



A STUDY ON SOLID WASTE GENERATION IN COMMERCIAL AREA AT  
INDERA MAHKOTA 5, KUANTAN, PAHANG

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## ABSTRACT

Solid waste is anything that been consume and discards from human's activities on their daily life. These waste also known as trash, garbage, refuse and rubbish. Increasing of solid waste production in commercial is one of the government concerns especially in Kuantan. In order to reduce and handle the solid waste, suitable methods must be chose for their efficiency and effectiveness. This research was focus on solid waste composition and solid waste generation rate in Indera Mahkota 5 commercial area. The commercial premises were divided into three categories: public, service and product with 15 participants. For this study, two methods of data gathering were applied: on site sampling involving weigh and segregate solid waste generated and questionnaire distribution. The relationship between solid waste composition and solid waste generation is based on type of the premise. Each premise generated different type of waste with different generation rate. Factors of waste generation also affect the waste composition and waste generation in commercial area. For public type service, the total sample weight is 44.80 kg. From the total sample weight, it consists 33 kg of food waste, 1.15 kg of paper, 6.90 kg of plastic and 3.75 kg of tin/can/metal/aluminum. For service type premise, the total sample weight is 26.56 kg. From the total sample weight, it consists 9.29 kg of food waste, 4.03 kg of paper, 6.89 kg of cardboard, 6.08kg of plastic, 0.20 kg of tin/can/metal/aluminum and 0.07 kg of other waste. For the product type premise, the total sample weight is 1009.64 kg. There are 892.07 kg of food waste, 23.07 kg of paper and 15.93 kg of cardboard, 0.05 kg of wood, 65.61 kg of plastic, 11.26 kg of tin/can/metal/aluminum and 1.65 kg of other wastes.

## ABSTRAK

Sisa pepejal ialah apa sahaja yang telah digunakan, terhasil dan disingkirkan daripada aktiviti harian manusia. Ia juga dikenali sebagai sampah. Peningkatan penghasilan sisa pepejal merupakan salah satu kebimbangan kerajaan terutamanya di kawasan Kuantan. Dalam usaha untuk mengurangkan dan menguruskan sisa pepejal di Malaysia, kaedah pengurusan yang sesuai harus dilaksanakan berdasarkan keberkesanannya. Kajian ini akan memfokuskan komposisi sisa pepejal dan kadar penghasilan sisa di kawasan komersial Indera Mahkota 5. Premis komersial akan dikategorikan kepada jenis awam, jenis servis dan jenis produk dengan jumlah keseluruhan 15 buah peserta. Untuk kajian ini, dua kaedah pengumpulan maklumat digunakan iaitu : kerja lokasi dengan menimbang dan mengasingkan sisa dan kaji selidik. Hubungkait di antara komposisi sisa dengan kadar penghasilan sisa adalah berdasarkan jenis premis itu sendiri. Setiap premis menghasilkan jenis sisa yang berlainan dengan kadar yang berbeza. Faktor kadar penghasilan sisa akan mempengaruhi kadar penghasilan sisa pepejal di kawasan komersial. Bagi jenis premis awam, jumlah berat sampel ialah 44.80 kg. Dari jumlah berat sampel, ia mengandungi 33 kg sisa makanan, 1.15 kg kertas, 6.90 kg daripada plastik dan 3.75 kg timah / boleh / logam / aluminium. Bagi jenis premis perkhidmatan, jumlah berat sampel ialah 26.56 kg. Dari jumlah berat sampel, ia mengandungi 9.29 kg sisa makanan, 4.03 kg kertas, 6.89 kg daripada kadbod, 6.08kg daripada plastik, 0.20 kg timah / boleh / logam / aluminium dan 0.07 kg sisa lain. Bagi jenis premis produk, jumlah berat sampel adalah 1009,64 kg. Terdapat 892,07 kg sisa makanan, 23.07 kg kertas dan 15.93 kg kadbod, 0.05 kg daripada kayu, 65,61 kg plastik, 11.26 kg timah / boleh / logam / aluminium dan 1.65 kg bahan buangan lain.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background of Study**

Solid waste generation is not a new issue. This is because humans have always produced trash and have always disposed of it in some way. Solid waste can refer to any variety of materials that are rejected or discarded as useless. Solid wastes could be defined as non-liquid and non-gaseous products of human activities (Leton and Omotosho, 2004). Solid waste can be classified into different types depending on their source. For example the solid waste can be the household waste which is generally classified as municipal waste, industrial waste as hazardous waste and biomedical waste or hospital waste as infectious waste.

