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EFFECTS OF LOCAL AND INDUSTRIAL ADSORBENTS ON BIOGAS GENERATION FROM COW DUNG.

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Abstract

The effect of local and industrial adsorbents on biogas production from cow dung was investigated. The result revealed that a total weekly mean volume of 5,055cm^3 5,782cm^3, 5,652.5cm^3 and 3,972.5cm^3 of biogas were produced by the mixtures of cow dung and local charcoal, cow dung and activated charcoal, cow dung and kaolin, cow dung and pectin respectively as compared to the control that gave a total weekly mean volume of 3,827.5cm^3 of biogas. While total weekly mean methane production of 4,737cm^3, 4,665cm^3, 4,389cm^3, 3,665.5cm^3 by volume were obtained from cow dung and kaolin mixture, cow dung and activated charcoal, local charcoal and cow dung, pectin and cow dung mixture respectively in comparison to 3,597.5cm3 total weekly mean volume of methane production by cow dung only (control) other physiochemical parameter of cow dung were determined and they include moisture, ash, total solid, volatile solid, organic Carbon Nitrogen and crude protein content. Overall result for the 10 weeks retention period indicated that biogas yield can be enhanced by local and industrial adsorbent and analysis of the remnant indicated that it could be used as a substrate for plant growth.

Key Words: Renewable energy, Adsorbents, Cow dung, Effects.

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Introduction.

Biogas technology is the use of biological process in the absence of oxygen for the breakdown of organic matter into biogas and high quality fertilizer[1]. Biogas is a mixture of colourless flammable gasses obtained through the anaerobic digestion of plant based organic waste materials acted upon by methanogenic bacteria in an anaerobic condition. However, the production of this gas involves a complex biochemical reaction that takes place under the presence of highly heat sensitive microbiological catalyst that is mainly bacteria.[2] The major products of this reaction were methane (CH_4) 50 – 70% and Carbon dioxide (CO_2) 30 to 40% and low amount of other Gases, Hashimoto et al., (1980)[3] Adsorbents are substances usually porous in nature and with a high surface area that can absorb substances onto its surface by intermolecular forces, Vanderwiet et at (1999).

Biogas production will go a long way to ameliorate the menace and nuisance constituted by urban wastes in many cities in Nigeria. Biogas as a renewable energy source could be a relative means of solving the problems of rising energy prices and creating sustainable development. It is one of the cheapest forms of energy and hence will serve as a way of creating wealth.

Objectives.

The objective of the study is to investigate the effects of some local and industrial absorbents on biogas generation from cow dung.

Principles.

The various reactions and interaction that take place among the methanogens, non-methanogenes on substrate fed into the digester as inputs are:-

Digestion = Hydrolysis → Acidification → Methanization

$(C_6H_{10}O_5)n + H_2O \rightarrow n(C_6H_{12}O_6)$ $n(C_6H_{10}O_6) \rightarrow nCH_3COOH)$ $CH_3COOH)$ $CH_3COOH \rightarrow CH_4 + CO_2$

Source: (FAO/CMS, 1996)

Methodology.

The samples used for this research work were cow dung, pectin, local charcoal, kaolin, activated charcoal. The local charcoal was treated and 250g of partially dried cow dung was weighed using weighing balance and mix with 1000ml of water to give a ratio of 1:4 (cow dung to water) I each of the digester; 10g each of both the local and industrial adsorbents were weighed separately into sixteen (16) numbers of the digesters used for the experiment. Each setup was in duplicate. A control experiment was also setup using the remaining four (4) digesters. The slurry were properly stirred to dissolve and to obtain a homogenous mixture. While the pH of all the slurries were taken to be between 6.39 – 7.41 in the digesters used. After charging each of the digesters with the prepared slurry and the 50cl plastic bottle with 300cm of 10% NaOH, they were sealed with candle wax to ensure airtight. The 1000ml measuring cylinders were filled with water and inverted into the trough containing water. The rubber tube from the digesters and the 50cl plastic bottles were carefully inserted into each of their own measuring cylinder, ensuring no formation of air bubbles and it was then clamped to a retort stand to provide support to it. The biogas generated was measured by downward displacement of water. The volume of water displaced was measured daily and the cylinder was also refilled as the volume of water is displaced.

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Results.

Table 1: Weekly Mean Production Volume (Cm3) Of Biogas Obtained From The Misture Of Cow Dung Wih Local And Industrial Adsorbents.

