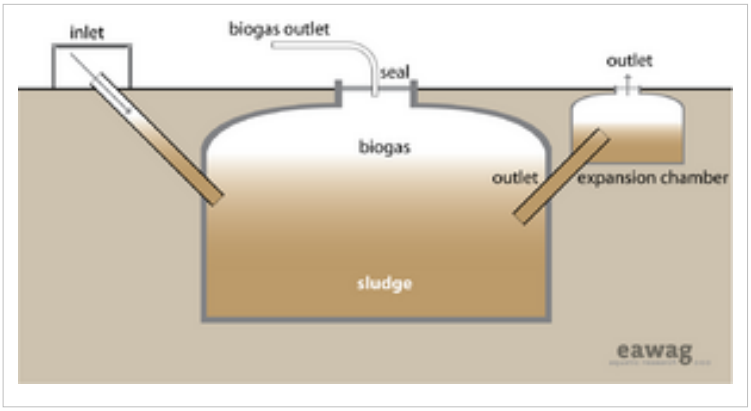
Anaerobic_Biogas_Reactor

Application level		Management level	
Household	XX	Household	XX
Neighbourhood	XX	Shared	XX
City	XX	Public	XX



Applicable to systems:	Languages / langues / idiomas
3, 6	

Inputs: Faecal Sludge , Organics , Blackwater

Outputs: Treated Sludge , Effluent , Biogas

An Anaerobic Biogas Reactor is an anaerobic treatment technology that produces (a) a digested slurry to be used as a soil amendment and (b) biogas which can be used for energy. Biogas is a mix of methane, carbon dioxide and other trace gasses that can be easily converted to electricity, light and heat (see Biogas as source of energy).

An Anaerobic Biogas Reactor is a chamber or vault that facilitates the anaerobic degradation of blackwater, sludge, and/or biodegradable waste. It also facilitates the separation and collection of the biogas that is produced. The tanks can be built above or below ground. Prefabricated tanks or brick-constructed chambers can be built depending on space, resources and the volume of waste generated.

The residence time of the fluid in the reactor should a minimum of 15 days in hot climates and 25 days in temperate climates. For highly pathogenic inputs, a residence time of 60 days should be considered. Normally, Anaerobic Biogas Reactors are not heated, but to ensure pathogen destruction (i.e. a sustained temperature over 50°C) the reactor should be heated (although in practice, this is only found in the most industrialized countries).

Biogas reactor in Vietnam (for credits, click the picture)

Once waste products enter the digestion chamber, gases are formed through fermentation. The gas forms in the sludge but collects at the top of the reactor, mixing the slurry as it rises. Biogas reactors can be built as fixed dome or floating dome reactors. In the fixed dome reactor the volume of the reactor is constant. As gas is generated it exerts a pressure and displaces the slurry upward into an expansion chamber. When the gas is removed, the slurry will flow back down into the digestion chamber. The pressure generated can be used to transport the biogas through pipes.

In a floating dome reactor, the dome will rise and fall with the production and withdrawal of gas. Alternatively, the dome can expand (like a balloon). Most often biogas reactors are directly connected to indoor (private or public)

toilets with an additional access point for organic materials. At the household level, reactors can be made out of plastic containers or bricks and can be built behind the house or buried underground. Sizes can vary from 1,000L for a single family up to 100,000L for institutional or public toilet applications.

The slurry that is produced is rich in organics and nutrients, but almost odourless and partly disinfected (complete pathogen destruction would require thermophilic conditions). Often, a biogas reactor is used as an alternative to a conventional septic tank, since it offers a similar level of treatment, but with the added benefit of biogas. Depending on the design and the inputs, the reactor should be emptied once every 6 months to 10 years.

