Estimation of Moisture Content of Household Solid Waste in Some Selected Areas of Jimeta Town

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Abstract: ***This study analyses the moisture content of Jimeta metropolis in Adamawa state, Nigeria. The purpose of the study is to assess the amount of moisture present in household solid waste of Jimeta for use in energy generation. The study will assist in promoting the development of technologies to utilize municipal solid waste as energy sources. The study was carried out in order to determine the suitability of the waste in energy production. The study area was classified into three different waste areas according to their income as follows:-(i) Waste area A (High income Area) Comprising 80 unit housing estate, Dougirei housing estate, and Government Reserve Area (GRA) (ii) Waste Area B (Medium income Area) which comprises State Low Cost housing, Nasarawo, and Demsawo (iii) Waste Area C (low income Area) comprising Luggere Quarters, Yelwa Quarters, and Rumde Quarters. The components of the waste and percentage composition were determined by hand sorting process and calculation respectively. The moisture content was determined by drying method using hot air oven set at105℃. The results show that the major portion of municipal solid waste in the areas under study was organic material and the average moisture content was found to be 61.33% indicating that the waste is wet and therefore may not be suitable for energy production.***

Keywords: Moisture content, Energy, Waste, Organic material, Percentage composition, Organic Material.

1. Introduction

Jimeta town falls within the north guinea savannah region and it is both the political and administrative capital of Adamawa State. It is the largest and most populated of the 21 urban centers in the state with an estimated population of 159,779 persons in 1991 to 234,472 in 2006 indicating an annual growth rate of 3.2% [1]. The study area is delimited on the north by latitude 9.2833^{o}N and in the east by 12.4667^{o}E and was classified into three waste area types according to high, medium and low income waste Areas called Area A, Area B and Area C respectively on the assumption that there is a significant positive correlation between per capita waste generation and income levels of residents [2]. Waste area A comprised of 80 unit housing estate, Dougirei housing estate, and Government Reserve Area (GRA). Waste area B comprised State Low Cost housing, Nasarawo, and Demsawo quarters. Waste area C comprised of luggere, Yelwa and Rumde quarters.

1.1 Municipal Solid Waste Characteristics and Management in Jimeta Metropolis

Municipal solid waste (MSW) refers to household waste combined with a minor portion of commercial waste collected together [3].

The total solid waste generation in Jimeta-Yola metropolis has been on the steady increase over the years due to rapid increase in population. However, waste collection management has remained stagnant or even declined from 2004 to 2008 [4]. The respective composition of solid waste in Jimeta (Yola North) has been found to include paper/cardboard (10%), plastics/nylon/polythene (24.5%), organic materials (35%), metals (8%), Rags (4%), others (18%) [5].

The Adamawa State Environmental and protection Agency (ASEPA) is responsible for waste collection and disposal in Yola. Dumpsters were provided by the authority at strategic locations along the streets of Jimeta metropolis wherein waste that is generated from households, commercial businesses, public buildings, and recreational areas was directly dumped by members of the general public. The waste was then collected at established intervals or as the situation may demand and transported to approve dumpsites.

2. Materials and Methods

This study involved characterization and calculation of generation rate of the waste in Jimeta town. Samples of the solid wastes were collected for moisture and waste composition analysis.

2.1 Waste Composition Study

To determine the waste composition, hand sorting of the waste samples was used. After collection of the waste samples according to the National guidelines on Environmental Health Practice in Nigeria, (NEHP) [6], from the households in the classified waste areas for 10 days, the

samples were then pooled together to form a huge waste composite sample.

The composite sample was then placed on a clear polyethylene sheets that were spread on the floor and then sorted by hand according to the following categories: - Paper, Plastics, Rubber, Textiles, Leather, Glass, Metals, and Organic/others. Then, each category was placed in its appropriate container and weighed. The various weights of the wastes categories were recorded in a data sheet.

2.2 Sample Preparation

Waste subsamples, each weighing between 2 - 5kg was extracted from the representative composite sample in each waste area to determine the moisture content. The subsamples were weighed as collected (wet weight). The samples were then spread on the floor and allowed to stand under the sun for 24hrs until it was air – dried.

