Municipal Solid Waste Composition in Urban Municipality: Case Study of Parit Raja

Mohammed Sani Yusuf[1], Radin Maya Saphira Radin Mohamed[2], Anwaruddin Ahmed Wurochekke[3]

Faculty of Civil and Environmental Engineering[1]
Universiti Tun Hussein Onn
Johor, Malaysia.
muhammad.saniyusuf@yahoo.com

Faculty of Civil and Environmental Engineering[2]
Universiti Tun Hussein Onn
Johor, Malaysia.
maya@uthm.edu.my

Faculty of Civil and Environmental Engineering[3]
Universiti Tun Hussein Onn
Johor, Malaysia.
yadembo02@yahoo.com

Abstract—**Solid waste management (SWM) is acknowledged as one of the most challenging issues faced by both the developed and developing countries. The problems increase due to growing population in recent years which results in increased generation of waste compositions. The aim of this study was to determine the current waste compositions at selected areas of Parit Raja municipality for improvement of waste management system. Compositional analysis of MSW was done covering 20 households which was categorized in 3 zones and 3 restaurants respectively. Types of waste components from the study area were determined by sorting out method. Results from the analyses indicate that the average majority of waste composition at the 3 zones was organic (53%). Recyclable wastes (plastic, paper, metal and wood/cardboards) make up 44% and the remaining 3% was miscellaneous component. Similarly, at the 3 restaurants the average majority of waste composition was organic (68%), while the recyclable wastes (plastic, paper, metal and wood/cardboards) make up 30% and the remaining 2% was miscellaneous component. These reveal high compositions of organic waste stream at the study area. Hence to enhance present and indeed future sustainable SWM the followings are recommended applicable mitigating measures :(i) Enhance food composting under controlled conditions to a state of sufficiently stable for nuisance free-storage and handling. This reduces the volume of MSW destined for disposal at landfills and yields agricultural manure. (ii) Design an intelligent system such as sensorised waste collection container meant for content estimation and collection optimization (iii) Enforcement of waste legislation and (vi) Continuous public awareness campaign on waste related issues such as separation of wastes at source for easy recycling reduces adverse environmental impact.**

Keywords—composition; generation; municipal solid waste; huosehold; restaurant

I. Introduction

The development of waste management strategy for any urban city or town requires the knowledge of the amount of waste generated and composition of the waste stream. In other words, it is necessary to know the intrinsic qualitative and quantitative characteristics of generated municipal solid waste such as physical and chemical compositions. This may pave way in predicting future solutions associated with solid waste problems. Municipal solid waste (MSW) is defined to include refuse from households, non-hazardous waste from industrial, commercial and institutional establishments (hospitals inclusive), market waste yard waste and street sweeping [1]. On the other hand municipal solid waste management (MSWM) refers to collection, transfer, treatment, recycling, resource-recovery and disposal of generated wastes from urban/rural areas. Urbanization, increase in population number and rising standards of living worldwide have significantly contributed to the expanding composition of waste generation and also to the degree of its complexity especially in developing nations like Malaysia [2, 3].

However [4] observed that in India, these factors have greatly influence the tremendous increase in waste generation in cities across the country. Economic development and population growth have increased the rate of waste composition in Beijing [5]. According to [6], stated that waste is the most visible environmental problem in many urban areas of Southeast Asian Nations (ASEANs). This is due to the fact that the region has been experiencing rapid urban growth, economic development and industrialization since in the late 1980s which result in increased generation and composition of solid waste.

According to [7] stated that the estimated quantity of MSW produced worldwide is 1.7 to 1.9 billion metric tons.

Municipal solid waste (MSW) collection and disposal is presently the main problem in urban environment worldwide. The reasons are due to lack of appropriate MSWM which leads to significant soil, water, air and aesthetic pollution, associated human health problems, as well as an increase in green house emission [8]. The outbreak of plaque in India in 1994 was as a result of the invasion of flea-bearing rats feeding from waste containers situated near a housing complex following the closure of solid waste disposal dump [9].