Nowadays, waste generation rates of developed countries are higher than the developing ones and attribute to the difference in technological advances. Cities like New York have generation rate of 18 liter/capita/day while most cities in developing countries have less than 1 liter/capita/day (AAHB, 1997). The problems of solid waste are growing and have increased the socio-political awareness over recent years within all over the world. Likewise, in Kuantan, the waste generation rate is continually increase by year due to uncontrolled waste composition and the amount of solid waste produced in Kuantan will be multiple in the next twenty years from now.

There are a few factors that lead to solid waste problems. The changes in lifestyle, particularly in the urban areas have led to more acute waste problems (Salim, 2007). For example, municipal solid waste consists of household waste, commercial wastes, construction and demolition debris, sanitation residue and waste from streets. With rising urbanization and change in lifestyle and food habits, the amount of

municipal solid waste has been increasing rapidly and its composition changing. With the large quantities of solid waste generation, the solid waste will produce foul smell, breeds, insects and organism. The uncontrolled solid waste generation will lead to changes the properties of air, soil and water and it will create the pollution such as air pollution, water pollution and land pollution.

## **1.2 Problem Statement**

Over solid waste generation is a serious problem nowadays. With our culture which generates ever larger amounts of disposable material and increasing of population density, we can no longer simply “throw things anywhere”. Although there is plenty of solid waste management such as reuse, recycling, lands filling and others management, the over solid waste generation problem still occur. The increasing of solid waste generation in commercial area is one of the government concerns. Therefore, this study is done to collect the data of solid waste the people generates in the commercial area at Indera Mahkota 5, Kuantan, Pahang. Besides, the study also identifies the categories of the solid waste thrown in commercial areas so that we can know the reasons of increasing the disposable material thrown and determine the factors of solid waste generation in commercial areas at Indera Mahkota 5, Kuantan, Pahang.

## **1.3 Research Objectives**

This research is carried out to accomplish the following objectives:

1. To collect the data of solid waste generation in commercial areas at Indera Mahkota 5, Kuantan, Pahang.
2. To identify the categories of the solid waste thrown in commercial areas at Indera Mahkota 5, Kuantan, Pahang.
3. To determine the factors of solid waste generation in commercial areas at Indera Mahkota 5, Kuantan, Pahang.

#### **1.4 Scope of Study**

The scope of the study is narrowed down to simplify the process of information gathering. Therefore it can be analyzed within an appropriate time limit and types of premises. The main priority of the study includes:

1. Data gathering for solid waste generation. All the data of solid waste collected is studied further in order to know the total quantity and categories of solid waste thrown in the study area
2. The study will focus on the commercial area which is in Indera Mahkota 5, Kuantan, Pahang.
3. 15 shops in commercial areas at Indera Mahkota 5, Kuantan, Pahang will be chosen.
4. The time limit for the study is one month which is in April 2013.
5. Questionnaire will be distributed to the respondents.

#### **1.5 Significance of the Study**

The study is important in order to collect the data for further municipal solid waste management. The composition of the solid waste generation will be classified in this study. Besides, it will show the factors of the solid waste generation in commercial area at Indera Mahkota 5, Kuantan, Pahang.

The study will contribute benefits to the government or local authorities that involve in the municipal solid waste management. Based on the data, they can choose the most suitable municipal solid waste management method that not only effective but suitable to the society and residents in the area. The result from the research will bring a better municipal solid waste management which will be more helpful to save the environment and bring out a bright future to the next generation.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

In this chapter it briefly discusses about the history of the solid waste generation, the categories of the solid waste thrown, characteristics of the solid waste, waste composition and waste generation. Besides, it also explains about the factors that lead to the waste generation. Moreover, it also discusses about the data collection or sampling method and solid waste management.

#### **2.2 Brief History of Solid Waste**

Solid waste can be defined as the useless and unwanted products which are in the solid state. All this wastes are usually produce from the activities done by the human and animals. According to Tchbanoglous, Theisen, and Vigil (1993), solid waste is all the waste arising from human and animal activities that are normally solid and that are discarded as useless or unwanted. Normally, the solid waste cannot be reused by the society because some of the solid waste may contains hazardous for human health. Besides, Worrell and Vesilind (2002) have both states that solid waste can be distinguished as it is from the waste humans emit into the atmosphere or the waste we discharge into the sewerage system. Besides, Tchobanoglous et al. (1993) claimed that problems with the disposal of wastes can be traced from the times when human first began to congregate in tribes, villages and communities and the accumulation of wastes become a consequence of life.

