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AN ANALYSIS OF MUNICIPAL SOLID WASTE COMPOSITION IN GOMBE-METROPOLIS.

[*]ISAH, MOHAMMED, [**]AHMED, CHINEDE ABDULLAHI, [***]ISTIFANUS, VICTOR, & [****]ADAMU, SANI JAURO,

[,**&***]Department of Environmental Management Technology, Abubakar Tafawa Balewa University, Bauchi, Bauchi State, Nigeria.[****]Department Of Planning, Research & Statistics, Ministry of Environment & Forest Resources, Pmb 0188 Gombe (Moenv.Gm.Gov.Ng), Gombe State, Nigeria.*

Abstract

An analysis of municipal solid waste composition was carried out around GOSEPA and INEX cleaners' dumpsites in Gombe metropolis. The municipal solid waste samples collected were characterized using American Society for Testing and Materials (ASTM D5231), the result of the composition analysis shows that at INEX cleaners dumpsite spoiled organic food materials had the highest value of 36.00%, while metal, paper, and soil had the least value of 0.83; 2.05; 2.7, while that of GOSEPA dumpsite indicated that agriculture waste had the highest value of 41.00%, paper, soil and metals had the least value of 0.71; 1.20; 1.43. This research recommends an assessment to determine the energy generating potentials of the solid waste in Gombe metropolis for renewable energy production. The research further recommend the establishment of Gombe fertilizing blending plant by the State government that uses municipal solid waste as a raw material, so as to harness the quantum of municipal solid waste that are being generated in the metropolis, as well as other LGAs of the State to boost agricultural production for the attainment of food security.

Keywords: *An Analysis of, Composition in, Gombe Metropolis, Municipal Solid Waste.*

INTRODUCTION

Waste in general is a material which the owner wants to dispose-off (Körner *et al.*, 2006). While the solid waste composes of solid constituents of waste, it comprises of hazardous substance generated from routine activities of human life (Laohalidanond *et al.,* 2015). It is usually collected by municipalities or other local authorities. Municipal solid waste includes mainly household (domestic waste), commercial, and institutional wastes (generated from shops and institutions) (Boukelia and Mecibah 2012; Seo 2013). By its nature it is a heterogeneous substance composed of a wide range of materials, it can be a liability if requiring disposal but also represents a considerable resource that can be beneficially recovered, e.g., through the recycling of materials such as aluminum cans, metals, glass (bottles), fibers, etc., or through recovery operations such as conversion to energy and composting (IEA, 2003). The amount of waste we are creating is increasing and the nature of waste itself is changing, partly due to the dramatic rise in the use of hi-tech products and changes in consumption pattern.

Solid Waste Management System

Solid waste management (SWM) system includes the generation of waste, sorting, storage, collection, transportation, processing and final disposal. SWM starts with the sorting and collection of solid wastes and ends with their disposal and/or beneficial use. Waste management systems must remain flexible in light of changing economic, environmental, social and other local conditions (I.E.A, 2003). In most cases, waste management is carried out by a number of processes, many of which are closely interrelated.

Solid Waste Generation

Solid Waste generation rates is the average amount that each person throws away, it varies widely within and between locations. The generation rates depend on income levels, socio-cultural patterns and climatic factors (UNEP, 2009).The rate at which the cities generate municipal solid waste is increasing due to rapid population growth and urbanization; this is more peculiar to cities in developing world. It is important to have adequate information about solid waste generation if a wise decision about future waste management is to be made. Solid waste generation is correlated with the population of an area or city,

due to which bigger cities with high population tend to generate more waste than those with low population. The total amount of solid waste generated per person per day in many cities of developing countries has noticeably increased as well. It has almost doubled during last ten years from 0.64 kg to 1.2 kg and is expected to reach 1.42 kg by year 2025 (I.E.A, 2003). High income countries generate more waste per person compared to low income countries due to differences in GDP. It is worthy to note that even within the same country or region the per capita generation may differ due vibrancy of economic activities, consumption pattern and local climate. In Nigeria (I.E.A, 2003) reported that the waste generation rates ranged from 0.44 to 0.66 kg/capita/day but this varies from city to city and even within cities.

Solid Waste Composition

The rate of waste generation and composition are index of socio-economic development and economic prosperity of a city or region. The municipal solid waste composition is influenced by many factors such as culture, economic development, climate and energy sources. The types of waste produced change according to the standard of living in a city. Wastes generated in low and middle-income cities have a large proportion of organic waste, whereas the wastes in high-income cities are more diversified with relatively larger shares of plastics and paper (I.E.A, 2003).

