Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency (EEAA)
Egyptian Pollution Abatement Project (EPAP)

Hazardous Waste Management

Manual For Industries

2003

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List of Acronyms

DDT	p,p'-Dichlorodiphenyltrichloroethane
EDTA	Ethylenediamine Tetraacetic acid
EEAA	Egyptian Environmental Affairs Agency
EMS	Environmental Management System
US EPA	United States Environmental Protection Agency
EPAP	Environmental pollution abatement project
ER	Executive Regulations
EU	European Union
HW	Hazardous Waste
ISO	International Organization for Standardization
MSDS	Material Safety Data Sheets
OECD	Organization for Economic Co-operation and Development
PCBs	Poly Chlorinated Biphenyls
PET	Polyethylene Terephthalate
PVC	Polyvinyl Chloride
VOC	Volatile Organic Compounds

Preface

Hazardous waste management is a growing concern for the Egyptian Government. Law 4/1994 for the Environment and its Executive Regulations (ER) specify the necessary requirements to be implemented by the different generating industries for the safe handling of hazardous waste throughout the different stages of its management. Within this framework it was deemed necessary to provide the industrial sector in Egypt with sufficient support to make it able to take practical steps towards the proper management of its hazardous waste.

On one hand, this would assist the Egyptian industries in fulfilling their legal obligations stipulated in Law 4/1994 and its ER with concern to hazardous waste. On the other hand, this would minimize the adverse effects of such waste on public health and the environment, assisting the industrial sector in improving its overall environmental and business performance and public image.

Promoting the environmental performance of the Egyptian industries is a main objective of this manual. This issue is addressed by presenting necessary background information regarding hazardous waste, Egyptian legal requirements for hazardous waste safe handling and proper management, as well as means for improvement and self-assessment for hazardous waste management within industrial establishments.

1. Introduction

1.1 Background

Improper management of hazardous waste can pose severe adverse impacts on public health and the environment. Within this context, Law 4/1994 for the Environment and its Executive Regulations (ER) have placed the issue of hazardous waste management into focus specifying the necessary measures for the safe handling of such waste throughout the different stages of its management, from generation to disposal.

Hazardous waste is generated from a wide range of activities encompassing domestic, agricultural, commercial and industrial activities. However, the industrial sector can be considered one major generator of hazardous waste. A large number of industrial activities use hazardous input material, even in small quantities, which are likely to result in the generation of hazardous waste. In Egypt, waste management practices in industry have historically given little consideration to the dangerous nature of hazardous waste. Such waste remains mostly un-segregated from non-hazardous waste with which it is collected, transported and disposed of. During these activities, necessary safety measures are seldom applied, posing health risks to the workforce and potential environmental pollution.

1.2 Purpose of the Manual

Encouraging the industrial sector in Egypt to take practical steps towards the proper management of its hazardous waste was deemed necessary. This is with the aim of helping it fulfill its legal obligations, and minimizing the adverse effects of such waste on public health and the environment. In this respect, this manual is prepared to be a user-friendly guide with the overall objective of providing the Egyptian industries with necessary information and basic tools for hazardous waste management. This would offer assistance to the industrial establishments in recognizing hazardous waste management needs, and taking the necessary steps towards addressing these needs.

Within this context, one other objective of this manual is to promote the environmental performance of the Egyptian industries by presenting means for self-assessment concerning hazardous waste management. Such means are prepared so as to enable the industries to identify areas of gaps and areas of non-compliance on one hand, as well as opportunities for improvement, on the other. In this regard, the manual addresses the concept of waste minimization, its different options as well as its legal, environmental, and economic benefits.

1.3 Manual Outline

The manual consists of six main sections:

Section 1 Introduction

This section briefly presents the needs for such a manual, and its purpose and objectives.

Section 2 Identification of Hazardous Waste

This section presents the definition of hazardous waste according to Law 4/1994, and introduces hazardous waste identification with some of the main issues and difficulties related to it. Hazardous characteristics are also discussed together with the how industries can identify their hazardous waste, particularly that subject to environmental inspection.

In this respect, examples and sources of different types of industrial hazardous waste as well as most likely industrial sectors generating such waste are included in Annex III**.**

Section 3 Impacts of Hazardous Waste

This is an overview of the likely adverse environmental and health impacts of the improper management of hazardous waste. These effects are briefly presented for common types of hazardous waste generated by different industrial sectors.

Section 4 Management of Hazardous Waste

This section outlines the legal framework for hazardous waste management in Egypt, and discusses the different components of a hazardous waste management system, namely:

- hazardous waste permitting,
- hazardous waste reductions at source,
- on-site storage,
- on-site treatment
- hazardous waste transportation
- hazardous waste disposal

Section 5 Hazardous Waste Minimization: Concepts and Principles

This section introduces the concept of waste minimization, and the different options and possible implementation schemes. In addition, the advantages and incentives for implementing hazardous waste minimization schemes are presented.

Section 6 **Environmental Improvement**

This section presents tools for elf-assessment of environmental performance of industrial establishments, with the purpose of identifying areas of gaps and non-compliance as well as opportunities for improvement.

2. Identification of Hazardous Waste

2.1 Definition of Hazardous Waste

Hazardous waste is waste having possible adverse impacts to human health and the environment as a result of physico-chemical and/or biological properties. rendering it dangerous. According to Law 4/1994 hazardous waste is defined as:

> *"Waste of activities and processes or its ashes which retain the properties of hazardous substances and have no subsequent original or alternative uses, like clinical waste from medical treatments or the waste resulting from the manufacture of any pharmaceutical products, drugs, organic solvents, printing fluids, dyes and painting materials".*

Prior to the presentation and discussion of the characteristics rendering a waste hazardous, there is a need for the introduction of the definition of what would constitute a "waste" within an industrial context. "Industrial waste" is determined as solid, liquid and/or gaseous materials which the holder (generator) discards or intends to discard (because such materials do not have subsequent on-site use in the form they are generated in), or is required to discard (because the use of such materials is illegal). This can encompass the following[1]:

- Materials spilled, lost or having undergone other mishappenings
- Residues of industrial processes (e.g. slag, still bottoms, etc.)
- Residues from pollution abatement processes (e.g. scrubber sludge, baghouse dust, spent filters, etc.).
- Substances that no longer perform satisfactorily (e.g. contaminated acids, contaminated solvents, exhausted tempering salts, etc.)
- Unusable parts (e.g. reject batteries, exhausted catalysts, etc.)
- Any materials, substances or products the use of which has been banned by legislation.
- Any material that is disposed of, involving burning and incineration, accumulation, storage or treatment, prior to disposal.

2.2 The Hazardous Characteristics

Solid, liquid, or gaseous wastes are considered hazardous if they possess one or more hazardous characteristics of the following:

- ***Flammable***: capable of burning or causing fire. It describes :
  - waste liquids that give off flammable vapors at a temperature of 60.5^0C.
  - solid waste which under transport conditions are readily combustible or may cause or contribute to fire through friction.
  - waste which is liable to spontaneous heating under normal conditions and then being liable to catch fire.

[1] Reference: Council Directive 91/156/EEC amending Directive 75/442/EEC on Waste

- waste which in contact with water are liable to become spontaneously flammable or give flammable gases in dangerous quantities.

Examples include waste organic solvents such as ethyl ether, methanol, acetone, toluene, benzene, kerosene.

- ***Corrosive***: able to corrode steel by chemical reaction as a result of extreme acidic or basic properties and is capable of causing severe damage when in contact with living tissues.
  Examples include waste alkalis such as caustic soda (sodium hydroxide) and waste acids such as sulphuric acid, nitric acid, hydrochloric acid, etc.

- ***Reactive***: undergoes violent reactions with air and/or water. It describes waste that:
  - is normally unstable and undergoes violent change without detonation.
  - is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure
  - forms potentially explosive mixture with water
  - When mixed with water, generates toxic gases, vapors, or fumes in a quantity sufficient to present danger to human or environment.

  Examples include wastes containing alkali and alkaline earth metals, phosphorus pentachloride.

- ***Oxidizing***: waste giving rise to highly exothermic[2] reactions when in contact with other substances, particularly flammable substances and may, by yielding oxygen, cause or contribute to the combustion of other materials.
  Examples include waste nitric acid, peroxide-containing waste.

- ***Irritant***: non-corrosive wastes which, through immediate, prolonged or repeated contact with the skin or mucous membranes can cause inflammation or other skin symptoms.
  Examples include waste chemicals such as tetra chlorobenzene, triethyl amine, acetic acid.

- ***Toxic***: waste containing substances which are poisonous. It describes:
  - waste which, if inhaled or ingested, or penetrates the skin may involve delayed or chronic effects including carcinogenity
  - poisonous waste which may cause death or serious injury if swallowed or inhaled or contacted the skin.

  Examples include wastes containing cyanide, chromium VI, arsenic, cadmium, and other heavy metals, in a dispersible form[3].

[2] Generating large amounts of heat.

[3] Dispersible form is one which can be easily scattered in the surrounding environment, either as a result of being soluble, in the form of sludge, colloids, emulsions, etc., or in the form of fine powder/small particles. For example scrap metal waste containing lead is not hazardous because the lead is not in a dispersible form. However, waste containing soluble lead salts, or waste lead in the

- ***Harmful***: waste containing substances and preparations which, if inhaled or ingested or penetrates the skin, may involve limited health risks.
  Examples include waste xylene, pyridine, styrene, lubricant oils and emulsions.

- ***Ecotoxic***: waste which may have toxic effects on biotic systems and which if released may present immediate or delayed environmental adverse impacts by means of bioaccumulation and/or toxic effects on one or more sectors of the environment.
  Examples include PCB[4] waste, DDT[5] waste, some waste pesticides.

- ***Carcinogenic*****:** waste which, if inhaled or ingested or penetrates the skin, may induce cancer in man or increase its incidence.
  Examples include waste benzene.

- ***Teratogenic*****:** waste containing substances and preparations which if inhaled or taken internally or penetrates the skin may induce non-hereditary genetic deformations, or increase their incidence.
  Examples include waste containing ethylene thiourea, tetra ethyl lead, lead alkylates.

- ***Mutagenic*****:** waste containing substances and preparations, which if inhaled or taken internally or penetrates the skin may induce hereditary inherent deformations, or increase their incidence.
  Examples include vinyl chlorides, DDT, aldrin and dieldrine.

2.3 Hazardous Waste Identification Internationally

Quantifying the hazardous characteristics presents an important parameter for the determination if a waste is hazardous or non-hazardous. Two of the main systems for hazardous waste identification are that of the European Union (EU) and that of the US Environmental Protection Agency (US EPA). In determining whether a waste is considered hazardous or non-hazardous, these systems are based on determining threshold concentrations for the hazardous characteristics. If the waste exhibits the hazardous characteristic at a quantity above such thresholds, it is then considered to be hazardous.

The EU legislation has set analytical methods[6] for the determination of physicochemical, toxicological and ecotoxicological properties of hazardous waste such as flammability, explosive properties, oxidizing properties, toxicity, teratogenity, mutagenity, etc. Waste is considered hazardous if the

form of fine powder/small particles is in a dispersible form and would therefore be considered hazardous.

[4] Poly Chlorinated Biphenyls

[5] p,p'-Dichlorodiphenyltrichloroethane

[6] The test methods are determined by Commission Directives 79/831/EEC and 84/449/EEC amending the Council Directive 67/584/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labeling of dangerous substances.

total concentration of one or more hazardous constituent equals or exceeds set concentration. The test methods determined by the EU system are based on those recognized and recommended by competent international bodies in particular OECD[7]. When such methods are not feasible, national standards or scientific consensus methods can be adopted.

As for the US EPA legislation, analytical test methods are also identified and procedures which could be used for measuring the characteristic which renders the waste hazardous specified. A waste is thus considered hazardous if the hazardous characteristic it exhibits exceeds the quantified limit set in the legislation, using the identified test methods. The toxicity characteristic is, on the other hand, measured based on both the concentration of the toxic constituents in the waste, as in EU legislation, and the leachability of these constituents from the waste to the surroundings.

2.4 How Can Industries Identify Their Hazardous Waste

2.4.1 Hazardous Waste Classification System

The industrial establishments are responsible for identifying the hazardous waste generated from the different processes to be able to comply with the requirements of Law 4/1994 and avoid potential risks to the workforce and surrounding environment. In this regard, a ***National Hazardous Waste Classification System*** is currently under adoption and operationalization in Egypt by different competent government ministries and authorities in coordination with EEAA[8].

Hazardous waste classification entails the application of approved standard criteria for the identification of HW on the basis of common agreed-upon characteristics. According to the proposed national classification system, HW is classified on the basis of four main characteristics ***Ignitability, Corrosiveness, Reactivity*** and ***Toxicity***.

