HAZARDOUS WASTE MANAGEMENT IN MALAYSIA: CURRENT SITUATION, POSSIBLE MANAGEMENT STRATEGY, AND TREATMENT APPROACHES.

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ABSTRACT

Malaysia has embarked seriously on identifying the possible toxic and hazardous waste in Malaysia. In 1987, the Department of Environment concluded that approximately 380 000 cubic meters of the waste was generated and about 600 000 containers of the waste are disposed yearly. It was found that about 647 out of 747 industries generated the waste. Currently, very little treatment; recovery, and recycling is carried out. The construction of a Central Treatment Plant is essential. Several sites were indicated for the construction of the plant but unfortunately one of the sites was rejected. The paper indicates the present situation and the possible treatment approaches that can be considered in Malaysia.

INTRODUCTION

The management of toxic and hazardous waste is currently gaining momentum from various authorities and is an important growing concern all around the world. Each day, the Environmental Quality Control Regulations pertaining to the management of such waste are becoming more stringent. More alternatives are being sought either to dispose or treat the waste and eventually rendering it harmless.

Several developing countries in South East Asia including Malaysia have embarked seriously on finding solutions pertaining to the treatment and disposal of such waste. In Malaysia, feasibility studies for treatment and disposal of such waste generated were initiated by the Department of Environment (DOE) as early as 1981 [5]. Successive studies with the assistance from several overseas agencies and governments continued until 1987.

LEGISLATION

Currently, the Environmental Quality Act, 1974 of Malaysia governs the discharge of toxic and hazardous waste in Malaysia. The Environmental Quality Act (Sewage and Industrial Effluent Regulations, 1979) requires industries in Malaysia to treat their wastewaters to the acceptable limits of discharge for hazardous material in wastewaters including heavy metals prior to discharge into any inland waterways [5].

In 1984, a set of Regulations known as the Environmental Quality (Scheduled Wastes) was drafted [2]. The purpose of the regulations was to provide a good management approach to treat or dispose the toxic and hazardous waste [2]. The proposed regulations mainly apply to:

1. Waste generators
2. Waste contractors
3. Waste disposal operators

At the moment, the set of the proposed drafted regulations is in the Attorney General's chamber for further consideration.

CURRENT SITUATION

The studies carried out until 1987, concluded that a total of 647 out of 747 industries were identified as potential generators of toxic and hazardous waste [5]. A significant amount of approximately 380 000 cubic meters (m3) of such waste was generated by the industries. Approximately, 600 000 containers of the 'scheduled wastes' are disposed yearly [5]. Industries investigated were mainly located on the west coast of West Malaysia stretching from Penang to Johore.

A distribution of the amount of waste is illustrated in Figure 1 and Table 1. Specifically, the waste were grouped into 19 broad waste categories as represented in Table 1. Three major producers of the waste were the States of Selangor, Penang, and Kuala Lumpur [5]. The three States, altogether, generated approximately 65 % of the total amount of waste. The single largest producer was Selangor; producing almost 31 % of the total waste. In Selangor, such industries concentrated mainly in the Klang Valley. Only a small amount of waste was produced in the east coast of West Malaysia. The only state that contributed a notable amount was Trengganu which generated almost 11 % of the total amount.

At present, Malaysia does not have any Central Treatment Facilities to treat the waste. However, a few larger industries carry out 'in-house' treatment to treat a few parameters of the waste.

The inavailability of a Central Treatment Plant and good disposal facilities is creating a lot of problems to various industries at present. For instance, a major electronic industry, Motorola Malaysia Bhd. in Selangor is facing a problem of disposing sludge that has already been stabilized. Blocks of stabilized sludge are being piled up within the premises of the factory.

