

## **PREFACE**

The Hon'ble Supreme Court of India is considering a Public Interest Litigation regarding management of hazardous wastes in India (Reference: CWP No. 657 of 1995). In October 1997, a High-Powered Committee (HPC), with Prof. M.G.K. Menon as its Chairman, was constituted to examine all matters in depth relating to hazardous waste and to give a report and recommendations on the fourteen Terms of Reference (ToR). The HPC submitted its final report in January 2001. The Hon'ble Court considered the report and passed a detailed and comprehensive order on 14.10.2003. This included, among other things, several directives to be implemented in a time-bound manner by various authorities / agencies involved in regulation and management of hazardous wastes.

**The Central Pollution Control Board (CPCB) was asked, vide afore-referred directive mentioned at serial number 24, to issue guidelines to be followed by all concerned including SPCBs / PCCs and the operators of the hazardous waste disposal sites for the proper functioning and upkeep of the said sites.**

**Accordingly, Dr. D.B. Boralkar, Senior Scientist in CPCB, presently on deputation as Member Secretary, Maharashtra Pollution Control Board, and Shri Tishya Chatterjee, former Member Secretary, Andhra Pradesh Pollution Control Board, prepared a draft document. Dr. B. Sengupta, Member Secretary, CPCB reviewed the draft document before wide circulation among the concerned agencies. Comments/suggestions for improvement were welcome by June 2004.**

**The present document is the finalized version of the afore-referred document incorporating the suggestions and comments received from various agencies, wherever deemed appropriate.**

**Contributions made by Dr. D.B. Boralkar, Shri Tishya Chatterjee, and Dr. B. Sengupta, in the preparation of the draft document are gratefully acknowledged.**

**Dr. S.P. Chakrabarti, Former Member Secretary, CPCB, finalized the report in association with Mr. N.K. Verma, Additional Director and Mr. J. Chandra Babu, Assistant Envi. Engineer.**

August 2004

(Dr. V. Rajagopalan)  
Chairman

## Chapter 1

### INTRODUCTION

**The Hazardous Wastes (Management & Handling) Rules, 1989, as amended, requires that the State Pollution Control Board (SPCB)/ Pollution Control Committee (PCC) shall grant authorization to the operator of a facility based on technical capability of the proponent. In order to facilitate implementation of the Rules, the Ministry of Environment and Forests (MoEF) and the Central Pollution Control Board (CPCB) have published several documents. These are:**

1. Guidelines for management of hazardous waste (MoEF, 1992)
2. Guidelines for setting up of operating facility: Hazardous waste management (CPCB document: HAZWAMS/11/1998-99)
3. Ready Reckoner: Hazardous waste **management** (HAZWAMS/12/ 1998-99)
4. Criteria for hazardous wastes landfills, HAZWAMS/17/2000-01
5. Manual for design, construction and quality control of liners and covers for hazardous waste landfills, HAZWAMS/20/2002-03

**The States of Andhra Pradesh, Maharashtra and Gujarat have promoted development of common facility in the private sector, for management of hazardous wastes in an environmentally sound and techno-economically viable manner. The services of treatment, storage and disposal facility (TSDF) are particularly useful for the hazardous waste generating units not only in the large category of industries but also for small & medium enterprises (SMEs), who on their own may not afford and are unable to provide on-site facility for proper disposal of hazardous wastes.**

It is expected that more TSDFs would come up in **the** future to cater to **the** need **for** management of hazardous wastes in other States/UTs. These TSDFs are required to comply with the provisions under the Hazardous Waste (Management & Handling) Rules [**HW(M&H)**] and guidelines issued by MoEF and CPCB from time to time. It is, therefore, necessary to bring about certain guidelines for facilitate the regulatory compliance by the TSDF operators.

The guidelines aim at establishing the standards, which define the requirements for management of hazardous wastes (**HW**) at TSDF operating in the State. **These guidelines shall apply to the generators of HW and the operators of the TSDF facilities.**

Following aspects have been illustrated in this document:

- Definition of hazardous wastes for TSDF
- Methodology for classification, identification and characterization of hazardous wastes
- Operating procedures for **TSDF**
- Requirements for handling, collection and transportation of hazardous wastes
- Applicable standards for compliance of regulations

- Additional information on regulatory requirements for managing hazardous wastes

## Chapter 2

### IDENTIFICATION/CHARACTERIZATION OF HAZARDOUS WASTES

- 2.1 Regulatory definition of hazardous wastes as given in the Hazardous Wastes (Management & Handling) Rules, 1989, and further amendments made there under, is reproduced below:

#### *Hazardous Wastes*

Hazardous wastes (*HW*) have been defined (Appendix) to include:

- a) Wastes, which are generated in the process, indicated in Column-2 of Schedule - 1, and consist of wholly or partly of the waste substances, referred to in Column-3 of the same schedule
- b) Wastes, which consist wholly or partly of substances indicated in Schedule-2 if the concentration of the substances is equal to or more than the limit indicated in the same schedule, and
- c) Wastes indicated in Lists A and B of Schedule-3 (Part-A) applicable only in case(s) of import or export of hazardous wastes in accordance with Rules 12, 13 and 14 if they possess any of the hazardous characteristics listed in Part (B) of the Schedule.

*Explanation: For the purpose of the clause: i) all wastes mentioned in column (3) of Schedule 1 are hazardous wastes irrespective of concentration limits given in Schedule 2 except as otherwise indicated and Schedule 2 shall be applicable only for wastes or waste constituents not covered under column (3) of Schedule 1. ii). Schedule 3 shall be applicable only in case(s) of import or export.*

- 2.2 Definition of hazardous wastes – its applicability

From the viewpoint of application of the HW (M&H) Rules, waste can be classified as hazardous if:

Waste substance is solid, semi-solid or non-aqueous liquid which because of its quantity, concentration or characteristics in terms of physical, chemical, infectious quality:

- (a) can cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitate reversible illness, or
- (b) pose a substantial present or potential hazard to human health or the environment when it is improperly treated, stored, transported, disposed of or otherwise managed

**Thus, a waste is hazardous if it exhibits whether alone or when in contact with other wastes or substances, any of the characteristics identified below:**

- **Corrosivity**
- **Reactivity**
- **Ignitability**
- **Toxicity**
- **Acute toxicity**
- **Infectious property**

## **2.3 Hazardous waste characterization**

### **2.3.1 Corrosivity**

A **waste** exhibits the characteristics of corrosivity if a representative sample of the waste has either of the following properties:

- (a) any liquid which has a pH less than or equal to 2 or greater than or equal to 12.5 as determined by **the** standard test procedure; or
- (b) a waste, which can corrode steel at a rate greater than 6.35 mm per year at a test temperature of 55 °C as determined by **the** standard test procedure.

### **2.3.2 Reactivity**

A **waste** exhibits the characteristics of reactivity if a representative sample of the waste has any of the following properties:

- (a) It is normally unstable and readily undergoes violent change without detonating
- (b) It reacts violently with water
- (c) It forms potentially explosive mixture with water
- (d) It is Cyanide or Sulfide bearing waste which when exposed to pH conditions between 2 and 12.5 can generate toxic gases, vapours or fumes in a quantity sufficient to **pose** danger to human health or the environment.
- (e) It is an explosive.

### 2.3.3 Ignitability

A **waste** exhibits the characteristics of ignitability if a representative sample of the waste has any of the following properties:

- (a) It is a liquid other than an aqueous solution containing less than 24% organic solvents by volume and has flash point less than 60 °C as determined by a Pensky Martins closed cup tester using **the** standard test method.
- (b) It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes, and when ignited burns so vigorously and persistently that it creates a hazard.
- (c) any oxidizing substance, when in contact with moisture or other materials/wastes, results in spontaneous fire or combustion.

