



EFFECT OF NICKEL CHLORIDE ON THE PRODUCTION OF BIOGAS FROM COW DUNG

Eric O. Osazuwa*

Department of Chemistry, Faculty of Physical Science, University of Benin, Benin City, Nigeria.

*Corresponding Author: Eric O. Osazuwa

Department of Chemistry, Faculty of Physical Science, University of Benin, Benin City, Nigeria.

Article Received on 14/12/2021

Article Revised on 03/01/2021

Article Accepted on 24/01/2022

ABSTRACT

Background: The need for alternative energy source from biomass cannot be overstressed especially with the attendant consequence of pollution and evolving diseases from fossil fuel and petro chemicals.. The effect of NiCl_2 (as a catalyst) on a biogas production from cow dung was investigated. **Methods:** 50 Litres of cow dung was mixed at a ratio of 10 L of distilled water and mixed till it was homogeneous (pot 1 experiment). This served as control. It was transferred to a 100L anaerobic digester locally constructed using a 100L tightly closed lid container, connections and rubber tube. The second mixture (pot 2 experiment) of 50 Litres cow dung was mixed and nickel chloride was prepared and added to the homogenous mixture at a ratio of 10L of cow dung to 1L of distilled water. The gas production was monitored over the course of ten (10) days and the Physiochemical properties of the Slurry of both the digester without NiCl_2 (control) and with NiCl_2 was determined before and after 10 days. The volatile organic matter and the Nitrogen content were analyzed **Results:** The decomposition of total solid and volatile organic solid were observed with the pot 2 experiment (34.4%) as compared to pot 1 (1.2%). There was also a reduction in the volatile organic matter and the Nitrogen in the digester without Nickel catalyst but was far higher in the catalyst spiked digester. **Conclusion:** The study confirmed the importance of catalyst (NiCl_2) in biogas production.

KEYWORDS: Biogas, cow dung, digester, NiCl_2 , Catalyst, Nitrogen, Organic matter.

1.0 INTRODUCTION

In today's energy demanding life style, need for exploring and exploiting new sources of energy which are renewable as well as eco-friendly is a must. In rural areas of developing countries, various cellulosic biomass (cattle dung and agricultural residues) are readily available which have a very good potential to cater for the energy demand, especially in the domestic sector. Biogas originates from the breakdown of organic matter in the absence of air (anaerobic condition). The demand, high cost and health implications of using energy derived from hydrocarbon has necessitated the continuous search for alternative source of energy (Alazraque-Cherni, 2008). In India alone, there are an estimated over 250 million cattle and if one third of the dung produced annually from these is available for production of biogas, more than 12 million biogas plants can be installed (Alazraque-Cherni, 2008). The conventional energy source such as petroleum is nonrenewable and have a negative environmental effect due to the release of greenhouse gases and fluctuating price. There is need to explore other energy source that is renewable and sustainable (Kashyap *et al.*, 2012). Biogas simply refers to a gas produced by the biological breakdown/disintegration of organic matter in the

absence of oxygen (Sawyer *et al.*, 2012). This is a renewable source of energy from organic waste such as dead plant and animal material, animal dung and kitchen waste can be converted into a gaseous fuel known as the 'Biogas' (Mohamed and Hanaa, 2020). Biogas technology offers a very attractive route to utilize certain categories of biomass for meeting partial energy needs. In fact proper functioning of biogas system can provide multiple benefits to the users and the community because it is a cheap source of energy and eco-friendly. Biogas is a gaseous fuel containing 60% methane, 40% carbon dioxide and small amount of hydrogen sulphide, nitrogen and hydrogen (Abubakar, 1990). It is obtained from biomass-plant and animal materials, by the process of anaerobic digestion or fermentation. Biogas can be used for cooking, heating, generating electricity and running a vehicle (Chandra *et al.*, 2012). Biogas is produced by the microbial degradation of organic waste in the absence of oxygen. The gas is made possible by anaerobic microorganism (Soccol *et al.*, 2011). The main factors affecting biogas production include: Hydraulic retention time, nutrients, pH of feedstock, temperature, retention time, oxygen, free ammonia (Raninger 2011).

