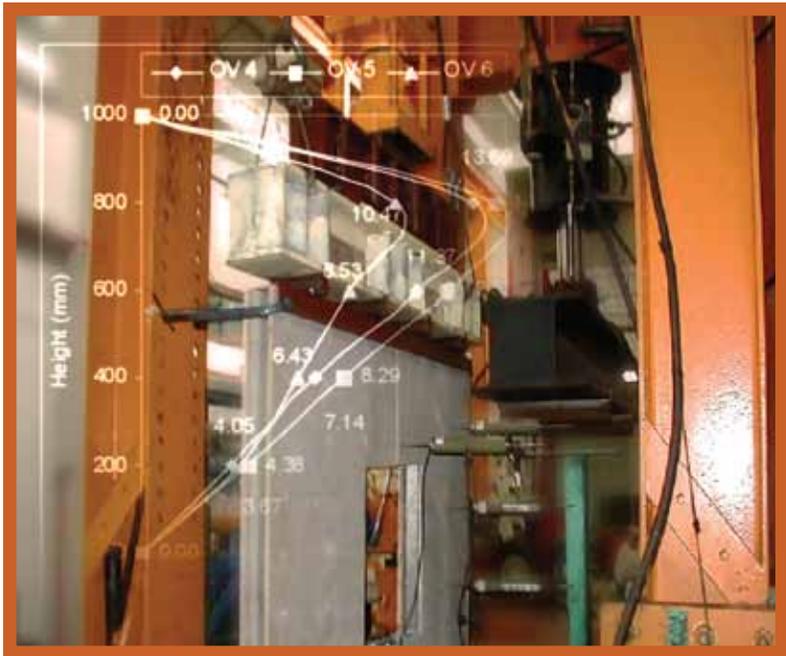


VOLUME 4 NO. 1
JUNE 2007

ISSN 1675-7009

SCIENTIFIC RESEARCH JOURNAL



SCIENTIFIC RESEARCH JOURNAL

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Scientific Research Journal is jointly published by Institute of Research, Development and Commercialisation (IRDC) and University Publication Centre (UPENA), Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.

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A Study on the Problems of the Usage of Incinerators in Malaysia

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ABSTRACT

Incineration is one of the options available to dispose municipal solid wastes (MSW) as it is capable of breaking down hazardous non-metallic wastes besides destroying bacteria and viruses. In terms of volume of wastes, incineration can reduce almost instantaneously by 90 %. In 1998, the government of Malaysia embarked on a pilot project to use incinerators to dispose MSW in four popular resort islands to see the effectiveness of this technique of waste disposal. Seven units of mini incinerators were installed on the islands and the local municipals were made responsible to manage and maintain. This project looked into the problems arises when incineration is used for MSW disposal on these islands. Data collected revealed that the plants were not properly managed and maintained. This was due to the lack of funds available for effective and smooth operation and the absence of highly expert personnel required to maintain the plant. Other factors that contribute to the inefficiency are inadequate air pollution control facilities and the infrastructure which do not condon the foul odour. Further research work need to be done to monitor the operation of these incinerators in order to explore its potential to dispose waste safely, effectively and cleanly.

Introduction

Waste has been dumped indiscriminately, burned uncontrollably and buried irresponsibly. In the present society, accumulation of waste appears to increase in quantity as the standard of living and the population increases.

Malaysia is not excluded in this scenario. Hence, appropriate and effective waste management in Malaysia is much needed to ensure the environment is well protected and sustainable for the well being of the future generations.

Incineration is the second oldest method for the disposal of waste, the oldest being landfill. By definition, incineration is an enclosed device using controlled flame combustion, the primary purpose of which is to thermally break down hazardous waste. During the 1980s, the use of incineration to destroy hazardous wastes expanded in the United States because it was seen as an alternative to landfilling. By the beginning of 20th century, 15 percent of major American cities were incinerating municipal solid wastes.

In Malaysia, incinerators are becoming more attractive due to limited landfill sites and improved technology. But incinerator is not without problem; high temperatures within incinerators produce toxic gases like dioxin and furans, which have been found to be carcinogenic, among other effects. However, the drastic reduction in volume of solid and liquid wastes makes incinerators rather attractive.

