

Solid Waste Composition Study at Taman Universiti, Parit Raja, Batu Pahat

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Abstract. Solid waste management is recognised as one of the most challenging issues confronted by both the developed and developing countries. The problems rise due to growing population in current years which results in increased generation of waste with various compositions. The aim of this study was to determine the waste compositions at Taman Universiti. Taman Universiti is a mix residential and commercial area which a preferred residential location amongst students and lecturers due to its proximate location to UTHM main campus. The waste collection was carried out for 50 houses on a daily basis. The collection and sorting out method was conducted according to Malaysian Standard MS 2505:2012 and the data was collected and recorded. The result showed that the average generation rate of household waste at Taman Universiti was 0.16kg/person/day and the moisture content was approximately ranging from 61%-68%. Household wastes collected were categorized and it consisted of food and organic, paper, rigid plastics, plastics film, baby diapers, glass, tetra pak, household hazardous waste, metal, rubber, textiles, garden waste and leather. The proportion of each wastes were approximately 64.67%, 9.36%, 9.22%, 5.33%, 3.51%, 2.53%, 1.37%, 1.05%, 0.84%, 0.85%, 0.80%, 0.27%, and 0.23%, respectively. Results from the analyses indicated that the food and organic waste are the major composition of household waste at Taman Universiti followed by the paper, rigid plastics, and plastic film. Meanwhile, the proportion of baby diapers, glass, tetra pak, household hazardous waste, metal, rubber, textiles, and garden decreasing accordingly. In addition, leather was recognized as the least category that contributed to the household waste.

Keywords: Waste composition, household waste, waste generation.

1. Introduction

Malaysia as a developing country has experiencing various urban transformations and rapid growth economy in parallel to extension of latest technology over the last decade. As a result, the waste generation in Malaysia has been increased gradually since year 2000 according to a report by the Ministry of Housing and Local Government. The source of the wastes may come from residential, institutional, or commercial sources which also known as Municipal Solid Waste (MSW).

According to Law of Malaysia [1] solid waste is defined as any scrap material or rejected product due to any application of any process, any substance that needed to be disposed of as being worn out, broken, contaminated or anything that is required by the authorities to be disposed of, and exclude wastes, sewage and radioactive materials. Municipal solid waste commonly disposed through



landfilling method or incineration which only about 2% of the waste generation is recycled or treated by biological composting [2].

The household waste (HW) is an important part of the municipal solid waste (MSW) stream [3]. Since household waste is the main source of MSW, therefore reliable information related to HW generation and composition is necessary to develop a 3Rs approach. In many part of developing country, the composition of household waste also reveal the trends of waste reuse and recycling habit which is in practice as informal act. In addition, the socio-economical conditions of the certain households and urban society also may be measured regarding to household waste capacity. Increment of the income will effect the consumption pattern of household which resulted the changes quantities and composition of household waste.

Municipal solid waste is referring to garbage generated by household and commercial sources. There are three sources of municipal solid waste in Malaysia including domestic, commercial and industrial solid waste. The wastes that come from households and public areas, including waste collected from residential buildings, litter bins, streets, marine areas and country parks are known as domestic solid waste. Meanwhile, commercial solid waste is the waste which comes from shops, restaurants, hotels, offices and markets in private housing estates and the other waste which is generated by all industries, but does not include construction and demolition waste, chemical waste or other special waste is called as industrial solid waste.

Initially, the trends of MSW generation in Malaysia have been studied since the early 1980s. Due to rapid population and economic growth, generation of Malaysia MSW has increased by more than 91% over the past 10 years [4]. The 36.73% of wastes are household waste, 28.34% industrial and construction wastes, and 34.93% of waste comes from other sources based on collection in central and southern regions of Malaysia [5]. A bulk density above 200 kg/m³ and a high moisture content proves that Malaysian solid waste contains a very high concentration of organic waste. However, based on a waste characterization study, found that the major components of Malaysia MSW are foods, papers and plastics where it covers 80% of overall weight [6]. Therefore, continuous effort is essential to identify a prudent management approach to minimize the burden of existing MSW disposal systems.

Household waste is normally defined as waste that is produced by normal household activities [7]. Household wastes are consisted of food/organic, paper, plastics rigid, plastics film, baby diapers glass, tetra pak, household hazardous waste, metal, rubber, textiles, garden, and leather. Municipal waste management have to allocate most cost to household waste since it is one of the major sources of municipal solid waste [8]. Increasing amount and complexity of waste has become one of numerous challenges faced by the waste management sector globally. Therefore, the environment will be effected in term of its quality if household waste and supermarket waste are not disposed or recycled properly.

