SUPERVISOR VALIDATION

I hereby declare that I have read this thesis and in my in my opinion this project is sufficient in terms of scope and quality for the award of Bachelor Degree of Technology Management (Innovation Technology)

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IMPLEMENTATION OF INCINERATION TECHNOLOGY FOR MUNICIPAL SOLID WASTE (MSW) TREATMENT AND DISPOSAL IN MELAKA.

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Report submitted in fulfilment of the requirements for the Bachelor Degree of Technology Management (Innovation Technology)

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DECLARATION

I hereby declare that this project entitled “Implementation of Incineration Technology for Municipal Solid Waste (MSW) Treatment and Disposal in Melaka.” has been prepared by my own self except the summaries and citation that I have clarified the resources.

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DEDICATION

I would wish to dedicate the appreciation to my family members, especially my parents Mohd Khairuddin Bin Mat Ripin and Noraini Binti Hashim, who supported me spiritually and financially, beloved supervisor and panel who guided me throughout the research, housemates and course mates that helped me through the journey of the research.

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ABSTRACT

Due to limitation of insufficient land resources, incineration or thermal treatment of waste is popular in nations such as Japan and Germany as the major technology for waste management scheme. The incineration technology is capable of dealing with the increasing demand for municipal and industrial solid waste treatment in urban neighborhoods. The evaluation of this municipal incineration in terms of secondary pollution potential, cost-effectiveness, and operational efficiency has become a new focus in the highly interdisciplinary area of production economics, systems analysis, and waste management. Exponential population growth and increasing number of tourists have brought forth a huge quantity of municipal solid waste (MSW) in Melaka. With average of 1200 ton municipal solid waste (MSW) per day contributed by the local communities and tourists had become a serious environmental issues recently. This study aims to generate experts' opinion about the suitability to implement the new management technology such as incineration technology to overcome the current landfill disposal method. This study uses qualitative method of interviewing the three respondents whom are working in the Melaka Green Technology Corporation. PESTLE analysis approach is applied as an exploratory research. The research presents the innovative/alternative ways using incineration technology integration in solid waste management for tackling the limitation to insufficient land resources and management of solid waste in effectively and efficiently. The finding shows that Melaka is capable to implement the incineration technology in large scale.

Keywords: Incineration, municipal solid waste, technology management

ABSTRAK

Oleh kerana had sumber-sumber tanah yang tidak mencukupi, sistem pembakaran atau sistem rawatan haba menjadi popular di negara-negara seperti Jepun dan Jerman sebagai teknologi utama bagi skim pengurusan sisa. Teknologi pembakaran mampu menguruskan permintaan yang semakin meningkat untuk rawatan sisa pepejal perbandaran dan perindustrian di kawasan bandar. Teknologi pembakaran ini dari segi potensinya mampu mencegah pencemaran, kos teknologi yang efektif dan kecekapan dalam operasi telah menjadi tumpuan baru di kawasan yang sangat tinggi disiplin dalam ekonomi pengeluaran, analisis sistem, dan pengurusan sisa. Pertumbuhan penduduk yang pesat dan peningkatan jumlah pelancong telah menjanakan kuantiti yang besar terhadap sisa pepejal perbandaran di Melaka. Dengan purata 1200 tan sisa pepejal perbandaran yang disumbangkan oleh masyarakat dan pelancong tempatan pada setiap hari, ia telah menjadi isu-isu alam sekitar yang serius baru-baru ini. Kajian ini bertujuan untuk menjana pendapat pakar-pakar mengenai kesesuaian untuk melaksanakan teknologi pengurusan baru seperti teknologi pembakaran untuk mengatasi kaedah pelupusan tapak pelupusan yang sedia ada. Kajian ini menggunakan kaedah kualitatif dengan menemuramah tiga responden yang bekerja di Perbadanan Teknologi Hijau Melaka. Analisis PESTLE digunakan sebagai kaedah untuk meneroka kajian ini. Kajian ini membentangkan cara yang inovatif / alternatif yang menggunakan integrasi teknologi pembakaran dalam pengurusan sisa pepejal bagi menangani had untuk sumber tanah yang tidak mencukupi dan pengurusan sisa pepejal dengan cekap dan berkesan. Dapatan kajian menunjukkan bahawa Melaka mampu untuk melaksanakan teknologi pembakaran dalam skala yang besar.