Moreover, urbanization and population growth has generally increased the standard of living in Malaysia but it also increase the waste generation. According to

Rajput R. et al. (2009), the rising urbanization and change in lifestyle and food habits will cause the amount of municipal solid waste been increasing rapidly and its composition changing. The Solid Waste and Public Cleansing Management Act 2007 defines solid waste as controlled solid wastes which includes commercial solids waste, household solids waste, institutional solids wastes and public solid wastes (Act 672).

Solid waste is not only unsightly but it can also pollute our water, air and land unless it is adequately managed. Solid waste that is generated without having a proper management can affect human health and the environment. The effects can be direct such as high levels of air pollution that causes respiratory problems or indirect such as contaminants in soils that reduce the productivity of land. Solid waste can produce hazardous substances that cause asthma and other respiratory diseases, bacteria, illnesses, birth defects, and cancer.

## **2.3 Types and Sources of Solid Waste**

### **2.3.1 Introduction**

In general, the term of solid waste is refers to non-hazardous waste. However, according to Resource Conservation & Recovery Act (RCRA) and other state regulations, hazardous waste is also a part of solid waste. Besides, solid waste is highly heterogeneous and its composition reflects the affluence of the society, their way of life, their economic status and their social behavior (AMR Environmental, 2004).

According to Management and Handling Rules (2000), prescribed under the Environment Protection Act 1986 by the Government of India defined that municipal waste as commercial and residential wastes generated in municipal or notified areas in either solid or semi solid form excluding industrial hazardous wastes but including treated bio-medical wastes. On the other hands, municipal solid waste includes the decomposable waste from household products during the preparation of meat, food, vegetable, and waste generated from shops, hotels, offices and other commercial units. Table 2.1 will illustrate the type of solid waste.

**Table 2.1: Type of solid waste**

<b>Category</b>	<b>Type of waste</b>
Organic Waste	Waste from market places, food, etc.
Combustibles	Paper, wood, dried leaves, packaging for relief items, etc. (contain high organic and low moisture content)
Non-combustibles	Metal, tins, cans, bottles, stones, etc.
Bulky waste	Tyres, leaves, tree branches, etc.
Ashes/Dust	Residue from fires used for cooking
Dead animals	Carcasses of domestic animals and livestock
Hazardous waste	Oil, batteries, medical waste
Construction waste	Broken concrete, cement, roofing, etc.

Source: Harvey and Reed (2002)

### 2.3.2 Municipal Solid Waste (MSW)

A municipal solid waste includes waste from many places and areas such as residential, commercial, institutional and some industrial areas. Municipal solid waste has been collected and managed by municipalities and growing faster than population due to the increase of consumption rate. Municipal solid waste has major impacts to the environment and human health. Table 2.2 described the general sources and types of municipal solid waste.

**Table 2.2: General sources and types of municipal solid wastes**

<b>Sources of Waste</b>	<b>Facilities or Activities Wastes are generated</b>	<b>Waste Generated</b>
Residential waste	Single family and multifamily detached dwellings, bungalow, terrace, low-, medium- and high-rise apartments, etc.	Food, paper and paper packaging, plastic, metals and hazardous household waste
Commercial waste	Shop houses, restaurants, stalls, night markets, hotels	Food, paper and paper packaging, plastic, special waste and metals
Institutional waste	Office buildings, schools, hospitals	Mostly paper and paper packaging and metals



**Table 2.2: Continued**

<b>Sources of Waste</b>	<b>Facilities or Activities Wastes are generated</b>	<b>Waste Generated</b>
Industrial non-toxic waste	Light and medium industries	Mostly paper and paper packaging, plastic and metals
Treatment plant sites; municipal incinerators	Water, wastewater and industrial treatment processes, etc	Treatment plant wastes, principally composed of residual sludge
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots, farms, etc.	Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes
Market waste	Wet market	Putrescible waste
Construction and demolition waste	Housing renovation and related work	Concrete, wood, steel, glass and soil

Source: AMR Environmental (2004)

### **2.3.3 Commercial waste**

Commercial waste is waste that is produced by businesses, trade and commercial premises. Commercial solid wastes consist of the organic (combustible) and inorganic (noncombustible) solid wastes. Typically, the organic fraction of solid waste consists of materials such as food waste, all types of paper, cardboard, all types of plastic, textiles, rubber, leather, wood and yard waste. However, the inorganic fraction of solid waste consists of item such as glass, crockery, tin cans, aluminum, ferrous metals and dirt.

