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EXPERIMENTAL STUDY ON GENERATION OF ELECTRICITY FROM BIOGAS USING EXTERNAL COMBUSTION ENGINE

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Abstract:

Proper control measures for reducing environmental pollution at present is necessary to save our natural resources as well as earth. Presently earth's atmosphere is highly affected by different pollutants. All the activities of human beings are major sources for pollution. The possible way is suitable treatment and disposal method. Under this condition this research study enumerates zero waste discharge of degradable wastes at source. Different methods are existing and available for the disposal of wastes. Anaerobic digestion method is selected for producing biogas and it was used as fuel for running external combustion engine for the generation of electricity.

Key Words: Anaerobic Digestion, Wastes, Biogas & EC Engine.

Introduction:

Biogas is a mixture of colorless, flammable gases obtained by the anaerobic digestion of plant-based organic waste materials. Biogas is typically made up of methane (50-70%), carbon dioxide (30-40%) and other trace gases. The use of alternative and more environmental -friendly energy sources such as biogas has been advocated. The possibility of using such wastes for biogas production should be explored. Biogas having advantages of non-polluting and renewable source of energy, Efficient way of energy conversion, Produces enriched organic manure, which can supplement or even replace chemical fertilizers, Leads to improvement in the environment, and sanitation and hygiene, provides a source for decentralized power generation, household wastes and bio-wastes can be disposed of usefully and in a healthy manner, the technology is cheaper and much simpler than those for other bio-fuels, and it is ideal for small scale application. This is one of the way to achieve zero discharge organic waste from source[(2)].

Characteristics of Biogas:

Composition of biogas depends upon feed material also. Biogas is about 20% lighter than air has an ignition temperature in range of 650 to 750°C.An odorless and colorless gas that burns with blue flame similar to LPG gas. Its caloric value is 20 Mega Joules (MJ) /m^3 and it usually burns with 60 % efficiency in a conventional biogas stove. This gas is useful as fuel to substitute firewood, cow-dung, petrol, LPG, diesel, and electricity, depending on the nature of the task, and local supply conditions and constraints. Biogas digester systems provides a residue organic waste, after its anaerobic digestion(AD) that has superior nutrient qualities over normal organic fertilizer, as it is in the form of ammonia and can be used as manure. Anaerobic biogas digesters also function as waste disposal systems, particularly for human wastes, and can, therefore, prevent potential sources of environmental contamination and the spread of pathogens and disease causing bacteria. Biogas technology is particularly valuable in agricultural residual treatment of animal excreta and kitchen refuse (residuals).

Anaerobic Digestion Process:

Anaerobic digestion (AD) is a microbial decomposition of organic matter into methane, carbon dioxide, inorganic nutrients and compost in oxygen depleted environment and presence of the hydrogen gas. This process, also known as bio-methanogenesis, occurs naturally in wetlands, rice fields, intestines of animals, manures and aquatic sediments, and is responsible for the carbon cycle in the ecosystems.Natural and anthropogenic sources account for 30 and 70 %, respectively, of the total methane released in the atmosphere every year. Major natural sources of methane are the wetlands and animal guts (mainly insects and ruminants) while the main anthropogenic sources have been identified in the fossil fuel processing industries, rice fields and landfills. Biological activity has been identified to be the cause for more than 80% of the flux of the atmospheric methane. Main objective of this experimental study is to generate electricity using biogas as fuel for external combustion engine.

External Combustion Engine (Stirling Engine):

A Stirling engine is a heat engine that operates by cyclic compression and expansion of air as working fluid at different temperatures, such that there is a net conversion of heat energy to mechanical work. Stirling engines have a high efficiency compared to steam engines, One of the advantages of Stirling engine is its external combustion. Another advantage with the external combustion chamber is that the fuel does not have to be refined as it does for other types of engines. The external combustion also provides for more complete combustion resulting in less unburned hydrocarbons emitted in the exhaust. The constant combustion process in the Stirling engine destroys almost 100% of hydrocarbons and generates very low NOx and CO2 emissions without exhaust after-treatment. Combined Heat and Power: Generates both electrical power and hot water for maximum efficiency. Hence Stirling engine is suitable for using biogas as fuel.

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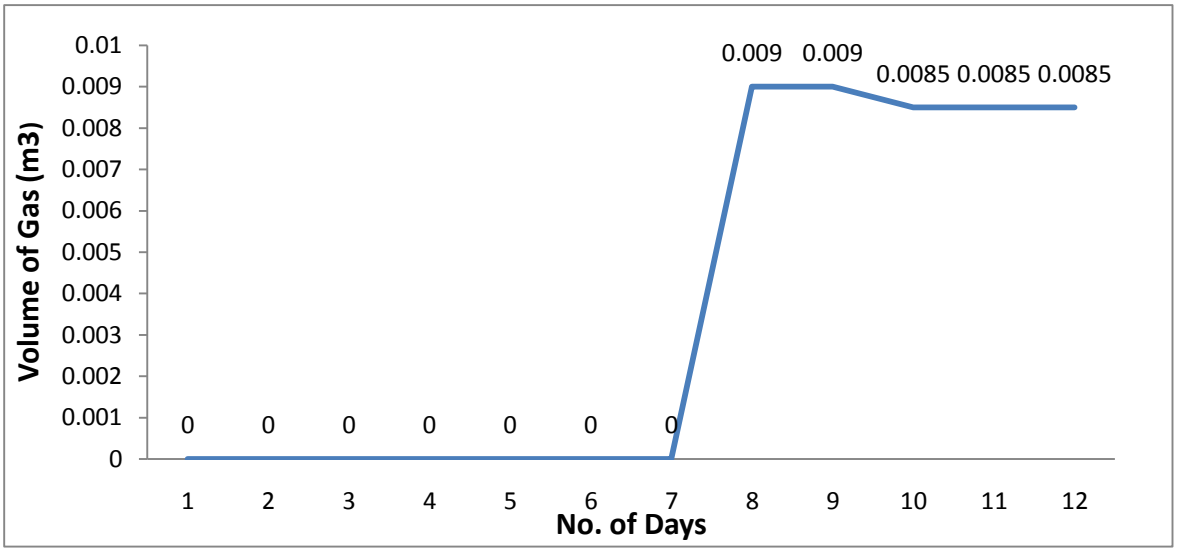
Experimental Study:

Fixed dome biogas plant of 0.023 cubic meter was used for this study. Volume of slurry in this plant was 0.015 m^3. And volume of gas holding capacity was 0.008 m^3. Every day slurry input was 0.3 liters. In this study fifteen liters of biogas outlet slurry was initially taken in the plant. Every day 0.3 liters of fresh cow dung was added. Ninth day onwards we received .0085 m^3 of biogas as yield.

Daily Input = 0.3 liters		
Type of waste = Cow dung		
Sl.No.	Days	Volume of gas produced (in m^3)
1	1	0
2	2	0
3	3	0
4	4	0
5	5	0
6	6	0
7	7	0
8	8	0.009
9	9	0.009
10	10	0.0085
11	11	0.0085
12	12	0.0085



Beta type stirling was used for generating electricity. This type engine having two cylinders. One of the cylinder was under normal temperature and the other cylinder which is large compared with previous was heated by using biogas as fuel.

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Result and Discussion:

Biogas production from the input of 0.3 liters of slurry was 0.0085m^3. Effects of impurities in the biogas in External combustion engine was less compared with internal combustion engine. This is one of the suitable way to dispose degradable solid waste with useful manner and achieve zero waste discharge at origin.

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