In Malaysia, there are seven operating municipal incinerators set up in the islands of Langkawi, Pangkor, Tioman and Labuan on trial basis. A study on the performance and operations of these incinerators were made here and comparison are based on their location, population of the island, capacity, model and supplier, date commissioned, usage frequency, gas emission monitoring, sources of wastes, volume of waste, segregation method, cost, ash disposal, efficiency and manpower.

Thus it remains to be the main objective of this project that is to study the problems arise from the use of incinerators in Malaysia. Besides that, this project hopefully can educate Malaysians to be more conscious on the environmental issues and more importantly to nurture the love for environmental preservation.

Solid Waste and Disposal Technologies

Many different technologies or methods are available to treat solid waste. Areas where wastes are buried, known as landfills are the cheapest and most common disposal method for wastes worldwide but landfills quickly become overfilled and contaminate air, soil and water.

Another method known as composting using natural biological processes to speed up decomposition of organic wastes, is an effective strategy for dealing with organic garbage. The product is a material that can be used as a natural fertilizer. Unfortunately, this method takes about

a month for the conversion of waste to fertilizer to complete even for a household capacity of 10 kg per day.

A current and more favorable method of recycling, extracting and reusing certain waste materials, has become an important part of municipal solid waste strategies in developed countries. Recycling plays a significant, informal role in solid waste management for many Asian countries.

Introduction to Incineration

Incineration technology is becoming an attractive alternative in solid waste management due to its ability to reduce waste into ash by burning them under very high temperatures. Incineration is best described as burning of solid wastes under controlled condition in furnaces at high temperature. In terms of space, the volume of solid wastes could be reduced by 80-90 % by incineration and the remaining 10 % which is mostly ash is transferred to the landfills, thus eliminating the problem of odours and leachate.

Types of Incinerator

There are several types of incinerators available commercially and for those commonly used for MSW are; Co-incineration, Fluidized-Bed Incineration, Multiple-hearth, Rotary Kiln, Single Chamber/Liquid Injection, Multiple Chamber and Starved-Air Combustion or Pyrolysis. The types of incinerators differ to one another in design due to shape, air intake, waste feeder, burning mechanism and capacity. Despite being attractive as a waste disposal option, it is not universally acceptable. The main disadvantage is its high initial cost of installing an incinerator and commissioning. Other contributing factor such as it requires highly skilled personnel and the additional cost of supplementary fuel to bring up to its operating temperature and maintain combustion.

Data Collections

The rapid development of economic activities, especially in the industrial and tourism industry means that, there must also be an improvement in the waste management. The introduction of incinerator technology in Malaysian islands showed that we have move a step forward in waste management.

There are seven small incinerators put to use to dispose municipal solid waste in four selected resort islands. All local authority of these islands use landfill technology to handle their solid waste before the introduction of incineration. However, this method has some problems such as it requires a vast land site and contribute to the causes of air and water pollution.

The lack of site is a serious problem in resort islands such as Langkawi, Tioman and Pangkor. The existence of many development projects causes the land around them not suitable as a site for waste disposal.

By using the incinerator, the existing landfills can last a lot longer, thus reducing the cost of finding and commissioning new landfills.

The sole supplier of all these incinerators was the George Kent (M) Bhd. which began their construction work in 1996 and were fully commissioned in 1997, The supplier provided training programs for local staffs, mainly technicians who were involved in the incinerator operation.

The incineration technology used is that of the Hoval type of Swiss origin. The technology consists of an automatic feeding system, the municipal waste combustion chamber and post combustion stages. Figure 2.1 below shows a simple flowchart of the incineration process.

