RECOVERY AND RECYCLING PROCESSES OF SCHEDULED WASTE IN MALAYSIA

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Thank you very much for your courage and support, may Allah bless my beloved

husband,
Hisam bin Hussain

childrens,
Aqilah Husna
Anwar Hazim
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and sister
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ABSTRACT

For the past four decades treatment and disposal of scheduled wastes resulting in many environmental problems such as illegal dumping, illegal export and import of wastes. Nevertheless, with new technology development and increasing commitment, many types of scheduled wastes can be recovered or recycled. However, there are three main issues to consider when discussing scheduled waste management hierarchy, which are lack of awareness on the importance of scheduled waste recovery or recycling, regulatory constraints, and lack of knowledge on the state-of-the-art technology for the recovery or recycling processes. The aim and objectives of the study are to produce the recovery or recycling process flow for potential scheduled wastes that can be recovered or recycled, identify the waste acceptance criteria and material balance calculation. The study was conducted through an evaluation and comparison on the recovery or recycling processes done by the related industries in Malaysia and site visit to recycling factory. From the study, it was found out that out of total 77 types of scheduled wastes listed in the Environmental Quality (Scheduled Wastes) Regulations 2005 First Schedule, there are 41(53%) types are being recovered or recycled while the flow of recovery or recycling processes for 16 (21%) types of scheduled waste has been reviewed. In addition, the waste acceptance criteria have been identified from the minimum level of acceptance prior to recovery or recycling processes. The material balance calculation which indicates the percentage of treated or recovered waste materials, residual sludge material generated and wastewater discharged if the plant is operated at its maximum capacity is also been addressed in order to enable the factory or consultant have the certainty to invest in the required new technology, hence to ensure efficient scheduled wastes recovery activities.

ABSTRAK

Dalam tempoh empat dekad yang lalu, rawatan dan pelupusan sisa terjadual mengakibatkan banyak masaalah alam sekitar. Walaubagaimanapun, dengan kemajuan teknologi terkini dan komitmen yang tingg, berbagai jenis sisa terjadual boleh diperoleh semula atau dikitar semula. Namun, terdapat 3 isu utama yang perlu dipertimbang bila membincangkan tentang hiraki pengurusan sisa terjadual; iaitu kurangnya kesedaran tentang kepentingan peroleh atau kitar semula sisa terjadual, kekangan peraturan dan pengetahuan yang cetek tentang teknologi pembinaan untuk proses perolehan semula atau kitar semula. Tujuan dan objektif kajian adalah untuk menghasilkan proses aliran peroleh semula atau kitar semula sisa terjadual yang berpotensi untuk diperoleh atau dikitar semula, mengenalpasti kriteria kebolehterimaan sisa dan pengiraan keseimbangan bahan. Kajian dijalanakan melalui penilaian dan perbandingan terhadap proses peroleh dan kitar semula yang telah dilaksanakan oleh industri yang terlibat di Malaysia dan lawatan ke kilang kitar semula. Hasil dari kajian, didapati daripada jumlah 77 jenis sisa terjadual yang disenaraikan dalam Peraturan Alam Sekitar (Sisa Terjadual) 2005, Jadual Pertama, 41 (53%) jenis boleh di peroleh atau dikitar semula sementara aliran proses peroleh atau kitar semula 16 (21%) jenis sisa terjadual telah dikaji. Berikutan itu, kriteria kebolehterimaan sisa telah dikenalpasti dari tahap minimum untuk penerimaan sebelum proses peroleh atau kitar semula. Pengiraan keseimbangan bahan yang menentukan peratus perolehan semula bahan dari sisa terjadual, sisa terhasil dan penghasilan air sisa jika kilang beroperasi pada tahap kapasiti yang maksimum juga dikenalpasti bagi membolehkan pengusaha kilang atau perunding kitar semula sisa terjadual yakin untuk melabur dalam teknologi kitar semula sisa terjadual untuk memastikan kecekapan aktiviti kitar semula sisa terjadual.

