A STUDY ON SOLID WASTE MANAGEMENT AT UNIVERSITI MALAYSIA PAHANG (UMP), GAMBANG CAMPUS

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ABSTRAK

Pada masa kini, jumlah penduduk di muka bumi saban hari semakin meningkat dan peningkatan ini telah menyumbang kepada masalah dalam pelbagai sektor dan tidak terkecuali masalah terhadap alam sekitar jika ianya tidak dikawal dengan sebaiknya. Segala jenis benda yang dihasilkan daripada sumber yang tidak digunapakai akan diklasifikasikan sebagai sisa. Institusi juga merupakan salah satu punca bagi menjana sisa. Kajian ini telah dijalankan di tiga kafeteria di Universiti Malaysia Pahang Kampus Gambang iaitu Kafeteria Kimia, Kafeteria Kolej Kediaman 1(KK1) dan 3 (KK3), dan Kafeteria Kolej Kediaman 4 (KK4). Kajian ini dijalankan bertujuan untuk mengkaji dan menentukan komposisi sisa pepejal . Kajian ini juga dijalankan bagi mendapatkan data-data sisa pepejal yang dihasilkan di kawasan institusi , kadar penjanaan dan juga faktor-faktor yang mempengaruhi kadar penjanaan sisa pepejal. Sisa pepejal yang telah dikumpul telah dikeringkan dan berat diambil berdasarkan kategori yang telah dibuat iaitu sisa makanan, kertas, gelas, aluminium dan lain-lain. Selain daripada itu, terdapat lebih kurang sepuluh soalan soal selidik telah diedarkan kepada 300 orang responden termasuk pelajar, kakitangan dan juga pekerja di Universiti Malaysia Pahang. Soal selidik ini dibuat bertujuan untuk mendapatkan maklumat dan pendapat serta pandangan daripada orang ramai mengenai kesedaran terhadap sisa pepejal. Pada akhir pengumpulan data, semua data akan dianalisis dengan menggunakan kaedah statistik dan hasil daripada analisis akan dinilai, dibincangkan dan diringkaskan. Menurut kajian ini, hasil sisa pepejal yang dihasilkan semasa cuti semester bagi tempoh tujuh hari berturut-turut di Kafeteria Kimia adalah sebanyak 7kg/minggu manakala bagi Kafeteria KK1 dan KK3 adalah sebanyak 5.15kg/minggu manakala bagi Kafeteria KK4 adalah sebanyak 7.85kg/minggu. Bagi jumlah sisa pepejal yang dihasilkan semasa semester dijalankan di Kafeteria Kimia adalah sebanyak 38.3kg/minggu, manakala bagi Kafeteria KK1 dan KK3 adalah sebanyak 64.7kg/minggu dan bagi Kafeteria KK4 adalah sebanyak 83.2kg/minggu. Komposisi sisa makanan menunjukkan nilai yang paling tinggi berbanding komposisi lain. Faktor-faktor lain yang mempengaruhi sisa pepejal dikawasan kajian adalah kerana kawasan tersebut merupakan kawasan yang dipenuhi dengan pelajar, kakitangan serta pekerja lain yang makan di kafeteria yang disediakan di dalam Universiti Malaysia Pahang Kampus Gambang.

ABSTRACT

Nowadays, the population is increasing and this increase contributed to problems in various sectors and no exception to the environment if not controlled properly. All types of objects generated from unused resources will be classified as waste. Institutions are also one of the sources to generate residuals. This area of study was at three cafeteria at Universiti Malaysia Pahang Campus Gambang that are Chemical Cafeteria, Kolej Kediaman 1(KK1) and 3(KK3) Cafeteria, and Kolej Kediaman 4(KK4) Cafeteria. This study was conducted to study and determine the composition of solid waste. This study also to obtain data on solid waste generated in the institution, and also the generation of the factors that influence the rate of solid waste generation. The solid waste that has been collected has been dried and weight was taken based on the composition of food waste, paper, glass, aluminium and others. In addition, there are approximately ten-question questionnaire was distributed to 300 respondents including students, staff and workers in the Universiti Malaysia Pahang. The questionnaire was aimed at obtaining information, opinions and views from the public on the awareness of solid waste. At the end of data collection, all data will be analyzed using the statistical method and the results of the analysis will be evaluated, discussed and summarized. According to this study, the results of solid waste generated during the semester break for the seven consecutive days in Chemical Cafeteria was 7kg /week while for KK1 & KK3 Cafeteria was 5.15kg /week while for KK4 Cafeteria was 7.85kg /week. For the amount of solid waste generated during the semester is carried out in the Chemistry Cafeteria was 38.3kg /week, while the cafeteria KK1 & KK3 was 64.7kg /week for the Cafeteria and KK4 was 83.2kg /week. The composition of food waste shows the highest value compared to other compositions. Other factors that affect solid waste in the study are because the area is filled with students, staff and other workers eating at the cafeteria provided at Universiti Malaysia Pahang Campus Gambang.

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LIST OF SYMBOLS

%	Percent
Kg	Kilogram
Kg/day	Kilogram per day
Kg/week	Kilogram per week

LIST OF ABBREVIATIONS

3R	Reuse, Reduce, Recycle
UMP	Universiti Malaysia Pahang
KK1 and KK3	Kolej Kediaman 1 and Kolej Kediaman 3
KK4	Kolej Kediaman 4
PVC	Polyvinyl chloride
am	Ante meridiem: Before noon
pm	Post meridiem: After noon

CHAPTER 1

INTRODUCTION

1.1 Introduction

The people of Peninsular Malaysia produced 30,764 tonnes of solid waste per day from 36,659 tonnes of solid waste a day for all of Malaysia including Sabah and Sarawak based on data released in 2014. More than 45.5 percent of wastes dumped into landfills are from organic waste and this is becoming more serious from year to year with the growing population of Malaysia. Major sources that are produced waste are from residential premises, commercial premises and business, establishments, street sweepings, institutional premises such as school, collages, hostel, hospitals and the others. Food waste can be converted into useful components such as soil fertilizer and biomass gases sources. Due to various constraints, source separation for food waste in waste recycling is not commonly practiced in Malaysia.

Waste can be considered as substance or objects which are disposed and may be defined as unwanted materials, from various sources, namely animal and human activity are discarded as unwanted and useless. Waste may be form in solid, liquid or gaseous form and its viewed as a discarded material which has no consumer value to the person.

Solid waste means its consists of both solid and liquid waste but it cannot be classified as waste water. The term that usually used to describe non-liquid waste material arising from domestic, trade, commercial, agriculture and industrial activities and also from public services are solid waste. Solid waste also consists of any refuse, sludge from wastewater treatment plant, water supply treatment plant or air pollution control facility or other discarded materials including solid, small amounts of solid,

semi-solid or contain gaseous materials resulting from industrial, commercial, mining and agricultural operations and from community activities.

Any urban solid waste which is biodegradable and non-degradable but is not corrosive, toxic, ignite or reactive is considered non-hazardous solid waste materials known as non-hazardous waste.

1.2 Problem Statement

In Malaysia, every day the solid waste generated is growing as a result of the ongoing economy as well as the growing economy and the rapidly growing economy throughout Malaysia which leads to the improvement of living standards and the population in the area.

Solid waste generated by UMP residents is to much in the cafeteria on a daily basis because they do not practice the 3R concept (Reuse, Reduce, Recycle). It is because of no ongoing campaign about disadvantages not practice the 3R concept among the students themselves, staff and employees.

Lack of awareness is also one of the causes of environmental pollution resulting from solid waste because of the casualness practiced. For example, most of students and staff of Universiti Malaysia Pahang themselves want to wrap the food using the prepared plastic which will result to a large amount of waste generated at Universiti Malaysia Pahang (UMP). This leads to the addition to the production of plastic materials.

1.3 Objectives

The purpose of this study are as follows :

i. To determine the composition and the total quantity of the waste generated in three cafeteria in Universiti Malaysia Pahang, Gambang campus.
ii. To identify the awareness level among the UMP students, staff, cafeteria owner, workers and hostel management.

iii. To provide the potential recommendation to improve the level of solid waste management in Universiti Malaysia Pahang Gambang Campus.

1.4 Scope of the Study

This study have been conducted in three cafeteria in Universiti Malaysia Pahang, Gambang Campus that are Chemistry Cafeteria, Kolej Kediaman 1(KK1) and 3(KK3) Cafeteria and Kolej Kediaman 4(KK4) Cafeteria. The solid waste collected from the cafeteria and have been dried before weighed according to the composition that has been made. The composition of the solid waste are food waste, paper, plastics, glass, aluminium and others. The data was collected based on peak hour and off peak for a week during semester break(off peak) and a week during the semester session(peak). While for the questionnaire, there are 300 respondent that was given the responded based on the question that asked and need to give their opinion based on the solid waste in the cafeteria.

1.5 Significance of the Study

By identifying the type of composition of solid waste that produced in each study area and feedback from the responded, so the solution have been made on how to reduce and managed the solid waste. The type of waste and the amount generated will be studied so that the existing system can be improved in order to reduce the solid waste in the study. Reuse, reduce and recycle (3R) campaigns can be improved and expanded so that awareness arises in everyone because this is the best way to reduce waste.

The reuse of solid waste such as water bottles, beverage cans, food waste and so on can reduce the production of solid waste in the cafeteria area as well as nurture the importance of green technology within each individual.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter was provided the literature review for the research on the Solid Waste Management in Cafeteria Universiti Malaysia Pahang (UMP), Gambang Campus. There are three parts was discussed wherein the first part was discussed about the sources and the types of solid waste. The types of organic and inorganic waste was provided at the second part and for the last part, the factor affect the generation rates of waste that produce by staff, students and workers was discussed.

2.2 Solid Waste

Waste can be considered as substance or objects which are disposed of or intended to be disposed of or required to be disposed of. Waste is defined as unwanted materials, leftovers from any human activities, refuse from plant, human or animal habitation. Waste is also defined as superfluous and has no further user value to its owner (Bagchi, 2017).

It may exist in the form of solid, liquid and gaseous. Solid waste is also a term often used to describe a non-liquid waste that results from trading activities, domestic, agricultural and industrial, commercial and also from the public services.

Municipal solid waste is less harmful than other types of waste in terms of both human health and the environment but depends on the process of how it is produced.

2.3 Classification of Solid Waste

Solid wastes are the organic and inorganic waste materials such as product packing, grass clipping, furniture, clothing, bottles, kitchen refuse, paper, appliances, paint cans, batteries and the other else produced in a society, which do not generally carry any value to the first users. Solid wastes, thus, encompass both a heterogeneous mass of wastes from the urban community as well as a more homogeneous accumulation of agricultural, industrial and mineral wastes. While wastes have little or no value in one setting or to the one who wants to dispose them, the discharged wastes may gain significant value in another setting (T. V. Ramachandra, 2006).

While organic waste can be defined as material that is biodegradable and comes from either a plant or animal. It can still be used if managed according to proper procedures. The garbage can be decomposed and breaks down into smaller and odourless sizes known as compost. Leaves, straw and grass are examples of compost ingredients produced. Organic waste is also divided into two types: wet organic waste such as vegetables and organic waste dry that contain little water content. Timber, twigs and dry leaves can be categorized as organic waste dry.

Inorganic waste is waste material that is no longer used. These ingredients are made up of non-renewable natural sources. Examples of non-renewable natural sources are minerals and petroleum or from industrial processes. The usual inorganic wastes generated in our environment are glass bottles, plastic bottles, plastic bags and cans.

2.3.1 Source based Classification

Solid waste can be classified based on its source as residential, agricultural, commercial, industrial, institutional or healthcare waste. The classification of waste as hazardous or non-hazardous and also as biodegradable or non-biodegradable also have been stated. Another word used in the context of biodegradable solid waste is putrescible, which means the waste decomposes (rots down) quite quickly. Waste can also be described as combustible or non-combustible depending on whether it will burn or not. The table below classifies waste using these different properties.

The source of solid wastes have been consistent, dependent on sectors and activities and these include the following :

i. Residential : This refers to wastes from dwellings, apartments and the other else, and consist of leftover food, vegetable peel, plastic, clothes, ashes and the other.

ii. Commercial : This refers to wastes consisting of leftover food, glasses, metals, ashes, generated from stores, restaurants, markets, hotels, motels, auto-repair shops, medical facilities and the other else.

iii. Institutional : This mainly consists of paper, plastic, glasses that are generated from educational, administrative and public buildings such as schools, colleges, offices and prisons.

iv. Municipal : This includes dust, leafy matter, building debris, treatment plant residual sludge. It also generated from various municipal activities like construction and demolition, street cleaning and landscaping.

v. Industrial : This mainly consists of process wastes, ashes, demolition and construction wastes, hazardous wastes and the other else that due to industrial activities.

vi. Agricultural : This mainly consists of spoiled food grains and vegetables, agriculture remains, little. It is generated from fields, orchards, vineyards and farms.

It is important to define the various types of solid wastes that are generated from various sources (T. V. Ramachandra, 2006)

2.3.2 Type based Classification

Solid waste may be classified into three parts of the city, where urban and industrial industry each representing a discrete entity. Solid waste sources in urban areas in human settlements have different types and quantities according to the size of the population in an area.

The division of the city is divided into two parts, which are derived from residential and non-residential sources such as commercial, institutional, service, construction and so on. The second part is the sources of materials used in economic and other related activities.