The Cabinet has recently indicated that construction of the proposed Central Treatment Plant be privatised [6]. It has been estimated that it would involve an approximate cost of between M $ 160 - $ 180 million. Two possible sites were chosen initially. Unfortunately, one of the sites, Valdor in Penang has been rejected by the Chief Minister of Penang due to its unsuitable location as a lot agricultural activities occur in the vicinity. Also, residents of the area and the surroundings indicted unhappiness and fear over the decision on choosing Valdor as a possible site and their sentiments were indicated by several picketings [4]. However, several other sites are being considered with the help of the Geological Department.

CURRENT PRACTICES

Treatment, recovery, and recycling practices in Malaysia at present are minimal. The much larger industries treat their wastewaters to ensure compliance with the regulations set by DOE. Unfortunately, the hazardous material separated from processes is hardly further

treated. Electronic and semiconductor industries for instance are stockpiling their sludges containing heavy metals at respective sites in the factories. Storage capacity problems are often caused due to such practices [1].

To an extent, a little solvent and oil recycling treatment practices are being carried out. A few petrol service stations also physically treat spent engine oil and further reuse it for other purposes. A few industries operating on a much bigger scale have also emerged recently. This includes the Metal Reclamation Sdn. Bhd. located in Batu Caves, Selangor. This industry plays a vital role in minimizing potential hazardous waste in Malaysia. The factory carries out reclamation activities i.e. recycling all types of lead waste and scrap in Malaysia [1]. Among the waste that is recycled include old and unused batteries from vehicles which contain considerable amount of lead. It has a production capacity of about 15 000 metric tons per year [1].

CLASSIFICATION

The treatment processes can be divided into 6 different classes [3]:

1. Thermal treatment.
2. Physical treatment.
3. Chemical treatment
4. Biological treatment.
5. Recovery and recycling
6. Solidification including stabilization.

OPTIONS APPROPRIATE FOR MALAYSIA

Figures 2 and 3 outline the possible treatment, recovery, and recycling practices that are possible with the different types of toxic and hazardous waste found in Malaysia. Such processes are only the most probable steps that can be taken. Modifications might further be necessary in upkeeping a good house- keeping programme. The various processes are outlined below.

Physical, chemical, and biological treatment
Physico-chemical treatment facilities are extremely essential in treating the hazardous waste. As indicated in Figure 2, which outlines the possible approaches that can be employed; acids and alkalis with possible heavy metals,

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paints/dyes/ink of both water and solvent in nature, photographic waste, sludges of mineral and oil nature, and sludges with paint and dyes would be suitable candidates for the physical and chemical treatment operations. This contributes approximately 55 % of the total amount of hazardous waste as indicated in Figure 3. Such a high ratio signifies that the facilities are extremely important and should be incorporated in the construction of any hazardous waste treatment facilities.

In addition, waste such as sludges with heavy metals, too, require Physico-chemical treatment immediately after recovery processes. Such sludges are generally residues from in-house wastewater treatment plants. The waste is generated mainly by electronic/semiconductor manufacturing firms, metal finishing industries, major textile industries, chemical plants, and rubber products manufacturing plants [1]. Metal finishing industries (i.e. including galvanizing, acid pickling, and electroplating) seem to be the major pollutors [1]. In addition, in a feasibility study carried out on the proposed Central Treatment Plant, it was envisaged that electroplating activities are the major generators of the hazardous waste and such waste could be treated by Physico-chemical methods [1]. In Klang Valley itself, they represented more than 75 % of the potential volume of waste that should be treated [1].

Biological treatment is necessary for some waste types. Waste of organic nature generally require such treatment. Usually, as indicated in the schematic flow, biological treatment usually follow Physico-chemical treatment.

Recovery and Recycling

Waste types that have good potential in undergoing recovery and recycling immediately upon generation are solvents (halogenated and non-halogenated), resin and glue, rags, paper and plastic, and sludges with heavy metals. To an extent, paint / dye /ink/ pigment, and sludges (mineral or oil in nature), too, can undergo this treatment as indicated in Figure 3 . An approximately 18 % of the total waste can possibly be recovered using best available technology. A significant amount of this is heavy metals in sludges from in-house treatment facilities.