### 2.3.4 Toxicity

A solid waste exhibits the characteristics of toxicity if the leachate from the representative sample by **Toxicity Characteristics Leaching Procedure (TCLP)** test method (as followed by USEPA, vide No: S.W 46, till Indian standards are notified by MoEF / CPCB) contains any of the contaminants listed in Table 2.1 below in excess of the concentration limits mentioned **thereupon**.

**Table 2.1 TCLP Test Limits\***

<b>S. No.</b>	<b>Contaminant</b>	<b>TCLP Limit (mg/l)</b>
01.	Arsenic	5.0
02.	Barium	100
03.	Benzene	0.5
04.	Cadmium	1.0
05.	Carbontetrachloride	0.5
06.	Chlordane	0.03
07.	Chlorobenzene	100.0
08.	Chloroform	6.0
09.	Chromium	5.0
10.	o-Cresol	200.0

<b>S. No.</b>	<b>Contaminant</b>	<b>TCLP Limit (mg/l)</b>
11.	m-Cresol	200.0
12.	p-Cresol	200.0
13.	Cresol	200.0
14.	2,4-D	10.0
15.	1,4-Dichlorobenzene	7.5
16.	1,2-Dichloroethane	0.5
17.	1,1-Dichloroethylene	0.7
18.	2,4-Dinitrotoluene	0.13
19.	Endrin	0.02
20.	Heptachlor (and its epaoxide)	0.008
21.	Hexachlorobenzene	0.13
22.	Hexachlorobutadiene	0.5
23.	Hexachloroethane	3.0
24.	Lead	5.0
25.	Lindane	0.4
26.	Mercury	0.2
27.	Methoxychlor	10.0
28.	Methyl ethyl ketone	200.0
29.	Nitrobenzene	2.0
30.	Pentachlorophenol	100.0
31.	Pyridine	5.0
32.	Selenium	1.0
33.	Silver	5.0
34.	Tetrachloroethylene	0.7
35.	Toxaphene	0.5
36.	Trichloroethylene	0.5
37.	2,4,5-Trichlorophenol	400.0

S. No.	Contaminant	TCLP Limit (mg/l)
38.	2,4,6-Trichlorophenol	2.0
39.	2,4,5-TP (Silvex)	1.0
40.	Vinyl Chloride	0.2

Note:

*\* These limits shall be applicable till the notification of leachate standards (including test method) under the E (P) Act, 1986*

- 1. Best Demonstrated Available Technology (BDAT) standards shall be employed for parameters not mentioned.*
- 3. Leachate collected shall be treated and disposed as liquid effluent in compliance of the standards notified under the E (P) Act, 1986.*

### **2.3.5 Acute toxicity**

A **waste** exhibits the characteristics of being acutely hazardous if a representative sample contains any of the following:

- (a) wastes generated in the manufacturing process of halogenated phenols and other halogenated compounds
- (b) wastes generated in the manufacturing/formulating process of pesticides or pesticide derivatives
- (c) wastes generated during the manufacturing process of halogenated benzene under alkaline conditions
- (d) off-specification or discarded products generated from the above processes, and
- (e) containers used for handling hazardous / toxic substances / wastes

### **2.3.6 Infectious property**

**Wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animal or humans fall under this category.**



## Chapter 3

### OPERATIONS AT TSDF

#### 3.1 Introduction

All operations involving treatment, storage and disposal shall comply with the guidelines/regulations issued by CPCB/MoEF as may be adopted by the SPCB/PCC and stipulated in the authorization under Rule 5 of the Hazardous Wastes (Management & Handling) Rules, 1989, as amended. The facilities should ensure that the wastes from the generators are accepted at the facility in compliance of the manifest notified under the said rules. Additional requirements regarding screening and analysis procedures at TSDF are outlined in this section so as to help the TSDF in proper acceptance of waste.

#### 3.2 Responsibilities of the Hazardous Waste Generator

In order to **optimize** and facilitate proper operations at TSDF, the hazardous waste generator shall be responsible for managing hazardous wastes before being sent to TSDF for further treatment and disposal. Certain responsibilities are listed as under:

- waste minimization, re-use of wastes to the maximum extent before sending to TSDF.
- waste characterization (Annexure I)
- segregation of hazardous and non-hazardous wastes to reduce the quantity of waste for disposal at TSDF (refer Annexure II)
- proper handling of wastes at the source
- labelling and packaging of the wastes according to procedures indicated in MoEF guidelines (1992) and Chapter 6 of the Motor Vehicles Act, **1988**, as amended.
- provide information on precautions for waste handling during transportation to TSDF.
- compliance of manifest for tracking of wastes.

##### 3.2.1 Collection and transportation of hazardous wastes

- (a) The generator of the hazardous waste shall ensure that wastes are packaged in a manner suitable for safe handling, storage and transport. Labelling on packaging is readily visible and material used for packaging shall withstand physical conditions and climatic factors.
- (b) **The** generator shall ensure that information regarding characteristics of wastes particularly in terms of being Corrosive, Reactive, Ignitable or Toxic is provided on the label.

- (c) Transport of hazardous wastes shall be in accordance with the provisions of the rules made by the Central Government under the Motor Vehicles Act, 1988 and other guidelines issued from time to time.
- (d) All hazardous waste containers shall be provided with a general label as given in Form 8 in Hazardous Waste (Management & Handling) Rules, 1989, as amended.
- (e) Transporter shall not accept hazardous wastes from an occupier (generator) unless six-copy (with colour codes) of the manifest (**Form 9**) is provided by the generator. The transporter shall give a copy of the manifest signed and dated to the generator and retain the remaining four copies to be used for further necessary action prescribed in the Hazardous Wastes (Management & Handling) Rules, 1989, as under:
  - Copy 1 (White) : **To be** forwarded to the SPCB/PCC by the occupier
  - Copy 2 (**Yellow**) : **To be** signed by the transporter and retained by the occupier
  - Copy 3 (Pink) : **To be** retained by the operator of a facility
  - Copy 4 (Orange) : **To be** returned to the transporter by the operator of facility after accepting waste
  - Copy 5 (Green) : **To be** forwarded to SPCB/PCC by the operator of facility after disposal.
  - Copy 6 (Blue) : **To be** returned to the occupier by the operator of the facility after treatment & disposal of HW.
- (f) The generator shall provide the transporter with relevant information in Form 10, i.e. **Transport Emergency** (TREM) Card regarding the hazardous nature of the wastes and measures to be taken in case of an emergency.

### 3.2.2 Test report and information

Generators sending hazardous waste to the facility for treatment, storage or disposal are required to provide necessary test report of hazardous waste to the operator along with the information on the process(s) of its generation, so as to facilitate the determination of pathway for treatment and disposal. Test report shall be submitted to the operator along with a copy marked to the SPCB.

Based on the analysis report/waste characterization, TSDF operator shall decide **the** suitable pathway for treatment/storage/disposal.

