Effect of Solar Heat on Foliage Gas

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Abstract*: All types of energy are required in our life; whether it is heat, electrical, solar, wind .It is observed that in our homes 70% of garbage consists of foliage waste. As this garbage will degrade the city, so before that why not use it as energy? In this research work, an attempt has been made to design and test the performance of a portable type Foliage Gas plant of volume capacity 150000 mm ^{3} for outdoor climatic condition of Dhule, India. This study involves utilization of solar heat combined with Foliage Gas and about solar heated foliage gas plants.*

Keywords: *Foliage Gas, Solar heat, Digester, Pressure gauge, Digital thermometer.*

1 Introduction

As liquefied petroleum gas prices are souring high, foliage gas can be used as an alternative fuel .Moreover it is made by the kitchen hold waste materials. Instead of using costly bacteria, mixture of waste vegetables, water, salt and lemon have been used. To improve efficiency the heat has been used. The field study has been carried under the monsoonal season of Dhule, India. In this experiment, a plastic bottle made digester of 20 Kg slurry capacity has been taken for batch system. In the batch system, the slurry has been added to the digester for whole duration of the process. The rate of foliage gas production with slurry temperature has been observed. It has been observed that (i) the foliage gas production depends strongly on slurry temperature and (ii) the retention period is nearly 30 days. The range of atmospheric temperature of atmosphere recorded during the observed period has been found as 31 to 42 ºC.

Foliage gas technology provides an alternate source of energy in rural India, and is an appropriate technology that meets the basic need for cooking fuel in rural areas by using local resources, viz. organic wastes and household waste.

The implementation of bio gas technology has a great potential of mitigating several problems related to ecological imbalance, minimize crucial fuel demand, improve hygiene and health, and, therefore, there is an overall improvement in quality of life in rural and semi-urban areas[1]. The anaerobic digestion process has a key role in environmental pollution control: methane is an important greenhouse gas, but if captured for use, it acts instead as a good renewable energy source [2]. Ravi had developed [3] a portable bio gas plant and also improved its efficiency by solar energy. He had used aluminum container to produce bio gas. Temperature is an important factor that may affect the performance of anaerobic digestion [4]. Typically for 25ıC to 44ıC, 0.25 m3 to 0.40 m3of methane gas is produced for each kilogram of volatile solids destroyed [5]. Conventional anaerobic digesters are commonly designed to operate in either the mesophilic temperature range or thermophilic temperature range. There are usually two reasons why the mesophilic and thermophilic temperatures are preferred. First, a higher loading rate of organic materials can be processed and, because a shorter hydraulic retention time is associated with higher temperatures, increased outputs for a given digester capacity results. Second, higher temperatures increase the destruction of pathogens present in raw manure

[6]. Thermophilic digestion is much faster than mesophilic. This means that thermophilic digesters would be only up to 30% of the size of mesophilic digesters [7]. Most digesters operate in the mesophilic temperature regime. Some operate in the thermophilic regime [8]. To keep the anaerobic digester temperature constant, external source of heating is used like electricity, oil, or part of the produced foliage gas. Generally, 20–40% of produced bio gas is used for digester heating [9].This source is environmentally friendly and economical.

2 Methodology and Materials

Different parameters like atmospheric temperature and pressure are measured weekly. These data have been taken at the interval of 4 hours and three readings have been taken in every day at 9 am, 1 pm and 5 pm in presence of solar heat. In this manner the average atmospheric temperature is calculated to find the different results and observations. The pressure inside the plastic bottle is measured in N/mm^2 with the help of pressure gauge. The production rate and methane fraction has also been observed under the influence of various temperatures.

Realization of this potential and fact that India supports the largest cattle wealth led to the promotion of National Bio gas Programmed in major way in the late 1970s as an answer to the growing fuel crisis. In India alone, there are an estimated over 250 million cattle and if one third of the dung produced annually from these is available for production of bio gas, more than 12 million bio gas plants can be installed which have the estimated foliage gas potential capacity of 17,000 MW.

Foliage gas is produced from organic wastes by concerned action of various groups by adding vegetable waste and mixing in it salt, lemon and water. Foliage gas decomposition is a two-stage process as on organic materials. In the first stage, acetic acid or lemon dismantle the complex organic molecules into peptides, glycerol and the simpler sugars. When these compounds have been produced in sufficient quantities, it was kept for few days for fermentation to convert these simpler compounds into methane. This methane produced is particularly influenced by the ambient conditions, which can slow or halt the

process completely. Globally, the reduction of green house gas emissions particularly of CO2 has become more important. Currently much of the carbon dioxide emitted to the atmosphere is a result of anthropogenic activities from the use of the fossil fuel in the transportation and energy sectors. Significant emission reductions may be achieved in the energy sector by improving efficiency through the use of alternative fuels. Through the use of foliage gas plant we can save the CO2 emission in the atmosphere.

Materials: Plastic bottle, Vegetable compost, PVC pipes, Digital thermometer, Pressure gauge, Reducer rubber pipe with clamp, airtight cork, adhesive.