Kata Kunci: Teknologi Pembakaran, sisa pepejal perbandaran, pengurusan teknologi

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ABBREVIATION	MEANING
PTHM	Perbadanan Teknologi Hijau Melaka
SWCorp	Solid Waste Corporation
NSWMD	National Solid Waste Management Department
UHLG	Ministry of Urban Wellbeing, Housing and Local Government
MSW	Municipal Solid Waste

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CHAPTER 1

INTRODUCTION

1.1. Introduction/Background Of The Study

Melaka is located in the southern region of Malaysia with the longitudes of 2.1944° N and latitude of 102.2491° E. Melaka was officially listed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as one of the World Heritage Sites (WHS) on 7 July 2008 (Teo et al. 2014). Melaka occupies a total land area of 1650 square miles (Melaka State Government, 2016). It has a population of approximately 931,210 and population densities of 493 per km2 (Department of Statistic, 2016). Over the past 10 years, Melaka has achieved remarkable economic growth which has brought about exponential population growth in addition to the high influx of foreign workers. At the same time, Melaka has received a large number of tourist arrivals which are 15.4 million people in 2014, although the country now smeared with the tragedy during the year. Chief Minister Datuk Seri Idris Haron said the figure showed an increase of 5.03 percent over the previous year with 26 per cent of overseas tourists. "We expect the number of tourists coming to Melaka will decline following the tragedy, disaster and so on but, these things do not happen (Utusan 2015). This industry effects positively on the Malaysian economy for increasing foreign exchange earnings, and employment opportunities (Bhuiyan et al. 2013). In addition, the development in the tourism sector also contributed positively to the expansion of activities in other sub-

sectors, particularly the hotel, travel and tour industry, retail and restaurants as well as transport (Karim 2012).

Thus, population growth and increasing number of tourists have directly led to an increase in the amount of generating MSW. MSW is produced by households, commercial activities and other sources whose activities are comparable to those of households and commercial enterprises. Example sources of MSW are, wastes from the offices, hotels, supermarkets, shops, schools, institutions, and municipal services such as street cleaning and maintenance of recreational areas (Ngoc UN & Schnitzer H, 2009, Singh RP et al.,2011). Core components of Melaka MSW are food, paper and plastics, which make up approximately 80% of the waste by weight (Green, Corporation, & Asia, 2015). The average moisture content of the MSW is about 60%, making incineration a challenging task. Nonetheless, it should be pointed out that higher percentages of combustible materials such as organics and paper may somewhat offset this concern. This is because organic materials are generally amenable to incineration since it destroys the organic fractions and converts them to CO2 and water vapor (LaGrega MD, Buckingham PL, & Evans JC, 2001).

The MSW causes damages to the environment and spreads diseases, having grow up to be a serious threat to the health of residents and an obstacle to social development. Due to the lack of MSW disposal capacity, the backward infrastructure and operational skills of MSW treatment facilities, as well as the lack of supporting facilities, some cities are faced with the “garbage siege” problem (Xin-Gang, Gui-Wu, Ang, & Yun, 2016). The composition of MSW in Malaysia differs from one place to another. Among some of the factors that might influence the composition of MSW produced in a specific location is the extent of reduction, reuse and recycling (3R's) programs and also the duration of years (Mohamed AR & Lee KT, 2006). Waste management in Malaysia is the responsibility of the Ministry of Urban Wellbeing, Housing and Local Government (UHLG) under the purview of the local authority as stipulated in Section 72 of the Local Government Act 1976 (Latifah AM et al.,2009). However, in order to facilitate handling

of MSW through an integrated management system, in Melaka, the management of solid waste is managed by the Solid Waste Corporation (SWCorp).

The harmless disposal of MSW is essential to build a resource saving and environment-friendly society, reduce pollution, improve the living environment and level of ecological civilization, and achieve scientific urban development (Cheng & Hu 2010). In response, the Melaka State Government is seeking more effective ways of MSW disposal. Compared with other MSW treatment technologies, the waste incineration performs best (Dong Jun et al.,2014), and it is a better waste management option (Ofori-Boateng Cynthia et al.,2013). The application of large scale incineration technologies is inevitable as landfill areas would ultimately cease (Abd Kadir et al. 2013). Thus, the incineration plant becomes a good choice in Melaka, which uses incineration to convert MSW to electricity. It takes advantage of waste resources and transfers them to electricity to achieve waste reduction, recycling and harmlessness, which can comply with the requirements of circular economy with significant economic and environmental benefits.

