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BIOGAS PRODUCTION BY ANAEROBIC DIGESTION OF FOOD WASTE

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Abstract— The food waste from college campus is normally dumped and remains as waste which require proper disposal. In this study the food waste from the college campus is tried to be used for the generation of biogas. To enhance gas production, cow dung was also added into the food waste. This paper deals with the set up of a biogas reactor for the production of biogas and the amount of biogas produced after a 3 week time period.

Keywords— Anaerobic, Biogas, Cow dung, Digestion, Kitchen waste

I. INTRODUCTION

Developing countries can rely on renewable energy which provide them with sustainable rural revitalization. It is a cheap option for energy and hence very ideal for low income communities. Biogas is one source for renewable energy which is affordable, available from waste material and can be easily handled by local communities. Heat and electricity production can be well managed by biogas and the residue from digester can be recycled and used as fertilizer. The production of biogas is relatively simple, economical, and even small and large plants can be set up in both rural and urban locations. Biogas usually contains about 55-65% methane, 30-35% carbon dioxide, and traces of hydrogen, nitrogen and other impurities. (M Gedefaw, 2015). BIOGAS is produced by bacteria through the bio-degradation of organic material under anaerobic conditions. Natural generation of biogas is an important part of bio-geochemical carbon cycle.

The world is facing massive waste management challenge because of rapid urbanisation. Also, the natural finite resources are getting depleted so fast leading the world to an uncertain future. The scarcity of coal and petroleum is becoming severe and there is lot research happening to combat pollution caused by combustion of coal and petroleum. Hence there is an urgent need to get access to new sources of renewable energy like solar energy, wind energy, different thermal and hydro sources of energy including biogas. (K V Navale et al, 2016).

Most developing countries can rely on renewable energy which can provide the much desired sustainable rural revitalization. It is an ideal alternative because it could be a less expensive option for low income communities. (M Gedefaw, 2015). Anaerobic digestion is the classical example of a process that combines the objectives of elimination of organic compounds from a waste stream with the generation of a valuable product in the form of methane-containing biogas.(A Malakhmad et al, 2009). Food wastes are rich in organic matter and as they release methane, a greenhouse gas. Anaerobic Digestion (AD) treats waste for environmental benefits in the absence of oxygen and produces methane for energy recovery (F Oliveira and and K Doelle, 2015). Methane is one of the constituent of biogas which has a great potential to be an alternative fuel.

Biogas plant can be easily implemented in urban or rural areas where waste food with high starch content is available which can be used to produce methane gas and remaining slurry can be used as manure. Since India is self-reliant in food production, biogas can become a .very good substitute for LPG gas. A regular feeding of biogas plant with proper amount will ensure consistent release of biogas and ensures uninterrupted production of gas (S Swapnil et.al, 2016). Cow dung is used to produce biogas to generate electricity and heat and is rich in methane. (S A Iqbal et.al, 2013). The aim of this work is to increase the access of bio-energy and biofertilizer and to create awareness about the technology to local farmers by giving training thereby scaling-up the technology to the poor rural households

II. MATERIALS & METHODS

Samples for treatment of food waste, both solid and liquid were collected from New Horizon Engineering of College canteen. About 15 kg of waste items collected are categorized as vegetables, fruits, rice, other food items and waste water which mixing together, forms semi solid state. Cow dung was collected from a village and added into the mixture. Experiments were conducted in two set ups-one with kitchen waste alone and another with kitchen waste and cow dung.

The experimental set up contains the following components.

Mixing tank – The food waste and cow dung were collected and mixed with water to form a homogeneous slurry.

Inlet pipe – The food waste and cow dung were fed into the digester through the inlet pipe.

Digester - The vessel in which the food waste and cow dung were collected and allowed to ferment resulting in biogas production.

Gas holder or gas storage dome - The biogas gets collected in the gas holder, which holds the gas until the time of consumption.

Outlet pipe - The digested slurry can be taken out through the outlet pipe which is connected to the opening provided at the bottom of digester.

The produced gas from both the digesters was measured by water displacement technique. For setup one digester it was arranged with inverted graduate cylinder (1000 ml) in the water filled tub and for setup two digester it was arranged with inverted graduate cylinder (500ml). The PVC flexible pipe was connected between digester and water filled tub. As the gas produced in digester, it will come and force the water to displace from cylinder to tub. The difference between the initial and the final reading on, gives the amount of gas generated. This method is known as water displacement method. The experimental set up is shown in Figure 1.

