ISSN: 2349-6495

Effect of Thermal Pre-treated Poultry Droppings and Pig Dung on Biogas Production

Ugwuoke E.C., Chikelu C.C., Ukwuani S.T., Eze N.N., Udeh, N. E

Projects Development Institute (PRODA), Emene, Enugu, Nigeria

Abstract— *Most work has been done to increase bioavailability of feedstock material to anaerobic bacteria. Those works were concentrated mostly on physical, biological, ultrasound and chemical pre-treatment. The aim of this work was to determine the effect of thermal pre-treatment on biogas production. Poultry droppings and Pig dung were used as feedstock. The two feed-stocks were pre-treated with temperature of 90°C and 105°C. The biogas and methane yield were determined using volume displacement method. It was observed that methane yield increased for the two different temperatures but methane yield was higher at 105°C and the untreated feedstock had lower methane yield.*

Keywords—Pre-treatment, Methane yield, Bioavailability, Temperature, Biogas

I. INTRODUCTION

In recent years anaerobic technology has been well established and satisfied performance in organic waste stabilization [1]. Due to the coupling of pollution reduction and energy production, various types of anaerobic digester have been installed and have been operated worldwide including cassava starch production factory in Thailand [2, 3]. However, in case of large-scale biogas plants, the cost-effective portion is sometimes critique. There have been many factors that have influenced the long-term profitability, mainly low consistency of biogas production. Such improvement of the process efficiency, the advanced development of production technologies, and application of the near zero-waste disposal strategy results in rather a low amount of waste discarded in many industries [4].

Lignocellulosic biomass research constantly tries to identify the best pre-treatment method in order to improve the hydrolysis efficiency [5]. One of the pre-treatment methodologies that could improve the hydrolysis is thermal pre-treatment which might be traditional or non-traditional way [6]. The non-traditional technique is an application of heat by microwave energy that is derived from a microwave oven [7]. The microwave energy of the oven is delivered directly into materials through molecular interaction with the electromagnetic field. The interaction causes physical changes on the structure of the biomass. The structural changes of the lignin rich material may improve its degradation. Therefore, the impact of microwave energy on the digestibility of poultry droppings and pig dung under mesophilic condition were investigated in this study.

In Thailand biogas production has grown rapidly and is considered as a potent source of renewable energy [8]. Not only energy is generated, but also large volumes of wastewater which are used for washing is discharged [9].

II. MATERIALS AND METHODS

2.1 Feedstock Collection

The Poultry droppings were collected from Ugwuoke's poultry farm in Iheakpu- Awka, Igbo Eze South Local Government of Enugu State, Nigeria. While the Pig dung was collected from Eze's farm in Nsude, Udi Local Government Area, in Enugu, State.

2.2 Pre-treatment Process

A thermal pre-treatment experiment was conducted in a lab-scale CEM Microwave Max asphalt oven (15 Amps, 50 Hz for 220-240 V). Pretreatment was performed under atmospheric pressure at 90°C, 105°C and 25°C for 10 mins.

2.3 Methods

The experiments were conducted with six different digesters of capacity 10000ml each. The digesters were run at normal atmospheric pressure and at mesophollic temperature of (37±.5°C). The innoculum composing sewage waste and food waste of (10%) from biogas plant at University of Nigeria, Nsukka were added. The experimental set up was monitored and volume of gas produced in each digester was determined by volume displacement method. The accumulated biogas volume of each digester was plotted in a bar chart of fig1 below.

A gas mixture of CH_4/CO_2 (65%/35%) was used as standard gas mixture [10]. The methane yield was calculated as stated in Estevez *et al*. (2012) based on the European Chemical Industry Ecology and Toxicology Centre (ECETOC) procedure [11] and ISO 11734 standards. The bar chart of methane yield is shown in fig2 below.

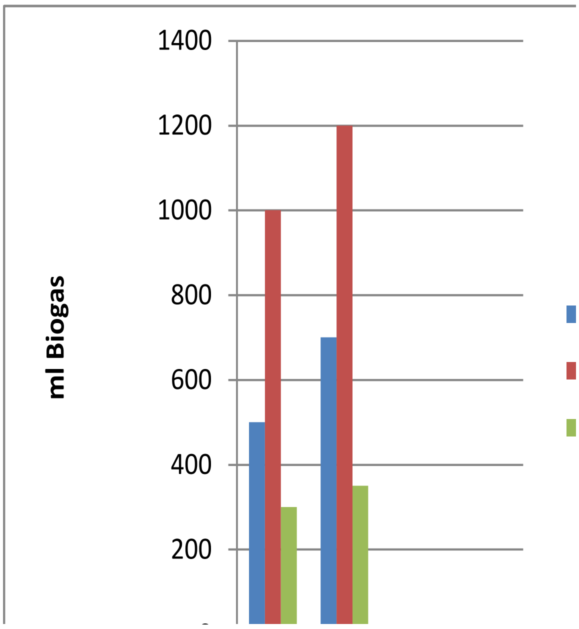

Fig. 1 Cumulative biogas yield of poultry droppings and pig dung at 90°C, 105°C and 25°C. 25°C is a control experiment at standard temperature and pressure.

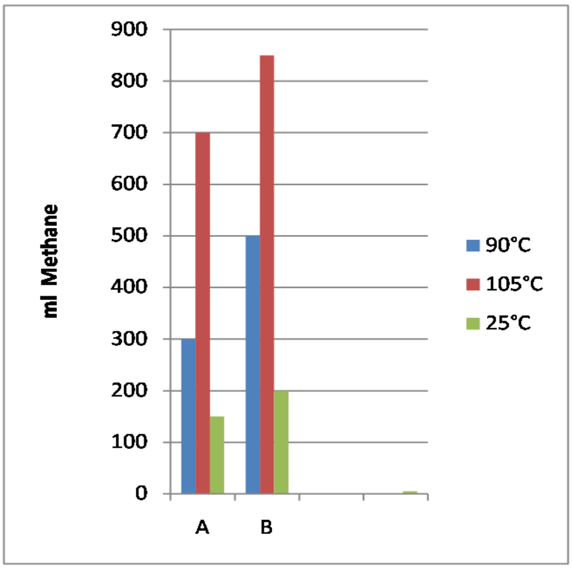

Fig. 2 Methane yield of poultry droppings and pig dung at 90°C, 105°C and 25°C. 25°C is a control experiment at standard temperature and pressure.

2.4 Statistical Analysis

Particle size discrimination of each feedstock was evaluated by using one-way ANOVA provided by the Minitab® 16 statistical software package. An alpha (α) level of 0.05 was used to determine the statistical significance of all analyses. Particular size of Poultry droppings and Pig dung were found lower than 5.66 mm. It was found that there were no significant differences between the two feedstock types among the means ($p>0.05$).

2.5 Results and Discussions

The microwave experimental results showed that pre-treated Poultry droppings and Pig dung were darker than untreated. Upon further rising temperature from 90°C to 105°C, colours of pre-treated feedstocks were ranged from light brown to dark brown (almost black colour). It was also observed that the pre-treated feedstock has more biogas yield than the untreated feedstock. This is as a result of the lignocellulose content break down on the course of pre-treatment.

III. CONCLUSION

Thermal pre-treatment enhances biogas production due to increase in availability of biodegradable material for anaerobic digestion.

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