Classification of wastes based on types for an example physical, chemical and biological characteristics of wastes is as follows : (T. V. Ramachandra, 2006)

i. Garbage : This refer to animal and vegetable wastes resulting from the handling, sale, storage, cooking and serving of food. Garbage comprising these wastes contains putrescible (rooting) organic matter, which produces an obnoxious odour and attracts rats and other vermin. It therefore, requires special attention in storage, handling and disposal.

ii. Ashes and residues : These are substances remaining from the burning of wood, coal, charcoal, coke and other combustible materials for cooking and heating in houses, institutions and small industrial establishments. When produced in large quantities, is in power-generation plants and factories, these are classified as industrials wastes. Ashes consists of fine powdery residue, cinders and clinker often mixed with small pieces of metal and glass. Since ashes and residues are almost entirely inorganic, they are valuable in landfills.

iii. Combustible and non combustible wastes : These consists of wastes generated from households, institutions, commercial activities excluding food waste and other highly putrescible material. Typically, while combustible material consists of paper, cardboard, textile, rubber, garden trimmings. For non-combustible material consists of such items as glass, crockery, tin and aluminium cans, ferrous and non-ferrous materials and dirt.

iv. Bulky waste : These include large household appliances such as refrigerators, washing machines, furniture, crates, vehicle parts, tyres, wood, trees and branches.

v. Biodegradable and non-biodegradable waste : Biodegradable wastes mainly refer to substances consisting of organic matter such as leftover food, vegetable and fruit peels, paper, textile, wood and the others else that generated from various household and industrial activities. Because of the action of microorganism, these wastes are degraded from complex to simpler compounds. Non-biodegradable wastes consists of inorganic and recycles materials such as plastic, glass, can, metals and the others. Table 2.1 below shows a comparisons of biodegradables and non-biodegradables wastes with their degeneration time. The time required to break from complex to a simple biological form.

Table 2.1 : Biodegradable and Non-Biodegradable Waste : Degeneration Time

Category	Type of waste	Approximate time taken to degenerate
Biodegradable	Organic waste such as vegetable and fruit peels, leftover foodstuff and the other else	A week or two
	Paper	10 – 30 days
	Cotton cloth	2 – 5 month
	Woollen items	1 years
	Wood	10 – 15 years
Non-biodegradable	Tin, aluminium and other metal items such as cans	100 – 500 years
	Plastic bags	One million years
	Glass bottles	Undetermined

From Table 2.1, we can easily deduce the environmental consequences associated with non biodegradable wastes such as plastics, glass and the other else. (T. V. Ramachandra, 2006)

Table 2.2 : Classification of Solid Wastes

Type	Description	Source
Garbage	Food waste : wastes from the preparation for cooking, cooking and serving of food. Market refuse, storage, waste from the handling, and sale of produce and meat.	Households, commercial and institutions concerns such as hotels, restaurants, storages , markets and the other else
Combustible and non-combustible	Combustible paper, boxes, cartons, cardboard, wood, cloth, plastic, rags, bedding, leather, grass, rubber, leaves, and yard trimmings	
	Non-combustible (primary inorganic) tin, glass bottles, metals, cans, crockery, stones	
Ashes	Residue from fires used for cooking and for heating building cinders	
Bulky wastes	Large auto parts, stoves, tyres, refrigerators, other large appliances, large crates, furniture, trees, branches, stumps	Streets, alleys, sidewalks, vacant lots and the other else
Street wastes	Street sweepings, dirt, leaves	
Dead animals	Cats, dogs, donkeys, rats	
Abandoned vehicles	Automobiles and spare part	
Construction and demolition wastes	Roofing and sheathing scraps, broken concrete, rubble, plaster, wire, conduit pipe, insulation	Construction and demolition sites
Industrial wastes	Solid wastes are resulting from industry processes and manufacturing operations, such as boiler house cinders, food processing wastes, wood, plastic and metal scraps, shavings	Power plants, factories
Hazardous wastes	Pathological wastes, explosives, radioactive materials	Households, institutions, hospitals, industry, stores
Animals and agricultural wastes	Manure, crop residues	Farms, livestock, feedlots and agriculture
Sewage treatment residue	Coarse screening grit, dewatered sludge, septic tank sludge	Sewage treatment plants and septic tanks

2.4 Waste Composition

Solid waste generated from residential and commercial sources are heterogeneous with respect to the physical and chemical composition. Over the last 50 years, the most dramatic changes have occurred where the increasing use of organic materials, paper, plastic and also waste materials. Solid waste components of various sizes, from the smallest dust until large items such as tires, furniture, bottles and others.

In addition, non-flammable and non-flammable materials such as glass, metal and ceramics are largely from solid waste streams. Other than that, waste composition is also influenced by external factors, such as geographical location, the population's standard of living, energy source, and weather. Generally, all low and middle income countries have a high percentage of compostable organic matter in the urban waste stream. (Bagchi, 2017)

2.4.1 Food Waste

Food supply chains begin from the primary agricultural phase, proceed with manufacturing and retail, and end with household consumption. During this life cycle, food is lost or wasted because of technological, economic and/or societal reasons. The definitions of "food waste" and "food loss" within the supply chain have been a subject of disagreement among related scientists. According to the European Union (EU) Commission Council Directive 2008/98/EC, "waste" is defined as "any substance or object, which the holder discards or intends or intends or is required to discard". According to the Foresight Project report prepared by the Government Office for Science (Foresight Project, 2011), food waste is defined as "edible material intended for human consumption that is discarded, lost, degraded, or consumed by pests as food travels from harvest to consumer". (Otles, Despoudi, Bucatariu, & Kartal, 2015)

In summary, all kinds of leftovers that we do not want to eat is a waste of food. These waste will be taken to the landfill for disposal. The food waste will attract pests such as flies, rats, cockroaches and other urban wildlife. These pests will spread germs and will affect health. On the landfill, harmful gases will be generated and these gases pollute the air and also not good for the environment.

Figure 2.1 : Food waste (Source : GRACE Communications Foundation)

2.4.2 Paper

Paper is a kind of material or material made of natural plant fibres called cellulose. It comes from cloth rags and also grass. Nowadays, paper has been produced from wood. Paper is a versatile item that has many uses. Often paper is used for printing, writing, packaging and so on. Due to the very widespread use of paper, various types of paper have been produced and improved quality to the dye, print and coatings.

Better use of paper is easy to print on writing things to make them easier to understand and recycle. In addition, it is light and easy to carry. The paper also has some disadvantages that cannot withstand when exposed to water and are easily damaged. Additionally, papers are made from wood and at the same time will cause the deforestation. This will lead to global warming.

Following are the process of paper :

i. Timber

- The wood used is taken from forests that have been managed to ensure sustainable growth when the tree has been taken can be planted with new trees.

ii. De- Barking Drum

- Bark is stripped from the logs by knife, drum, abrasion, or hydraulic barker. The stripped bark is then used for fuel or as soil enrichment.

iii. Chipper

- Stripped logs are chipped into small pieces by knives mounted in massive steel wheels (used in chemical pulping process). The chips pass through vibrating screens, whereby both undersized chips, dust etc and oversized chips are rejected. Accepted chips are then stored in huge bins ready for the next process.

iv. Thermomechanical Refiner

- This is where the cellulose fibers pass through a refining process which is vital in the art of papermaking. Before refining, the fibers are stiff, inflexible and form few bonds. The stock is pumped through a conical machine which consists of a series of revolving discs. The violent abrasive and bruising action has the effect of cutting, opening up and declustering the fibers and making the ends divide. This is called fibrillation. In this state, the fibers are pliable and have greater surface area, which significantly improves the fiber bonding. The properties of the paper are directly related to the refining process. Refining used to be called beating.

v. Paper Making Machine

- The Paper Machine is a very large piece of machinery. A typical machine is about the length of two football pitches and around 4 meters wide. The machine itself consists of 7 distinct sections.

(Dr. Surendra Kumar, 2009)

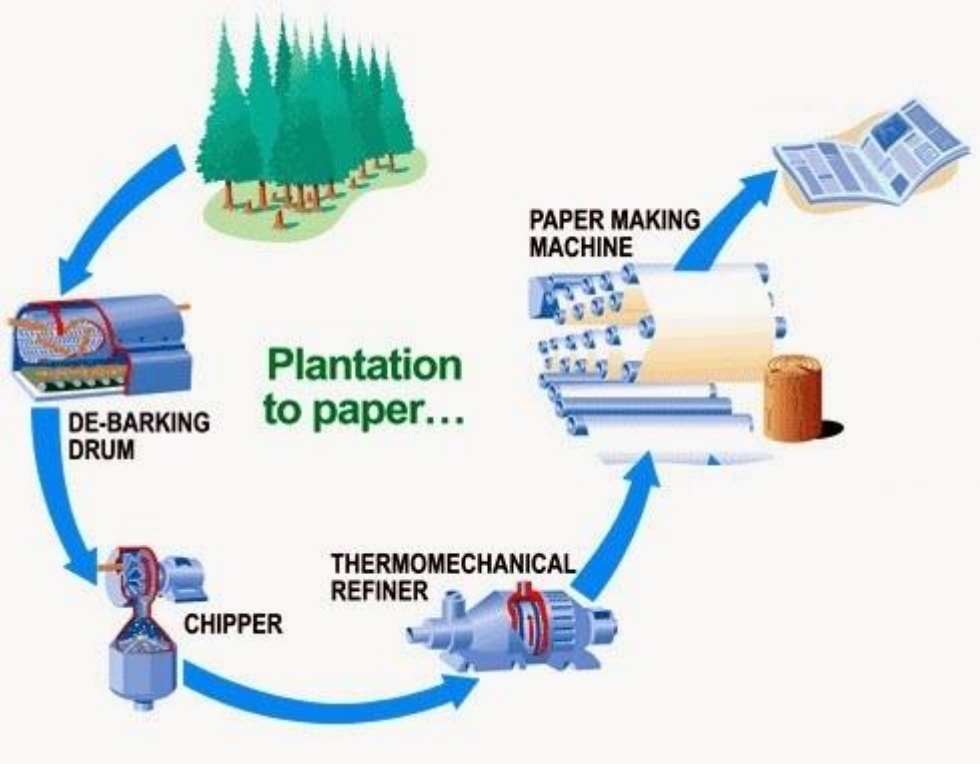

Figure 2.2 : The paper making process diagram (Ivan Mizanul, 2016)

2.4.3 Plastics

Plastic is a material that is familiar in the daily life of human beings and can not be separated. Every day, the amount of plastic used in the world is increasing. Its low density, strength, user-friendly designs, fabrication capability, long life, light weight and low cost are the factors behind such phenomenal growth. Plastics have been used in packaging, industrial applications and automotive, flood prevention, medical desalination, housing and other uses.

Plastics are widely used in everyday life because it has some advantages which is versatile because it is suitable for many things such as wrapping food, facilitating carriage of goods and not easily tearing. In addition, it is light and easy to carry. Its production costs are also relatively low and plastic is the preferred ingredient by many people.

Figure 2.3 : Plastic at landfill (Source : National Geographic)

Table 2.3 : Uses of plastics and recycles plastics (Rafat Siddique, 2008)

Name of plastic	Description	Some uses for plastic	Some uses for plastic made from recycles waste plastic
Polythylene terephthalate (PET)	Clear tough plastic, may be used as a fiber	Soft drinks and mineral water bottles, filling for sleeping bags and pillows, textile fibres	Soft drink bottles. (multi-layer) detergent bottles, clear film for packaging, carpet fibers, and fleecy jackets.
High density polyethylene (HDPE)	Very common plastic, usually white or colored	Crinkly shopping bags, freezer bags, milk and cream bottles, and cream bottles, bottles for shampoo and cleaners, milk crates	Compost bins, detergent bottles, crates, mobile rubbish bins, agricultural pipes, pallets, kerbside recycling crates
Unplasticised polyvinyl chloride (UPVC)	Hard rigid plastic	Clear cordial and juice bottles, blister packs, plumbing pipes and fittings	Detergent bottles, tiles, plumbing pipe fittings
Plasticized polyvinyl chloride (PPVC)	Flexible, clear, elastic plastic	Garden hose, shoe soles, blood bags and tubing	Hose inner core, industrial flooring
Low density polyethylene (LDPE)	Soft, flexible plastic	Lids of ice cream container, garbage bags, garbage bins, black plastic sheet	Film for builders, industry, packaging and plant nurseries, bags
Polypropylene (PP)	Hard, but flexible plastic – many uses	Ice cream containers, potato crisp bags, drinking straws, hinged lunch boxes	Compost bins, kerbside recycling crates, worm factories
Polystyrene (PS)	Rigid, brittle plastic. May be clear, glassy	Yoghurt containers, plastic cutlery, imitation crystal “glassware”	Clothes pegs, coat hangers, office accessories, spools, rules, video/CD boxes
Expanded polystyrene (EPS)	Foamed, light weight, energy absorbing, thermal insulation	Hot drink cups, takeaway food containers, meat trays, packaging	

Plastic give a bad impact that also noteworthy because the use of potentially harmful chemicals has been used to produce plastic intended for stabilizers or colorants. Most of the plastics produced do not undergo a predetermined assessment of environmental risk assessment and the effects that will affect human health and the environment become uncertain.

For example, phthalates are used in the PVC manufacturing process. Among the materials used to produce most children toys are PVC and it is likely that the toys will be sniffed and put into the mouth of the child. This will affect the health of the child. Plastics also take a long time to decompose itself once they are landfills. The growing number of plastics used in everyday life, the greater the amount of disposal area required for the plastic to decompose itself. (Rafat Siddique, 2008)

2.4.4 Glass

The glasses used by mankind throughout most of our history have been based on silica. Glass are traditionally formed by cooling from a melt. Glasses can form by vapor deposition, by sol-gel processing of solutions, and by neutron irradiation of crystalline materials. Most traditional glasses are inorganic and non-metallic. A vast number of organic glasses are currently use. Metallic glasses are becoming more common with every passing year. Obviously the chemical nature of the material cannot be used to define a glass. (James E Shelby, 2005)

All glasses found to date share two common characteristics. First, no glass has a long range, periodic atomic arrangement. Even more importantly, every glass exhibits time dependent glass transformation behaviour. This behaviour occurs over a temperature range known as the glass transformation region. A glass can thus be defined as "an amorphous solid completely lacking in long range, periodic atomic structure, and exhibiting a region of glass transformation behaviour". Any material, inorganic or metallic formed by any technique which exhibits glass transformation behaviour is a glass. (James E Shelby, 2005)

Glass is also the same as other materials that have the advantage. Glass can be made in various sizes, shapes and colours and makes it look more expensive and attractive. Glass is also a non-rusted object and will maintain its beauty.

