PERFORMANCE EVALUATION OF PORTABLE HIGH DENSITY POLYETHYLENE DIGESTER

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ABSTRACT
At present, environmental friendly energy is being encouraged to reduce the effect of the green house gases, ozone layer depletion and other environmental hazards? This work focused on the use of blended pig and cow dung to generate biogas. The digester used is High Density Polyethylene container with metal top to maintain mesophillic temperature during anaerobic degradation. The ambient temperature, digester temperature and volume of gas produced were recorded and the graph plotted. Sample was taken at interval of two days and PH was determined using PH meter.
Keywords: Biogas, Anaerobic Digestion, Temperature, Total solid, High Density Polyethylene.

I. INTRODUCTION.

Biogas has been explored as an alternative to petrol and diesel to lighten the import burden[1] .Natural gas in compressed form is already being used successfully as vehicle fuel in many European countries like Argentina,
Pakistan, India etc. [2]. New Delhi, the capital of India has the world's largest fleet of public buses run on compressed natural gas (CNG)[3].Natural gas has 75-98 % methane with small percentages of ethane, butane, propane while biogas has about 60 % methane and 40 % carbon dioxide[4].

Anaerobic digesters have been in use around the world to break down organic matter into useable energy sources [5]. On the farm, the process for anaerobic digestion is relatively simple. The raw material (i.e. raw dairy cow manure) enters an enclosed, impermeable and often insulated container called a digester in the absence of oxygen [6]. Depending on the characteristics of the raw material, the size of the digester and a number of external factors such as ambient temperature, the manure must remain in the digester for a minimum holding period to allow for sufficient breakdown of the organic material [7]. In many digesters, including the common plug-flow, an equal amount of "treated" manure or effluent exits the container as raw manure is introduced to the system [8]. The digester will function most effectively with the use of organic matter free of sand and other inorganic particulates and while maintaining a constant temperature and pH [9]. Temperatures around 95°F are generally considered optimal for gas production for mesophillic digestion. This means that in colder climates, anaerobic digesters must be heated to accommodate this desired temperature. In recent years anaerobic technology has been well established and satisfied performance in organic waste stabilization [10].

Types of biogas digesters

General digester types can be divided into two main groups; those utilizing dispersed growth bacteria and those utilizing attached growth bacteria. Because most digesters are operated as flow-through without sludge recycling, the dispersed bacteria overflow into the digesters slurry discharge, making HRT equally to mean cell retention time in the digester. To provide longer cell retention time in the digester, attached growth digester has been employed. In this case the anaerobic bacteria attracted to artificial media or settled as a blanket in the digester, to decompose the organic waste.

1. **Dispersed growth digester**.

(a) Combined digester and fixed gas holder fixed dome.

In this type of digester the gas storage volume is directly above the content of the reactor with the volume of slurry and gas combined. The roofs are constructed either of brick in site or pre-cast concrete. The inlet and displaced tanks are made of lime clay. The top and the bottom are hemispheric and are joined together by straight sides. The digester is completely buried underground to ensure even temperature distribution, to save space and to make sure of sort support.

(b) Floating Gas Holder Digester.

The digester consists of cylindrical well, most commonly made from bricks, though chicken wire meshes re-enforced concrete has been used. Pressure in the digester remains constant, because the gas produced is tapped under a floating cover on the surface of the digester which rises and falls on external guides. The cover is usually constructed with mild steel although owing to corrosion problems; other kinds of plastic and fiber glass have been used.

(c) Plug flow digesters

There are two main types of plug flow; those mounted vertically and those which are horizontally on the ground.

The horizontal type consist of a long French cut into the ground and are lined either with concrete or impermeable membrane. The digester is covered either with fixed cover anchored to the ground

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which acts as a gas holder or with a concrete or galvanized iron top. The main difficulty in plug type is that plug type digester should ensure true plug flow condition and to achieve this, the length has to be considerably greater than the width.

II. MATERIALS AND METHODS.

2.1 Collection of Feedstock.

The feedstock that was used was sourced from livestock farm in Nsukka town, Nsukka local government Area, Enugu State. The feedstock is a blended pig and cow dung. The inoculums used in the experiment composed of sewage manure and was collected from sewage tank at university of Nigeria, Nsukka.

2.2 Reactor Experiment.

The reactor was made of cylindrical high density polyethylene drum with a metal top to maintain a mesophillic temperature of 30°C-45°C. The temperature gives the highest yield of methane gas. The reactor was charged with a blended pig and cow dung mixed with water and inoculums at a ratio of 2:1:1. The reactor was monitored daily, reactor temperature; ambient temperature and biogas yield were recorded. The PH was also measured at interval of two days.

2.3 Statistical Analysis.

ANOVA test was performed with software SPSS 16.0 to see the statistical significant differences between the pre-treatment with difference substrates. The statistical significance level was selected at p-value<0.05.

