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Use of Food Waste for Generation of Biogas

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***Abstract*—Biogas production requires anaerobic digestion. We should go for creating an Organic Processing Facility to create biogas which will be more cost effective, eco-friendly, cut down on landfill waste, generate a high-quality renewable fuel, and reduce carbon dioxide & methane emissions. The anaerobic digestion of kitchen waste produces biogas, a valuable energy resource [1]. Anaerobic digestion is a microbial process for production of biogas, which consists of primarily methane (CH4) & carbon dioxide (CO2). Mixture of vegetable wastes was an-aerobically digested in a 5L capacity lab scale batch reactors. Biogas can be used as energy source and also for numerous purposes. But, any possible application requires knowledge & information about the composition and quantity of constituents in the biogas produced. The research work was conducted to investigate the production ability of biogas as an alternative energy from kitchen waste with co-digestion of cow dung through anaerobic digestion. In the experiment two digesters were used with same composition of food waste but different amount of cow dung.**

***Keywords—* Biogas, kitchen waste, Anaerobic digestion, Methane**

I. INTRODUCTION

Food and vegetable waste come under putrescible waste which is a serious environmental and economical concern all around the world. The fast and highly decomposable nature of this waste demands efficient management for it to become a sustainable operation. Since these wastes are generated in large quantities in highly populated and urban areas, the space available for it to be handled is very limited. It has become a global threat to the environment and health due to its inappropriate disposal in the developing countries, while in developed countries a majority of them is still ending up in landfills.

Anaerobic digestion is controlled biological degradation process which allows efficient capturing & utilization of biogas (approx. 60% methane and 40% carbon dioxide) for energy generation. The technology involves treatment of organic wastes in a closed system in which a series of processes occurs where microorganisms break down biodegradable material in the absence of oxygen [2]. This technology can be integrated with waste treatment, energy generation and organic fertilizer production systems very efficiently. Anaerobic digestion (AD) is a promising method to treat the kitchen wastes. The biodegradability of a feed is indicated by biogas production or methane yield and percentage of solids (total solids or total volatile solids) that are destroyed in the anaerobic digestion [3] .The biogas or methane yield is measured by the amount of biogas or methane that can be produced per unit of volatile solids contained in the feedstock after subjecting it to anaerobic digestion for a sufficient amount of time under a given temperature[4].

This research work was conducted to utilize kitchen waste and cow dung in different proportion and aims at investigating its effect on generation of biogas.

II. COMPOSITION OF FOOD WASTE OF COLLEGE MESS

The college canteen waste was analyzed and over 50 % of waste was composed of cooked rice,20% of waste was cooked vegetables and 23% of uncooked fruits and vegetables. Eggs, raw meat, the main source of pathogens were relatively low in mass about 7% of cooked meat was there.

TABLE I. THE CHARACTERISTICS OF FOODWASTE USED IN THE EXPERIMENT

S/N	Parameter	Range
1	pH	4-7.1
2	COD(g/L)	5-25
3	TS(g/L)	80-110
4	TVS(g/L0	68-93
5	Moisture content	40-80

Characteristics of food waste reported by Zhang [5] (TableII), that the physical and chemical composition are important information for design reactors and process stability during anaerobic digestion. This information include moisture content (MC), volatile solids content (VS), nutrient content, particle size and biodegradability.

TABLE II. ANAEROBIC DIGESTION OPERATING PARAMETERS

S/N	Parameter	Range
1	pH	6.5-7.5
2	VS/TS(g/L)	80-97
4	Temperature	68-93
5	Moisture content	74-90

III. EXPERIMENTAL PROCEDURE

The experiment was done in 5lt bottle digesters two sets of experiments. The amount of cow dung used is varying in both the 5lt bottles and same composition of kitchen waste mixture is being utilized. It was done to observe the production of gas using kitchen waste and varying amount of cow dung. The bottles were filled up to 4.5 litres with the slurry mix and were kept for a week before further analysis could be done. All waste materials were chopped and mixed with water before they were fed to the digester. Mixing was achieved by putting the daily waste amount into a bucket and adding water in equal proportion. All the prepared food waste and cow dung was added in the digester in one day.