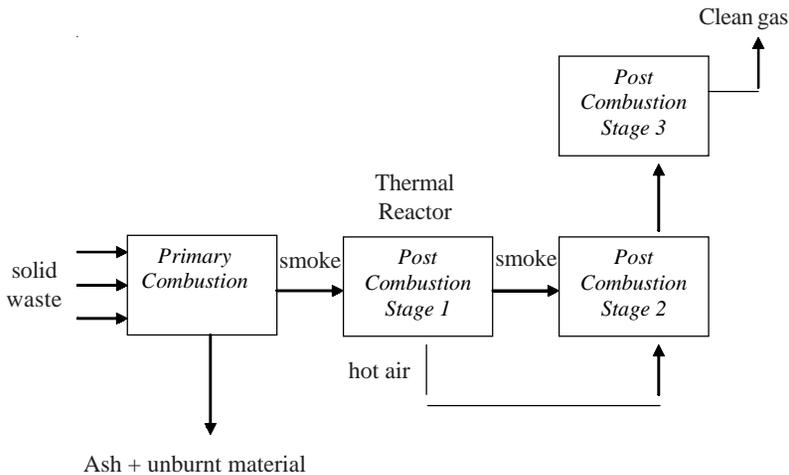


Figure 1: Flowchart of Waste Incineration Process

Incinerator in Langkawi Island

Two units of the mini incinerator plant, Hoval GG 42 were installed under the care of Majlis Daerah Langkawi (MDL). Each unit has the ability to burn a total of 10 tonnes of waste in a day. The operation started on January 1999 with 4 operators. These operators were non-skilled, with responsibility mainly to keep the place clean and tidy. The technical maintenance was highly dependent on the supplier's expertise.

Although, this incinerator could not dispose all the waste collected in a day, which amounts to about 80 tonnes, it managed to reduce the amount of solid waste disposed in the landfill.

Langkawi is a famous resort island in Malaysia with a local population of 54,000 people and a host to 2 million tourists per year. The attractions and developments in Langkawi did not just increase the number of tourists but it also increased the level of waste disposed in the island. The chart below (Figure 2) shows the total amount of solid waste disposed annually in Langkawi Island between the year 1991 and 2001. The high peak in the year 2000 is due to the influx of tourists as the result of the 'Visit Malaysia Year' campaign.

Incinerator in Tioman Island

Tioman Island is recognised as one of the most beautiful islands in the world with clear emerald waters, sheltered reefs and mountains shrouded

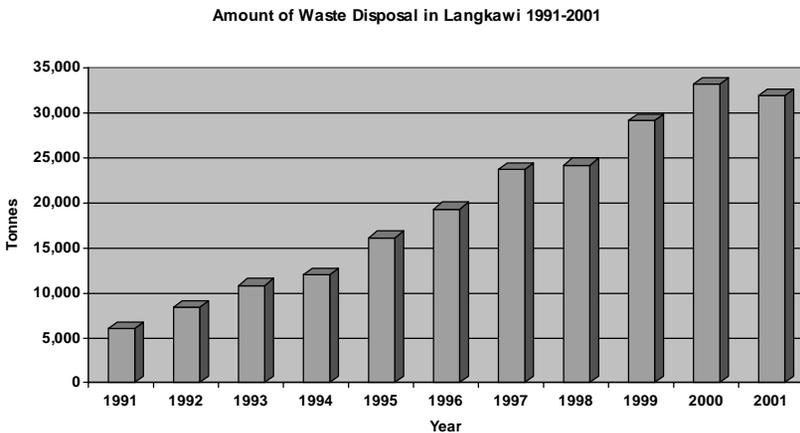


Figure 2: Amount of Waste Disposal 1991-2001

in mist and clouds. It has a land area of 13360 hectare and a local population of 3000 inhabitants. Tioman Island is the most visited island in the east coast of Malaysia having an average number of 190,000 visitors annually.

Tioman Development Authority (TDA) or Lembaga Pembangunan Tioman is fully responsible to keep the island clean and safe for the locals and the visitors. TDA is therefore responsible to manage the municipal solid wastes which amounts to 10 tonnes per day. The main bulk of the wastes comes from the 5-star Berjaya Tioman Beach Resort, amounting to 4 tonnes per day. Wastes generated on the west coast of the island, considered the more developed area are burnt using two mini 3 tonnes incinerators while, on the east coast, the wastes are landfilled. Since the west coast can only cater for 6 tonnes of wastes a day, another mode of disposal is being practised. A barge system or a 'tongkang' used to transfer the wastes to the mainland at Mersing. A barge, a flat-bottomed boat is used as freight to transport waste across the sea to Mersing for landfilling (Figure 3).



