



CHAPTER – I
INTRODUCTION

One of the ugly faces of industrialization is generation of large quantity of solid and hazardous wastes which need to be managed in an environmentally sound manner. Such wastes maybe generated as a by-product in the manufacturing processes (which is subsequently separated during various purification processes) or maybe generated from the use of various media / catalysts which need to be disposed off when spent / exhausted. The waste thus contains part of the raw materials used / intermediates produced in the process which may be toxic, flammable, corrosive, reactive, explosive in character. Due to presence of these constituents, the disposal of such waste always poses hazards to human health and environment.

Till the early eighties, the regulations governing environmental pollution in the country were the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974. Growing urbanization and rapid industrialisation forced the National Policy Makers look at the other environmental hazards of development. This resulted in the enactment of an umbrella legislation “The Environment (Protection) Act, 1986” which provides the Government wide ranging powers to enact rules to deal with various issues concerning environmental protection. Various Rules were enacted under Environment (Protection) Act to address specific issues such as The Noise Pollution Regulation and Control Rules, 2000, Hazardous Waste Management and Handling Rules, 1989, The Municipal Solid Waste Management and Handling Rules, 1989, The Manufacture, Use, Import, Export Storage of Hazardous Micro Organisms, Genetically Engineered Organisms or Cell rules, 1989 and whole gamut of Rules to govern Hazardous Chemicals Manufacture, Use and Storage, Chemical Accidents etc.

The Hazardous Waste Management and Handling Rules were enacted first in the year 1989. These rules classified hazardous wastes into 18 categories in its Schedule-1 based on constituents present. The Government of India amended the Rules in the year 2000 (principally to bring them in compliance with Basel



convention) and further in the year 2003 (to include Environmentally Sound Technologies for recycle of Hazardous Waste). These amended Rules brought in following basic modifications with respect to definition of wastes:

- Identified the types of hazardous wastes likely to be generated from different industrial processes. Such wastes are listed in Schedule-1 and are deemed as 'hazardous' irrespective of constituents / concentrations.
- Identified concentrations of constituents of wastes in Schedule – 2 (sub-categories A - E). Wastes which are not covered in Schedule – 1 are to be classified 'hazardous' only if they exceed the threshold concentration limits given in Schedule-2.

In response to a Public Interest Litigation filed by Research Foundation for Science, Technology and Natural Resource Policy (W.P.No. 657 of 1995), Honorable Supreme Court passed a judgment dated 28.10.2003, directing each State Pollution Control Board to prepare a detailed inventory of Hazardous Waste generation in their state and submit the same to CPCB. Maharashtra has large number of industries generating hazardous waste. The range of industries includes dyes, drugs, pesticides, textiles, chemicals and petrochemicals, metallurgical, automotive and engineering etc. Looking at the enormity of the job of preparation of Hazardous Waste Inventory for the entire state, Maharashtra State Pollution Control Board realised that the job of inventorisation of hazardous waste, particularly from chemical industries, requires good knowledge of process chemistry and chemical manufacturing technology. Hence, it was decided to outsource the work to the experts processing requisite background. Considering the changes in categories of the Amended Rules and in order to ensure compliance to order of the Supreme Court, dated 14.10.2003, inventorisation of Hazardous Waste was taken up by the Board in February 2004. The work was completed in May 2005 and report submitted to the CPCB. This is final report.

1.1 Past Inventorisation Efforts (based on 1989 Rules) :

The Hazardous Waste Management and Handling Rules, 1989, identified 18 categories of wastes in Schedule – 1 (reproduced in **Table 1.1**).