Besides, information on waste composition is essential in accessing possible choice for sustainable waste disposals, reuse and recycling. Due to the unknown pathways of waste streams in the environment especially with all the existence of various waste system and management as well as limited survey possibilities, the detailed information on the Malaysian waste composition is rather under developed and doubtful accuracy. Knowledge of solid waste necessary knowledges vital for an effective management of urban solid waste [9] [10]. However based on the previous study, waste composition in Malaysia is known to be dominated by putrescible wastes which insert processed kitchen waste and food waste are included mainly in rural landfills, followed by paper waste and plastic-based waste. The recyclable items represent about 60% of total waste volume without the retrieval activity which is obviously becoming the larger amount of wastes [11]. Therefore, in this study organic waste such as food waste are estimated to be the dominant in the wastes category.

2. Materials and methods

The sampling boundary area, size required (number of premises), period and method of sampling, categorization and laboratory analysis was carried out according to Malaysian Standard MS 2505:2012 Guidelines for sampling of household solid waste-composition and characterisation analysis prepared by Department of Standards Malaysia. The solid waste sample was analysed in the Environmental Laboratory of Faculty of Civil and Environmental Engineering University Tun Hussein Onn Malaysia. This study was conducted by covering 41 unit of single-storey houses at Taman Universiti. A target amount of 200 kg of wastes were collected daily from the 41 houses (Figure-1).

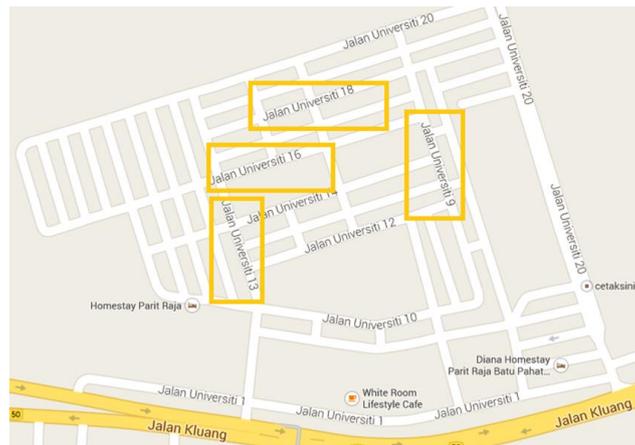


Figure-1. Location of selected single-storey houses at Taman Universiti.

(Source: <https://www.google.com.my/maps>)

The aim of this study were focusing on waste discarded and waste retained. The survey was conducted by distributing questionnaires to the houses owner and the number of surveys conducted were 100 % of the total number of houses to be sampled (completed survey). In addition, the survey was within the sampling boundary. As a result, the study gathered the details on household waste generation and recycling behavior, at the local level.

During the sample collection, the residents were provided with two plastic bags with label recyclable and non-recyclable on daily basis to put all their waste into these bags accordingly. The composition of solid waste disposal was identified by separating the recyclable and non-recyclable item. The collection of recycling materials occurred on the same day with other waste collection. However, the organic waste and recycling materials was ensured that they were not mixed together and there was no spillage occurred. Then, the sample waste was sorted and classified into waste composition accordingly. Goggle and face mask were used for protection purposes during sorting out.

The total weight of the waste composition was determined by weighing all the categories of household wastes. In order to have a precise reading, the waste was weighed for three times and an average value was taken. These procedures, were followed throughout the experiment. The weight of waste compositions were recorded on the worksheet classification of waste compositions and was illustrated in terms of percentage. As a result, the most abundant household waste in Taman Universiti area were determined based on the weight of the recorded wastes. The moisture sample for each categories of waste was taken by weighed it into 500 g each and recorded as wet weight of sample. Then, the wet sample was dried to a constant weight at a temperature not exceeding 105°C using oven at RECESS laboratory in Universiti Tun Huessein Onn. The sample allowed to be cooled and then weighed again to achieve the last reading. Then, the sample was recorded as dry weight of sample. As for the last step, the moisture content of each categories were determined.

3. Results and discussion

3.1 Survey

A questionnaire that consist of two sections was distributed within the sample boundary of Taman Universiti. For the first part, consists of respondents' basic informations and as for the second part, two questions regarding the household solid wastes were given. The distribution of questionnaires cover 41 number of single storey terrace houses which most of the respondents mainly consist of students and local residents. Throughout the survey, essential informations such as total number of family members living in the house, amount of recyclable items produced and recycling method practiced by the residents had been identified. Average total numbers of people living in the house ranged between 4-7 person per house.