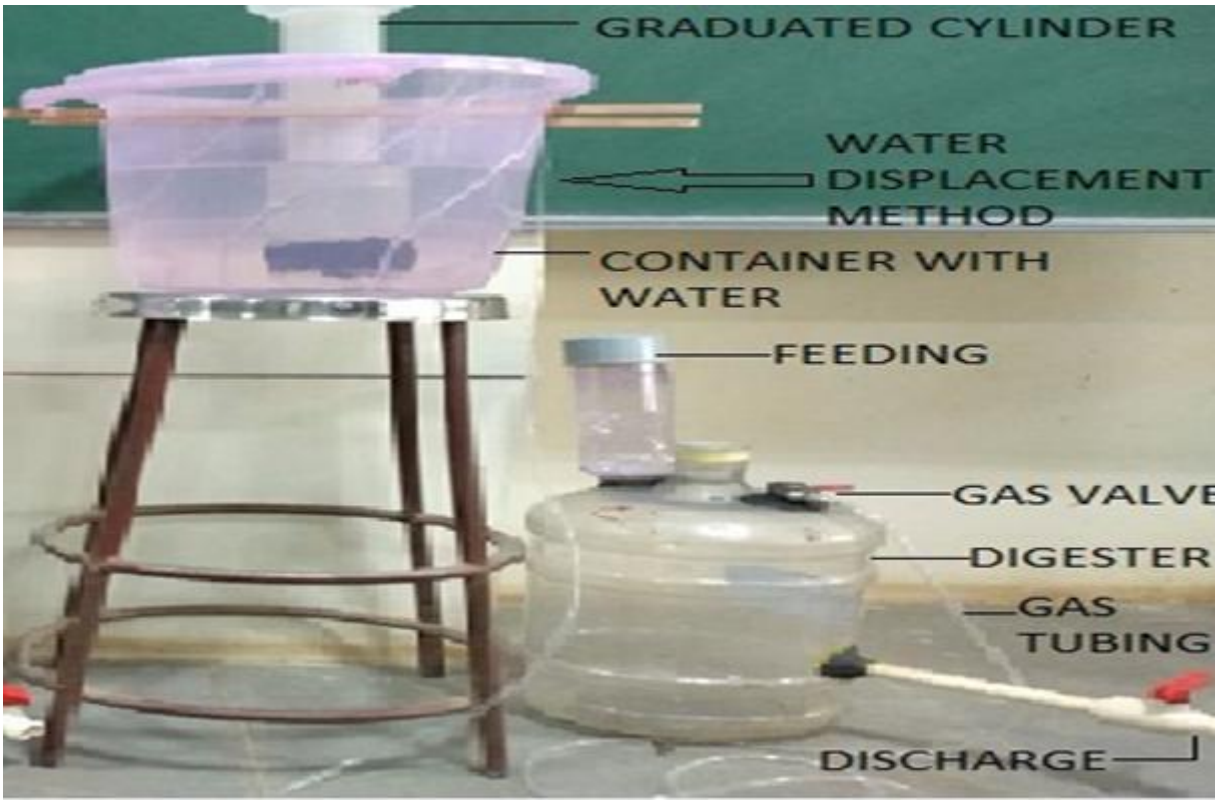

Fig 1. Experimental set up

A representative sample of the feed material was taken after thoroughly mixing the contents. Initial characteristics of the substrate is given in Table 1

Table 1. Initial characteristics of the substrate

Parameter	**Food waste substrate**	**Food waste+ Cow dung**
pH	4.5	7
Temperature	26 ^{0}C	26 ^{0}C
BOD	5130 mg/l	7255 mg/l
COD	22700 mg/l	24660 mg/l
Acidity	610 mg/l	783 mg/l

III. RESULTS AND DISCUSSIONS

VARIATION OF PH

pH was determined daily for the entire period of 22 days. It was found to have little variations only during the 22-day period. pH drop in anaerobic digestion indicates that acidic intermediates such as VFA are produced in considerable quantities. Lower the pH, higher would be the VFA accumulation, which can lead to inhibition of the biogas production during methanogenesis, so a constant pH has been maintained.

The low value of pH indicate that the samples were in acidic nature and in the process of hydrolysis and acidogenesis. Low pH value inhibit the production of biogas. Hence to enhance the process of hydrolysis, acidogenesis and methanogenesis, the optimum pH of 6.5-7.5 has to be maintained. The pH variation is given in Figure 2.