Table 1.1

Category of Hazardous Waste as per Schedule – 1 of HW Rules, 1989

Waste Category No. 1	Cyanide Waste	1 kilogrammes per year calculated as Cyanide
Waste Category No. 2	Metal Finishing Waste	10 kilogrammes per year the sum of the specified substance calculated as pure metal
Waste Category No. 3	Waste containing water soluble chemical compounds of Lead, Copper, Zinc, chromium, Nickel, Selenium, Barium & Antimony.	10 kilogrammes per year the sum of the specified substance calculated as pure metal
Waste Category No. 4	Mercury, Arsenic, Thallium and Cadmium bearing wastes.	5 kilogrammes per year the sum of the specified substance calculated as pure metal.
Waste Category No. 5	Non-halogenated hydrocarbons including solvent.	200 kilogrammes per year calculated as non-halogenated hydrocarbons.
Waste Category No. 6	Halogenated hydro-carbon including solvents	50 kilograms per year calculated as halogenated hydrocarbons.
Waste Category No. 7	Wastes from paints, pigments, glue, varnish and printing ink.	250 kilogrammes per year calculated as oil or oil emulsions.
Waste Category No.8	Wastes from Dyes and Dye intermediate containing inorganic chemical compounds.	200 kilogrammes per year calculated as inorganic chemicals.
Waste Category No. 9	Wastes from Dyes and Dye intermediate containing organic chemical compounds.	50 kilogrammes per year calculated as organic chemicals.
Waste Category No. 10	Waste oil and oil emulsions.	1000 kilogrammes per year calculated as oil and oil emulsions.
Waste Category No. 11	Tarry wastes from refining and tar residues from distillation or prolytic treatment.	200 kilogrammes per year calculated as tar
Waste Category No. 12	Sludge arising from treatment of waste waters containing heavy metals, toxic organics, oils emulsions and spend chemical and incineration ash.	Irrespective of any quantity.
Waste Category No. 13	Phenols.	5 kilogrammes per year calculated as phenols.
Waste Category No. 14	Asbestos.	200 kilogrammes per year calculated asbestos.



Waste Category No. 15	Wastes from manufacturing of pesticides and herbicides and residues from pesticides and, herbicides formulation units.	5 kilogrammes per year calculated as pesticides and their intermediate products.
Waste Category No. 16	Acid/Alkaline/Slurry	200 kilogrammes per year calculated as Acids/Alkalies.
Waste Category No.17	Off-specification and discarded products.	Irrespective of any quantity.
Waste Category No.18	Discarded containers and Containers liners of hazardous and toxic wastes.	Irrespective of any quantity.

In the year 1995, in response to the PIL filed by Research Foundation for Science Technology and Natural Resource Policy (W.P. No. 657 of 1995) the Supreme Court directed MPCB to prepare an Inventory of hazardous waste generation through NEERI. However, the Inventory prepared by NEERI was found to be inadequate in many respects and was rejected by MPCB. The MPCB then asked its own officers to obtain authentic data from Industries (by getting declarations on stamp paper and by visiting industrial units) and prepare own inventory of Hazardous Waste Generation in the State. The Hazardous Waste Inventory for Maharashtra State was thus prepared in 1996-97 and submitted to the Honorable Supreme Court. The findings of the same are summarised in **Table 1.2** and **Table 1.3**.

Table 1.2
Findings of Hazardous Waste Inventory – 1996-97
(carried out by MPCB Officers)

Number of Districts	33
Districts having Hazardous Waste Generation	33
No. of units generating Hazardous Waste	3,953
Quantity of Hazardous Waste Generated (TPA)	
▪ Recyclable	8,47,436 TPA
▪ Incinerable	5,012 TPA
▪ Landfillable	11,55,398 TPA
Total	20,07,846 TPA



Table 1.3
Quantity of Waste Generated Category Wise
(as per HW Rules 1989)

Waste Category No.	Waste Category (*)	Quantity (TPA)
1	Cyanide Waste	3,394
2	Metal Finishing Waste	7,156
3	Waste containing water soluble chemical compounds of Lead, Copper, Zinc, chromium, Nickel, Selenium, Barium & Antimony.	11,708
4	Mercury, Arsenic, Thallium and Cadmium bearing wastes.	2,821
5	Non-halogenated hydrocarbons including solvent.	6,930
6	Halogenated hydro-carbon including solvents	2,413
7	Wastes from paints, pigments, glue, varnish and printing ink.	5,672
8	Wastes from Dyes and Dye intermediate containing inorganic chemical compounds.	27,775
9	Wastes from Dyes and Dye intermediate containing organic chemical compounds.	29,595
10	Waste oil and oil emulsions.	14,778
11	Tarry wastes from refining and tar residues from distillation or pyrolytic treatment.	4,900
12	Sludge arising from treatment of waste waters containing heavy metals, toxic organics, oils emulsions and spend chemical and incineration ash.	16,51,972
13	Phenols.	7,768
14	Asbestos.	239
15	Wastes from manufacturing of pesticides and herbicides and residues from pesticides and, herbicides formulation units.	2
16	Acid/Alkaline/Slurry	21,761
17	Off-specification and discarded products.	1,52,540
18	Discarded containers and Containers liners of hazardous and toxic wastes.	56,422
	Total	20,07,846

However, the following observations are made with respect to the above inventorisation effort.



