

Environmental Impact Assessment for Setting up a Biogas Plant

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Abstract

The production of biogas from municipal sewage sludge as an alternative source of energy has become topical. The healthy, safety and environmental considerations are of utmost importance especially the environmental impact assessment for setting up, commissioning, operating and decommissioning the biogas plant. Healthy and safety considerations for noise, dust emissions as well as gaseous emissions from the process must be minimized. The socio-economic benefits that come with the setting up of a biogas plant such as employment creation must be maximised.

Keywords: Biogas, energy, environmental impact assessment, safety considerations

1. INTRODUCTION

Biogas is a renewable type of energy that is produced from the anaerobic digestion of organic waste (Ghe and Mare, 2013). During biogas production, the organic waste is converted to methane (55-70%), carbon dioxide (30-45%) and trace components which include hydrogen sulphide (<2%), water vapour (2-7%), oxygen (<2%) and ammonia (<2%). A solid residue,

digestate is also produced and has potential to be used as an organic fertilizer (ref). Sewage sludge from municipal plants are also an attractive source of raw material for biogas production, however its processing have environmental and health considerations that must be put in place. The biogas production process is shown in Figure 1.

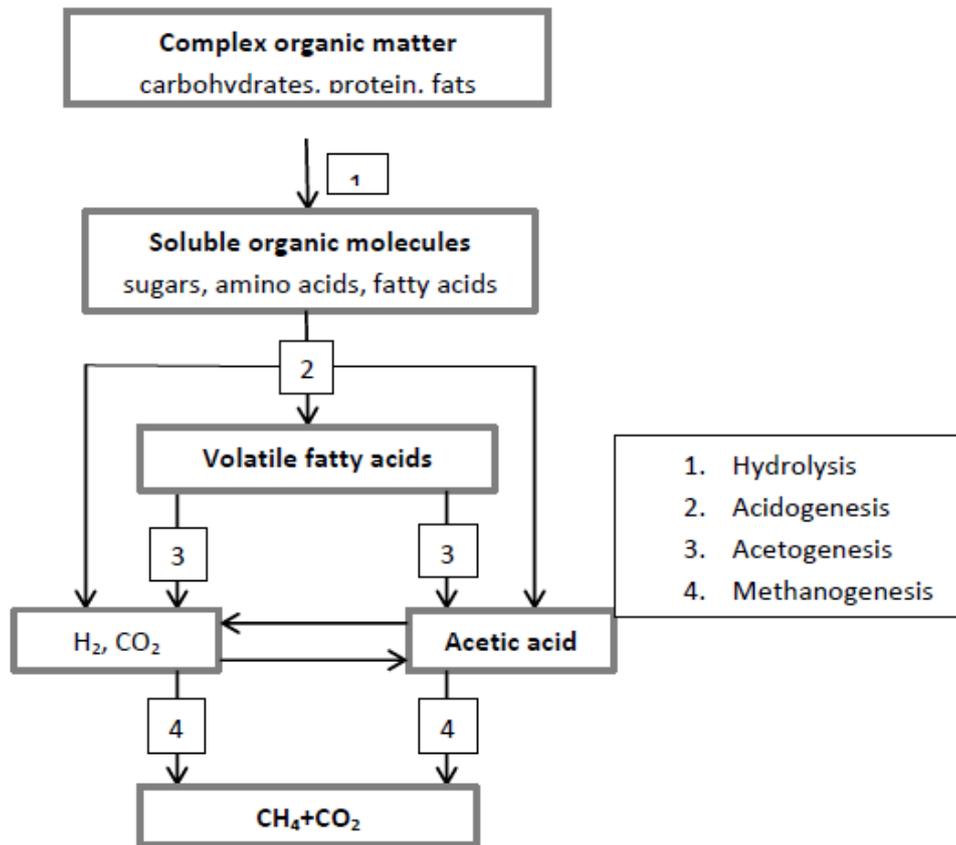


Figure 1: Biogas production process

Environmental Impact Assessment (EIA) considers the likely effects of the wet and dry processing on the environment. The assessment can then be used to reduce or prevent the negative effects of the activity on the environment and enhance the positive effects for development. A case study for the EIA considerations for setting up a biogas plant was done for a municipal wastewater treatment plant in Harare, Zimbabwe.

2. GOVERNING ORGANIZATIONS AND ACTS

The assessment of the EIA process is done by the Environmental Management Agency (EMA). The setting up of a biogas plant is affected by the Environmental Management Agency's Environment Management Act (Chapter 20:27). The act provides for the sustainable management of natural resources and protection of the environment; the prevention of pollution and environmental degradation.

The Act also goes hand in hand with the following acts which are affected by biogas production: Natural Resources Act (Chapter 20:13), the Atmospheric Pollution Prevention

Act (Chapter 20:33), the Hazardous Substances and Article Act (Chapter 15:05), the Forest Act, the Wildlife Act and the Explosives substances Act

3. ENVIRONMENTAL IMPACTS CONSIDERATIONS

Potential environmental issues associated with biogas recovery from sewage sludge include the following:

3.1 Air emissions

Air emissions from biogas production facilities consist of greenhouse gases (GHGs) typically carbon dioxide and nitrous oxide), other gaseous inorganic compounds, and particulate emissions, especially particulate matter less than 10 microns in aerodynamic diameter. These gases have a negative effect on the environment and must be cleaned by scrubbing before being emitted to the environment.

3.2 Industrial process wastewater

Process water is generated from the biogas scrubbing unit and from the boiler section. Process water discharges from scrubbing units are limited typically to acid wash from scheduled cleaning activities and purges, accidental releases, leaks of small quantities of liquids from product storage tanks, and acidic and caustic effluents from the boiler feed water preparation.

