


PERPUSTAKAAN UMP

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A STUDY ON THE GENERATION RATE IN COMMERCIAL AREA OF TAMAN SRI GADING,
AND SOLID WASTE
KUANTAN

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ABSTRACT

Nowadays, rapid development and increase in population had contributed to a variety of problems including the uncontrolled environmental problems. As a result the unused resources will be classified as waste. One of the sources of waste generated is from the commercial area. This study will be conducted in Taman Sri Gading, Kuantan, Pahang. This study is aimed at determining the commercial solid waste composition, waste generation rate and the factors that influence the solid waste generation rate. There are two types of premises involved in this study which are product and service type premises. In order to get the generation rate, this study is carried out to get the data of waste collection by segregation and weighing of the solid waste from 30 premises which have been selected randomly. The solid waste collected from the samples will be segregate into six components which are organic, food scraps, paper & cardboard, plastic, glasses, aluminum and others. Other than that, there is about 30 questionnaires are distributed to get some information about the type of waste generated, solid waste management and public awareness. The questionnaire distribution is a way to identify and collect the information on factors effecting the solid waste composition. At the end of data collection, all of the data will be analyzed and findings from the analysis are being evaluated, discussed and summarized. According to this study, product type premise produced about 3.15 kg/employee.day and service type premises produced about 3.23 kg/employee.day. The range of waste composition for food waste in product and service type premises were about 1.45 to 8.35 kg/day and 0.00 to 3.88 kg/day. For paper and cardboard, the waste compositions produced by product and service type premises were about 0.02 to 0.7 kg/day and 0.03 to 0.98 kg/day. Besides that, the waste compositions on plastics for product and service type premises were 0.06 to 0.66 kg/day and 0.00 to 0.57 kg/day. Meanwhile, the composition of glass waste for both product and service type premises were 0.00 to 0.65 kg/day and 0.00 to 0.04 kg/day. For aluminium waste composition, it was about 0.00 to 0.07 kg/day for product type premises and 0.00 to 0.03 kg/day for service type premises. The composition for the others wastes such as rubber for product and service type premises were about 0.00 to 0.44 kg/day and 0.07 to 1.14 kg/day. The higher waste composition in this area was food waste and the lowest waste composition was aluminium. It was because of the factors of Asian people which had habit on eating. The other factors that influenced the solid waste generated because of that area was an urban area that was developed. So, the population growth had influenced the solid waste generation rate in Taman Sri Gading.

ABSTRAK

Pada masa kini, berdasarkan perkembangan pesat pembangunan dan peningkatan jumlah penduduk telah menyumbang kepada pelbagai masalah termasuk masalah alam sekitar jika ianya tidak dikawal dengan baik. Hasil daripada sumber yang tidak digunapakai akan diklasifikasikan sebagai sisa. Salah satu punca sisa yang dijanakan adalah dari kawasan komersial. Kajian ini akan dijalankan di Taman Sri Gading, Kuantan, Pahang. Kajian ini bertujuan untuk menentukan komposisi sisa pepejal di kawasan komersial, kadar penjaan dan faktor-faktor yang mempengaruhi kadar penjaan sisa pepejal. Terdapat dua jenis premis yang terlibat dalam kajian ini yang produk dan perkhidmatan premis jenis. Kajian ini dijalankan untuk mendapatkan data-data dengan pengasingan dan pengambilan berat sisa pepejal sebanyak 30 premis yang telah dipilih secara rawak. Sisa pepejal yang dikumpul daripada sampel yang akan mengasingkan kepada enam komponen yang organik, sisa makanan, kertas dan kadbod, plastik, kaca, aluminium dan lain-lain. Selain daripada itu, terdapat kira-kira 30 soalan soal selidik telah diedarkan untuk mendapatkan beberapa maklumat mengenai jenis sisa yang dihasilkan, pengurusan sisa pepejal dan kesedaran awam. Pengedaran soal selidik adalah salah satu cara untuk mengenal pasti dan mengumpul maklumat mengenai faktor-faktor yang mempengaruhi komposisi 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, premis jenis produk menghasilkan kira-kira 3.15 kg/employee.day dan premis jenis perkhidmatan menghasilkan kira-kira 3.23 kg/employee.day. Rangkaian komposisi sisa untuk sisa makanan di dalam premis jenis produk dan perkhidmatan kira-kira 1.45-8.35 kg/day dan 0.00-3.88 kg/day. Untuk kertas dan kadbod, komposisi sisa yang dihasilkan oleh premis jenis produk dan perkhidmatan kira-kira 0.02-0.7 kg/day dan 0.03-0.98 kg/day. Selain daripada itu, komposisi sisa plastik untuk premis jenis produk dan perkhidmatan adalah 0.06-0.66 kg/day dan 0.00-0.57 kg/day. Sementara itu, komposisi sisa bagi kaca untuk kedua-dua jenis premis produk dan perkhidmatan adalah 0.00-0.65 kg/day dan 0.00-0.04 kg/day. Komposisi sisa bagi aluminium adalah kira-kira 0.00-0.07 kg/day bagi premis jenis produk dan 0.00-0.03 kg/day bagi premis jenis perkhidmatan. Komposisi bagi lain-lain sisa seperti getah bagi premis jenis produk dan perkhidmatan kira-kira 0.00-0.44 kg/day dan 0.07-1.14 kg/day. Komposisi sisa yang lebih tinggi di kawasan ini adalah sisa makanan dan komposisi sisa terendah adalah aluminium. Ia adalah kerana faktor orang Asia yang mempunyai tabiat pemakanan. Faktor-faktor lain yang mempengaruhi sisa pepejal yang dijanakan kerana kawasan itu adalah kawasan bandar yang telah dibangunkan. Jadi, pertumbuhan penduduk telah mempengaruhi kadar penjaan sisa pepejal di Taman Sri Gading.