- The Inventory was prepared hurriedly.
- The data was based solely upon the information submitted by the industry to the MPCB and / or upon the personal judgment with limited knowledge of industrial processes. Due to this, number of discrepancies were observed in the data.
- The inventories were based upon the definition of hazardous waste as provided in 1989 HW Rules. There were ambiguities in the waste categories identified in these Rules. Explanations were not readily forthcoming which brought in subjectivities in the quantification of waste. This led to inclusion of large quantities of high volume low toxic waste such as phosphor-gypsum, red mud, slags from iron and steel and ferro-alloy industry, ETP sludges (biological) etc.

In October, 1997, Honorable Supreme Court of India passed an order to set up a High Power Committee to look into the entire gamut of issues pertaining to HW generation, import, treatment and disposal in India. In order to gain a realistic idea of the nature and quantum of hazardous wastes generated within the country, the High Power Committee sought status reports in 3 specific areas from each state :

- a) Number of units involved in generation / handling of hazardous waste and covered under HW Rules 1989.
- b) Nature of wastes handled
- c) Quantities of hazardous waste generated

Ideally, the data in (b) and (c) above could have been available had the industrial unit been authorized and had disclosed the correct data regarding nature and quantities of waste generated / handled or disposed off or had maintained the records as per Form 3. However, it was observed by the HPC that information submitted by industries was lacking and no records were maintained in Form 3. The High Power Committee also noted that the Boards are experiencing difficulties in making inventories of hazardous wastes due to lack of technical expertise and that ambiguity in the definition of wastes in certain categories had brought in subjectivity in quantification of the wastes.



Thus, the High Power Committee in its Report to the Honorable supreme Court of India noted that it could not rely on the sporadic efforts undertaken in the country to inventorise hazardous wastes generated and lamented that there were no authentic figures available on the hazardous waste generation in the states even after 10 years of passage of the Hazardous Waste Management Handling Rules.

The Honorable Supreme Court of India, in its judgment dated 28.10.2003 directed the Boards to take –up the inventorisation of hazardous waste generating industries (as per amended HW Rules 2003) and furnish report to Central Pollution Control Board.

1.2 Scope of Work :

Maharashtra Pollution Control Board identified following scope of work :

- To evaluate information available in Maharashtra Pollution Control Board files/records for each industry and assess waste generation from these industries. Also undertake field visits for verification wherever required.
- To identify waste generation based on the study of manufacture process.
- To identify waste category as per Schedule –1/2 of Hazardous Waste Management Rules 2003.
- To assess quantum of waste generated from each unit.
- To identify disposal options most suited for the types of waste generated.
- To present the report to Maharashtra Pollution Control Board.

1.3 Methodology :

In order to complete the assignment as per identified scope, given by Maharashtra Pollution Control Board, team was formulated under the leadership of Dr. P.V. Arur (Rtd. General Manager – Technical, H.O.C. Ltd.) It was felt that, in order to prepare a comprehensive hazardous waste inventory,



the issue should be looked in all its dimensions. Thus, the following sources of Hazardous Waste were identified :

- Industries
- Common Effluent Treatment Plants
- Non-industrial sources such as service stations, ports, docks, battery recyclers etc
- Waste lying inside/outside factories & MIDC areas in temporary storage/ illegal dumps etc (as one time generation)

1.3.1 Treatment / Disposal options for Hazardous Wastes :

Prior to beginning the detailed process studies, the HW streams identified in Schedule -1 & Schedule – 2 of HW Rules, 2003, were reviewed. The best treatment / disposal options for each hazardous waste streams identified in the Schedules were designated. **Annexure I & Annexure II** lists the treatment / disposal options for Schedule -1 & Schedule – 2 HW streams respectively.

