Keywords: Scheduled waste, hazardous waste, scheduled waste management.

Abstract. Industry has become an essential part of modern society, and waste production is an inevitable outcome of the developmental activities. A material becomes waste when it is discarded with impunity and may pose a potential hazard to the human health or the environment (soil, air, waste) when improperly treated, stored, transported or disposed off or managed. In other words, scheduled waste contributes a major share towards environmental degradation. Scheduled and hazardous waste is the most difficult waste to be managed due to the dangerous elements not only for the environment but also for public health. In Malaysia, in the last two decades, the waste management has been a major concern. Malaysia has developed a comprehensive set of legal provisions related to the management of toxic and hazardous wastes. In this work, an evaluation of the scheduled waste management in Malaysia is made: in term of legislation framework, type of wastes and waste volume production.

Introduction

Scheduled waste management has different meaning and classification according to the country. For example, most of the waste is classified under hazardous waste (HW) because of their physical characteristics that suit with HW. HW can be classified on the basis of their hazardous nature which includes toxicity, flammability, explosively, corrosively and biological infectivity [1]. In Malaysia hazardous waste is defined as any waste falling within the categories of waste listed in the First Schedule of the Environment Quality (Scheduled Wastes) Regulation 2005. Sources of scheduled waste in Malaysia include hospitals, timber treatment, petrol storage, metal finishing, paint manufacture, vehicle servicing, agriculture / horticulture, electricity distribution, dry cleaning, etc. These activities use toxic and hazardous materials for everyday usage, therefore produce scheduled or hazardous wastes that can injure or even threaten living things. Scheduled waste must be handled in special ways to prevent threats to human health and the environment. When disposed of in the municipal landfill or otherwise improperly managed, these materials have the potential of contaminating the ground water - our drinking water. Thus, the management of scheduled waste is a growing concern in Malaysia due to increase in the number of non-compliances and illegal dumping cases.

All countries generate scheduled and hazardous wastes. The quantities generated and their potential impacts depend on many factors, including the level of industrial development, the way in which wastes are managed, the existing state of the local environment and the capacity of the receiving media. Small countries like islands often have very fragile environments which are easily damaged by even very small amounts of mismanaged hazardous wastes [2]. While many developed countries now have effective hazardous waste management systems in place, countries such as China [3] and India [4,5] which have a long term industrial base have not yet developed their hazardous waste management systems to the same extent. Until recently, the main sources of hazardous wastes in less industrialised countries were ubiquitous wastes such as waste oils. Today the origin of many hazardous wastes in such countries is imported chemicals. Primary industries, particularly highly polluting industries such as metal processing, fertiliser production, leather tanning and textile dyeing, are increasingly being focused in developing economies where pollution controls are less stringent and labour costs low. Newly industrialising countries are also becoming
important production centres for goods such as refined oil products, chemicals, pharmaceuticals and electronic equipment. All of these generate hazardous wastes.

Due to its toxic nature, the management of hazardous waste is given priority to ensure these wastes are monitored so as to avoid contaminating the environment, which may bring adverse effect to human, plant and animal health and biodiversity. Hence, the Ninth Malaysia Plan focuses on strengthening the institutional capacity of the relevant agencies through the adoption of a global harmonized system for the registration of imports, transportation and safe handling of the hazardous waste. A framework to facilitate the utilization of approaches and technologies to treat and convert toxic waste into a resource for reuse will also be undertaken.

Scheduled waste management legislation in Malaysia

As Malaysia grows into a fully developed country by 2020 it is envisaged that 80% of the population will be living in urban areas. With this growth, waste management is a key issue that needs to be addressed as we forward the motion to develop in a sustainable manner. The manufacturing sector significantly contributes to the generation of scheduled and hazardous waste, and the generation rate has been increasing constantly, especially since the 1980s [6].