TABLE III. THE COMPOSITIONS OF THE SLURRIES

Sample 1	Sample 2
Cow dung: 400 gm Food Waste 450gm Water: to an optimum level	Cow dung: 1 kg Food Waste 450gm Water: to an optimum level

Fig. 1. Experimental Setup

IV. RESULTS & DISCUSSION

In the study it was observed that sample 1 takes lesser time to produce gas then sample 2. It was observed that the production of gases are rapid in sample one than that of sample 2. There are many factors that could have played there role in the variation of production of gases the samples.

TABLE IV. MEASUREMENT OF BALLOON DIAMETER OF EXPERIMENT

Days	Sample 1 (cm)	Sample 2 (cm)
1	10.4	5.8
2	16.2	7.9
3	17.3	12.3
4	21.3	14.5
5	20.3	16.4

V. GRAPH ANALYSIS

The observation were taken for5 days. And it can be seen from the graph itself that sample 1 has a rapid growth of gas production than that of the sample 2. Sample 2 also have gas produce but its taking some time in the process. There is a decrease in gas production in day 5 in the sample. This may be due to some leakage in the experimental setup or gas production was ceased due some other biological factor [6].

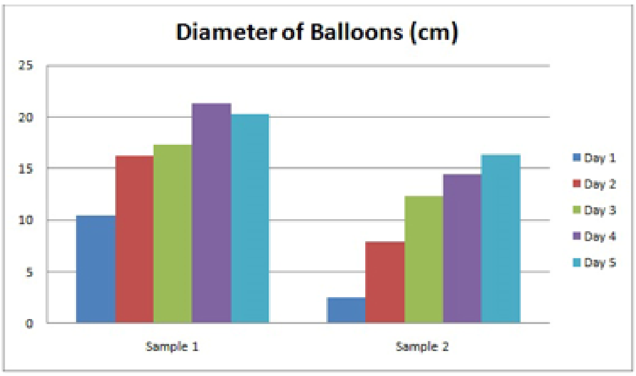

Fig. 1. Diameters of Balloons of Samples in Lab Experiment

VI. BIOGAS COMPOSITION

Syringe method was used for the measurement of amount of methane and carbon dioxide in our gas produced .The resulting biogas was composed up of 66.8% of CH4, 27.2% of CO2, 1.5% of O2 and 4.5% of N2. Thus the methane content was high. According to Voegeli et al. (2009) the methane in biogas produced from food waste should be 56.8%[7].

VII. CONCLUSION

The effective implementation of plastic biogas digester for production of biogas by decomposing kitchen waste offers a relevant resource development solution and an effective waste management system. Its low cost and its independent working conditions under suitable considered parameters prove that it is economic. It is a technology that can be surely assured for processing organic kitchen waste using a plastic biogas digester .It has suddenly experienced a significant positive vibe in the recent go and is a strong contender in becoming the next renewable energy source. This method is more suitable in urban region as more amount of organic waste is generated here due to larger population.It is worth mentioning that it can also influence rural regions as these regions are having insufficient fuel supply and can be used as a means to meet this requirement.

The following conclusions are drawn from the study:

- It was found that the generation of biogas was rapid in sample 1 which was having less cow dung as compared to sample 2.
- Composition of biogas produced shows it can be effectively used as a replacement for conventional fuels.
- The gaseous output can be completely trapped and used as fuel or energy onsite preventing any GHG emissions to the environment.

It is suggested that anaerobic digestion of food waste to recover energy depends on many parameters like composition of feedstock, temperature and methodology as well the feedstock loading. More research should be done to increase methane content in biogas so as to increase its calorific value.The anaerobic co-digestion of kitchen waste with cow manure is demonstrated to be an attractive method for environmental protection and energy savings.

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