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LIST OF ABBREVIATIONS

AuCl	auric chloride
Ag	silver
AgCl	Silver chloride
CCA	Copper-chrome-arsenic
CPI	Corrugated Plate Interceptor
DOE	Department of Environment
EIA	Environmental Impact Assessment
EPU	Economic Planning Unit
GDP	Gross Domestic Product
H^+	hidrogen
HCL	hydrochloride acid
HDPE	High-density polyethylene
HNO_3	nitric acid
IBC	Intermediate bulk container
IC	Integrated Circuit
N_2	nitrogen
NaCl	Sodium chloride
$NaNO_3$	Sodium nitrate
NH_4	Ammonium
N_2H_4	hydrazine

NH_4Cl	Ammonium chloride
PCB	Printed Circuit Board
Pd^{2+}	palladium
R	Resin
SS	Suspended Solids
SW	Scheduled Waste
TDS	Total Dissolved Solids
WAC	Waste Acceptance Criteria

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CHAPTER 1

INTRODUCTION

1.1 Preface

According to the Environmental Quality (Scheduled Wastes) Regulations, 2005 scheduled waste means any waste falling within the categories of waste listed in the First Schedule. Due to its quantity, concentration, physical, chemical or infectious characteristics, scheduled waste may cause to an increase in mortality, or an increase in irreversible or incapacitating illness. Nevertheless, scheduled waste may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored or disposed of, or otherwise mismanaged.

Increasing volume of scheduled waste generated daily demands good management system as well as effective support of infrastructure. High volume of waste generated by Malaysian industries for the past three decades provides enough supply of wastes for recovery purposes (Azni *et.al*., 2004). With decreasing capacity of treating scheduled waste at Kualiti Alam Sdn Bhd, there is need to recover or recycle scheduled wastes for other uses.

Scheduled wastes such as spent solvent, spent oil, slag and dross, as well as contaminated rag generated during manufacturing or packaging has been found having significant values. Hence, recovery and recycling of scheduled waste can offer a number of environmental in terms of reducing the volume of scheduled waste that needs to be finally disposed. In addition, recovery and recycling would help

industry to obtain alternative resources and give meaning to a concept of "waste to wealth" which is also able to reduce their manufacturing cost. As pollution is bad for business, innovative environmental management methods are designed to satisfy all regulatory requirements, to protect and enhance the value of physical assets as well as corporate reputations.

1.2 Problem Statement

There are three main issues to consider when discussing scheduled waste management hierarchy of reduce, reuse, recycle, and recover. The three main issues are lack of awareness on the importance of scheduled waste recovery and recycling, regulatory constraints, and lack of knowledge on the state-of-the-art technology for the recovery and recycling processes.

Manufacturing industry plays an important role for Malaysia's economic growth for the past four decades. This sectors contribute to Malaysia's Gross Domestic Product (GDP) grows 18.2% from 2004 to 2008 (EPU, 2008). The Malaysian Government is intended to focus its effort on developing the country's agricultural industry as stated in The Ninth Malaysia Plan, however the manufacturing industry turn up as the leading sector for development process and economic growth.

The existing management systems in Malaysia for industrial wastes give priority to end-of-pipe approach which promotes the use of treatment and disposal method, rather than recovery or recycling (Ahmad Fariz Mohamed *et.al*., 2008). Consequently, this approach has been found creating many environmental problems such as new land requirements for disposals and illegal dumping as the industrial activity generates huge amount of wastes.

Scheduled waste management in Malaysia is well-established after more than 35 years of experience commencing from the enactment of Environmental Quality Act 1974. Nonetheless, problems associated with scheduled waste management such

as lack of sustainable awareness, enforcement, periodical monitoring as well as illegal dumping still exist that necessitate urgent intervention from relevant stakeholders.