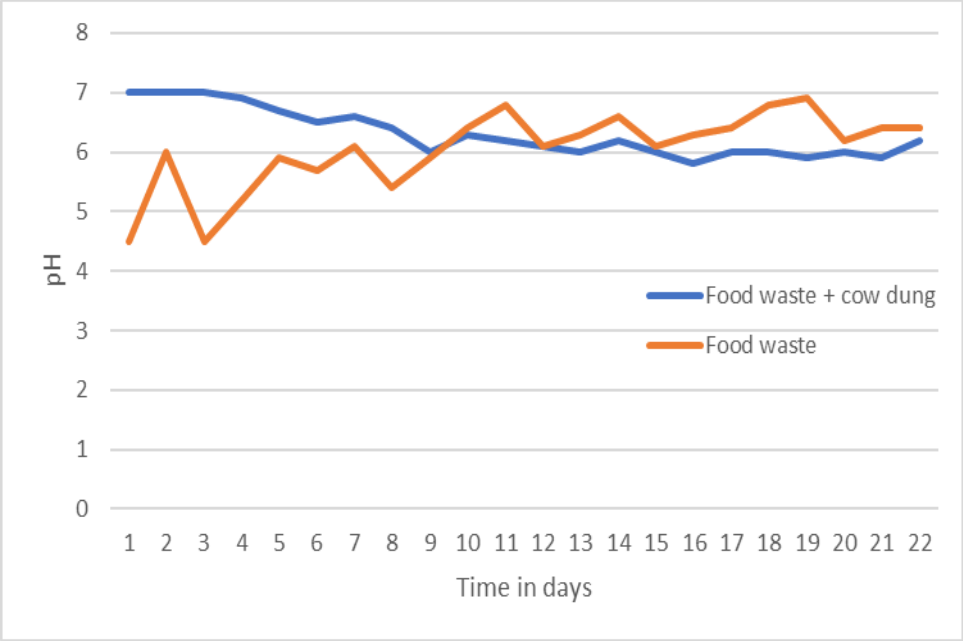

Fig 2. Variation of pH

VARIATION IN ACIDITY

Acidity was increased by the addition of cow dung. The acidity was more initially and is reducing with age. The variation of acidity with time is given in Figure 3.