## 3.3 Responsibilities of the Hazardous Waste Transporter

Transporter of hazardous wastes shall be responsible for:

- Obtaining permission from SPCB/PCC for transport of hazardous waste [in addition to any other permissions that may be required under the Motor Vehicles (Amendment) Act of 1988]
- Suitably designing the transport vehicles to handle and transport the hazardous wastes of various characteristics
- Maintaining the manifest system as required
- Transporting the wastes in closed containers at all times
- Delivering the wastes at designated points
- Informing SPCB/PCC and other regulatory authorities **immediately** in case of spillage, leakage or other accidents during transportation
- Cleaning up in case of contamination

### 3.4 Responsibilities of the Operator of TSDF

The operator of TSDF would be responsible for:

- Accepting hazardous wastes at TSDF from the generators authorized by SPCB/PCC.
- Establishing a system for optimal **movement** of hazardous wastes transportation, **treatment and disposal operations**, which may include **resource recovery/ recycling** as the case may be.
- Fingerprinting analysis to confirm the wastes shall be the responsibility of the operator (**Annexure II** of the report)
- Operating the TSDF as per conditions stipulated in the authorization.
- Ensuring waste treatment and/or disposal as per Hazardous Waste (Management & Handling) Rules, 1989, as amended.
- Undertake cleanup operation in case of contamination resulting from TSDF
- Pollution and the odour arising out of TSDF operations and subsequent abatement.
- Compliance of regulations concerning occupational safety and health of TSDF employees.

### 3.5 Waste disposal into a Landfill

Landfills shall have to be designed and constructed as a secured facility to contain the waste material and any leachate generated during the process. **To meet these requirements, the base, slope, liner system etc. of the landfill shall have to be designed and constructed as per the guidelines of MoEF/ CPCB (Guidelines for Setting up of Operating Facility-Hazardous Waste Management, HAZWAMS/11/98-99 and Criteria for Hazardous Waste Landfills, HAZWAMS/17/2000-01), and the conditions stipulated by SPCB/PCC in the authorization to operate TSDF while granting consent to establish.** Prior to the placement of waste, an engineered capping over the surface shall be placed after completion of work daily so as to minimize the infiltration of rainfall.

The base liner and capping shall be a composite system comprising compacted clay layer and synthetic membrane as may be approved by the SPCB/PCC. A leachate collection drainage system is to be provided at the base of the landfill, immediately above the liner to ensure that the head of leachate will not exceed 300 mm during any season of the year.

The following objectives have to be considered in the design of an engineered landfill:

- Minimization of the possibility of contamination of surface and/or groundwater
- Control over gaseous emissions **if any**.
- Prevention and control of any other possible adverse impact(s) on the environment
- Utilization of excavated soil as cover material
- Harvest of upstream rainwater flowing into the **land fill**.
- Preferred use of clay with plasticity index between 10-30, which is well-graded having at least 30% passing **through** 75 micron. Clay fraction shall be kept at greater than 15% or more whereas gravel fraction shall be < 50% of clay lining.
- Clay having clod size less than 50 mm **be compacted to optimum** moisture content using a sheep foot roller.

Placement of wastes into a landfill would have to be done judiciously as it may cause impact(s) throughout the active life of the waste in the landfill. Therefore, waste disposal into the landfill be restricted as per the concentration limits/criteria for acceptance of hazardous waste in landfill **as** presented at **Annexure III**, besides the restrictions for waste placement into landfill stipulated by the SPCB/PCC.

Placing bulk, containerized, or non-containerized liquid hazardous wastes containing free liquids (whether or not adsorbents have been added) in any landfill **shall be** prohibited by SPCB/PCC.

### **3.5.1 Operations at a TSDF**

Suggested sequence of the operations at TSDF is presented below:

- **Operator from the generator shall receive a comprehensive report on analysis of the waste.**
- The operator of TSDF shall examine the report and plan pathway for waste treatment and disposal.
- Upon confirmation of the same by the operator of TSDF to the generator, the waste shall be dispatched to the TSDF accompanied by transport manifest.
- Upon receipt at the facility, the wastes shall be weighed and properly logged.
- Waste shall then undergo a visual inspection to confirm the physical appearance.
- A representative sample of the waste shall be collected and sent to the on-site laboratory for fingerprinting analysis (**Annexure II**).
- The results of fingerprinting analysis shall be compared with the results of earlier analysis.
- Upon confirmation, waste shall then be sent for TSD operations according to the identified pathway.

### **3.5.2 Waste TSD options**

Waste at TSDF could be handled in different ways as follows:

- Direct disposal into landfill
- Treatment/stabilization of wastes and then disposal into landfill
- Direct incineration
- Pre-treatment and incineration
- Pre-treatment, incineration and disposal of incineration ash in landfill
- Waste processed for fuel/industrial by-products for **recycling**
- Others

### **3.5.3 Pathway of wastes accepted for direct disposal**

Wastes accepted for direct disposal shall conform to the concentration limit/criteria stipulated by the SPCB/PCC (Annexure - III).

### **3.5.4 Comprehensive analysis for waste acceptance for direct disposal**

Generators of hazardous wastes shall identify and provide analysis report including CRIT criteria of the waste consignments. TSD facility should require that the generator provides such information regarding:

- The through put and process that generates the waste with quantities
- The physical and chemical description of the waste as per parameters given in Annexure I
- The analytical procedures and interpretation of results used to characterize the waste or process knowledge documentation
- Hazardous waste codes are placed as per Schedule 2 of the Hazardous Waste (Management and Handling) Rules, 1989, as amended.

**The operator at TSD, so as to ascertain direct disposal into a landfill, shall perform the following fingerprinting analysis:**

- Free liquid content (Paint Filter Liquids Test and Liquid Release Test)
- pH
- Calorific value
- Flash point
- Reactive sulfide
- Reactive cyanide
- Chemical compatibility
- Any other specific parameter, which may be decided on merit of each case.

The waste shall be placed at the toe of the working face and spread evenly by mechanical equipment in approximately 0.5 meters layers. Spreading and compaction is an important part of operation to achieve maximum waste density within the landfill. After every days operation soil cover of at least 100 mm thickness shall be placed over the waste. The placement and compaction is continued to uniformly raise the level of the cell. At the point of reaching the final design height, the final cover is placed over that section, as the work proceeds.

### 3.6 Pathway for Hazardous Wastes not Accepted for Direct Disposal

Wastes not accepted for direct disposal into landfill shall have to either be treated / stabilized before disposal into a landfill, or would have to be incinerated, or otherwise managed as per the conditions stipulated by the SPCB/PCC.

#### 3.6.1 Waste treatment / stabilization

Waste treatment / stabilization is a process designed to convert hazardous wastes in the form of non-aqueous liquids, semi-solids or reactive solids into less leachable solids that can then be deposited directly into the secured landfill in compliance with the concentration limits/criteria stipulated by SPCB (Annexure III). The treatment/stabilization operations will be carried out for all wastes identified for the purpose, so as to minimize their contaminant leaching potential. This will change the nature of these wastes to a less hazardous category. Treatment/stabilization involves immobilization of leachable materials by fixation as non-reactive solids, reduction of volume, reducing contaminant level of organic/inorganic components. Selection of technology would depend on the nature of waste, physical properties, options for technology applications, cost etc. Suggested flow chart for screening the wastes going to treatment/stabilization for developing treatment **plant** is given in the **Figure 1 in the CPCB-document: Hazwams/17/2000-01**. The treated wastes before disposal in the landfill shall be assessed for compatibility with other wastes as well as with liner system

The term treatment/stabilization is intended to cover number of mechanisms including:

- ***Immobilization/Chemical fixation*** - the chemical binding of contaminants within a cementing structure to reduce the mobility or leachability of the waste constituents
- ***Encapsulation*** - the occlusion or entrapment of contaminant particles within a solid matrix
- ***Solidification*** - the conversion of slurries that do not readily de-water into solids by addition of solidification and adsorption agents.

Typical reagents that would be used for the stabilization process may includes lime, fly-ash, bentonite (clay), cement, saw dust etc., in combination with sodium silicate solution, if required to create additional binding properties of the wastes.