According to Abd Kadir et al.,(2013), for the case of small incinerators located within the aforesaid tourist islands, there are already several key economic instruments recommended by the Economic Planning Unit (EPU) aimed at improving their MSW management. These recommendations, if implemented, will directly affect the application of incinerators. The recommendations include (1) application of tourist eco tax for island visitors; (2) application of consumption tax on goods; (3) application of assessment tax on commercial establishments; (4) application of recycling subsidy; and (4) application of waste disposal charge (Economic planning unit,2004). The general concept of these key economic instruments. These applications, if successfully implemented, would lessen the reliance on small incinerators in the future.

1.2. Problem Statement.

In Melaka, almost 99% of MSW managements are via landfilling while incinerators are being used only on a very small scale basis, such as for clinical waste disposal which is located at Bukit Rambai, Melaka. The Krubong landfill commissioned since the 1980s has reached maximum capacity with almost a billion tonnes of accumulated solid waste (The Star online, 2014). It forces the local authorities to shut down the landfill. To overcome this problem, the local authorities had opened a new landfill on Sungai Udang, Melaka in April 2015. However, the level of landfilling at the new landfill increased drastically which it has achieved about 5 levels of landfilling for the period of one year after it was operated. With the average MSW generation about 1200 tons per day collection in Melaka, this has alarmed the government to form a special cabinet committee to propose a more comprehensive waste management structure in the region, especially within densely populated regions. One of the recommendations is required of an incinerator which acts as an alternative to replace the landfill system for MSW treatment. The main rationale of using incineration technology for MSW management is to reduce the volume of the MSW by as much as 95% (Aishah et al. 2013). This research, therefore, to investigate the suitability to implement incineration technology in Melaka as an alternative solution to overcome the solid waste disposal problems as well as energy recovery initiatives related to incineration of MSW in Melaka..

1.3. Research Questions.

The main questions to be answered in this research is what is the suitability to implement incineration technology in Melaka for a large scale. The research also will be guided by the following research questions:

1. What are the factors that contribute towards the implementation of this technology in large scale?

2. What are the challenges that will be faced to implement this technology in a large scale?
3. What the possibilities of the incineration technology to be implemented for a larger scale in Melaka?

1.4. Research Objectives.

The broad of this research is to investigate the suitability to implement incineration technology in Melaka as an alternative solution to overcome the solid waste disposal problems. The specific objectives of the research are:

1. To identify the factors that contribute towards the implementation of this technology for large scale in Melaka.
2. To investigate the challenges that will be faced to implement this technology for a large scale in Melaka.
3. To find out the possibility of the incineration technology to be implemented for a larger scale in Melaka.

1.5. Scope Of The Study.

This study primarily designed to investigate the suitability to implement incineration technology in Melaka as an alternative solution to overcome the solid waste disposal problems. There are 6 external possible factors which were based on PESTLE framework that influence the implementation of incineration technology. There are political, economical, social, technology, legal and environmental. This study uses the qualitative method which is interview to collect data. The interview has been conducted among the three respondents whom are working in Melaka Green Technology

Corporation (PTHM). The interview process contains the questions about suitability to implement incineration technology for a large scale in Melaka based on PESTLE framework. The researcher assumes that the respondents are honest in answering the question during the interview and can get full cooperation from the respondents.

1.6. Limitation And Key Assumptions Of The Study.

In the process for completing this study, the researcher has met some limitations. The researcher is new in this field, so the researcher is lack of experience on how to conduct the interview and collect the data. Other than that, the researcher assumes that the respondent provide the honest answer even though the answer not related to the field of municipal solid waste management. Moreover, the reseacher assume that the respondent has adequate knowledge to be apart of primary data collection. Last but not least, the researcher assumes that the respondents have more experience in handling with matters related to municipal solid waste management in Melaka when he or she can provide justifiable answers.

1.7. Importance Of The Study (Significance/Contribution)

The research presents the innovative/alternative ways using incineration technology integration in solid waste management for tackling the limitation to insufficient land resources and management of solid waste in effectively and efficiently. In addition, it is also to overcome the pile of solid waste at the landfill due the limited land resources.