Apart from that, Malaysia has developed a comprehensive set of legal provisions related to the management of toxic and hazardous wastes. The legislation was based on the cradle to grave principle. A facility which generates, stores, transports, treats or disposes scheduled waste is subject to the following legislations:

- Section 34B, Environmental Quality Act, 1974;
- Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Regulations 1989;
- Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) (Amendment) Regulations 2006;
- Environmental Quality (Scheduled Wastes) Regulations 2005;
- Environmental Quality (Scheduled Wastes) (Amendment) Regulations 2007;
- Environmental Quality (Dioxin and Furan) Regulations 2004;
- Environmental Quality (Prescribed Conveyance) (Scheduled Wastes) Order 2005;
- Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Order 1989;
- Customs (Prohibition of Export) Order (Amendment)(No. 2) 1993, and;
- Customs (Prohibition of Import) Order (Amendment)(No. 2) 1993.

The Environmental Quality Act (1974) was enacted in 1974, and the Department of Environment (DOE) was established [3]. Since then, many regulations on scheduled and hazardous waste were introduced, including those addressing the definition and classifications of scheduled waste, as well as collection, storage, transportation, treatment and disposal facilities. Scheduled waste facilities manage three types of waste: ‘hazardous’, clinical and radioactive wastes. The Environmental Quality (Scheduled Wastes) Regulations 2005 came into force since 15 August 2005, and is replacing the Environmental Quality (Scheduled Wastes) Regulations 1989. In 20 March 2007, the Environmental Quality (Scheduled Wastes) Regulations 2005 are then amended in the First Schedule, in relation to the particular appearing against code SW 104, by inserting after the word “containing” the words “aluminium”.

The wastes can be stored, recovered and treated within the premises of the waste generators. Such activities do not require licensing by the Department of Environment. A waste generator may store these types of wastes generated by him for 180 days or less after its generation provided that the quantity of the wastes accumulated on site shall not exceed 20 metric tonnes. However, waste generators may apply to the Director General in writing to store more than 20 metric tonnes of
wastes. The containers that are used to store wastes shall be clearly labelled with the date when the wastes are first generated, name, address and telephone number of the waste generator.

Started on 1 January 2007, DOE have implemented E-Consignment Note (ECN) application system. This system involved all scheduled waste generator, waste transporter and scheduled waste receiver. Waste generators are required to fill in the information as in the sixth schedule to comply with the requirements of the Regulation 12, Environmental Quality (Scheduled Wastes) Regulations, 2005. Waste generators shall also keep an up to-date inventory of scheduled wastes generated, treated and disposed off. Objectives of ECN application were to enter the information regarding scheduled waste generation, inventory and consignment note of scheduled waste. ECN will help the effectiveness of scheduled waste management in Malaysia for better future.

Proper labelling, containers and storage areas as well as prohibition of storage of incompatible waste are also required by law. Waste generators may apply for special management of scheduled wastes to have the scheduled wastes generated from their particular facility or process excluded from being treated, disposed of or recovered in premises or facilities other than at the prescribed premises or onsite treatment or recovery facilities, as stipulated under Regulation 7(1), Environmental Quality (Scheduled Wastes) Regulations 2005. Apart from that, Malaysia on 8 October 1993 acceded to the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1989 with the principles of environmentally sound waste management, to protect human health and environment and to prevent dumping.

Scheduled waste in Malaysia

Economic growth and industrialization in Malaysia has lead to better living quality but at a large cost of excessive waste and pollutants. Throughout the years of industrialization, our environment has become severely polluted and contaminated. Legislative requirements are enforced to implement proper waste management systems in all of the industries. Sustainable waste management aims to recover, recycle, reuse and reduce wastes from industrial productions.

With the current population rate at 1.4% [7], rapid progress in urbanization and industrialization has become a challenge in scheduled waste management. Overall, Malaysia’s economy expanded by a creditable 5.1% in 2011, in line with the rate of expansion of the manufacturing sector but below the 7.2% posted in 2010. The 2011 result was one that some analysts saw as stemming from the easing in overseas demand for Malaysian exports, a trend that will probably continue through the first half of 2012 but start to reverse itself mid-year and beyond [8]. The growth of the manufacturing sector had already decrease 0.2% from 2011 to 2012, with 24.9% [9] gross domestic product (GDP) in 2012.

