UTILISATION OF KITCHEN WASTE FOR BIO-GAS PRODUCTION

[1]Ms. Megha M. Sarvade , [2] Shivaji M. Sarvade, [3] Mulani Sohail
[1]Assistant Professor, [2] Assistant Professor, [3] UG Student.
[1]Department of Civil Engineering,
[1]Fabtech Technical Campus, College of Engineering and Research, Sangola, India

Abstract-Due to scarcity of petroleum and coal it threatens supply of fuel throughout the world also problem of their combustion lead to research in different corners to get access the new sources of energy, like renewable energy resources. Solar energy, wind energy, different thermal and hydro sources of energy, biogas are all renewable energy resources. But, biogas is distinct from other renewable energies because of its characteristics of using, controlling and collecting organic wastes and at the same time producing fertilizer and water for use in agricultural irrigation. Biogas does not have any geographical limitations nor does it require advanced technology for producing energy, also it is very simple to use and apply. Kitchen waste is organic material having the high calorific value and nutritive value to microbes, that's why efficiency of methane production can be increased.

Index Terms- Bio-Gas, Kitchen Waste, Renewable Energy

I. INTRODUCTION

In most of cities and places, kitchen waste is disposed in landfill or discarded which causes the public health hazards and diseases like malaria, cholera, typhoid. Inadequate management of wastes like uncontrolled dumping bears several adverse consequences: It not only leads to polluting surface and groundwater through leach ate and further promotes the breeding of flies , mosquitoes, rats and other disease bearing vectors. Also, it emits unpleasant odours and methane which is a major greenhouse gas contributing to global warming. Mankind can tackle this threat successfully with the help of methane, however till now we have not been benefited, because of ignorance of basic sciences – like output of work is dependent on energy available for doing that work. This fact can be seen in current practices of using low calorific inputs like cattle dung, distillery effluent, municipal solid waste (MSW) or sewage, in biogas plants, making methane generation highly inefficient. We can make this system extremely efficient by using kitchen waste/food wastes. Anaerobic digestion is controlled biological degradation process which allows efficient capturing & utilization of biogas (approx. 60% methane and 40% carbon dioxide) for energy generation. Anaerobic digestion of food waste is achievable but different types, composition of food waste results in varying degrees of methane yields, and thus the effects of mixing various types of food waste and their proportions should be determined on case by case basis.

II. LITERATURE REVIEW

Arti – Appropriate Rural Technology of India, Pune (2003) has developed a compact biogas plant which uses waste food rather than any cow dung as feedstock, to supply biogas for cooking. Dr. Anand Karve (ARTI) developed a compact biogas system that uses starchy or sugary feedstock (waste grain flour, spoilt grain, overripe or misshapen fruit, nonedible seeds, fruits and rhizomes, green leaves, kitchen waste, leftover food, etc.). Just 2 kg of such feedstock produces about 500 g of methane, and the reaction is completed with 24 hours. The conventional biogas systems, using cattle dung, sewerage, etc. use about 40 kg feedstock to produce the same quantity of methane, and require about 40 days to complete the reaction. Thus, from the point of view of conversion of feedstock into methane, the system developed by Dr. Anand Karve is 20 times as efficient as the conventional system, and from the point of view of reaction time, it is 40 times as efficient.

Hilkiah Igoni (2008) studied the Effect of Total Solids Concentration of Municipal Solid Waste on the Biogas Produced in an Anaerobic Continuous Digester. The total solids (TS) concentration of the waste influences the pH, temperature and effectiveness of the microorganisms in the decomposition process. They investigated various concentrations of the TS of MSW in an anaerobic *Continuously Stirred Tank Reactor* (CSTR) and the corresponding amounts of biogas produced, in order to determine conditions for optimum gas production. The results show that when the percentage total solids of municipal solid waste in an anaerobic continuous digestion process increases, there is a corresponding geometric increase for biogas produced.

Kumar et al., (2004) investigated the reactivity of methane. They concluded that it has more than 20 times the global warming potential of carbon dioxide and that the concentration of it in the atmosphere is increasing with one to two per cent per year. The article continues by highlighting that about 3 to 19% of anthropogenic sources of methane originate from landfills.

Carrasco et al. (2004) studied the feasibility for dairy cow waste to be used in anaerobic digestive systems. Because the animal's wastes are more reactive than other cow wastes, the study suggests dairy cow wastes should be chosen over other animal wastes.