*General operations for waste treatment/stabilization shall include:*

- Receiving waste for its storage in appropriate/designated place
- Adding of reagents as per the pre-estimated quantities
- Mixing and curing

- Thermal treatment to remove moisture, organics etc.
- Analysis of the stabilized sample (TCLP)
- Transfer of stabilized material to landfill

The above process operations generally have the potential to create gaseous and particulate emissions into the air. This can be controlled by various management practices as stipulated by SPCB/PCC including masking (and would have to be properly managed).

Also ambient odour near facility coming from the industrial **wastes** has to be neutralized in the following manner by the operator:

As indicated at Section 3.5, placing bulk, containerized, or non-containerized liquid hazardous wastes containing free liquids (whether or not absorbents have been added, liquids that have been absorbed in biodegradable materials and liquids that have been stabilized by sorbents but will release liquids when compressed under normal pressure that might occur during and after land-filling) in any landfill is prohibited regardless of the length of time, presence of liners or leachate collection system.

Hence, TSDF shall use the paint filter liquid test (PFLT) to comply with this requirement. This test determines whether the waste can be accepted to landfill subject to its passing the PFLT. The waste is not subject to a ban if it passes the PFLT. However, if it does not, it must be treated before it can be placed in the landfill.

Waste treatment/stabilization would have to be performed on all wastes that find their final disposal into a landfill but do not meet the landfill disposal criteria. Typical analysis protocol for waste treatment/ stabilization would be as indicated in Annexure I (comprehensive analysis). Finger printing analysis for the same would be as indicated in Annexure II.

### **3.6.2 Identification parameters required for waste treatment / stabilization**

Waste treatment/stabilization parameters shall include both physical and chemical tests. Physical tests shall be performed to characterize wastes before and after stabilization/solidification/treatment. The chemical tests shall primarily be the leaching tests, which will be conducted to evaluate the performance of specific treatment processes. The analysis shall be in line with the parameters as indicated in Annexure I.

### **3.6.3 Analysis protocol to confirm treatment/stabilization of waste**

#### **Physical Tests**

The TSDF operator has to conduct and document the results of the following physical tests applicable to incoming waste as well as on treated/stabilized hazardous waste.

The physical tests shall be classified into the following categories

<b>TEST</b>	<b>PURPOSE</b>
<b>Index Property Tests</b> Particle size analysis (PSA)	To determine the particle size distribution of a material
<b>Moisture Content</b> Paint filter liquid test (PFLT)	To determine the presence of free liquids in a representative sample of bulk or non-containerized waste.
<b>Density Testing</b> Bulk density	To determine the in-place density
Compaction testing	
Moisture density relations	To determine relation between moisture content and density of the waste
<b>Permeability Testing</b> Falling head permeability / constant head (FHP/CH)	To measure the rate at which water will pass through a stabilized waste
<b>Strength testing</b> Unconfined compressive strength (UCS)	To evaluate how cohesive the stabilized materials behave under mechanical stress
Flexural strength (FS)	To evaluate the stabilized wastes ability to withstand loads over a large area
Cone index (CI)	To evaluate a stabilized wastes stability and bearing capacity
<b>Durability Testing</b> Wet and dry durability (WDD)	To determine how the stabilized waste behaves or degrades after repeated wet-dry cycles.

### **Chemical Tests**

Leaching tests shall be used in evaluating the performance of treatment/stabilization/solidification processes for wastes as per the recommended TCLP procedure for the identified chemical constituents in the stabilized waste. The waste stabilized should meet the **Best Demonstrable Available Technology (BDAT)** standards of **Unites States Environment Protection Agency (USEPA)** before their disposal to the landfill till the BDAT standards are notified/stipulated under the Environment (Protection) Act, 1986, and rules made thereunder.

### **3.7 Waste Storage**

Owner/operator of TSDf shall store such wastes in lined containers solely for the purpose of the accumulation of such quantities of hazardous waste as necessary to facilitate proper



recovery, treatment or disposal for which economically viable treatment/disposal techniques are presently not available at or outside the facility. Each container shall be clearly marked to identify its contents and the date(s) of accumulation at the facility and such information for each consignment is recorded and maintained in the operating records at the facility.

Separate area should be earmarked for storing the waste at TSDF. The storage area may consist of different cells for storing different kinds of hazardous wastes. In designing these cells, the following points may be taken into consideration:

Those ignitable, reactive and non-compatible wastes shall be stored separately.

That wastes containing volatile solvents or other low vapour pressure chemicals should be adequately protected from direct exposure to sunlight.

The storage area should have a proper containment system. The containment system should have a collection area to collect and remove any leak, spill or precipitation.

It should be designed in such a way that the floor level of the storage area is at least 150 mm above the maximum flood level

The operator of the TSDF should put in place a system for inspection of the storage area to check the conditions of the containers, spillages, leakages etc., and maintain proper records as may specified by the SPCB/PCC in the authorization to operate TSDF.

The hazardous wastes should not be stored for more than two weeks at this temporary storage area.

In case of waste is not in accordance with the authorization issued by the SPCB/PCC to the generator, the TSDF operator shall reject the waste for the waste for further treatment and disposal. Information to this effect shall be immediately sent to the SPCB/PCC for advice.

### **3.8 Acceptance / Rejection of Waste Consignments for Storage**

Owner/operator of TSD facility shall store such wastes for upto two years(s) unless MoEF / CPCB / SPCB/PCC demonstrates that such storage is not solely for the purpose of accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment or disposal. Otherwise, such wastes shall be stored at the facility beyond the stipulated period and owner/operator of the facility bears the burden of proving that such storage is solely for the purpose of accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment or disposal.

The operator of TSDF shall accept the hazardous wastes as per the authorization issued by SPCB/PCC to the generator and then undertake the operations for treatment/stabilization and disposal as per the conditions stipulated by the SPCB/PCC to the operator of TSDF.

## Chapter 4

### INCINERATION

#### 4.1 Introduction

Incineration is an ultimate treatment process, applied to certain wastes that cannot be recycled, reused or safely deposited in a landfill. It is a high temperature, thermal oxidation process in which hazardous wastes are converted in presence of oxygen in the air into gases and incombustible solid residue. The gases are vented into the atmosphere through gas cleaning system as may be necessary while the solid residue is sent for direct disposal into the landfill. Applicability of incineration of hazardous waste depends on certain considerations illustrated as under:

- The waste is biologically hazardous
- It is resistant to biodegradation and persistent in the environment
- It is volatile and therefore easily dispersed
- It cannot safely be disposed into a landfill even after stabilization/treatment
- Volume reduction of waste is necessary

Incineration may take place either in dedicated, custom-built facility or in suitably adapted high-temperature process plants which maintain the required temperature for complete incineration of the material and are equipped to control air emissions as per the norms stipulated by the SPCB.

#### 4.2 Incinerable Wastes

In general, if the waste is organic, then it has a high potential for incineration in view of its high calorific value. Typical wastes that would need to be incinerated by the operator of TSDF may include:

- Solvent wastes (spent solvents)
- Waste oils, oil emulsions and oil mixtures
- Hospital wastes of categories 1,2,3,.....and 10 of the Schedule I of the Notification No. S.O. 746 E, dated 20th July 1998, of MoEF, GOI, subject to authorization by the SPCB.
- Pesticide wastes
- Pharmaceutical wastes

- Refinery wastes
- Phenolic wastes
- Grease and wax wastes
- Organic wastes containing halogens, sulphur, phosphorous or nitrogen compounds
- Capacitors containing PCBs
- Solid materials contaminated with oils
- Others with calorific value >2500 Kcal/Kg.

