International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

BIOGAS PRODUCTION FROM KITCHEN WASTE

Umapathy H[1], Dr. D P Nagarajappa[2], Dr. P. Shiva Keshava Kumar

[1]PG Student, [2]Professor and Chairman
[1,2]Department of Civil Engineering, University B.D.T.College of Engineering, Davanagere, Karnataka, India
[3]Professor and Head, Department of Civil Engineering, Proudadevaraya Institute of Technology, Hosapete 583225,

---

Abstract - *The Kitchen waste (food waste) used to be accumulated from distinctive hostels of and Messes as feedstock for our reactor which works as anaerobic digester machine to produce biogas energy. Through, the anaerobic digestion of kitchen waste produces biogas which is a treasured electricity resource. Anaerobic digestion is a microbial procedure for manufacturing of biogas, which consists of principally Methane (CH4) and Carbon Dioxide (CO2). Biogas can be used as power supply and additionally utilized for several purposes. In this process, any viable purposes require fundamental understanding & facts about the composition of one-of-a-kind sources, volume of elements in the biogas produced and conveying for a number of purposes.*

Key Words: **Anaerobic Digestion, Biogas, Kitchen waste, Methane, Liquid Petroleum Gas**

1. INTRODUCTION

Anaerobic-digestion is an assuring technique to deal Kitchen-waste. Although anaerobic-digestion with cow dung treatment is common in generating countries' rural components, record of the operational and technical feasibility of organic stable waste solution in those kinds of parts are limited. There are many factors influencing layout and ultimate efficiency of anaerobic digestion. In real time, others are concerned with feed-stock properties, reactor graphs and operational requirements. Physico-chemical characteristics of organic wastes are important for the design and operation of digester, given the fact that they affect the production of bio-gas and the balance of anaerobic-digestion at some point. They include content of moisture, volatile solids, and content of nutrients, particle-size, & degradability. The degradation of a feed is demonstrated through the production of bio-gas or methane-yield, and the proportion of solids that are demolished in AD. The yield of bio-gas or methane is determined by the amount of bio-gas or CH4 that can be developed per group of volatile solids enclosed in the feed-stock after being subjected to AD for a sufficient amount of time below a specific temperature, which in our case is considered to be lab-temperature.

1.1 Biogas Production Principles

Organic compounds from living creatures to dead organisms emerge in broad range. Natural objects are made up of carbon, combined with elements like hydrogen, oxygen, nitrogen and sulphur to create a variety of natural products like carbohydrates, proteins and lipids. In fact, micro-organisms split the complex carbon into small substances through the process of digestion. Digestion processes are of 2 types:

- Aerobic-Digestion
- Anaerobic-Digestion

1.2 Anaerobic Digestion Flow-Chart

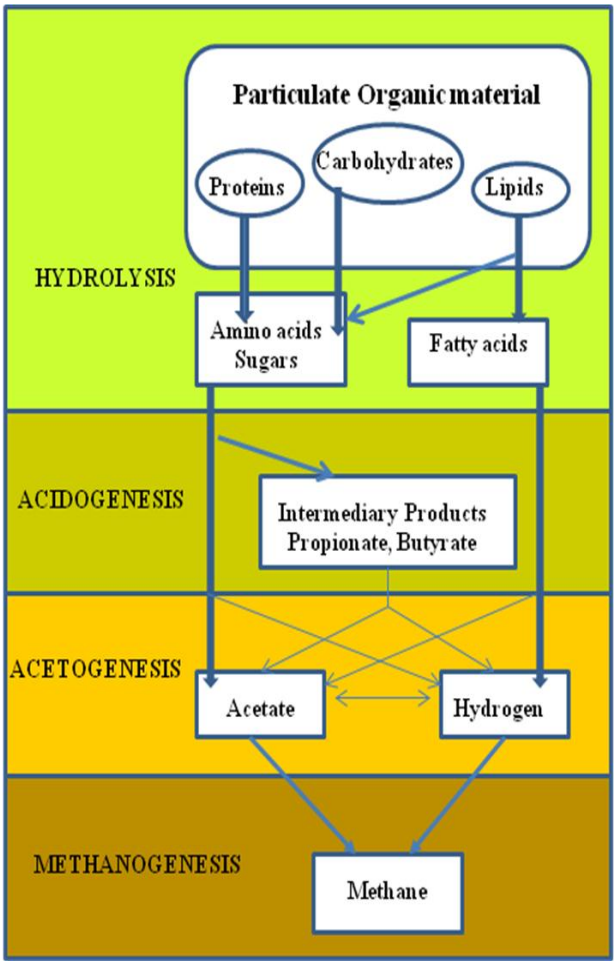

Fig-1: Anaerobic Digestion Flow-Chart

1.3 Objectives

- To analyse Kitchen waste composition
- To optimize the Biogas production
- To compare Production of Biogas with conventional plants.

2. MATERIALS AND METHODOLOGY

This study accomplished by using following materials and methodology:

2.1 Study area

University B D T College of Engineering, Davanagere having the collaborative college cafeteria works under guidance of the teachers and students at the college premises. It satisfies the requirements of faculty and instructors through healthy food, and beverages at affordable prices.

2.2 Materials Used

a) Kitchen waste: Kitchen waste (KW) sample was collected from Canteen, University B D T College of Engineering, Davanagere. This canteen food-waste constitutes of vegetables, cooked-rice, plastic covers, papers, peels and unused parts of vegetables, later it is segregated to obtain fermentable fractions sample, then it was crushed in mixers for experimentation. The pictorial view of Sample of KW is as shown in Plate-1 below.

Plate-1: Kitchen Waste Sample

Different Volume of containers used between 5 liters to 20 liters to store the kitchen wet-waste, cooked-stale food, milk-waste-products with tight lids. Kitchen vegetables-waste such as peel-off, rotten-potatoes and leaves of coriander are segregated in different polythene covers of different size. The handling these containers should be carrying out with optimum safety and used hands protections.

b)Cow Dung: Cow dung is equine cattle-waste product. Cow manure is the indigestible accumulation of plant material that has traversed the gut of the animal. The resulting faeces are minerally rich. The colours vary from greenish to blackish, sometimes darkening shortly after air exposure.

Plate-2: Fresh Cow Dung

2.3 Safety measures Before Sampling

a) Kitchen-Waste

- A particular box for coconut-shell, peel-offs, plastic-waste and paper.
- Mixer grinder is then used to smash those separately.
- Separate 5 L capacity containers for storing wet-waste, rotten cooked food, waste dairy products. The vegetables wastes such as coriander-leaves, peel offs, staled or rotted potatoes.

b) Setting Up

Essential factor in easier plant running by preventing plant strangling. It is due to dense organic-waste not entering to kill the micro-organisms. Converting waste products into solvent-slurry is the simple solution to this issue. Grinders are used for shaping solid-waste into slurry.

2.4 Experimentation

This experiment will done in three different capacity bottle container, 1 lit, 2 lit and 20 lit bottles used as digester. Various concentration & mixture of waste can be used in various input and effect parameters such as total-solid, volatile-solid, VFA, pH, temperature, Nitrogen, carbon, phosphorus. Consequently, twenty litre plastic-containers will consider for experiment study done and to check the biogas productions.

Test No. 1

- Take 2L water-bottle.
- Take 50 gms of kitchen-waste and cow-dung.
- Fill remaining portion of bottle volume by H2O.

Plate-3: Lab Scale Experimentation Setup-1

Test No. 2

This experiment is done on three different sets by using one litre and two litre bottles, three separate set of bottles with various compositions were as follows

Set-1:200 gms of cow-dung is taken and mix the water and prepare one litre solution and transfer it to one litre capacity bottle.

Set-2: 50 gms of grinded-kitchen-waste is combined with 150 gms of cow-dung and then water is added to it, to make one litre slurry and transfer it to one litre capacity bottle.