In this context, listings for HW, by source and type, were developed in order to facilitate the identification of such waste: List **S** including special waste such as medical waste, radioactive waste, asbestos, waste oil and empty containers; List **F** including waste from non-specific industrial sources such as solvents, sludges from wastewater treatment, etc.; List **K** including waste generated from specific industrial processes; List P including waste containing acutely hazardous materials; List **U** including waste containing discarded toxic off-specification materials.

In addition, the six line ministries[9] concerned with HW management have developed lists including HW generated within their scope of competence. Within the industrial sector, the Ministry of Industry

[7] Organization for Economic Co-operation and Development
[8] Guidelines for the Classification, Characterization, and Coding of the Egyptian Hazardous Waste.
[9] Ministry of Industry, Health, Electricity, Interior, Petroleum and Agriculture.

developed such a list for wastes generated from different activities in this sector. Annex (I) presents the list of the Ministry of Industry.

Figure (1) below shows the main categories of hazardous waste classification

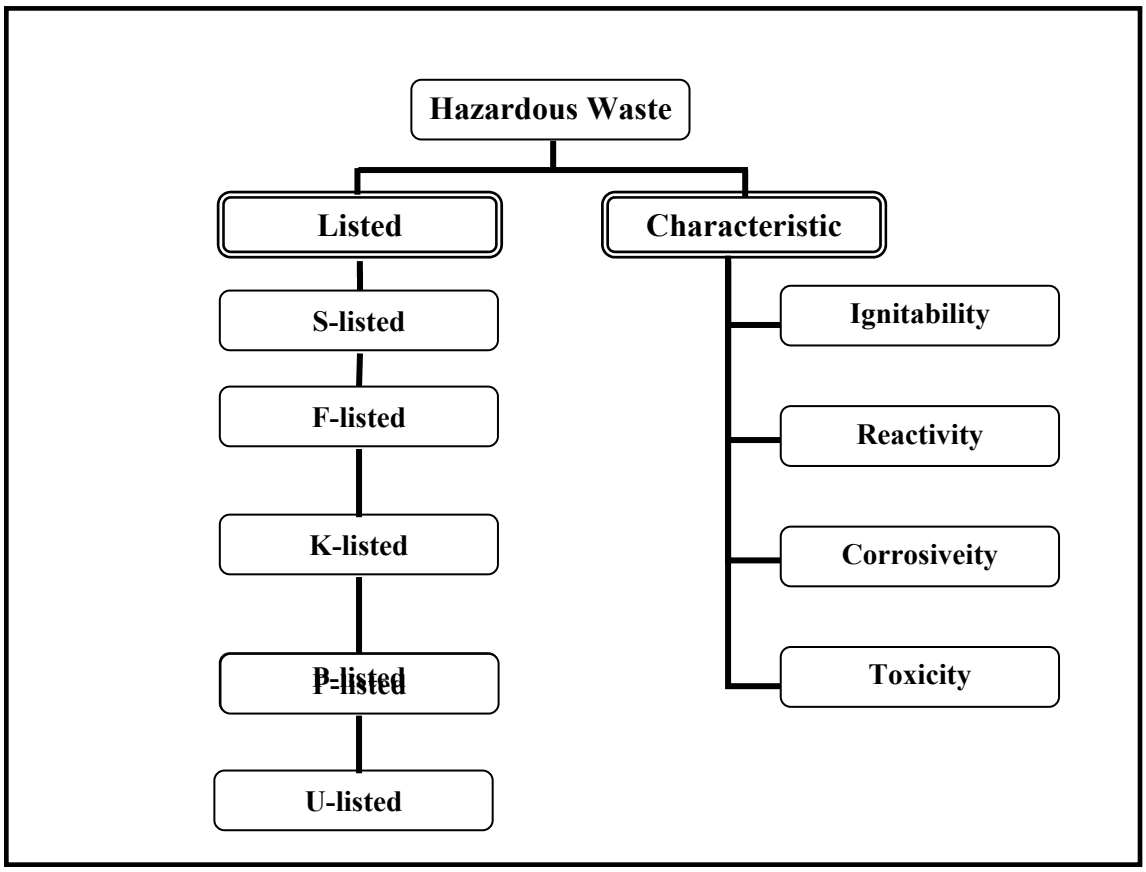

Figure (1): The Main Categories for HW Classification

Within this context, Annex (II) presents the master flowchart used for the classification of HW in the National HW Classification System. Further details and the listings of HW, together with the laboratory tests and criteria for determining the hazardous characteristics, can be found in the EEAA document titled "Guidelines for the Classification, Characterization and Coding of the Egyptian Hazardous Waste"[10].

2.4.2 Industrial Experience

In addition to using hazardous waste lists, the industrial establishments can foresee the types of hazardous waste likely to be generated based on the identification of hazardous input materials, as well as their knowledge of the industrial processes at hand. The input materials can be identified as hazardous through the use of either the Material Safety Data Sheets (MSDS), or through the Hazardous Substances Lists published by the Ministry of Industry.

[10] Refer to the General Department of Hazardous Substances and Wastes in EEAA.

2.4.3 Hazardous Substances as Input Materials

The Material Safety Data Sheets (MSDS) provide the necessary information for workers and emergency personnel to understand and deal with the potential hazards associated with a particular substance. MSDS also give clear descriptions of the most important hazards the substance can create for human health, the environment and/or property. Furthermore, MSDS indicate the appropriate methods for safe disposal of the surplus and/or the waste resulting from foreseeable use of the substance, as well as any contaminated packing material and other hazardous waste. The dangers involved in the storage, transport and disposal of these latter are also considered. In this regard it is crucial for industrial establishments to ensure that MSDS is obtained for each input material from the different international and domestic chemical suppliers.

In addition to MSDS, the Hazardous Substances List prepared by the Ministry of Industry could also be used as means for foreseeing potential hazardous waste generation. In this respect, the Hazardous Substances Information Management System, located at EEAA, can prove a useful tool for accessing extensive information regarding the hazardous substances categorized on the Ministry of Industry Hazardous Substances Lists, as well as about 1800 substances.

2.4.4 Examples of Industrial Hazardous Waste

Annex (III) illustrates industrial sectors most commonly generating hazardous waste and the likely generated types of waste.

2.5 Industrial Hazardous Waste Subject to Inspection in Egypt

Identifying hazardous waste subject to environmental inspection is considered an essential pre-requisite for the success of the hazardous waste management process in an industrial establishment. Improper identification of the generated hazardous waste can result in either :

- Including part of the non-hazardous waste within the hazardous waste management system. This would increase the amount of waste handled by the system, thus increasing the financial burden and legal liability on the industrial establishment.
- Having part of the hazardous waste escaping from the management system, which would result in potential adverse environmental and health impacts. In such cases the concerned industrial establishment could be liable for these impacts, and would not be meeting its legal obligations.

In this regard, and within an industrial context, hazardous waste entails materials generated from industrial processes, which possess hazardous characteristics, and which are intended for discard, i.e. with no subsequent use in the form they are generated in. Such materials would therefore be considered hazardous waste and are subject to the enforcement of hazardous waste legislation, and consequently environmental inspections. Figure (2) schematically illustrates this.

In this figure, discharges (1) are hazardous waste because they have no subsequent on-site use in the form they are generated in, and are intended for discard by the generator. This is carried out through delivery to either a transporting entity with a hazardous waste permit, or through delivery to entities licensed for treatment and/or disposal of hazardous waste. Discharge (2) has no subsequent on-site use in the form it is generated in, and has to undergo treatment[11]. Discharges (3), however, are not discarded of by the generator, as they have subsequent on-site use in the from they are generated with (either from the industrial process, or the treatment process). In this respect, they are considered as hazardous input materials[12].

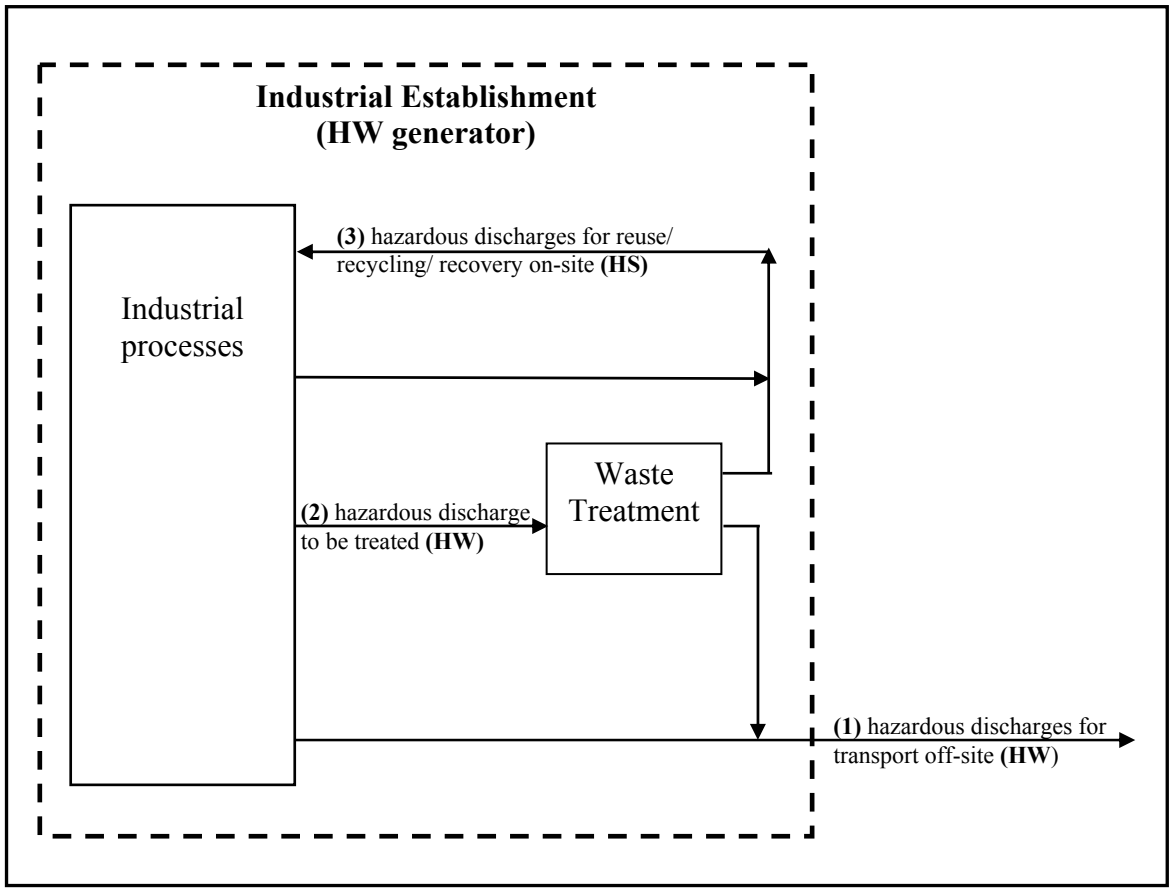

Figure (2): Industrial Discharges Subject to Hazardous Waste Inspection

3. Impacts of Hazardous Waste

Hazardous waste poses numerous concerns which can result in immediate danger to the environment and to human health. In some

[11] Waste Treatment is any process that changes the physical, chemical or biological character of that waste, to make it less of an environmental threat. Treatment can neutralize the waste, recover energy or material resources from the waste, render the waste less hazardous, or make the waste safer to transport, store, or dispose of. (Ref. US EPA Office of Solid Waste)

[12] These would be subject to articles 29 and 33of Law 4/1994, and articles 25, 26, 27, 31 and 32 of the ER.

cases, such impacts could be difficult and/or very expensive to mitigate, while in others the impacts could be irreversible.

3.1 Routes of Transport of Hazardous Waste to the Environment and Exposure to Humans

Hazardous waste can affect the environment as well as human health through different routes of transport into the environment and exposure to humans. These routes can be direct, such as direct human contact or the direct discharge into an environmental medium (air, water, soil), while others are indirect such as atmospheric deposition of wind born particulates to surface waters.

Common routes of transport to the environment entail leaching of hazardous waste from unsecured disposal sites which could result in contamination of surface and/or underground water. The use of such contaminated water for drinking or irrigation purposes would present an important route of exposure to humans. Furthermore, crops cultivated on contaminated soil, as well as aquatic organisms living in contaminated waters, may take up hazardous constituents, resulting in their accumulation in the food chain. In addition, direct skin contact with the waste during handling in collection, storage, transport treatment and/or disposal operations, as well as inhalation of hazardous waste dusts and vapors constitutes another potential pathway for exposure of humans.

The potential pathways of exposure to hazardous waste are illustrated in figure (3).

