TO STUDY THE EFFECTIVENESS OF SOLID WASTE COLLECTION AND TRANSPORTATION SYSTEM AROUND KUANTAN MUNICIPAL HOUSING AREA

SHARUL RIZUAN BIN ISMAIL

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UNIVERSITI MALAYSIA PAHANG

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ABSTRACT

Solid waste collection and transportation system is one of the important elements in solid waste management. Population growth and rapid economic development requires an effective solid waste collection and transportation system. This is important to avoid the various problems that may arise due to the increasing of solid waste generation from day to day. In addition, an effective collection system can reduce the cost of solid waste management, as 50-80% of the management cost is contributed by collection and transportation activities. Therefore, a study on the effectiveness of the solid waste collection and transportation system has been conducted around Kuantan municipal housing area to see its effectiveness. Residences involved in this study were Taman Seriku, Taman Seri Mahkota, Taman Indera Mahkota 5 and Taman Indera Mahkota 6. Data collection methods used in this study is weighing the waste generated by the population in the study area three times a week before collection work is carried out. In addition the questionnaire method was also used in this study in order to get data about collection data at study area. Data was analyzed using Microsoft Excel. Data were analyzed from various aspects such as the weight of waste produced per household before garbage collected, the frequency of garbage collection performed, ethics and view of residents with existing collection system. Results showed that the collection and transportation system around Kuantan municipal housing area is good and effective, but there are some small problems that need to be look up to avoid any problems in the future.

ABSTRAK

Sistem pungutan dan pengangkutan sisa pepejal merupakan salah satu elemen yang penting di dalam pengurusan sisa pepejal. Pertambahan penduduk dan perkembangan ekonomi yang pesat memerlukan sistem pungutan dan pengangkutan sisa pepejal yang efektif. Ini adalah penting untuk mengelakkan pelbagai masalah timbul daripada penjanaan sisa pepejal yang kian bertambah dari hari ke hari. Selain itu, sistem pungutan yang efektif dapat mengurangkan kos pengurusan sisa pepejal, memandangkan 50 – 80% kos pengurusan adalah daripada aktiviti pungutan dan pengangkutan. Oleh yang demikian, satu kajian tentang keberkesanan sistem pungutan dan pengangkutan sisa pepejal telah dijalankan di sekitar taman perumahan daerah Kuantan untuk melihat keberkesanannya. Kawasan perumahan yang terlibat dalam kajian ini ialah Taman Seriku, Taman Seri Mahkota, Taman Indera Mahkota 5 dan Taman Indera Mahkota 6. Kaedah pengumpulan data yang digunakan dalam kajian ini ialah dengan menimbang berat sampah yang dihasilkan oleh penduduk di kawasan kajian sebanyak tiga kali seminggu iaitu sebelum kerja-kerja pingutan sampah dijalankan. Selain itu kaedah soal selidik juga digunakan didalam kajian ini dalam proses pengumpulan data. Data kemudiannya dianalisis dengan menggunakan Microsoft Excel. Data dianalisis dari pelbagai aspek seperti berat sampah yang dihasilkan bagi setiap rumah sebelum sampah dikutip, kekerapan pungutan sampah yang dijalankan, etika pekerja dan pandangan penduduk di kawasan kajian tentang sistem pungutan yang sedia ada. Hasil kajian menunjukkan sistem pungutan dan pengangkutan sisa pepejal di kawasn kajian adalah baik dan masih efektif, cuma terdapat beberapa masalah kecil yang perlu diambil tindakan supaya tidak menimbulkan sebarang masalah pada masa akan datang.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The disasters that happen during the 14th century known as Black Death sacrifice almost half of the Europe's population. This tragedy caused by a serious outbreak effect from the lack of planning in solid waste management at highly public population (Tchobanoglous, Theisen and Vigil, 1993). The relation between public health and improper in storage, collection, and disposal of solid waste is very clear. Health department have seen that rats, flies and others diseases vector breeder like to be in open dump, food storage and everywhere else that that got food supplies and suitable for them to live. Research form U.S Public Health Service (USPHS) shown that there are 22 human diseases caused by improper in solid waste management (Tchobanoglous, Theisen, Vigil, 1993).