Set-3: 400 gms of cow-dung is blended with H2O and prepare two litre solution and transfer it to one litre capacity bottle.

Plate-4: Lab Scale Experimentation Setup 2

Test No. 3

Installation: In this Test No.3 both the digester was installed in environmental laboratory in civil department in our college UBDTCE. Make use of the 20 liter capacity empty water can as bio-digester.

Procedure: Collect freshly prepared cattle dung then add water to it and properly mix them with by using hand and then transfer it to 20 L capacity reactor. Materials of the previous-experiment can be utilised as Inoculums (of kitchen waste), contains the required amount of microorganism which will used in AD. But after a little days of retention of the inoculum bioreactor as well as checking of biogas-production. Than one or two days, kitchen-waste is applied then biogas-production checked, during the gas production pH maintained higher between 6.8 to 7.25.

Plate-5: Experimental Setup for Test No.3

The following are the requirements for this experimentation

- 20 L capacity bio-digester
- Cow-dung + Kitchen waste and add water
- 2.5 L of Cow-dung
- 3.8 L of Kitchen Waste
- Water – 13.5lit
- 5.02 pH
- To adjust pH, add solution of Sodium hydroxide and sodium bicarbonate

3. RESULTS AND DISCUSSION

3.1 Kitchen Waste Composition

Following table and graphical representation shows the results.

Table-1: Kitchen Waste Composition

Composition	Quantity in %
Un-cooked fruit and vegetable	51
Cooked-rice	16
Paper	15
Breads	11

Teabags/powder	5
Plastic cover	2

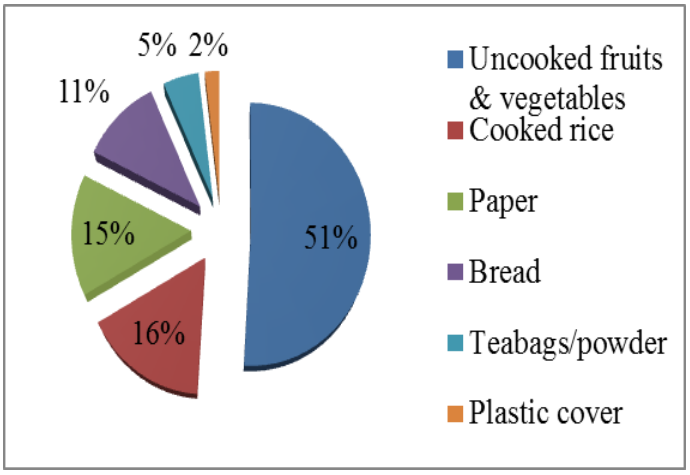

Fig-2: Kitchen Waste Composition

3.2 Biogas Production

Test No. 1: Production of Biogas was observed, measurement of Biogas was not done, and it burned with **Blue-flame.**

Test No.2: On review the results, observed the 2nd Set, has kitchen-waste generates higher biogas; compared to another sets. The 2nd set with kitchen-waste generates avg 376.29% higher biogas compared to 1st set and 148.9% higher biogas compared to 3rd set. Significant difference would be that cooking-waste generates greater biogas over cow-dung since it comprises of more nutrients than cow-dung. Consequently, through use of kitchen- waste seems to be a more productive and reliable approach for producing biogas.

Table-2: Biogas of Production(in ml)

Set-No. /Days	1st	2nd	3rd	4th	5th	6th	7th	8th	Avg
Set-1	29	34	19	11	14	39	24	11	23.75
Set-2	82	145	125	55	65	68	92	119	89.37
Set-3	78	72	59	33	21	21	69	99	60.02

