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Energy Generation Using Municipal Solid Waste

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ABSTRACT

Municipal solid waste (MSW) generation has become an increasing environmental and public health issue all over the world especially in a developing country like Nigeria. This paper has explored the usage of biodegradable waste aspect of MSW to generate energy as a means to reduce it. A fabricated digester of 14kg gas cylinder was used for the anaerobic digestion. The study revealed the generation of energy in eco-friendly environment to reduce waste.

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1. INTRODUCTION

The management of waste has become a major environmental challenge due to the increasing urbanization and rise in population. Municipal solid waste (MSW) commonly known as trash or garbage in the United States and rubbish in Britain consist of materials such as household garbage, food wastes, yard wastes, machinery and abandoned materials to mention a few. In other words, solid waste is the material generated from various human activities and is normally disposed as useless and unwanted. Municipal solid waste includes wastes generated from residential, commercial, industrial, institutional and its composition in cities are heterogeneous; it contains both biodegradable and non- biodegradable materials which are mostly e-waste, plastic and polythene materials.

Tadesse *et.al*. (2014) posited that municipal solid waste generation has become an environmental and public problem everywhere in the world, particularly in developing counties because of rapid urbanization and population growth. Most of these are improperly disposed of in landfills or simply discarded. This not only affects the health of the populace by causing diseases like malaria, cholera and typhoid but is also disastrous to the environment. Uncontrolled dump of wastes results in the pollution of surface and or groundwater by leachate and the spread of diseases causing organisms such as flies, mosquitoes and rats. Akash *et.al* (2024) affirmed that even kitchen waste leads to stink and produces methane, which is a greenhouse gas that supports global warming.

A sustainable waste management system has become an integral part of resources management. Municipal waste i.e., food waste, vegetable waste, animal material, kitchen waste etc. can be converted into biogas by the anaerobic digestion in presence of microbes (Vandana *et al.*, 2021). Biogas production from the municipal solid waste is one of the best methods of waste disposal. It has reduced environmental impact, especially greenhouse effect and global warming (Ali et al., 2016). The organic waste in MSW is raw material for anaerobic digestion in biogas production process (Igoni *et al*., 2008). Biological wastes are found as municipal wastes, kitchen wastes, agricultural waste and animal wastes and these can utilize with the help of various technologies adaptation for leading to the use of renewable energy systems effectively and efficiently. This article therefore is a conversion of bio-degradable waste to energy with the use of a fabricated digester.

2. MATERIALS AND METHODS

2.1 Collection of Materials

The materials used in this research work were collected from Captain Cook and Yakoyo Food Restaurant along Eripa road, Iree in Osun State. The waste was sorted out into various components in order to bring out the bio-degradable waste. The bio-degradable waste material was weighed to enhance the percentage of the waste to be used depending on the size of the digester.

2.2 Digester Design

The research was conducted on a modified or fabricated digester using a 14kg gas cylinder as shown in Figure 1.

Figure 1: A fabricated digester

The digester vessel (tank) is a corrosion protected material that was placed above the ground with allowances for entry and exit of feeds (waste material), pipes and/or other appetencies. The digester vessel was equipped with a suitable cover designated for the accumulation and collection of gas.

3. RESULTS AND DISCUSSION

The results of the laboratory work are presented in Tables 1 and 2

3.1 Results

Table 3.1: Characterization of Kitchen Waste

Waste type	Weight(kg)	Percentage (%)
Food/ putrescible	6.5	92.857
Nylon	0.5	7.143
Total	7	100

Table 2: Result on Weight on Various Components

Description	Weight (kg)
Total weight of waste obtained	6.5
Weight of the digester before loading	14.0
Weight of the putrescible waste used for digestion	5.5
Weight of waste water used	0.5
Weight of waste plus addition of waste water	6.0
Total weight of digester after loading	20.0

3.2 Discussion

Table 1 indicates the physical characteristics of the waste material collected for the digestion process. The table shows that 92.85% of the wastes material is made up of biodegradable material while the other composition is nylon made up of 7.143%. This is in line with previous research work by Hoornweg *et al*.(1999) and Ogwuleka (2009).