Solid waste generation is depending on a few factors such as human activities, climate, standard of livings, customs and beliefs, topography and season. Garbage dump in city of Calcutta India is said have reached 200 years, but still can be used. Even though the population there is quiet high, but due to the low standard of livings, the quantity of solid waste generated is low and its components maybe made up from material that easily decomposed (Fadil Hj. Othman, 1986).

Malaysia is one of country which is growing and expanding constantly in terms of development, economy and social also experienced increase in population growth. The total population of Malaysia in year 2010 is 27.6 million with an average annual population growth rate 2.17% in the period 2000 to 2010. This statistics announced by

the Minister in the Prime Minister's Department Tan Sri Mohamed Yakcop. The increase in the population growth and development lead to the increase of solid waste generation. This situation is very worrying if it is not control because the limited landfill capacity cannot accommodate the solid waste generated. According to the Southern Waste Management (SWM), on average every person generates 0.8kg-1.0kg solid waste every day and Malaysia citizens generate 1800 metric tons of solid waste averagely every day. Therefore, effective solid waste management must be done to avoid it is increasing and cause problems in the future.

Careful planning is necessary so that the existing landfill sites can accommodate solid waste generated by Malaysia citizens and it can bu used to the maximum possible extent. Besides that, the increasing solid waste generation from day to day also will cause an increase in the high cost of managing the waste produced. One of the measures that can be taken to save the cost of management is viewed in terms of garbage collection and transportation performed. This is because 50-70 % solid waste management cost related to the collection and transportation. Therefore, the effectiveness of solid waste collection and transportation should be seen as a small percentage change in the collection and transportation operation will have a big impact on the overall cost (Tchobanoglous, 1993).

In year 2000, local governments in Asia have spent a total of US$ 25 billion (RM 95 billion) per year for solid waste management, in which 50-80 % of the total expenditure contribute by the middle-income countries for the collection of solid waste. In Malaysia, 50 % of the municipal operating budget spent on municipal solid waste materials and 70 % of it is spent on garbage collection (Urban Development Sector Unit, East Asia and Pacific Region, 1999).

Definition of solid waste includes all solid and semi-solid material discarded or not in desire. It generate from the daily activities including food scraps, discarded items, glass, plastics, sewage sludge and crop residues. According to the second edition of the Kamus Dewan Bahasa dan Pustaka, effectiveness is defined as an action taken can be seen from the results obtained after it done. With other words effectiveness means that the level achieved from a thing or anything that were done.

This chapter will discuss about a few subtopic that relate to the study such as problem statement, objective, significance, scope and expected outcome of this study. The most important things in this chapter are the objective of the study because all the things that was done must be to achieve the objective. The study also can be said successful if the objective is achieved.

1.2 Problem Statement

Rapid development from various aspects has increased the population around Kuantan district. As the number of population increase, the quantity of solid waste generated in Kuantan also increase because the quantity of solid waste generated is directly proportional to the numbers of population.

Therefore a systematic solid waste management must be plan so that any problems due to the failure in management and the effect from it can be avoided. The failure in solid waste management would bring an undesirable effect and will cause pollution to environment. So, a research must be done to find out the effectiveness of solid waste collection and transportation in Kuantan residential area as solid waste collection is an important aspect in solid waste management and the estimated collection cost are 60-80 % from the total cost.

1.3 Objectives

This study is focusing on the effectiveness collection and transportation system of solid waste. The objective of this study is to assess the effectiveness of solid waste collection and transportations system that is used around Kuantan municipal housing area. The solid waste collection and transportation that is used around Kuantan municipal housing area right now is three times a week collection.

Second objective is to obtain feedback from the public and evaluated in several aspects such as collection time, the collection frequency, service provided and work ethics of collector. The opinion of respondents can help this study to know the effectiveness of solid waste collection system at their residences.

