Solid Waste Composition and Quantification at Taman Melewar, Parit Raja, Batu Pahat

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Abstract. The poor management of solid waste is noticeable through the increasing of the solid waste each year and the difficulties in disposing the waste in the current available landfill. This study was undertaken to analyze the quantity and composition of waste generation in Taman melewar. Taman Melewar is a student residential area and this study is focusing on student's daily waste composition. The objective of this study was to identify the amount of solid waste generation, analyze and classify the composition of solid waste in Taman Melewar. The waste collection was conducted for 50 houses on a daily basis for two weeks. The average household waste generation rate was 0.082 kg/person/day. Organic waste was the major constituent of waste production. The average of organic waste represents about 72.4% followed by paper (9%), plastics film (5.5%), plastics rigid (4.7%), napkins (3.8%), tetrapek (1.3%), glass (1.1%), household hazardous waste (0.85%), textiles (0.52%), metal (0.51%) and rubber (0.34%). The moisture content was ranging from 27.67% to 28.68%. An evaluation was made based on student's behavior towards waste production and recycling. In conclusion, the results revealed that organic waste is the highest waste generated and recycling habits is also poor in Taman Melewar.

Keywords: Waste generation, waste composition, student residential area.

1. Introduction

It is to be estimated that the waste generation rate in Malaysia is about 9,092,000 tons/year as in 2020 correspondence with the increasing in population [1]. Meanwhile, based on previous study [2] the average solid waste generated per person per day in Malaysia is ranging from 0.5 kg to 0.8 kg in rural area whiles at the urban area, the average of solid waste generated per person per day at urban area is 1.9 kg. Hence the waste generation rates are increasing each year especially in the urban area. This will eventually lead to insufficient landfill and difficulties in managing the waste. In managing solid waste, it is highly important to consider the characteristic of the solid waste generated by knowing the waste composition, generation rates and sources [3]. The source of the waste generated comes from different sectors. This also may include waste from residential, commercial, industries and institutional. Statistics had showed that nearly 50% of the waste generated in Malaysia is household waste [2].

Meanwhile, according to Dinie et. al., [1] 36.73% of waste generated are from household followed by 28.34% from industrial and construction wastes and 34.93% from other sources. In summary, household waste contribute the most on the waste production. Moreover, the pattern of the

consumption of household waste is changing correspondence with the changing lifestyle of the Malaysian over the years.

In planning a good waste management, it is highly important to identify the waste composition on the household waste. Waste composition consists of variable type of materials or substances and waste composition is different on each country. Therefore, the availability of reliable data is also different and it is highly dependable on the country waste generation. Basically, household waste is a type of waste based on the normal household production. The waste production is based on day to day operations of households [4]. In Malaysia, the composition of households waste are consists of organic waste, paper, plastic, napkins, tetrapek, glass, metal, household hazardous waste, rubber, textiles, leather, garden and others waste. Furthermore, waste composition can be divided into two categories which is organic and inorganic waste. The quantity of organic and inorganic waste is depending on the country itself. The data on the waste composition is limited especially in local area. Therefore, reliable data on waste composition is highly needed.

For the past years, Parit Raja's population increased and the economy becomes more stable due to the existence of Universiti Tun Hussein Onn Malaysia (UTHM), which clearly had increased the waste generation in the area. In order to implement proper planning on Household Solid Waste (HSW) management, a study on the local needs to be done. A reliable data on the waste generation rate is difficult to achieve especially on small town or city like Parit Raja.

According to Ojeda-Benitez et.al. [5] by analyzing the household waste the waste generation rate and any potential use for recyclable wastes can be identified. Meanwhile Suthar et. al. [6] mentioned that the local resident's composition of HSW reflects their way of their living and attitude Nevertheless, the composition of waste generated are able to determine the possible treatment method and through proper management practice, the waste composition rate will be changed. The composition of the waste generated is inconsistent due to seasonal, standard of living, legislation factor and culture which makes it is more difficult in defining and measuring the waste composition rate [7]. In addition, the students are among the community living in Parit Raja. Due to that, the consumption of HSW pattern might be different.

Parit Raja is lacking of disposing facilities for recyclable items. Additionally, slum area is usually are not included in the waste collection routes by the local authorities. Therefore, the waste generated by the household is fully under the responsibility of the resident. In addition, previous paper by [8] stated that the waste generation rate in slum areas are expected to increase if the urbanization is increasing at the rate of which faster than the local authorities can handle. Without a proper guidance, this will only contribute to the household waste generation rate and eventually will worsen the household waste management. Other than that, lack of concern or knowledge among the local society especially students will eventually bring out a negative impact to the composition of the household waste. The practice of 3R concept can be determined by the composition of waste generated by the house resident. The aim of this study is to determine the waste composition of Taman Melewar, Parit Raja, Batu Pahat. This study were able to reveal the local attitude on the waste management throughout the waste composition that was collected during the investigation.