Jantsch and Mattiasson (2004) discuss how anaerobic digestion is a suitable method for the treatment of wastewater and organic wastes, yielding biogas as a useful by-product. However, due to instabilities in start-up and operation it is often not considered. A common way of preventing instability problems and avoiding acidification in anaerobic digesters is to keep the organic load of the digester far below its maximum capacity. There are a large number of factors which affect biogas production efficiency including: environmental conditions such as pH, temperature, type and quality of substrate; mixing; high organic loading; formation of high volatile fatty acids; and inadequate alkalinity.

III. METHODOLOGY

3.1 Source of kitchen waste:

The waste used in this study is collected from FABTECH Hostel mess. Waste contains the cooked rice, vegetables and non-used vegetables waste. This waste is crushed by mixer grinder and slurry was prepared mixing with water.

3.2 Materials Required:

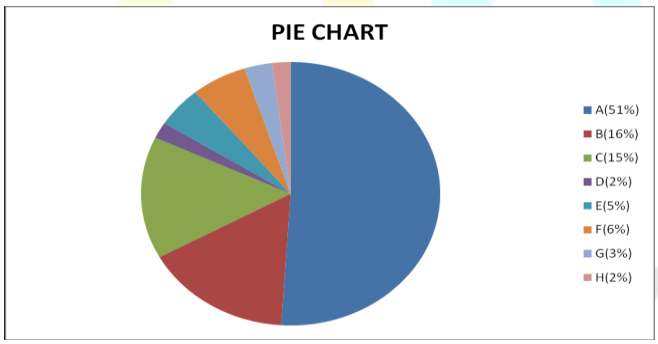
1. Empty can 100ltrs capacity: 1 number. (To be used as Digester Tank).
2. Empty can 80ltrs capacity: 1 number. (To be used as Gas Holder Tank) (Make sure the smaller can fits inside larger one and moves freely).
3. 50 mm diameter PVC pipe: about 100 cm long (To be used for feeding waste material).
4. 25 mm dia. PVC pipe: about 25 cm long (fixed on digester tank to act as outlet for digested slurry).
5. M-seal or any water-proof adhesive.
6. Gas outlet system.


Fig. 1 Empty can 100 litres and 80 litres capacity and

Fig. 2 Arrangement of Digester.

3.3 Composition of Kitchen Waste of FABTECH Hostel.

Daily production of kitchen waste in FABTECH CAMPUS mess is about 150 kg per day. So yearly production of kitchen waste from FABTECH CAMPUS is about 54.75 ton and that waste have potential to generate tremendous amount energy Average composition of kitchen waste was analysed on various occasions. Over 50 % of waste was composed of uncooked vegetable & fruit waste. Eggs, raw meat, the main source of pathogens were relatively low in mass at 1.5% & 1.2% also about 15% of cooked meat was there.



(A) Uncooked fruits & vegetables
(B) Cooked meat
(C) Uncooked meat
(D) Bread
(E) Teabags
(F) Eggs
(G) Cheese
(H) Paper

Fig. 3 Composition of kitchen waste

3.4 Precautions while Collecting Sample:

1. A separate container for coconut shells, egg shells, peels and chicken mutton bones. These will be crushed separately by mixer grinders.
2. Different containers of volume 5 litres to collect the wet waste, stale cooked food, waste milk products. The vegetables refuse like peels, rotten potatoes coriander leaves collected in bags.

3.5 Production Process:

A typical biogas system consists of the following components:

1. Kitchen Waste collection.
2. Making slurry.
3. Feeding to the digester.

4. Anaerobic digestion.
5. Gas production.
6. Use of gas.

Biogas is a renewable form of energy. Methanogens (methane producing bacteria) are last link in a chain of microorganisms which degrade organic material and returns product of decomposition to the environment. The digestion process occurs without (absence) oxygen and is called anaerobic digestion which generates mixtures of gases. The gas produced which is mainly methane produces 5200-5800 KJ/m3 which when burned at normal room temperature and presents a viable environmentally friendly energy source to replace fossil fuels (non-renewable).

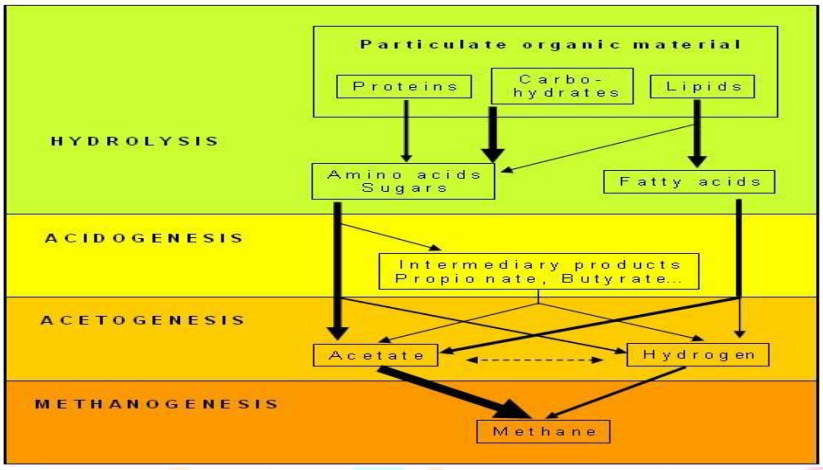


Fig. 4 Flow Chart of Anaerobic Digestion.