Whether or not these wastes can be properly incinerated depends on the choice of incinerator temperature and its gas cleaning system - an important qualification, since the act of disposal should not itself cause a threat to the environment.

### 4.3 Guidelines for Incineration

The primary aim of incineration is completely destroy the toxicity of wastes and to get products (solids and gases) of combustion that are harmless. To achieve these aims, attention must be given to the “Three Ts of Combustion”:

- Temperature
- Time
- Turbulence

Availability of oxygen is an additional parameter, which forms an integral part of the incineration system. When the waste is burnt at the higher temperature destruction would be complete and formation of un-burnt waste, formation of organic by-products etc. would also be eliminated. The longer the waste is held at high temperature, the greater will be the degree of destruction and the less-likelihood of formation of **Products of In-complete Combustions (PICs)**.

Turbulence relates to the degree of mixing between the waste and oxygen in the combustion air and to the absence of temperature gradients within the furnace. Greater turbulence provides better control, better access to air and more complete oxidation destruction of the waste being burnt.

Finally, availability of oxygen is important for combustion of material.

### **Guidelines for operation of incineration:**

- Temperature of 900-1100 °C for hydrocarbon wastes and 1100-1200 °C for certain wastes like PCBs, waste oil residues etc. For certain halogenated organics this has to be decided on a case-to-case basis.
- Time: Minimum gas phase residence time of 2 seconds. Residence time of hearth solids is measured in hours and thus control would be on complete destruction of solids.
- Combustion Air: 100% in excess of stoichiometric requirements
- Turbulence: is achieved through good incinerator design.

The destruction and removal efficiency (DRE, %) of persistent organic pollutants in the hazardous wastes [particularly by Persistent Organic Hazardous Compounds - POHC] is to be calculated as indicated below:

$$\text{DRE} = \frac{(\mathbf{W}_{\text{in}} - \mathbf{W}_{\text{out}}) \times 100}{\mathbf{W}_{\text{in}}} \%$$

Where,

- $\mathbf{W}_{\text{in}}$  - Concentration of the compound in the waste feed X mass rate of feed.
- $\mathbf{W}_{\text{out}}$  - Concentration of the compound in the stack gas X volumetric flow rate of stack gas.

**As a rule DRE must be greater than 99.99%.**

#### **4.4 Gas Cleaning**

The constituents of flue gas depend on the composition of wastes and the severity of combustion conditions. The purpose of gas cleaning is to remove, as completely as is practicable, particulates and non-combustible contaminants such as fly-ash and metal oxides and acidic gases (particularly HCl). Un-burnt wastes and tract organic by-products shall be removed in the gas cleaning equipment. Air pollution control system for combined incineration of hazardous wastes at the TSDF is required to meet the emission standards as may be stipulated by the SPCB/PCC (Annexure IV).

#### **4.5 Fuel Blending of Organic Wastes**

Fuel blending and thermal treatment at lower temperatures in certain cases can be a low cost option for waste disposal as alternate to incineration, however, the emission standards applicable for these would be the same as applicable to incinerators.

## Chapter 5

### LEACHATE TREATMENT AND DISPOSAL

Having considered leachate quantity, quality and the variations associated **properties**, it is also essential to identify the components of the leachate that are to be treated or removed such as:

- Removal of high concentrations of degradable organic compounds
- Removal of high concentrations of non-degradable organic compounds
- Removal of varying concentrations of specific hazardous organics
- Removal of varying concentrations of specific hazardous inorganics
- Removal of ammonia
- Denitrification of nitrates/nitrites
- Removal of odours including sulphides
- Removal of suspended solids and
- Disinfection (if required)

TSDF operations shall comply with the consent conditions stipulated by the SPCB/PCC under the provisions of the Water (Prevention and Control of Pollution) Act, 1974, with reference to collection, treatment and disposal of leachate originating from the secured landfill (**Table 5.1**).

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**Appendix**

**( Schedule 1,2 of the HW ( M & H ) Amendment Rules, 2003**

**COMPREHENSIVE ANALYSIS REQUIREMENTS FOR  
HAZARDOUS WASTES – GENERATOR /TSDF OPERATOR**

<b>Method of Analysis</b>	<b>Comprehensive Analysis to be submitted by the Generators of Hazardous Wastes</b>
<b>Physical Analysis</b>	Physical State of the waste (liquid / slurry / sludge / Semi-solid / solid: inorganic, organic, metallic)
	Description of different phases of the wastes (in cases of solid wastes slurries and sludge) contained in aqueous / non-aqueous liquids / solutions
	Colour and Texture
	Whether the waste is multi-layered (Yes/No)? If yes, quantify each layer
	Specific Gravity
	Viscosity
	Calorific Value
USEPA, SW-846; Method 1010 and 1020	Flash Point
	% Moisture content loss on ignition at 105°C
	% Organic content loss on ignition at 550 °C
USEPA, SW-846; Method 9095	Paint Filter Liquid Test (PFLT)
<b>Chemical Analysis</b>	
USEPA, SW-846; Methods 9040, 9041 and 9045	pH
<b>Inorganic Parameters Analysis</b>	
USEPA; SW-846; Vol. 1C Part II; Test Method 8000-10-1-1 HCN, Method 8000-10-1-2	Reactive Cyanide (ppm)

<b>Method of Analysis</b>	<b>Comprehensive Analysis to be submitted by the Generators of Hazardous Wastes</b>
Method to determine HCN released from Wastes	
USEPA; SW-846; Vol. 1C Part II; Test Method to determine H <sub>2</sub> S released from wastes	Reactive Sulfide (ppm)
USEPA; SW-846; 9010, 9011, 9012	Sulphur (elemental)
USEPA; SW-846; Vol. 1A, 1B, 1C and Vol. 2	Concentration of In-organics [as per Schedule 2 of HW (M&H) Rules, 1989, as amended].
<b>Organic Parameters Analysis</b>	Oil & Grease
	Extractable Organic (in special cases only)
	% Carbon
	% Nitrogen
	% Sulphur
	% Hydrogen
USEPA; SW-846; Vol. 1A, 1B, 1C and Vol. 2	Concentration of individual organics [as per Schedule 2 of HW (M&H) Rules, 1989, as amended]
USEPA; SW-846; Method 1311, 1330	Toxicity Characteristics Leaching Procedure (For the parameters identified in <b>Section 2, Table 5.1</b> and the listed parameters as presented in Method 1311 of SW 846; USEPA)



**FINGERPRINT ANALYSIS REQUIREMENTS FOR  
HAZARDOUS WASTES - TSD FACILITIES**

<b>Method of Analysis</b>	<b>Fingerprint Analysis by the Operators of TSD Facilities</b>
<b>Physical Analysis</b>	Physical State of the waste (liquid/slurry/sludge/semi-solid/solid: inorganic/organic/metallic)
	Identification of different phases of the wastes (in cases of solid wastes contained in aqueous/non-aqueous liquids/solutions for slurries and sludge)
	Colour & Textures
	Whether the waste is multi-layered (yes/no)? If yes, quantify each layer
	Specific Gravity
	Viscosity
USEPA, SW-846; Method 1010 and 1020	Flash Point
	Loss on ignition at 10 °C
	Loss on ignition at 650 °C
USEPA, SW-846; Method 9095	Paint Filter Liquid Test (PFLT)
USEPA, SW-846; Method 9096	Liquid Release Test (LRT)
<b>Chemical Analysis</b>	
USEPA, SW-846; Method 9040, 9041 and 9045	pH
USEPA, SW-846; Vol. 1C Part II; Test Method to determine HCN released from Wastes	Reactive Cyanide (ppm)
USEPA, SW-846; Vol. 1C Part II; Test Method to determine H <sub>2</sub> S released from Wastes	Reactive Sulfide (ppm)