Physical and chemical compositions are of high importance in classification and proper management of Solid waste, based on physical composition (Scharfe, 2010) classified the whole of MSW to include materials (such as vegetables, food, and garden waste), paper and paperboard (including paper, wrapper, cardboard, and packaging paper), plastics (including plastic bags, plastic bottles, and packaging material), glass/ceramics (including glass bottles, broken glass, pottery items and earthen pot), metals (cables, foils, ferrous and nonferrous material), (including textiles), and others including inert and a lot more.

However, the amount and composition of solid waste generated in the collection area for a potential incineration plant, and possible seasonal variations, must be well established for the successful setting of waste to energy plant. Therefore, data in one city cannot be transferred to another city for the establishment of waste to energy plant.

In the wider context the composition of solid waste can be highly variable, particularly between developed and developing nations; the removal of materials for recycling tends to leave a residue that has a significant calorific (heating) value making it suited to energy recovery operations. Typically, a ton of Solid Waste has about one-third of the calorific value of coal (8-12 MJ/kg as received for Solid Waste and 25-30 MJ/kg for coal) and can give rise to about 600 kWh of electricity (I.E.A, 2003).

Waste composition dictates the waste management strategy to be employed in a particular location. Organics in Solid Waste are put rescible, and are food for pests and insects and hence need to be collected and disposed of on a daily basis. The amount of recyclables like paper and plastic in Solid Waste dictates how often they need to be collected. Recyclables represent an immediate monetary value to the collectors. Organics need controlled biological treatment to be of any value, however due to the general absence of such facilities in many cities of developing countries, organics do not represent any direct value to informal collectors (I.E.A, 2003).

Materials and Methods

The Study Area

Location of the Study Area

Gombe city the capital of Gombe State is located in the northeastern part of Nigeria on coordinates 10017'N 11010'E. It has a total area of 52Km^2 (20sq mi) with a population of 377,341 according to 2006 census, and the projected population of 534,314.856 people (Adamu., Danladi., & Mahmoud., 2017), and high rate of urbanization (3.5%) and population growth rate of 3.2%, it stands the potential of generating more municipal solid waste (NPoP'C, 2009). Gombe metropolis has challenges of managing the generated municipal solid waste of 21,297 tons and 5,832 tons per month for INEX and GOSEPA dumpsites respectively (INEX, 2018, & GOSEPA, 2018), resulting to indiscriminate dumping of the waste, as well as it incineration which poses serious environmental hazard.

The state has eleven local Governments areas which include Akko, Balanga, Billiri, Dukku, Funakaye, Gombe, Kaltungo, Kwami, Nafada, Shongom and Yamaltu-Deba.Gombe was carved out of the old Bauchi State on 1st October, 1996 by the Military Regime of General Sani Abacha (Misbahu, 2015).

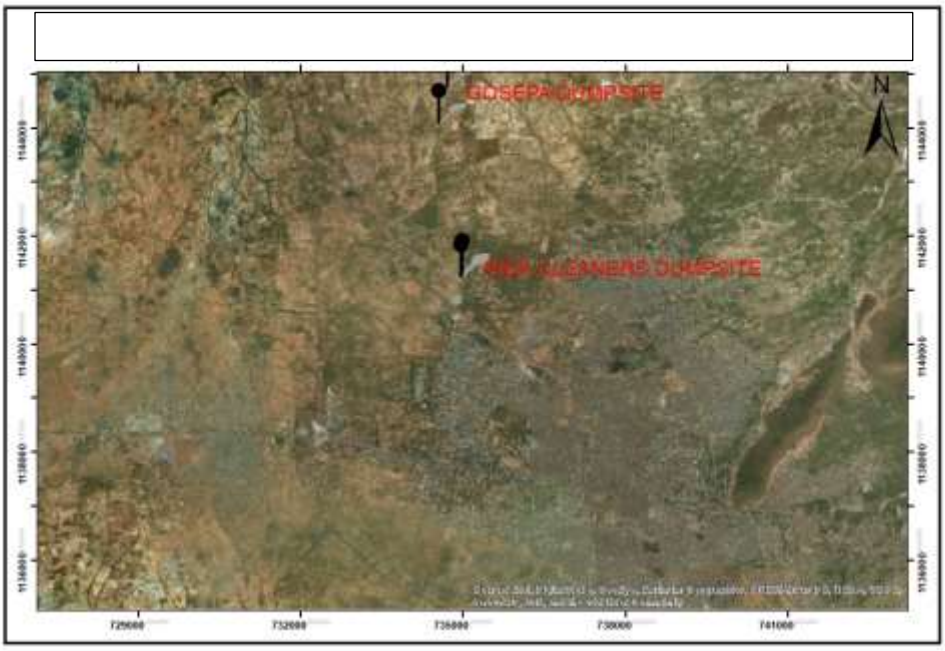

Plate 1: Image of Gombe Metropolis Showing INEX Cleaners and GOSEPA Dumpsites (in red colors)

Plate 2: Solid Waste sample collection at one of the dumpsite of the study area

Plate 3: Preparation of Waste Samples for weighing at the Laboratory

Climatic conditions

Temperature

Gombe has an average temperature of $27^0C \pm 7^0C$ annually. There are relatively cooler month that ranges from November to February during harmattan. The monthly mean temperature attend to lowest 21^0 and $23^0C \pm 9^0C$ during

December and January. Temperature rises to about 32^0C in March and early April annually (Jibrin, 2011).