At present, only a few of such practices are being carried out. If even so, the quantity involved is extremely small. This include the solvents and materials such as paper, plastic, and lead scrap.

A lot of information has been documented on the methods that are currently being used in the developed countries. With a careful consideration, it would be possible to employ some of the techniques in Malaysia.

Solidification and Stabilization
Asbestos, dust, slag, clinker, and ashes can successfully be treated i.e. stabilized and eventually solidified. Approximately 13 % of the total waste has such potential. Asbestos, dust, slag, clinker, and ashes represented approximately 9 and 7 % of the total waste generated respectively. Waste generated by the asbestos products manufacturing industries are mainly in the form of asbestos dust and sludges [1]. Good treatment practices are extremely essential for these waste types.

Incineration
Thermal incineration processes are necessary. Oils, hydrocarbons (including PCBs) and pathogenic/pathologic waste can be incinerated immediately whereas for most of the other waste types, incineration serves to reduce the volume of the waste generated. This constitutes almost 6 % of the total waste. But, as indicated in Figure 2, incineration plays a vital role for the treatment of sludges from Physico-treatment and biological treatment facilities. Wastes such as slag, ashes from incinerator can further be used in solidification processes.

Agriculture
A little of the waste including the dust, slag, clinker, and ashes could possibly be incorporated in improving the texture of some kinds of soils. Perhaps, to an extent these could possibly be used as fertiliser. However, pretreatment might be necessary to remove some of the substances that might be toxic e.g. heavy metals.

RECOMMENDATIONS AND CONCLUSION

In considering the types of treatment that should be practiced in Malaysia, it is important to look into all possible treatment operations that are currently being carried out successfully in developed countries with very rigorous management programmes.

The best available and yet cost-effective techniques should be applied. However, the construction of a Central Treatment Plant involves a huge capital cost. As proposed by the Cabinet, it is only appropriate if the construction of the Central Treatment Plant is privatised and closely monitored by DOE. Industries which then send waste for treatment would be subjected to paying a certain fee.

On the whole, in treating the toxic and hazardous waste, it is essential that the proposed treatment plant include the following facilities:

- O Thermal treatment such as incineration.
- O Physico-chemical and biological treatment facilities.
- O Solidification including stabilization
- O Recovery and reclamation facilities.
- O Proper landfills or disposal sites.

However, the Government must first pass the Environmental Quality (Scheduled Wastes) Regulations before the construction of the Central Treatment Plant can be considered [7]. On passing the regulations, the Federal Government must then negotiate with the respective State Governments on selecting the appropriate site for the treatment plant and disposal facility.

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TABLE 1
Categories and amount (%) of scheduled wastes.

No.	Categories	Amount (%)
1.	Resin & Glue	0.1
2.	Solvent (spent halogenated)	0.2
3.	Sludge,paint/dye/ ink/pigment (solvent)	0.3
4.	Sludge,paint/dye/ ink/pigment (water)	0.4
5.	Solvent (spent non-halogenated)	0.7
6.	Pathogenic/Pathologic	0.9
7.	Sludge, oil	0.9
8.	Paint/dye/ink/ Pigment (solvent)	1.2
9.	Rags,paper,Plastics	1.5
10.	Photographic	3.2
11.	Oil & Hydrocarbons	5.3
12.	Alkalis (with possible heavy metals)	7.1
13.	Dust/slag/clinker/ashes	7.3
14.	Paint/dye/ink/pigment (water)	7.6
15.	Asbestoe	9.1
16.	Sludge, Mineral	12.5