It is also waterproof. Every advantage must have been a disadvantage. Glass is one of the most expensive objects in comparison with plastic and paper. Additionally, it is also fragile and will melt when at high temperatures. Glass can also cause injury when it breaks. This is because the fragments of broken glass are sharp.

Figure 2.4 : The pieces of broken glass

2.4.4 Aluminium

Aluminium is the most common metal in the world and after silicon and oxygen is the third most abundant element of all. Around 8 percent of Earth's outer layer (crust) is made up of aluminium. Despite its abundance human only discover aluminium in the 19th century. Unlike metals such as a gold and silver, aluminium never occurs alone in nature. Instead, it forms compounds with other elements. To reveal the pure metal, these compounds must be broken down by an industrial process called refining, which requires a huge amount of energy. (John Farndon, 2001)

Aluminium is a metal that is shiny and silver. Its light and soft so that it will bend easily by hand. Aluminium oxide coating will be formed when the surface of the log is exposed to air. Its uses range from making chewing gum wrappers and beverage cans.

Table 2.4 : Advantages and disadvantages of Aluminium

Advantages	Disadvantages
Aluminium oxidizes quickly, and the resulting surface coat of aluminium oxide resists further corrosion, by air, water, and chemicals. This protective coating is clear, colourless, and non-staining.	Aluminium requires special processes to be welded.
Aluminium can be easily coloured by anodization, and holds paint extremely well. Aluminium can be finished in various ways.	It is abrasive to tooling, or more accurately, the aluminium oxide coating that forms upon it is.
Aluminium conducts electricity even better than copper.	It is more expensive than steel.
Aluminium is 100% recyclable without losing any of its natural characteristics.	
Aluminium has the highest strength-to-weight ratio of any metal.	
For applications where magnetism needs to be avoided, aluminium is an excellent choice.	

Figure 2.5 : Chewing Gum Wrappers

CHAPTER 3

METHODOLOGY

3.1 Introduction

All the methodology that have been used discussed in this chapter. First, all the step that involves will be describe and will follow by the data representation. There are few method that have been used to get the result from this study, such as questionnaire, sampling and characterization of the solid waste. The sample was taken from three different cafeteria out of five from the Universiti Malaysia Pahang (UMP) Gambang Campus. All the data was collected for a week for each cafeteria that have been chosen during the semester break and in semester. All the information and data was taken by recorded the weight of the categories for the solid waste.

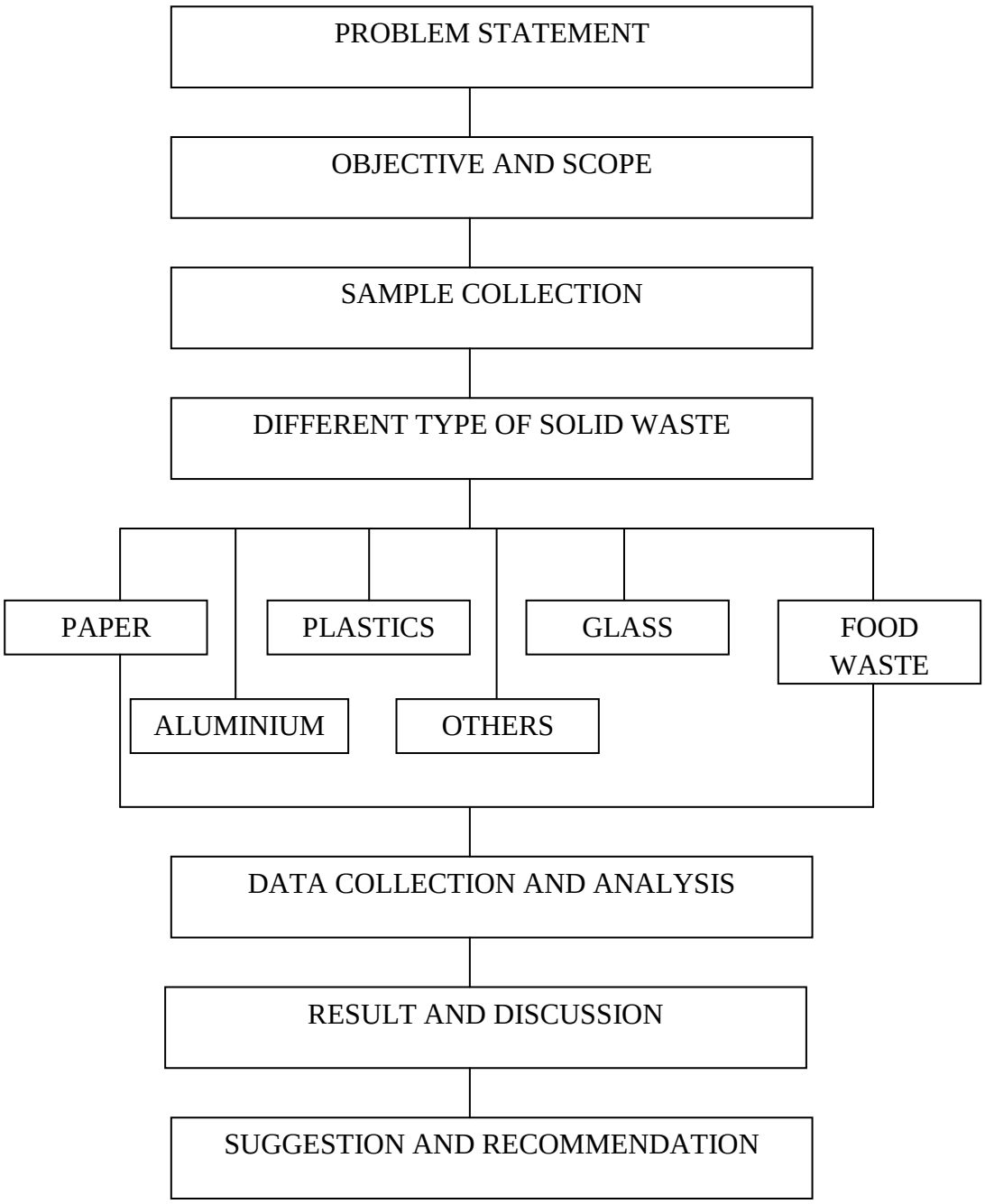

Figure 3.1 : Flow chart of the research methodology

3.2 Preliminary Stage of Study

The preliminary investigation about the peak hour of student, staffs and workers come and eat or buy at the cafeteria was recorded. The observation and data collection from the sampling and characterization of solid waste was recorded to identify the weight of solid waste that have been produced at the cafeteria that have been chosen. There are three cafeteria that have been chosen from the five cafeteria in the UMP. The selection of the cafe were made based on number of visitors because the cafe is the main choice of students and staff. The cafeteria that have been choosed are cafeteria Kolej Kediaman 1(KK1), cafeteria Kolej Kediaman 4(KK4) and chemical cafeteria.

3.3 Data Collection Method

All the information and data collection was collected from two different sources that were from the questionnaire and the second is from the sampling and characterization. This method have been used to identify the different type of solid waste from the study area. Based on the information gathered, it can be used to reduce the amount of solid waste produced by the students, staff or worker.

3.3.1 Site Visit

A site visit to distribute the questionnaire and the feed back from the students, staff or worker have been done for this study. This is very important in order to know the real situation from the different cafeteria about the condition and arrangement of the rubbish bin. From this visit also can examine whether students, staffs or workers use the bins correctly or not. The questionnaire also can detect either the consumer know how to separate the waste correctly or not or they know the type different type of waste. In the questionnaire, there were divided into three parts of questionnaire. The first part is about the general information of respondent. While the second part is the knowledge about the waste such as type of waste, how to separate the waste, how many time that they will spent at the cafeteria and the others. The last part is about the suggestion how to reduce the solid waste, how to awaken the consumer about the solid waste and either the consumer can avoid from used the solid waste.

3.3.2 Sample Collection

There are three cafeteria that have been chosen from the five cafeteria in UMP Gambang. The selected cafeteria are cafeteria Kolej Kediaman 1(KK1)and 3 (KK3), cafeteria Kolej Kediaman 4(KK4) and chemical cafeteria. This selection of cafeteria is based on the monitoring the number of students, staffs or workers randomly that are going to that cafeteria. For the cafeteria Kolej Kediaman 4(KK4) and chemical cafeteria, there are only one rubbish bin and at the cafeteria KK1 there are two type of rubbish bin. One used for waste food and the other one is for rubbish.

3.3.3 Sampling Procedure

The data and the sampling result was taken for each cafeteria from the study area. The duration of sampling taken is one week for each cafeteria during the semester and one week for each cafeteria during the semester break. This is because to get the actual amount of solid waste during peak time and during no students in the university. The sample was taken three times a day that is at 10.00am, 3.00pm and 9.00pm. The time was chosen after a peak hour. After the sampling was collected, all the sample was dried and have been segregated based on two categories that are biodegradable such as human and animal waste and food waste and the other one is non-biodegradable such as glass, plastics and metals. At the end, the waste have been weighed and the result was recorded. The overall procedure has been shown at the flow chart in Figure 3.2.

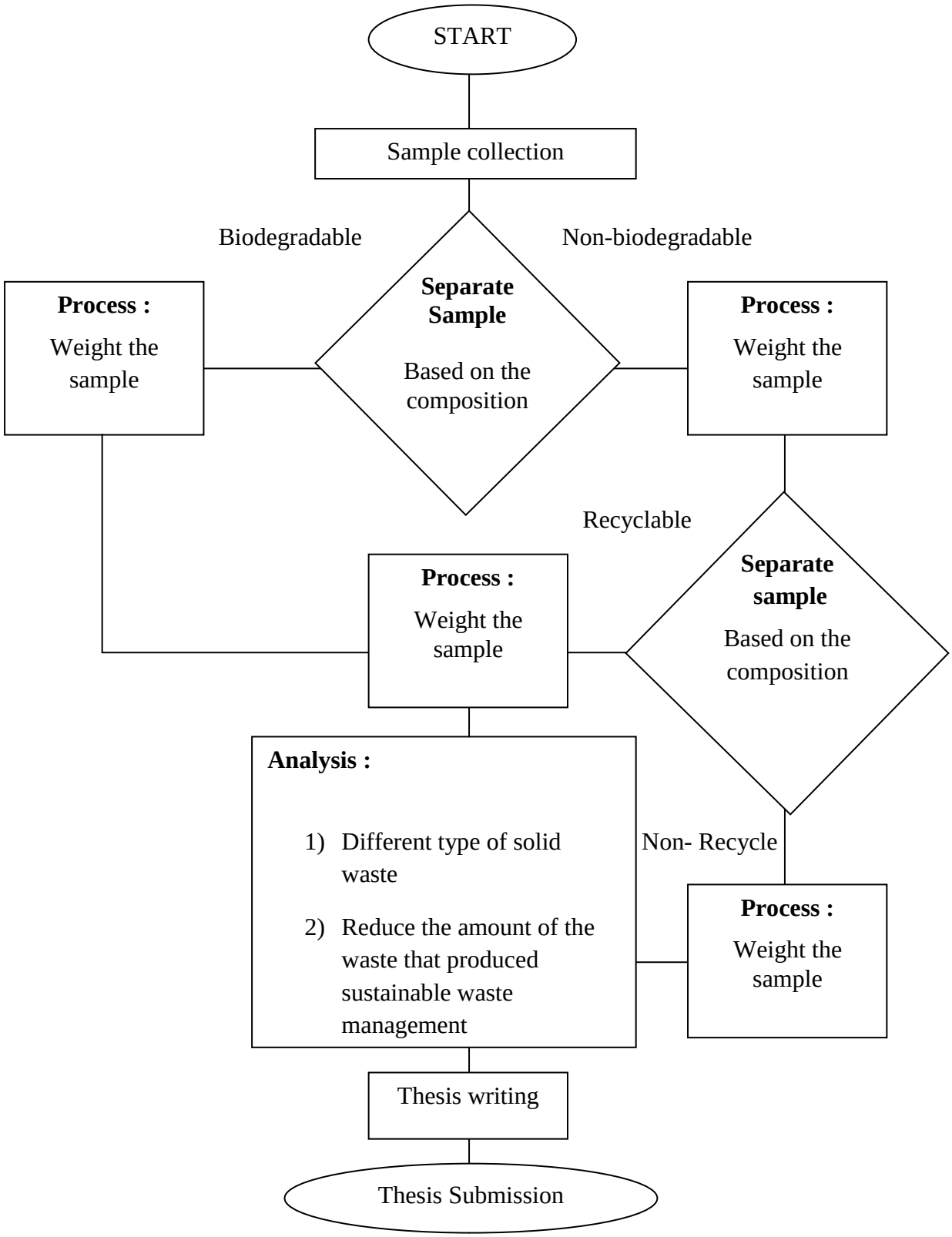

Figure 3.2 **:** Flow Chart of Sampling Method

3.3.4 Equipment

The data was collected based on the weight of each compositions in the study. The equipment that will be used in this case of study to assist the sampling are :

i. Weighing scale – used to weight the waste collected

ii. Plastics bag – every cafeteria was produced by the plastics bag to fill the waste

iii. Gloves – to separate the waste

Figure 3.3 : Weighing Scale

Figure 3.4 : Plastic bag

Figure 3.5 : Gloves

3.4 Compilation And Transfer Data

Through the questionnaire and the sampling and characterize, all the data were collected and have been arranged in separate arrangement. Based on the question that have been asked, the data will be divided and separated as appropriately.