2.3 Experimentation

1kg of the partially dried samples was again extracted and placed into a preheated (hot-air) oven set at 105℃ for 2hrs. The heated or dried sample was then removed from the oven using metal tongs and placed into a desicator for cooling and then weighed (dry weight). The weight and dry weights were then recorded. The percentage moisture content for each waste area was then obtained through the following formula [7]:

$$Moisture\ content,\ M_C\ (\%) = \frac{W_W - W_D}{W_W} \times 100\% \quad (1)$$

3. Results and Analysis

Table 1: Daily Waste Composition Data Sheet. Location: Area A

Day	Waste Components (kg)						
	Paper	Plastics /Rubber	Textiles	Leather	Glass	Metals	Organic Materials
1	0.3	0.5	0.3	1.0	2.8	0.2	3.0
2	0.3	0.7	0.06	0.8	-	0.02	7.0
3	0.7	0.2	0.2	1.2	-	-	10.2
4	0.9	0.3	0.9	1.3	0.7	0.04	18.3
5	1.1	0.5	1.1	1.5	0.5	0.05	16.2
6	0.6	0.4	0.5	0.9	0.7	0.05	18.0
7	0.5	0.3	0.07	1.3	0.8	0.1	18.4
8	0.8	0.7	1.0	0.7	1.5	0.15	10.4
9	0.7	0.5	0.09	0.8	2.2	0.1	17.2
10	0.7	0.3	0.9	2.1	0.8	0.06	17.7
Ave.	**0.66**	**0.41**	**0.51**	**1.16**	**1.00**	**0.77**	**16.34**

Table 2: Daily Waste Composition Data Sheet. Location: Area B

Day	Waste Components (kg)						
	Paper	Plastics /Rubber	Textiles	Leather	Glass	Metals	Organic Materials
1	3.8	0.2	0.3	2.0	0.6	0.2	22.5
2	0.2	0.5	1.0	4.0	1.0	1.2	23.0
3	0.6	0.8	0.4	1.0	0.3	1.2	31.5
4	0.2	0.1	0.3	0.5	0.6	0.1	17.1
5	0.1	-	0.3	1.5	0.2	-	14.0
6	0.2	0.3	0.4	0.6	0.6	0.1	9.6
7	0.1	0.2	0.2	1.6	0.3	1.0	20.1
8	3.2	0.1	0.4	3.0	1.5	1.3	28.5
9	0.3	0.7	0.3	2.0	0.4	0.1	19.0
10	0.3	0.7	0.2	3.0	0.2	0.2	5.2
Ave.	**0.97**	**0.38**	**0.38**	**1.92**	**0.57**	**0.54**	**19.05**

Table 3: Daily Waste Composition Data Sheet Location: Area C

Day	Waste Components (kg)						
	Paper	Plastics/ Rubber	Textiles	Leather	Glass	Metals	Organic Materials
1	3.0	0.6	1.9	9.8	0.8	0.6	140.1
2	0.9	1.3	0.8	6.0	1.0	0.6	94.5
3	2.8	2.0	3.2	5.8	0.6	1.2	100.8
4	0.8	0.5	0.8	1.8	0.4	0.1	88.8
5	0.5	0.3	0.4	1.9	0.4	0.3	83.4
6	0.8	0.9	0.8	5.2	0.6	0.3	94.8
7	0.8	0.8	1.7	4.9	0.8	0.1	101.2
8	2.5	1.1	1.2	6.0	0.2	0.6	98.2
9	1.6	2.0	0.9	4.8	0.4	1.0	78.6
10	2,4	0.7	1.7	4.3	1.1	0.6	118.6
Ave.	**1.61**	**1.02**	**1.34**	**5.05**	**0.63**	**0.54**	**99.9**

Tables 1 to 3 shows the records of the various weights of the wastes categories generated in Jimeta metropolis.