Cow dung generation over time has been identified as the largest source of methane emission. Cow dung from slaughterhouses, farms and homes has very great potential for the generation of biogas which can serve as alternative source of energy (Angelidaki *et al.*, 2018 and Budaraga *et al.*, 2016). Cow dung is an excellent substrate for biogas production in anaerobic digesters (Ojolo *et al.*, 2008). A major significant of bio-digestion of cow dung is that it provides a viable solution to the problem of waste pollution, disposal, control and management. Biogas holds the greatest promise as a cheap household energy source because it is renewable, simple to generate, convenient to use, and cheap. However, its potential generation from cow dung is still underexploited in Nigeria.

2.0 MATERIALS AND METHODS

The material selection for this research work was done considering the feed material, type of gas to be produced, convenience and availability; (i) two plastic tank, 100L each, to serve as digester (ii) Graduated cylinder (1000 mL) to measure volume of biogas produce. (iii) Connections (plastic hollow bolts and nuts, rubber seals, washers and hose clips) (iv) Rubber tube (4.2 m × 0.8 cm diameter hose) (v) Nickel Chloride.

The method adopted in this study is similar to the method of Ahamed *et al.*, 2016). 5kg of cow dung was mixed at a ratio of 1 kg:1L of distilled water and mixed till it was homogeneous. This served as control. It was transferred to a 100L anaerobic digester locally constructed using a 100L tightly closed lid container, connections and rubber tube. The second mixture of 5kg cow dung was mixed and nickel chloride was prepared

and added to the homogenous mixture at a ratio of 1kg of cow dung to 1L of distilled water. The gas production was monitored over the course of ten (10) days and the Physiochemical properties of the Slurry of both the digester without NiCl_2 (control) and with NiCl_2 were determined before and after 10 days according to standard methods.

3.0 RESULTS AND DISCUSSION

Table 1 shows that the highest decomposition of total solid and volatile organic solid waste observed when the slurry was treated with 1 mg/L of NiCl_2 which was found to be 1.2% and 34.4% respectively. This result is in agreement with the report by Irvan (2012) who reported that the degradation rate of total solid and volatile solid increase with the addition of trace metals such as Iron (Fe). From Fig 1, the anaerobic digester with NiCl_2 had more biogas produced than the anaerobic digester without NiCl_2 .

Table 1: Volume of biogas produced with catalyst and without catalyst.

Days	Control (ml)	NiCl_2 (ml)
1	-	20
2	-	22
3	-	27
4	-	45
5	10	47
6	40	80
7	60	100
8	65	120
9	80	250
10	100	400

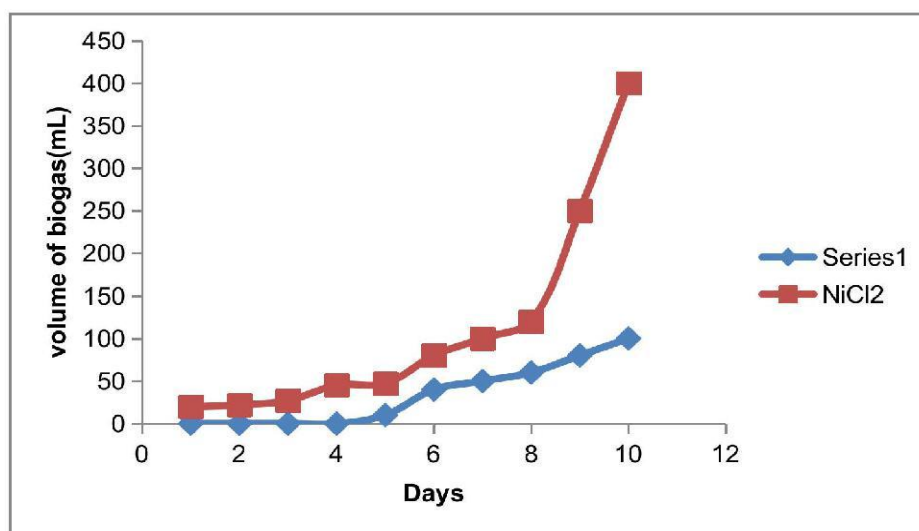


Figure 1: graphical representation of volume of biogas produced.