Hence for integrated solid waste planning, it is indispensable to indicate solid waste generation and its composition from the communities [10, 11]. Consequently, solid waste management system (SWMS) needs to be updated to suit the waste quality, quantity and composition [12]. The composition of generated waste is extremely variable as a consequence of seasonal, lifestyle, demographic, geographic, and legislation factors which increase or decrease its volume. This variability's makes defining and measuring the composition of waste more difficult and at the same time more essential [13].

The goals of municipal solid waste management are to promote the quality of the urban environment, generate employment and income, and protect environmental health and support the efficiency and productivity of the economy [1]. Solid waste management is the application of suitable techniques to execute the functions of collection, transport, processing, treatment and disposal of solid waste [14]. The process of solid waste management involves five stages namely generation, sorting, collection, storage, transport and disposal of waste [15]. Similarly, [16] stated that it is a process of solid waste collection and subsequent transfer, treatment and disposal and recycling. Thus, generally solid waste management refers to the process of sorting, storage, collection and haulage of discarded materials (either for recycling or) for final safe disposal in sanitary landfills.

Local authorities in Malaysia have been responsible for solid waste management services in their various areas of jurisdiction [17]. However, over the years due to various constraints in infrastructure, institutional setup, financial and technical resources led to privatisation process by the Malaysian government in 1996. The composition of Malaysian MSW changes with time due to its tropical climate which is hot and humid throughout the year [2] as can be seen in Table 1. The existence of Universiti Tun Hussein Onn Malaysia near Parit Raja, led to rapid development of the town in both socioeconomic aspect and population growth which increases MSW production from the municipality.

The main objective of this study is to evaluate the present solid waste composition within selected households and restaurants in Parit Raja municipality. The overall aim is to determine the composition and effectiveness of waste management system. Thus, enhance environmental quality, encourage resource re-use and waste minimisation. It is therefore of vital importance to study the current state of municipal solid waste and challenges it faces from the study area for future planning and management purposes within the municipality.

TABLE 1. Composition of MSW from various researchers in Malaysia: (Chua et al., 2011).

Types of waste	2003	2004	2005	2007	2010
Food waste & organic	37.4	49.3	47.5	42.0	43.5
Mix plastic	18.9	9.7	-	24.7	25.2
Mix paper	16.4	17.1	18.5	12.9	22.7
Textiles	3.4	-	2.13	2.5	0.9
Rubber/lather	1.3	-	-	2.5	-
Wood	3.7	-	4.41	5.7	-
Yard wastes	3.2	-	2.72	-	-
Ferrous	2.7	2.0	-	5.2	2.1
Glass	2.6	3.7	-	1.8	2.6
Pampers	5.1	-	3.81	-	-
Others	5.3	18.2	21.93	2.6	1.8
Total	100	100	100	100	100

II. Materials and Method

Easy accessibility for collection of generated wastes at the households and restaurants from the study area was achieved through the map of site selection zones as indicated in Figure1.

Fig. 1. Map of Site Selection Zones

Generated waste compositions were collected at the site selection zones as per following distributions indicated in table 2 and sampling category was done according to [18] method, as indicated in Table 3.

TABLE 2. Site Selection Zones

Zone	Identification	Houses	Restaurants
One	Parit Raja	10	1 (KFC)
Two	Taman U	5	1(Al-Azhar
Three	Quarters	5	
-	Melewar Quarters UTHM Campus		1(TSN)
Total		20	3

TABLE 3. Sampling Category

Type of Waste	Category
Paper	paper, book and printed materials
Pack	packing materials
Can	can, jar, tin and metal
Plastic	plastic, polythene and rubber
Textile	textile, rags and jute
Glass	glass and ceramic
Vegetable Rocks	vegetable and food waste
Wood	rocks, dirt and miscellaneous wood, grass and leaves

Waste compositional analysis (sorting out) was conducted between 05/09/2013 to 05/23/2013 at Environmental Engineering Laboratory, Faculty of Civil and Environmental Engineering, Universiti Tun Hussein Onn, Malaysia.

