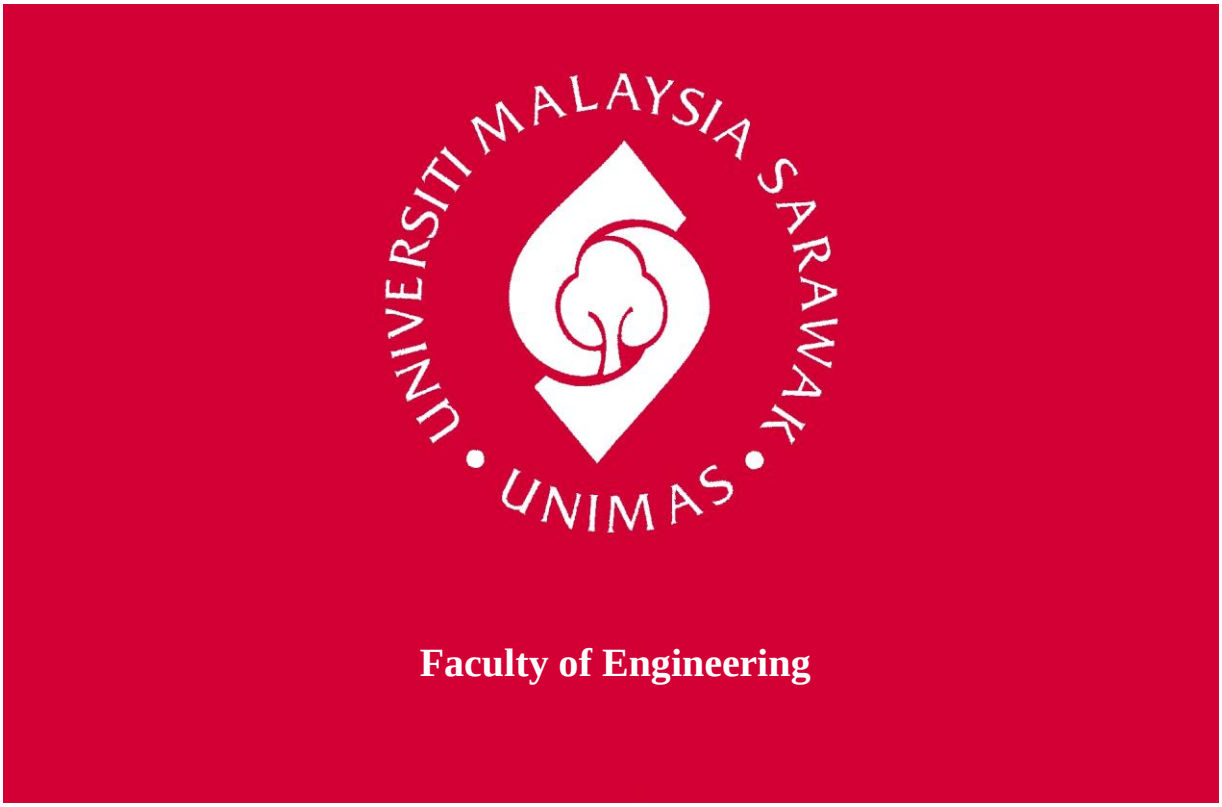

CHARACTERISTICS AND CHARACTERIZATION METHODOLOGIES OF MSW AT SOURCE - A REVIEW

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Bachelor of Engineering with Honours
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CHARACTERISTICS AND CHARACTERIZATION METHODOLOGIES OF MSW AT SOURCE - A REVIEW

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This project is submitted in partial fulfillment of

the requirements for the Degree of Bachelor of Engineering with

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To my beloved parents, siblings and cherished friends

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ABSTRAK

Sejak kebelakangan, ekonomi negara yang bertambah, populasi negara yang kian menambah, dan pertukaran kehidupan seharian telah meyebahkan sisa-sisa pepejal bandaran kian bertambah juga. Sisa Pepejal Bandaran adalah sisa yang mengandungi alatan komponent seperti kertas, kaca, logam, plastik, getah dan kulit, tekstil, sisa ela, sisa makanan dan bahan-bahan buangan bukan organik. Kertas ini membentangkan satu kajian semula pada ciri-ciri dan kaedah-kaedah pencirian bagi sisa pepejal bandaran pada tapak pelupusan. Kaedah yang digunakan untuk menentukan ciri-ciri sisa pepejal bandaran adalah pensampelan. Bahan sisa dikutip di beberapa tempat dan diasingkan. Ciri-ciri bahan sisa dibahagikan kepada ciri fizikal dan ciri kimia. Ciri-ciri kimia sisa pepejal bandaran adalah ditentukan dengan kaedah experiment. Pertemburan tanah adalah satu strategi pengurusan sisa pepejal bandaran. Pertemburan tanah boleh menghasilkan gas-gas buangan yang mencemarkan alam dan masyarakat. Gas Metana dan Karbon dioksida adalah komponent utama dalam gas-gas buangan. Gas Metana boleh dikumpulkan dan digunakan sebagai tenaga pemulihan. Pencirian sisa pepejal bandaran adalah penting untuk memilih kaedah pelupusan yang sesuai dan menentukan impak kepada alam dan masyrakat.