From the questionnaire results, the data collection have been analyzed. In order to ensure the number of the questionnaire that have been collected and all the data was save and analysis the process using a computer.

3.4.1 Method of Analyzing the Data

After all the information and data have been collected, use the tables, Excel histogram and pie chart to show the results. The data from the sampling collection were recorded based on the two characterization. Which were biodegradable such as human and animal waste and food waste and non-biodegradable such as glass, plastics and metals.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, the questionnaire and the data of the sample that have been collected at the study area were analyzed. The data collection was taken to determine the solid composition produced in the study area. Solid waste composition is a prime consideration before considering any process for disposal or combustion or recycling or actions to be taken. There were three cafeterias involved in the study that are chemical cafeteria, cafeteria KK1 and KK3, and Cafeteria KK4. There are some reviews from the questionnaires made by staff, employees and students. Some of the reviews are related to the way waste management in the cafeteria. In addition, whether the campaigns that have been conducted are able to provide public awareness.

4.2 Solid Waste Generated In Each Cafeteria

4.2.1 Solid Waste Generated In Each Cafeteria during Semester Break

For this study, all solid waste has been divided into several categories and were recorded daily total for a week during semester break. As we can see in Figure 4.1, the highest amount of solid waste generated on 15 January 2018 which is about 7kg/day in chemistry café. In Figure 4.2, the highest amount is 5.15kg/day in the Kolej Kediaman 1(KK1) and 3(KK3) Cafeteria and in Figure 4.3, the highest amount is 7.85kg/day in the Kolej Kediaman 4(KK4) Cafeteria. This is because on 15 January 2018 is on Monday where all employees start working and most students have a full class schedule on the day and eat at the cafeteria to save their time.

Meanwhile, the lowest amount of solid waste as we can see in Figure 4.1 that were generated during the semester break for Chemistry Cafeteria is on 13 and 14 January 2018 which is on the weekend. No amount has been recorded because the cafeteria was closed during the weekend. In Figure 4.2, the lowest amount for KK1 and KK3 Cafeteria is 3.65kg/day on 11 January 2018. As we can see in Figure 4.3, the lowest amount that has been recorded for KK4 Cafeteria is 5.6kg/day on 13 January 2018.

Table 4.1 : Daily Solid Waste Generated in Chemistry Cafeteria during Semester Break

Type of Waste		Food Waste (kg)	Paper (kg)	Plastic (kg)	Glass (kg)	Aluminium (kg)	Others (kg)	Total (kg)
Day	**Date**							
1	9/1/2018	4.15	0.85	1.15	0	0.25	0	6.40
2	10/1/2018	3.70	1.10	1.05	0.40	0.40	0.30	6.95
3	11/1/2018	4.20	1.00	0.75	0	0.20	0	6.15
4	12/1/2018	3.55	0.75	0.75	0.35	0.45	0.60	6.45
5	13/1/2018	0	0	0	0	0	0	0
6	14/1/2018	0	0	0	0	0	0	0
7	15/1/2018	3.90	1.05	1.05	0.25	0.55	0.20	7.00

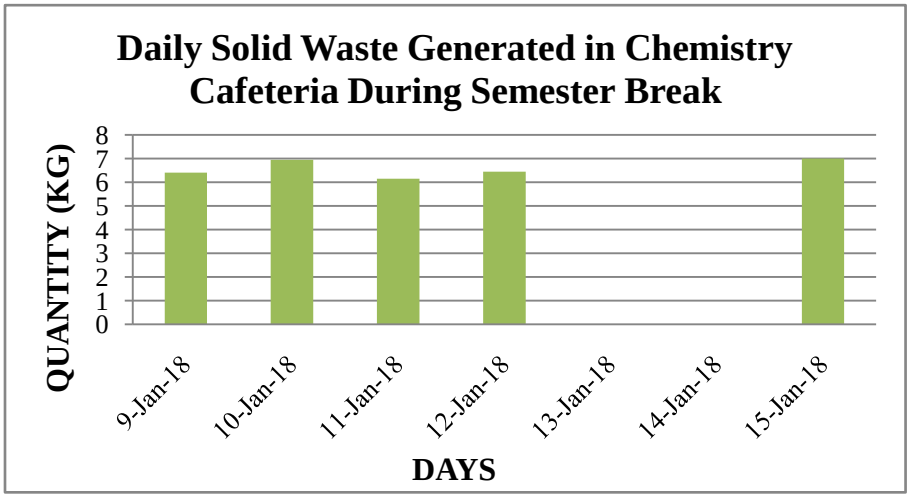

Figure 4.1 : Daily Solid Waste Generated in Chemistry Cafeteria during Semester Break

Table 4.2 : Daily Solid Waste Generated in KK1 and KK3 Cafeteria during Semester Break

Type of Waste		Food Waste (kg)	Paper (kg)	Plastic (kg)	Glass (kg)	Aluminium (kg)	Others (kg)	Total (kg)
Day	**Date**							
1	9/1/2018	1.90	0.45	0.90	0	0.20	0.40	3.85
2	10/1/2018	2.10	0.55	0.80	0.40	0.45	0	4.30
3	11/1/2018	1.90	0.45	0.65	0	0.35	0.30	3.65
4	12/1/2018	2.30	0.55	1.15	0.35	0.20	0	4.55
5	13/1/2018	2.15	0.40	0.95	0.15	0.20	0	3.85
6	14/1/2018	2.20	0.70	0.85	0	0.15	0	3.90
7	15/1/2018	2.25	0.60	0.70	0.50	0.40	0.70	5.15

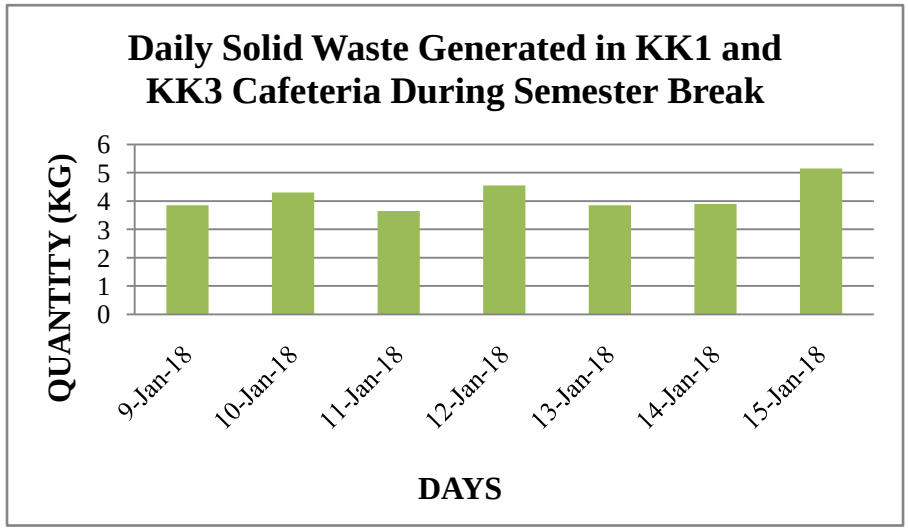

Figure 4.2 : Daily Solid Waste Generated in KK1 and KK3 Cafeteria during Semester Break

Table 4.3 : Daily Solid Waste Generated in KK4 Cafeteria during Semester Break

Type of Waste		Food Waste (kg)	Paper (kg)	Plastic (kg)	Glass (kg)	Aluminium (kg)	Others (kg)	Total (kg)
Day	**Date**							
1	9/1/2018	4.50	0.75	0.70	0.20	0.20	0.30	6.65
2	10/1/2018	4.65	0.65	0.95	0	0.15	0	6.40
3	11/1/2018	4.60	0.75	0.80	0.50	0.35	0	7.00
4	12/1/2018	4.45	1.00	0.85	0	0.50	0.50	7.30
5	13/1/2018	4.05	0.65	0.55	0.25	0.10	0	5.60
6	14/1/2018	3.85	0.45	0.85	0	0.15	0.40	5.70
7	15/1/2018	4.90	1.00	0.85	0.65	0.45	0	7.85

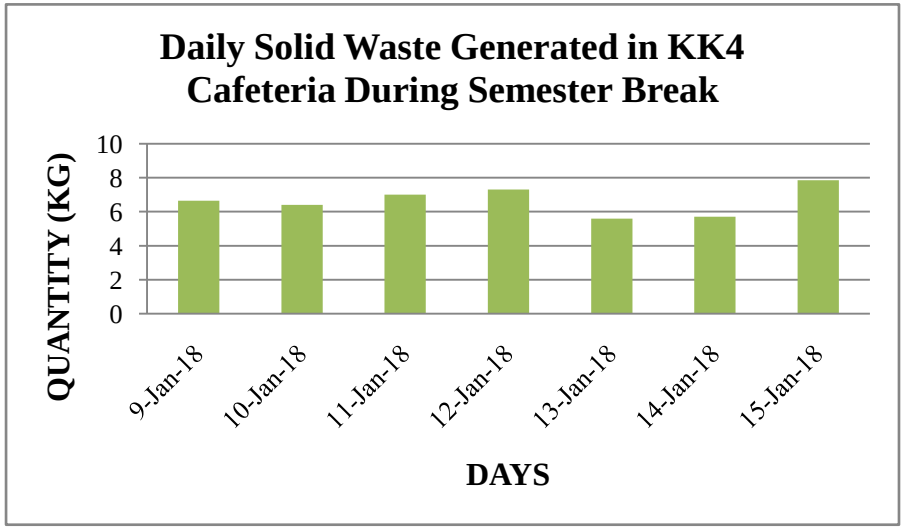

Figure 4.3 : Daily Solid Waste Generated in KK4 Cafeteria during Semester Break

4.2.2 Solid Waste Generated In Each Cafeteria during Semester Session

For this study, all solid waste has been divided into several categories and were recorded daily total for a week during semester session. In Figure 4.4 and Figure 4.5, the highest amount of solid waste generated on 28 February 2018 with each reading is 42.6kg/day and 67.3kg/day respectively. This reading was recorded at Chemistry Cafeteria and KK1 and KK3 Cafeteria. In contrast to the readings taken in the KK4 Cafeteria, solid waste weight readings are the highest recorded on 5 March 2018 with a reading of 83.2kg / day

For the lowest amount of solid waste as we can see in Figure 4.4 that were generated during the semester session for Chemistry Cafeteria is on 3 and 4 March 2018 that is during the weekend. No amount has been recorded because the cafeteria was closed during the weekend. In Figure 4.5, the lowest amount for KK1 and KK3 Cafeteria is 3.65kg/day on 11 January 2018. As we can see in Figure 4.3, the lowest amount of solid waste generated at KK1 and KK3 Cafeteria that is 41kg/day on 4 March 2018. While Figure 4.6 shows the lowest amount of waste generated for KK4 Cafeteria which is 39.6kg/day on 3 March 2018. This is because during the weekend is not a working day causing the number of visitors to cafeteria to decrease.

Table 4.4 : Daily Solid Waste Generated in Chemistry Cafeteria during Semester

Type of Waste		Food Waste (kg)	Paper (kg)	Plastic (kg)	Glass (kg)	Aluminium (kg)	Others (kg)	Total (kg)
Day	**Date**							
1	27/2/2018	27.5	2	3.3	0	0	0	32.8
2	28/2/2018	33	2.2	5.5	0.4	0.5	1	42.6
3	1/3/2018	25.6	2.7	3.9	0	0.3	0.5	33
4	2/3/2018	16.75	0.1	0.5	0	0	0	17.35
5	3/3/2018	0	0	0	0	0	0	0
6	4/3/2018	0	0	0	0	0	0	0
7	5/3/2018	30.7	1.9	4.3	0.5	0.2	0.7	38.3

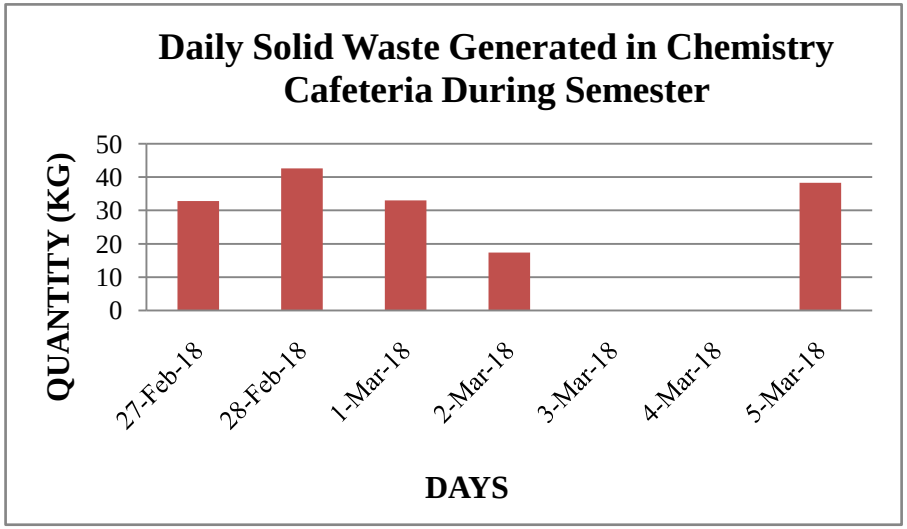

Figure 4.4 : Daily Solid Waste Generated in Chemistry Cafeteria during Semester

Table 4.5 : Daily Solid Waste Generated in KK1 and KK3 Cafeteria during Semester

Type of Waste		Food Waste (kg)	Paper (kg)	Plastic (kg)	Glass (kg)	Aluminium (kg)	Others (kg)	Total (kg)
Day	**Date**							
1	27/2/2018	45.3	5.7	12.1	0.3	0.6	0	64
2	28/2/2018	48.5	4.6	13	0	0.4	0.8	67.3
3	1/3/2018	46.1	5.7	12.5	0	0.55	0.45	65.3
4	2/3/2018	42.1	5.2	10.5	0.8	0.8	0.6	60
5	3/3/2018	30.7	2.7	7.5	0	0.1	0.2	41.2
6	4/3/2018	30	3.4	6.8	0	0.4	0.4	41
7	5/3/2018	43.8	5.7	14.1	0.3	0.6	0.2	64.7