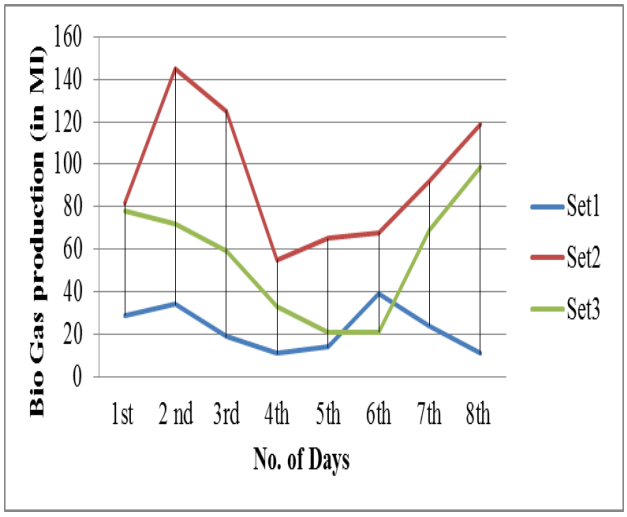

Fig-3: Biogas production

In fact, it was found in analyzing the findings that pH decreases as the cycle goes on as the bacteria generate fatty acids. In these experiments, methanogen-bacteria's that make use of such a fatty-acids are compared to those other slow reactions, thus limiting the reaction phase. In set-2 that includes kitchen-waste pH reduces significantly mean process is rapid, that mean the hydrolysis and acid reaction becomes rapid as organism uses the waste much quickly than cow-dung. And in set-2 the cumulative solids also reduces even further.

Table-3: pH and Total Solids (in %) Details

Days	1st Set		2nd Set		3rd Set	
	pH	TS	pH	TS	pH	TS
1	7.35	8.5	7.15	6.5	7.35	8.1
4	6.75	7.7	5.75	5.5	6.65	7.6
5	6.80	7.6	6.35	5.5	6.95	7.6
8	6.55	7.5	4.85	4.8	6.6	7.1

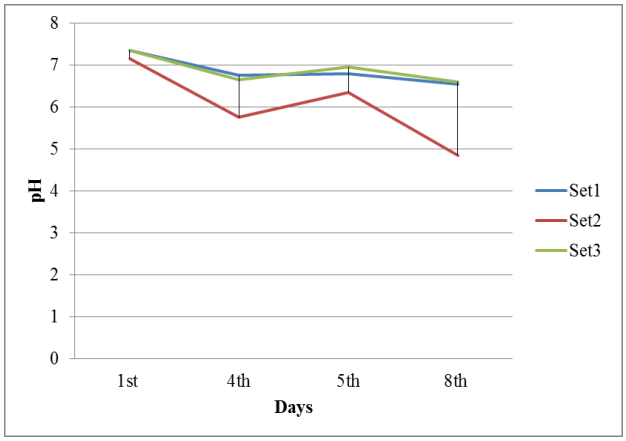

Fig-4: pH reduction Details

Test No. 3: Biogas production and pH variations from this experiment is as follows

