Anaerobic Digestion Plant for Domestic Waste Treatment

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Abstract*—The need for efficient waste management is on the increase in recent time. This is as a result of good hygiene advocated by many health professionals and even some non-governmental organization. Waste generated from homes are not being used properly rather they are being thrown away and these causes environmental pollution, which is detrimental to both human and aquatic life. This work focused on the utilization of domestic waste in generation of biogas through anaerobic digestion. Five anaerobic plants of 50 litres each were used to perform the experiment. The wastes from five different homes with maximum of five persons in each home were charge in the digester and allowed anaerobic digestion to take place. The ratio of waste to water to inoculums is 2:2:1. The volume of biogas yield, volatile solid, and PH values were recorded. The experiment gave 11.7 litres as maximum biogas yield.*

***Keywords*—** *Anaerobic digestion, waste treatment, biogas yield, volatile solid, PH.*

I. INTRODUCTION

The quantity of waste generated every day in the world is increasing due geometric population increase. Many scholars have worked so hard in devising a means of the waste disposal to reduce both air pollution and land pollution. The various ways of waste disposal are burning in the air, incinerator burning and disposal in water. Some of these methods are not safe due to air pollution and destruction of aquatic life. One of the better ways of home waste disposal is degradation by anaerobic bacteria otherwise called anaerobic digestion. 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 [2] Anaerobic digestion (AD) has become an increasingly important industrial process [3]. AD is a green technology involving the generation of methane-rich biogas via the biological degradation of regionally available biomass like agricultural and municipal solid wastes and Wastewaters [4]. AD processes have for many years been used to treat and sanitize sewage sludge waste from aerobic wastewater and animal manure, reduce its odor and volume, and produce useful biogas [5]. Biogas in turn is a first generation, renewable biofuel that offers the prospect of replacing fossil fuels in the transportation sector and limiting the net greenhouse gas emissions implicated in climate change [6]. Between 1950-1980, high production-rate systems were developed and used to process effluents from agricultural and industrial sectors [7].

Processing of effluents that contained toxic and recalcitrant compounds from the pulp/paper, petrochemical, and other chemical industries was later possible as both technology and knowledge pertaining to toxicity and biodegradability were enhanced [8]. AD technology has been widely adopted by Germany and Denmark, which have implemented rigorous waste disposal legislation. Since 2000, annual electricity generation from digester projects in the USA has increased almost 25-fold from 14 million kilowatt-hours (kWh) to an estimated 331 million kWh per year [9]. By the end of the 19th century the development and utilisation of anaerobic digestion received great impacts when it was discovered that it can be used for wastewater treatment [10]. It is reported that the first digestion plant was built at a leper colony in Bombay, India in 1897[11]. The produced gas was used for lightning and beginning from 1907 it powered an engine for electricity generation (Eladawy, 2005) [12]. It was also in 1907 when the German engineer and inventor Karl Imhoff - a pioneer and a driving force for major advancements in wastewater engineering in the early 20th century - developed the so called Imhoff tank which was the first anaerobic digester in wastewater treatment (Eder and Schulz, 2006)[13].

II. MATERIALS AND METHODS

Collection of waste material.

The waste used was a mixture of domestic yam peelings, cassava peelings, decay food, leaves of plants and grasses around the compound. The waste was accumulated domestic waste left for a very long time in an enclosure. These wastes were collected from five families with average of five individual in the family. The five homes are located at Enugu East, Enugu, Nigeria.

Experimental method.

The wastes were measured and appropriate weight of the waste from five different homes recorded. The inoculums

used was also measured and recorded. Five anaerobic plants (digester) of equal volume of 50 litres each were set up. The waste to water and inoculums ratio is 2:2:1. The wastes from four digesters were heated conventionally for 5min, 10min, 15min and 20min respectively. The other plant was not heated or its temperature being raised, and served as control experiment. The digesters were charged with the domestic waste and were monitored daily and biogas yield, volatile solid and PH value were recorded.

Statistical Analysis.

ANOVA test was performed with software SPSS 16.0 to see the statistical significant difference between substrate in the five different digesters.