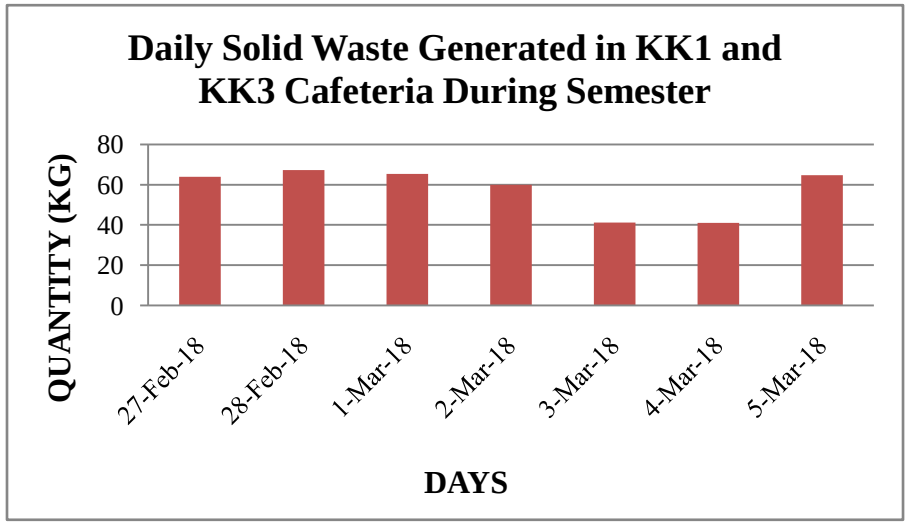

Figure 4.5 : Daily Solid Waste Generated in KK1 and KK3 Cafeteria during Semester

Table 4.6 : Daily Solid Waste Generated in KK4 Cafeteria during Semester

Type of Waste		Food Waste (kg)	Paper (kg)	Plastic (kg)	Glass (kg)	Aluminium (kg)	Others (kg)	Total (kg)
Day	**Date**							
1	27/2/2018	63.4	5.8	7.9	0	0.4	0	77.5
2	28/2/2018	69	4.5	7.3	0	0.3	0.2	81.3
3	1/3/2018	61.7	5.9	7.3	0.3	0.3	0.5	76
4	2/3/2018	49.7	3.8	4.5	1.2	0.8	0.2	60.2
5	3/3/2018	32.5	3.6	3.3	0	0.2	0	39.6
6	4/3/2018	34	3.2	3.4	0	0	0	40.6
7	5/3/2018	65.9	6.5	9.4	0.5	0.9	0	83.2

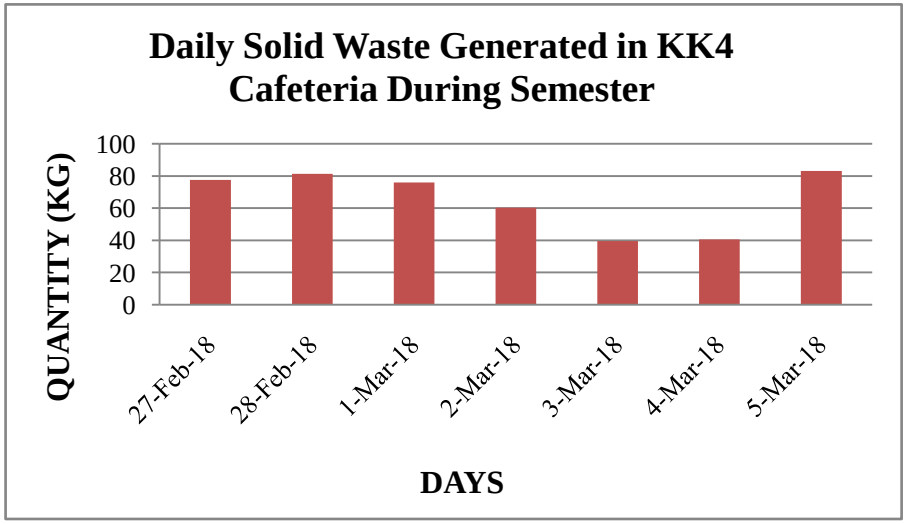

Figure 4.6 : Daily Solid Waste Generated in KK4 Cafeteria during Semester

4.3 Solid Waste Generated Detailing

4.3.1 Solid Waste Generated Detailing during Semester Break

In this study , the daily amount of solid waste generated for a week during the semester break for Chemistry Cafeteria are shown in Table 4.7. The data recorded on a daily basis shows approximately the same amount for a week except on 13 and 14 January 2018. No data was recorded on that day because chemistry cafeteria closed on every Saturday and Sunday. Solid waste recorded during the evening was higher than in the morning. Total solid waste recorded at chemistry cafeteria during semester break is 32.95kg/week. Total solid waste generated for each category can also be seen in Table 4.8. Figure 4.7 shows the percentage distribution was made based on Table 4.8. It can be clearly seen that food waste represents the highest percentage at 59% followed by 15% for paper, plastics 14%, 6% aluminium and glass and other shows the same percentage of 3%. Food waste is the highest percentage of solid waste. This is because most who visit the cafeteria produce more food waste after eating in the cafeteria.

For the KK1 and KK3 Cafeteria, the data shown in Table 4.9 recorded that the total amount of solid waste recorded for a week is 29.25kg. Total waste produced by category has been recorded in Table 4.10. The table shows that food waste is the highest waste that is 14.8kg/week compared to paper, plastic, glass, aluminium and others. The percentages shown in Figure 4.8 show that 49% of waste originated from food waste, 20% plastic, 12% paper, aluminium and other waste materials showed the same value of 7% and glass was the least produced waste is only 5%.

For data produced at KK4, Cafeteria can be seen in Table 4.11 where it shows that the data was taken and recorded in the morning and evening. The amount of solid waste produced in the evening for each category is higher than the solid waste produced in the morning except for the glass.

This is because the weight of the solid waste from the glass shows a decrease in the afternoon compared to the morning which is a reduction of 0.8kg/week. Total solid waste produced at KK4 Cafeteria is 46.50kg/week. For the data of total solid waste produced daily for each category for a week was recorded in Table 4.12.

Based on Figure 4.9, food waste produced at KK4 Cafeteria is the highest recorded value compared to the value recorded in the Chemistry Cafeteria and KK1 and KK3 Cafeteria that is 61%. Plastic and other types are the second highest value recorded at KK4 Cafeteria at 11% followed by 10% paper, 4% aluminium and the lowest rating is 3%.

Table 4.7 : Data of Solid Waste Generated at Chemistry Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Type of Waste		**Food Waste (kg)**		**Paper (kg)**		**Plastic (kg)**		**Glass (kg)**		**Aluminium (kg)**		**Others (kg)**		**Total (kg)**
Day	**Date**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	
1	9/1/2018	1.50	2.65	0.30	0.55	0.40	0.75	-	-	-	0.25	-	-	6.40
2	10/1/2018	1.20	2.50	0.50	0.60	0.35	0.70	0.40	-	-	0.40	0.30	-	6.95
3	11/1/2018	1.45	2.75	0.45	0.55	0.25	0.50	-	-	0.20	-	-	-	6.15
4	12/1/2018	1.30	2.25	0.30	0.45	0.30	0.45	-	0.35	0.45	-	-	0.60	6.45
5	13/1/2018	-	-	-	-	-	-	-	-	-	-	-	-	-
6	14/1/2018	-	-	-	-	-	-	-	-	-	-	-	-	-
7	15/1/2018	1.35	2.55	0.40	0.65	0.40	0.65	-	0.25	-	0.55	0.20	-	7.0
	Total	6.80	12.70	1.95	2.80	1.70	3.05	0.40	0.60	0.65	1.20	0.50	0.60	32.95

Table 4.8 : Data of Total Solid Waste Generated at Chemistry Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Categories	Food Waste	Paper	Plastic	Glass	Aluminium	Others
Total amount generated (kg)	19.50	4.75	4.75	1.00	1.85	1.10

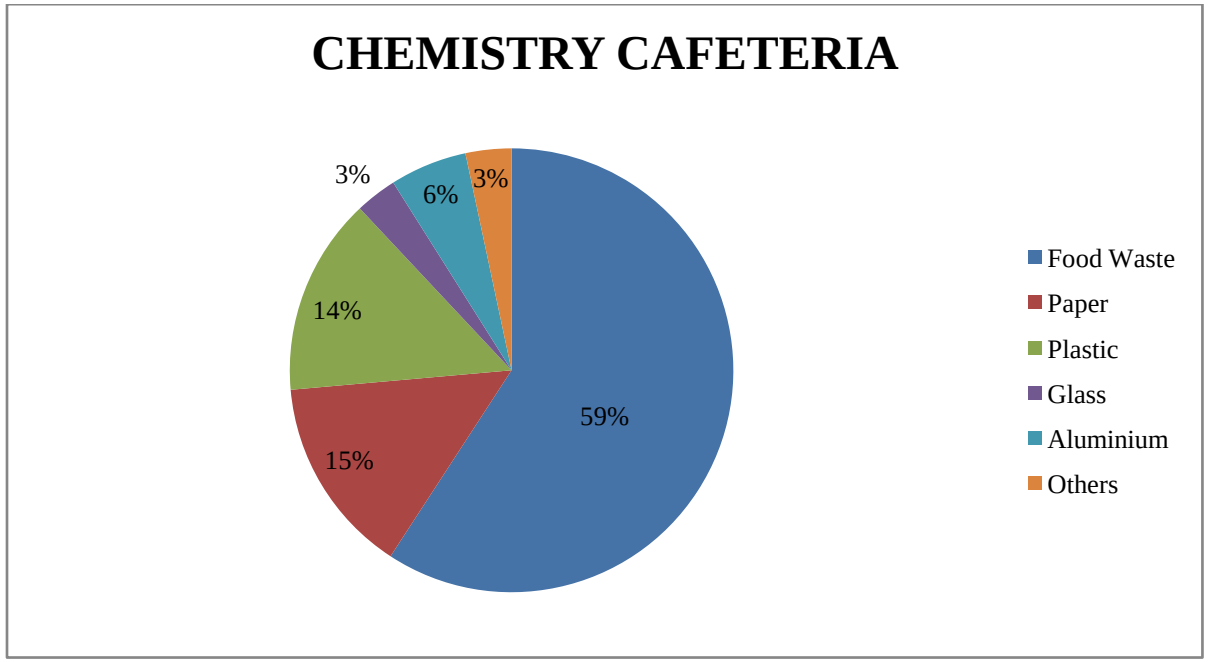

Figure 4.7 : Total of Solid Waste Generated at Chemistry Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Table 4.9 : Data of solid waste generated at KK1 and KK3 Cafeteria Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Type of Waste		**Food Waste (kg)**		**Paper (kg)**		**Plastic (kg)**		**Glass (kg)**		**Aluminium (kg)**		**Others (kg)**		**Total (kg)**
Day	**Date**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	
1	9/1/2018	0.75	1.15	0.15	0.30	0.40	0.50	-	-	-	0.20	0.4	-	3.85
2	10/1/2018	0.50	1.60	0.25	0.30	0.20	0.60	-	0.40	0.15	0.30	-	-	4.30
3	11/1/2018	0.60	1.30	0.20	0.25	0.30	0.35	-	-	0.10	0.25	-	0.30	3.65
4	12/1/2018	0.45	1.85	0.20	0.35	0.5	0.65	-	0.35	-	0.20	-	-	4.55
5	13/1/2018	0.40	1.75	0.15	0.25	0.45	0.50	0.15	-	0.20	-	-	-	3.85
6	14/1/2018	0.50	1.70	0.30	0.40	0.30	0.55	-	-	0.15	-	-	-	3.90
7	15/1/2018	0.65	1.60	0.25	0.35	0.25	0.45	0.50	-	-	0.40	-	0.70	5.15
	Total	3.85	10.95	1.50	2.20	2.40	3.60	0.65	0.75	0.60	1.35	0.4	1.00	29.25

Table 4.10 : Data of Total Solid Waste Generated at KK1 and KK3 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Categories	Food Waste	Paper	Plastic	Glass	Aluminium	Others
Total amount generated (kg)	14.8	3.7	6	1.4	1.95	2.1