1.4 Scope of Study

The scope of this study involves the effectiveness of solid waste collection and transportation system conducted by private sector that has been appointed by Majlis Perbandaran Kuantan (MPK), which is Alam Flora Sdn Bhd for selected area only.

The selected areas in this study are Taman Seriku, Taman Seri Mahkota, Taman Indera Mahkota 5 and Taman Indera Mahkota 6. The reason these residential areas selected because these area are easy to access. The size of every residence that involve in this study also quite small and that ensure the result of this study will be more accurate. Besides, all the selected area are in Kuantan district.

This study will look at the effectiveness of the collection and transportation system of solid waste by analyzing the weight of solid waste before collection is done. For every residence, 20 houses will be selected randomly and for each house, their weight of solid waste will be weighed three times a week before collection.

Besides, a questionnaire also will be distributed to 100 random respondents. For each residence, 25 random respondents will be selected to answer the questionnaire. The questionnaire is very important to know the respondents opinion on the solid waste collection at their residences.

1.5 Significance of Study

The significance of this study is to see to what extent the effectiveness of solid waste collection and transportation system carried out by the Alam Flora Sdn Bhd and see the deficiencies in carrying out their task so that any ideas for improvement can be suggested in order to overcome any problems that may arise to the population there as well as to environment and the effectiveness in collection and transportation of solid waste can be achieved.

1.6 Expected Outcome

During conducting this study, there are a few outcome that expected at the end of this study. The expected outcomes of this study are the collection and transportation system around Kuantan municipal housing area is satisfying. Besides that, the three times a week collection system in Kuantan is expected still effective. Another outcome that is expected at the end of this study is residents at study area satisfy with current collection system.

1.7 Conclusion

As a conclusion, chapter 1 is a little bit briefing about this study. In this chapter, problem statements, the objectives, scope of study and significant of this study already mentioned clearly. This chapter is important because, from this chapter the direction of this study can be determined and the objectives can be achieved.

The study on the effectiveness collection and transportation system of solid waste is very important because if the system is not effective, many problems will arise and will make the public feel uncomfortable. As our country becomes more developed from day to day, this aspect must be taken seriously.

In the next chapter, desk study will be conducted. In that chapter, all the information about an effective solid waste collection and transportation system will be discuss and the information will be obtain through reading journal, internet, previous study, books or any other sources that can help to improve the knowledge about this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, factors that influence the effectiveness of solid waste collection and transportation system will be discuss more thoroughly. All the knowledge in this chapter were obtain by doing a desk study. Among the factors that will be discussed in this chapter are, type of solid waste, properties of solid waste, solid waste management and collection of solid waste.

In Malaysia, we defined solid waste as any scrap material or other unwanted surplus substance or rejected products arising from the application of any process that required to be disposed of as being broken, worn out, contaminated or otherwise spoiled or any other material that is required by the authority to be disposed of. In United Kingdom, they defined solid waste as any material or an effluent and other undesired surplus that comes up from the application of any process that needs to be disposed or has been broken, contaminated or damaged and it also related with anything which needs to cast off or else if it were waste and shall be anticipated as waste except conflicting is verified. Economy development and the growing sophistication of urban systems give an impact to the community lifestyle. This development caused the solid waste generation increased from day to day and generate with many form. The increased in number of population and economy growth led to the need of effective solid waste management parallel with the increasing solid waste generation in Malaysia (Munira, 2006).

From 1991 until 2020, it is predicted that solid waste generation will increased with average 3.24 % annually and equal to 4.6 million tons every year or 17 million cubic meters of solid waste that must be disposed at disposal sites in Malaysia (Munira, 2006).

The government already consign more than RM500 million for solid waste management services in Malaysia and more than half from the overall spending involve the collection and transportation of solid waste operation meanwhile the rest is spend for disposal operation (Munira, 2006).