Table 2 shows that 0.5kg of waste water was added to a portion of 5.5kg of the food / putrescible waste material to aid a faster decomposition and increase in the surface of the material for better digestion of the bacterial responsible for the hydrolysis. Also, the weight of the fabricated digester was weighed before and after feeding of the waste material. The benefits associated with the operation of the waste in a liquid environment are it enables more thorough circulation of materials and contact between the bacteria and their food. This enables the bacteria to more readily access the substance on which they are feeding and increase the rate of gas production. This is in line with previous research work conducted by Zaman. (2010).

The gas after production was collected using a tyre tube as a storage tank in other to ensure maximum safety precautions connected to an outlet pipe fixed to the head of the fabricated digester. A gas was produced with odoriferous smell, extracted using a deflated tyre tube as storage tank which was inflated when in contact with the outlet pipe as shown in Fig 2. This implies that a gas has been generated. This corresponds with the research work on anaerobic digestion process by Martin, (2007) where the gas is normally stored on top of the digester in an inflatable gas bubble.

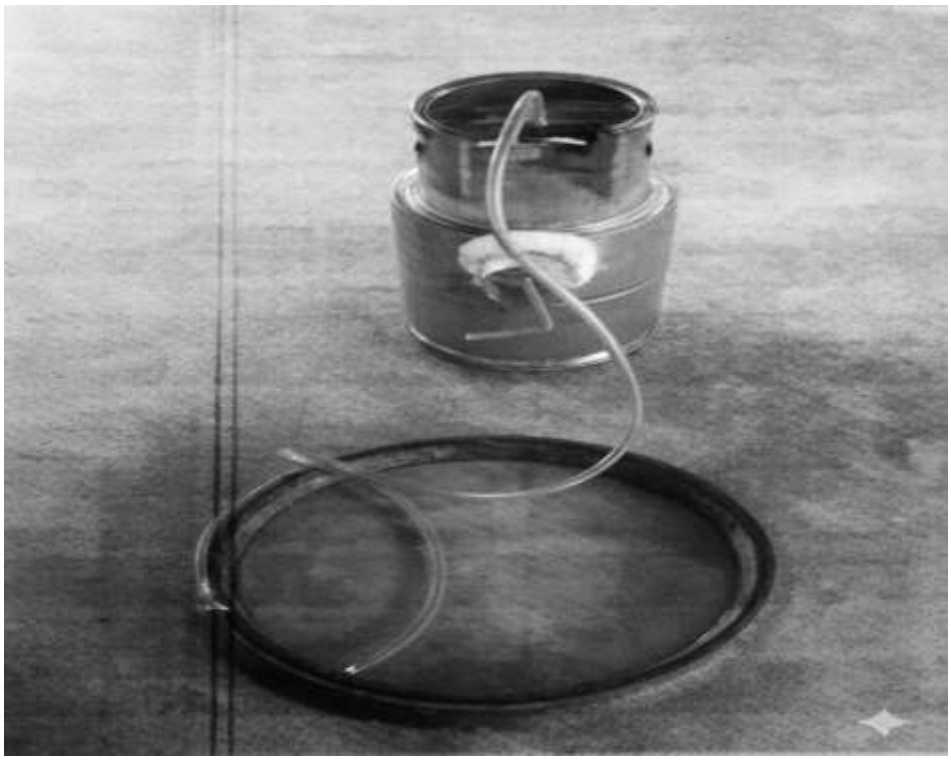

Figure 2: Extraction of product gas from digester

4. CONCLUSION

Municipal solid waste is not a waste entirely. It can be converted to energy which is one of the basic entities for all economic activities. The concepts of Municipal solid waste utilization using a fabricated digester plant for biogas production offers effective waste management and resource development solution with positive measures for the economy and improve environment quality. So anaerobic digestion of municipal solid waste using a modified fabricated plant is a proven technology for processing source-separated biodegradable waste. Also, anaerobic technology is a good agent to reduce the greenhouse effect from the atmosphere and also a worthy replacement for fossil fuel.

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