

Energy Conservation and Generation through Biodegradable Solid Waste- A Compact Bio-Gas Plant

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ABSTRACT- This paper evaluates the use of renewable source of energy i.e. biogas and suitability of a compact biogas system as a decentralized treatment option for the organic decomposition and fraction of market and household solid waste. For the research, a plant was installed and operated to evaluate its performance when fed with used Tea Powder of our canteen. The system proved to be effective interims of the reduction of waste volume and organic load. The performance of the digester considering the gas production was found to be good. The operation and maintenance was also easy as compared to that of the conventional biogas plant.

INTRODUCTION:-

In today's fast moving world the resources are getting depleted due to their overuse though there rapid progress and development in all aspects. As there is scarcity of petroleum and coal and other such non-renewable energy sources, there is a strong need to look for new sources of energy i.e. renewable Energy sources like solar, wind, hydro, tidal, nuclear and biomass energy. Bio-gas is also renewable energy resources but it is distinct from other renewable energies because of its characteristics of using, controlling and collecting the domestic organic waste and at the same time producing by-products like fertilizer and water for use of agricultural irrigation. A compact bio-gas plant which uses waste food rather than cow dung or manure as feed stock to supply bio-gas for cooking. This plant is sufficiently compact to be used by urban households. In economically developing countries the solid waste management is gaining importance as it threats to public health and environmental quality. The household waste mostly consists of biodegradable organic material. As the most common practice is to dispose of the waste in the streets or in open dumps leads to pollution of ground and surface water leading to its contamination and contributes to the breeding of insects and rodent vector spreading diseases and epidemics.

By anaerobic digestion we can deal with solid waste by its organic fraction and decomposition. Biomethanation is an ideal option as it consumes waste and provides renewable energy and organic fertilizer. Though, in developing countries, anaerobic digestion of organic waste is mostly inexistent and people have very less information and there is need to create awareness regarding the operation of biogas plants. However, in India, different biogas plants treating various types of organic solid waste have been implemented

in recent years but generally in urban areas people do not use this due to space required and its unhygienic appearance.

Overcoming all these, our team has developed a small scale but fully operational biogas system i.e. compact biogas plant designed for decomposition of solid waste in year 2013. It uses organic solid waste rather than manure as feedstock.

Although biogas technology has been known in Africa for decades for the treatment of animal manure, its application for organic domestic waste has only been introduced recently.

DESIGN AND TECHNOLOGY:-

The compact biogas system is made from two cut-down standard high-density polyethylene water tanks and standard plumber piping(Fig. 1). The larger tank acts as the container containing the waste material while the smaller one (Digester tank) acts as the container containing the waste material while the smaller one (gas holder tank) is inverted and telescoped into this larger one. The rise in gas holder tank is proportional to the gas produced and acts as a storage space for the gas(Fig. 2).

The produced biogas can then be used directly for cooking on an adjustable gas stove and the liquid effluent which is poured out from the overflow section of the digester can be used as fertilizer in garden or for agriculture. This would be organic and give better results as compared to synthesized fertilizers as these are produced due to organic fraction.

TABLE:-01

Technical Specifications			
Sr. No.	Particulars	Quantity	Unit
1.	The capacity of plant	1	m ³
2.	Feedstock	1.5-2	kg
3.	Space required	2	m ³
4.	Height of plant	2.5	m
5.	The effective volume of digester tank	850	lit

6.	Inner radius	51.5	cm
7.	Position of the overflow pipe	1.4 above from ground level	m
8.	Area covered by gas holder tank	Approx 0.6m ² (78%) of the total surface of digester area of	m ²

In other words, the gas released through 22% of the digester surface is lost to the atmosphere without being utilized. The usable gas volume of the 750 lit -gasholder is 400 lit.

COMPACT BIOGAS PLANT:-

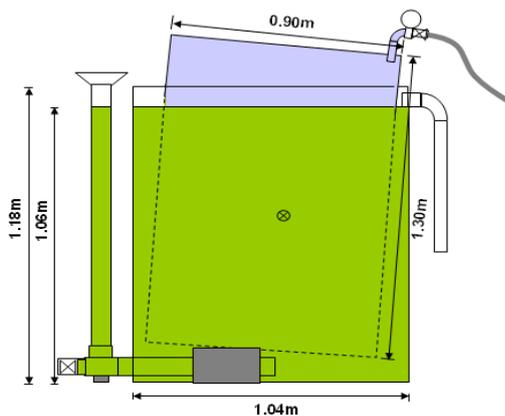


Fig 1.Initial State of Plant

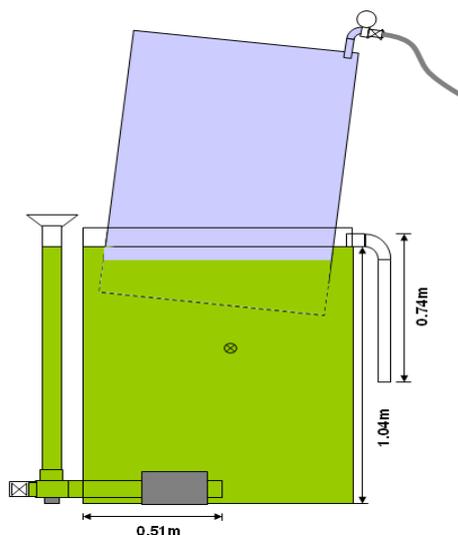


Fig 2.Final State of Plant when Methane is produced

METHODOLOGY:-

To conduct a detailed monitoring of the compact biogas plant, a fully operational unit was installed and operated in the campus of Shri Datta Meghe Polytechnic, Nagpur. However, this plant is operated on experimental basis and we are aiming to provide gas to the chemistry lab of our college. We have allowed flexibility in terms of changes in feedstock and on-site measurements of physical and chemical parameters of interest as well as gas production and composition.

During the start-up period, the biogas plant was inoculated or fed with 250 kg of cow dung mixed with water and 300 lit effluent from an existing biogas plant. Thereafter, the plant was left without further feeding for 45 days, in which only changes in gas production and composition were monitored.

After 45 day the biogas plant was then fed with 1.5 kg/d used tea powder from canteen. The feeding rate of 1.5 kg per day was chosen because on one hand it represents a realistic quantity of organic waste produced by an average household and on the other hand it conforms to the reactor specifications.

BACKGROUND:-

Renewable energy sources:-

In today’s date, India is a large consumer of fossil fuel such as coal, crude oil etc. The rapid increase in use of Non renewable energies such as fossil fuel, oil, natural gas has created problems of demand & supply. Because of which, the future of Non renewable energies is becoming uncertain. Also India has had a negative Energy Balance for decades, which has resulted in the need to purchase energy from outside the country to fulfill the needs of the entire country. A domestic unsubsidized LPG cylinder cost approx Rs. 1300/-and it is not possible for middle class family to afford such expensive fuel round the year. Hence they start using other fuels such as firewood which creates pollution and degrades environment.

CONCLUSION:-

The results of the research and study reveal that there is wider scope in biogas and it has great potential. The plant has proved to be effective in terms of reduction of waste volume and organic load, thus it proves to be an alternative to cooking gas as well as it can be used in generation of electricity.

Moreover, it overcomes almost all drawback of conventional plant and do not produce waste at all and residue of this plant can be used as organic fertilizer.

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