Advantages	Disadvantages/limitations
- Generation of a renewable, valuable energy source. - Low capital costs; low operating costs. - Underground construction minimizes land use. - Long life span. - Can be built and repaired with locally available materials. - No electrical energy required. - Small land area required (most of the structure can be built underground).	- Requires constant source of water. - Requires expert design and skilled construction. - Gas production below 15°C is not economically feasible. - Digested sludge and effluent still requires treatment

Adequacy

This technology is easily adaptable and can be applied at the household level or a small neighbourhood (refer to Technology Information Sheet T15: Anaerobic Biogas Reactor for information about applying it at the community level).

Biogas reactors are best used for concentrated products (i.e. rich in organic material). If they are installed for a single household that is using a significant amount of water, the efficiency of the reactor can be improved significantly by also adding animal manure and biodegradable organic waste.

Depending on the soil, location, and size required, the reactor can be built above or below ground (even below roads). For more urban applications, small biogas reactors can be installed on the rooftops or in a courtyard. To minimize distribution losses, the reactors should be installed close to where the gas can be used. Biogas reactors are less appropriate for colder climates as gas production is not economically feasible below 15°C.

Health Aspects/Acceptance

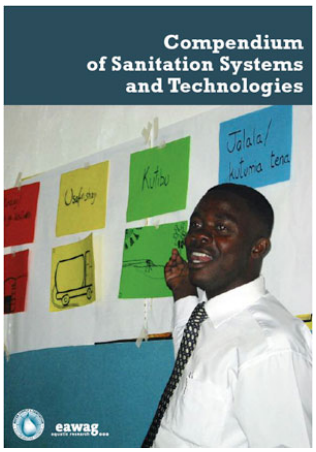
The digested slurry is not completely sanitized and still carries a risk of infection. There are also dangers associated with the flammable gases that, if mismanaged, could be harmful to human health.

The Anaerobic Biogas Reactor must be well built and gas tight for safety. If the reactor is properly designed, repairs should be minimal. To start the reactor, active sludge (e.g. from a septic tank) should be used as a seed. The tank is essentially self-mixing, but it should be manually stirred once a week to prevent uneven reactions.

Gas equipment should be cleaned carefully and regularly so that corrosion and leaks are prevented. Grit and sand that has settled to the bottom should be removed once every year. Capital costs for gas transmission infrastructure can increase the project cost. Depending on the quality of the output, the gas transmission capital costs can be offset by long-term energy savings.

Acknowledgements

The material on this page was adapted from: Tilley, E. et al. (2008). Compendium of Sanitation Systems and Technologies [2], published by Sandec [3], the Department of Water and Sanitation in Developing Countries of Eawag [4], the Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland. The publication is available in English, French, and will be made available in Spanish. Available in the IRC Digital Library [5]



Download the Eawag Compendium of Sanitation Systems and Technologies! [1]

References and external links

- Food and Agriculture Organization (FAO) (1996). Biogas Technology: A Training Manual for Extension. Consolidated Management Services, Kathmandu. Available: http://www.fao.org
- ISAT (1998). Biogas Digest Vols. I–IV. ISAT and GTZ, Germany. Available: http://www.gtz.de
- Koottatep, S., Ompont, M. and Joo Hwa, T. (2004). Biogas: A GP Option For Community Development. Asian Productivity Organization, Japan. Available: http://www.apo-tokyo.org
- Rose, GD. (1999). Community-Based Technologies for Domestic Wastewater Treatment and Reuse: options for urban agriculture. IDRC, Ottawa. pp 29–32. Available: http://idrinfo.idrc.ca
- Sasse, L. (1998). DEWATS: Decentralised Wastewater Treatment in Developing Countries. BORDA, Bremen Overseas Research and Development Association, Bremen, Germany.

References

[1] http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/compendium_e/index_EN
[2] http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/publications_sesp/downloads_sesp/compendium_high.pdf
[3] http://www.eawag.ch/organisation/abteilungen/sandec/index_EN
[4] http://www.eawag.ch/index_EN
[5] http://www.irc.nl/docsearch/title/163208

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