It should be stressed that the best scheduled waste management is by reducing the generation of the wastes, nevertheless, reuse or recycling and recovery of wastes by the local industries can promote local sustainability initiatives. As such, specific legislations on "green" production for industries such as implementation of cleaner technology should be enacted to facilitate this initiative.

Regulation 6 in the Environmental Quality (Scheduled Wastes) Regulations 2005 and the amendment Regulations 2007 defines in a very general manner the recovery of material or product from scheduled waste. The 77 types of scheduled wastes listed in the First Schedule should be defined specifically by waste acceptance criteria prior recovery and recycling processes. A complete description of scheduled waste should identify source, type, categories and also the process involved in the generation of the scheduled waste. The chemical composition such as heavy metals, sulfur, benzene, etc should be defined as well.

In addition, the criteria to be met before waste is accepted for recovery and recycling would enable the factory to have the certainty to invest in the required new technology. Environmental Impact Assessment Guidance Document states that the Waste Acceptance Criteria (WAC) contains the level of pollutants (impurities) in the scheduled wastes that can be accepted in the recovery process, as well as the level or percentage of precious metals that can be economically recovered. Basic processes used for recovery facilities are electrolysis, distillation, extraction, salvation, smelting, chemical stripping, etc. (DOE, 2007).

Recovery and recycling of scheduled wastes, such as waste catalyst, spent or waste solvent, contaminated rag, paper and plastic, used drum, used HDPE container, etc. has become an important support industry. This is in line with the increasing volume of scheduled waste generated plus increasing demand for limited natural resource. Therefore, it provides alternative resources for the recycling industry and reduces dependency on natural resource such as oil for plastic and metal for drum.

However, the infrastructure for physical system such as transportation, handling facilities, and transfer station and treatment plant for industrial waste recovery is not fully established. These infrastructures are important to ensure that industrial waste recovery and recycling are done in sustainable manner and able to minimize impact to the environment and human health. Subsequently, there are also weaknesses in other sectors such as legislation, governance, technology, physical system, economic and human resource (Ahmad Fariz *et.al*., 2008).

Malaysia is targeting to achieve 30% of total solid and scheduled waste recycling in 2020 besides 5% currently (Utusan Malaysia, 2009). Therefore, the current management approach needs to be changed towards a more sustainable management regime as there are now technology and demand to recover and recycle waste including scheduled waste for other uses. Through the Ministry of Natural Resources and the Environment and the Ministry of Housing and Local Government, scheduled waste recovery and recycling has been identified as an important activity. In addition, The Ministry of Energy, Green Technology and Water plus Key Performance Indicator as announced by Prime Minister recently could speed up the invention of scheduled waste recovery technology.

Thus, the study would guide the investors on how the scheduled waste can be recovered and the quantity produced in Material Balance calculation for recovery and recycling processes.

1.3 Aim and Objectives

The aim of the project is to produce the recovery and recycling process flow of selected scheduled wastes.

The objectives of the study are:

(i) To initiate the possibility of scheduled waste recovery and recycling processes based on the Environmental Quality Act requirements

(ii) To organized recovery and recycling processes of selected scheduled waste listed under Environmental Quality (Scheduled Waste) Regulations 2005

(iii) To formulate the Waste Acceptance Criteria (WAC) and Material Balance calculation for the recovery and recycling processes.

1.4 Scope of Project

The scope of this study is the recovery and recycling processes practiced by factories in Malaysia who are involved in the scheduled waste recovery and recycling. Assessment on physical and chemical characteristics, WAC and material balance calculation will be based on current practice and findings by the related factories.

1.5 Significant of the Study

Scheduled waste recovery or recycling contributed significantly to economic benefits and environmental protection. Currently, the amount of scheduled waste generated by the manufacturing industries in Malaysia shows increasing trends. Therefore, the study would help the Environmental Impact Assessment Consultant, investors and also private and government sectors to create an innovative technology in recovery or recycling processes for scheduled waste as listed in the Environmental Quality (Scheduled Wastes) Regulations 2005.