Physicochemical properties of fresh manure and manure after digestion (Table 2) were also monitored. It was observed that the addition of catalyst facilitated the degradation of the organic carbon and total nitrogen present in the digester. The anaerobic digestion without

the catalyst could only partially decompose the organic fraction and this is in agreement with Arnaiz *et al.*, 2006) claim of Volatile solid reduction being frequently used as a parameter to characterize the performance of anaerobic sludge digestion.

Table 2: Physicochemical properties of fresh manure and manure after digestion.

Parameter (%)	Fresh manure	Slurry nickel Without	NiCl ₂ spiked slurry
		Manure after digestion	
Total solids	14.8	7.16	1.24
Volatile Organic Solids	82.24	81.28	34.44
Organic carbon	47.7	47.15	20.43
Total nitrogen	19.148	12.716	5.321
C:N ratio	26.1	24.1	14.1
Ash	2.51	1.34	0.5

CONCLUSION

Biogas is a renewable form of energy which is readily available and if adequately harness will create a clean form of energy that reduces the production of green house gases, and eliminate waste from the environment. Biogas produced from cow dung with the addition of trace metal salts such as Nickel chloride improves the startup of anaerobic digestion. The trace metals additive can increase the degradation of organic matter and increases the yield of biogas production.

REFERENCES

1. Abubakar, MM (1990). Biogas generation from animal wastes. *Nigerian J Renewable*, 5: 69-79.
2. Ahamed, JU Raiyam, MF, Hossain, S and Rahman, M (2016). Production of biogas from anaerobic digestion of poultry droppings and domestic waste using catalytic effect of silica gel. *International Journal of automotive and mechanical engineering*, 13(2): 3503-3517.
3. Angelidaki, I Treu, L Tsapekos, P Luo, G Campanaro, S Wenzel, H and Kougias, PG (2018). Biogas upgrading and utilization: current status and perspective. *Biotechnology advances Journal*, 36(2).
4. Alazraque-Cherni, J (2008). Renewable Energy for Rural Sustainability in Developing Countries. *Bulletin of Science, Technology and Society*, 28(2): 105-114.
5. Arnaiz, C, Gutierrez, JC and Lebrato, MJ (2006). Biomass stabilization in the anaerobic digestion of wastewater sludges. *Bioresource technology Journal*, 97(10): 1179-118.
6. Budaraga, K Fridarti, A and Usnel, E (2016). Cattle Cow Dung Use As An Alternative Energy Source and Organic Fertilizer for Friendly Environment in Village Kasang Districts Batang Anai.
7. Chandra, R, Takeuchi, H and Hasegawa, T (2012). Renewable and sustainable energy review, 16(3): 14-62.
8. Irvan, M (2012). The effect of Fe concentration in the quality and quantity of biogas produced from fermentation of palm oil mill effluent. *International Journal of science and engineering*, 3(2): 2086-502.
9. Kashyap, DR. Dadhich, KS and Sharma, SK (2003). Biomethanation under psychrophilic conditions: a review. *Bioresour Technol*, 87: 147-153.
10. Mohamed, NK and Hanaa, M (2020). Biogas production. *Research gate Journal*, 2(2): 30410-31680.
11. Ojolo, SJ, Bamgboue, AL, Ogunsina, BS and Oke, SA (2008) Analytical approach for predicting biogas generation in a municipal solid waste anaerobic digester. *Iran J. Environ. Health Sci. Eng*, 5(3): 179.
12. Raninger, B (2011). Biogas to Grid in China: Challenges and opportunities of a new market from Industrial large scale biogas plants in biogas engineering application journal, 2.
13. Padang Pariaman, *International Journal of Scientific & Technology Research*, 5(9): 171-175
14. Sawyerr, N Trois, C Workneh, TS and Okudoh, V. (2012). An overview of Biogas Production: Fundamentals, Applications and Future Research. *International Journal of energy, Economics and Policy*, 9(2): 105-115.
15. Soccol, CR Faraco, V Karp, S Thomazsoccol, LP Woiciechowski, V and Pandey, AA (2011). Lignocellulosic Bioethanol: Current Status and Future Perspective. *Europe. Elsevier*.