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QUANTIFY THE AMOUNT OF BIOGAS PRODUCTION FROM BIO WASTES

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ABSTRACT

Solid waste is a waste that includes predominantly household waste with some times the addition of commercial wastes collected by a municipality with in a given area. Batch Anaerobic reactor was set up to decompose the waste to produce methane, co2, hydrogen and other gases in traces. Anaerobic digestion of wastes was carried out in the laboratory at room temperature, to assess the biogas production. The total biogas production from the wastes was found to be 6lit/kg. The results from the biomethanation process showed that an increase in gas production was observed with increase in digestion period, when bioconversion parameters were found to be favorable for the production of gas.

KEYWORDS: Anaerobic digestion, kitchen waste, distillery sludge, biogas.

INTRODUCTION

In many cities in developing countries, the most serious environmental and health problems are related with inadequate solid waste management (SWM). Urbanization or an increase in population, respectively, leads to increase waste generation in urban areas. Most problems are strongly related to inappropriate treatment of the organic fraction of municipal solid waste (OMSW). Composting and anaerobic digestion (AD) are seen as the most favored options to deal with OMSW. Both treatment options reduce the environmental burden and enable the generation of a nutrient rich Fertilizer.

Anaerobic digestion of OMSW is commonly and successfully used in industrial countries. Biomethanation of organic solid waste is considered as an issue that has only come up in the recent past. Various low-tech digesters have been developed in order to treat biodegradable solid waste. But information about the status quo in that field is still missing. The study was focused on case studies of currently working biogas plants that produce biogas mainly out of solid waste, such as Kitchen waste, cowdung, distillery sludge etc. Most of the anaerobic digesters implemented did or do not work properly. Many projects in that field failed, not only due to technical reasons, but also as operation and management has been done inadequately. The service provided by municipal institutions and private companies is not keeping pace with the amount of waste generated. Several problems are due to the disposal of organic waste into still commonly used open dumps. The waste, mainly organic waste, dumped in open places causes' heavy environmental pollution to soil, groundwater and surface waters. In order to tackle these problems the disposal of organic material needs to be avoided (as already done in some industrial countries). Aiming at sustainable development the organic waste as a source of nutrients and energy has to be reused. Nowadays, composting and anaerobic digestion (AD) are seen as the most favored options to deal with organic solid waste. Both treatment options reduce the environmental burden and enable the generation of a nutrient rich fertilizer. Furthermore, in the case of AD energy in form of biogas is produced. Nowadays, energy is scarce and their production out of biodegradable waste is willingly seen. Thus, AD is attaining more relevance in SWM sector. In many low- and middle-income countries, AD has been applied using manure or faecal sludge as main feedstock material. Especially in India, China and Nepal millions of biogas plants have been installed, but mainly in rural areas. Bacteria degradation of biological and organic matter in the absence of oxygen known as Anaerobic Digestion generates Biogas. The Anaerobic digestion is an effective proven Technology for handling and treating biological wastes and effluents for generation of district. Heating and electricity supplies, as well as clean environment. Depending on the feedstock, Biogas is principally mixture of methane (CH_4) g, Carbon dioxide (CO_2) g and minute traces of hydrogen sulphide (H_2S) g, hydrogen, nitrogen, ammonia (NH_3) g and sulfur dioxide (SO_2) g. Methane is the only constituent of Biogas with significant fuel value. The inert diluents of Carbon dioxide (CO_2) g and nitrogen lowers the calorific content of the gas, while hydrogensulphide (H_2S) g, corrosive nature wears down the anaerobic digester and pipes involved in the gas distribution. This report summarizes the case studies found. It gives an overview about existing biogas projects in the field of SWM in low- and middle-income countries. The aim of the project was to set up a biogas plant to achieve the maximum possible Conversion of organic components of communal sewage into biogas for use as a substitute for primary energy.