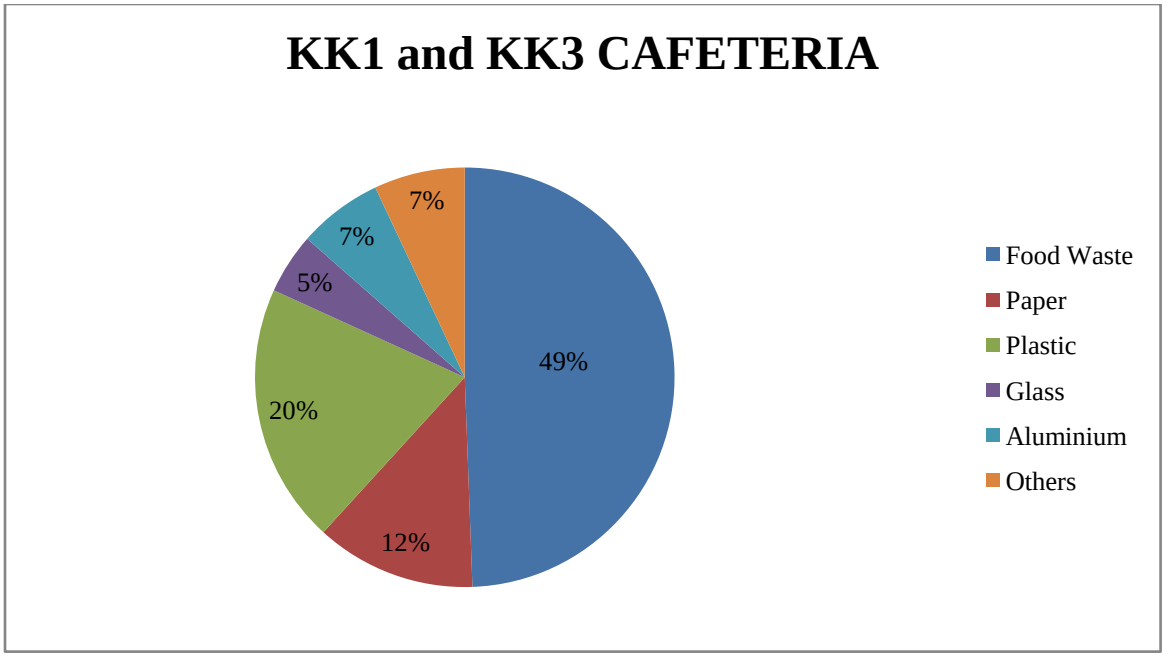

Figure 4.8 : Total of Solid Waste Generated at KK1 and KK3 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Table 4.11 : Data of Solid Waste Generated at KK4 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Type of Waste		**Food Waste (kg)**		**Paper (kg)**		**Plastic (kg)**		**Glass (kg)**		**Aluminium (kg)**		**Others (kg)**		**Total (kg)**
Day	**Date**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	
1	9/1/2018	2.00	2.50	0.30	0.45	0.20	0.50	0.20	-	-	0.20	-	0.30	6.65
2	10/1/2018	2.15	2.50	0.25	0.40	0.30	0.65	-	-	-	0.15	-	-	6.40
3	11/1/2018	2.20	2.40	0.25	0.50	0.25	0.55	0.35	0.15	0.10	0.25	-	-	7.00
4	12/1/2018	2.10	2.35	0.40	0.60	0.40	0.45	-	-	0.15	0.35	0.50	-	7.30
5	13/1/2018	1.85	2.20	0.20	0.45	0.20	0.35	0.25	-	-	0.10	-	-	5.60
6	14/1/2018	1.70	2.15	0.15	0.30	0.35	0.50	-	-	-	0.15	-	0.40	5.70
7	15/1/2018	2.35	2.55	0.35	0.65	0.25	0.60	0.40	0.15	0.15	0.30	-	-	7.85
	Total	14.35	16.65	1.90	3.35	1.95	3.60	1.20	0.40	0.40	1.50	0.50	0.70	46.50

Table 4.12 : Data of Total Solid Waste Generated at KK4 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

Categories	Food Waste	Paper	Plastic	Glass	Aluminium	Others
Total amount generated (kg)	31	5.25	5.55	1.6	1.9	5.55

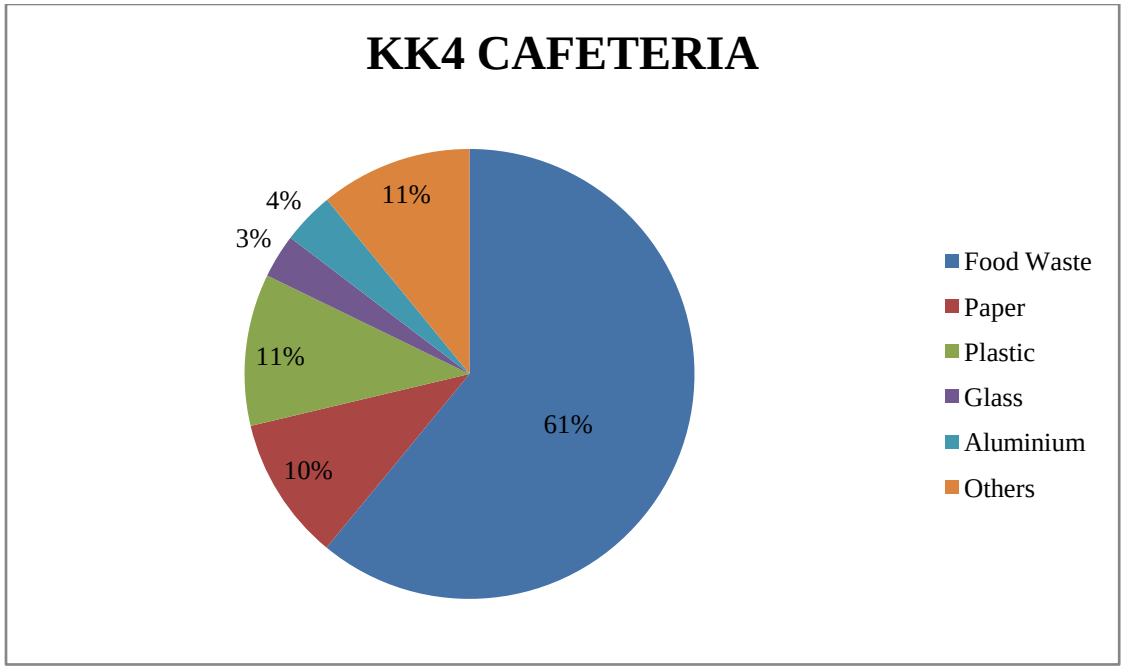

Figure 4.9 : Total of Solid Waste Generated at KK4 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester break.

4.3.2 Solid Waste Generated Detailing during Semester Session

For this case study, solid waste data taken for a week on a daily basis has been conducted in the semester session. Just like the data recorded on semester breaks, several categories have been created to isolate every solid waste generated is food waste, paper, plastic, glass, aluminium and others. The solid waste data produced at the Chemistry Cafeteria during the semester was recorded as shown in Table 4.13. The data was recorded twice a day for seven days, in the morning and in the evening. It can be seen that food waste records the highest number of waste compared to solid waste from other categories. Total solid waste produced at Chemistry Cafeteria is 164.05kg. However, no data was recorded on 3 and 4 March 2018 as the cafeteria closed on Saturday and Sunday. Table 4.14 shows that food waste produced 133.55kg of waste for seven consecutive days. Based on the percentages shown in Figure 4.10, 81% of solid waste originates from food waste, 11% of plastic, 5% of paper and glass, aluminium and others showing the lowest percentage of 1%.

For KK1 and KK3 Cafeteria, data of solid waste that generated during the semester were recorded in Table 4.15. The data was recorded during the morning and evening for seven days. Total solid waste produced is 403.50kg. The total solid waste produced at the weekend on 3 and 4 March 2018 which recorded the least amount of 41.20kg/day and 41kg/day compared to the total solid waste recorded on the working day. For each category, food waste recorded the highest amount of solid waste disposal in the morning or even in the afternoon. Total daily solid waste generated during the week can be seen in Table 4.16. Percentage of solid waste produced at KK1 and KK3 Cafeteria has been shown in Figure 4.11. Food waste has recorded the highest percentage of 71% followed by plastic by 19%, paper by 8%, aluminium and 1% and glass being the least recorded solid waste.

Meanwhile, the details of data of solid waste generated at KK4 Cafeteria during the semester were shown in Table 4.17. Data for this cafeteria has also been taken twice in a day. The data were taken for seven consecutive days to obtain the value of solid waste produced. Solid waste produced at KK4 Cafeteria recorded the highest value compared with Chemistry Cafeteria and KK1 and KK3 Cafeteria of 458.40kg.

The data taken during the seven days in a row, the amount of solid waste which is the lowest value recorded on 3 and 4 March 2018, on Saturday and Sunday of the weekend. For total solid waste for a week it can also be seen in Table 4.18. Food waste recorded the highest amount of 376.2kg/week while other wastes recorded the lowest value of 0.9kg/week. While Figure 4.12 shows that the percentage produced by solid waste is 82% while plastic is 9%. The papers recorded the highest third recorded at 7% followed by glass and other waste by 1% while aluminium had the lowest percentage. Food waste is the highest percentage of solid waste that are generated at the cafeteria because the visitors came and eat at the cafeteria so that are more solid waste was produced.

Table 4.13 : Data of Solid Waste Generated at Chemistry Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Type of Waste		**Food Waste (kg)**		**Paper (kg)**		**Plastic (kg)**		**Glass (kg)**		**Aluminium (kg)**		**Others (kg)**		**Total (kg)**
Day	**Date**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	
1	27/2/2018	12.0	15.50	0.80	1.20	0.80	2.50	-	-	-	-	-	-	32.80
2	28/2/2018	15.0	18.00	1.00	1.20	1.50	4.00	-	0.40	-	0.50	1.00	-	42.60
3	1/3/2018	8.20	17.40	1.30	1.40	1.60	2.30	-	-	0.30	-	-	0.50	33.00
4	2/3/2018	12.60	4.15	-	0.10	0.20	0.30	-	-	-	-	-	-	17.35
5	3/3/2018	-	-	-	-	-	-	-	-	-	-	-	-	-
6	4/3/2018	-	-	-	-	-	-	-	-	-	-	-	-	-
7	5/3/2018	14.20	16.50	0.40	1.50	1.20	3.10	0.50	-	0.20	-	0.70	-	38.30
	Total	62.00	71.55	3.50	5.40	5.30	12..20	0.50	0.40	0.50	0.50	1.70	0.50	164.05

Table 4.14 : Data of Total Solid Waste Generated at KK4Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Categories	Food Waste	Paper	Plastic	Glass	Aluminium	Others
Total amount generated (kg)	133.55	8.9	17.5	0.9	1	2.2

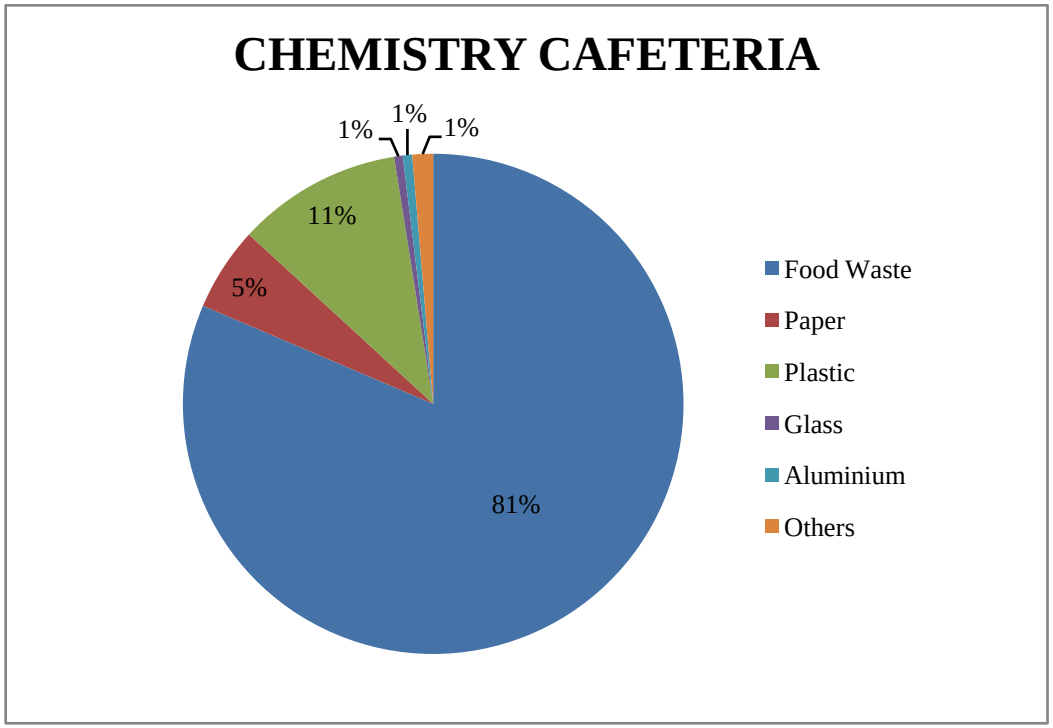

Figure 4.10 : Total of Solid Waste Generated at Chemistry Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Table 4.15 : Data of Solid Waste Generated at KK1 and KK3 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Type of Waste		**Food Waste (kg)**		**Paper (kg)**		**Plastic (kg)**		**Glass (kg)**		**Aluminium (kg)**		**Others (kg)**		**Total (kg)**
Day	**Date**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	
1	27/2/2018	18.00	27.30	2.60	3.10	5.40	6.70	-	0.30	0.60	-	-	-	64.00
2	28/2/2018	16.40	32.10	1.90	2.70	5.90	7.10	-	-	-	0.40	0.50	0.30	67.30
3	1/3/2018	16.70	29.40	2.40	3.30	5.70	6.80	-	-	0.55	-	0.45	-	65.30
4	2/3/2018	15.30	26.80	2.30	2.90	4.30	6.20	0.80	-	0.30	0.50	-	0.60	60.00
5	3/3/2018	12.10	18.60	0.90	1.80	2.70	4.80	-	-	0.10	-	-	0.20	41.20
6	4/3/2018	12.70	17.30	1.20	2.20	2.50	4.30	-	-	0.40	-	0.40	-	41.00
7	5/3/2018	17.50	26.30	2.20	3.50	6.20	7.90	0.30	-	0.20	0.40	-	0.20	64.70
	Total	108.70	177.80	13.50	19.50	32.70	43.80	1.10	0.30	2.15	1.30	1.35	1.30	403.50