Retention Time (Weeks)	Cow DUNG Mixed with Local Charcoal	Cow Dung Mixed with Activated Charcoal	Cow Dung Mixed with Pectin	Cow Dung Mixed with Kaolin	Cow Dung only (control)
1	445	465	260	555	485
2	765	665	585	817.5	602.5
3	885	1,025	642.5	842.5	620
4	622.5	632	487.5	565	327.5
5	602.5	625	400	690	415
6	490	585	385	510	572.5
7	495	775	540	605	365
8	530	547.5	530	562.5	152.5
9	170	310	140	330	287.5
10	50	150	102.5	175	-
Total	5,055	5,782.5	3,972.5	5,652.5	3,827.5

Table 2: Weekly Mean Production Volume (Cm3) Of Methane Obtained From The Mixture Of Cow Dung With Local And Industrial Adsorbets

Retention Time (Weeks)	Cow DUNG Mixed with Local Charcoal	Cow Dung Mixed with Activated Charcoal	Cow Dung Mixed with Pectin	Cow Dung Mixed with Kaolin	Cow Dung only (control)
1	680	592.5	497.5	597.5	140
2	425	450	272.5	490	422.5
3	695	609	375	705	565
4	295	475	177.5	450	187.5
5	515	433	505	445	337
6	655	577.5	727.5	605	462.5
7	495	618	527.5	620	543
8	362	510	390	475	435
9	230	320	120	275	397.5
10	37.5	80	70	75	87.5
Total	4,389.5	4,665	3,662.5	4,737.5	3,577.5

Table 3: Proximate Compositions Of Partially Dried Cow Dung Before And After Digestion (%).

COMPONENTS	ANALYSIS BEFORE			AFTER DIGESTION		
	DIGESTION	Cow Dung Activated Charcoal Mixture	Cow Dung Local Charcoal Mixture	Cow Dung Kaolin Mixture	Cow Dung Pectin Mixture	Control
Moisture	37.0	70.0	71.9	72.3	71.0	70.0
Ash	31.4	20.3	11.6	15.7	11.1	10.7
Total Solid	63.0	30.0	28.2	29.0	27.7	30.1
Volatile Solid	68.6	20,3	11.6	15.7	11.1	10.7
Organic Carbon	18.3	5.6	9.6	11.9	9.6	11.2
Nitrogen	1.0	0.5	0.4	0.7	0.8	0.2
Crude Protein	6.3	3.3	2.4	4.1	4.8	1.0

DISCUSSION:

Biogas production started on the 1st week. This indicated a good period of adaptation and agrees with Uzodinma and Ofoefule (2009), that biogas production commenced within 24 to 72 hours of charging digesters with slurry. [4], [5] The result of the experiment carried out for the 10 weeks indicated that mixture of local and industrial adsorbents with cow dung enhanced the total biogas yield compared to the control. The peak period of biogas production were noticed on the 3rd week in all the digesters with adsorbents and cow dung respectively. Biogas productions in all the digesters were inconsistent and vary daily. This may be due to change in daily ambient temperature and other environmental factors. This agrees with [2] that satisfactory gas production takes place in the mesophilic range, between 25^{0}C to 30^{0}C and virtually stops at 10^{0}C.

Table1 shows that high volume of biogas production was obtained on the 3rd week and lowest volume on the 10th week. This may be attributed to microbial activity under different operational conditions as reported by Santosh et al (2003). Table 2 shows the weekly mean volume of methane production from the mixture of Cow dung and local and industrial adsorbents. From the table, weekly mean methane productions were fluctuating and vary between the 1st to the 10th week. The result shows that adsorbent improves biogas production with high methane content than the control. This result agrees with the findings of Santosh et al. (2003) that certain adsorbents improve gas production.

Table 3 shows the proximate composition of Cow dung before and after digestion. From the table, there was marked difference in the composition of moisture, ash content, total solid, volatile solid, organic carbon, nitrogen and crude protein before and after digestion.[6] The moisture content of the slurry increased after digestion between 70% - 72.3% than 37% obtained before digestion of the Cow dung because water vapour is a product of digestion process and this resulted to high gas yield. This is related to the findings of Abdulkareem (2009) that water vapour is the product of biodegradation.

Conclusion.

Biogas production started on the 1st week of the study. The result of the experiment carried out for the 10 weeks indicated that mixture of local and industrial adsorbents with cow dung enhanced the total biogas yield compared to the control. The peak period of biogas production were noticed on the 3rd week in all the digesters with adsorbents and cow dung respectively.

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