17.	Sludge with heavy metals	15.4
18.	Acids (with possible heavy metals)	21.9
19.	Others	4.4
		100.0

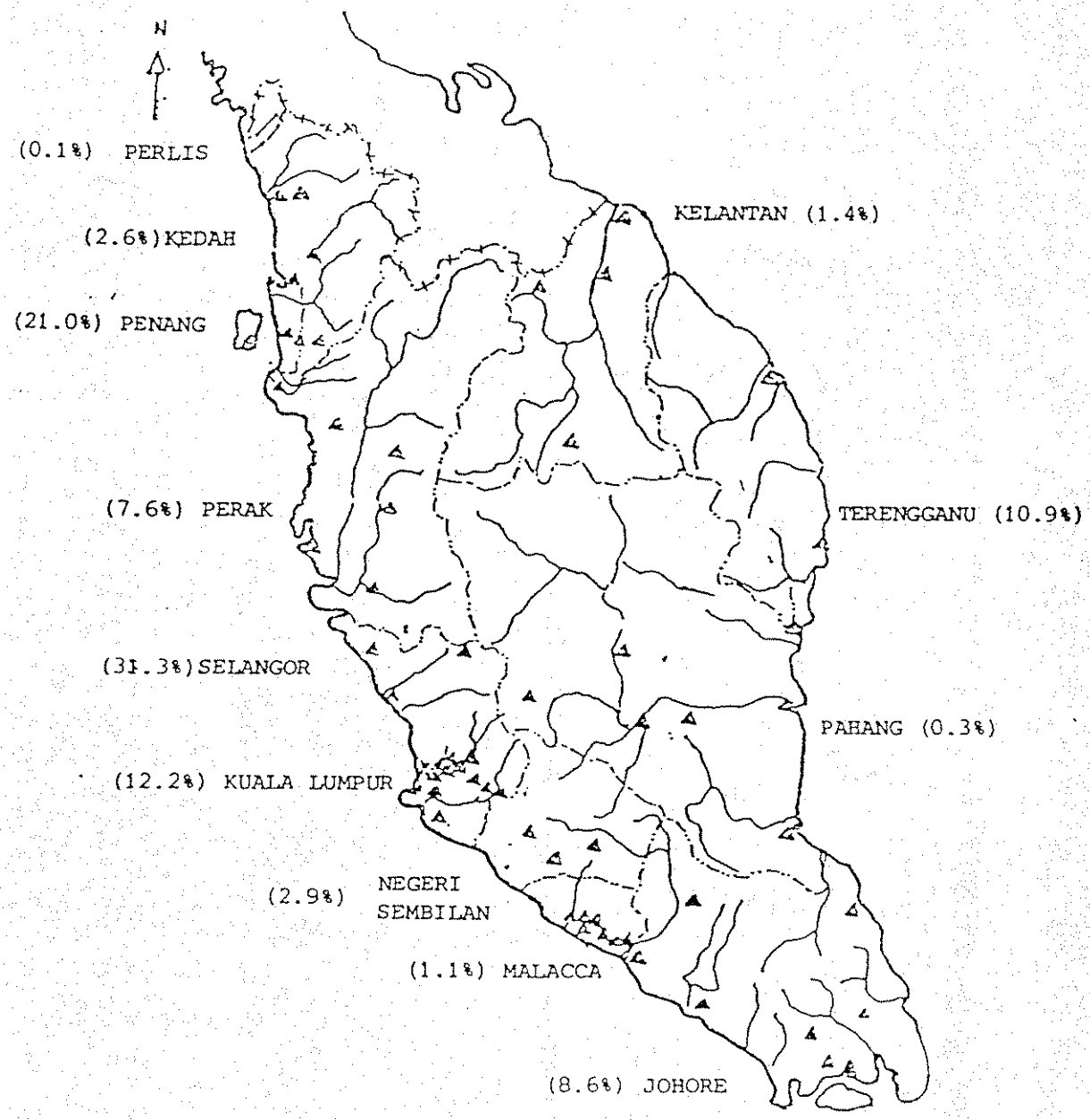

Figure 1: Distribution of Toxic and Hazardous Waste (%) in Various States.