1.3.2 Industrial Sources :

All manufacturing units are covered under consent / authorization procedure. Information pertaining to their current production, raw material usage and effluent treatment practices etc is available with the Board. Industry has to inform quantity and quality of hazardous waste generation while applying for Consent. They need to maintain registers in Form 3 for record on treatment and disposal of hazardous waste. Annual returns are also required to be submitted in Form 4.

The survey team examined following documents :

- Copies of consent / Authorisation granted by Maharashtra Pollution Control Board
- Consent applications filed by Industries
- Applications for authorization filed by Industries
- Other information such as manifest copies / process details etc available with the MPCB.

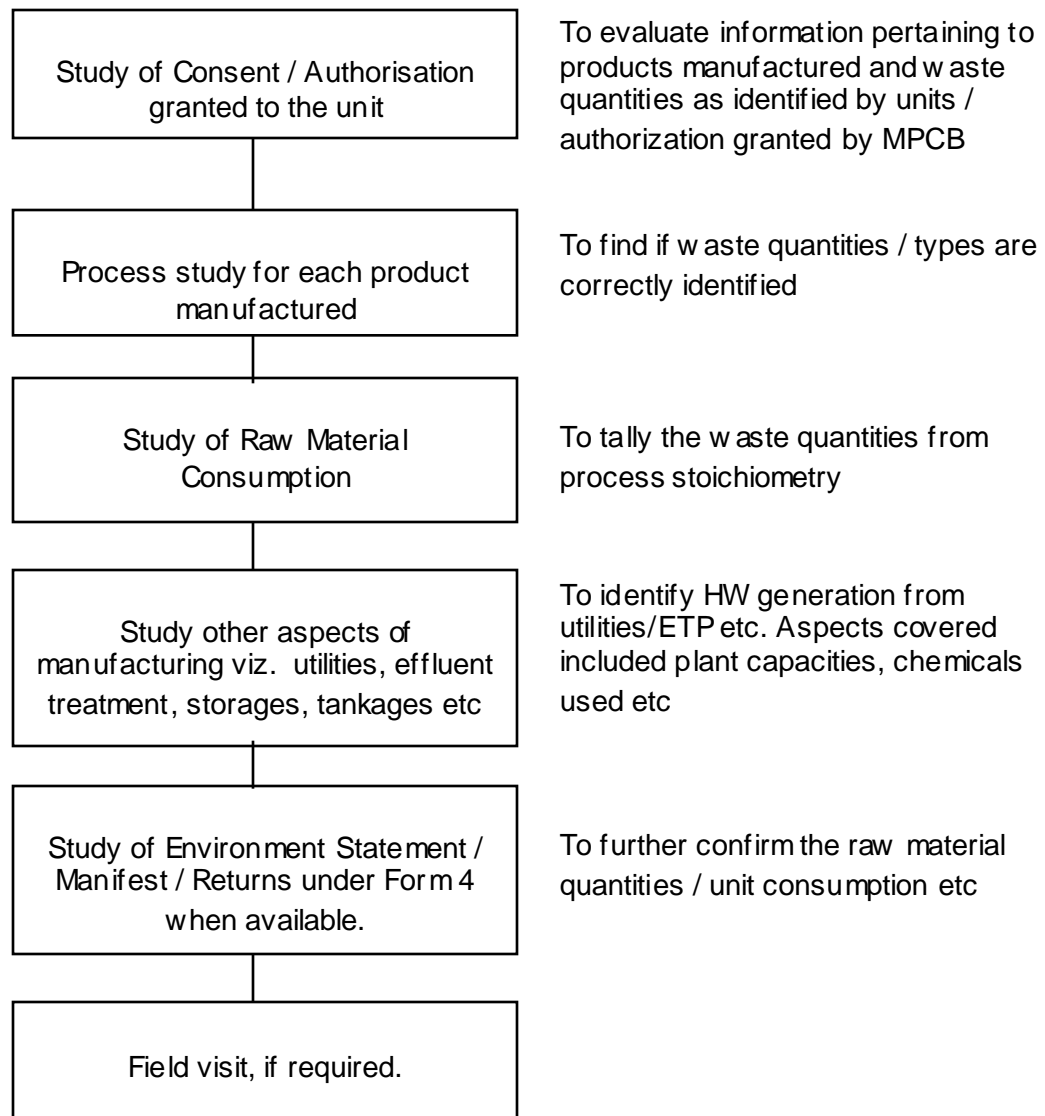


Whenever required field visits were also done.

