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Full-text Available Online at
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www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage. *June 2014*
Vol. 18 (2) 211-215

Characterisation of Domestic Solid Waste for the Determination of Waste Management Option in Amassoma, Bayelsa State, Nigeria

***[1]DI; IGBINOMWANHIA; [2]AI.; OBANOR; [3]YP; OLISA**

[1, 2]*Mechanical Engineering Department, University of Benin, Benin City, Nigeria*
[3]*Mechanical Engineering Department, Niger Delta University, Amassoma, Nigeria*

KEY WORDS: Solid waste generation, Classes of waste, Quantity generated, Method of management

ABSTRACT: The work reported in this paper involves the characterization of residential solid waste in Amassoma for the determination of household solid waste management option in Amassoma, Bayelsa state in Nigeria. A site-specific study was carried out in order to determine the components and estimate the quantity of residential solid waste generation in the town. Structured questionnaires were applied to collect primary information such as size of households, educational level, monthly income etc. from households. The results from the study was then applied to determine the waste management option for residential waste in Amassoma town The results obtained revealed that the total solid waste generated in Amassoma is 1115.2kg/day from domestic activities. Furthermore, analysis of the sample collected showed that 51.34% of compostable waste (garbage) is generated, 33.62% of combustible waste and 15.04% of incombustible waste is generated in Ammasoma. The study also showed that dumpsite is the current waste disposal option in Amassoma. As Amssoma is a riverine area, the use of landfill for the purpose of solid waste disposal is not a good option because it can lead to eutrophication. Therefore the recommended safe option for solid waste management in Ammasoma is an integrated waste management programme incorporating recycling, composting and incineration with energy recovery.

http://dx.doi.org/10.4314/jasem.v18 i2.9

Introduction: Municipal solid waste (MSW) management is one of the most important environmental issues faced by modern society. In recent years research has shown that there is a high proportion of organic materials (food waste, paper, cardboard, wood, and yard waste) in municipal solid waste (MSW) and when MSW, containing organic components is land filled, anaerobic bacteria degrade the organic materials producing CH_4 and CO_2. (Vigil, 2011). According to European Union's action on community waste strategy (European Commission 1996), the waste management hierarchy should give priority first to prevention, second to materials recovery, third to incineration, and last to land filling. Most industrialized countries respect the above hierarchy and have already adopted it in their waste management programmes.

In many developing countries like Nigeria, the most common practice of waste disposal is by open dumping and indiscriminate burning of waste. The environmental degradation caused by such disposal of waste can be manifested in the contamination of surface and ground water through leachate and soil contamination through direct contact with waste. The impact can also be expressed by air pollution through burning of wastes, spreading of diseases by different vectors like birds, insects and rodents and uncontrolled release of methane by anaerobic decomposition of waste.

Studies on waste composition in some Nigerian cities (Bamgboye, 2004) indicate that about 25% of most urban wastes in Nigeria comprise of paper and other non-toxic materials and presently, these waste materials are either burnt uncontrollably to reduce volume or disposed of in landfills and these have ecological implications. The emissions from this type of uncontrolled burning can be noxious, whereas the availability of sites for landfill in urban cities is rather low.

In the last few years waste generated in Amassoma has been on the increase due to the expansion of human activities as a result of increase in population because of high influx of people from neighboring

**Corresponding author's Email: digbinomwanhia@uniben.edu*

communities and from other parts of Nigeria to Amassoma since the establishment of Niger Delta University in the town. Solid waste disposal has therefore become a major issue in the town. In fact among the problems existing in the fast growing Amassoma, solid waste appears to be the most prominent in recent years. There is currently no organized waste disposal and management system, hence solid waste is seen in huge heaps on any piece of unused land, around buildings and in the open market places. Living with solid waste littered around appears to be acceptable among the people in the town.

Municipal solid waste is generated from domestic and commercial activities. Wastes generated from domestic activities usually increase more rapidly with increase in population of middle and upper social classes. These are the people who are able to afford packaged commodities, new furniture, cars or clothing, buy daily newspapers and replace their non-renewable items in a short time. This appears to be the case of Amassoma and the poor state of solid waste management in Amassoma is now not only an environmental problem, but also, a social handicap.
What is the quantity of domestic solid waste that is generated and at what rate is it being done? The work reported in this paper aims to address such questions in Amassoma with a view to determine the management option suitable for sustainable waste management in the town.

MATERIALS AND METHOD

This study was carried out in two phases – A study of current waste management activities in the town and site-specific study of domestic solid waste in Amassoma. The site-specific study involved the following steps – selecting a representative sample, sample collection, sample analysis and obtaining primary information such as size of households, income, educational level etc. from households. A stratified random sampling method (Drew, 1980) was applied for the sampling process and a total of 50 households made up of 244 persons were selected for the survey. Each selected household was visited several times. In the first visit, contact was made and participation consent requested. Upon approval, a second visit was made to distribute moderate size bags for storing their solid waste over the following seven days. The next visits were made at regular interval to collect the solid waste generated over seven days at each household and oral interviews were also conducted. After collection the waste was sorted and each component weighed and recorded.