MATERIALS AND METHODS

COLLECTION OF SAMPLES

The distillery sludge for this study was collected from Trichy distillery & chemicals located in senthanni, Trichy, Tamilnadu (India). A bulk sample of fresh secondary treatment sludge was taken from hopper of distillery industry. After collection the sludge was thoroughly mixed and stored in plastic lined container at room temperature before use.

The slurry for this study was collected from biogas plant, Periyar Maniammai University, Vallam located in Thanjavur, Tamilnadu (India). The sample was taken from the hopper of gas plant. The collection of samples was stored in container at room temperature before use.

The kitchen wastes were collected from my house, Natarajapuram colony located in Thanjavur, Tamilnadu (India). The collection of samples was stored in container at room temperature before use.

Equipment and Apparatus

PH meter, Kjeldahl apparatus, hot air oven, muffle furnace, weighing balance, crucible dish.

Chemicals

Conc. sulphuric acid, orthophosphoric acid, ferrous ammonium sulphates.

PHYSICAL PARAMETERS

DETERMINATION OF PH

The PH is defined as the negative logarithm of hydrogen ion concentration. Make 100gm of sample into a suspension in 100ml-distilled water and shake on rotatary shaker for 10 minutes. Filter through what Mann filter paper under vacuum using a bunchneer funnel. Determine pH of the filtrate by pH meter.

DETERMINATION OF TEMPERATUER

About 1gm of sample is accurately weighed and placed in LOD dish. The moisture content was determined by heating a sample at 105 degree in an oven at a constant weight.

DETERMINATION OF TOTAL SOLIDS

A weighed sample is evaporated in a weighed dish and dried to a constant weight in a convection oven for overnight at a temperature of 105°C, the weighed samples are placed in the during the above specified time and dried until constant mass is obtainable.

DETERMINATION OF VOLATILE SOLIDS

After determining the final weight in total solids analysis, the respective cooled oven dried samples and crucible were placed in a muffle furnace and ignited at 550°C at a ±25°C for exactly 1hr. Following the ignition duration for complete combustion process to take place, the oven ignition switch is switched off and allowed to cool down for 10 minutes. The cooled muffle furnace-dried samples were then placed and kept in desiccators for an hour. Immediately after samples were allowed to desiccate, samples were weighed together with the crucible in the sensitive analytical measuring balance.

CHEMICAL PARAMETERS

DETERMINATION OF ORGANIC CARBON

Take a weighed sample in 500ml conical flask. Add 50ml of 1(N) potassium chromate in the burette and swirl a little. Then add 50ml of conc.sulphuric acid and swirl again 2-3 minutes. Allow standing for 30min in a dark place and there after add 200ml water. Then the volume was made up to 500ml in a volumetric flask out of this 50ml liquor was taken in another 50ml conical flask. Add 15ml of orthophosphoric acid and 1ml of diphenylamine indicator. Titrate with 0.5 ferrous ammonium sulphates till the color changes occur.

DETRMINATION OF ORGANIC NITROGEN

Calculate the total organic nitrogen using kjeldhal method

DETERMINATION OF C: N RATIO

Calculate the C: N ratio by dividing the organic carbon value with the total nitrogen value.

EXPERIMENTAL SET UP

The experiments were conducted in 500ml serum bottles. One serum bottle was used as digestion bottle and another as gas collection bottle. The mouth of the digestion bottle was closed by rubber cork with proper ceiling to ensure anaerobic condition; the collection bottle was hung in inverted position. The headspace of the reactor bottle was initially purged nitrogen gas to maintain strict anaerobic condition. The reactors were fed with different combination of the feedstock. The experiments were conducted at ambient temperature condition (28°c ± 5°c).

ANALYSES

Volume of biogas produced in all reactors was measured daily by using displacement method (R. S. Khoiyangbam et al., 2004). The concentrations of gases were analyzed by using orset method.

RESULTS

TABLE 1: Characteristics of substrates before digestion.