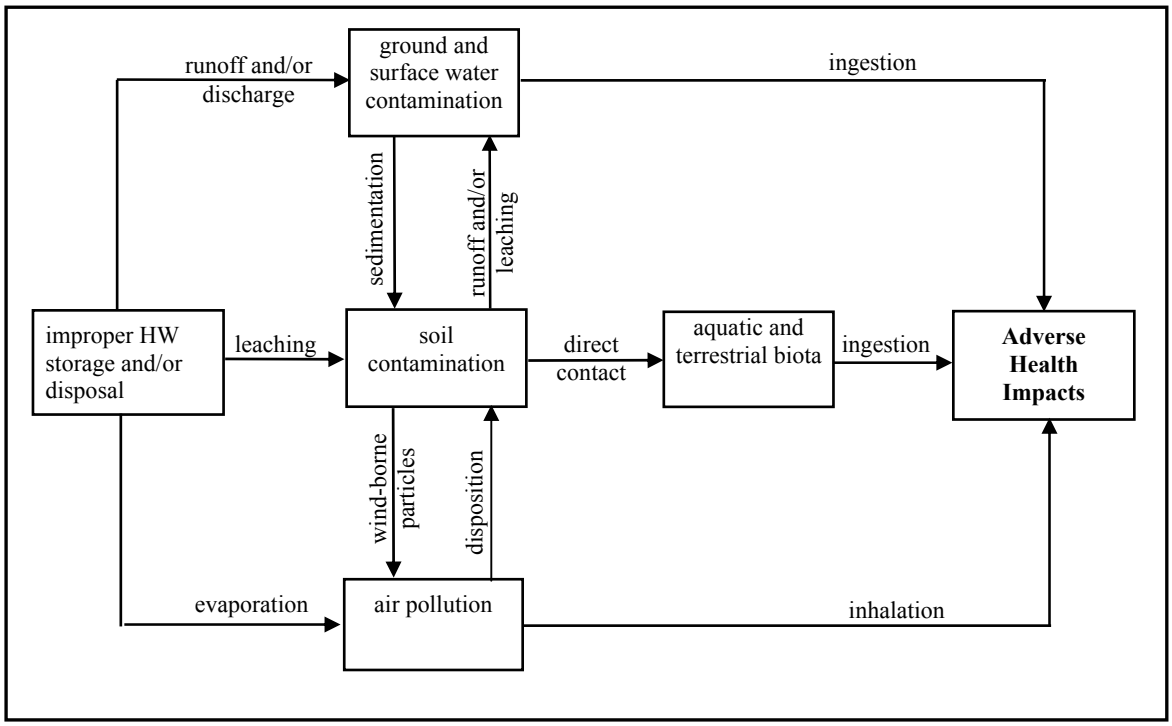

Figure (3): Routes of Transport of Hazardous Waste[13]

3.2 Health and Environmental Impacts of Industrial Hazardous Waste

Hazardous waste generated from the different industrial sectors can result in severe health and environmental impacts. For example, many hazardous waste constituents have been identified as occupational carcinogens, such as benzene and chromium VI. Lead in metal sludges can cause neurological dysfunction in adults and children or malfunction of the kidneys and the nervous system. Table (1) below describes the adverse impacts of some of the most commonly generated hazardous waste in Egypt. The most likely sources of such waste are also presented.

[13] Based on *The Safe Disposal of Hazardous Wastes: The Special Needs and Problems of Developing Countries*, Vol.I, World Bank Publication (1989).

Table (1): Adverse Health and Environmental Impacts of Common Industrial Hazardous Waste in Egypt

Hazardous Waste	Health /Environmental impact	Industrial sector
Waste xylene	• eyes and mucous membranes irritation, • disturbances of liver and kidney function	pulp and paper, textile, paints
Waste benzene	• cancer • blood disorder • skin irritation	paints, paper, leather
Peroxides waste	• eye and skin irritation • lung irritation • irritation and inflammation of nose, throat and respiratory tract	pulp and paper, textile
Waste containing lead	• neurological dysfunction in adults and children • high blood pressure in adults • affects blood chemistry, kidney and nervous system • bioccumulates in some shellfish such as mussels.	lead smelting, inorganic chemical industry, iron and steel, pigments, paint
Waste containing cadmium	• causes cancer • kidney damage • de-calcification of bone tissues • toxic to human	textile, leather, inorganic chemical industry, iron and steel, wood preserving, dyes and pigments
Waste containing chromium VI	• causes cancer • chronic irritation of the respiratory tract	metal finishing, leather fur, textile, paper printing, tanning steel, chemicals manufacturing
Waste containing arsenic	• can cause cancer • skin, eye and respiratory irritations • bioaccumulates in aquatic organisms	pigments, paints, wood preserving, inorganic chemicals, lead metallurgy
Waste containing cyanide	• toxic, can cause prompt death due to respiratory arrest • can cause blindness, and damages to optic nerves and retina. • affects the central nervous system • toxic to animals and aquatic organisms	dyes and pigments, metal treatment and coating
Waste sulphuric acid	• irritating to skin, eyes and mucous membrane	textile, inorganic chemicals, printing inks, secondary lead smelting, metal treatment
Waste sodium hydroxide	• irritating to the upper respiratory system • causes skin irritation	textile, metal treatment
Waste halogenated solvents (e.g. dichloromethane)	• probable human carcinogen • affects central nervous system, liver, kidney or respiratory system	organic chemical industry, textile, pesticide, dyes and pigments, paint, inks

4. Management of Hazardous Waste

4.1 Legal Framework for Hazardous Waste Management in Egypt

Hazardous waste management is addressed by Law 4/1994 for the Environment and its Executive Regulations (ER) which present the overall legal framework for the management of such waste in Egypt. Law 4/1994 and its ER determine the legal procedures that should be implemented by hazardous waste generators to ensure the safe handling and proper management of this waste. Within an industrial context, this is to be implemented by the industrial establishments for the generated industrial hazardous waste. Furthermore, laws 93/1962 and 48/1982 regulate the discharge of industrial wastewater which may contain hazardous material into public sewers, the River Nile and other waterways.

In addition to the above, Egypt is a party to the Basel Convention on the Transboundary Movement of Hazardous Waste. In this respect, it is required to harmonize the stipulations of the Convention into its national laws. According to Basel Convention, Egypt has to ensure that the transboundary movement of hazardous waste is reduced to the minimum and is conducted in a manner which protects human health and the environment. Furthermore, export of this type of waste from Egyptian industrial establishments for the purpose of treatment or recycling, is to take place only upon the approval of the Egyptian Environmental Affairs Agency (EEAA), following the procedures set in the Convention.

4.2 Proper Management of Hazardous Waste

In order to comply with the law regulations, the industrial establishments are required to take all necessary measures to properly manage their hazardous waste on site. Law 4/1994 and its ER address the measures to be implemented at the different stages of the management process starting from the reduction of waste at source through to identification, collection, on-site storage, on-site treatment, transport for off-site disposal, as well as keeping records.

Following are the main requirements to be implemented by an industrial establishment generating hazardous waste. These are summarized in table (2) below in section 4.2.1. Details for these requirements are then presented in sections 4.2.2 through to 4.2.10.

4.2.1 Summary of Requirements

Table (2): Legal Requirements for Hazardous Waste Management

Regulatory requirement	Description
Hazardous waste handling[14] permits *(Articles 25, 26, 27 - ER)*	- Permits for handling HW must be obtained from the Ministry of Industry. - The industrial establishment must meet the permitting conditions to be granted the handling permit. - The permit would be issued for a maximum period of five years which can be renewed. - The permit can be suspended by the granting body in cases of violations
Reduction of hazardous waste at source *(Article 28.1 - ER)*	- HW should be reduced quantitatively and qualitatively[15]. - Industrial establishments can use waste minimization options to reduce the generation of HW.
Identification of hazardous waste *(Article 28.1 - ER)*	- Industrial establishments must have complete description of the types and quantities of the generated HW. - For identification, the establishments are to use the HW list of the Ministry of Industry. Alternatively, the Basel Convention lists could also be used.
Hazardous waste segregation *(Article 26.8 - ER)*	- HW must be separated from other types of non-hazardous waste - The different types of HW must not be mixed together in order to avoid any undesired harmful interaction.
On-site storage of hazardous waste *(Article 28.2 A, B,E - ER)*	- HW should be stored in specifically designated areas. - Safety condition must be set for these storage areas. - Emergency plans must exist in order to confront any likely accidents. - HW storage containers must be made of suitable materials and be properly sealed to avoid any leakages or spills into the surroundings.
Labeling of hazardous waste storage containers *(Article 28.2 C - ER)*	- Clear signs must be inscribed on the containers indicating the ***waste in the containers and*** *the associated* hazard,

[14] Handling of a material is defined in Law 4/1994 as " any [activity] that leads to the movement of materials, with the intention of collection, transporting, storing, treating, or using them".

[15] Quantitative reduction means reducing the amounts of generated HW. Qualitative reduction means reducing the degree of hazard of the generated waste, i.e. making it less hazardous.

Regulatory requirement	Description
	in case of improper handling of the waste.
Collection of HW *(Article 28.2 D - ER)*	- HW should be collected according to a set time schedule in order to avoid accumulation of the waste for long periods. - In case of transfer off site, HW is to be submitted only to licensed transport contractors.
On-site treatment of hazardous waste *(Article 28.1 C - ER)*	- In case of HW treatment on-site, EEAA is to approve the treatment system and the technical specifications of the treatment units and their operational programs.
Transportation of hazardous waste *(Article 28.3 - ER)*	- HW should be transported only by licensed bodies. - Transport vehicles should be fitted with all necessary safety equipment - Clear signs must be placed on the vehicles indicating the extent of danger of their cargo - Divers must be trained to take necessary action in case of emergency
Disposal of hazardous waste *(Article 28.5 - ER)*	- The capacity of the disposal area must be suitable to accommodate the waste - Disposal site must be equipped with all necessary safety equipment - The site must be surrounded with brick walls and have more than one entrance gate.
Hazardous waste register *(Article 33 - ER)*	- The HW register should be established including information about the types and quantities of the generated waste and methods of its disposal.
Training and Awareness *(Article 31-ER)*	- Personnel handling HW should be aware of the hazard associated with such waste - Training on proper HW handling should be provided to all concerned employees

Table (3) below summarizes the regulatory bodies concerned with permitting of the different operations for industrial hazardous waste management.

Table (3): Industrial Hazardous Waste Permitting Bodies

Hazardous Waste Management Operation	Associated Regulatory Body		
	Ministry of Industry	EEAA	Governorate
On-site HW disposal	License	n/a	n/a
On-site HW treatment	License	Approval	n/a
Off-site HW storage/treatment/ recovery/disposal	n/a	n/a	License
Off-site HW transportation by the establishment or transport operator	License	n/a	n/a

4.2.2 Hazardous Waste Handling Licenses

1. Industrial establishments carrying out on-site treatment and/or disposal or off-site transportation, must apply for a hazardous waste handling license from the Ministry of Industry. Other HW management activities (e.g. on-site handling, on-site storage, on-site transportation, on-site recycling and recovery) do not need handling licenses.
2. To be granted the license, the establishment must meet the permitting conditions, stipulated in article 26 of the ER of Law 4/1994, encompassing providing detailed information about the types and quantities of the generated waste and the intended procedures for its management.

Annex (IV) provides details of the licensing criteria and the conditions for permit suspension.

Currently, the national system for hazardous waste permitting[16] for issuing hazardous waste licenses is under adoption. In this respect, the conditions stipulated in the ER for granting such licenses form the basis for this system, as well as the enforcement of Law 4/1994 until this system is fully operational.

4.2.3 Reduction of Hazardous Waste at Source

Industrial establishments are to strive to reduce the generation of hazardous waste at source. This can be achieved through various waste minimization alternatives, as presented and discussed in section 5 of this Manual.

4.2.4 Identification of Hazardous Waste

1. Industrial establishments are required to establish complete descriptions of their generated hazardous waste, indicating quantities and composition. This information is to be included in the HW register.

[16] The Administrative Guidelines for Hazardous Waste Permitting prepared by EEAA.

2. This identification is to be carried out according to the National Hazardous Waste Classification System discussed in section 2 above.

It is important to point out that the proper identification of hazardous waste is essential for effective hazardous waste management.

The industrial establishment should be aware that HW can be generated from different sources which can sometimes be overlooked or forgotten by the industrial establishment. This may cause that part of the generated HW would not be registered. The sources of HW include:

- Normal process situation
- Periodical operations such as cleaning of equipment, tanks or separation units
- Occasional events such as failing of stored chemicals and spills

4.2.5 Hazardous Waste Segregation

1. Hazardous waste must be separated at source from other types of non-hazardous waste. Besides, the different types of hazardous waste must not be mixed together in order to avoid any undesired harmful interaction between them. Annex (V) gives examples of compatibility of selected hazardous waste and the likely outcome of mixing different hazardous wastes.
2. Proper identification of hazardous waste forms a basis for waste segregation. It is therefore essential that all concerned personnel in the industrial establishment are familiar with waste identification.
3. The segregation process should start at the different production units and utilities. An organized segregation process will facilitate successive management phases, such as storage, treatment and disposal.
4. It is recommended that during segregation, the waste intended for different subsequent stages such as temporary storage, treatment or disposal, be kept separate. This waste can then be transferred to the concerned facility. Thus, waste collected for temporary storage is to be transferred to the main hazardous waste storage area within the industrial establishment; waste intended for treatment is transferred to the treatment facility; finally, waste intended for disposal is transported to the final disposal facility.
5. It is also recommended that records indicating the types and quantities of hazardous waste could be kept by each waste generating activity for the purpose of facilitating the tracking of such waste inside the industrial establishment.