ABSTRACT

Rapid economic growth, increasing population and change in lifestyle contribute to increasing the generation of municipal solid waste (MSW). Municipal Solid Waste (MSW) are waste which consist of components such as papers, glass, metal, plastics, rubber and leather, textiles, yard waste, food waste and miscellaneous inorganic wastes. This paper presents a review on the characteristics and characterization methodologies of Municipal solid waste at sources. The method used to determine the characteristics of MSW is sampling. Materials are collected at different sources and are separated. The material is then characterized by its physical and chemical characteristics. Chemical characteristics of municipal solid waste are determined by chemical analysis. Landfilling is a one of the municipal solid waste management strategy. Landfilling produces landfill gas which contaminates the nature and also society. Methane and Carbon dioxide are the major component in landfill gas. Methane is collected and reuse as a new energy. Proper characterization of municipal solid waste is fundamental for the planning of municipal waste management services.

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LIST OF ABBREVIATIONS AND NOTATIONS

MSW	-	Municipal Solid Waste
USA	-	United States of America
UK	-	United Kingdom
Q	-	Methane generated in current year (m^3/year)
Lo	-	Methane generation potential (m^3/Mg waste)
R	-	Average annual waste acceptance rate during active life
k	-	Methane generation rate constant ($year^{-1)}$
c	-	Time since MSW landfill closure ($year^{-1}$)
t	-	Time since MSW landfill opened ($year^{-1}$)

CHAPTER 1

INTRODUCTION

1.1 Background

Municipal solid waste (MSW) has been increasing dramatically for the past 20 years. Due to the increase of population in the urban area, environmental pollution has been increasing because of the MSW. This has become a serious social problem which hinders urban development, especially in the larger cities in the development countries such as Kuching city. Findings ways to reduce the impacts on the environment and to effectively reuse the waste are very critical in this stage.

1.2 DEFINITION OF SOLID WASTE

Solid waste is any unwanted solid material that is no more needed and rejected by the society. They are said to have negative economic value which suggests that they are not worth the cost and effort involved in recycling and are cheaper to throw away than to recover.

1.3 Municipal Solid Waste (MSW)

Municipal solid waste (MSW) can be grouped into 3 categories, such as durable goods, nondurable goods, containers and packaging, from sources like residential, industrial, commercial, and institutional. Examples of waste from these categories include paper and paperboard, yard trimmings, glass, metals, plastics, wood, and food waste. The durable goods do not include paper and paperboard. The nondurable goods category include only the small amounts of metals and essentially no glass or wood where else the containers and packaging category includes only rubbers, leathers, and textiles.

Municipal solid waste which primarily originates from the residential sector requires a proper management system to be disposed off. MSW management covers various aspects ranging from collection, storage, transporting, sorting, recycling, and treatment for disposal. Besides, source reduction is the most rational approach in MSW management system.

In Malaysia, the average MSW generation rate currently records at 0.8-1.0 kg of waste per capita per day. In Malaysia, the MSW is disposed off through direct hauling from storage system to landfill or dump sites. Recycling activities is practiced only on a very limited extent and compositing is not yet implemented, even though it is suitable to be used.

One of the main problems in Malaysia is the awareness level of public towards waste management activities proposed by local authorities. In additions, the laws

which enforce the public, the industrial and the commercial sectors to separate the waste and recycle the waste have not been implemented. However, changes in Malaysia have started to appear.

1.4 Objective

The objective of this project focuses on the collection of data, analysis on municipal solid waste in several countries and in Malaysia and to access the characteristics, characterization methodologies and management practices on Municipal Solid Waste. From the data and information collected, suitable management of the MSW will be recommended for the use in Malaysia.

1.5 Structure of Thesis

As stated in the objective, the primary purposes of this study are to identify the characteristics and characterization methodologies of the MSW. Comparison is done by referring to several countries and Malaysia to obtain a suitable management is the purpose of this study.

Chapter 1 gives general information related to the topic and basic principles of solid waste. This chapter consists of the background of the solid waste and the definition of “solid waste” and “municipal solid waste”. The aims and objectives of this study and the structure of the project also included.