2.2 Type of Solid Waste

In general, solid waste can be classified according to the type of solid waste generated. Based on the Environmental Engineering book written by Peavy, Rowe, and Tchobanoglous in 1985, types of solid waste that can be categorized are as below:

a) Municipal solid waste (MSW)
b) Industrial Waste
c) Hazardous Waste
d) Agricultural Waste
e) Hospital Waste

2.2.1 Municipal Solid Wastes (MSW)

Municipal solid waste includes waste from many places and areas such as residential, commercial, institutional, and some industrial or construction areas. It is been collected and managed by municipalities and growing faster than population due to increase of consumption rate. Municipal solid waste is the main concern of this study and has major impacts to environmental and human health. The main sources of municipal solid wastes base on Peavy, Rowe, and Tchobanoglous, 1985 are:

a) Residential area

Solid wastes from residential areas also known as domestic wastes. Solid wastes are generated from domestic daily usage. These include food wastes, rubbish, ashes, yard trimmings and etc. Waste from residential areas always come in form of solid, semi-solid, and liquid and most of the solid wastes are from organic material that easily decomposed, rotten and produce unpleasant smell.

b) Commercial and institutional area

Commercial waste includes wastes that are generates from the office buildings, shopping malls, warehouses, hotels, airports, restaurants, school, and medical facilities. Most of the wastes produced are papers, plastics, glasses and etc. This waste can be recycled the amount of waste that need to be disposed at disposal site.

c) Construction and industrial areas

Construction wastes are the waste produced by the construction of the building or renovation of the building. Usually, wastes generated are wood, stone, cement, iron nails and others. Most of the wastes from construction site are very hard to dispose. Meanwhile, industrial waste produced varies depending on the type and the production of a particular industry.

2.2.2 Industrial Wastes

Industrial wastes are wastes generated from industrial activities of an industry that is produced during the manufacturing process of that industry. It includes wood, glass, plastic, paper, ash, construction waste and others. There is also a hazardous waste produced by some of the industries that have an impact on the environment and population. The remnants of these wastes require special treatment and should be disposed on-site disposal set by the responsible party.

2.2.3 Hazardous Wastes

Wastes generated are hazardous either at the time the waste generated or in the future or at a particular period. Hazardous waste will cause harm to life, plants or animals. These wastes will cause irritation to the skin, corrosion, reactive and toxic. Hazardous waste can be categorized as in Table 2.1 below.

Table 2.1: Category of Hazardous Waste and Its Source

Category Of Hazardous Waste	Sources
Radioactive waste	Nuclear Power Plant, Laboratories, Hospital
Chemical waste	Battery Shop, Laboratories, Electronic Shop, Hospital
Biological waste	Hospital, Clinic, Medical Research Center, Medicine Shop
Flammable waste	Petroleum Refining and Processing Central
Explosive waste	Construction Company, Firearms Manufacturing Center

(Source: Tchobanoglous et. Al, 1997)

This type of waste must be handle carefully and in a right way. If not it can cause any unwanted accidents. There are two reasons why hazardous waste need to be handle carefully.

Firstly, the waste cannot be thrown into the air or released into the drainage system such as drains, ditches, streams, lakes or sea. Such removal will cause problems such as blocked drains, flash flood pollution and air pollution.

And the second is, solid wastes are something that generated continuously due to human activity. That is why solid wastes need to be managed properly so that it will not give any problem and bad impacts to human life, animals, plants and other creature that live in this earth.

Since the solid waste generation gives bad impacts to human life and environment, a few regulations were set by the Department of Environment (DOE). Control of the hazardous waste disposal under the responsibility of the Department of Environment (DOE) through the implementation of the Regulation of the Environmental Quality (Scheduled Wastes) 1989. The things that must be adhered are:

a) Inventory control waste generated by operators must be stored correctly and completely for the purpose of inspection and verification.
b) Disposal of hazardous waste is only allowed in areas designated by the DOE.
c) Waste must be put in containers, including warning signs in accordance with the standards set by the DOE.
d) Disposal of hazardous waste can only be performed by a licensed contractor and registered with the DOE.

2.2.4 Agricultural Wastes

Agricultural waste is usually used to describe waste from various farming activity. Waste generated includes natural and non-natural waste. Agricultural waste consists of the waste from the activity of agriculture itself, animal waste, food processing waste, pesticide residues and plants. Disposal of agricultural waste, including tree branches, grass wastes and damaged fruit that fell to the ground and unwanted by anyone.