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LIST OF SYMBOLS AND ABBREVIATIONS

MSW	-	Municipal Solid Waste
MSWG	-	Municipal Solid Waste Generation
SWM	-	Solid Waste Management
US	-	United State
UK	-	United Kingdom
DOE	-	Department of Environment
NSWM	-	National Solid Waste Management
%	-	Percent
Kg/day	-	Kilogram per day
Kg/week	-	Kilogram per week
Kg/month	-	Kilogram per month
Kg/commercial.day	-	Kilogram per commercial a day
Kg/employee.day	-	Kilogram per employee a day

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CHAPTER 1

INTRODUCTION

1.1 Preamble

Waste is a left-over, an excessive product or material of no marginal value for the owner and which the owner wants to be discharged. Solid waste is a waste in a solid state. However, solid waste may be in solid state or liquid state as sludge or as a free chemical phase. In the highly competitive world of business and manufacturing, solid waste disposal is often neglected. The solid waste may be divided into two which are organic and inorganic waste. Organic waste is such as food scraps which can be broken down and biodegradable. While inorganic waste is such as plastics which contain harmful chemical and non-biodegradable.

Composition is the term used to describe the individual components that make up a solid waste stream and their relative distribution, usually based on percent by weight. The information related to the composition of solid waste is important in evaluating equipment needs, systems and management programs and plans. The data of solid waste generation is also useful to provide the public with a viewpoint on the solid waste problem. The data may provide a gauge to judge the environmental performance of the public.

There are several factors that lead to differences in solid waste generation rate. From earlier studies, it appears there is some argument that the solid waste generation rate was influenced by the standard of living, income and daily activities of the population. Apart from the factors already mentioned, other factors also play an important role that will change the way of life of the community. The rapid development also invites to

generating of more garbage. This will cause more problems such as pollution and health disorders that are shackle the society if not managed well, while the community is an important asset in the development of a country.

1.2 Problem Statement

In Malaysia, the increase in the rate of garbage production is a result of continued economic vibrancy and rapid development taking place in the local area that will lead to improved standard of living and increasing population in the area. Waste generation is linked to economical activities and flow of materials in society.

The solid waste takes up space and does not disappear by itself. Where waste accumulates over time because of ineffective waste collection and public cleansing, nuisances such as odors, flies, and others may develop and become a problem for human and aesthetic problem for the community.

The accumulated waste easily accessible by insects, animals and humans, in particular children, may constitute to health issues. Pathogens in the waste may spread by direct and indirect contact or the waste may enhance the survival and spreading of infected vectors such as rats that feed. Thereby, they may carry the pathogens outside the waste when migrating.

Landfill had a negative global warming potential impact, which means that they all contribute with saving with respect to greenhouse gas emission. They only exception was waste disposed directly in a conventional landfill equipped with a flare but no energy recovery.

1.2 Research Objectives

The purposes of this study are as follows:

- i) To determine the composition of solid waste in commercial area of Taman Sri Gading, Kuantan.
- ii) To identify the factor effecting the solid waste composition in commercial area of Taman Sri Gading, Kuantan.
- iii) To analyze the generation rate of solid waste in commercial area of Taman Sri Gading, Kuantan.