The materials used for the study include a weighing machine, plastic waste bags for refuse collection, hand gloves and nose mask.

RESULTS AND DISCUSSION

The waste generated by the 50 households over a period of seven days was sorted into the three main classes of solid waste and individual class was weighed and recorded. These are shown in Table 1. The waste was further analyzed and the results from the analysis for households are shown in Table 2 and Table 3.

Table 1 shows the average weekly waste generation from 50 households in Amassoma while Table 2 shows the percentage and the amount of waste generated per person per day. The categories of waste found in the collection are organic materials, paper, cardboards, rubber, plastics, wood, leather, textile material, glasses, ferrous metals, metal cans and ceramics.

Amassoma, is a small riverine community and has a population of about 6970 (NPC, 2006) inhabitants. Analysis of the result obtained showed that 0.16kg per person per day (ppd) was generated in Amassoma. This therefore implies that an average total of about 1,115.2 kg of household waste is generated per day.

The result of the waste survey carried out shows that a total of 275.63kg of household waste was generated per week by 50 households consisting of 244 persons. This implies that 0.16 kg/person/day was generated. Results from the analysis of the waste revealing the total amount of waste that can be generated for the three classes of waste are shown in Table 2 and this indicated that 51.34% of garbage is generated and 33.62% and 15.04% of combustible waste and non combustible waste are generated in Amassoma. The value of garbage (food waste), the highest at about 51.34%, consist mainly of vegetables, meal left-over and scraps associated with preparation of food compared favourably with residential waste for some towns in Nigeria and developing countries, such as Nsukka in Enugu state of Nigeria with about 56% (Ogweleka, 2003), Gwadalajara, in Mexico with about 52.9% (Gerardo, 2001), Lagos with about 47% (Igbinomwanhia et al, 2011). The food waste content of residential waste is very high because of the heavy dependence on home prepared meals, When compared to the food waste found in the USA of about 12.7% (USEPA, 2009) the cultural difference stands out (Zavodska, 2003).

Table 1: Average weekly waste generated in Amassoma

Household	Number of Persons in Household	Garbage (kg)	Combustible Waste (kg)	Non-combustible Waste (kg)	Total
1	2	1.86	1.40	0.50	3.76
2	2	2.60	2.40	1.15	6.15
3	2	1.86	2.80	0.33	4.99
4	2	0.75	0.48	0.33	1.56
5	2	1.25	0.45	0.48	2.18
6	2	2.10	1.28	0.63	4.01
7	2	2.03	1.04	0.43	3.50
8	2	1.28	1.05	0.13	2.46
9	2	1.25	0.80	0.63	2.68
10	2	0.83	1.56	0.30	2.69
11	3	1.80	0.68	0.95	3.43
12	3	1.83	0.80	0.30	2.93
13	3	1.95	0.95	0.33	3.23
14	3	1.43	1.05	0.43	2.91
15	3	1.56	0.53	0.35	2.44
16	3	1.53	0.83	0.48	2.84
17	3	1.70	0.95	0.35	3.00
18	3	3.25	1.05	0.15	4.45
19	3	2.33	1.85	0.33	4.51
20	3	3.00	1.80	0.20	5.00
21	4	2.75	2.18	0.78	5.71
22	4	3.58	2.23	0.83	6.64
23	4	1.93	1.30	1.03	4.26
24	4	2.33	1.08	0.78	4.19
25	4	3.00	1.58	0.63	5.21
26	4	2.48	2.03	0.83	5.34
27	4	2.13	1.23	0.35	3.71
28	4	1.85	1.60	0.70	4.15
29	4	1.55	2.83	0.33	4.71
30	5	2.33	1.29	0.83	4.45
31	5	2.55	2.75	0.30	5.60
32	5	2.90	3.05	0.33	6.28
33	5	2.40	1.25	1.28	4.93
34	6	2.85	1.98	0.55	5.38
35	6	3.40	1.90	1.03	6.33
36	6	2.55	1.00	0.63	4.18
37	6	3.68	2.55	0.68	6.91
38	7	4.90	2.50	1.00	8.40
39	7	4.00	1.38	1.88	7.26
40	7	3.28	2.95	1.60	7.83
41	7	4.43	2.23	1.50	8.16
42	7	5.13	3.10	0.88	9.11
43	7	4.58	2.18	1.25	8.01
44	8	5.48	2.83	1.38	9.69
45	9	4.65	2.93	2.63	10.21
46	0	4.53	1.95	2.08	8.56
47	10	4.33	3.93	1.98	10.24
48	11	4.73	3.70	1.88	10.31
49	11	5.13	2.33	1.35	8.81
50	13	6.58	4.70	1.06	12.34
Total	244	142.2	92.29	41.14	275.63