Table 4.16 : Data of Total Solid Waste Generated at KK1 & KK3 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Categories	Food Waste	Paper	Plastic	Glass	Aluminium	Others
Total amount generated (kg)	286.5	33	76.5	1.4	3.45	2.65

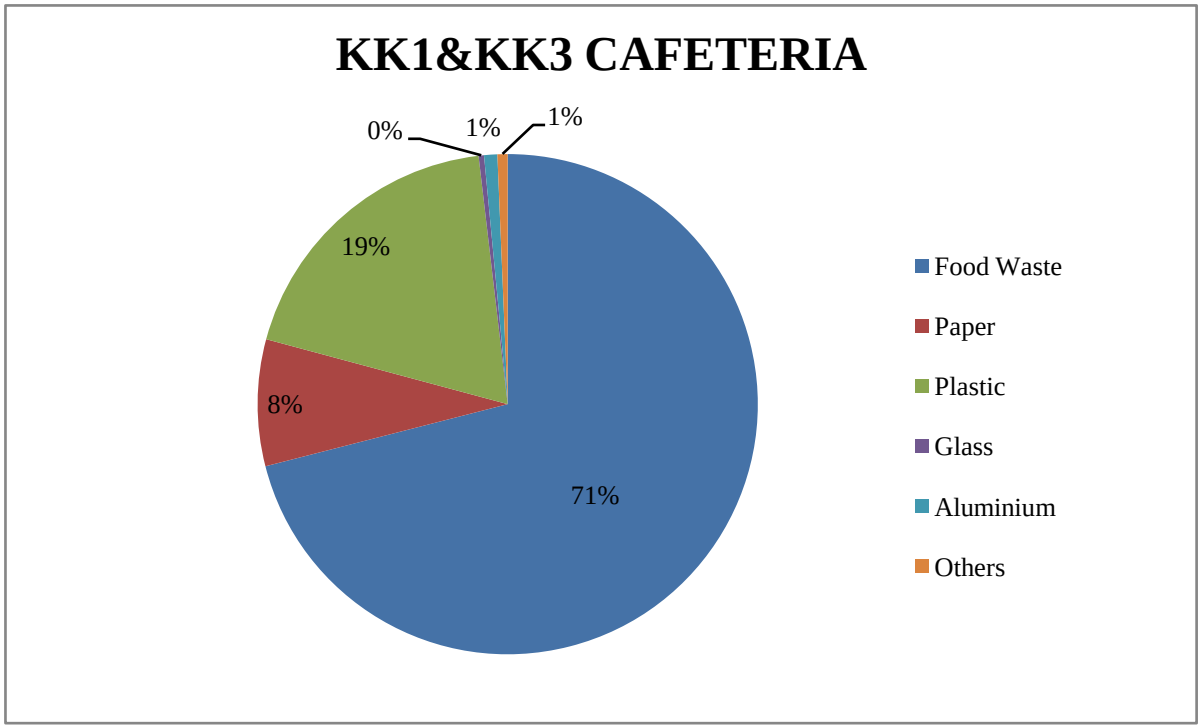

Figure 4.11 : Total of Solid Waste Generated at KK1 and KK3 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Table 4.17 : Data of Solid Waste Generated at KK4 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Type of Waste		**Food Waste (kg)**		**Paper (kg)**		**Plastic (kg)**		**Glass (kg)**		**Aluminium (kg)**		**Others (kg)**		**Total (kg)**
Day	**Date**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	
1	27/2/2018	21.30	42.10	2.30	3.50	3.70	4.20	-	-	-	0.40	-	-	77.50
2	28/2/2018	23.70	45.30	1.90	2.60	3.40	3.90	-	-	-	0.30	0.20	-	81.30
3	1/3/2018	21.90	39.80	2.70	3.20	2.80	4.50	-	0.30	0.30	-	-	0.50	76.00
4	2/3/2018	18.30	31.40	1.50	2.30	1.70	2.80	1.20	-	0.50	0.30	0.20	-	60.20
5	3/3/2018	11.20	21.30	1.20	2.40	1.20	2.10	-	-	0.20	-	-	-	39.60
6	4/3/2018	10.90	23.10	1.30	1.90	1.50	1.90	-	-	-	-	-	-	40.60
7	5/3/2018	24.50	41.40	2.30	4.20	4.10	5.30	-	0.50	0.50	0.40	-	-	83.20
	Total	131.80	244.40	13.20	20.10	18.40	24.70	1.20	0.80	1.50	1.40	0.40	0.50	458.40

Table 4.18 : Data of Total Solid Waste Generated at KK4 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

Categories	Food Waste	Paper	Plastic	Glass	Aluminium	Others
Total amount generated (kg)	376.2	33.3	43.1	2	2.9	0.9

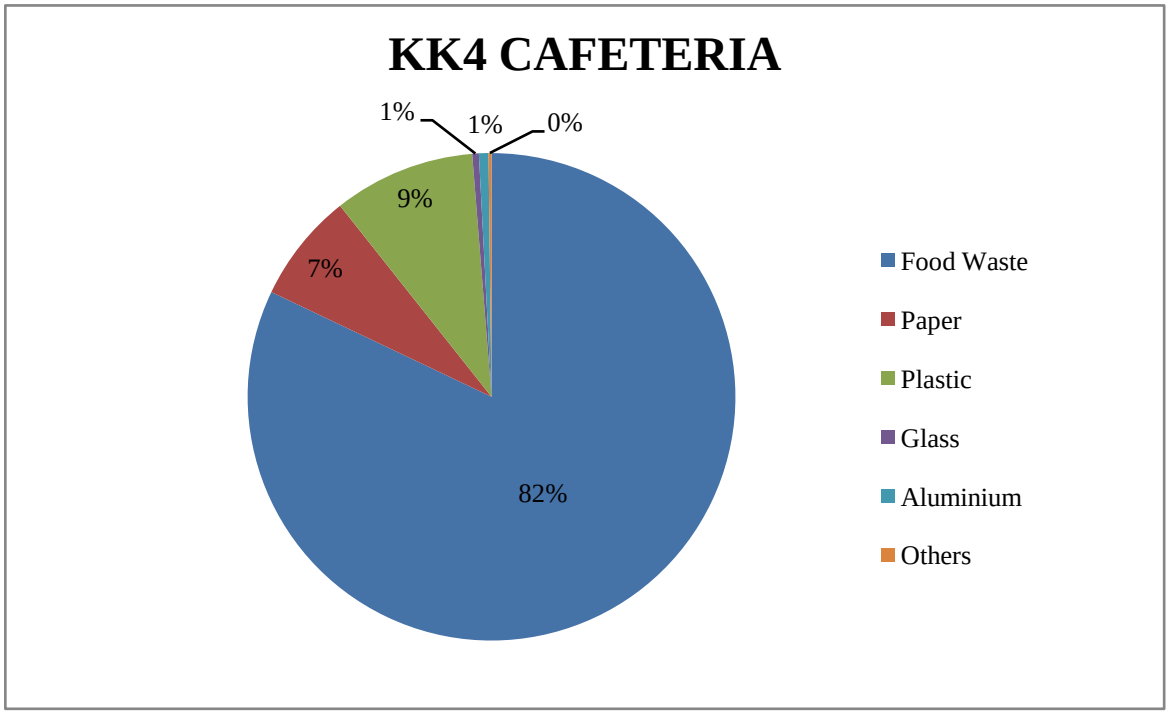

Figure 4.12 : Total of Solid Waste Generated at KK4 Cafeteria, Universiti Malaysia Pahang, Gambang Campus within a week during semester.

4.4 Questionnaire Analysis

The three hundred (300) questionnaire that had been distributed at the study area that are Chemical Cafeteria, KK1 and KK3 Cafeteria and KK4 Cafeteria. A total of one hundred (100) questionnaire was distributed in each cafeteria to get feedback on how the management of solid waste in each cafeteria.

4.4.1 Section A Analysis : Demographic Question

According to the distributed questionnaire, there was about 38.3% male and 61.7% female was involve in this analysis. There are 78% of respondents among the students, 13.7% of the staff while 8.3% were among the workers from Universiti Malaysia Pahang. In addition, it also consists of the 72.7% Malay,15% China, 6.7% India and 5.7% others.

Table 4.19 shows the majority of respondents who have been taken at the cafeteria of the study area. There were 234 students, 41 staff and 25 workers who had been asked to get feedback on solid waste at the cafeteria. Most Asians like to eat and this will result in a high amount of food waste. Therefore, the food waste produced become the most waste generated over other categories of solid waste produced.

According to the Figure 4.13 the highest number of respondents from Chemistry and KK1& KK3 cafeteria are female. This is because most of the respondents are from the students. This cafeteria is more visited by girls because the neighbourhood is populated by female students. Meanwhile for KK4 Cafeteria, the surrounding area is inhabited by male residents. Only some women visit that area.

For Figure 4.14, it is show the race among the respondents from each cafeteria. It show the highest number of respondents from the Malay race for each cafeteria while for other races shows the lowest value except for KK4 Kafeteria because the lowest number of respondents is from the Indians.

Meanwhile for Figure 4.15, the number of students who come to the cafeteria is much higher when compared with the staff and workers. This can be seen because the food in the cafeteria is much cheaper than eating out of the campus. Apart from that, the short distance between classes from one class to another makes it difficult for students to leave the campus because eating in the cafeteria is more time saving.

Table 4.19 : Demographic Survey

Demographic	Option	Number of Respondents			Total	Total Percentage (%)
		Chemistry Cafeteria	KK1&KK3 Cafeteria	KK4 Cafeteria		
Gender of Respondents	Male	29	24	62	115	38.3
	Female	67	78	40	185	61.7
Race of Respondents	Malay	72	67	79	222	72.7
	Chinese	18	19	8	45	15
	Indian	4	9	7	20	6.7
	Others	2	7	8	17	5.7
Employer of Respondents	Students	73	83	78	234	78
	Staffs	14	11	16	41	13.7
	Workers	9	8	8	25	8.3

