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THE STUDY OF COW DUNG AS CO-SUBSTRATE WITH KITCHEN WASTE IN BIOGAS PRODUCTION

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Abstract: The co-digestion of cow dung with kitchen waste for biogas production at laboratory scale was the subject of this investigation. The study was carried out at room temperature i.e., 26 - 29°C for a period of 35 days. The biogas produced was collected by water displacement method which was subsequently measured. Sample A (50 wt % cow dung, 50 wt % Kitchen waste), Sample B (25 wt % cow dung, 75 wt % Kitchen waste), Sample C (0 wt % cow dung, 100 wt % Kitchen waste) showed a cumulative biogas production as follow 102 ml,129 ml,60 ml at the end of the 35th day of the experiment.

Key words: **Biogas, cow dung, co-digestion, kitchen waste.**

I. INTRODUCTION

Biogas is a term used to represent a mixture of different gases produced as a result of the action of anaerobic microorganisms on domestic and agricultural waste [1]. It usually contains 50% and above methane and other gases in relatively low proportions namely CO_2, H_2, N_2 and O_2 [2]. The mixture of the gases is combustible if the methane content is more than 50% [3]. Biogas production involves three steps:

A. ***Hydrolysis:*** **This converts organic polymers into monomers (with the help of hydrolytic bacteria).**
B. ***Acid formation:*** **Which involves conversion of monomers into simple compounds such as acetic acid, propionic acid, CO_2, NH_3 and H_2, using a group of acid forming bacteria (acetogenic bacteria).**
C. ***Methane formation*****: Involving conversion of simple compounds into methane CH_4 and CO_2, utilizing anaerobic methanogenic bacteria.**

Co-digestion is the simultaneous digestion of more than one type of waste in the same unit. Advantages include better digestibility, enhanced biogas production/methane yield arising from availability of additional nutrients, as well as a more efficient utilization of equipment and cost sharing [4]. Studies have shown that co-digestion of several substrates, for example, banana and plantain peels, cow dung, spent grains an rice husk, pig waste and cassava peels, sewage and brewery sludge, among many others, have resulted in improved methane yield by as much as 60% compared to that obtained from single substrates[5]. The need for more research into biogas production as a renewable energy source alongside the added benefit of solving major environmental

problems posed by the wastes used as substrates is well established. This work was carried out to explore the potential of biogas production from co-digestion of Kitchen waste and cow dung.

II. METHODOLOGY

A. SAMPLE COLLECTION

Cow dung was obtained from Baben village, Bardoli. Approximately 15kg of cow dung was collected for the purpose of this research. Kitchen waste was collected from S. N.P. I. T canteen.

B. MATERIALS / INSTRUMENTS

Buckner flask (500 and 1000 ml), conical flask (250 ml), measuring cylinder (50 ml), a top loading weighing balance, digital pH meter, thermometer, Sodium Chloride (NaCl), tap water, mortar and pestle, corks and connecting tubes.

C. APPARATUS SET-UP

A set of 3 Buckner flasks (500 ml) was used as digesters for this research, that is, one digester for each sample. Another set of 3 Buckner flasks (1000 ml) was used. Each contained a solution and was connected to a particular digester by means of a connecting tube and also, on the other side, connected to a conical flask by means of a connecting tube. Thus, the biogas produced in the digester by the fermentation slurry (sample) passed through the connecting tube to the Buckner flask containing solution. The pressure of the biogas produced caused a displacement of the solution through a connecting tube on the other side of the conical flask. The weighing balance was used to determine the mass of cow dung and kitchen waste that made up the total solid for particular fermentation slurry. The digester was operated at ambient temperatures. A thermometer was used to determine the daily temperature. The average temperature was calculated and assumed to be the operating temperature. A digital pH meter was used to determine the pH of the fermentation slurry (sample) on the first day of the experiment. Figure 1 is a schematic diagram of the experimental set-up.

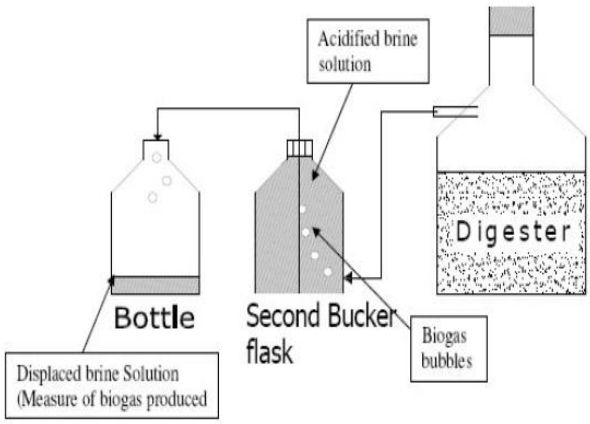

Figure 1. Schematic diagram of experimental set-up

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D. ACIDIFIED BRINE SOLUTION AND BIOGAS MEASUREMENTS

In order to prevent the dissolution of biogas in the water, an acidified brine solution was prepared by adding Neck to water until a supersaturated solution was formed. Little drops of sulphuric acid were added to acidify the brine solution. This formed the solution contained in the second Buckner flask (1000 ml). As biogas production commenced in the fermentation chamber, it was delivered to the second chamber which contained the acidified brine solution. Since the biogas is insoluble in the solution, a pressure build-up provided the driving force for displacement of the solution. The displaced solution was measured to represent the amount of biogas produced [6].