According to the Department of Environment (DOE), a total of 2,854,516.78 metric tonnes of scheduled wastes were generated in Malaysia in 2012. This represents a decrease of 13 % as compared to 3,281,569.73 metric tonnes reported in 2011. Of which dross/slag/clinker/ash, gypsum, mineral sludge, oil and hydrocarbon, heavy metal sludge and e-waste were again the main categories (Table 1) [10]. Sources of scheduled waste generated in Malaysia were mainly from cement manufacturing, water treatment plant / power station, coal-fired power plant, chemical manufacturing operations, electroplating process, oleo chemical and many more industries.

In 2012, a total of 446 off-site recovery facilities have been licensed by the Department of Environment (DOE) to recover various categories of scheduled wastes. The most issued licensed facilities according to categories of waste are electronic and electrical wastes (153 facilities) followed by oil/ mineral sludge/spent coolant (58 facilities) dross/ ash/ slag/ catalyst (57 facilities), heavy metal sludge/ rubber (37 facilities), used container/ contaminated waste/ ink/ paint/lacquer (34 facilities), solvent (31 facilities) and acid/ alkaline (27 facilities), whilst four (4) other wastes categories totalling of 49 facilities. The state of Terengganu generated the largest amount of scheduled wastes (20.9%), followed by Johor (20.14%), Perak (14.23%), Selangor (12.87%), Pulau Pinang (8.58%), whilst the other 10 states generated a total of 23.28% [10].
In terms of policies on hazardous waste management, the Malaysian government’s does not allowed the importation of hazardous waste including e-waste, for recovery or disposal. However, the importation of used electronic and electrical equipment waste for direct reuse shall not be more than three years from date of manufacture that stated in Guidelines for the Classification of Used Electrical and Electronic Equipment in Malaysia, published by DOE in 2008. Malaysia also does not allowed hazardous waste to be exported out of the country whether for final disposal since the recovery facilities already established. If the local recovery facilities do not have the capability to carry out such activity, DOE will be approved based on solid evidence and is on case by case basis.

End of pipe approaches is the existing management system in Malaysia which give more priority to disposal more than other management options that lead to environmental concern due to increasing the requirement for disposal land, leachate problems from illegal landfill sites and greenhouse gases emissions. This is due to the fact that environment awareness and basic infrastructures must first be put in place to cope with the voluminous waste produced by various industries. The increasing amount of hazardous wastes generate from industries in recent years reported by DOE, imply that the management system required to be changed toward more sustainable management regime. Thus, the emphasis in recent years was more focused towards cleaner production and zero-discharge-engineering, which were aimed to achieve pollution prevention and sustainable development.

Recently, DOE encourage a new paradigm shift in scheduled waste management from cradle to grave system which waste was once regarded solely as an unwanted by product to cradle to cradle approach which waste recycling and resource recovery are now seen as potential resources (Figure 1). This framework seeks to create production techniques that are not just efficient but are essentially waste free. In cradle to cradle production all material inputs and outputs can be recycled or reuse with no loss of quality in close-loop cycle. By contrast cradle to grave refers to a company taking responsibility for the disposal of goods it has produced, but not necessarily putting products’ constituent components back into service. The researches were conducted mainly by universities, government research institutes and private companies as well as industries to achieve the new paradigm shift towards developing a sound scheduled and hazardous waste management system.
Malaysia also provided incentives for the storage, treatment and disposal of toxic and hazardous waste to encourage proper industrial waste management. The incentives include pioneer status incentive for five years to companies which are principally engaged in an integrated operation for the storage, treatment and disposal of toxic and hazardous wastes. The Government also extends the current import duty and sales tax exemption scheme for machinery, equipment, raw materials and components.

**Conclusion**
Scheduled waste is the most difficult waste to be managed due to its dangerous effect to human health and environment. For the most part, the framework for scheduled waste management is already in place in Malaysia. With the issuance of the scheduled waste regulations, an awareness has been created for the management of scheduled wastes; however effective practice for safe management need to be improved. In order to meet the policy target, various strategies and programs have been implemented by the government. These include legislative control, proper collection, treatment and disposal facilities, supporting services and economic incentives. The technical issues pertaining to the waste treatment and disposal needs to be strengthened and the technology input requirements have to be worked out to achieve sustainable development. Therefore, a holistic approach to achieving effective scheduled waste management that integrate the efforts of all sectors, government, private and community are still needed for the betterment of human health and the environment.

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