1.3 Scope of the Study

This study will be conducted in Taman Sri Gading, Kuantan, Pahang. The commercial areas are selected to perform this study. About 30 premises of public premises, product premises and service premises will be selected randomly as a research sample. The solid waste collected from the samples will be segregate into six components which are organic, food scraps, paper & cardboard, plastic, glasses, aluminum and others. The solid waste will collected everyday on daily, weekly and a month basis. There are about thirty sets of questionnaire that will be distributed to the selected premises. The questionnaire distribution is a way to identify and collect the information on factors effecting the solid waste composition.

1.5 Expected Outcomes

By quantify the solid waste generation, we may increased manufacturing competitiveness through reduced solid waste disposal costs, reduced energy costs and optimized used of raw materials, packaging and floor space. Unintentionally, it can decrease reliance on landfills for disposal due to the composition of solid waste

determined. The factors that been collected may be help for the waste management soon.

1.6 Significance of the Study

By identifying the solid waste composition, it may help in identifying the way to reduce the component. The volume and types of waste generated also may be analyzed so that the existing system may be review. This study is useful to find the way to eliminate or reduce the amount of the solid waste produced. The composition of the produced solid waste that had been determined may help on finding the appropriate program such as reuse, reduce and recycle (3R), because by reducing the waste is the best way, reusing is a better way and recycling is a good way to manage the solid waste.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

According to Christensen (2011), waste is a left-over, a redundant product or material of no or marginal value for the owner and which the owner wants to dispose. Being waste is not a true property of an item but depend on the how the owner values the item. Study by Christensen (2011), waste may rely on many factors, for example time, location, state, income level and personal preferences. In addition, becoming a waste depend on which items are being purchased and consumed. Hence, the waste generation rate and composition different widely over time. Christensen (2011) found that solid waste would be expected to be a waste in a solid state. However, Christensen (2011) studied that solid waste may be solid or liquid as sludge or as a free chemical phase.

Landfilling is the main solid waste disposal method in Malaysia and most of the sites are open dumpsites, and the capacity has been overloaded (Anwar Johari *et al.*, 2012). Similarly to Latifah Abd Manaf *et al.*, (2009) found that landfill sites are filling up at a very fast rate and at the same time, the constructing new landfill sites is becoming difficult due to increase of land prices and high demand.

There are some factors affecting the solid waste composition and generation rate. According to Guerrero *et al.*, (2012), the increasing population levels, rapidly growing economy, rapid urbanization and the rise in community living standards have greatly accelerated the municipal solid waste composition in developing countries. Similarly, Anwar Johari *et al.*, 2012 found that the rise in population causes the increase in human

activities and indirectly turn leads to increase in waste composition. Lebersorger *et al.*, (2011) studied also found that the residents density, age, education, overnight stays and socio-economic factors are the factors affecting solid waste generation.

According to Begum, *et al.*, (2007), waste minimization includes source reduction and recycling while reduction is defined as any activity that reduces or wipe out the generation of waste at the source, usually within a process. Besides that, the recycling is defined as the recovery and/ or reuse of what would otherwise be a waste material. 3R concepts which are reusing, reducing and recycling should be applied to minimise the solid waste composition.

2.2 Municipal Solid Waste

2.2.1 Introduction

Municipal solid waste, MSW is defined as solid waste includes all domestic refuse and non-hazardous wastes such as commercial and institutional wastes. The World Bank (1992) identified that solid waste is one of the three major environment problems faced by most municipalities in Malaysia.

Ashok V. Shekdar (2009) found that the main sources of MSW, the waste generators and the types of solid waste generated as presented in Table 2.1. Similarly, MSW therefore includes a proportion of commercial, non-hazardous industrial waste and potentially also demolition waste and sewage sludge (Tchobanoglous *et al.*, 1993, Strange, 2002 and Vesilind *et al.*, 2002). A hierarchy manner is provided in Figure 2.1.

Table 2.1: Sources and types of municipal solid waste

Sources	Typical Waste Generators	Types of Solid Waste
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer, electronics, batteries, oil and tires) and household hazardous wastes
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, government center, hospitals, prisons	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal Services	Street cleaning, landscaping, parks, beaches, recreational areas	Street cleaning, landscape and tree trimmings, general wastes from parks, beaches and other recreational areas