IV. RESULTS

4.1 Test Results:

Following Graphs shows the results of various tests conducted on the samples.

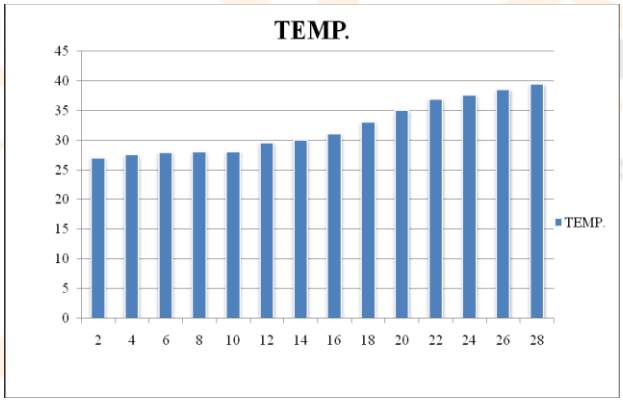
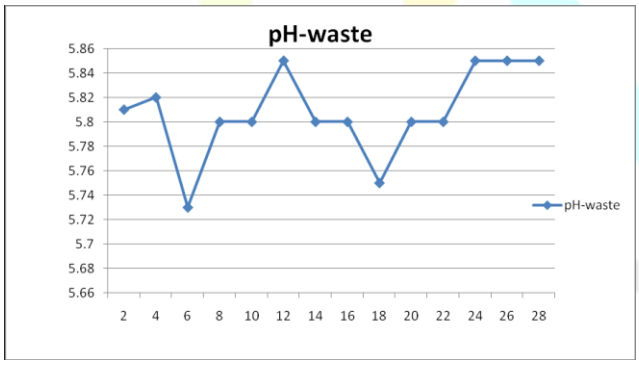


Fig. 5 Variation of Temperature.



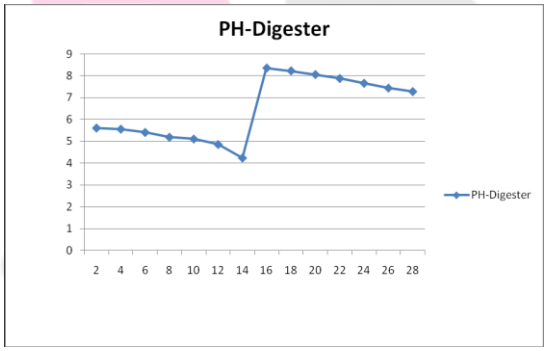


Fig.6 Variation of pH

4.2 Gas Production:

Following table shows volume of gas produced from the kitchen waste digester.

Table 1. Gas Produced.

Days	Height (cm)	Gas Volume (cm^3)
1-10	1.6	1911.35
11-20	3	3583.7
21-30	3.8	4539.4
31-40	3.7	4419.98

V. CONCLUSION

Food waste is one of the single largest constituent of municipal solid waste stream. Diversion of food waste from landfills can provide significant contribution towards climate change mitigation, apart from generating revenues and creating employment opportunities. A kitchen waste gas plant can take care of household wet waste and provide energy for household working. By-products can be effectively utilised as fertilizers for house gardening.

VI. REFERENCES

[1] Karve .A.D. (2007), Compact biogas plant, a low cost digester for biogas from waste starch. http://www.arti-india.org.

[2] Karve A.D (2006), Compact biogas plant compact low-cost digester from waste starch. www.bioenergylists.org.

[3] Hilkiah Igoni, M. F. N. Abowei, M. J. Ayotamuno and C. L. Eze (2008), Effect of Total Solids Concentration of Municipal Solid Waste on the Biogas Produced in an Anaerobic Continuous Digester.

[4] Heo, N.H., Park, S.C., Kang, H., 2004. Effects of Mixture Ratio and Hydraulic Retention Timeon Single-Stage Anaerobic Co-Digestion of Food Waste and Waste Activated Sludge, International Journal of Hydrogen Energy 29 (15), 1607-1616.