III. RESULTS AND DISCUSIONS

The result showed that biogas could be generated from waste in homes. The biogas yield from fig 1 indicated that biogas yield increased as the pre-treatment by heating increases. The control experiment in fig 1 has lower yield compare to the other experiments treated with 5min, 10min, 15min, and 20min. That was as a result of lignocelluloses breakdown by anaerobic bacteria. Ugwuoke et al reported that more distingration of lignocelluloses gives higher biogas yield [14].

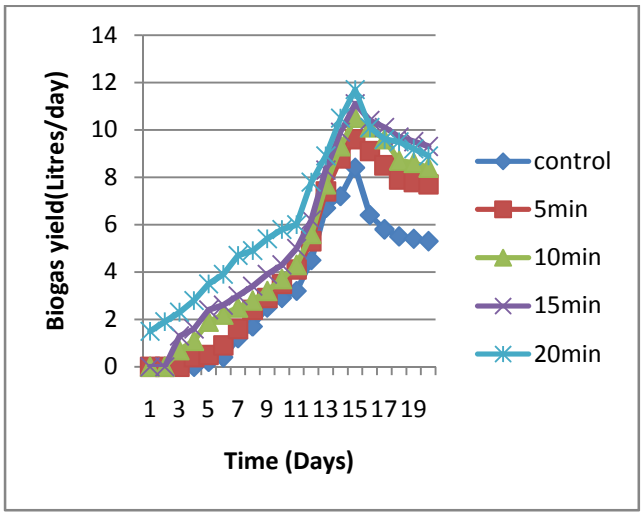

Fig. 1. A graph of Biogas yield (litres) versus Time (Days)

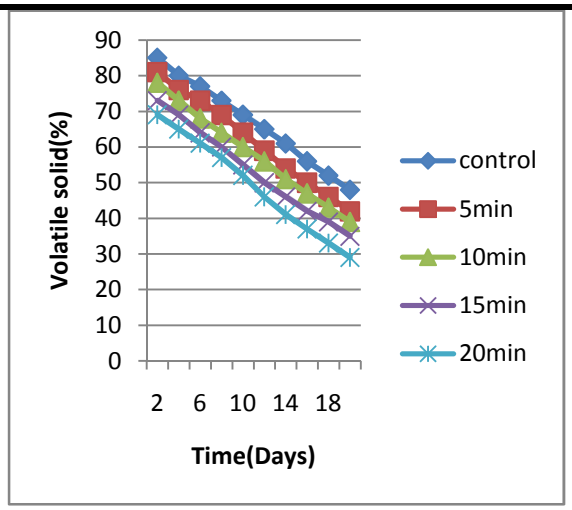

Fig. 2: A graph of Volatile solid (%) versus Time (Days)

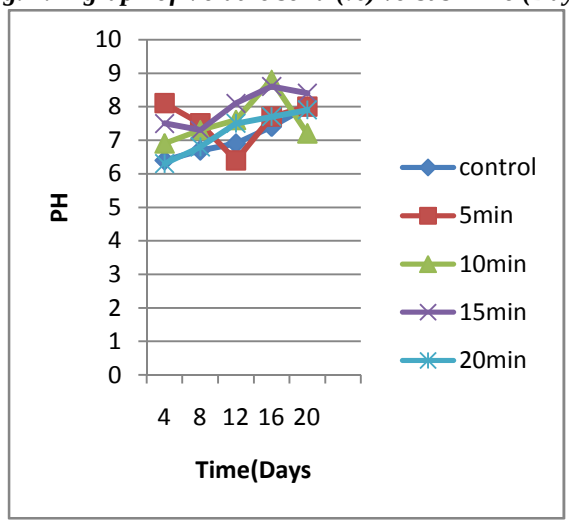

Fig. 3: A graph of PH versus Time (Days)

IV. CONCLUSION

The waste from home could be used to generate biogas which is very essential energy for coking, power generation and powering of vehicle. Anaerobic degradation is very important in waste treatment and environmental control which in turn generates biogas.

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