Wastes resulting from food processing industries are also categorized as agricultural waste. Some processing factories such as poison and fungi factories is a major contributor to hazardous waste because it can threaten human life if exposed in the long term.

2.2.5 Hospital Wastes

Hospital wastes or clinical wastes typically minor sources of solid waste generation and can be categories as hazardous waste. The appearance of hospital waste posed a major problem in solid waste management for most countries and contaminates environmental, air, land and water resources. Improper disposal of medical wastes can cause serious disease like Hepatitis A and B (World Health Organization, 2002).

2.3 Characteristic of Solid Wastes

Characteristic of the solid waste is very important to note before analyzing and reviewing the effectiveness of the management, storage, collection and disposal of solid waste as well as the determination of the level of pollution and so on. The characteristics of the solid waste that must be considered in solving the problem of solid waste management by engineering way are as follows:

1. Physical characteristic
2. Chemical characteristic

2.3.1 Physical Characteristic of Municipal Solid Wastes

Physical characteristic consists of individual components, analysis of particle size, moisture content and density (Peavy, Rowe, and Tchobanoglous). Data and information related to the characteristic of the solid waste is very important and useful in the analysis and design of landfills. It is also very important to determine the initial level of pollution and ways to control and overcome the long-term contamination by identifying the physical components of the solid waste itself.

Percentage rate for solid waste components is difficult to estimate, particularly for areas with large populations. This percentage will vary based on the products used by the population, lifestyle, economic status and current activities in the study area are. With this, the study should be conducted to get accurate information and data for analysis purposes.

The size of the components affects the effectiveness of waste resource recovery and material recovery. By using mechanical separation techniques, particle size can be separated effectively. For organic waste, size is important for biological treatment. Reduction of particle size will increase the rate of biological change.

Typically, the moisture content of municipal solid waste is between 15 -30% water. Based on previous study by Noraini, 1994, moisture can contents measured by drying the sample at 77 ° C (170 ° F) for 24 hours and count with:

$$M = ((w-d) / w) \times 100$$

Where: M = percent moisture content
w = initial weight of wet sample
d = final weight of dry sample

2.3.2 Chemical Properties of Municipal Solid Wastes

Analysis of the chemical content of a solid waste is essential especially to know the energy content of the waste, recover the original source material and the selection of the appropriate treatment and disposal.

Wastes containing high energy content. Each Every wastes has different energy level. It depends on the chemical properties contained in the waste. Energy contained in the waste can become fuel (Fadhil, 1986).

Chemical composition consisting of a combination of burnt and unburned material. It consists of the carbon (C), hydrogen (H), oxygen (O), nitrogen (N) and sulfur (S). These chemicals cannot be seen with the naked eye. However, the chemicals contained in the waste will be hazardous to health when it began to decompose.

2.4 Solid Waste Management

Solid waste management is essential in order to facilitate the selection process of solid waste management, retrieving the original source material, makes it easy to analyze energy content in the solid waste and the selection of treatment and disposal process. In addition, the main factor why waste should be managed in a systematic and organized manner so that management costs can be reduce and put to good use and avoid waste from occur.

Well planned and systematic management system should be implemented in order to meet the growing population developed life. This is due to solid waste generation depending on the number of population as well as the standard of living and economy. The increasing number of solid waste should be managed so that the effects of management failure do not occur. Impacts that will arise such as unpleasant odors, health disorders, an unpleasant view, increase the number of disease-carrying as well as increased management costs. Well planned, organized, efficient, effective and high-tech management is necessary to ensure the welfare of human and animal life and the environment.

2.5 Solid Wastes Storage

Solid waste that has been generated will be collected and piled up in an area where it will be collected to the disposal site. Basically wastes need to be managed consistently and well. Therefore temporary storage of waste should be made while waiting for the collection and disposal of solid waste in other area is completed.

According to Tchobanoglous (1993), factors that need to be considered in the storage proses are types of storage container, location of storage container, effect of storage to waste content and health and esthetic aspect.