2. Materials and methods

2.1 Sampling area

The study was carried out in one of the UTHM's residential college which is in Taman Melewar. The selected area consists of student residential area. Taman Melewar is one of the UTHM's residential colleges in which accommodate about 433 students and staffs. Basically, this residential area comprised of 77 single storey terrace house. However, only 50 houses were occupied and willing to give full commitments. As for the household size, it can reach up to 8 residents per household.

2.2 Survey

A survey on the selected house needs to be done in order to identify the waste retain, the number of household members and also to seek for their permission to participate in the study. During the process of surveying, the participants were briefed regarding the survey and the procedures on the waste collection from their house. Each house that agreed to participate in this study was labeled with a reminder notes on not to discard their wastes out of the house.

2.3 Sampling method

This study was conducted according to Malaysian Standard MS 2505:2012. Since the purpose of this study is to identify the solid waste generation, the selection of sampling point will be waste as-generated. Sampling waste as-generated known as the waste that will contribute to the total amount of waste generated from the household. The waste also including both the waste kept at home for recycling or reuses purpose and the unwanted waste place at the collection point. The targeted households were provided with two plastic bags with labeled. Each plastic bag was labeled Monday to Sunday and the plastic bags also had been labeled as organic and inorganic. The waste collection process was done by collecting wastes directly from house to house. The plastic bags were collected daily for a week. The collected plastic bags (organic and inorganic) for each house were straightly weighted at the location and the data will be recorded daily. In addition, the house number of the collected waste also had been recorded for reference purpose. The organic wastes were straightly weighed and recorded. Meanwhile, the collected inorganic wastes were weighed and brought to the laboratory for sorting purposes. This procedure was repeated for one week until the minimum requirement for waste collection obtained (minimum of 50 houses or 200 kg). The collection of wastes was done twice in order to get more accurate data. The inorganic wastes were sorted accordingly into category and weighed in the laboratory. The sorting process was done daily. The collected wastes were sorted accordingly into 14 categories as listed in the Malaysian Standard MS 2505:2012 guidelines. Weighing was carried out three times and the average value was recorded in the data sheet. The weight value recorded as wet weight with a weight scale. During this process, it is important to use the personal protective equipment (PPE) to avoid any unwanted incident and hygiene purpose.

3. Results and discussion

3.1 Analysis on waste generation rate

Figure-1 represent about the total of waste collected by day on week 1. The data demonstrated on day 6 (Saturday) and day 7 (Sunday) have the least of total waste by 27.46 kg and 28.65 kg. This might be due to the outdoor activities involved by the students during weekend. The highest number of waste collected is on day 1 (Monday) with 38.87 kg. The highest inorganic waste being produced was also on day 1(Monday) with 12.44 kg, meanwhile, organic waste was highly produced on day 3 (Wednesday) with 27.5 kg. The lowest organic being produced was on day 6 (Saturday) with 17.67 kg and as for inorganic was on day 2 (Tuesday) with 7.57 kg. The overall waste collected for the total 50 houses in 7 days was 227.91 kg. The total organic waste was 160.81 kg. Followed by the inorganic waste collected for the week was 67.1 kg. In average, the waste collected for 7 days was found to be 32.56 kg per day. In conclusion, the total waste generation rate was 0.0841 kg/person/day.

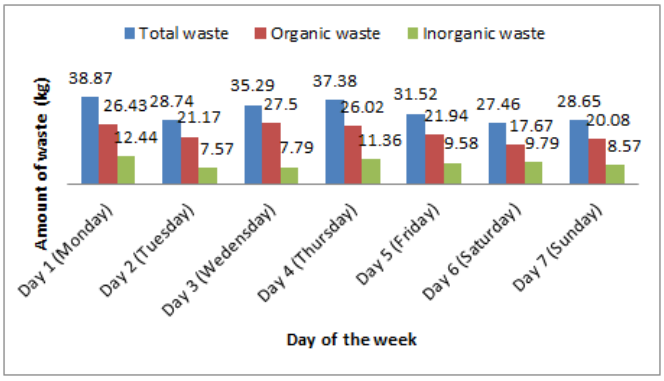

Figure 1. Data of week collection (week 1).