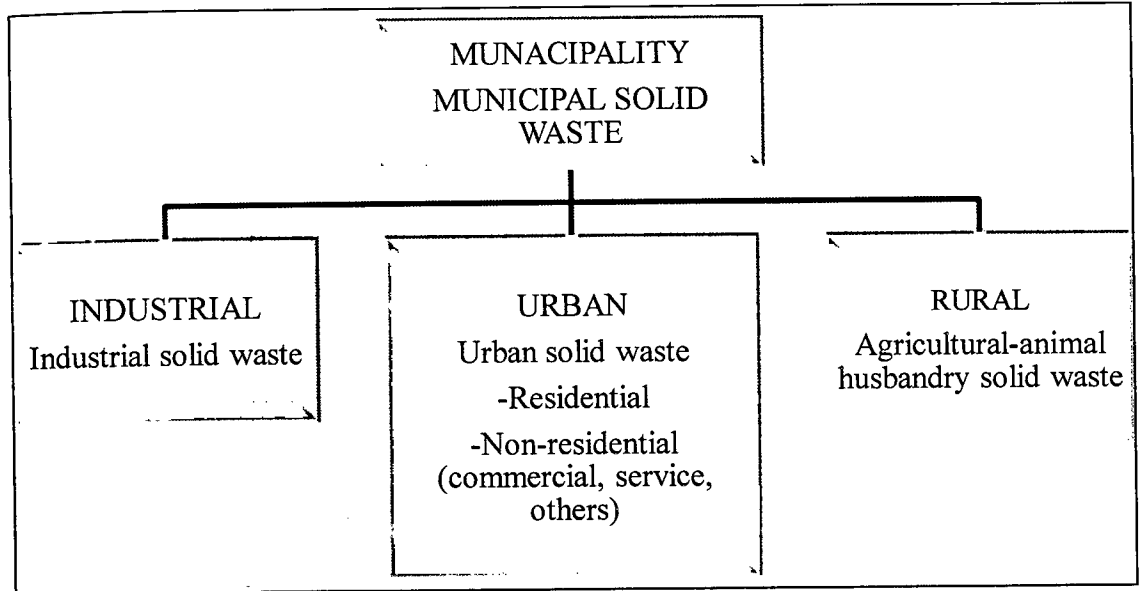


Figure 2.1: The classes that each division produces

2.2.2 Sources of Municipal Solid Waste

According to Buenrostro *et al.*, (2001), the classification categorizes the sources into three divisions and seven classes of sources: residential, commercial, institutional, construction/ demolition, agricultural-animal husbandry, industrial and special. Buenrostro *et al.*, 2001 studied also found that the source classification of MSW considers three divisions: urban, industrial and rural; each one is represented as discrete entity. Other than that, the urban is divided into two subdivisions, which originate classes of sources residential and non-residential (commercial, institutional/ services, construction/ demolition and special). Commercial waste is the waste generated in commercial facilities, department stores, supermarkets, restaurants and marketplaces.

Bruner *et al.*, (1996) defined MSW as the materials collected by the municipality or by authorized organizations. However, when ‘municipal activities’ or ‘collected by the municipality’ are considered as features of MSW, the solid waste generated in the outskirts of the urban centers are not considered as MSW (Buenrostro *et al.*, 2001). In Table 2.2 below shows the sources, activities, typical amenities or locations where wastes are generated and types of solid waste produced (Singh, 2011).

Table 2.2: General Sources of Municipal Solid Waste

Source	Activities, typical amenities or locations where wastes are generated	Types of solid waste
Residential	Single-family and multi-family home, low, medium and high rise apartment, etc.	Food wastes, rubbish, paper waste, ashes, special wastes
Commercial and institutional	Warehouses, restaurants, markets, offices buildings, hostels, shopping malls, schools, print shops, auto repair shops, medical facilities, and institutions and prisons	Food wastes, rubbish, ashes, demolition and construction wastes, special wastes, occasionally hazardous wastes
Open areas	Streets, alleys, parks, vacant lot, playgrounds, beaches, highways, recreational areas, marriage halls, etc.	Street sweepings, roadside litter, rubbish and other special wastes
Treatment plant sites	Water, sewage and industrial waste treatment processes	Treatment plant sludges

2.2.3 Types of Municipal Solid Waste

Buenrostro *et al.*, 2001 found that paper, plastics garden clippings, glass and other materials are recognized as Municipal Solid Waste, MSW. It is considered that this type of waste is mainly generated by residential, institutional and commercial sources (Hockett *et al.*, 1995). Other than that, Smyth *et al.*, (2010) has made diversion category which are recyclable, compostable and non-recyclable. The primary category for recyclable are such paper and paperboard, disposable hot beverage cups, beverage containers, plastics, glass, expanded polystyrene, ferrous metal and non-ferrous metal.

In Lebersorger *et al.*, (2011) studied also found types of MSW such are residual waste, bulky waste, biogenic waste from collection in bio-waste containers, waste paper and cardboard, light-weighting packaging, metal packaging, waste glass, other recyclables, waste electrical and electronic equipment and hazardous household waste. According to D.P Smyth *et al.*, 2010, Table 2.3 reports the mean weights and composition of each material type recovered. The wastes are sorted into recyclable, compostable and non-recyclable material.