The experimental system of waste mitigation process includes polythene bags for waste collection, weighing balance, hand gloves, goggle and nose mask for protection purposes during sorting out. Thus the study employed a physical site survey and sampling of wastes as data collection tools targeting 20 households and 3 restaurants in order to ascertain types of generated waste. For sorting of waste composition, polythene bags were used for collection of generated wastes within 24 hours and analyzed at Environmental Engineering Laboratory. Using weighing balance, total weight of generated waste from each bag was found and recorded. The waste was then spread on a clean plastic material and segregation was done by hand from which the corresponding weights for each type of waste from the selected households and restaurants were obtained and recorded [17]. Percentage weight for each waste component was then calculated.

III. Results and Discussions

Followings were the results of waste analysis for households and restaurants.

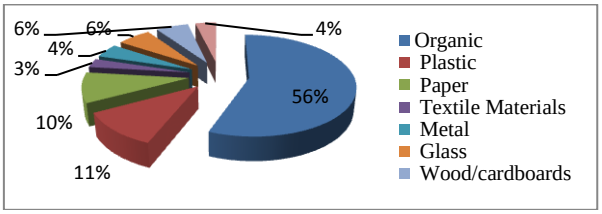

Fig. 2. Municipal Solid Waste Compositions Zone 1

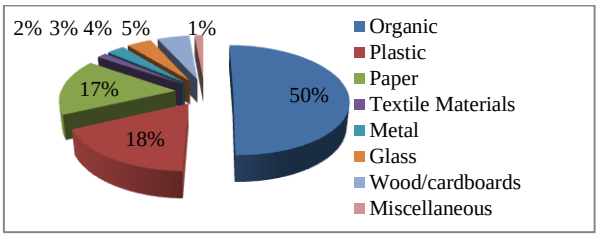

Fig. 3. Municipal Solid Waste Compositions Zone 2

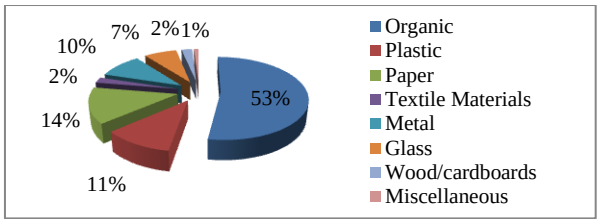

Fig. 4. Municipal Solid Waste compositions Zone 3

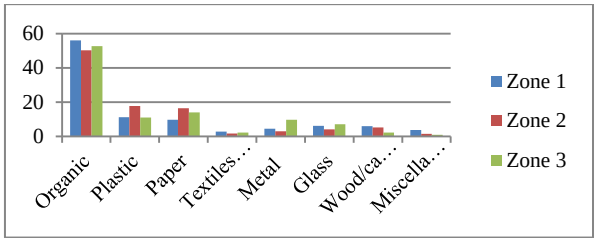

Fig. 5. Summary (%) of MSW Compositions at Zone 1-3

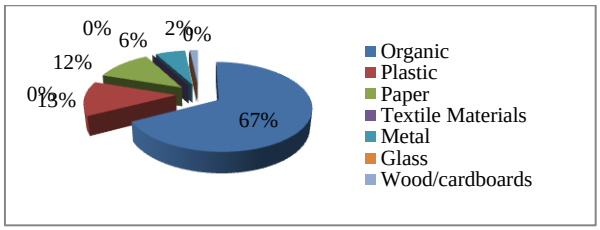

Fig. 6 Municipal Solid Waste Compositions TSN Cafeteria

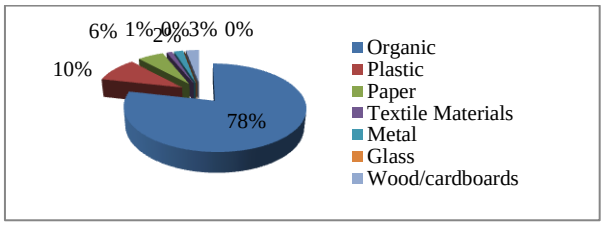

Fig. 7. Municipal Solid Waste Compositions Al-Azhar Restaurant

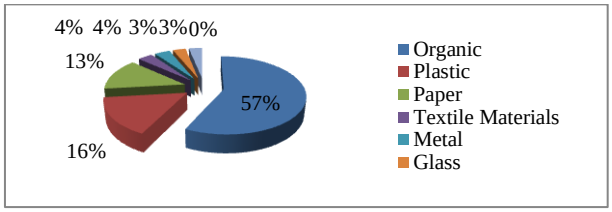

Fig. 8. Municipal Solid Waste Compositions KFC Restaurant

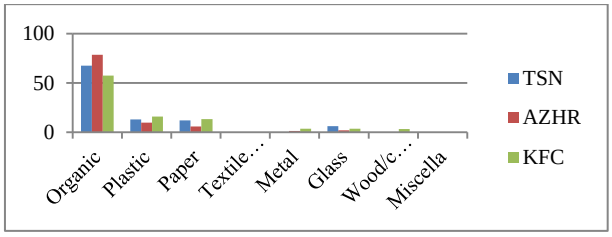

Fig. 9. Summary (%) of MSW Compositions for the 3 Restaurants

Since waste is a by-product of human activities its composition in term of location and individual habit is expected to vary widely. MSW composition is no exception as it can be seen by the wide range of percentage for each type of waste presented in figures 1-8. This variability can be explained by different collection method and management strategies by diverse people and consequently the amount of waste generated varies accordingly with every usage. Figure 10 shows the overall summary of MSW Compositions at the study area from which the highest waste component was organic (68%) from restaurants as against 53% from the households. Organic wastes were generally generated when there was a gathering of people at restaurants, festivals, political and other social activities.