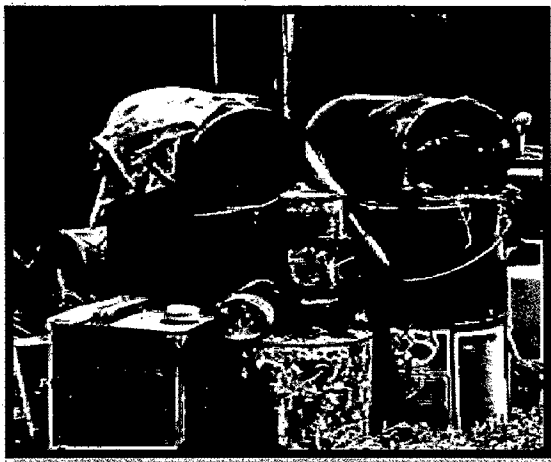
Commercial waste also can be divided into putrescible waste and non putrescible waste. Putrescible commercial waste is solid waste that contains organic matter that has a tendency to decompose. This waste stream is made up of waste collected mostly from office buildings, hotels, manufacturers, retailers and food service establishments. However, non putrescible commercial waste is defined as waste that does not contain organic matter that has a tendency to decompose. It includes of dirt, concrete, rock, rubble, slag, ashes, fiberglass, ceramic tiles, asphalt, wood, metal, steel,

glass, plastic pipes and tubes, rubber hoses and tubes, electric wires and cables, paper and cardboard.

#### **2.3.4 Hazardous Wastes**

Hazardous wastes can be known as wastes that pose a substantial present or potential hazard to human health or living organisms. There are many of the products used around the home are toxic and can be hazardous to the health and the environment. The products are like household cleaners, personal products, automotive products, paint products and garden products. However, the hazardous wastes produced by the commercial establishments are related to the services provided. Typical examples include inks from the print shops, solvents from dry cleaning establishments, cleaning solvents from auto repair shops and paints and thinners from painting contractors.

According to Rajput R. et al. (2009), hospital waste contaminated by chemicals used in hospitals is considered as hazardous waste because all these chemicals include formaldehyde and phenols which are used as disinfectants and mercury which is used in thermometers or equipment that measure blood pressure. Besides, direct exposure to chemicals in hazardous waste such as mercury and cyanide can be fatal. Rajput R. et al. (2009) also stated that India generates around 7 million tonnes of hazardous wastes every year and states such as Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh, which are relatively more industrialized face problems of toxic and hazardous waste disposal far more acutely than less developed state. The major hazardous waste generating industries in India include petrochemicals, pharmaceuticals, pesticides, paint and dye, petroleum, fertilizers, asbestos, caustic soda, inorganic chemicals and general engineering industries. Figure 2.1 shows the types of commercial hazardous waste and it is harm to the environmental and human health.



**Figure 2.1:** Commercial hazardous waste

Source: eWaste Disposal Inc (2013)

### **2.3.5 Hospital Waste**

Hospital waste or biomedical waste which normally produced from health care facilities such as clinic and hospitals and medical labs are usually includes pathological, anatomical infection and hazardous waste.

According to Rajput R.et al. (2009) the hospital waste is generated during the diagnosis, treatment or immunization of human beings or animals and in research activities in these fields. Similarity, it may include wastes like anatomical waste, cultures, discarded medicines, chemical wastes, disposable syringes, glucose bottles, cotton swabs, bandages, body fluids and human excreta. If the waste is not managed in a scientific manner, it can be a serious threat to human health because the waste is highly infectious.

Moreover, the quantum of waste that is generated in India is estimated to be 1-2 kg per bed per day in a hospital and 600 gm per day per bed in a general practioner's clinic and it is estimated that only 5-10% of this comprises of hazardous or infectious waste (Rajput et al., 2009). Besides, Figure 2.2 shows the medical waste which are handled and processed separately from other solid wastes.