According to the previous study by Anwar Johari *et al.*, (2012), in Table 2.3 show the typical MSW characterization in Malaysia.

Table 2.3: Typical Malaysia MSW characterization

Source	Residential high income (%)	Residential medium income (%)	Residential low income (%)	Commercial (%)	Institutional (%)	Average (%)
Food organic	30.84	38.42	54.04	41.48	22.36	37.43
Mix paper	9.75	7.22	6.37	8.92	11.27	8.71
High grade paper	-	1.02	-	0.35	-	0.69
Corrugated paper	1.37	1.75	1.53	2.19	1.12	1.59
Plastic	3.85	3.57	1.90	3.56	3.56	3.29
Pamper	6.49	7.58	5.83	3.80	1.69	5.08
Textile	1.43	3.55	5.47	1.91	4.65	3.40
Rubber	0.48	1.78	1.46	0.80	2.07	1.32
Wood	5.83	1.39	0.86	0.96	9.84	3.78
Yard	6.12	1.12	2.03	5.75	0.87	3.18
Glass	1.58	2.07	1.21	2.90	0.28	1.61
Ferrous	1.93	3.05	2.25	2.47	3.75	2.69
Non-ferrous	0.17	0.00	0.18	0.55	1.55	0.49
Aluminium	0.34	0.08	0.39	0.25	0.04	0.22
Battery	0.22	0.18	-	0.29	0.06	0.19
Others	-	-	-	-	6.97	6.97

2.3 Waste Composition

2.3.1 Introduction

Composition is the term used to describe the individual components that make up a solid waste stream and their relative distribution, usually based on percent by weight (Christensen, 2011). The information related to the composition of solid waste is important in evaluating equipment needs, systems and management programs and plans. Table 2.4 shows the previous study for relative composition of municipal solid waste from low, medium and high-income countries.

Table 2.4: Relative composition of municipal solid waste from low, medium and high-income countries

Parameters (%)	Low-income country	Medium	High-income
Organic	40-85	20-65	20-30
Paper	1-10	15-30	15-40
Plastics	1-5	2-6	2-10
Metal	1-5	1-5	3-13
Glass	1-10	1-10	4-10
Rubber, leather, etc.	1-5	1-5	2-10
Other	15-60	15-50	2-10
Moisture content (%)	40-80	40-60	5-20
Density	250-500	170-330	100-170
Calorific value	800-1100	1000-1300	1500-2700

Sources: INTOSA (2002) and Cointreau (2006)

2.3.2 Organic Waste

2.3.2.1 Introduction

Organic waste is such as food scraps which can breakdown and biodegradable. Biodegradable is capable of being decomposed by the action of biological process.

Organic wastes are typically the heaviest component of a waste stream, thereby costing the most money to dispose of, and have the highest potential to emit green house gases, once buried in a landfill. According to Al-Salem *et al.*, (2009), the various waste products, consisting of either end-of-life or production (scrap) waste, are feedstock of secondary techniques, thereby generally reduced in size to a more desirable shape and form, such as pellets, flakes or powders, depending on the sources, shape and usability.

Besides that, in the research of Christensen (2011) found that organic material contains many different organic compounds of varying composition and degradability. Biodegradable packaging are most suitable for domestic and/or municipal composting and collected with organic waste at household level for composting(Davis *et al.*, 2006).

2.3.2.2 Types of Organic Waste

Organic waste or known as biodegradable waste consist of food and kitchen waste, green waste and paper. According to Anwar Johari *et al.*, 2012, food/organic is made up of 37.43% while paper (mix paper, new print, high grade paper and corrugated paper) is 16.78%. Malaysian solid waste contains a very high concentration of organic waste and consequently has a high moisture content and a bulk density above 200kg/m³ (Latifah Abd Manaf *et al.*, 2009). In Latifah Abd Manaf *et al.*, 2009 also found that the main components of Malaysia waste were food and paper.

Besides that, in the research of Anwar Johari *et al.*, 2012 found that at least 61.17 % of Malaysian MSW is made up of biomass materials such as food, paper and wood. In Anwar Johari *et al.*, 2012 also found that the largest single constituent of the waste is food/organic, making up 37.43% and occurring mostly in residential low income waste (54.04%). Paper or pulp-based materials is ranging from wrapping paper, cartons boxes, disposable cups and plates, bags and envelopes (Davis *et al.*, 2006). In Table 2.5 below shows the organic waste and the waste items.