4.2.6 On-site Storage of Hazardous Waste

<u>Storage areas</u>

1. Hazardous waste generated from different activities within the industrial establishment should be properly stored on site prior treatment and/or disposal.
2. The waste storage areas should be away from public places in order to prevent any harm to the public or those persons exposed to the waste, and should be of adequate size for the waste quantities to be stored.
3. These areas should be clearly designated and equipped with the necessary safety and protection equipment such as fire extinguishers, protective clothing, absorbing materials and first aid equipment.
4. The industrial establishment must have an emergency plan for accidents, particularly spills and fire.

Storage containers

1. Hazardous waste storage containers must be of inert materials which would not react with the waste. For example, highly corrosive waste will react with metal drums, the drums may fail and waste can be released into the surrounding. Thus, corrosive waste can be stored in plastic drums, or plastic-lined metal drums.
2. Storage containers must also be properly sealed to avoid any leakages or spills during storage or movement.
3. The hazardous waste containers should be labeled with clear signs indicating their content, the handling requirements and the associated hazards if improperly handled. Annex (VI) presents the hazardous signs for HW storage.
4. It is recommended that the storage area is inspected on periodic basis for the purpose of detecting leaks or deteriorations of containers.
5. HW storage practices must minimize possibilities of contamination of soil and groundwater. More specific information regarding HW storage area, storage containers, as well as procedures to be followed in storing and/or moving such waste is provided in the EEAA HW storage guidelines[17].

4.2.7 On-site Treatment of Hazardous Waste

1. For on-site treatment, the industrial establishment should obtain a license from the Ministry of Industry. In addition, EEAA is to approve the treatment operations, the technical specifications of the treatment units and their operational programs.
2. The treatment site is to be equipped with the necessary protective and safety requirements prescribed in the labour and occupational health regulations.

A guiding document for hazardous waste treatment is being prepared by EEAA. Description and areas of application of common treatment

[17] These are available at the General Department of Hazardous Substances and Wastes at EEAA.

methods are summarized in Annex (VII). When on-site treatment is not feasible, generated hazardous waste is transported to off-site treatment facilities[18].

4.2.8 Transportation of Hazardous Waste

1. Collection of hazardous waste for off-site transfer should be carried out according to an appropriate time schedule set to avoid accumulation of waste on site for long periods.
2. In case the waste is not transported by the industrial establishment generating it, it should be delivered only to licensed hazardous waste transport contractors, and a record kept of this delivery. In this respect, the industrial establishments are responsible to ensure that the contractors are authorized for hazardous waste transportation.
3. For hazardous waste transported off-site by the generating industrial establishment, the establishment should obtain HW transportation licenses from the concerned authority. Moreover, the establishment is responsible for ensuring that the transported waste is delivered to establishments licensed for hazardous waste treatment and/or disposal. Records of this delivery are to be kept by the generator. The generating establishment is also to ensure that vehicles used in transport meet the requirements of the Law, namely:
    a. The capacity of the vehicles and their rotation schedule must be adequate for quantities of the waste to be transported, preventing accumulation of such waste on-site.
    b. The vehicles must be clearly signed indicating the type of waste transported.
    c. The vehicles must be equipped with the necessary safety equipment, such as fire extinguishers, protective clothing and absorbing materials in case of spills, as well as first aid equipment, etc.
    d. Drivers of these vehicles must be trained to take the necessary action in case of emergencies and accidents.
    e. Hazardous waste transport vehicles should not pass through populated areas through daytime, in order to minimize risks in case of accidents.
4. In addition, the following conditions are recommended:
    a. In case the vehicles transport bulk waste, the material of the vehicle tanks must be suitable for the types of waste transported.
    b. These tanks should not contain substances liable to react dangerously with the content of hazardous waste.

[18] An off-site treatment facility is currently under establishment in the Alexandria area by the Hazardous Waste Management Project, funded by the Finish Government.

c. The tanks are to be properly washed between loads if these differ in nature. The generated wastewater is to be considered hazardous.

d. Documentation providing records for waste movement is important, as it would serve as a chain of custody, limiting the legal liability on the industrial establishment once the waste is delivered elsewhere. This is usually implemented through a manifest system.

In this regard, EEAA is currently in the process of preparing guiding documents for hazardous waste transportation[19].

4.2.9 Disposal of Hazardous Waste

Industrial establishments carrying out on-site HW disposal should obtain a disposal license from the Ministry of Industry. Sites where hazardous waste are disposed of are to be located at a minimum distance of 3 km from populated and residential areas. Moreover, such sites must meet the following requirements:

1. Their areas must be adequate to accommodate the waste to be disposed of.
2. The sites must be surrounded with brick walls of minimum height of 2.5 m.
3. The sites must be provided with more than one entrance gate of suitable width to enable easy access of waste transport vehicles.
4. The sites must be equipped with all necessary safety equipment described in the labour and vocational health laws, a telephone line, water supply, and all other equipment and facilities necessary for the disposal of the waste.

4.2.10 Hazardous Waste Register

1. Industrial establishments handling hazardous waste are to keep a register, as detailed in article 33 of the ER, of the generated waste, with details of the methods of disposal and the parties who receive this waste.
2. This register is to be made available for environmental inspections.

Annex (VIII) presents a model for the hazardous waste register.

4.2.11 Training and Awareness

1. The industrial establishments should ensure that the personnel involved in hazardous waste management are aware of the risks associated with improper management of such waste and that they receive continuous training on proper handling procedures of the different types of this waste.

[19] Hazardous Waste Transportation Guidelines.

2. The industrial establishments should also develop environmental awareness programs for all employees.

5. Hazardous Waste Minimization

5.1 Hazardous Waste Minimization Within Hazardous Waste Management

Minimizing the generation of hazardous waste is a significant concern of Law 4/1994 and its ER with the aim of encouraging the reduction of hazardous waste subject to collection, transportation, treatment and disposal.

Hazardous waste minimization is considered one of the important components of an effective hazardous waste management scheme. It not only minimizes the associated health and environmental risks of hazardous waste, but also reduces the costs of managing and disposing of such waste. Waste minimization is reducing at source, to the extent feasible, the generated hazardous waste. This would result in the reduction of its total amount which needs to be collected, transported, stored, treated and disposed of.

Waste minimization can be considered as part of a broad hierarchy of waste management approaches, where it occupies the highest levels. Waste reduction at source entails improving existing technologies, and introducing cleaner production and pollution prevention measures. The next level down this hierarchy encompasses waste recycling and reuse, including material and energy recovery. At a lower level of the hierarchy comes treatment. This is with the purpose of reducing the volume and/or the hazardous properties of the waste for rendering this waste less or non-hazardous and suitable for disposal. The lowest level of the hierarchy comprises final safe disposal of the treated waste.

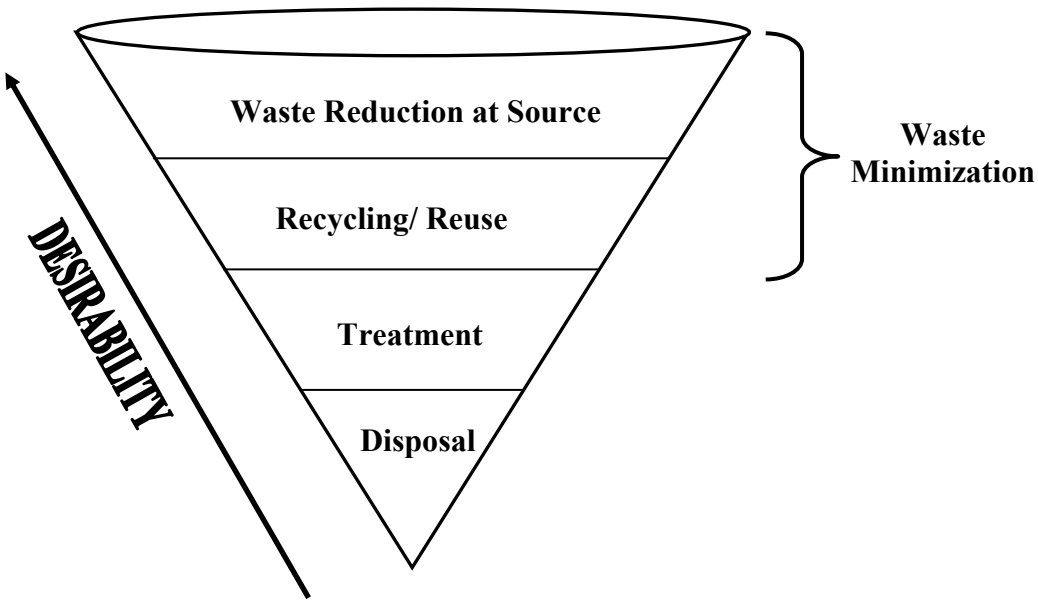

Figure (4): Waste Management Hierarchy

5.2 Options for Hazardous Waste Minimization

Minimization of hazardous waste could be achieved by a number of methods, as presented schematically by figure (5) below. It is important to point out that each industrial establishment can adopt any of these methods within its individual financial and technical capabilities and according to its own circumstances and policies.

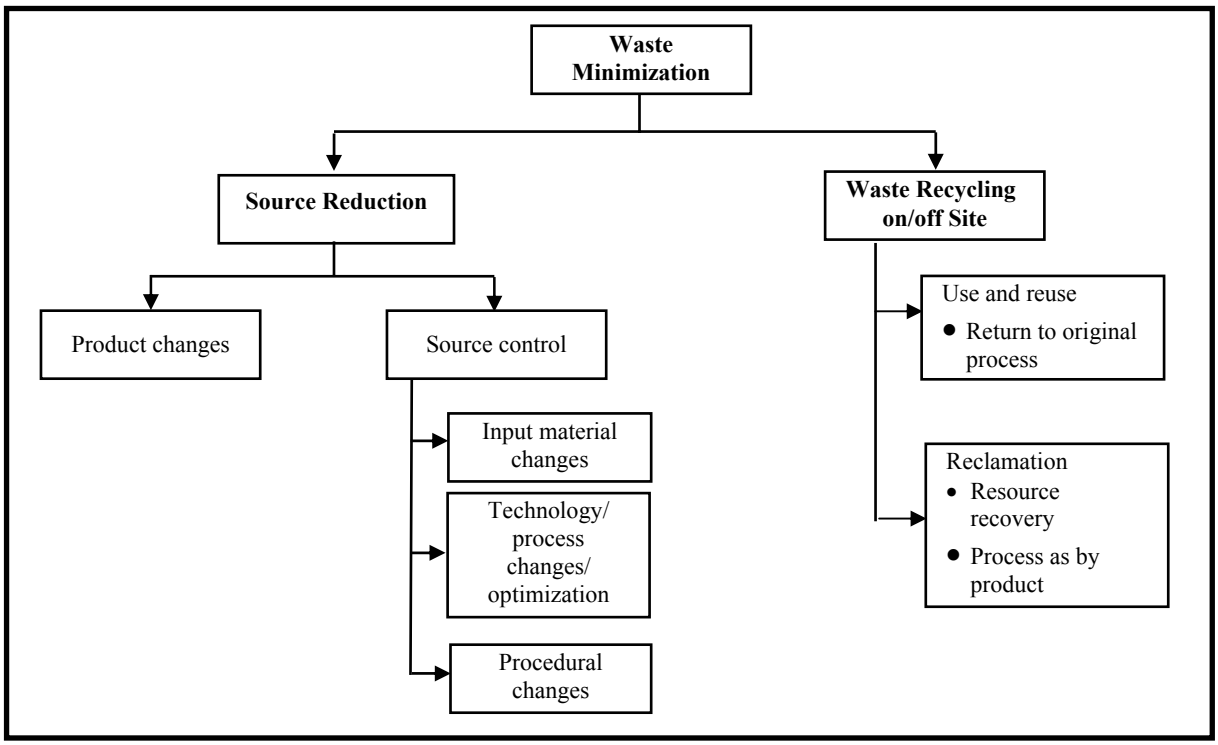

Figure (5): Waste Minimization Options

Following are details for the different methods of waste minimization:

5.2.1 Source Reduction

Source reduction is the use of materials, processes, or practices that reduce or eliminate the generation of wastes at the source. This option is considered the most rational as it aims at avoiding or preventing the generation of the waste in the first place. The adoption of source reduction approach is usually encouraged because it is often the most cost-effective option as it may reduce raw material losses, energy and water consumption, the reliance on expensive "end-of-pipe" treatment technologies and disposal practices and most importantly reduces the potential liability associated with improper management of waste.