The same pattern was observed, plastic (13%), paper (12%) and textile materials (2%) were found to be similar at both households and restaurants. The reason for these similarities (plastic and paper) was because of rapid usage of the materials at both households and restaurants [19]. Other components which differ were metal (6%, 4%), glass (6%, 1%) and wood/cardboards (6%, 3%) for households and restaurants respectively. Metal, glass and wood/ cardboards differs from plastic and paper due to their high cost of production and transportation while plastic/paper has great potential of being recycled, cheap, easy to manufacture and carry.

In some zones such as zones 2 and 4, percentage contribution of waste compositions (78%, 67%) was high due to the presence of UTHM student hostels.

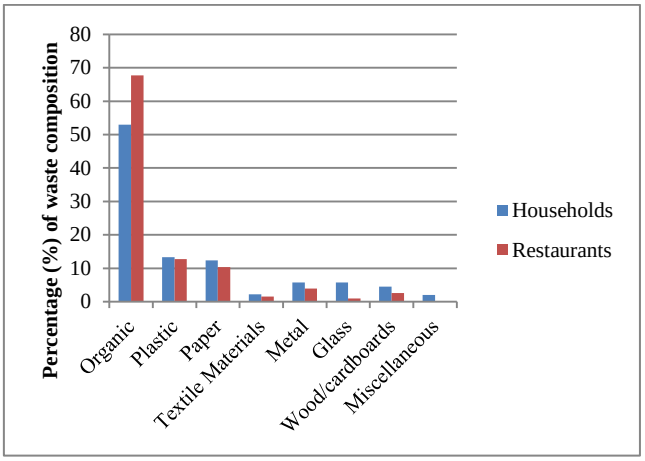

Fig.10. Overall Summary of MS W Compositions at the Study Area

However, producers should aim at using more recycled materials and less new extracted raw materials as industry best practice. Consumers from businesses as well as households should separate their waste at source for easy recycling thereby lessening adverse environmental impact. Recycling of organic wastes into compost manure can be used to substitute chemical fertilizer in urban agriculture. This reduces the volume of waste generation as well as water pollution by leachate either from landfills or chemical fertilizer. Local Government Authority/private partners should provide more waste disposal containers and be placed at different locations of the municipality to counteract illegal open waste disposal.

IV. Conclusions

In general, the average waste composition at households was organic (53%) by weight. Recyclable wastes (plastic, paper, metal and wood/cardboards) make up 44% while the remaining 3% was miscellaneous component. Similarly at restaurants the average waste composition was organic (68%), while the recyclable wastes make up 30% and the remaining 2% was miscellaneous component. MSW recycling and agricultural compost manure may serve as promising strategies in term of significant savings, reducing the risk of air and water borne diseases especially in urban areas. However, some important questions may arise regarding MSW re-use such as acceptability with regard to cultural values, affordability and financial benefits. Answers to these questions can be addressed by public awareness, seminars and training activities related to solid waste management.

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