Contents	Kitchen waste	Distillery sludge	Cowdung
PH	5.6	7.4	5.68
Total solids %(dry wt.)	17.64	14.2	15.5
Volatile solids %(dry wt.)	53.91	37.76	42.5
Temperature (%)	74.3	68.8	83.4
Organic carbon %(dry wt.)	43.4	38.7	55.1
Organic nitrogen %(dry wt.)	2.24	1.45	2.17

TABLE: 2: CHARACTERSTICS OF WASTES AFTER DIGESTION.

Content	Sludge with Kitchen waste (I)	Sludge with kitchen waste with cowdung (II)	Sludge with kitchen waste with cowdung(III)	Sludge with Kitchen waste(IV)
PH	6.8	5.3	5.0	6.3
Total solids %(dry wt.)	6.69	14.69	13.89	11.84
Volatile solids %(dry wt.)	37.9	69.8	61.5	42.1
Temperature (%)	80.68	86.24	82.1	76.62
Organic carbon %(dry wt.)	41.05	45.73	45.69	40.78
Organic nitrogen %(dry wt.)	3.69	2.93	2.89	3.61

TABLE 3: SLUDGE WITH WASTE (I).

Days	Gas evaluation
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	150
10	60
11	75
12	0
13	0

14	0
15	950
16	150
17	30
18	0
19	0
20	0
21	22
22	0
23	0
24	0
25	600
26	0
27	0
28	0
29	50
30	100
31	0
32	0
33	150
34	0
35	220
36	0
37	0
38	0
39	100
40	50

TABLE 4: SLUDGE WITH KITCHEN WASTE WITH COW DUNG (II).

DAYS	Gas evaluation
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	600
13	600
14	250
15	0
16	0
17	60
18	0

19	0
20	0
21	650
22	0
23	0
24	0
25	0
26	25
27	0
28	0
29	0
30	0
31	175
32	0
33	0
34	0
35	0
36	250
37	0
38	0
39	100
40	300

TABLE 5: SLUDGE WITH KITCHEN WASTE WITH COW DUNG (III).

DAYS	Gas evaluation
1	0
2	0
3	0
4	0
5	25
6	90
7	500
8	0
9	0
10	60
11	0
12	0
13	400
14	1200
15	1355
16	650
17	0
18	0
19	50
20	885
21	650
22	665
23	0

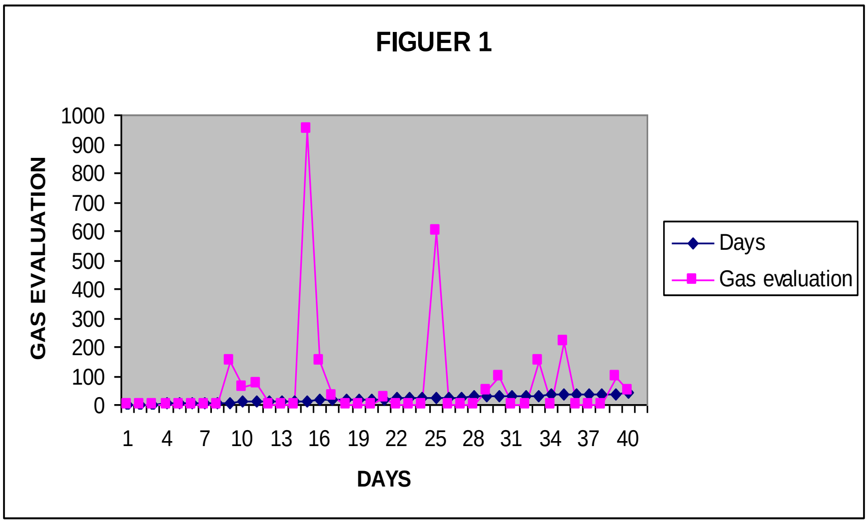
24	0
25	0
26	0
27	0
28	0
29	0
30	0
31	25
32	0
33	680
34	300
35	0
36	0
37	250
38	0
39	0
40	250

TABLE 6: SLUDGE WITH WASTE (IV).