**CONCENTRATION LIMITS/CRITERIA FOR ACCEPTANCE OF  
HAZARDOUS WASTES FOR DIRECT DISPOSAL TO SECURED LANDFILL**

<b>Leachate Quality *</b>	<b>Concentration</b>
pH	4 - 12
Total Phenols	< 100 mg/l
Arsenic	< 1 mg/l
Lead	< 2 mg/l
Cadmium	< 0.2 mg/l
Chromium-VI	< 0.5 mg/l
Copper	< 10 mg/l
Nickel	< 3 mg/l
Mercury	< 0.1 mg/l
Zinc	< 10 mg/l
Fluoride	< 50 mg/l
Ammonia	< 1,000 mg/l
Cyanide	< 2 mg/l
Nitrate	< 30 mg/l
Adsorbable organic bound Chlorine	< 3 mg/l
Water soluble compounds except salts	< 10%
<b>Calorific value</b>	<b>&lt; 2500 K.Cal/kg</b>
<b>Strength</b>	
Transversal strength (Vane Testing)	> KN/m <sup>2</sup>
Unconfined Compression Test	> KN/m <sup>2</sup>
Axial Deformation	< 20%
<b>Degree of Mineralization or Content of Organic Materials (Original Sample)</b>	
Annealing loss of the dry residue at 550°C	< 20% <b>by weight</b> (for non-biodegradable waste)  < 5% <b>by weight</b> (for biodegradable waste)
Extractible Lipophilic contents (Oil & Grease)	< 4% <b>by weight</b>

\* *Leachate quality is based on Water Leach Test*

**Table 5.1 Leachate Disposal Standards**

S.No.	Parameter	Standards (mg/l)			
		Inland Surface	STP	CETP (See note)	Marine Coastal Areas
Additional Parameters Recommended					
1.	Adsorbable Organic Halogens (AOX)	0.50	-	-	0.50
2.	Poly Aromatic Hydrocarbons (PAH) (each)	0.059	-	-	0.059
3.	Benzene	0.14	-	-	0.14
4.	Toluene	0.08	-	-	0.08
5.	Xylene (sum of o, m, p-xylene)	0.32	-	-	0.32

**Note :**

1. In addition to the above, General Standards for discharge of environment pollutants Part-A: Effluents notified, vide G.S. R. 422 (E), dated 19.5.1993 and published in the Gazette No. 174, dated 19.5.1993 under the Environment (Protection) Act, 1986, and rules made thereunder, shall also be applicable for disposal of leachate into sewage treatment plant, common effluent treatment plant, Inland surface water bodies or coastal areas.
2. For each CETP and its constituent units, the SPCB/PCC shall prescribe standards as per the local needs and conditions; these can be more stringent than those prescribed above. However, in case of clusters of units, the SPCB/PCC may prescribe suitable limits.
3. **Leachates having high COD shall be concentrated through evaporation (forced) and fed to the incinerator of the integrated TSDF in view of its high calorific value, and the residue ash shall be disposed off in their secured landfill.**
4. The Bioassay test shall be substituted by 'Fish Toxicity' test, and a dilution factor of 2 (two) may be considered.

## EMISSION STANDARDS FOR COMMON HAZARDOUS WASTES INCINERATOR

- A. Emission limit of incinerator while operating properly at 100% rated capacity, shall have an emission limit from the discharge stack to atmosphere of less than or equal to:

Parameter	Emission limit (mg/Nm <sup>3</sup> )
Particulates	50
HCl	50
SO <sub>2</sub>	200
CO	100
Total Organic Carbon	20
HF	4
NO <sub>x</sub> (NO and NO <sub>2</sub> expressed as NO <sub>2</sub> )	400

*Note: All values corrected to 10% oxygen on a dry basis*

- B. Hydrocarbons: 10 ppm, over an hourly rolling average dry basis, measured as propane.
- C. Opacity: While operating properly at 100% rated capacity, the system shall have a visible emission rate of less than or equal to 10%, except for condensed water vapour, from the discharge stack to atmosphere (one hour rolling average).
- D. Dioxins/Furans: While operating properly at 100% rated capacity, the system shall have an emission of dioxins and furans of less than or equal to 0.1 ng TEQ/Nm<sup>3</sup> corrected to 10% oxygen. Sampling period shall be minimum 6 hours and maximum 8 hours. Analysis of dioxins and furans as well as reference measurement methods to calibrate automated measurement systems shall be carried out as given by CEN-standards. If CEN-standards are not available, ISO standards, National or International Standards, which will ensure the provision of data of an equivalent scientific quality, shall apply.
- E. Metals: While operating properly at rated capacity, the system shall have an emission rate from the discharge of stack to atmosphere less than or equal to

Metals	Emission Limit (mg/Nm <sup>3</sup> )
Cd + Th (and its compounds)	0.05
Hg (and its compound)	0.05
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V (and their compounds)	0.50

*Note: All values corrected to 10% oxygen on a dry volume basis*

F. Operating standard:

1. Combustion efficiency (CE) shall be at least 99.9% and shall be computed as follows:

$$CE = \% \text{ CO}_2 \div [\% \text{ CO}_2 + \% \text{ CO}] \times 100 \%$$

2. Temperature of the primary chamber shall be at least 850 °C.
  3. Secondary chamber gas residence time shall be at least 2 (two) seconds at 1100°C, with minimum 3% oxygen in the stack gas.
  4. *Destruction and Removal Efficiency (DRE) for each principal organic hazardous constituent (POHC) in the waste feed shall be at least 99.99%.*
  5. *DRE for hazardous waste containing PCBs, PCTs and other chlorinated compounds shall be 99.9999%.*
- G. Air pollution control device: The emission control system shall be installed for gas cleaning and removal of air pollutants. The system shall comprise the following equipment, singly or in combination, with design efficiencies to meet the emission norms:
- (i) Waste heat boiler / heat exchanger / quencher
  - (ii) Bag filters / ESP / Cyclone
  - (iii) Dry / wet scrubber with hydrated lime or sodium hydroxide injection
  - (iv) Chimney / stack of minimum 30 m height or as per formula:  $H = 14 (Q)^{0.3}$  [where, Q is the emission rate of SO<sub>2</sub> in kg/hr] which ever is more.
- (Note: Dry/wet ESP, spray dryer, dedioxide filter and mist eliminator shall also be considered as may be required)*

- H. Operating conditions: Incineration plants shall be operated in order to achieve a level of incineration such that the Total Organic Carbon (TOC) content of the slag and bottom ashes is less than 3%, or their loss on ignition is less than 5% of the dry weight of the material. If necessary appropriate techniques of waste pretreatment shall be used.

Incineration plants shall be designed equipped, built and operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogenous fashion and even under the most unfavorable conditions, to a temperature of 850 °C, as measured near the inner wall or at another representative point of the combustion chamber as authorized by the competent authority, for two seconds. If hazardous wastes with a content of more than 1% of halogenated organic substances, expressed as chlorine, are incinerated, the temperature has to be raised to 1200 ± 100 °C for at least two seconds.

Each line of the incineration plant shall be equipped with at least one auxiliary burner. This burner must be switched on automatically with the temperature of the combustion gases after the last injection of combustion air falls below 850°C or 1100 °C as the case may be. It shall also be used during plant start-up and shut-down operations in order to ensure that the temperature of 850 °C or 1100 °C, as the case may be, is maintained at all times during these operations and as long as unburnt wastes is in the combustion chamber.