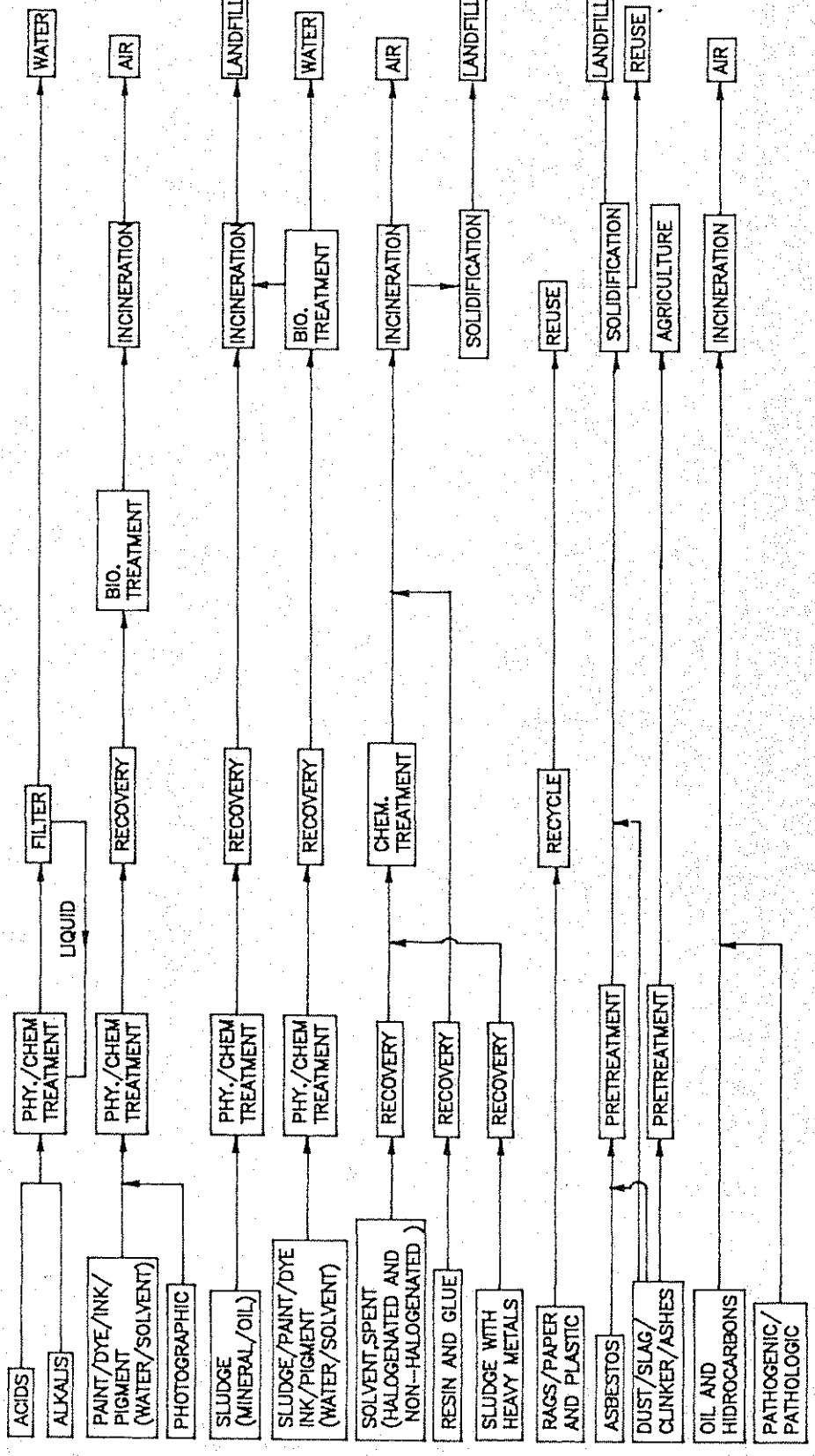

Figure 2 . Schematic flow to indicate the possible treatment/ recovery option.