On the other hand, Figure-2 represents the total of waste collected by day on week 2. The waste collected for week 2 also showed the same characteristic as the sample for week 1 in which day 6 (Saturday) and day 7 (Sunday) has the least waste by 25.32 kg and 30.2 kg. The highest number of waste collected was on day 1 (Monday) by 36 kg. As for the organic consumption pattern, the highest organic waste recorded was on day 1 by 29.19 kg and the lowest was on day 6 by only 19.53 kg. Inorganic waste was the highest in day 5 (Friday) by 10.39 kg and the lowest in day 6 by only 5.79 kg. In conclusion, the overall data of waste collected for 7 days was 220.84 kg. The highest organic and inorganic waste for the week recorded was 164.47 kg and 56.17 kg. The average value of waste in 7 days period was 31.55 kg and the total waste generation rate for week 2 was 0.0815 kg/person/day.

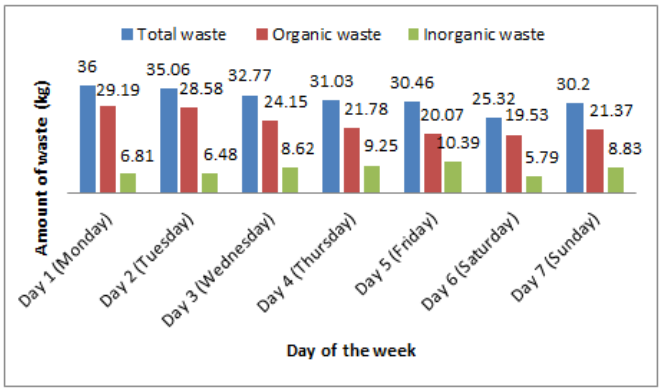

Figure 2. Data of week collection (week 2).

3.2 Waste composition

The waste composition was divided into 15 categories namely, food organic, paper, tetrapek, plastics film, plastics rigid, napkins, textiles, rubber, leather, wood, garden, glass, metal, household hazardous waste and others. Figure-3 represents the waste composition for week 1 and Figure-4 represent the waste composition for week 2. Based on the pie chart on Figure-3, the highest weight of waste collected was food waste which is 71% (160.14 kg) then followed by paper with 10% (21.03 kg). The paper waste may include boxes, newspaper, magazines and others paper. Next is plastic film and plastic rigid with 6% (14.26 kg) and 5% (11.56 kg). Plastic films consist of polystyrene, foam and the most common is plastic bags. Meanwhile plastic rigid may consists of waste from bottles, pipes, plastic toys, hard plastic, spectacles and crates. Napkins may include diapers, facial cottons and tissues. The reading for napkins was 3% (7.36 kg). Other than that, the lowest reading values of wastes were tetrapek with 1% (2.51 kg), metal with 1% (1.3 kg), textiles with 1% (1.79 kg) and glass with 1% (3 kg). Household hazardous waste recorded to be 1% (2.35 kg) and it may consist of battery and mostly medicines.

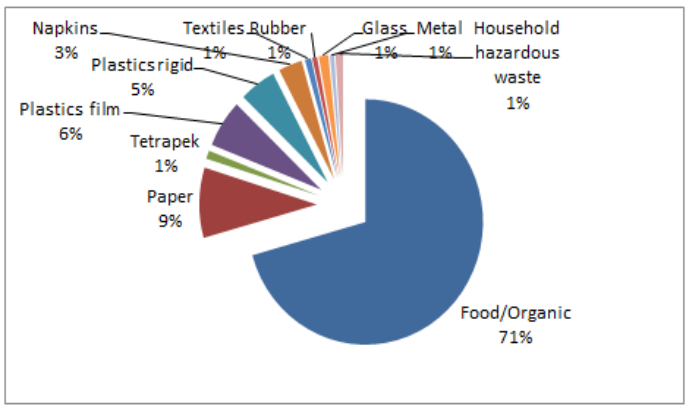

Figure 3. Waste composition for week 1.

Based on Figure-4, the highest amount of waste collected was still food waste with 74% (162.37kg) and the second highest waste collected was paper with 9% (18.99 kg). Plastic films and plastic rigids also one of the highest wastes recorded in this study which was 5% (10.25 kg) and 4% (9.5 kg). Next, napkins weight recorded was the same as plastics rigid which was 4% (9.35 kg). Tetrapek contributes to only 2% (3.27 kg) of the total waste collected. As for glass and household solid waste, it contributes 1% of total waste production. Glass value was 1.8 kg and household solid waste was 1.45 kg. Meanwhile, the lowest value of waste collected in a week is textiles with 0.5 kg followed by metal with 0.96 kg. The glass consists of mirror and glass while household hazardous waste consists of medicines, liquid fluid, light bulbs and pesticides.