3.1 Composition of Municipal Solid Waste (MSW)

Table 4: Results of Waste composition (%) in the Waste Study Areas

Waste Components	Waste Areas		
	A (%)	B (%)	C (%)
Paper	4.6	0.9	1.3
Plastics/Rubber	1.8	0.3	0.8
Textiles	4.6	1.7	1.2
Leather	6.5	5.7	3.8
Glass	2.8	2.3	0.8
Metals/Cans	0.2	0.3	0.4
Organic/Others	79.5	88.8	91.7
Total	**100**	**100**	**100**

Table 4 shows the variations in the average percentage weight of the various waste components from the waste areas under study. The table clearly indicated that organic wastes constitute the major constituent of the waste in all the waste areas under the study with 79.50%, 88.8%, and 91.7% in areas A, B, and C respectively. This indicates that the low income area produced waste of more organic content.

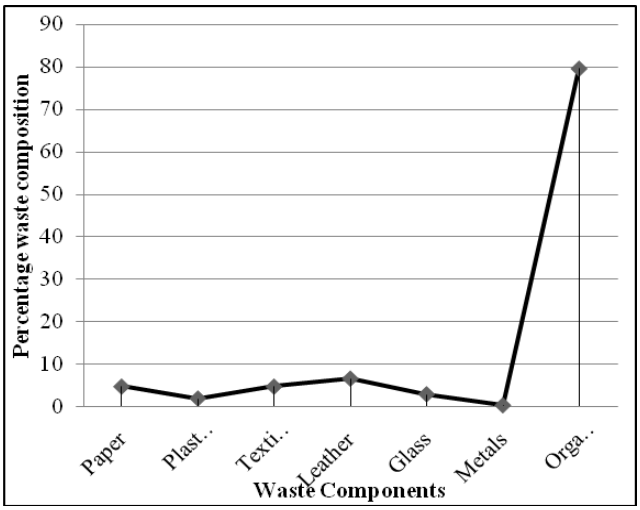

Figure 1: Percentage waste composition for waste area A

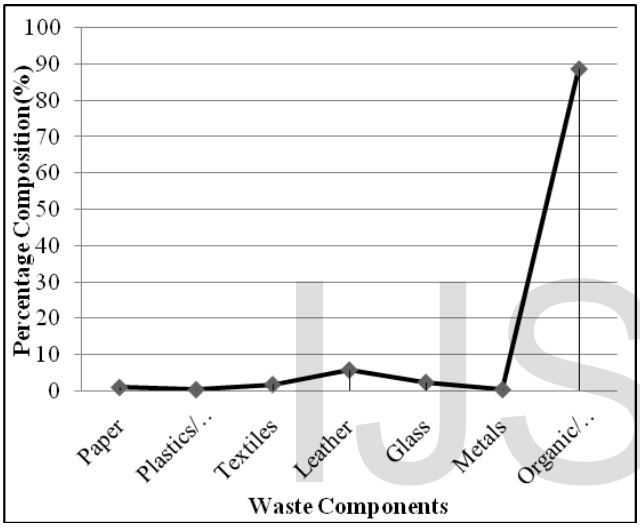

Figure 2: Percentage waste composition for waste area B

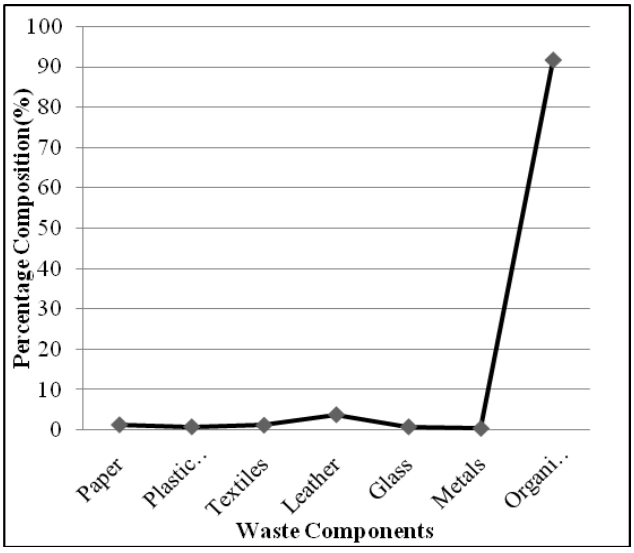

Figure 3: Percentage waste composition for waste area C

Figures 1, 2, and 3, show the percentage waste composition of the different waste component in each waste area. It is shown from these figures that waste area A has the highest percentage of paper (4.6%), plastics/rubber (1.8%), textiles (4.6%), leather (6.5%) and whereas waste area C has the highest percentage of metals (0.4%), and Organic materials (91.7%).

