

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The number of waste generated continues to rise due to the increasing population and it led to a serious environmental problem in Malaysia (Sin et al., 2013). Khan (2015) stated that in Malaysia, the average waste generation rate in a day per person was estimated to be 1.1kg/day/person in the year of 2012, which gives a total of 33,000 tons of waste generated per day. Municipal solid waste (MSW) is the substances or scrap materials which the holder discards or intends to discard within the area of municipal; residential, industrial, commercial, city centre and institutional (Abas & Wee, 2013). Trends in the composition of MSW in Malaysia showed that food, plastic and paper are the main components of waste received in landfill with distribution of 46%, 15%, and 14% respectively (Pariatamby, 2014).

The management of MSW in Malaysia is mainly through landfill (refer Figure 1.1) and there are 165 disposal sites which catered 95% of the waste generated. As the waste increases with years, most of the landfill in Malaysia are filling up and has reached its capacity. Moreover, the cost of developing new landfill space is costly (Yahaya, 2013). Out of 165 disposal sites in Malaysia, 8 of it is sanitary and the rest are open dumps (unsanitary). Unsanitary landfill is capable of producing greenhouse gases (GHG) mainly methane and carbon dioxide. Therefore, due to the lack of landfill capacity, high cost of landfill development and GHG emission, it is imperative for the authorities to implement the other waste management approaches such as recycling and incineration. Incineration is a combustion-based process and even though it is an attractive technology, it has become the subject of intense debate around the world. This is due to the possibility of dioxins being emitted to the air which adversely affect the human health and environment.

Recycling refers to the widespread collection and reuse of waste dispose. By referring to figure 1.1, it shows that the implementation of recycling practice in solid waste management is at the lowest since this method was said to be still in infant stage (Sin, et al., 2013). Most of the Malaysian are still lacking of awareness in implementing this method of MSW management. Other than that, recycling requires aggressive marketing efforts to locate market and sells with higher price. Lack of good recycling market will hinder the effectiveness in implementing waste recycling (Sin, et al., 2013).



Figure 1.1: Solid waste management in Malaysia for 2013 (CleanMalaysia, 2016)

Biodegradation process involves biological and chemical processes. The enzyme activity is affected by substrate concentration, temperature, pH and microbiological activity to degrade waste (Scopes, 2002). Microorganisms-induced degradation of organic material depends on the activity of hydrolytic enzymes. Therefore, the rate of microbial cellulose degradation is depending on the environmental condition, activity of microorganisms, pH, and temperature (Humphreys et al., 2010).

Cellulose is one of the major component in MSW composition. It is a linear polysaccharide which consists of 1000-1200 glucose residues with β -1,4-glycosidic linkages (Khatiwada et al., 2016). In laboratory, filter paper is commonly used to represent pure cellulose. The crystalline structure and insoluble nature of cellulose become a big challenge in enzyme hydrolysis. Therefore, the degradation of cellulosic materials is a complex process and thus, requires participation of microbial cellulolytic enzymes (Irfan et al., 2012). For many years, cellulose-degrading bacteria have been isolated and characterized from various type of sources especially from soils and in this present study, the cellulolytic bacteria will be isolated from landfill soil.

1.2 Motivation

Escalating generation of municipal solid waste has become an issue worldwide. Statistic of municipal solid waste composition produced around the world has stated that cellulose waste such as organic waste and paper, are the major biodegradable component of MSW, which contributes to more than 50% of the total MSW composition. For many years, study on the production of cellulase by bacteria has attracted the attention of many researchers due to its ability in degrading cellulosic material. Degradation of cellulosic material is a complex process and requires participation of microbial cellulolytic enzyme (Irfan, et al., 2012). According to Sadhu & Maiti (2013), 5- and 6- carbon sugar can be found in lignocellulosic waste such as municipal cellulosic solid waste, comprised of mainly cellulose which hydrolysed by complex enzyme named as cellulase. These types of sugar are used in animal feeds, industrial feedstock and as raw material for fermentation industry. Therefore, due to the high proportion of cellulose waste in MSW composition, biodegradation of cellulose waste using cellulase produced by cellulolytic bacteria is proposed. Biodegradation of cellulose waste using cellulases is assumed to have possibility in reducing number of waste accumulated in dumpsite and indirectly keeping the environment safe.

1.3 Problem Statement

Presently, the amount of municipal solid waste (MSW) disposed to the landfill are rapidly increasing with time. This leads to a serious environmental problem in Malaysia such as air pollution due to methane gas emission, odour pollution and groundwater pollution caused by leachate. Disposal of waste through landfill in Malaysia has become more difficult due to lack of landfill capacity (Abas, & Wee, 2013) and natural degradation of waste in soil is taking longer time. Other than that, the cost of managing municipal solid waste is highly priced, where 40 – 80% of the local authorities expenditure is on managing solid waste and public cleansing (Yahaya, 2013). Development of new landfill also requires high expenditure at which according to Yahaya (2013), the average capital expenditure (CAPEX) of new landfill is around RM 30 Million. Other waste management alternatives such as incineration and recycling have their own disadvantages and hence, implementing new approach should be emphasized to manage MSW.