Chapter 2 is the literature review on some related papers and journals about the characterization methodologies, characteristics and management of municipal solid waste.

Chapter 3 describes the methodology which is formed from analysis of research data and information collected. The related characteristics and methods of characterization are to study and analyze.

Chapter 4 focuses on the results and discussions of this study. Results of different researches will be put into discussion in this chapter. Chapter 5 assimilates the conclusion and some recommendations of this review.

CHAPTER 2

LITERATURE REVIEW

2.1 DEFINITION OF SOLID WASTE

Solid waste is any unwanted solid material that is no more needed and rejected by the society. They are said to have negative economic value which suggests that they are not worth the cost and effort involved in recycling and are cheaper to throw away than to recover. Nowadays, people all over the world are concerned about pollution that happens everywhere. Extra efforts and serious consideration and actions to protect the mother earth from being polluted or leat to reduce the potential of pollution have been taken. Several regulations and laws or acts had been set up to prevent pollutions.

2.1.1 Source of Solid Waste

Knowledge of the sources and types of solid wastes, along with data on the composition and rates of generation, is basic to the design and operation of the functional elements associated within the management of solid wastes.

(Tchobanolous et al, 1993). Typical waste generation facilities, activities or locations associated with each of these sources are reported in Table 2.1.

Table 2.1 Source of Waste within a Community

Source	Typical waste generators	Types of solid waste
Residential	Single and multifamily dwelling	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes.).
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.
Institutional	Schools, hospitals, prisons, government centers.	Same as commercial.
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.
Process (manufacturing, etc.)	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing.	Industrial process wastes, scrap materials, off-specification products, slay tailings.
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms.	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).

(Source: Tchobanolous et al. 1993)

2.1.2 Types of Solid Waste

According to Rimberg (1975), municipal solid waste can be classified into six categories; i.e food waste, rubbish, ashes, and residues, demolition and construction wastes, special wastes and treatment plant wastes. The descriptions of these wastes are given in the Table 2.2.

Table 2.2 Classification of Municipal Solid Waste

Component	Description of Waste
Food wastes	The animal, fruit, or vegetable residues (also called garbage) result from the handling, preparation, cooking and eating of foods. Because food wastes are putrescible, they will decompose rapidly, especially in warm weather.
Rubbish	Rubbish is any combustible and non-combustible solid wastes, excluding food wastes or other putrescible materials. Typically combustible rubbish consists of materials such as paper, cardboard, plastics, textiles, rubber, leather, wood, furniture, and garden trimmings. Non-combustible rubbish consists of items such as glass, crockery, tin cans, ferrous and non-ferrous metals, dirt, and construction wastes.
Ashes and residues	Materials remaining from the burning of wood, coal, coke and other combustible wastes are called ashes and residues. Residues from power plants normally composed of fine, powdery materials, cinders, clinkers and small amounts of burned and partially burned materials.
Demolition and construction waste	Wastes from razed buildings and other structures are classified as demolition wastes. Wastes from the construction, remodeling, and repairing of residential, commercial, and industrial buildings and similar structures are classified as construction wastes. These wastes may include dirt, stones, concrete bricks, plaster, lumber, shingles, plumbing, heating, and electrical parts.
Special wastes	Waste such as street sweepings, roadside litter, catch basin debris, dead animals, and abandoned vehicles are classified as special wastes
Treatment plant wastes	The solid and semisolid wastes from water, wastewater, and industrial-waste treatment facilities are included in this

(Source: Rimberg, 1975)

2.1.3 Municipal Solid Waste (MSW)

Municipal Solid Waste (MSW) includes most of the non-hazardous solid waste from city, town, or village that require a routine or a periodic collection and transport to a processing or disposal site. Sources of MSW include private homes, commercial establishments and institutions such as school, as well as industrial facilities. However, MSW does not include industrial process waste, construction and demolition debris, sewage sludge, mining wastes or agricultural wastes.

MSW comprise of two types of materials; refuse and thrash. Refuse includes garbage and rubbish. Garbage contains putrescible or highly decomposable food waste, such as vegetables and meat scraps. Rubbish contains mostly dry, non-putrescible materials such as paper, textiles or wood objects. Thrash includes bulky waste materials that are generally require special handling and is therefore not collected on a routine basis. An old mattress, television or refrigerator is examples of thrash (Nathanson, 1997)

2.1.4 Sources of Municipal Solid Waste

Sources of MSW include both residential and commercial locations. Residential waste (including waste from multi-family dwellings) is estimated to be 55 to 65 percent of the total MSW generation. Commercials waste (including waste from schools, some industrial sites where packaging is generated, and business) contributes between 35 and 45 percent. Local and regional factors, such as climate