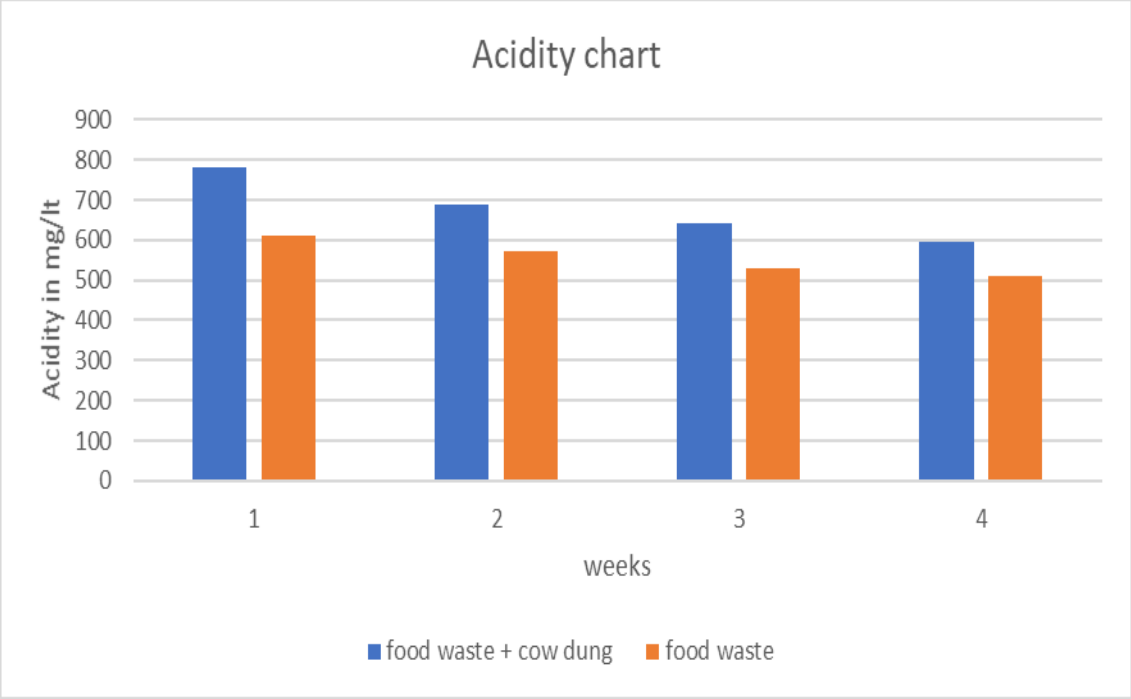

Fig 3. Variation of acidity with time

VARIATION IN BOD AND COD

The variation of BOD and COD with time is given in Figure 4 and Fig 5. There is a decrease in BOD/COD of the substrate with time. In general, COD and BOD indicate the content of decomposable organic materials. The degradation inside the mixing tank is getting faster and there is a decrease in BOD and COD.