Source reduction involves product change and source control. Both alternatives are discussed in details.

Product change

This involves the replacement of a product with another one suitable for the same end use, with the generation of less or no hazardous waste. Hazardous waste can be minimized by eliminating the use of hazardous material from the product design. For instance, if the product contains lead or mercury it could be possible to redesign it so that the hazardous substances are eliminated from the production process. Examples for product change include:

- Batteries can be redesigned such that the toxic constituents, for example mercury and cadmium are reduced or eliminated.
- Using PET (Polyethylene Terephthalate) instead of PVC (Polyvinyl Chloride) in pipes and plastic manufacturing
- Designing products for disassembly so that they are easy to repair, upgrade or disassemble at their end-of life.

Source control

Source control encompasses input material substitution, re-engineering production processes and/or improving procedural practices.

- *Input material changes*
  Changing the used hazardous input materials can contribute to reducing the generation of hazardous waste. This reduction can be achieved by replacing the hazardous input materials with less or non-hazardous ones. Replacement of hazardous input materials involves carrying out product inventories and examining the uses of the existing materials and identify those that can be replaced. A major consideration for a successful input material change is whether the substitute provides acceptable results. Therefore product efficiency, using the substitute, is to be comprehensively investigated. Examples for input materials substitution include:
  - The use of non-toxic, non-carcinogenic dyes with no heavy metal content in the textile industries
  - The use of water-base inks and pigments instead of the solvent-base ones.

- *Technology/ process changes*
  This option can be implemented through improving or modifying the existing technologies used in production processes. Process modification ranges from eliminating leaks from the existing equipment, to installing of new advanced equipment. A product can sometimes be manufactured by alternative processes. A certain process can generate less waste than another. In

this regard, industries can change the used, more polluting, process to the less polluting one. Modification of equipment and process automation are also means for waste minimization.

- *Process control/optimization*
  Process control and optimization would most likely result in the generation of less waste.

- *Good housekeeping*
  Good housekeeping or sound procedural practices play a considerable role in controlling waste at source. These practices contribute to a great extent in minimizing the losses of input materials and eliminating leaks and spills of hazardous materials from the processes. Periodic maintenance, continuous checkup, and leak detection plans are considered important components of good housekeeping practices. Good practices also include efficient hazardous waste segregation from other non-hazardous waste streams, thus facilitating its handling and management. Finally, raising the environmental awareness of all workers and employees, as well as the continuous training is regarded as a major factor in achieving the goals of waste minimization schemes.

5.2.2 Reuse/Recycle/Recovery

If source reduction is not feasible, the second best waste minimization option is to recycle and/or reuse the generated hazardous waste.

- *Reuse*
  Reuse refers to the direct use once more of the waste, in the form it is generated in, in the same industrial process it is generated from, or in another processes, without the need for prior treatment or modification. Reuse may also be an exchange of waste that can be practiced in-house or among different industries. Examples for waste reuse:
  - Reuse of solvents for equipment cleaning
  - Reuse for acidic and alkali solution
  - Reuse of ferric chloride waste from manufacture of titanium oxide as wastewater conditioner
  - Reuse of chromium solutions in tanneries

- *Recycling*
  This involves prior treatment of waste so that is can be used as raw materials in the same process it is originating from, or in other processes. Recycling of

waste is characterized by two major practices additional to direct waste reuse as discussed above. These are:

- Recovery of a secondary material for a separate end use such as the recovery of a metal from sludge
- Removal of impurities from a waste to obtain relatively purer substances which can be reused

- *Recovery or reclamation*
  This involves recovering and treating "waste" byproducts to be used as raw materials in the same or another process. Reclamation processes include chemical, physical and electrochemical separation, some of the major reclamation technologies include the following:
  - Distillation of solvent wastes
  - Dechcloronation of halogenated solvent wastes
  - Metal concentration techniques such as leaching, solvents extraction, ion exchange, precipitation, crystallization, and evaporation to treat dilute metal-bearing waste streams

After examining the different alternatives and options of the waste minimization schemes, it is important to reiterate that each industrial establishment can adopt any of the above mentioned approaches within its individual financial and technical capabilities and according to its own circumstances and policies.

5.3 Motivations and Benefits of Hazardous Waste Minimization

Waste minimization is not only a sustainable option for long term management of hazardous waste and environmental protection but also can result in substantial benefits:

- *Legal benefits*
  By implementing waste minimization options, industrial establishments will be able to fulfill their legal obligations and comply with the environmental laws reducing non-compliance liabilities. The legal motivations are considered an important incentive for industries to be more proactive in implementing waste minimization schemes.

- *Environmental benefits*
  Hazardous waste minimization reduces potential adverse environmental impacts of the waste and contributes to conserving the non-renewable natural resources. It also reduces the exposure of employees and the surrounding communities to the harmful impacts of waste making jobs easier and safer.

- *Economic benefits*
  - Waste is lost valuable resources and reducing such waste would result in achieving savings in the costs of raw material.

- Waste minimization would result in a decrease of treatment and disposal costs. These are likely to become significant with the proper enforcement of environmental regulations and the increase of their stringency.
- Waste minimization can enable industries to compete in the international markets, since in many cases consumers require information on the environmental impacts of both the manufactured products, as well as the manufacturing process
- Waste minimization reduces the costs of clean ups

- *Energy and material conservation*
  Many waste minimization schemes result in reduction in energy and material consumption. For example reductions in usage of fuel, electricity and water are common results from waste minimization.

- *Improving company image*
  Waste minimization programs create a positive "green" image of the company and improve the public perception about the polluting industries.

5.4 The Implementation of Hazardous Waste Minimization Schemes

Waste minimization is seen as a cornerstone of an effective waste management policy. An effective waste minimization schemes consists of a number of logical and sequential steps:

1. *Identifying hazardous waste generation processes*
   This involves carrying out site surveys, quantitative and qualitative inventory of waste generating processes. Accordingly, the size of the waste problem is identified. This step requires familiarity with the industrial establishment as well as detailed process knowledge.

2. *Identifying the types of generated hazardous waste*
   The nature, composition and amount of waste generated from each process are determined. Classification is carried out according to the National Hazardous Waste Classification System. The hazardous waste classification draft list of the Ministry of Industry can also be used as guidance for waste identification.

3. *Identifying waste minimization opportunities*
   At this stage, opportunities for waste minimization, applying any of the above mentioned minimization options, can be identified.

4. *Establishing priorities*
   Priority actions for waste reduction are determined taking account of environmental impacts, frequency of occurrence, quantity and volume generated, the legal requirements and the economic considerations. Financial feasibility analyses can also be carried out to help identifying such priority actions. Their level of detail would depend mainly on the complexity of the waste minimization option selected. For example, if the minimization options to be taken involve low-cost measures, such as good housekeeping or proper material handling, then detailed analysis is not necessary.

5. *Allocate resources*
   Waste minimization options vary from those of low cost to those which are costly in terms of available resources, research and development, capital expenditure, and operational time. Targets are set according to these different parameters. Resources allocation is therefore considered a key parameter for an efficient waste minimization scheme.

6. *Implementation*
   Responsibilities are allocated and time frames are determined in order to achieve the set targets and goals.

7. *Progress measurement and program evaluation*
   This is carried out to assess implemented waste minimization schemes. It determines the actual waste reduction, quantitatively and qualitatively, the amount of savings achieved and the payback periods.

Measuring the percentage of waste reduction is considered one straightforward analytical approach to assess the effectiveness of waste minimization. The percentage of waste reduction is calculated according to the following equation[20]:

$$WR = \left[\left(\frac{W1}{P1} - \frac{W2}{P2} \right) \Big/ \frac{W1}{P1} \right] \times 100$$

where, WR = percentage of waste reduction
W1 = waste generated in year "n"
W2 = waste generated in year "n+1"
P1 = production output in year "n"
P2 = production output in year "n+1"

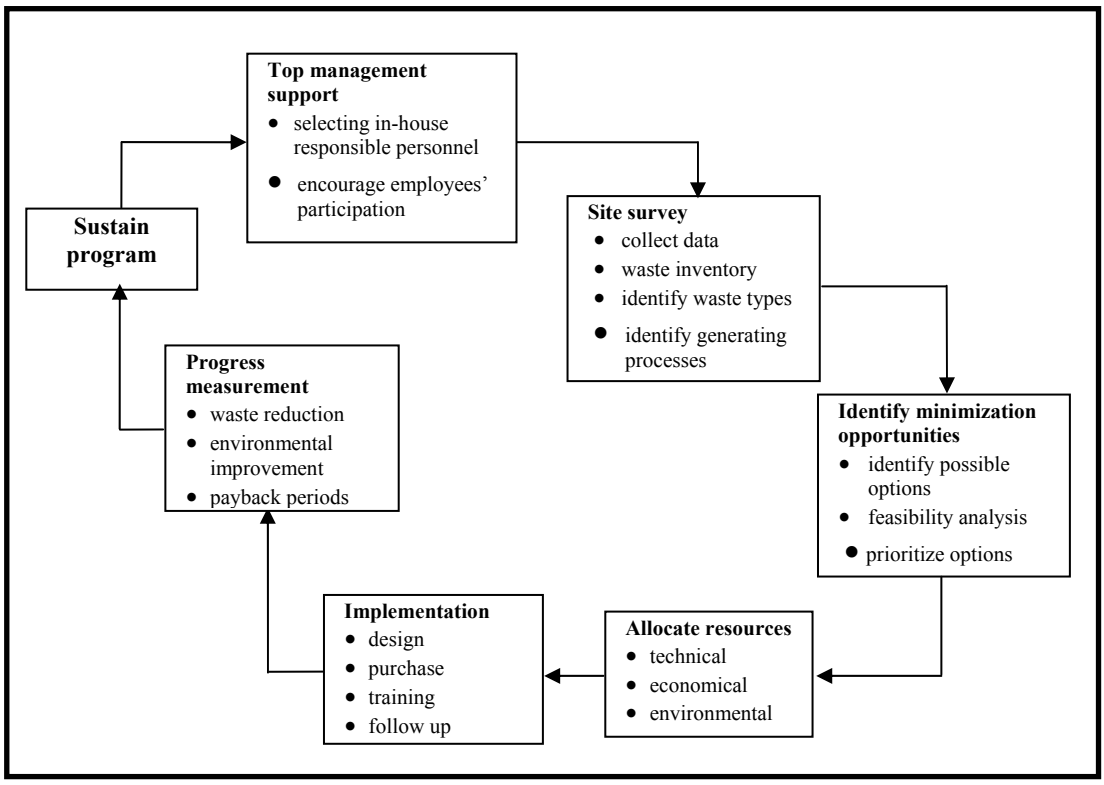

Figure (6): Waste Minimization Strategy Loop

It is important to point out that the top management commitment and support to the waste minimization program, is considered an essential prerequisite for its success. Once this is realized, there will be solid basis to build up on all the steps mentioned above. Such support will also ensure the efficiency and sustainability of the program. Furthermore, all employees need to be aware of the concept of waste minimization and be informed about its benefit to them and the company. This will enhance the participation of the employees, which can trigger ideas that might result in further hazardous waste reduction

[20] Source: The Safe Disposal of Hazardous Wastes (1989), The Special Needs and Problems of Developing Countries, Vol.I, World Bank Publication.

and more improvement in the environmental performance of the company. Figure (6) schematically presents the procedures for implementing a waste minimization program.

5.5 Possible Options for Minimizing Common Industrial Hazardous Waste

Various types of hazardous waste can be reduced using any of the different minimization alternatives discussed above. Table (4) below briefly presents examples for possible hazardous waste minimization in different industries.

Table (4): Possible Minimization Schemes for Common Types of Hazardous Waste

Industrial process	Hazardous waste	Minimization option
Electroplating	Chromic acid cleaners	Substitution with less hazardous sulphuric acid and hydrogen peroxide
	Lubricating oils used in cold forming	Substitution with non-hazardous hot lime bath or borax soap
	Halogenated solvents e.g. trichloroethylene) used for degreasing	Substitution with petroleum solvents or alkali washes.
	Alkaline etching bath used for cleaning nickel and titanium alloys	Process modification by using mechanical abrasive system
	Used copper etching baths	Regeneration and copper recovery
	Used silver cyanide baths	Regeneration and silver recovery
Textile industry	Waste dyes containing chromium VI	Substitution with chromium free dyes.
	Sodium hypochlorite from bleaching processes	Substitution with less harmful peroxides
	Sodium sulphide and chromate solution used for sulphur black dyeing	Substitution with glucose or dextrose for sodium sulphide and hydrogen peroxide, sodium perborate for chromate solution
	Used dye baths	Reuse of the baths
	Rinsing water	Process modification to reduce the rinsing water
Printing industry	Ferro cyanide bleaches	Substitution with iron-EDTA bleaches
	Solvent based processing	Substitution with water-developed lithographic plates and films

	Used VOC-based adhesives from binding operations	Substitution with water-soluble adhesives, hot-melt adhesives, or mechanical methods.
	Vaporized ink	Reduce vaporization by using diaphragm pumps which do not heat ink .
	Waste ink	Recycle where possible

Annex (IX) presents a case study for industrial hazardous waste minimization in the textile sector.