Figure 3: Barge Used in Tioman Island

The incinerator plant here is managed by one technical personnel and three unskilled labourers. The technician monitors the running of the plant operation and the labourers upkeep the cleanliness.

Major maintenance of the equipment is again very much dependent on the supplier's expertise. At the time of our visit, one incinerator was out of order for a week due to a major breakdown. The supplier was informed and a specially trained engineer was due to arrive to put it back into operation. The annual maintenance cost is around RM20,000. Since only one incinerator was in operation, the barge system was intensified to the maximum. The operational cost of the plant is RM20,000 a month and transportation charges costs another RM20,000 a month.

The waste was not segregated and as such the ash contained large amount of metals and glass. The ash was dumped to a land nearby and intermittently covered with top soil and sand. Recycling of aluminium cans can be seen at several isolated locations.

Air pollution control and analysis is at its minimal and is monitored three times a year by the Department of Environment. Although the site looked reasonably clean but the odour surrounding the site was unbearable. Fortunately, the site is located far away from residential areas.

Incinerator in Pangkor Island

In Pangkor Island there is only one unit of the mini incinerator plant, Hoval GG 42 which has the ability to burn about 5 tonnes of waste a day.

The smoke's level (smoke released from the complete combustion) abides the maximum level permitted by the Department of Environmental through the 'Akta Kualiti Alam Sekeliling 1974.

For the purpose of investigating the quality of air, Majlis Daerah Pangkor has appointed a registered chemist to monitor and analyze the smoke released from the incinerator.

Incinerator in Labuan island

Labuan comprises one main island and six other smaller ones covering an area 92 sq. km. The population of Labuan is about 75,000. Due to its wide area and large in population, Labuan is equipped with two mini incinerators.

Majlis Perbandaran Labuan planned to use incinerator since 1992. Only in 1995, the request to use 2×10 tonnes/day incinerator was agreed by Ministry of Housing and Local Authority and Economic Planning Unit.

The ministry was made responsible to handle the tender and to find the supplier for the incinerator. George Kent (M) Sdn. Bhd. was appointed as the supplier and contractor.

The incinerators were placed at Kg. Kalam, which is also the site of a landfill. All the cost for the land site was funded under 'The Sixth Malaysia Plan'.

The construction of a mini incinerator in Labuan started in January 1997. It was completed in November 1998 and began its operation in December 1998.

Data Analysis

Waste disposal has been a common problem for all society. Landfills are being used in many countries to overcome this problem. Instead of relying on landfill only, new alternatives are needed. In many islands, the continuous increase of waste volume means more space are needed. It will eventually cause a problem due to limited land area in the islands.

By using incinerator technology, the problem of searching and operating new landfills are solved. The advantage of using incinerator is the reduction in volume and weight of the waste. Besides that, incinerators are also a proven effective technology that do not require extensive labour force.

The incinerators were supplied to all the islands by an engineering firm, George Kent (M) Bhd, which installed the Hoval GG 42 model. The capital cost of installing the incinerators is equal since they were supplied by the same manufacturer. But the operating and maintenance cost are different due to different regions where they are located. The differences of costing are due to the number of units available, capacity of the incinerators and frequency of malfunctioned incinerators.

The capacity of incinerators which were installed depended on the population of the islands. For Langkawi and Labuan each has two 10 tonnes/day incinerators, Pangkor has one 5 tonnes/day unit and Tioman has two 3 tonnes/day unit. In Labuan, 7 labourers are required to operate the incinerator, 6 labourers in Langkawi and 4 labourers in Pangkor and Tioman.

The cost of operation for the incinerator in Langkawi is RM300,000 per year. Meanwhile the operating cost of incinerating in Pangkor is RM220,000. In Tioman, the Malaysia government has allocated RM 500,000 and for Labuan, RM315,000 annual budget.

Although the local population of Langkawi is less than Labuan, its capacity is similar to Labuan due to the existence of 2 million tourists annually in Langkawi, especially during world class events such as LIMA and world delegation meetings.

Besides that Langkawi has the highest volume of waste, which is about 80 tonnes/day followed by Pangkor, Labuan and Tioman. Most of the waste in Pangkor, Langkawi and Tioman come from the same sources such as from household, hotels and small industries.