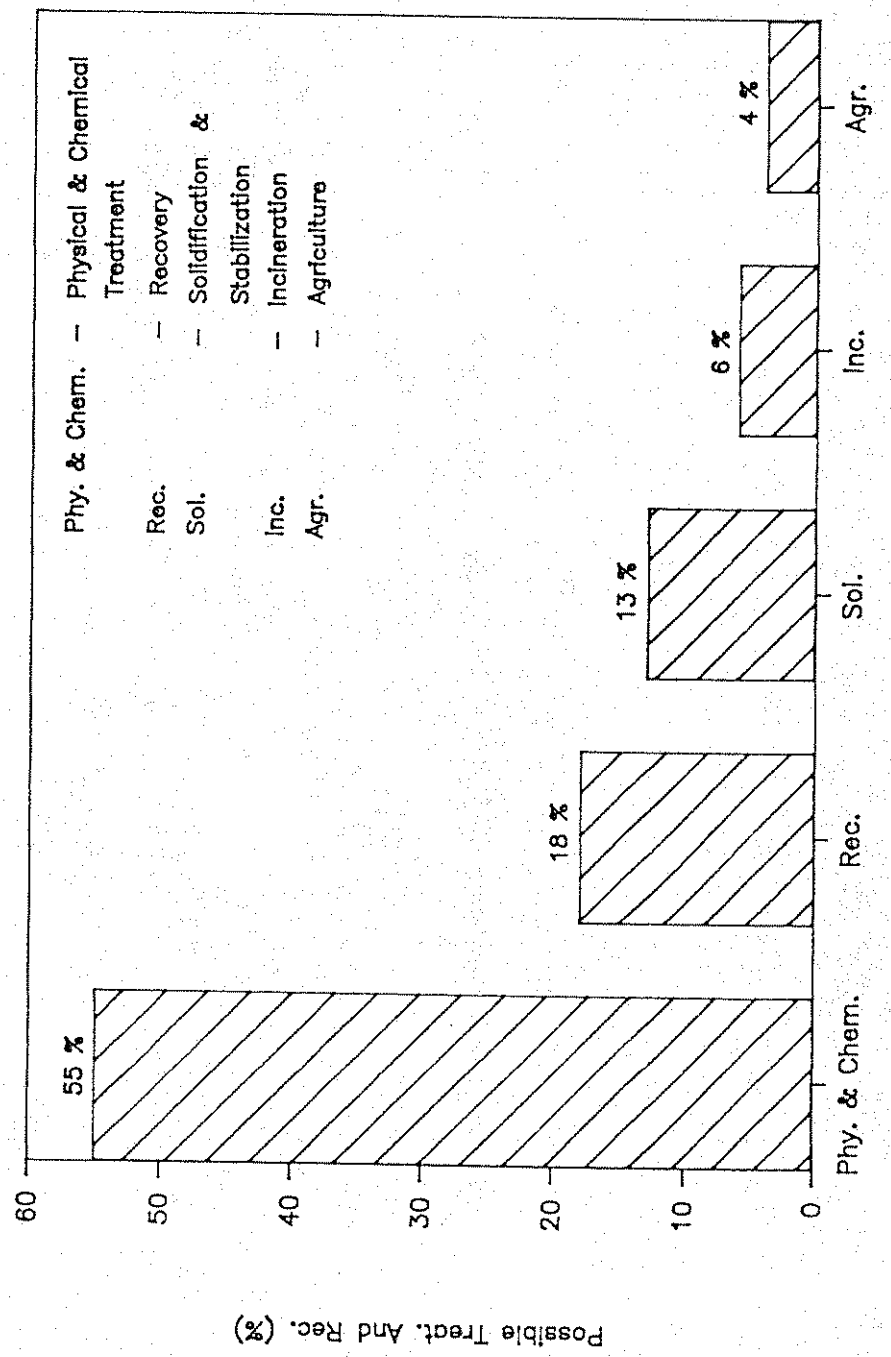

Figure 3. Amount of possible treatment and recovery / recycling process.