6. Environmental Improvement

6.1 Self-Assessment

The basic objectives of waste management programs are to monitor and verify compliance with the environmental regulations and evaluate the effectiveness of in-place waste management processes. Proactive industries can go beyond compliance and use such programs to assist them in improving their environmental performance. This can be achieved through identifying areas of weaknesses and opportunities for improvement.

One major component of an effective waste management program entails periodic and routine self-assessment activities. These activities include inspections and reviews of critical areas. A successful self-assessment program should be an ongoing process of planning, implementation, measurement and review. There are various tools and means which can be used by the industrial establishments to carry out self-assessment for their waste management processes. One such tool is a hazardous waste self-assessment checklist, which can be used to assess the procedures implemented by the establishment for complying with the legal requirements for hazardous waste management, as well as assist in identifying areas of non-compliance and opportunities for improvement. Table (5) below provides an example for such a check list.

Table (5): Hazardous Waste Self-Assessment Checklist

		Yes	No	Legally Required
1.	**Is the establishment generating HW?** (use Annex 3 of this Manual as a guide)			
2.	**Permits, HW Register and Other Essential Documents**			
2.1	Does the establishment have the necessary HW licenses?			●
2.2	Are these valid?			●
2.3	In case of HW treatment on-site, does the establishment have an approval from EEAA on the treatment operation(s)?			●
2.4	Is the HW Register available?			●
2.5	Is it consistent with the requirements of article 33 of the ER?			●
2.6	Are the HW Register contents fully describing the situation in the establishment?			●
2.7	Is the HW Register up to date?			●
2.8	Is the Emergency Plan for confronting accidents available?			●
3.	**Training and Awareness**			
3.1	Are the establishment personnel handling HW aware of and trained for risks involved and necessary safety measures?			●
3.2	Are the conductors of HW transportation vehicles trained for acting in emergencies during transport?			●
3.3	Are records for training of the establishment personnel available? *(optional as proof for training personnel)*			
4.	**Hazardous Waste Generation**			
4.1	Are the generated quantities of HW specified?			●
4.2	Are the processes/utilities generating HW identified?:			
4.3	Are the quantities of HW generated at each process/utility specified?			
5.	**Hazardous Waste Identification**			
5.1	Is generated HW identified?			●
5.2	Which of the following sources are used for this identification:	*(tick as applicable)*		
	• The National HW Classification System			n/a
	• The HW list of the Ministry of Industry			N/a
	• MSDS			n/a
	• Industrial experience			n/a
	• Others *Specify:*			n/a
5.3	Are the types of HW generated at each process/utility identified?			
5.4	Are the types and quantities of generated HW consistent with information in the HW Register? *(see point 2.6 above)*			●

6.	**Hazardous Waste Segregation**			
6.1	Is the HW segregated from non-HW at each generating process/utility?			●
6.2	Are the different types of HW separated from each other at each generating activity? *(use Annex 5 of this Manual as a guide for HW incompatibility)*			●
6.3	Are the handling alternatives for HW generated at each process/utility identified? *(recycling, storage, disposal)*			
7.	**Hazardous Waste Storage**			
7.1	Is there a specifically designated storage area for HW?			●
7.2	Is this storage area properly isolated from its surroundings?			●
7.3	Is this storage area clearly marked?			
7.4	Are all HWs stored in the specifically designated area?			●
7.5	Is the capacity of the area suitable for the quantities of stored HW?			●
7.6	Does the HW collection schedule ensure that HW is not stored for excessive periods of time?			●
7.7	Are incompatible HWs stored separately from each other?			●
7.8	Is the storage area equipped with all the necessary safety equipment*?* *(fire extinguishers, protective clothing, spill collection material/equipment, etc.)*			●
7.9	Are storage registers upkept?			
	Storage Containers:			
7.10	Are containers compatible with the waste they contain?			●
7.11	Are containers in good condition?			●
7.12	Are containers kept closed?			●
7.13	Are the containers properly labeled?			●
7.14	Are containers handled/stored in a way which ensures prevention of leaks?			●
7.15	Are the containers handled/stored in a way which ensures the detection of leaks?			
7.1	Are containers inspected regularly for leaks and defects?			
8.	**Hazardous Waste Treatment**			
In case of treatment of generated HW on-site				
8.1	Is the treatment operation approved of by EEAA?			●
8.2	Are the treatment conditions consistent with this approval? *(see point 2.3 above)*			●
8.3	In case HW is generated from the treatment process(es), is this waste identified? *(see points 4.1 to 5.4)*			●
8.4	Is this waste properly managed? *(see points 6.1 to* 9.6)			●
9.	**Hazardous Waste Transportation**			
In case of HW transportation by the generating establishment				
9.1	Is the capacity of the transport vehicles and the transport schedule adequate to the quantity of HW transported?			●

9.2	Are the transport vehicles equipped with the necessary safety equipment? *(fire extinguishers, protective clothing, spill collection material/equipment, etc.)*			●
9.3	Are the transportation vehicles clearly and adequately marked?			●
9.4	Are the transportation vehicles well maintained and clean?			●
9.5	Is the routing for HW transportation specified?			●
In case of HW transportation by a different entity				
9.6	Is the transportation contractor to which HW is delivered licensed to do so?			●
10.	**HW Minimization**			
10.1	Has HW minimization been considered at the establishment?			●
In case of HW minimization opportunities having been identified				
10.2	Are any of these opportunities being implemented? If not, specify the reasons:			
11.	**Overall HW Management**			
11.1	Is there a specifically designated person at the establishment responsible for overall coordination of HW management?			
11.2	Is this person properly coordinating with all concerned personnel?			

6.2 Environmental Management System

An Environmental Management System (EMS) is considered a voluntary[21] systematic approach to ensuring that environmental activities are well managed in any organization. EMS is a continual cycle of planning, implementing, reviewing and improving performance. The most familiar form of an EMS is the 14001 Standard, established by the International Organization for Standardization (ISO).

An effective EMS helps identify the causes of environmental problems and present options for combating and eliminating them. It can save money by reducing waste, increasing efficiency and reducing costs associated with environmental compliance and liability. Not only does it focus on what environmental problems exist, but also on why they exist. Over time, this systematic identification and correction of system deficiencies leads to better environmental compliance as well as better overall business performance.

[21] Environmental Management System is not a requirement of Law 4/1994 or its ER.

Waste management, in general, and hazardous waste management in particular, present essential components of EMS. In this respect, an EMS adopted by an industrial establishment would present a tool with significant contribution towards better management of its hazardous waste.

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Annex I
Draft Hazardous Waste List of Ministry of Industry

Draft List of Hazardous Waste subject to the Legal Requirements of Law 4/1994 and its ER within the Industrial Sector

Hazardous Wastes prohibited from importation, and transit through the Arab Republic of Egypt

Metal and meta-bearing wastes:

1. Metal wastes and waste consisting of alloys of any of the following :
   - Antimony
   - Arsenic
   - Beryllium
   - Cadmium
   - Lead
   - Mercury
   - Selenium
   - Tellurium
   - Thallium

   excluding such wastes specifically listed on list B, entry 2.

2. *Waste having as constituents or contaminants any of the following, except for bulky waste from the metallurgical sector (metal sheets, sections, bars, etc…)*
   - Antimony; antimony compounds
   - Beryllium; beryllium compounds
   - Cadmium; cadmium compounds
   - Lead; lead compounds
   - Selenium; selenium compounds
   - Tellurium; tellurium compounds

3. Wastes having as constituents or contaminants any of the following:
   - Arsenic; arsenic compounds
   - Mercury; mercury compounds
   - Thallium; thallium compounds

4. Wastes having as constituents any of the following:
   - Metal carbonyls
   - Hexavalent chromium compounds

5. Galvanic sludges

6. Waste liquors from the pickling of metals

7. Leaching residues from zinc processing, dust and sludges, such as jarosite, hematite, etc.

8. Waste zinc residues, containing lead and cadmium in concentrations sufficient to exhibit hazardous characteristics listed in the attached annex.

9. Ashes from the incineration of insulated copper wire

10. Dusts and residues from gas cleaning systems of copper smelters

11. Spent electrolytic solutions from copper elctrorefining and electrowinning operations

12. Waste sludges, excluding anode slimes, from electrolyte purification systems in copper electrorefining and electrowinning

13. Spent etching solutions containing dissolved copper

14. Waste cupric chloride and copper cyanide catalysts

15. Lead from waste acid batteries, whole or pulverized.

16. Unsorted waste batteries

17. Waste electrical and/or electronic assemblies or scrap containing components such as accumulators, batteries, mercury-switches, glass from cathode-ray tubes and other activated glass, PCB-capacitors, or contaminated with constituents contained in this list to an extent rendering them hazardous following the criteria presented in the attached annex.

Waste containing principally inorganic constituents, which may contain metals and organic materials:

18. Glass waste from cathode-ray tubes and other activated glass

19. Waste inorganic fluorine compounds in the form of liquids or sludges, but excluding such waste specified on list B

20. Waste catalysts, including waste liquid catalysts and those containing hazardous heavy metals

21. Waste asbestos (dusts and fibers)

Wastes containing principally organic constituents, which may contain metals and inorganic materials:

22. Waste from the production or processing of petroleum coke and bitumen

23. Waste mineral oils unfit for their originally intended use

24. Wastes that contain, consist of, or are contaminated with leaded anti-knock compound sludges

25. Waste thermal (heat transfer) fluids

26. Wastes from the **production**, **formulation** and **use** of resins, latex, plasticizers, glues/adhesives

27. Waste nitrocellulose

28. Waste phenols, phenol compounds, including chlorophenol in the form of liquids or sludges

29. Waste ethers, excluding those specified on list B

30. Waste leather dust, ash, sludges and flours when containing hexavalent chromium compounds or biocides

31. Waste paring and other waste of leather or of composition leather not suitable for the manufacture of leather articles, containing hexavalent chromium compounds or biocides

32. Fellmongery wastes containing hexavalent chromium compounds or biocides or infectious substances

33. Fluff-light fraction from shredding

34. Waste organic phosphorus compounds

35. Waste non-halogenated organic solvents

36. Waste halogenated organic solvents

37. Waste halogenated or unhalogenated non-aqueous distillation residues arising from organic solvent recovery operations

38. Wastes arising from the production of aliphatic halogenated hydrocarbons (such as chloromethane, dichloro-ethane, vinyl chloride, vinylidene chloride, allyl chloride and epichlorhydrin)

39. Wastes, substances and articles containing, consisting of, or contaminated with polychlorinated biphenyl (PCB), polychlorinated

terphenyl (PCT) polychlorinated naphthalene (PCN) or polybrominated biphenyl (PBB), or any other polybrominated analogues of these compounds, at a concentration level of 50 mg/kg or more.

40. Waste tarry residues (excluding asphalt cements) arising from refining, distillation and any pyrolitic treatment of organic materials

Wastes which may contain wither inorganic or organic constituents:

41. Wastes from the **production** and **preparation** of pharmaceutical products, but excluding such wastes specified on list B

42. Waste from the **production** and **formulation** of biocides and phytopharmaceuticals

43. Wastes from the **manufacture**, **formulation** and **use** of wood-preserving chemicals.

44. Wastes that contain, consist of, or are contaminated with, any of the following:
    - Inorganic cyanides
    - Organic cyanides

45. Waste oils/water, hydrocarbons/water mixtures, emulsions

46. Wastes from the **production**, **formulation** and **use** of inks, dyes, pigments, paints, lacquers, varnish

47. Waste acidic or basic solutions with a pH lower than 2 and higher than 11.5

48. Wastes from industrial pollution control devices from cleaning of industrial off-gases, but excluding such waste specified on list B

49. Wastes that contain, consist of, or are contaminated with any of the following:
    - Any congener of polychlorinated dibenzo-furan
    - Any congener of polychlorinated dibenzo-dioxin

50. Wastes that contain, consist of, or are contaminated with peroxides.

51. Waste packages and containers containing residues of hazardous wastes on this list, or hazardous substances specified on the Ministry of Industry list

52. Waste consisting of, or containing, off specification or outdated chemicals corresponding to the hazardous substances specified on the Ministry of Industry list

53. Waste chemical substances arising from research and development which are not identified, and/or are new, and whose effects on human health and/or environment are not known

54. Spent activated carbon

55. Waste containing, and/or consisting of Chlorofluorocarbons (CFCs)

56. Waste assemblies or scrap resulting from electricity generating activities, containing, or contaminated with, oils, polychlorinated biphenyls (PCB), and polychlorinated terphenyl (PCT).