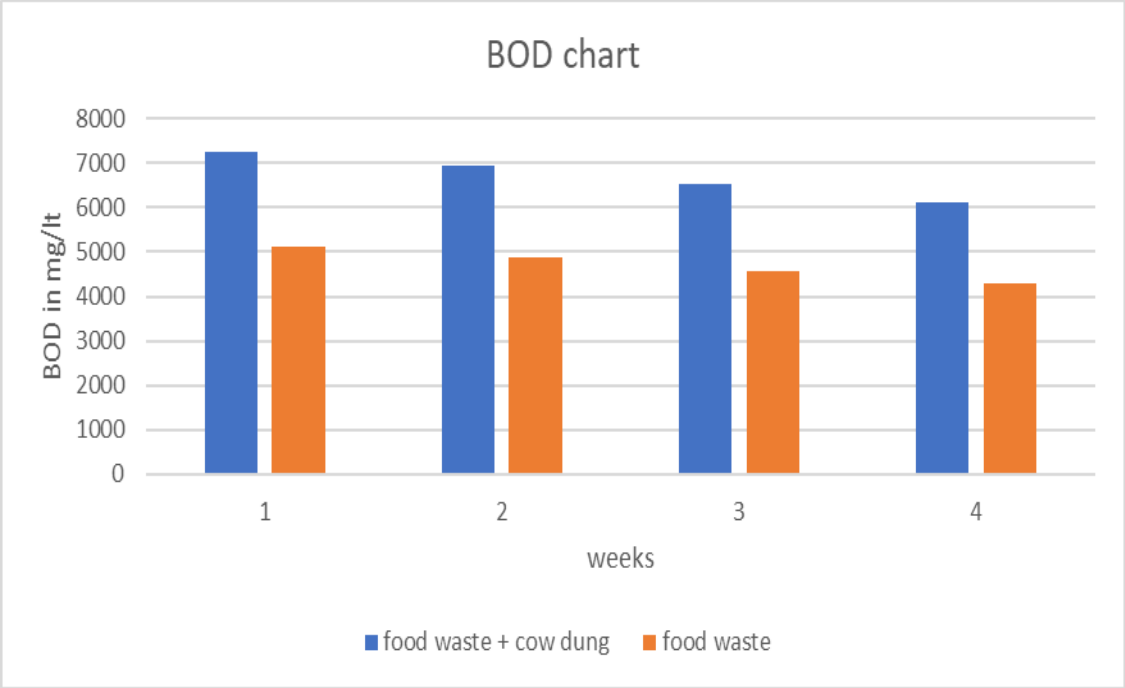

Fig 4. Variation of BOD with time

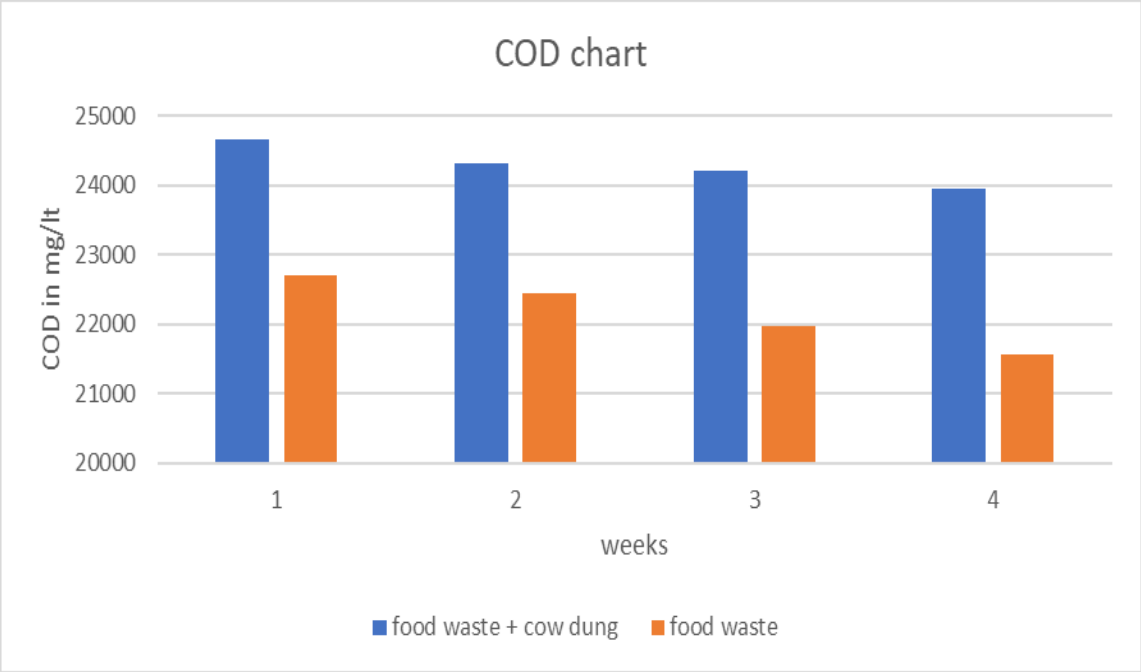

Fig 5. Variation of COD with time

GAS PRODUCTION

The biogas produced is more for food waste and cow dung mixture. The biogas produced was having 55% methane and the rest was other gases. The production of biogas with time is given in Figure 6.

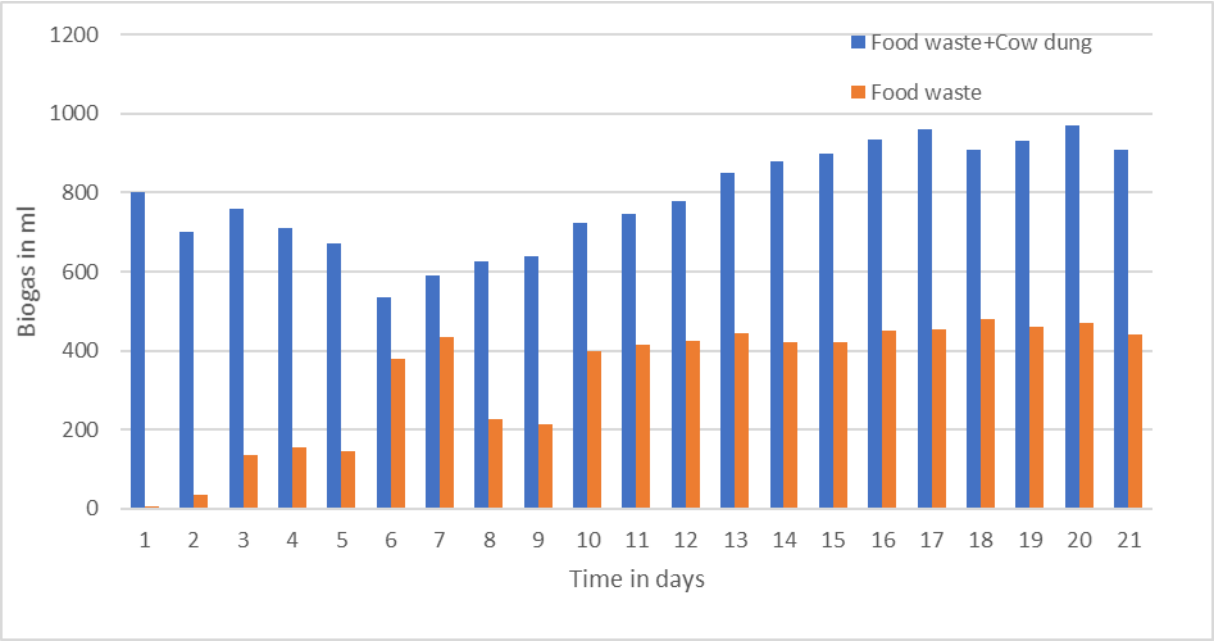

Fig 6. Production of biogas with time

CONCLUSION

The anaerobic digestion of kitchen waste was found to be an attractive method for biogas production which is environmental friendly and save energy. Also, with the addition of cow dung the biogas production can be enhanced. The gas production depends on temperature and additional tests to be done to find out the variation of gas production with temperature. More reasonable results can be obtained by providing ambient conditions.

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