The survey team consisted of fourteen persons with four Team Leaders having background in chemical engineering / industrial processes. The approach adopted for inventory is presented in **Fig. 1.1**. The format used for data collection is presented in **Annexure – III**.

Fig. 1.1

Approach Adopted for Preparation of Inventory of HW Generation from Industrial Sources





1.3.3 Common Effluent Treatment Plants :

Common Effluent Treatment Plants (CETPs) have been set-up in many industrial estates, to treat the effluents from various small, medium, large units. Although most of the large / medium units have provided effluent treatment facilities, small units have provided only primary treatment facilities. Also, the effluent treatment facilities provided by large / medium units may not lead to desired treated effluent quality. This results in the combined effluent not meeting the prescribed standards and hence poses environmental risk. Hence, the concept of CETP was mooted by MIDC / MPCB as a second line of defence before discharge of industrial effluents into natural water bodies.

The CETPs were evaluated by studying their design characteristics, the effluent characteristics at the inlet, their chemical consumptions and the various treatment units provided.

1.3.4 Non-Industrial Sources :

Various non-industrial sources identified include the following :

**Table 1.4
Non Industrial Sources of Hazardous Wastes**

Source	Type of Hazardous Waste
Service stations / garages / workshops	Used lubricating oil, greases etc
Power generation, transmission, distribution	Transformer oil
Ports	Waste oil / sludge / bilge from ships
Airports	Used / waste oil from aircraft servicing
Storage battery recyclers	Lead containing waste



The methodologies / approach adopted to collect information pertaining to each of these sources is as given below :

1.3.4.1 Service Station / Garages / Workshops :

It is observed that these are in two categories viz organised and unorganised sector. Service stations / garages / workshops in organised sector are set up by

- Fleet Owners (eg. Municipal transport companies / state transport corporation / private fleet owners)
- Automobiles companies
- Attached to retail outlet of petroleum companies

The data on these sources were gathered as follows :

- Inventory of number of service station spread across the State
- Getting information pertaining to number of vehicles serviced, oil sold, water used etc from some of these stations in order to arrive at an estimate of total hazardous waste generation from these sources

The formats prepared for obtaining information in respect of the above are presented as **Annexure – IV, V & VI** respectively.

1.3.4.2 Power Generation / Transmission / Distribution :

Transformers and capacitors used in power generation, transmission and distribution use oils. Power generators in the State include BSES / Tata Thermal, MSEB and some private industries having Captive Power Plants. Those engaged in Transmission and Distribution include BSES, MSEB, BEST and Tata Power company. The generation sources were covered during industrial inventory preparation while information pertaining to waste oil generation from the transmission and distribution sections were collected subsequently using formats presented in **Annexure – VII**.



1.3.4.3 Ports / Docks :

Mumbai is one of the oldest port in India and has large facilities for passenger / cargo handling. The Jawaharlal Nehru Port was also developed near Mumbai to ease congestion in Mumbai Port.

The ports have different sources of hazardous waste generation as under :

- Oily sludge, bilge and furnace oil sludge from the ships for which facilities have to be provided by the Ports as per International Convention for Marine Pollution Prevention (MARPOL).
- Automotive lube and system oil due to use of large number of material handling equipments to handle cargo
- Ship breaking activity carried out to a small extent within the port.
- Unclaimed / unsold chemical cargo which poses disposal problems to authorities.

Thus, different types of wastes get accumulated in the Ports and have to be disposed off in environmentally sound manner. Format used for data collection from Ports is presented in **Annexure - VIII**.

Mazgaon Docks at Mumbai is a major Ship building / Ship repair facility. The Indian Navy also has a Ship Repair facility in Mumbai. Format used for data collection from Docks is presented in **Annexure – VIII**.

1.3.4.4 Airports :

Mumbai is a major International Airport catering to nearly all International traffic from Southern / Western Maharashtra. It has a peak frequency of flight take off / landing once every four minutes. Other important airports in Maharashtra include Pune / Nagpur / Nashik / Kolhapur and Aurangabad.