57. Wastes of Tellurium and Selenium in elementary metallic form, including powders

58. Metal-bearing wastes arising from melting, smelting and refining of metals:
- Zinc skimmings
- Aluminium skimmings

59. Slags from copper processing or refining containing arsenic, lead or cadmium

60. Calcium fluoride sludge

61. Bauxite residue ("red mud")

62. Precious-metal-bearing residues in solid form, which contain traces of inorganic cyanides

63. Precious-metal ash from the incineration of photographic film

64. Waste photographic film containing silver halides and metallic silver

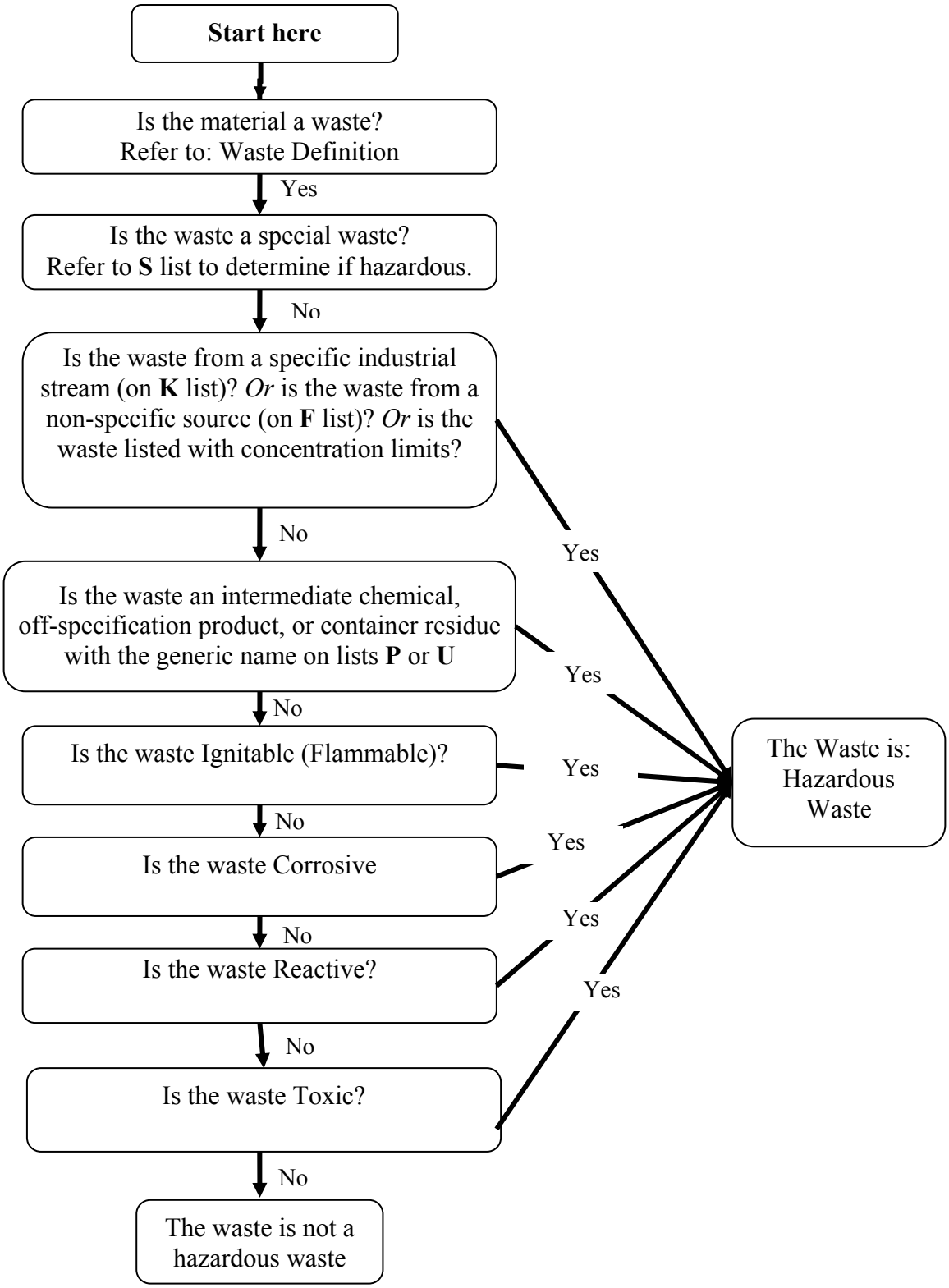
65. Waste photographic paper containing silver halides and metallic silver

66. Solid plastic waste:
Scrap plastic of non-halogenated polymers and co-polymers (not completely polymerised, and/or post consumer wastes)

67. Waste PVC

Annex II
Master Flow Chart For Hazardous Waste Identification

Master Flow Chart For HW Identification*



* Details of the charts and lists referred to in this master chart are found in the Guidelines for the Classification and Coding of the Egyptian Hazardous Wastes, prepared by EEAA, and available from the General Department of Hazardous Substances and Wastes of EEAA.

Annex III
Activities Generating Hazardous Waste

Industrial Activities
Generating Hazardous Waste

Industrial Sector	Waste type
Pulp and paper industry	- Sludges from bleaching processes contaminated with chlorinated organic compounds, dioxins, furans and chlorophenols, peroxides - De-inking sludges from paper recycling contaminated with organic solvents and heavy metals
Leather and fur industry	- Degreasing waste containing solvents such as ethers, waste sludges containing hexavalent chromium compounds. - Tanning liquor containing chromium - Sludges from effluent treatment containing chromium - Waste tanned leather contaminated with chromium
Textile industry	- Finishing waste containing organic halogenated and non-halogenated solvents - Wastes from bleaching processes containing peroxides, sodium hypochloride, chlorine - Highly alkaline effluents - Waste dye stuff and pigments containing azodyes, heavy metals (Cd, Cr) - Sludges from effluent treatment containing cadmium, arsenic, lead, hexavalent chromium, arsenic, mercury, halogenated organic solvents
Inorganic chemical industry	- Sluphuric acid - Hydrochloric acid - Hydrofluoric acid - Phosphoric acid - Nitric and nitrous acid - Calcium hydroxide - Sodium hydroxide - Ammonia - Salts and solutions containing cyanide - Waste containing heavy metals and heavy metal oxides (antimony, lead, arsenic, mercury, cadmium, hexavalent chromium, metal carbonyls, beryllium. - Waste containing arsenic - Waste containing mercury - Inorganic pesticides and biocides and wood preserving agents. - Spent activated carbon

Industrial Sector	Waste type
Organic chemical industry	- Aqueous washing liquids and mother liquors (non-halogenated and halogenated organic solvents, - Organic halogenated solvents - Halogenated still bottoms - Halogenated still bottoms - Halogenated filter cakes - Sludges from effluent treatment containing heavy metals, halogenated and non-halogenated organic solvents
Iron and steel industry	- Solid waste from gas treatment of electrical arc furnaces (heavy metals, lead and cadmium) - Waste from cooling water treatment containing oil - Sludges from gas treatment containing heavy metals
Wood processing	- Inorganic wood preservatives (chromate copper arsenate, - Non-halogenated organic wood (creosote) preservatives - Organo-chlorinated (chlorophenolics - pentachlorophenols) - Organo-metallic wood preservatives - Waste pigments (lead, chromium, cadmium
Pesticide industry	- Organic halogenated solvents - Waste organophosphorous compounds (organophosphorous pesticides, thiophosphates) - Halogenated organic solvents, washing solutions and mother liquors - Halogenated filter cakes - Sludges from effluent treatment - Outdated pesticides and/or ones off specifications
Dyes and pigment industry	- Aqueous washing liquids and mother liquors - Halogenated organic solvents - Halogenated still bottoms - Sludges from effluent treatment - Waste pigment and dyes - Waste oils/water, hydrocarbon /water mixtures and emulsions
Paint and varnish industry	- Waste paint and varnish containing heavy metals (cadmium, chromium, lead, mercury, etc..) - Waste from paint or varnish removal containing organic solvents - Aqueous suspensions containing paint or varnish

Industrial Sector	Waste type
Printing inks manufacture	- Waste inks containing halogenated solvents - Waste non-halogenated solvents - Waste etching solutions (highly acidic solutions) - Waste aqueous liquids and sludges containing inks (heavy metals)
Soap, fat, grease detergents, disinfectants and cosemetics	- Aqueous washing liquids and mother liquors containing non-halogenated organic solvents, halogenated organic solvents, vinyl chloride, chloromethane, vinylidene chloride, etc.. - Waste organic halogenated solvents - Halogenated still bottoms and reaction residues - Halogenated fliter cakes and spent absorbents - Sludges from effluent treatment (heavy metals, waste oils/ water, hydrocarbon/ water mixtures and emulsions)
Power stations and other combustion plants	- Sulphuric acid - Fly ash from emulsified hydrocarbons used as fuels
Aluminum thermal metallurgy	- Tars and other carbon-containing waste from anode production - Primary smelting slags/ white drosses (heavy metals) - Spent pot lining (cyanide compounds) - Salt slags from secondary smelting (inorganic fluoride compounds) - Black drosses from secondary smelting (heavy metals) - Flue gas dust (heavy metals) - Sludges from gas treatment (heavy metals)
Lead thermal metallurgy	- Slags from primary and secondary smelting (Pb, Cd. As, Cr, Hg, and other heavy metals) - Dross and skimmings (lead, antimony and other heavy metals) - Calcium arsenate - Waste sulphuric acid (from secondary smelting) - Flue gas dust and other particulates (heavy metals) - Sludges from gas treatment (heavy metals)
Zinc thermal metallurgy	- Slags from primary and secondary smelting (heavy metals) - Leaching residues, dust and sludges such as jarosite, hematite, etc - Dross and skimming from primary and secondary smelting (heavy metals) - Flue gas dust and other particulate

Industrial Sector	Waste type
Copper thermal metallurgy	- Slags from primary and secondary smelting - Dross skimmings from primary and secondary smelting - Waste from electrolytic refining - Flue gas dust and other particulates - Solid waste from gas treatment - Sludges from gas treatment
Metal treatment and coating of metals	- Cyanidic alkaline waste containing heavy metals - Cyanidic alkaline waste not containing heavy metals - Cyanide free waste containing chromium - Acidic pickling solutions - Waste acids and alkalis
Photographic industry	- Water based developer and activator solutions - Water based offset plate developer solutions - Solvent based developer solutions - Fixer solutions - Bleach solutions and bleach fixer solutions - Waste containing silver from on-site treatment of photographic waste - Single use cameras containing batteries
Electronic industry	- Chlorofluorocarbons - Halogenated solvents - Sludges or solid waste containing halogenated solvents - Sludges or solid waste containing other solvents
Coolants, foam/aerosil propellants industry	- Chlorofluorocarbons - Halogenated solvents and solvent mixes - Sludges and solid waste containing halogenated solvents or other solvents

In addition to the above types of waste, which are specific to the different industrial sectors, there are other types of hazardous waste that can be common to most industrial activities. These waste include:-

- ***Waste oils, fats and grease:***
  - Waste machining oils containing halogens
  - Waste machining oils free of halogens
  - Waste machining emulsions free of halogens
  - Synthetic machining oils
  - Hydraulic oils containing PCB, PCT
  - Insulating or heat transmission oils containing PCB or PCT
  - Chlorinated/ non-chlorinated insulating or heat transmission oils
  - Synthetic insulating or heat transmission oils
  - Brake fluids
  - Chlorinated/ non-chlorinated engine, gear and lubricating oils
  - Spent waxes and fats
  - Steam degreasing waste

- Oil/ water separators oils and sludges
- Oil/water emulsions

- ***Waste from packaging and empty containers:***
  - Packaging containing residues of/ or contaminated by hazardous substances

- ***Waste from absorbent, filter materials, wiping cloths and protective clothing***
  - Absorbents, filter materials, wiping cloths and protective clothing

- ***Discarded equipment and its components***
  - Transformers and capacitors containing PCBs or PCTs
  - Discarded equipment containing CFCs
  - Discarded equipment containing free asbestos

- ***Chemicals and gases in containers***
  - Waste containing inorganic/ organic chemicals, e.g. laboratory chemicals and fire extinguishing powder

- ***Batteries and accumulators***
  - Ni-Cd batteries
  - Mercury containing batteries
  - Electrolyte from batteries and accumulators

- ***Spent catalysts***
  - Spent catalysts containing dangerous transition metals or transition metal compounds
  - Spent catalysts containing phosphoric acid
  - Spent liquid used as catalysts

- ***Waste from specific physico/ chemical treatment of industrial waste (e.g. dechromation, decyanidation, neutralization)***
  - Metal hydroxide sludges

- ***Laboratory and research chemicals***
  - Expired chemicals
  - Reaction residues
  - Waste solvents
  - Waste acidic and alkaline solutions

- ***Waste from wastewater treatment plants***
  - Grease and oil mixtures from oil/water separation
  - Sludges from treatment of industrial waste water
  - Solutions and sludges from regeneration of ion exchange

- ***Expired chemicals***
  - Outdated chemicals
  - Off specification chemicals

Annex IV
Information to be Submitted for Acquiring a Hazardous Waste Permit

Information to be Submitted for Acquiring a Hazardous Waste Permit[1]

(Article 26, 27 - ER of Law 4/1994)

When applying for a hazardous waste handling permit, industrial establishments should provide the following information regarding their intended hazardous waste management practices:

Description	- Provide complete description of the types and composition of the used hazardous substances and the generated hazardous waste.
Quantity	- Determine the annual quantity of the used hazardous substances and the generated hazardous waste
Storage	- Describe the intended mean of HW packaging (barrels-tanks-etc.) - Describe the period and storage methods of hazardous substances and HW. - Be committed to clearly label the containers of hazardous substances and HW indicating the content and the actions taken in the case of emergency.
Transport	- Describe the intended modes of hazardous waste transportation, their routing and time schedule
Treatment	- Comprehensive description of the indented hazardous waste treatment and disposal methods.
Emergency plan	- Detailed description of the emergency plan in order to confront unexpected incidents - The plan should be reviewed and approved by the permit granting authority, the Ministry of Industry
Previous experience	- The establishment should provide documents for previous experience in handling of hazardous substances and waste
Commitments	- The industrial establishment should provide a written commitment to the following: - Not to mix hazardous substances and waste with other non-hazardous substances and waste. - Take all essential measures for proper packaging storage and transportation of hazardous waste. - Keep comprehensive records for such waste - Keep such documents for 5 years from after the date of establishment.
Declaration	- Provide a declaration of the correctness of the data stated above

[1] Guidelines for permitting are currently under preparations by EEAA.