1.8. Summary

This chapter detailed out about the development of the framework for the research. The framework acts as guidelines for the researcher to ensure the research align with the objectives of the research. It includes basic information about the research such as introduction of municipal solid waste management in Melaka and the suitability to implement incineration technology in Melaka as an alternative solution to overcome the solid waste disposal problems. Moreover, the purpose of doing the research and the expected outcome is also discussed in this chapter. Last but not least, this chapter covers the scope of the research.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction.

In this section, the researcher provides the whole of the study describing the literature as a main source. This section also consists of the relevant statement and related written sources such as journals, articles, books, newspaper articles and previous studies by a lot of philosophies that support the research in strengthening arguments given. It is very important to the researcher to emphasize and assert the topic in order to come up with solid and strong evidence unhesitatingly. Lastly, the information that was obtained from various reference sources that can be used to strengthen the understanding of the proposed framework.

2.2. The Factors Contributed Towards The Use Of Incineration Technology Around The World.

There are many factors that cause a country wants to use the incineration technology for their MSW treatment and disposal method. Each nation may have their different factors why they use. In this research, the researcher will cover up in term of PESTLE framework.

2.2.1 Political Factors

The factors may be altered by the government's influence on a country's infrastructure. It includes the current and potential influences from political pressures and hence, the stability of the industry's environment and the cost of operating will be affected (Cadle et al., 2010). Political factors often impose costs upon organizations such as taxes. The governments are often trying to protect firms in their countries from foreign competition through tariffs and import restrictions, and to encourage their development through cheap loans and a large government contracts.

According to Xin-Gang et al. (2016), it is a part of the external factors that cause changes in a decision making in the use of incineration technology in China. They also stated that it has shown clearly the goals of incineration industry, showing that the central government is seeking to pave the way for the development of this industry. "The 12th Five-Year Plan (2011–2015)" of Chinese government puts forward the goals, major tasks and standards for the harmless disposal of urban waste and the incineration industry (The State Council, Republic of China, 2012). According to the "Plan", all municipalities, provincial capitals, and cities specifically designated in the state plan will achieve the harmless disposal of MSW reaching a rate of 90% and over, and that in rural areas reaching 70% in 2015.

Moreover, in Sweden, the SYSAV (Sysav South Scania Waste) waste-to-energy plant represents an incineration plant in Malmö (Figure 2.1). Trickier problems are waste separation, recycling, and collection. Malmö is helped by national laws that oblige the makers of plastics, glass, electronics, and packaging to recover and recycle their products (Tulloch 2009). Swedes are used to separate these products into special bins

Figure 2.1: SYSAV incineration plant in Malmö, Sweden, capable of handling 25 metric tons (28 short tons) per hour of household waste.

2.2.2 Economic Factors.

An economic factor is necessary and essential in this field. It could be the degree of growth within an economy, or market confidence in the economies within which the organization operates (Cadle et al., 2010). If an economic boom, it will promote the growth of many industries while the economic downturns caused difficulties to the industries (Haberberg, 2008). A systematic literature review is made which applies economic analysis and theories to the issues (Antonio 2015).

The Spittelau incineration plant in Vienna, Austria, becomes a tourist attraction as well as a solution to waste (Irish Times News, 2000). It can boast that its principal waste-treatment plant has grown up to be a major tourist attraction. At the same, it boasts the economic development of the incineration industry as well as the economics of Austria. Designed by the famous Austrian painter and architect, Friedensreich

Hundertwasser, the Spittelau incinerator (Figure 2.2) has been one of the city's eye-catching landmarks since it was rebuilt in 1989; it even features on tourist postcards.

Figure 2.2: The Spittelau incineration plant in Vienna, Austria, designed by Friedensreich Hundertwasser.

2.2.3 Social Factors.

This factor takes into consideration all events that affect the market and community socially. Thus, the advantages and disadvantages to the people of the area in which the project is taking place also need to be considered. These events include cultural expectations, norms, population dynamics, health consciousness, career altitudes and global warming (Paul et al. 2010).

Public acceptance is considered most critical for the effectiveness of any integrated MSW management scheme (Xin-Gang et al. 2016). In their research, incineration plant is misunderstood and even resisted or rejected by the public. It is a