Analysis from the questionnaire shown that kitchen waste dominates the amount of waste produced. For week one collection, kitchen waste was estimated 76kg followed by others such as papers, magazine and plastic rigid which are 10.4kg, 10.2kg, and 9.91kg respectively. The domination factor is due to the daily cooking activities by the residents. The amount of weight for other items such as newspapers (9.6kg), drinking plastics (7kg), steel can (5.2kg), others (5kg), aluminium can (4.4kg), glass bottle (4.3kg) and plastic bag (3.71kg) are decreased accordingly. Meanwhile, papers had the highest number of recyclables produced for the survey conducted during the first week of collection sample by 197 numbers followed by drinking plastics (189), kitchen waste (177), plastic rigid (119), and napkins (100) based on the survey on the estimation quantity of recyclables produced by number. The highest number of other papers produced for week one may contributed by the students who discarded their books, learning modules and used tissue papers.

Survey on the preference of recycling method by the residents in Taman Universiti indicate that most of them do not practice any of the recycling method and discarded all the wastes generated to the dustbin as comingled wastes. Some residents prefer to bring the waste such as magazine (4 houses), newspaper (5 houses), plastic drinking (5 houses), and plastic rigid (4 houses) to the recycling centre which made this method as second most popular compared to others.

Furthermore, the feedback on solid waste management and recycling in community given by the resident also stated that 12% of them agreed that the solid waste management in Taman Universiti is at satisfying level meanwhile 10% of them gave compliment for the very good service provided. However 2% from the number of residents are unhappy for the bad service and 5% of them stated that the service is not too good and need to be improved. One of the ideas suggested by the respondent in the way to improve the system is to perform daily waste collection in order to prevent any unpleasant smell coming from the wastes which will attract uninvited animals such as rat, snakes and cockroaches to their neighborhood. However, all the data collected from the survey mostly are inconsistent due to non-cooperative behavior from the respondents and also difficulties in estimating the waste produced.

3.2 Generation rates and composition

All materials discarded, whether or not they are later recycled or disposed in a landfill was considered as waste generated. The total waste collected for Taman Universiti for the first week is 231.47 kg, meanwhile for the second week is 226.07 kg which made it 228.77 kg as average. Then, this amount was calculated to a daily per capita generation rate of 0.1613 kg/person/day and 0.1575 kg/person/day for both weeks. Based on the waste generation by day, Day 1 (Monday) hold the highest number of waste being produced compared to the other day. Nevertheless, the waste productions continue to drop until day 5. Day 6 and day 7 can be considered as the lowest waste production of the week. This might be due to the weekend in which most of the residents going out which contribute to the less waste production.

The number of waste collected were classified into 15 categories throughout the week. The pie chart shows the percentage of waste by its category. Based on Figure-2, it can be concluded that the highest percentage for the first week waste collection at Taman Universiti was food waste which is 68.3%. The second highest waste being produced was plastics rigid and paper. with 8% respectively.

Next, napkins and plastics film which is 4% for each category meanwhile glass and household hazardous waste contribute to 2% of the total waste produce in Taman Universiti. Rubber, textiles, metals, glass and household hazardous waste are all considered as lowest waste production. Rubber, textiles, tetra pak and metals each contribute to only 1% of waste.

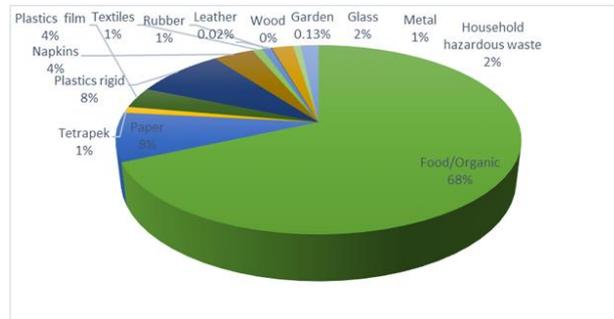


Figure-2. Composition distribution of household waste (week 1)

On the other hand, Figure-2 shows the classification of waste in Taman Universiti according to its category by percentage for the second week. The pattern of waste production is still the same compared with the first week data collection. Similar to week 1, food waste is still the highest waste being produced in Taman Universiti which is 61% in total for 7 days then followed by paper and plastics rigid by 10% for each category. Next is plastics film by 7%. The rest of the categories hold the lowest waste production. Babies diapers and glass hold by 3%, tetrapek 2% while textiles, leather, rubber and metals by 1%.