Table 1. Proportion of substrates in each sample.

Samples	% of X	% of Y
A	50	50
B	25	75
C	0	100

x represents the cow dung.; y represents the kitchen waste.

Table 2. Composition of materials in each sample.

Sample	Mass of X(g)	Mass of Y(g)	Mass of Z(g)
A	7.5	7.5	15
B	3.75	11.25	15
C	0	15	15

x represents the cow dung; y represents the kitchen waste.; z represents the sum of the kitchen waste and cow dung, this total solids; represents the amount of water needed for any given mass of z.

III. RESULTS AND DISCUSSION

A. Biogas production:

The biogas production with time from samples A, B and C are shown in Table 3. Sample A (50 wt % cow dung, 50 wt % kitchen waste) was observed to produce the highest quantity of biogas. The initial anaerobic digestion process that produced 10,20,30 ml of biogas on the 15th day, respectively is followed by 14 days of inactivity before a sudden burst of production of 30 ml. This inactivity is probably due to the methanogens undergoing a methamorphic growth process by consuming methane precursors produced from the initial activity as suggested by [7]. The cumulative gas production of sample A (50% cow dung, 50% kitchen waste) on the 35th day was 102 ml (Table 3). From investigation of the optimum time for the production of biogas from cow dung reported that 14 days retention time was the best for maximum production of biogas from cow dung.

Table 3: Daily and cumulative biogas production with time

Day	Sample A (ml)		Sample B (ml)		Sample C (ml)
	Daily production	Cumulative production	Daily production	Cumulative production	Daily production
1	-	-	-	-	-
2	-	-	-	-	-
15	10	10	20	20	30
20	18	28	28	48	45
25	30	58	35	83	56
30	50	102	46	129	60
35	-	102	-	129	60

From Table 3, sample B (25% cow dung, 75% kitchen waste) was observed to produce a total amount of 129 ml of biogas though this production was observed on the 15th day of the experiment. Sample C (100% kitchen waste) produce total of 60 ml biogas throughout experiment. It is well known that the composition of biogas as well as biogas yields depend on the substrates owing to differences in material characterization in each feed material [8]. High starch content of kitchen waste is responsible for higher production of biogas [9]. Studies on possible uses of kitchen waste have indicated its potential use in electricity generation and as a fuel [10].

IV. CONCLUSION

- The outcome of this research suggests that co-digestion of kitchen waste with cow dung at this temperature improves the digestibility of kitchen waste for biogas production.
- Kitchen waste has higher potential for biogas production at the temperature range of 26 - 29°C.
- Kitchen waste can be useful under community level biogas program, where we can save LPG for cooking purposes.

REFERENCES

[01] Ezeonu SO, Dioha IJ, Eboatu AN (2005). 'Daily Biogas Production from different wastes and identification of methanogenic bacteria involved. Nig. J. Solar Energy 15: 80-85.

[02] Kalia VC, Sonakya V, Raizada N (2000). Anaerobic digestion of banana stems waste. Bioresource. Technol. 73: 191-193.

[03] Parawira W, Murto M, Zvauya R, Mattiasson B (2004). Anaerobic digestion of solid potato waste alone and in combination with sugar beet leaves. Renew. Energy 29: 1811-1823.

[04] Agunwamba JC (2001)"Waste Engineering and Management Tool" Immaculate Publication Limited, Enugu.

[05] Babel S, Sae-Tang J, Pecharaply A (2009). Anaerobic co-digestion of sewage and brewery sludge for biogas production and land application. Int. J. Environ. Sci. Tech. 6: 131-140.

[06] Itodo IN, Lucas EB, Kucha EI (1992). The Effect of Media Materials and its Quality on Biogas Yield. Nig. J. Renewable Energy 3(1, 2).

[07] Bal AS, Dhagat NN (2001). Up flow anaerobic sludge blanket reactor – a review. Indian J. Environ. Health 43: 1-82.

[08] Momoh Y (2004) "Biogas Production from the Co-Digestion of Cow Dung, Paper Waste and Water Hyacinth", M.Sc, Thesis in Environmental Engineering, University of Port Harcourt.

[09] Pualchamy C, Dharmaraj P, Laxmanan U (2008). A preliminary study on co-digestion of ossein industry waste for methane production. Eur Asia J. BioSci. 2: 110-114.

[10] Rozainee M, Ngo SP, Salema AA, Tan KG (2008); "Study on the quality of rice husk ash at different fluidizing velocity in a fluidized bed combustor", J. Solid Waste Technol. Manage. 34:1-6.

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