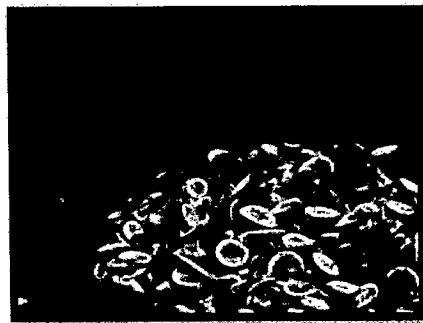
**Figure 2.2:** Medical waste which are handled separately

Source: Buzzle (2013)

### **2.3.6 Agricultural Waste**

Agricultural waste is composed of organic waste such as animal excreta in the form of slurries and farmyard manures and waste such as plastic, waste oils pesticides, fencing and veterinary medicines. Agricultural wastes may include horticultural and forestry wastes which comprise crop residues, animal manure, diseased carcasses and unwanted agrochemicals.

Rajput R.et al. (2009) said that leaking and improper storage of agricultural waste can also pose serious threat surface waters. Similarity, farming activities can give rise to emissions of ammonia and methane which can cause acidification and contribute to greenhouse gases emissions. Therefore, if the agricultural waste is not well managed, there will have a number of potential environmental impacts. Besides, Figure 2.3 shows the skin of fruits is one of the types of agricultural waste.



**Figure 2.3:** Skin of the fruits as one type of agricultural waste

Source: <http://www.blueplanetgreenliving.com/tag/agricultural-waste/> (2013)

### 2.3.7 Food Waste

Food waste is food material that is discarded or unable to be used. Food waste can be any waste raw, cooked, edible and associated inedible material. For example the materials are like bones, egg shells, fruit and vegetables peelings which are generated during the preparation or consumption of meals. The food waste does not include man-made packaging. The causes of wasted food are numerous and occur at the stages of production, processing, and retailing.

Food waste can be divided into avoidable and unavoidable food waste. Avoidable food waste was edible at some point prior to disposal. For example the avoidable food waste is slice of bread, plate residues and others. Unavoidable food waste is not edible food waste from preparation and consumption like bones, egg shelf, coffee grounds and others.



**Figure 2.4:** Avoidable food waste

Source: [http://www.earthisland.org/journal/index.php/elist/eListRead/clean\\_your\\_plate/](http://www.earthisland.org/journal/index.php/elist/eListRead/clean_your_plate/) (2013)



**Figure 2.5:** Unavoidable food waste

Source: <http://www.greenbiz.com/news/2012/02/29/unilever-calls-companies-tackle-mountain-food-waste> (2013)

## **2.4 Characteristics of Solid Wastes**

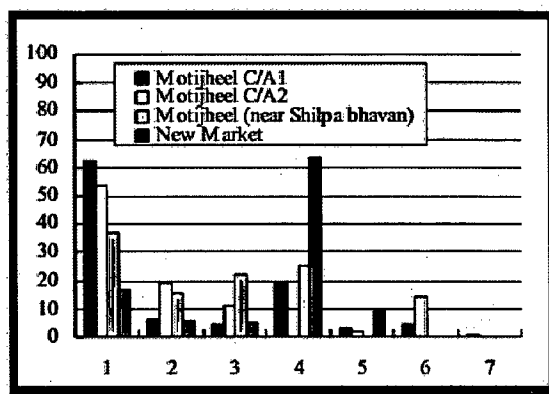
Characterization of waste is important to determine its possible environmental impacts. The characteristics or the composition of Malaysia solid waste is different from other countries. Due to its tropical climate with heavy rainfall, the Malaysian municipal solid waste contains high moisture content ranging from 52.6% to 66.2% (Hassan et al., 2001). Besides, another salient characteristic is the high biodegradable or organic matter contents of the Malaysia solid waste. At the same time, according to Visvanathan et al. (2013), the solid waste composition in most Asian countries is highly biodegradable with high moisture contents such as food waste, paper, plastic/foam, agriculture waste, rubber/leather, wood, metal, glass and textiles.

In the other hands, the quantity of municipal solid waste is invariably higher in the developed nations compared to the developing nations. According to the report of Springer (2012), typical waste characteristics of the developing nations are high waste densities, high moisture contents, large organic fraction, and cities with sweeping as well as open ground storage characterized by large amount of dust and dirt.

## **2.5 Waste Composition**

### **2.5.1 Definition and type of waste composition**

Waste compositions as well as the classification used to collect data on waste composition in municipal solid waste vary widely in different regions and countries (Riitta, 2006). According to Ahmed and Rahman (2000), the composition of solid wastes in Bangladesh is favorable for composting with a higher percentage of organic matter, precisely the right moisture content and C/N ratio slightly higher but adjustable. The Figure 2.6 below will illustrate the waste composition of commercial waste in Bangladesh.