Soil

The soil of the study area is a combination of sandy and loamy types of soils. Sandy soil contains visible large particles to the unaided eye and stays loose allowing moisture to penetrate easily. This soil type cannot form ball when squeezed in the fist and feels coarse in texture when wet or dry (Jibrin, 2011).

Relative Humidity

Gombe metropolis the capital city of Gombe state is characterized with a Relative Humidity of 64% (Jibrin, 2011).

Sun

The length of the day in Gombe does not vary substantially over the course of the year, staying within 12 hours *43 minutes* throughout (Jibrin, 2011).

Materials and Method

Solid Waste Samples Collection at INEX Cleaners Dumpsite

The 89,177.16m^2 area of the INEX dumpsite was segmented into two (2) sampling points at 120m intervals during the months of February and June, 2019. Coordinates of the sampling points were recorded (11°8'36.757"E 10° 20'45.095"N and 11°8'42.73"E 10° 21'6.575"N). Waste samples were randomly collected from the sampling points and a composite was formed. The composite obtained were segregated and sorted into agriculture/vegetables waste, paper, spoiled organic food, plastics/polyethene, soil, metals, glass and textiles.

Solid Waste Samples Collection at GOSEPA Dumpsite

The 28,832.19m^2 area of the GOSEPA dumpsite was segmented into two (2) sampling points at 120m intervals during the months of February and June, 2019. Coordinates of the sampling points was recorded (11°8'50.898"E 10° 19'15.474"N and 11°8'50.522"E 10° 19'13.164"N). Waste samples were randomly collected from the sampling points and a composite was formed. The composite obtained were segregated and sorted into agriculture/vegetables

waste, paper, spoiled organic food, plastics/polyethene, soil, metals, glass and textiles.

RESULTS

Composition of the Solid Waste at the Dumpsites under study

Table 1: Composition of Solid Waste at INEX Cleaners and GOSEPA Dumpsites (2019)

Table 1 shows the composition of the solid waste from INEX cleaners and GOSEPA dumpsites. The result indicated that at INEX dumpsite spoiled organic food materials had the highest value of 36.00%, while metal, paper, and soil had the least value of 0.83; 2.05; 2.7, while the composition of the solid waste from GOSEPA dumpsite indicated that agricultural waste had the highest value of 41.00%, while paper, soil and metals had the least value of 0.71; 1.20; 1.43.

Table 1: Composition of Solid Waste at INEX Cleaners and GOSEPA Dumpsite (2019)

Category	% weight Composition	
	2019	
	INEX	**GOSEPA**
Plastic	18.40	11.40
Paper	2.05	0.71
Textiles	6.02	6.90
Agriculture Waste	34.30	41.00
Soil	2.70	1.20
Metals	0.83	1.43
Spoiled Organic Food	36.00	38.00

Source: Laboratory Analysis Adamu, 2019.

Discussion of Result

Composition of the Solid Waste at the Dumpsites under study

The result of the composition analysis in Table 1 shows that at INEX cleaners dumpsite spoiled organic food materials had the highest value of 36.00%, while metal, paper, and soil had the least value of 0.83; 2.05; 2.7, while the composition analysis of the solid waste from GOSEPA dumpsite indicated that

agriculture waste had the highest value of 41.00%, while paper, soil and metals had the least value of 0.71; 1.20; 1.43. The higher % of spoiled organic food materials, and agricultural waste at INEX and GOSEPA dumpsites respectively corroborated the findings of (Aliyu, 2010) which shows that spoiled organic food materials and agricultural waste constitutes 70% of the solid waste that are being generated in developing countries of the world because of their income level and development.

CONCLUSION AND RECOMMENDATIONS

Conclusion

An analysis of municipal solid waste composition was carried out at the two officially designated waste dumpsite (GOSEPA and INEX cleaners dumpsites) in Gombe-metropolis, and the result of the composition analysis shows higher % of spoiled organic food materials, and agricultural waste at INEX and GOSEPA dumpsites respectively.

Recommendations

This research recommends an assessment to determine the energy generating potentials of the solid waste in Gombe metropolis for renewable energy production. The research further recommend the establishment of Gombe fertilizing blending plant by the State government that uses municipal solid waste as a raw material, so as to harness the quantum of municipal solid waste that are being generated in the metropolis, as well as other LGAs of the State to boost agricultural production for the attainment of food security.

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