During the start-up and shut-down or when the temperature of the combustion gas falls below 850 °C or 1100 °C, as the case may be, the auxiliary burner shall not be fed with fuels which can cause higher emissions than those permitted.

- I. Monitoring requirements: Continuous monitoring and recording system for opacity, CO, SO<sub>2</sub> and NO<sub>x</sub> shall be; installed and reports shall be sent to the State Pollution Control Boards on regular basis. Interlocking arrangements for CO and temperature controls (in primary and secondary chamber) with feeding devices shall also be provided.

Waste feed has also to be terminated on loss of ignition in the afterburner.

Safety valve shall be provided in case of high-pressure development in the furnace.

- J. Notification of compliance: The operator of the incinerator shall undertake comprehensive performance test. Within 90 days of completion of comprehensive performance test, the operator shall issue a notification of compliance documenting compliance or non-compliance, as the case may be, for public information / notice.

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HAZARDOUS WASTE MANAGEMENT

**GUIDELINES FOR GRANTING  
CONSENT TO ESTABLISH / OPERATE TSDF  
BY SPCB/PCC**

(A SUGGESTED DRAFT)

**TO BE ISSUED TO M/s ABCD**

**STATE POLLUTION CONTROL BOARD**  
**August 2004**

Order No.:

Dated:.....

**Sub: Consent to Establish /Operate TSDF**

Consent to Establish / Operate under Section 25 / 26 of the Water (Prevention & Control of Pollution) Act, 1974, as amended and under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981, as amended and Authorization under Rule 5 of the Hazardous Wastes (Management & Handling) Rules, 1989, as amended, and the Bio-Medical (Management & Handling) Rules, 1998, notified under the Environment (Protection) Act, 1986 (to be hereinafter referred as Water Act, Air Act, HW (M&H) Rules and Bio-Medical Rules, respectively) is hereby granted to :

**M/s ABCD**

( name & address with telephone number)

to establish / operate a common facility as ‘Operator for collection, treatment, storage and disposal of composite hazardous wastes’ (hereinafter referred as TSDF), subject to the following conditions.

1. The consent to establish is granted as Operator of the facility, under **Rule 5 of the Hazardous Waste (Management & Handling) Rules, 1989, as amended**, and to set up common hazardous wastes and bio-medical waste, collection, **transportation**, treatment, **storage** and disposal facility (TSDF) **at ..... (provide address)**
2. The consent to establish is valid for the period of two years from the date of issue of this consent order.
3. The installed and operating capacity of the TSDF shall be as under:
  - (a) Secured landfill : ..... tonne / year HW + ..... tonne / year of incineration ash, i.e. @ .....% of HW incinerated
  - (b) Incineration : ..... tonne/ year
  - (c) Bio-medical wastes : ..... tonne year
4. The capital cost of the proposed project shall not be less than **Rs..... crores** which shall include plant and machinery, buildings, site infrastructure etc. as per the criteria of selection adopted by State Industrial Development Corporation..... and its agreement to this effect with the TSDF operator.
5. The TSDF shall cater to the requirements of environmentally sound management as required under the HW (M&H) Rules, for the hazardous wastes generated by the industries possessing valid authorization by (State) Pollution Control Board (SPCB) and operating in the following SIDC and nearby non-IDC Industrial Areas:
  - (a)



- (b)
  - (c)
  - (d)
  - (e)
  - (f)
  - (g) Till the common TSDF for .....(name: industrial estates) is established, hazardous wastes from SIDC industrial area at **(designated area)** shall also be accepted by TSDF at .....(area).
  - (h) Depending upon the technical capacity and feasibility, hazardous wastes from industries operating in non-IDC industrial areas and also industries operating in SIDC areas other than mentioned at no. (a) to (f) above and authorized by concerned SPCB, shall also be accepted by the TSDF at this area.
6. SPCB shall issue suitable amendments in the authorizations issued under Rule 5 of HW (**M & H**) Rules, to the industries generating hazardous wastes and operating in the areas mentioned at Serial Number 5 (a to h), directing them to send their wastes to the TSDF at..... , through implementation of manifest system stipulated in the **HW (M&H) Rules**, failing which their authorization shall be revoked or not granted.
  7. The generators of the hazardous wastes utilizing the common facility of TSDF at .....shall be bound to pay the costs to the TSDF Operator (on polluter pays principle as enunciated by the Honourable Supreme Court of India) based on the criteria adopted by the SIDC in its RFP (Request for Proposal) document No....., based on which SIDC has entered into agreement with the TSDF operator. The revision of costs involved in TSDF operations shall be further governed accordingly. SPCB shall issue suitable directions in this regard to all concerned.
  8. In case of variations in the quantities of hazardous wastes available for TSDF operations, concerned SPCB shall review, as may be required, and revise the jurisdiction of the command area allocated to the TSDF at .....
  9. The Operator of the TSDF shall **only** accept the wastes covered under the HW (M&H) Rules and Bio-medical Waste Rules.
  10. Transportation of hazardous wastes and bio-medical wastes shall be done in compliance with the HW (**M&H**) Rules and Bio-medical Waste (**M&H**) Rules respectively. Suitable transport vehicles, closed containers etc. shall be provided commensurate with the nature/characteristics of wastes. Transportation costs shall be recovered from the waste generators in accordance with the RFP and the agreement of SIDC with the TSDF Operator.
  11. The TSDF operator shall be responsible for implementation of conditions and criteria as laid down in the RFP document and agreement with SIDC.
  12. The TSDF Operator shall be legally bound under this authorization to co-operate and comply with the directions as may be issued by SIDC in terms of its agreement with TSDF operator.
  13. Treatment and disposal of the hazardous wastes shall be done as under:

- [a] Secured Landfill**
  - (a1) Direct landfill
  - (a2) Landfill after treatment
- [b] Incineration**
  - (b1) Direct incineration
  - (b2) Treatment followed by incineration and disposal of ash in the landfill.
- [c] Physico-chemical treatment**

14. Secured landfill shall be constructed in accordance with the guidelines issued by CPCB in its document entitled "Criteria for Hazardous Wastes Landfills, [HAZWAMS/17/2000-01]". However, the total clay thickness provided shall be 1m at the base of the landfill without any intermittent clay layer. Double liner system shall also be provided. Rest of the requirements in the said document shall remain unchanged.
15. Quality control and assurance programme during the course of construction and installation/commissioning shall be prepared by the TSDF Operator and its implementation shall be done under the supervision of ...SPCB and SIDC, as the case may be. ....SIDC may consider appointing a special authority for this purpose as provided in the RFP.
16. ....SIDC, being an authority notified under Rule 8 of HW (M&H) Rules, shall coordinate with the TSDF Operator for implementation of the project in accordance with its agreement with the Operator. For this purpose, continuance of the role of the Expert Committee for HWM set up by SIDC is envisaged for advice from time to time and this may inter-alia include arbitration in terms of cost escalations and dispute resolution.

**17. Incinerator**

In order to treat combustible and organic hazardous wastes, incinerator shall be designed, constructed and commissioned for operation in accordance with the requirements stipulated in the Schedule "A" of this consent order.

The incinerator shall be a dual chambered incinerator with the primary chamber operating at **a temperature** > 850 °C and the secondary chamber operating **at a temperature** > 1100 °C. The incinerator shall be provided with a minimum gas phase residence time of 2 seconds and combustion air shall be 100% in excess of **the** stoichiometric requirements.