3.2 Moisture Content of the Municipal Solid Waste

The moisture content was determined using equation (1) after the weighing and drying processes.

Table 5: Wet and Dry Weights of MSW in various Waste Areas

Waste Area	Wet Weight(Kg)	Dry Weight(Kg)
A	43.39	21.19
B	35.00	25.80
C	98.40	34.90

The results of the moisture content of the wastes in the various waste areas were shown in fig. 4.

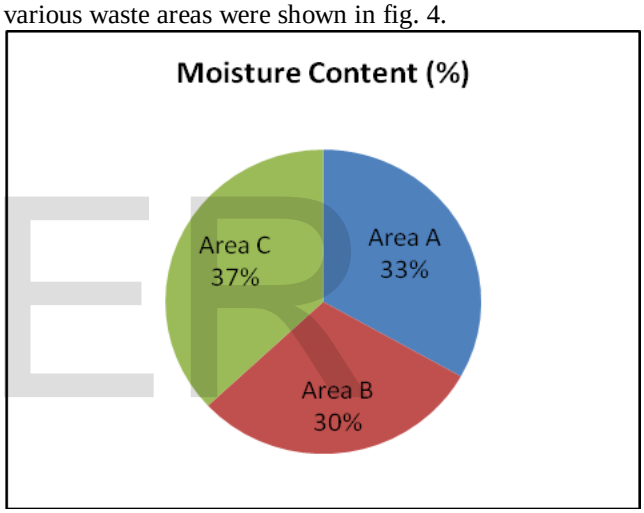

Figure 4: Moisture contents of MSW in the various waste areas.

From Fig. 8, the highest percentage of the moisture content is 68.0% for waste area C followed by 60.50% for waste area A. Waste area B has the lowest percentage of moisture content (55.0%). The values obtained are high and indicate that the waste in the study area is very wet. The high values of the moisture content might be due to the large quantity of wet basis materials such as the organic components in the waste stream. The average of moisture content analysis for the study waste area is 61.33%. This suggests that the moisture content of the municipal solid waste of Jimeta metropolis is high probably due to the high content of organic materials present in the waste.

Conclusion

The largest portion of municipal solid waste in Jimeta metropolis as found by this study consists of organic materials or easily degradable components. The organic materials were estimated to be 79-90% by weight of the total waste generated. The various waste components found in the waste stream of Jimeta metropolis include paper,

plastics/rubber, textiles, leather, glass, metals/can, and organic materials. The organic wastes constitute the major constituent of the waste in all the waste areas under the study with 79.50%, 88.8%, and 91.7% for areas A, B, and C respectively. The moisture contents of the wastes in the various waste areas under study were found to be 60.50%, 55.00%, and 68.00% for areas A, B, and C respectively. The average of moisture content analysis of the waste in the study area was found to be 61.33%. This value indicates that the moisture content of Jimeta metropolis is high and this will affect the efficiency of waste processing equipment and also reduces the calorific value of the waste. Therefore, this study concludes that the municipal solid waste of Jimeta metropolis may not be suitable for energy production due to the high moisture content of the waste but could be used for composting.

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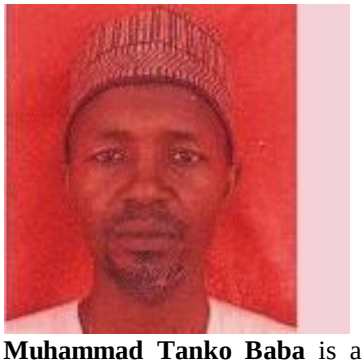
Authors Profile



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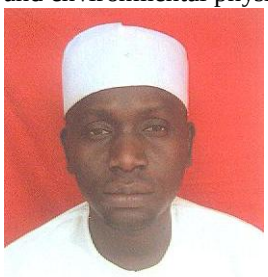

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