Of these, only Mumbai airport has hangers for servicing of aircrafts. Both private and Government owned aircrafts are serviced in Mumbai. Format used for data collection from these facilities is presented in **Annexure – IX**. The formats were sent to both Private and Government owned air travel companies



and information pertaining to waste generation was collected from them.

1.3.4.5 Battery Recyclers :

Storage batteries are collected from many sources – industrial / non-industrial sources including commercial offices, hospitals, residences etc. The used batteries are many times recycled by automotive electrical repair shops and specialists in battery servicing / repairs. It was observed that large number of unorganized sector battery recyclers still exist in spite of best efforts of MPCB to get them registered. Information regarding number of batteries recycled was collected by MPCB officials through primary survey. Estimation of waste generation by this activity is based on information provided by MPCB.

1.3.5 Waste Lying in Factories / Illegal Dumps etc :

Maharashtra has one Common Hazardous Waste Treatment, Storage and Disposal (CHWTSDF) facility at Taloja in District Raigad and another in TTC Area. Prior to setting up of Taloja facility, numbers of illegal dump sites were created in the State. As part of Supreme Court Directive, Maharashtra Pollution Control Board has prepared an inventory of such illegal hazardous waste dump sites in MIDC area in the State. Inventory of hazardous waste sites outside MIDC areas is under progress. After enactment of the HW Rules, few industries had created on-site disposal / temporary storage facilities for hazardous waste. Information regarding temporary storages inside industrial premises was collected during inventorisation studies. An estimate of waste stored in above sites / facilities was made by undertaking site visits and used to arrive at an estimate of quantity of stockpiled hazardous waste. Also, lot of sludge is found to be accumulated in Effluent, collection pit of CETP's. Estimates of sludge accumulated in collection pit of CETP's have been made jointly with MIDC.

Needless to say, this will be a one time estimate of waste quantity needing safe / proper disposal (as no further waste is being allowed to be disposed off or accumulated at such illegal dump sites and within factory premises now). These quantities are not considered in the quantities of hazardous wastes in the inventory prepared. However, estimates of quantities & status of disposal of



such wastes has been independently mentioned in Chapter V of the Report.

1.4 Observations made while conducting the studies :

The following observations were made while scrutinising consent applications made by industries :

- There are many units with a diverse product range eg. engineering units also manufacturing chemicals, paints, solvents etc. In some cases, these are governed under one consent while some units have different consents for different products.
- Number of units have included in its product list, large number of products on the premise that they are batch processes which could take-up manufacturing of any of the products based on market demand. This was particularly evident in chemical / drug manufacturing.
- Several units have obtained additional consents for
 - Their expansion activities
 - Addition of products in existing plants
 - Completely new product range
- Many units had applied for and have been granted consent without mentioning product quantities i.e. on an “as per order” basis. Such units had also not given any raw material consumption details. This was particularly observed in case of engineering, metal finishing and bulk drug units. This created difficulties in ascertaining waste quantities from these units.

Following observations were made regarding documentation in MPCB offices :

- In units where multiple products are manufactured, it was seen that the details regarding process, raw material consumption were not available for all the products but only a select few – this resulted in delays in compilation of waste quantity as the requisite details had to be specifically called from concerned industry.
- While consent applications are filed with the Regional Offices, documents such as Environment Statement, Manifest for Hazardous



Waste transport are filed with Head Office. Thus, all details are not available in the Regional Office file for cross verification.

1.5 Limitations of Present Inventory :

- This inventory is based upon best understanding of the processes as per details provided by industry.
- This inventory is based primarily upon secondary information as available in Maharashtra Pollution Control Board records. In the given timeframe it was not possible to visit each individual industry for clarification / process study. However, wherever gross errors were observed in the data submitted to MPCB discussions were made/site visits undertaken to, the concerned industry to submit required information.
- The inventory is based upon process related information, assuming production of all products mentioned in the consent at maximum capacity.
- The waste quantity estimates are given on 'dry' basis.
- While preparing the inventory, only those files having valid papers (consent documents/visit reports etc) as of year 2000 and on wards were taken up for detailed study.
- Some industries have been granted longer duration Consent (15 year term) by the MPCB. Hence, data / information presented by these industries was found to be lacking w.r.t. current legislation / requirements (MPCB has already taken up this matter on a war footing and industries with 15 year consents have been asked to submit fresh application and obtain new Authorisations / consents).