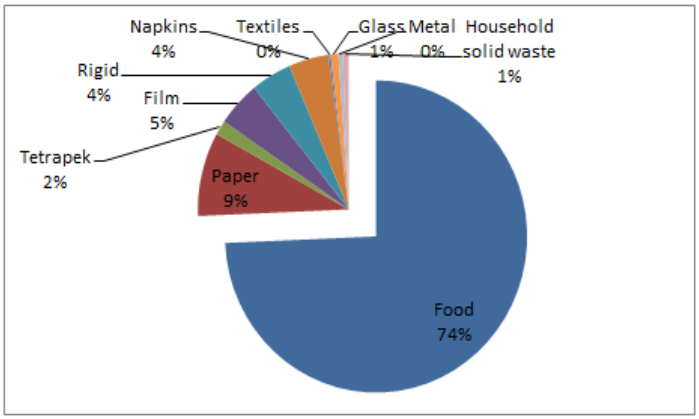

Figure 4. Waste composition for week 2.

Based on the above data, the differences of number of waste production between the food waste and other categories varied significantly as for both samples. Taman Melewar is one of the UTHM's residential colleges. Therefore, the residents of Melewar were not allowed to cook in their house. Despite the limitation, the food waste contributed most to the waste production in Taman Melewar. The high rate of food waste production might be due to the habit of the residents. This finding is also similar with the previous study that claimed production of food waste is higher mainly because food is the essential needs for people [9]. In addition, the society preferably to throw this type of waste rather than recycling it. This explained the high production of this type of waste.

3.3 Waste characterization

The moisture content for each category was determined by drying the samples for 24 hours in an oven with temperature of 105°C. 500g of each waste were taken representing the overall weight of the waste. The value of dry mass was then calculated to get the moisture content representing week 1 and

week 2. From the data, organic waste had the highest moisture content for 34%. Meanwhile, the recyclable items like tetrapek had the highest moisture content in compared with all the others categories by 37.5%. Tetrapek was used as a liquid container. Hence, this explained the higher moisture content value of the waste. Besides tetrapek and organic waste, the moisture content for napkins was 22%. The value was considerably high. Plastics film, rubber, paper and glass wastes had lower moisture content level. This might be due to their chemical compositions that do not absorb the moisture. The overall weight of waste after sorting for week 1 was 226.8 kg and as for week 2 was 218.44 kg. In summary, the value of moisture content for week 1 was 27.67% and week 2 was 28.68%. To compare with previous study, moisture content in Taman Melewar was considerably low for both weeks. Based on previous study, the moisture content for 113 households was approximately 50% [10]. Owing to the fact that the wastes collected in this study were not exposed to rain as the wastes were collected directly from the house and it is sorted properly by day.

4. Conclusion and recommendation

It can be concluded that the average household waste generation for both weeks was 0.082 kg/person/day of which food waste was dominating the waste generation rate in Taman Melewar. The waste generation rate in this study was low compared with previous study. The result was indirectly proved that the bigger the households are, the lower the daily waste generation rate.

The average food waste accounted for the highest proportion by 72.4% (161.26 kg) and the least was rubber by 0.34% (0.75 kg). Among the recyclable items, paper fraction accounted for the highest proportion about 9% (20.01 kg) followed by plastics film and plastics rigid by 5.5% (12.26 kg) and 4.7% (10.53 kg). Other than that, the average napkins production was 3.8% (8.36 kg). In addition, tetrapek, household hazardous waste and textiles average value was 1.3% (2.89 kg), 0.85% (1.9 kg) and 0.51% (1.15 kg). Meanwhile, glass and metal were comparatively low. Glass was about 1.1% (2.4 kg) and metal was only 0.51% (1.13 kg). The study also revealed that the moisture content was ranging from 27.67% to 28.68%. These values were representing from two weeks of sampling.

The results had proven that the residents of Taman Melewar have a poor practice in recycling. In addition, the high rate of the production of food waste needs to be addressed carefully. The high in number of recycling waste like paper and plastics reveals the most of the residents do not practice the 3R concept which is reuse, reduce and recycle. Improper waste facilities might be one of the reasons to the poor waste segregation. Proper waste facilities need to be provided in order to increase the recycling waste. Without a doubt, waste segregation is highly important. By segregation, not only it will help the waste sorters, it will also help to improve the selection of recyclable items. There are many parts of the wastes that are useful in terms of economic and environment. The future research is highly needed in order to gain more reliable information regarding household waste composition and generation rate.

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