Permits for handling hazardous substances and waste are valid for a maximum period of five renewable years. The permit can be suspended by the Ministry of Industry by justified decision in the following cases:

1. If the permit has been issued upon the submission of incorrect information.

2. If the party who has been granted the permit has violated its conditions.

3. If an activity results in severe adverse impacts which were not foreseen at the time of permit issuance.

4. If new technologies become available, that may if implemented with minor modification, can result in further improvement in the environmental conditions and human health.

5. If EEAA concludes that it is unsafe to handle the hazardous substances and waste stated in the permit.

Annex V
Waste Compatibility

Examples for Waste Compatibility

No.	Reactivity Group Name
1	Acids, Mineral, Non-oxidizing
2	Acids, Mineral, Oxidizing
3	Acids, Organic
4	Alcohols and Glycols
5	Aldehydes
6	Amides
7	Amines, Aliphatic and Aromatic
8	Azo Compounds, Diazo Compounds and Hydrazines
9	Carbamates
10	Caustics
11	Cyanides
12	Dithiocarbamates
13	Esters
14	Ethers
15	Fluorides, Inorganic
16	Hydrocarbons, Aromatic
17	Halogenated Organics
18	Isocyanates
19	Ketones
20	Mercaptans and Other Organic Sulfides
21	Metals, Alkali and Alkaline Earth, Elemental
22	Metals, Other Elemental & Alloys as Powders, Vapors, or Sponges
23	Metals, Other Elemental & Alloys as Sheets, Rods, Drops, etc.
24	Metals and Metal Compounds, Toxic
25	Nitrides
26	Nitriles
27	Nitro Compounds, Organic
28	Hydrocarbons, Aliphatic, Unsaturated
29	Hydrocarbons, Aliphatic, Saturated
30	Peroxides and Hydroperoxides, Organic
31	Phenols and Cresols
32	Organophosphates, Phosphothioates, Phosphodithioates
33	Sulfides, Inorganic
34	Epoxides
101	Combustible and Flammable Materials, Miscellaneous
102	Explosives
103	Polymerizable Compounds
104	Oxidizing Agents, Strong
105	Reducing Agents, Strong
106	Water and Mixtures Containing Water
107	Water Reactive Substances

Legend	
Code	Consequences
H	Heat Generation
F	Fire
G	Innocuous and non-flammable gas generation
GT	Toxic Gas formation
GF	Flammable Gas formation
E	Explosion
P	Violent Polymerization
S	Solubilization of toxic substance
U	May be hazardous, but Unknown

Source: EPA's Chemical Compatibility Chart EPA-600/2-80-076 l 1980, US Environmental Protection Agency

Annex VI
Hazard Signs

Hazard Signs

Explosive

Flammable Liquids

Flammable Solids

Spontaneously Combustible

Dangerous when Wet

Oxidizing

Organic Peroxides

Corrosive

Toxic

Infectious

Annex VII
Common Hazardous Waste Treatment Methods

Common Hazardous Waste Treatment Methods

Option	Description	Application
Physical treatment		
Sedimentation	- It is a process relying upon gravity to remove suspended solids from aqueous waste streams. It can be carried out in lined impoundments, conventional settling basins or clarifiers.	- applied to remove suspended solids heavier than water. - as a pretreatment step for many chemical processes.
Solvent Extraction (liquid-liquid extraction)	- It is the separation of impurities of a liquid by contact with another immiscible liquid for which the impurities have high affinity.	- recovery of phenol from aqueous wastes. - recovery of halogenated hydrocarbon solvents from organic solutions containing other water-soluble components.
Ion Exchange	- It is a process in which ions, held by electrostatic forces on the surface of a solid, are exchanged for ions of similar charge in a solution.	- removal of dissolved heavy metals in wastewater such as chromium, zinc, lead, etc.
Physical Stabilization/ Solidification	- Physical stabilization: involves blending semi-solid waste with a bulking agent to produce a coarse-grained solids that can be transported. - Solidification: is the production of a solid mass with sufficient structural integrity suitable for transport without requiring secondary containers	- to convert hazardous waste streams into inert, physically stable mass with low leachability and sufficient mechanical strength to be suitable for landfilling.
Chemical treatment		
Precipitation/ flocculation	- It is a physicochemical process based on alteration of chemical equilibrium affecting the solubility of inorganic substances. - The dissolved substances	- removal of metals (zinc, cadmium, chromium, copper, lead, etc.) from wastewater in form of metal hydroxides or sulfides, usually using lime or sodium sulfides.

Option	Description	Application
	is transformed into a solid phase.	

Option	Description	Application
Chemical oxidation	- Oxidation involves electron transfer from the substances being oxidized to the oxidizing agents.	- facilitates the complete breakdown of hazardous waste into non-hazardous components. - oxidation of cyanide effluents, phenols, etc cyanide solution - the used oxidizing agents include potassium permanganate, ozone, chlorine hydrogen peroxide, UV radiations, etc.
Chemical reduction	- Reduction involves electron transfer from the reducing agent to the substances being reduced	- reduction of hexavalent chromium to the trivalent chromium before carrying out hydroxide precipitation.
Neutralization	- It is the process of adjusting an acidic or basic waste stream to a pH near neutrality.	- precipitation of dissolved heavy metals. - providing neutral pH solution suitable for recycling. - used in oil emulsion breaking.
Chemical Stabilization/ Solidification	- Chemical stabilization: is the immobilization of hazardous substances by reacting them chemically to form insoluble compounds. - Solidification: is the production of a solid mass with sufficient structural integrity suitable for transport without requiring secondary containers.	- to convert hazardous waste streams into inert, physically stable mass with low leachability and sufficient mechanical strength to be suitable for landfilling.
Biological treatment Sludge Processing	- It is the treatment of sludge resulting from wastewater treatment processes. The process involves sludge conditioning, digestion (aerobic/ anaerobic) and composting.	- recycling: such that sludge quality is suitable for the reuse system (eg. land application). - disposal: in order to reduce the volume of sludge prior disposal.
Treatment of Oily waste	- it is the process of oil removal through skimming, emulsion	- separation of oily waste from cleaning operation, machinery maintenance,

	breaking, flotation, etc.	washing or rinsing of oily parts, spills and leaks, etc.

Option		Application
Thermal Treatment	- It is a high temperature, thermal oxidation process in which hazardous waste is converted, in the presence of oxygen, into gases and/or incombustible solid residues. Incineration is accompanied by significant reduction in the weight and volume of waste. - The product gases can be released to the atmosphere with or without cleaning and the solid residue can be landfilled.	Incineration is chosen for - biologically hazardous waste - non-biodegradable and persistent waste - volatile dispersible waste - waste with flash point below 40^0C - for cyanide and sulphide bearing waste

Annex VIII
Model for Hazardous Waste Register

Model for Hazardous Waste Register

Instruction for filling in the register

1. This is a register where the generated HW is to be recorded.

2. A designated person should be responsible for filling the register. His name and position are to be stated in points 3 and 4 of section I.

3. The time period covered by the current data (point 5, section I), is that time period for which the hazardous waste data provided in section II and III are valid.

4. The frequency for filling in this register depends on the amounts of hazardous waste generated. As guidance, it is recommended that this register is filled quarterly and kept for a period of 10 years.

I) General Information:

1. Name of the Establishment: …….....

2. Name of owner of the Establishment*……..

3. Address:…….……..Tel*:……

District*:..……Governorate*…….

4. Name of the person responsible for filing the register:

…….……...……..

5. Job title of the person responsible for filing the register:

…….…….

6. The period covered by the current data:
……..……...……..…….

7. Specific conditions issued for the establishment by EEAA: (attach where applicable)
……..……..….

8. Date on which the form is filled: ……...……..

9. Signature of the officer in Charge: ……...……...…..

* These information are not explicitly required by article 33 of ER regarding requirements of the HW register

II) Types and Quantities of Generated Hazardous Waste:

Type of hazardous Waste	Generating Process	Quantity[2]	Waste Composition*	Physical Status*

III) Methods of Hazardous Waste Disposal:

Type of Hazardous Waste	Quantity Disposed of	Disposal Method	Name of waste contractor where applicable

IV) Licensed HW Contractors to Receive Waste:

Name of Contractor	Type of license (off-site treatment/ disposal)	Types of Waste delivered	Quantity delivered

[2] The quantity is given for the time period stated in point 5 section I.

Annex IX
Case Study for Industrial Hazardous Waste Minimization

Case Study for Industrial Hazardous Waste Minimization: Sulphur Black dyeing in Textile Industry [3]

Background

Sulphur dyes are mainly used for dyeing cotton, rayon and cotton-synthetic blends. These dyes are widely used throughout Egypt as it is a low cost dye and exhibits excellent wash, good light fastness, good covering properties and durability. Sulphur black dyes are converted from the insoluble state into the water soluble state using a reducing agent such as sodium sulphide in order to be easily absorbed. Once absorbed, the dye needs to be reconverted to the insoluble state to fix on the fabric. This is carried out through oxidation using acetified chromate (usually potassium or sodium dichromate).

Problem Description

The adverse aspects of sluphur black dyeing result from the use of both sodium sulphide (skin irritant, can cause eye injuries, and corrosive substance) and the dichromate solution (chromium VI which can cause cancer, and chronic irritation of the respiratory track) which may leave harmful residues on the fabric and generate effluents that are damaging to the environment.

The Scheme

A demonstration project was implemented at El Nasr Company for Spinning and Weaving in Mahalla, for the minimization of such hazardous effluents at source The size of the problem and pollution prevention opportunities were identified through industrial audits.

The minimization measures implemented entailed substituting the hazardous sodium sulphide and potassium dichromate by less harmful substances, while retaining the quality of the dyeing process. Possible sodium sulphide substitutes included glucose, dextrose, dextrine and hydrol. Acidified Dichromate substitutes included hydrogen peroxide, sodium perborate, ammonium persulphate and potassium iodate. Selection of the most suitable substitutes was based on laboratory trials to determine the optimum combination of the substitutes.

Sodium perborate and glucose were found acceptable as substitutes for dichromate and sodium sulphide respectively. This was mainly due to their reasonable costs as well as their good operation results.

Costs and Benefits

The benefits of this schemes were associated with process optimization, entailing no major capital costs for implementation. An overall saving of 2 to 16 % for all consumable materials has been achieved for each ton of fabric, compensating the limited increase in the overall costs of chemicals used in the process. In addition elimination of sodium sulphide and acidified dichromate resulted in significant decrease of their concentrations in the generated effluents.

[3] Textile Sector Report (1999), Sulphur Black Dyeing: A Cleaner Production Approach, Egyptian Environmental Affairs Agency and SEAM.

The following Table summarizes the effluent characteristics before and after implementation of this waste minimization scheme.

Effluent Characteristics from the End of the Dyeing Line

Concentration (mg/l)	*Grey dyeing*		*Black Dyeing*	
	Before	**After**	**Before**	**After**
Sulphide	68	1	117	2.5
Chromium VI	26	nil	27	Nil