Separating of waste is essential prior to feeding it into the incinerator as certain items can cause problems such as choking the feeding chute. However compared to Labuan, Pangkor and Tioman, only the waste in Langkawi undergoes a segregation process. Here, the labourers will separate the waste manually for items such as glass bottles, metal and bulky items. The segregated waste will then be discharged into the landfill situated next to the site of the incinerator.

The efficiency of each incinerator is between 80 % to 90 %. However in Tioman, the efficiency of its incinerators is only 50 % at the time of our visit. This is because one of the incinerators was out of order and awaiting repair.

Conclusion

Municipal solid waste management in Malaysia must be handled and treated the best practicable way. At the same time, the need to educate the public is crucial on how to minimise waste and practice reuse and recycle. Many well developed countries like Denmark, Japan and Singapore always ensure that their people are aware of waste generation and the cost involved in the treatment of waste. Although waste is unavoidable but it is believed that waste must be minimized. The authorities concerned must play their role in keeping the environment sustainable.

If rules and regulations are already outlined but not observed by the public at large then it is difficult to have a sustainable environment. Malaysians have to learn the experience of the advanced countries on how they keep their environment sustainably clean. Countries like Singapore and Japan are good examples. In Germany, it takes twenty years for the people to understand and practice good waste disposal etiquette.

Table 3: Comparison among the Incinerators in Malaysia Islands

Location	Population	Capacity (tonnes/day)	Manufacturer/Supplier	Date Commissioned	Usage Frequently	Gas Emission Monitoring	Source of Waste
Tioman Island	3,000	2 × 3.0	Hoval GG42 George Kent (M) Bhd.	Late 1997	2 units/day	3 times/year by DOE	Domestic of local & Tourist
Pangkor Island	27,558	1 × 5.0	Hoval GG42 George Kent (M) Bhd.	1999	1 unit/day	Once a year by Environmental Science S/Bhd	Housing area, hotels and small industries.
Langkawi Island	54,000	2 × 10.0	Hoval GG42 George Kent (M) Bhd.	January 1999	2 units/week	Once a year	Mainly tourist, hotels and small industries.
Labuan Island	75,000	2 × 10.0	Hoval GG42 George Kent (M) Bhd.	December 1998	2 units/day	Once a year	Housing area, and small industries.

Location	Volume of Waste	Segregation of Waste	Operating Cost	Ash Disposal	Efficiency	Manpower
Tioman Island	10 tonnes/day	No segregation	500,000/year	Landfill at site nearby	50% (one of the unit broke down)	1 technical personnel and 3 labourers
Pangkor Island	8-10 tonnes/day	No segregation	220,000/year	Landfill at site nearby	100%	1 supervisor and 3 labourers
Langkawi Island	80 tonnes/day	Segregation	300,000/year	Landfill at site nearby	100%	6 labourers
Labuan Island	10 tonnes/day	Segregation	315,000/year	Landfill at site nearby	100%	1 technical personnel, 2 Bob Cat operators and 5 labourers

Recommendation

On the whole the incinerators help to reduce the waste volume that would otherwise be dumped in the landfill. But due to its inadequate air pollution facilities, Labuan have taken another step to replace the existing units. The new technology that is being built in Labuan island uses thermal oxidation process. The new plant is designed with due considerations given to the environmental and economical factors including location and process selection. Compared to the old incineration plant, the new plant has a capacity to dispose 40 tonnes of waste per day.

As an overall conclusion, there are a few points to be considered as recommendations to this project.

1. Effective waste handling system can be achieved, only if the following are included:
 - scheduled garbage collection
 - recycled waste separation
 - combustible waste and non-combustible waste separation.
2. Effective waste processing system – choice of incineration or landfill can only be decided after a thorough study of the following:
 - Selection criteria
 - process method
 - suitable site and location
 - co-generation, energy recovery, energy utilization.
3. Light industry waste or “non-hazardous waste” – must make every effort to convert the waste to useful products, and as such generate income.
4. Duty of all citizens – The people must be educated and made responsible for their waste by:
 - observing regulations as set by authorities
 - educating the public especially the young on environmental
 - minimize waste generation by recycling and reusing.

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