Table 2: Average amount ppd. and percentage of the classes of domestic solid waste in Amassoma

Components	Weight (kg) ppd.	% Components
Garbage	0.082	51.34%
Combustible Waste	0.054	33.62%
Non-combustible Waste	0.024	15.04%
Total	0.160	

ppd - per person per day

*[1]*DI. IGBINOMWANHIA; [2]AI. OBANOR; [3]YP. OLISA*

Table 3: Average percentage of the components of solid waste in Amassoma

Component	kg ppd	% Components
Garbage	0.0821	51.34
Paper	0.0040	2.52
Plastic and Rubber	0.0321	20.00
Textile	0.0078	4.87
Wood	0.0022	1.35
Leather	0.0032	2.02
Cardboard	0.0046	2.86
Non-combustible Waste	0.0241	15.04
Total	0.160	100

Combustible waste of about 33.62% consist of about 2.52% paper, 20.0% plastic and rubber, 4.87% textile, 1.35% wood, 2.02% leather and 2.86% cardboard respectively. The high value of the plastic waste may be attributed to the life style of the residents in the small university town. There is a high dependence on water packaged in plastic bottles and plastic sachet for drinking water and the use of plastic bags for carrying provisions and food items purchased from the market. The paper waste was also significant with respect to other waste and stood at about 2.52%. The incombustibles waste of 15.04% consists of steel materials, metal tins used for food packages, aluminum, glass and ceramics.

The dumpsite option is currently applied in Amassoma. There is currently no organised waste management system. The residents dispose their waste by themselves and a large number of residents patronise hand cart operators. When waste is generated, residents store them in external waste bins and call on the hand cart operators and when there is delay in the hand cart operators turning up for collection of the waste, they burn them in open air without pollution control and others dispose their waste in the environment. Hence waste is seen disposed indiscriminately on any piece of unused land and around the market place. Oral interviews were conducted on the residents in order to seek their opinions about the issue of solid waste. They mentioned the aesthetic loss from the unsightly condition resulting from indiscriminate disposal of solid waste in the environment, but no one expressed serious concern about health. This can be explained by the fact that loose litter and garbage in the street are a normal part of their daily life. Every one interviewed said that they would like to see an improvement in solid waste management and a large percentage indicated that they would be ready to pay some fee if it would improve cleanliness of the environment.

This work revealed as earlier mentioned that the current waste management system in Amassoma is the dump site waste disposal and open air burning without pollution control. This is not sustainable as it does not bring financial returns at the end point of the waste. Amassoma is a riverine community, hence the dump site option will result in adverse environmental effect such as incubation of pathogens and euthrophication. The study showed that 51.34% of garbage is from domestic source in Amassoma. This indicates that Amassoma is a ready source of feed stock for composting (organic recycling). There is therefore need for the establishment of a composting system in the town. Hence, the integrated waste management system consisting of recovery, recycling, composting and incineration with energy recovery will be the best waste management option in Amassoma.

It is obvious that funding is a major constraint in solid waste management; hence special attention should be paid to financial planning by the waste management authorities in Bayelsa state for Amassoma. The government should create special fund for research and development of integrated waste management system which include incineration with energy recovery. Since Amassoma is a riverine community the residents will benefit from incineration of waste with energy recovery in agro-products processing.

Waste management is a complex part of the society and therefore requires a comprehensive approach. The Bayelsa state government should formulate and implement policies that would encourage the participation of private sector in waste disposal and management as this cannot actually be handled by the public sector alone. The policies should make integrated waste management mandatory. The private sector should be made to provide a clear plan involving waste resource recovery, recycling, composting and incineration with energy recovery for agro product processing. This will also help to create job opportunities as new ideas will be injected

Conclusion: The study showed that 0.16kg of solid waste is generated per person per day (ppd) in Amassoma. The study also revealed that about

51.34% of compostible, 30% of recyclable and 33.62% of combustible solid waste is generated from domestic sources in Amassoma. Considering the results obtained from this study, an integrated solid waste management system consisting of recovery, recycling, composting and incineration with energy recovery processes is the best option of solid waste management for Amassoma. In addition the result obtained indicate that there is need for urgent attention to be paid to the issue of solid waste management as the adverse environmental effect resulting from the indiscriminate disposal of waste in Amassoma is on the increase. Moreover, this urgency is further necessitated by the increase in waste generated as a result of the daily influx of people from other parts of the country due to the establishment of the Niger Delta University in Amassoma.

*Recommendation:*Presently, in Amassoma public awareness on solid waste issues is very poor. Public awareness needs to be improved. This can be achieved using various means such as integration of environmental education with emphasis on solid waste into school curricula beginning with elementary/primary school. Other means that could be employed include messages in churches and mosques, notices in church and mosque bulletins and environmental sanitation enlightenment by radio and television stations. Town hall meetings could also be employed in the campaign. These are plausible and financially feasible methods that can be used for increasing public awareness in Amassoma.

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