3 Experimental Procedures

A plastic made foliage gas chamber of 20 kg slurry capacity has been used under the outdoor simulation above the ground, so that the digester can direct receive the solar radiation. The diameter and height of digester have been taken as 260 and 480 mm respectively.
Plastic material is more efficient to increase the sufficient temperature inside the digester which increases the production rate of foliage gas. Four calibrated thermocouples have been used to measure ambient, slurry, gas temperature by using digital temperature indicator of resolution 0.1 °C. A junction between plastic bottle and inlet PVC pipe is used. For gas outlet a 75 mm pipe is used and a plastic pipe is inserted in it as shown in Figure 1. Pressure gauge is used to measure pressure. A calibration bath is a uniform temperature enclosure with a constant temperature setting that can be adjusted manually or with automation. This field study has been done at the Chavara English medium school, Dhule in the monsoonal season, which is having highly fluctuating environmental conditions. These observations have been taken during day time at 9:00 am, 1:00 pm and 5:00 pm during the month of August to September 2012 (monsoon season) in Dhule, India. Gas production has been recorded on daily basis by the observation and reading on pressure gauge.

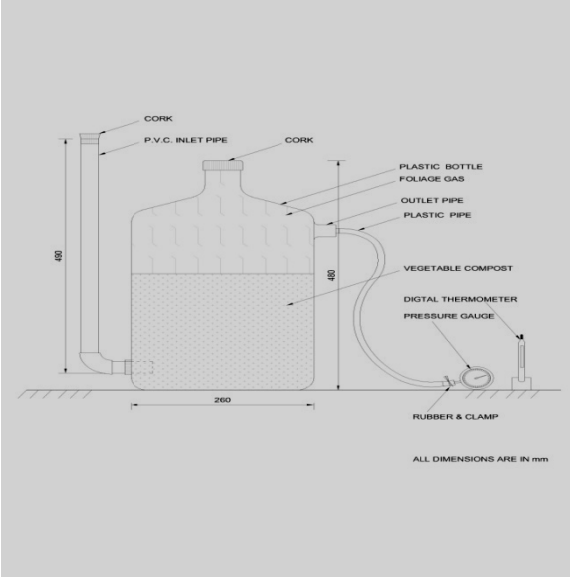

Figure 1: Line diagram of experimental set up

4 Results and Discussion

In this study, it has been observed that the production of foliage gas is dependent upon the temperature and the solar intensity of the atmosphere. The methane fraction increases each and every week. The synthesis of foliage gas has been started from the third day of the slurry feeding inside the foliage gas chamber. There is no role of humidity and precipitation in foliage gas production. Initially solar intensity increased up to two weeks but after this it decreases due to cloudy weather condition, because the monsoonal season is very fluctuating. The arrangement of various components for Foliage gas plant is photographed and is shown in Figure 2. The slurry temperature was always more than atmospheric temperature during the whole experimentation period. The average atmospheric temperature is calculated to find the different results and observations are shown in Table1.It is observed that as temperature increases, the production of foliage gas increases. For week 1 and week 2 results are not shown as the vegetable compost degraded in it. Due to decomposition of vegetable compost, foliage gas is formed .At sixth week the total foliage gas pressure observed is 0.02 N/mm^2 in morning and with solar heat it is 0.04 N /mm^2 after four hours at noon. This shows that there is 100% increase in pressure of foliage gas by solar heat. One of the limitations is in accuracy system of measuring temperature less than one degree Celsius.

Figure 2: Arrangement of various components of Foliage Gas plant.

Table 1: Observation of Temperature and pressure of Foliage Gas

Week	Time	Temperature (in degree Celsius)		Pressure (N/mm^2)	% Change
		Inside	Outside		
3	9 am	26	-	0.005	-
	1 pm	-	37	0.01	100
	5 pm	-	32	0.01	100
4	9 am	27	-	0.01	-
	1 pm	-	38	0.02	100
	5 pm	-	30	0.02	100
5	9 am	29	-	0.02	-
	1 pm	-	38	0.03	50
	5 pm	-	33	0.03	50
6	9 am	28	-	0.02	-
	1 pm	-	39	0.04	100
	5 pm	-	34	0.04	100

(Week 1 and week 2 are not shown as the vegetable compost degraded in it.)

5 Conclusions

In this experiment it has been observed that the foliage gas plant is also successful during the monsoon season because here the temperature varies between 26 to 39°C. Plastic bottle can use for foliage gas production because it is more durable, less prone to corrosion, light in weight and more heat absorbing capacity comparative to iron made foliage gas plant. It maintains sufficient temperature inside the digester which increases the rate of production of foliage gas. It has many advantages like Pollution free gas, made easily at home from food waste so it is economical. Decomposition of vegetable compost leads to formation of foliage gas. There is 100% increase in pressure of foliage gas by solar heat.

6 Future Scope

These are also economically feasible for developing country especially for India. The slurry temperature can be increased inside the digester by coating black paint on the surface of plastic made foliage gas chamber. It will increase the absorption capacity of sunlight on its surface. In next experiment we will also analyse the rate of production of foliage gas and its methane fraction under greenhouse chamber. And also the LPG prices soaring high, it can be also used as alternative fuel. Moreover it can be used to produce electricity. Thermocouples are a widely used type of temperature sensor for measurement and control and can also be used to convert heat into electric power. They are inexpensive and interchangeable, are supplied fitted with standard connectors, and can measure a wide range of temperatures.

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Author's Profile

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