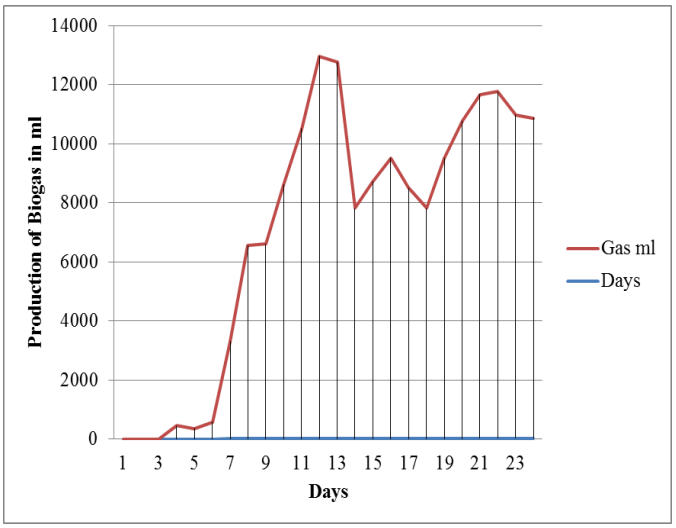

Fig-5: Biogas Production from Test No. 3

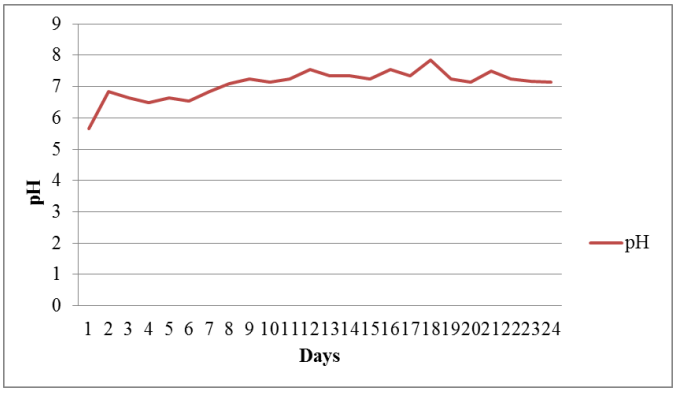

Fig-6: pH in Digester from Test No. 3

4. CONCLUSIONS

- Biogas-Production from biodegradable kitchen-waste science easily accepts relatively fermentable organic trashes from kitchens, and it is utilised in community households, canteens, hostels, restaurants etc. End product of this process produces the residue, which is utilized for soil-conditioning.
- Production of biogas from biodegradable kitchen waste more efficiently and effectively than the traditional Biogas system use of cattle dung.

REFERENCES

[1] ISAT/GTZ."Biogas Digest Volume I. Biogas Basics, Information and Advisory Service on Appropriate Technology (ISAT)" Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ); 1999a

[2] Bouallagui, H., Touhami, Y., Ben Cheikh, R., Hamdi, M., "Bioreactor performance in anaerobic digestion of fruit and vegetable wastes". Process Biochemistry 40, 2005 (3–4), 989–995

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

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

[5] Agrahari, Ravi, and G. N. Tiwari, "The Production of Biogas Using Kitchen Waste" International Journal of Energy Science (2013).

[6] Singh, Jasvinder, and Sai Gu. "Biomass conversion to energy in India—a critique" Renewable and Sustainable Energy Reviews 14.5 (2010): 1367-1378.

[6] Shalini sing, sushil kumar, M.C. Jain, Dinesh kumar (2000), "The increased biogas production using microbial stimulants"

[7] 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"

[8] Tanzania Traditional Energy Development and Environment Organization (TaTEDO), "BIOGAS TECHNOLOGY- Construction, Utilization and Operation Manual"

[9] The University of Southampton and Greenfinch Ltd, "Biodigestion of kitchen waste-A comparative evaluation of

mesophilic and thermophilic biodigestion for the stabilisation and sanitisation of kitchen waste"

[10] Ranjeet Singh, S. K. Mandal, V. K. Jain (2008), "Development of mixed inoculum for methane enriched biogas production"

[11] Kumar, S., Gaikwad, S.A., Shekdar, A.K., Kshirsagar, P.K., Singh, R.N. (2004), Estimation method for national methane emission from solid waste landfills. Atmospheric Environment" 38: 3481–3487.

[12] Jantsch, T.G., Matttiason, B. (2004), "An automated spectropphoyometric system for monitoring buffer capacity in anaerobic digestion processes" Water Research. 38: 3645-3650.

[13] Thomsen, A.B., Lissens, G., Baere, L., Verstraete, W., Ahring, B. (2004), "Thermal wet oxidation improves anaerobic biodegradability of raw and digested biowaste" Environmental Science and Technology.38: 3418-3424.

[14] Meres, M., Szczepaniec-Cieciak, E., Sadowska, A., Piejko, K., Oczyszczania, M.P., Szafnicki, K. (2004), "Operational and meteorological influence on the utilized biogas composition at the Barycz landfill site in Cracow" Poland. Waste Management Resource.22: 195–201.