**Figure 2.6:** Waste composition of commercial area in Bangladesh

Source: IFRD (1998), Hossain et al. (2000)

From the Figure 2.6 of waste composition of commercial area in Bangladesh, the 1 represent food waste, 2 represent the paper, 3 represent the polythene or plastic, 4 represent the cloth, 5 represent the garden trimming, leaves and branches, 6 represent the brick or stone, wood, metal, glass or ceramic and 7 represent others of the solid waste. From the figure, the food waste is the most among others waste. This is because food wastes constituting a major part of the wastes from the Motijheel area where a large number of hotels and restaurants are operating. (IFRD, 1998 and Hossain et al., 2000) In the same time, the clothes also dominate the wastes from the New Market in Bangladesh. Besides, the paper and plastic also constitute major fraction of solid waste in the commercial areas.

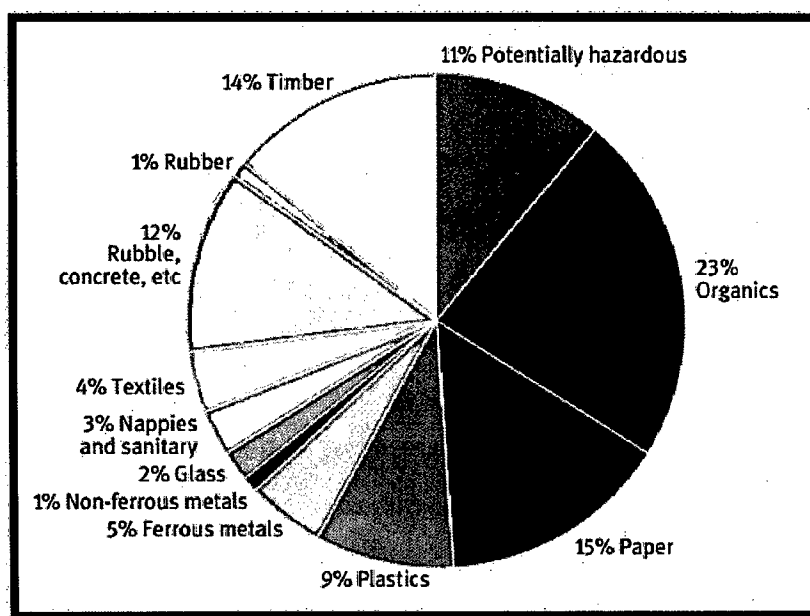
**Table 2.3:** Waste composition (%) in Beijing from 1990 to 2003

Year	Food Waste	Plastic	Brick and Tile	Wood	Glass	Fiber	Ash	Metal	Others
1990	24.89	5.08	4.11	4.13	3.10	1.82	52.22	0.09	-
1995	35.96	10.35	1.50	8.37	10.20	3.56	10.92	2.96	-
2000	44.20	13.60	0.88	7.47	6.34	9.58	2.02	1.17	0.5
2003	48.00	10.29	2.41	8.04	2.30	1.83	8.54	0.26	0.05

Source: Beijing Statistics Bureau (1990–2003)

Based on the Table 2.3, it illustrates the waste composition in Beijing in percentage. Food waste always comprises the highest proportion except in year 1990

and its representation has an increasing trend from year 1990 to 2003. Plastic, paper and ash also occur in relatively high proportions. According to Rong (2004), from 1990 to 2003, the proportion of organics substances (food waste, paper, plastic, wood and fiber) increased gradually and accounted for 86% in 2003. Meanwhile, the proportion of recycling waste (plastic, glass, paper, fiber and metal) also increased from 15% in 1990 to 45% in 2000. However, it decreased in 2003 due to the increase of food waste.



**Figure 2.7:** Estimates of the composition of waste disposed of to landfills in commercial areas at New Zealand, 2004

Source: Waste Not Consulting (2006)

Figure 2.7 indicates the waste received disposed of to landfills in commercial areas at New Zealand in 2004. Nearly a quarter of wastes are organic material which is 23 percent. Paper comprises 15 percent, timber 14 percent and rubble and concrete 12 per cent. Potentially, these waste types can be diverted from landfills for reuse or reprocessing (Waste Not Consulting, 2006).