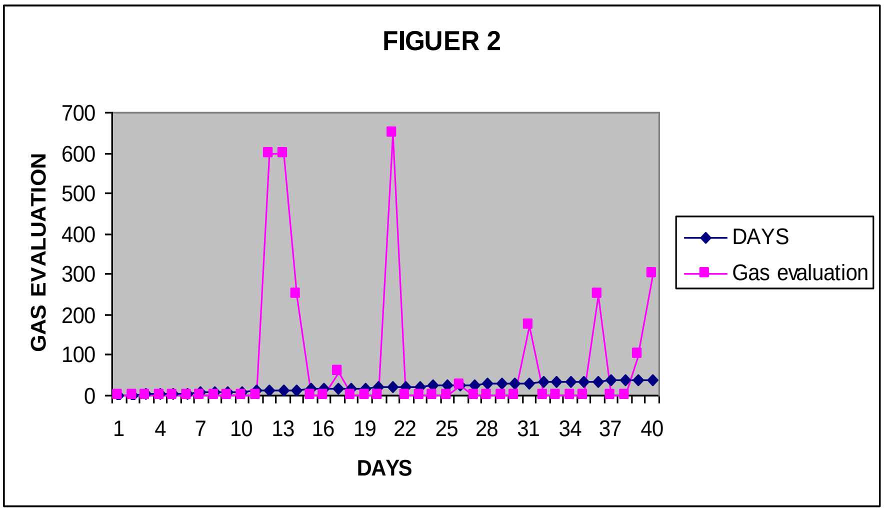
DAYS	Gas evaluation
1	0
2	100
3	160
4	0
5	0
6	0
7	0
8	0
9	0
10	1300
11	250
12	360
13	0
14	0
15	835
16	200
17	0
18	600
19	0
20	650
21	0
22	0
23	0
24	0
25	0
26	750
27	0
28	0