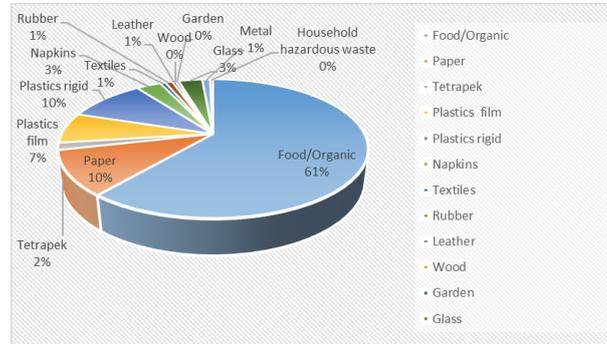


Figure-3. Composition distribution of household waste (week 2)

During two weeks collection period, a total of 228.33kg and 223.92kg of waste was sorted involving fifteen categories of household waste with average 226.13kg (Figure-3). The pattern of waste production is still the same for both sampling. Food waste still contribute most of the waste production and followed by paper, plastics film and plastics rigid. From the previous study, organic waste is also the main composition in Kuala Lumpur, Malaysia with 74% from total solid waste generation [12]. In addition, 61% from solid waste generation in Sangammer City, India is also organic waste [13]. In Pulau Pinang, Malaysia shown by United Nation Development Programme (UNDP) under administration of local council, Majlis Perbandaran Seberang Perai (MPSP) determined 63% organic waste from municipal solid waste collected under their authority area (United Nation Development Programme, Malaysia, 2008). Food wastes became main contributor of waste composition with the average from two weeks sampling time of 146.24kg.

The values of the moisture content for total waste collection in first week are 28.99% and 21.24% for the second week. Generally, the determination of moisture content of wastes may assist in obtaining water content of wastes and thus leachate from landfill not only contributed by waste

moisture but also from rain and groundwater. Furthermore, moisture content also a vital controlling parameter during the treatment process of waste incineration and composition.

4. Conclusion and recommendation

This study had successfully determined that average total rate of waste generation for two weeks was 0.16kg/person/day, of which food waste accounted for the highest proportion (approximately 61%-68%) meanwhile wood and garden accounted as the lowest. The total moisture content of solid wastes collected for the first week was 28.99% and 21.24% for the second week. The result from the waste collection showed some similarities with the result obtained by the survey which organic wastes become the highest composition followed by other papers, magazine and plastic rigid accordingly. High amount of organic waste produced in Taman Universiti need to be taken seriously, and require major concern regarding on the problem that may occur from it.

References

- [1] United Nation Development Programme, Malaysia. (2008) . Malaysia Developing a Solid Waste Management: Model for Penang. Kuala Lumpur, Malaysia.
- [2] Chen, C. C. (2005). An Evaluation of Optimal Application of Government Subsidies on Recycling of Recyclable Waste. Polish Journal of Environmental Studies. 14(2), pp.137-144
- [3] Dangi, M. B., Pretz, C. R., Urynowicz, M. A., Gerow, K. G., and Reddy, J. M. (2011). Municipalsolid waste generation in Kathmandu, Nepal. Journal of Environmental Management, Vol 92, pp.240–249.
- [4] Periathamby, A., Hamid, F. S., and Khidzir, K. (2009). Evolution of Solid Waste Management in Malaysia: Impacts and Implications of The Solid Waste. Journal of Material Cycles and Waste Management. 2009. Bill, 2007. 11 pp.96–103.
- [5] Abdullah, A. R. (1995). Environmental pollution in Malaysia: trends and prospects. Trends in Analytical Chemistry, 14, pp.191–198.
- [6] Kathirvale S., Muhd Yunus, M. N. Sopian K., and Samsuddin A. H. (2003). Energy potential from municipal solid waste in Malaysia. Journal of Renewable Energy, 29, pp.559-567.
- [7] Mbande, C. (2003). Appropriate approach in measuring waste generation, composition and density in developing areas. Journal of the South African Institution of Civil Engineering, 45, pp.2–10.
- [8] Karak, T., Bhagat, R.M. and Bhattacharyya, P. (2012). Critical Reviews in Environmental Science and Technology. Municipal solid waste generation, composition, and management: The world scenario, 42, pp.1509–1630.
- [9] McDougal, F., White, P., Franke, M. and Hindle, P. (2002). Integrated Solid Waste Management: A Life Cycle Inventory. Second ed. Oxford: BlackwellScience UK.
- [10] Zhang, H., Zhao, Y. and Qi, J. (2007). Study on use of MSWI fly ash in ceramic tile, pp.106-114.
- [11] Osman, M. S., Nasir, M. H. and Mujeebu, M. A. (2009). Assessment of municipal solid waste generation and recyclable materials potential in Kuala Lumpur, Malaysia. Waste Management, 29(7): 2209–13.
- [12] Budhiarta, I., Siwar, C. and Basri, H. (2012). Current Status of Municipal Solid Waste Generation in Malaysia. International Journal on Advanced ScienceEngineering Information Technology. 2(2), pp.2088-5334
- [13] Thitame, S. N., Pondhe, G. M. and Meshram, D. C (2009). Characterisation and composition of Municipal Solid Waste (MSW) generated in Sangamer City, District Ahmednagar, Maharashtra, India. Environ Monit Assess, 170, pp.1-5.