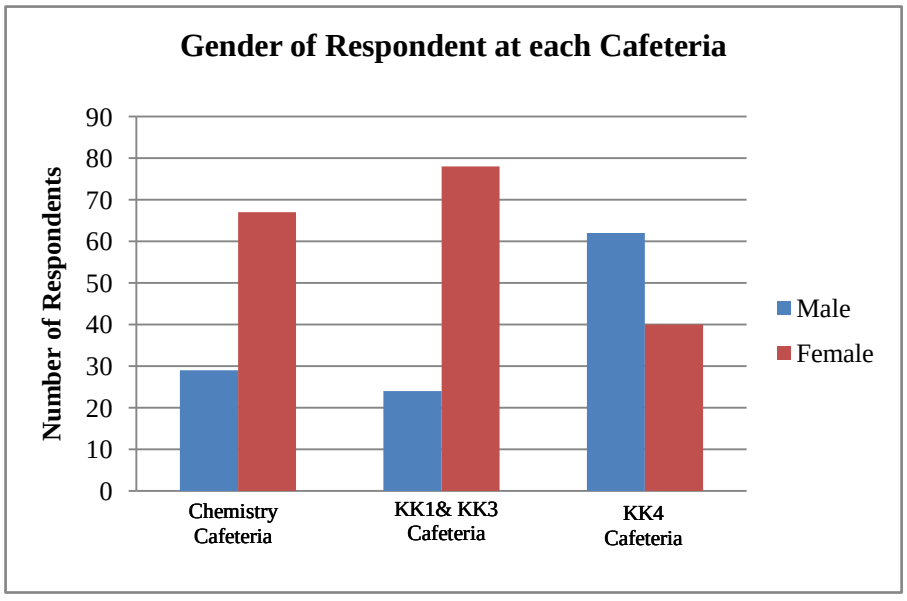

Figure 4.13 : Gender Respondents at each Cafeteria

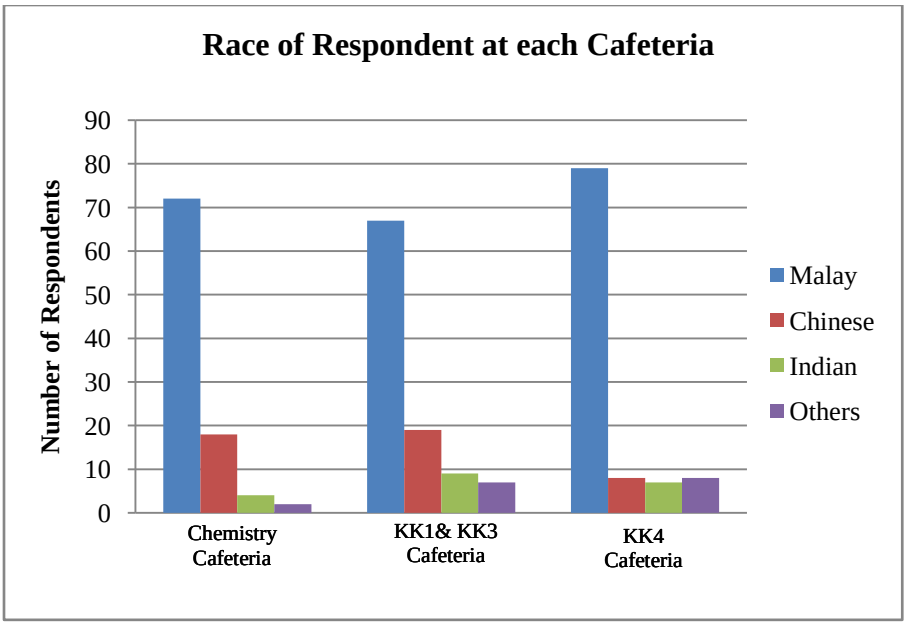

Figure 4.14 : Race of Respondents at each Cafeteria

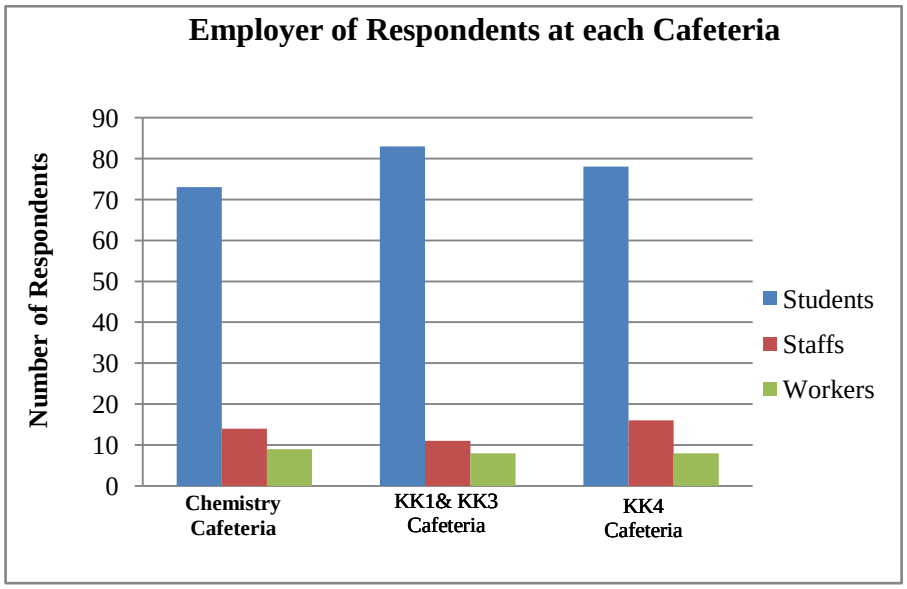

Figure 4.15 : Employer Respondents at each Cafeteria

4.4.2 Section B Analysis : Type of Waste Generation in Cafeteria

From the Table 4.20, there were types of waste generated came from organic and inorganic wastes. Generally, paper, cardboard, glass, aluminium and plastic were recyclable and reusable instead of simply disposed into the landfill. Meanwhile the food waste would be composting.

According to Table 4.20, the most organic waste generated was food waste for Chemistry Cafeteria, KK1 and KK3 Cafeteria and KK4 Cafeteria; 22%, 24% and 23%. Asian people produce a lot of food waste from food preparation such as onion skins, potatoes skins and others that contribute to many waste generated as well. For paper waste that are generated for Chemistry Cafeteria, KK1 and KK3 Cafeteria and KK4 Cafeteria; 7%, 6% and 6%, 1% of cardboard was produced at each cafeteria and other waste that are generated for Chemistry Cafeteria, KK1 and KK3 Cafeteria and KK4 Cafeteria; 1%, 4% and 4%.

While for inorganic waste generated are shown in Table 4.20 that was glass, aluminium, plastic, dish/ash and others. The highest amount of inorganic waste generated in Chemistry Cafeteria, KK1 and KK3 Cafeteria and KK4 Cafeteria was plastic; 17%, 16% and 16%. Plastic resulting from the use of drinking water is purchased in the cafeteria, plastic food wrap and also there are some students who do not use provided plate but using plastic food containers. While for the lowest inorganic waste was generated was others which only for Chemistry Cafeteria, KK1 and KK3 Cafeteria and KK4 Cafeteria; 1%, 4% and 4%. It was because of there was only small value of students that produce others waste.

Table 4.20 : Type of Waste Generated

Type of Waste Generated		Number of respondents			Percentage (%)			Total Percentage (%)
		Chemistry Cafeteria	KK1 and KK3 Cafeteria	KK4 Cafeteria	Chemistry Cafeteria	KK1 and KK3 Cafeteria	KK4 Cafeteria	
Organic	Food Waste	89	96	91	22	24	23	69
	Paper	27	25	23	7	6	6	19
	Cardboard	4	3	5	1	1	1	3
	Other	5	16	16	1	4	4	9
Inorganic	Glass	11	14	14	2	3	3	8
	Aluminium	45	44	39	9	9	8	26
	Plastic	83	79	80	17	16	16	49
	Dirt/Ash	17	19	24	3	4	5	12
	Other	2	7	11	1	2	2	5

4.4.3 Section C Analysis : Solid Waste Management in Cafeteria

According to Table 4.21, 82% of respondents disposed waste according to the prescribed category. The balance of 18% of respondents do not dispose of waste by category. In addition, the provision of bins by category needs to be provided in each cafeteria. This can make it easier for students to dispose of waste by categories and facilitate the management to manage the waste.

A total of 79% of respondents, 24% of the Chemistry Cafeteria, 28% of KK1 and KK3 Cafeteria and 27% of the KK4 Cafeteria have been practicing waste separation or recycling. While the 21% surplus does not apply waste separation or recycling in their daily lives. The most recycled residue by the respondents was paper 39% followed by 38% plastic and lastly 23% aluminium. This data can be seen more clearly based on Table 4.21.

In Malaysia, it is estimated that the amount of recyclable materials thrown to the garbage disposal site annually is 2.3 million tons with an estimated value of RM900 million. In 2013, the country total waste generation increased to 33,000 tonnes per day, compared to 19,000 tonnes per day in 2005.(Tan Su Lin, 2016)

Table 4.21 : Solid Waste Management in Cafeteria

Solid Waste Management		Number of respondents			Percentage (%)			Total Percentage (%)
		Chemistry Cafeteria	KK1 and KK3 Cafeteria	KK4 Cafeteria	Chemistry Cafeteria	KK1 and KK3 Cafeteria	KK4 Cafeteria	
Do you Throw the Wasted based on the Category?	Yes	74	90	82	25	30	27	82
	No	22	12	20	7	4	7	18
Did you practice waste separation or recycle?	Yes	71	85	81	24	28	27	79
	No	25	17	21	8	6	7	21
Please specify the type of waste do you recycle?	Plastics	56	68	70	11	13	14	38
	Paper	70	67	63	14	13	12	39
	Aluminium	36	49	29	7	10	6	23
	Others	0	0	0	0	0	0	0

4.4.4 Section D Analysis : Public Awareness

Table 4.22 : Public Awareness about the waste at the Cafeteria

Public Awareness		Number of respondents			Percentage (%)			Total Percentage (%)
		Chemistry Cafeteria	KK1 and KK3 Cafeteria	KK4 Cafeteria	Chemistry Cafeteria	KK1 and KK3 Cafeteria	KK4 Cafeteria	
Do you concern about the waste problem in cafeteria ?	Yes	83	93	94	28	31	31	90
	No	13	9	8	4	3	3	10
Will you participate in a recycle program ?	Yes	89	94	96	30	31	32	93
	No	7	8	6	2	3	2	7
Does the current campaigns are able to provide public awareness?	Yes	63	67	60	21	22	20	63
	No	33	35	42	11	12	14	37
What is your opinion about the waste management in the cafeteria ?	Satisfactory	72	77	81	24	26	27	77
	Non-Satisfactory	24	25	21	8	8	7	23

Table 4.22 clearly shows that as many as 90% of respondents are concerned with the waste problem in the cafeteria. While the remaining 10% of respondents do not care about the waste problem. A total of 93% of respondents are willing to participate in the recycling program. While the remaining 7% will not participate. This is because there is no time and much work to be done.

63% said that existing campaigns were able to provide awareness to the public but 37% of respondents denied it. This is because the campaign alone is not capable of giving awareness to the general public. It is incapable of opening the eyes of the public on the recycling of benefits. The emphasis on recycling should be made from home. Children should be taught about the importance of recycling so they will get used to practice until today. Multimedia should also play a role in the campaigns on recycling will always occur continuously. This data was shown in Table 4.22.

Various campaigns have been mobilized by the government and the private sector, but awareness for recycling among Malaysians is still unsatisfactory while the benefits are huge for life. It can still be seen that most people take easy recycling that can save resources, prevent pollution and contribute to public health. Not many realize that recycling also creates job opportunities and can generate side income easily. (Nor Azizah Mokhtar, 2016)

Some opinions on waste management at the cafeteria were taken and 77% expressed satisfaction on the way management was available while 23% disagreed as shown in Table 4.22. This is because there are still some people who do not dispose of waste by category. The management itself should be more concerned about this because the waste sorting facilities by category should be provided to facilitate students, staff, workers and others to remove solid wastes. Other than that, the dirty cafeteria situation and food waste left on the table after eating proves that there is still a lack of awareness of solid waste. Scheduling a regular basis to the management should be provided so that the bins are always in a clean and not full of rubbish.

CHAPTER 5

CONCLUSION

5.1 Conclusion

This study was conducted at Universiti Malaysia Pahang (Ump), Gambang Campus at the three different cafeteria that are Chemistry Cafeteria, KK1 & KK3 Cafeteria and KK4 Cafeteria to determine the composition and the total quantity of the waste that was generated, to identify the awareness level among the UMP students, staff, cafeteria owner, workers and hostel management and to provide the potential recommendation to improve the level of solid waste management.

From the results analysis, it was found that the highest solid waste come from KK4 Cafeteria that was 45.30kg/week during the semester break. While during the semester session, KK4 also get the highest value that generated the solid waste compare to the other cafeteria that was 458.4kg/week. According to the result obtain, it was found that the highest solid waste generated at the every cafeteria was food waste.

The result from questionnaire distributed had gained some information about the demographic survey, types of waste generation, solid waste management in cafeteria and awareness of solid waste among the students, staff and workers. The factor that affecting the generation of solid waste were because the low awareness among the respondent about the management of solid waste. Not having enough time to participate in a campaign or recycling program is one of the reasons given.

5.2 Recommendation

After the study was successfully done, I would suggest some recommendation to be implementing for the future study. For collecting data of waste to be weighing, it need to be done with the cooperation from the visitors of cafeteria such as waste separation during remove the waste. It is because the waste must be separated after collected from each cafeteria.

Campaigns should continue to be carried out on campus to promote awareness of the importance of managing solid waste. 3R waste bins (reuse, reduce, recycle) should be provided at each cafeteria. Reduce, reuse and recycle (3R) were the three most important components that should be practiced by the consumer responsibility towards the environment. Reduce means if there is less waste, then there is less to recycle or reuse. For an example print on both sides of the paper to reduce paper wastage. Reuse is used back the materials that don't want to use anymore as something else such as waste paper can be used to make note and recycle means something that can be transform again into anything else. For an example, use the recycling paper for printing or making paper handicraft. This is to apply the value of self discipline in order to throw the waste based on the predetermined category.

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APPENDIX A

QUESTIONNAIRE FORM / *BORANG KAJI SELIDIK*

Date/*Tarikh :* _____ Location / *Lokasi :* _____

*Tick (/) in the box provided. / *Tandakan* (/) *dalam kotak yang disediakan.*

Part A/ *Bahagian A* (General Information Questions / *Soalan Maklumat Am)*

1. Name / *Nama* : _____
2. Gender / *Jantina* : _____
3. Race / *Bangsa* : _____
4. Age / Umur : _____
5. Employer / *Pekerjaan* : _____
6. How many times eat at cafeteria :

1	
2	
3	
More than 3times / *lebih daripada 3kali*	

7. Ways :

Take away / *bungkus*	
Dine in / *makan*	

Part B / *Bahagian B* (Type of Waste Generation in Cafeteria / *Jenis Sampah yang dihasilkan di Kafeteria*)

8. Type of organic waste generated. / *Jenis sampah organik yang dihasilkan.*

Food Waste / *Sisa makanan*	Paper / *Kertas*	Cardboard / *Kadbod*	Other / *Lain-lain*

9. Type of inorganic waste generated. / *Jenis sampah tidak organic yang dihasilkan.*

Glass / *Kaca*	Tin/ Can/ Metal/ Aluminium/ *tin / besi/ aluminium*	Plastic / *plastik*	Dirt, ash / *habuk, debu*	Other / *Lain-lain*

Part C / *Bahagian C* (Solid Waste Management in Cafeteria / *Pengurusan Sisa Pepejal di Kafeteria*)

10. Did you Throw the Wasted based on the Category? / *Adakah anda membuang sampah berdasarkan kategori?*

☐ Yes / *Ya*

☐ No / *Tidak*

11. Did you practice waste separation or recycle? / *Adakah anda mengamalkan pengasingan atau kitar semula sisa?*

☐ Yes / *Ya*

☐ No / *Tidak*

12. Please specify the type of waste do you recycle ? / *Sila nyatakan jenis sisa yang anda kitar semula ?*

☐ Plastic / *Plastik*

☐ Paper / *Kertas*

☐ Tin / *tin*

☐ Others (Please Specify) / *lain-lain (nyatakan)* _____

Part D / *Bahagian D* (Public Awareness / *Kesedaran orang ramai*)

13. Do you concern about the waste problem in cafeteria ? / *Adakah anda prihatin tentang masalah sampah di cafeteria?*

☐ Yes / *Ya*

☐ No / *Tidak*

14. Will you participate in a recycle program ? / *Adakah anda berminat untuk turut serta dalam program kitar semula ?*

☐ Yes / *Ya*

☐ No / *Tidak*

If no, give a reason / *Jika tidak, berikan sebab :* _____

15. Does the current campaigns are able to provide public awareness ? / *Adakah kempen-kempen sedia ada mampu memberikan kesedaran umum?*

☐ Yes / *Ya*

☐ No / *Tidak*

If no, give a reason / *Jika tidak, berikan sebab :* _____

16. What is your opinion about the waste management in the cafeteria ? / *Apakah pandangan kamu terhadap pengurusan sampah di kafeteria?*

☐ Satisfactory / *Memuaskan*

☐ Non-satisfactory / *Tidak Memuaskan*

If no, give a reason / *Jika tidak, berikan sebab :* _____