29	250
30	0
31	0
32	0
33	565
34	0
35	0
36	250
37	0
38	0
39	0
40	175

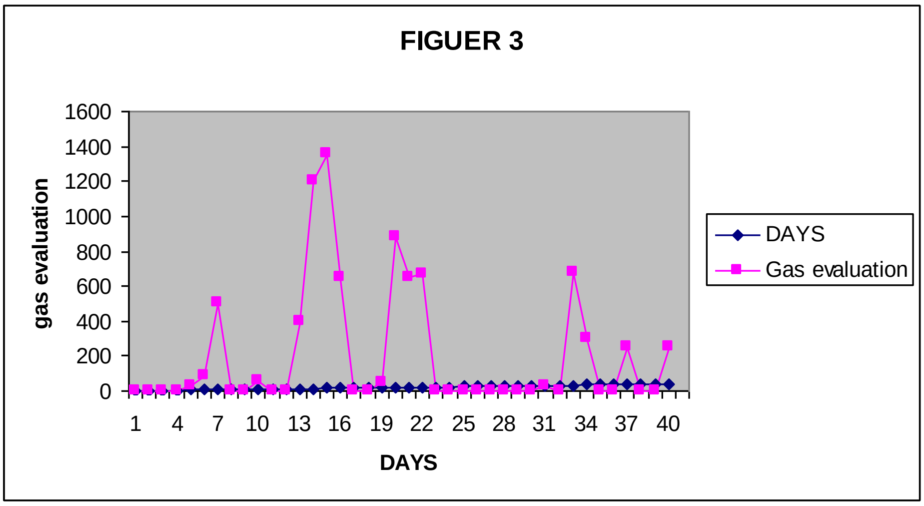
Sludge with kitchen waste



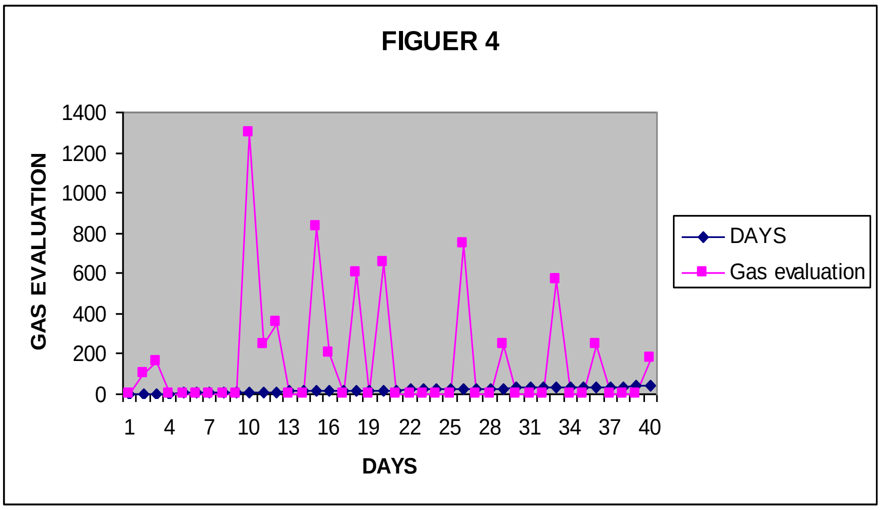
Sludge with kitchen waste with cow dung



Sludge with kitchen waste with cow dung



Sludge with kitchen waste



DISCUSSION

The initial pH of the wastes was 5.6 (Table 1) during digestion process there was increase in the value of pH about 6.8 (table 2) was observed at the initial stages and this is possibly due to Conversely, prolific methanogenesis may result in a higher concentration of ammonia, increasing the pH above 6.8 which will impede acidogenesis. A high pH will encourage the production of acidic co2 to neutralize the mixture again.(V. Lingaiah and P. Rajasekaran, 1986). Temperature is the most critical process parameter. During the experiment temperature was not completely steady. it varied from 32-35c while throughout the experiment the average temperature in the bioreactor was around 32c (i.e.) mesophilic medium was maintained. Mesophilic bacteria tolerate greater changes in their environment, including temperature. The stability of the mesophilic process makes it more popular in current AD facilities. The initial value of Ts, Vs, TN, TOC of the wastes for before digestion were shown in (table 1). the results of Ts, Vs, TN, TOC showed little variation between different wastes(S.P. Singh and Pandey Prerna., 2009). The chemical composition of wastes after digestion was observed in that (table 2). These results indicated that the processes of biogas generation from a mixture Ts decreases, the reduction in TS during digestion is approximately equal to the total amount of VFA converted from the Volatile solids**.** The reduction in the percentage of total carbon with decreases in digestion process which may be due to first phase of anaerobic digestion process called hydrolysis, it coverts complex molecules into constitute monomers. The total nitrogen increases with time due to the conversion of nitrogen into simple amino acids, which utilized by the microorganisms as their nutrients for the biological activity. The amount of biogas production from anaerobic degradation of wastes is recorded in table (I). From 1-40 days of production of gas was recorded in four of the digesters, though in digesters II and III (table 4 and table 5) fermentation was shown to have resulted to gas production but at minimal level when compared to I and IV (table 3 and table 6). Fourth Digester recorded the highest volume of gas produced. This result indicates the mixture of sludge with kitchen waste gives high yield of methane production when compared to that of mixture sludge with kitchen waste with cow dung.

CONCLUSION

The substrate showed significant reduction in the characterizing parameters of wastes during the digestion process. Stabilized wastes can be utilized as compost for plant growth. Conversion of wastes to biogas through anaerobic digestion process can provide added value to manure as energy resource and reduce environmental problems associated with wastes. In future study has to be proposed for the complete nutrients of study after vermicomposting.

Distillation Unit

The slurry for this study was collected from biogas plant.

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