III. Results and Discussions.

The minimum ambient temperature recorded at 6am was 26°C and maximum temperature recorded at 3pm was 42°C. The temperature of the digester increased from 24°C to 51°C. Biogas yield increased gradually, reached maximum value in day 11 and drop to 1 litre in day 14. This was as a result of gradual decay of the organic manure by anaerobic bacteria. The decay was due to lignocelluloses breakdown [12] as observed by Ugwuoke (2015).

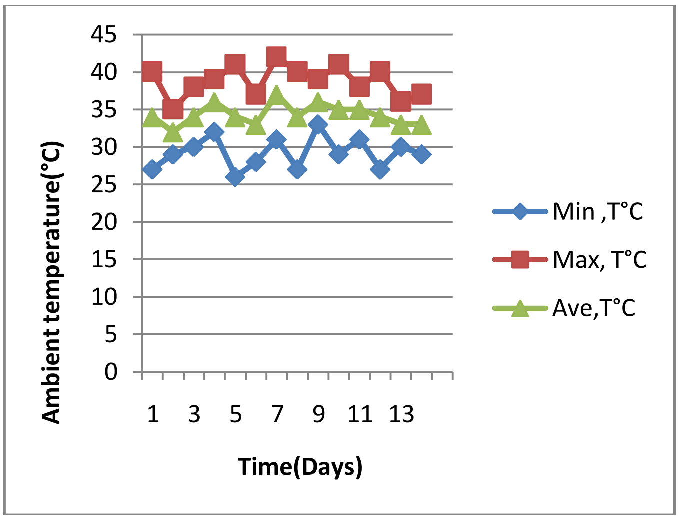

Figure 1: A Graph of Ambient temperature versus time (days)

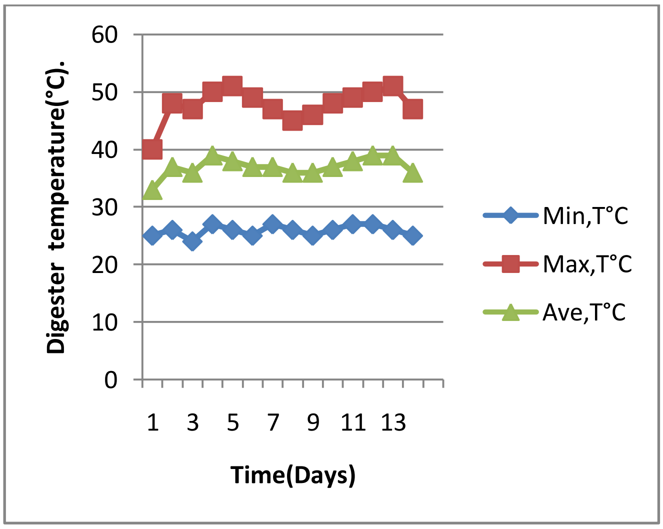

Figure 2: A graph of digester temperature versus time (days)

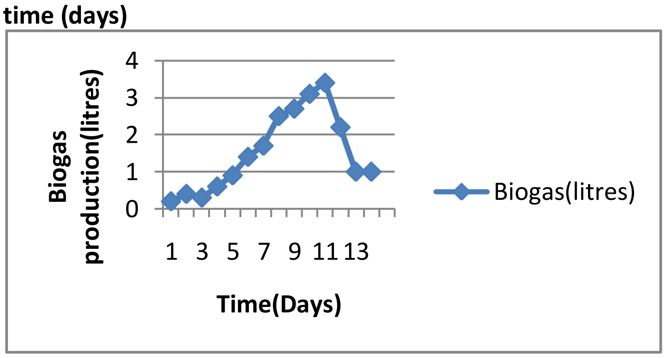

Figure 3: A graph of Biogas yield versus Time (days

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Table 1: Min, Max ambient Temp. Measured at 6am and 3pm.

T(days)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Min,T°C	27	29	30	32	26	28	31	27	33	29	31	27	30	29
Max,T°C	40	35	38	39	41	37	42	40	39	41	38	40	36	37
Ave,T°C	34	32	34	36	34	33	37	34	36	35	35	34	33	33

Table 2: Min and Max digester Temp measured at 6am and 3pm.

T(days)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Min,T°C	25	26	24	27	26	25	27	26	25	26	27	27	26	25
Max,T°C	40	48	47	50	51	49	47	45	46	48	49	50	51	47
Ave,T°C	33	37	36	39	38	37	37	36	36	37	38	39	39	36

Table 2: Biogas yield

T(days)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Biogas(lit)	0.2	0.4	0.3	0.6	0.9	1.4	1.7	2.5	2.7	3.1	3.4	2.2	1	1

IV. CONCLUSION

The result showed that anaerobic digestion of waste yields biogas. This was as a result of breaking down of intracellular and extracellular molecules during anaerobic degradation Eskicioglu et al [12]. Using High Density Polyethylene weight reduction was able to achieve and mesophillic temperature of 35°C-45°C was also maintain by using metal top.

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