Techniques that can be adopted for treating the industrial wastewater include filtration for separation of filterable solids, flow and load equalization; sedimentation for suspended solids reduction using clarification; ammonia and nitrogen removal using physicochemical methods or biological treatment methods. Dewatering of the bio solids and their safe disposal of residuals in designated waste landfills must be done.

3.3 Hazardous materials

Biogas harnessing facilities use significant amounts of hazardous materials, including raw materials and intermediate/final products. The handling, storage, and transportation of these materials will be managed properly to avoid or minimize the environmental impacts. Recommended practices for hazardous material management include handling, storage, and transport.

3.4 Noise

Typical sources of noise emissions are mainly from the biogas plant. These include large size rotating machines such as compressors, pumps, electric motors, rotating hammers, conveyors belts, cranes, fired heaters, and from emergency depressurization.

4. GENERAL SAFETY REQUIREMENTS AT THE PLANT

Safety considerations are very important. Good housekeeping is essential for the plant safety as each piece of equipment and material under processing is a potential hazard (Pubule et al., 2012).

4.1 Working environment

The plant and yard are must be kept free of loose wires or lines, pipes, hoses, or other obstacles. High voltage lines, field connections, and wet ground surfaces are other hazards to the Technician. Any loose connections and improperly grounded equipment are required to be reported immediately for rectification. Ladders or stairways to provide safe access to all parts of the plant are required to be covered or protected. All stairs and platforms are also required to have secure handrails. Truck traffic patterns are planned with both safety and convenience in mind. Vehicles entering the plant to pick up a load of the processed organic fertilizer should not cross the path of loaded trucks leaving the plant. Also trucks should not have to back up.

4.2 Dust

Dust can be generated from dry sewage sludge and bio solids. Dust is very much hazardous to humans. It is not only a threat to the lungs and eyes, but also contributes to poor visibility, especially when trucks or front-end loaders are working on stockpiles or cold bins. Through reduced visibility in work traffic, it is usually a prime cause of accidents. Thus the need to put on dust masks during processing.

4.3 Noise

Noise is harmful to the ears and affect shearing and may distract' awareness of moving equipment or other dangers during production. Noisy areas are to be installed alarm lights in case of an emergency and also these areas are to be labelled for operators to put on ear muffs or ear plugs. Usually these are areas with noise levels above 90 decibels according to the Standard Association of Zimbabwe (S.A.Z) and should be monitored and controlled.

4.4 Conveyor belts

Moving belts transporting raw materials and belts to motors or sprockets and chain drives are also dangerous especially all rotating objects and they should have covers to make them safe for operators because loose clothing may get caught in machinery during the organic fertilizer production.

4.5 Flames and high temperatures

Burner flames and high temperatures around the plant oil pipe line system are dangerous. Manual control valves that may be operated from a safe distance are required to be installed on the oil pipe line. Flame safety devices also are required to be installed on all oil pipe lines.

Smoking is not permitted near the oil storage tanks. Leaks in the oil line and heat exchanger or jacketing on the reactor are dangerous.

Screens

Screens, barrier guards, and shields as protection from steam, hot binder, hot surfaces, and similar dangers should be installed.

5. PRELIMINARY ENVIRONMENT IMPACT ASSESSMENT

The environment impact assessment is done in all stages of a project from the planning, construction, operation and decommissioning stages (Karapidakis et al., 2010). The negative and positive impacts and mitigation measures at each stage are analyzed.

Planning stage: This stage has little or no impact to the environment as it is administrative in nature as the various stakeholders are informed and goals are set. The stakeholders include the Chiefs, EMA and District administrators in reference to the governing act that affect the biogas plant project. Table 1 shows the impacts and mitigation at the construction, operation and decommissioning stage that can be encountered during biogas plant setting up, operation, commissioning and decommissioning stages.

Table 1: EIA for a biogas plant

Stage	Negative impacts	Positive impacts	Mitigation measures
Construction	Disruption of fauna and flora	Construction of access roads	Selective clearing of areas
	Wildlife will flee because of noise	Creation of settlement area	Isolation of the area being constructed
	Disruption of ecosystem by tree cutting and bush clearing	Development of area due to structural buildings like clinics, shops and schools as well as dams	Using dampening effect instruments to minimize vibration which will affect the wildlife
	Dust emissions during construction		Personnel working should wear protective clothing like ear muffs.
	High levels of noise during construction		
	-Migration of people to seek for work		
	Exerts pressure on the available land		
Operation	High level of noise crushing equipment	Employment creation	Provision of ear muffs
	Air quality is affected because of dust	Continual development of the area	Use of bag filters to minimize emissions into air.
	Rapture of machinery in particular fluidized bed separator	No production of tailings, thus minimal /no pollution to the rivers	Stringent control on the equipment with safety trips and alarms
Decommissioning	Idle buildings	Equipment can be sold to give salvage money	Continuous rehabilitation by back filling of the gangue to

			the mined areas since the gangue is chemically inert (no chemical usage in the process)
	The inability of the land to be rehabilitated	-the buildings can be sold or leased for the same purpose of mining or another line of work	

6. SOCIO-ECONOMIC IMPACTS

The production of biogas from sewage sludge provides an alternative source of energy for communities. Furthermore, the biogas can be sold for upgrading to further uses like electricity generation. There is potential for employment creation from the biogas plant operation creating livelihoods for people (Rutz et al., 2008).

7. CONCLUSION

Biogas production provides an alternative source of energy for communities. However there is need to be aware of the health, safety and environmental considerations during the setting up, operation and closure of a biogas plant so that the environment and the personnel are protected.

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