The destruction and removal efficiency (DRE %) of the persistent organic pollutants (PoPs) in the hazardous wastes shall be greater than 99.99.

**18. Laboratory**

The TSDF Operator shall set up the laboratory for analysis of hazardous wastes in accordance with the provisions contained in the RFP document. The laboratory shall have the capability to carry out the comprehensive and finger print parameter (s) analysis as may be necessary for treatment and disposal of the hazardous wastes. The laboratory shall be

adequately staffed and equipped to carry out the above work. The laboratory shall be responsible to maintain the analytical records.

Laboratory instruments and equipment as indicated in the RFP document of .....SIDC and the techno-business proposal submitted by the TSDF Operator shall be installed and commissioned. Any additional instruments/equipment required for sampling, storage, transportation, analysis etc. shall also be procured by TSDF operator.

## **19. Transportation of Wastes**

The TSDF operator shall also be responsible for transportation of hazardous wastes as “transporter”. The transportation vehicles and containers shall be suitably designed to handle the hazardous wastes and bio-medical wastes. The transporter shall carry / display the TREM card during transportation of the hazardous wastes and comply with the provisions under Motor Vehicles Act (MVA), 1988, as amended, and rules made thereunder.

The TSDF operator shall be responsible for cleanup operators in case of spillage, leakage or any other accidental/incidental discharge of hazardous wastes and shall keep the .....(concerned) SPCB suitably informed.

The waste transporter shall be responsible to maintain the manifest system.

## **20. Emergency Preparedness Plan**

The TSDF operator shall prepare an on-site emergency plan and provide adequate training to the staff at the facility. The emergency preparedness plan shall be prepared and put in place prior to the commencement of TSDF operations and shall be submitted to the concerned SPCB along with application for Consent to Operate.

## **21. Conditions regarding Water Act**

- (i) The daily quantity of water consumption shall not exceed ..... KLD.
- (ii) The daily quantity of trade effluent from the TSDF operations shall not exceed .... KLD.
- (iii) The daily quantity of sewage from the TSDF operations shall not exceed ..... KLD.
- (iv) Trade effluent treatment

The TSDF Operator shall provide comprehensive treatment system consisting of Primary / Secondary and / or Tertiary treatment as may be warranted with reference to influent quality, and operate and maintain the same continuously so as to achieve the quality of the treated effluent to the following standards before disposal:

S. No.	Parameters	Standard
1.	pH	5.5 - 9
2.	BOD, 3 days, 27°C	100
3.	Oil & Grease	20
4.	Suspended solids	100
5.	Residual chlorine	1
6.	NH <sub>3</sub> as N	50
7.	TKN as N	100
8.	COD	250
9.	Arsenic (as As)	0.2
10.	Mercury (as Hg)	0.01
11.	Lead (as Pb)	1.0
12.	Cadmium (as Cd)	2.0
13.	Total Chromium (as Cr)	2.0
14.	Copper (as Cu)	3.0
15.	Zinc (as Zn)	15
16.	Selenium (as Se)	0.05
17.	Nickel (as Ni)	5.0
18.	Cyanide (as CN)	0.2
19.	Fluoride (as F)	15
20.	Sulphide (as S)	5.0
21.	Pesticides	Absent
22.	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	5.0

*Note: All parameters are in mg/l except pH*

- (v) **Trade Effluent Disposal Outlet Conditions:** Treated effluent complying with the disposal standard shall be transported to nearby CETP till incineration facility for disposal of treated effluent (forced evaporation system) is commissioned by the TSDF operator alongwith the commissioning of hazardous waste incinerator.
- (vi) **Sewage Treatment:** The TSDF Operator shall provide a comprehensive treatment system as is warranted with reference to influent quality and operated and maintain the same continuously so as to achieve the quality of treated effluent to the following standards before disposal:

Suspended solids	Not to exceed 100 mg/l
B.O.D., 3 days, 27°C	Not to exceed 100 mg/l

- (vii) **Sewage Disposal Outlet Conditions:**  
Refer : General standards for sewage treatment and disposal as per E(P) Act, Rules

(viii) **Non-hazardous Solid Wastes:**

Type of waste	Quantity Treated (Tonnes/year)	Disposal
Incineration ash	6000	Secured Landfill

(ix) **Other Conditions:**

.....

Please mention, if any.

**22. Conditions under the Air (P&CP) Act, 1981**

- (i) The TSDF Operator shall erect the chimney(s)/stack(s) of the following specifications:

S. No.	Chimney/ Stack attached to	Height (m)	Diameter at top (m)	Gas velocity (m/s)	Gas discharge (Nm <sup>3</sup> /hr)
01.	CHW Incinerator	30	0.80		
02.	BMW Incinerator	30	0.50		
03.	Gen. set: 300 KVA				
04.					

- (ii) Incinerator for composite hazardous wastes (CHW)

The TSDF Operator shall install a comprehensive air pollution control system consisting of dust separators, gas scrubbers, and stack height of at least 30 m. and operate & maintain the same continuously so as to achieve the emission level of air pollutants from the CHW incinerator in compliance with the following emission standards/ limits:

S. No.	Parameters	Emission limit*
1	Particulates	30 mg/Nm <sup>3</sup>

2	HCl	60 mg/Nm <sup>3</sup>
3	SO <sub>2</sub>	200 mg/Nm <sup>3</sup>
4	CO	100 mg/Nm <sup>3</sup>
5	HBr	60 mg/Nm <sup>3</sup>
6	Dioxin/Furan	0.1 ng TEQ/Nm <sup>3</sup>
7	Opacity	10%
8	Cadmium (Cd)	0.05 mg/Nm <sup>3</sup>
9	Thallium (Tl)	0.05 mg/Nm <sup>3</sup>
10	Mercury (Hg)	0.05 mg/Nm <sup>3</sup>
11	Antimony (Sb)	0.5 mg/Nm <sup>3</sup>
12	Arsenic (As)	0.5 mg/Nm <sup>3</sup>
13	Lead (Pb)	0.5 mg/Nm <sup>3</sup>
14	Chromium (Cr)	0.5 mg/Nm <sup>3</sup>
15	Cobalt (Co)	0.5 mg/Nm <sup>3</sup>
16	Copper (Cu)	0.5 mg/Nm <sup>3</sup>
17	Manganese (Mn)	0.5 mg/Nm <sup>3</sup>
18	Nickel (Ni)	0.5 mg/Nm <sup>3</sup>
19	Vanadium (V)	0.5 mg/Nm <sup>3</sup>
20	Tin (Sn)	0.5 mg/Nm <sup>3</sup>

\* 10% Oxygen, dry basis

(iii) Incinerator for Bio-medical wastes

(a) Emission Standards

The TSDF Operator shall install a comprehensive air pollution control system consisting of dust separators, gas scrubbers and stack height of at least 30 m and operate & maintain the same continuously so as to achieve the emission level of air pollutants from the incinerator of the bio medical wastes in compliance with the following emission standards/ limits:

S. No.	Parameter	Emission Limit*
01.	Particulate matter	150 mg/Nm <sup>3</sup>
02.	Nitrogen Oxides	450 mg/Nm <sup>3</sup>
03.	HCl	50 mg/Nm <sup>3</sup>
04.	Stack Height	30 m above the ground
05.	VOC in ash	Not more than 0.01%

\* 12% CO<sub>2</sub> correction

**Note:**

- Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants
- Chlorinated plastics shall not be incinerated.
- Incineration ash containing toxic metals shall be treated as hazardous wastes and disposal of the same shall be done at the secured landfill as per conditions stipulated for disposal of hazardous wastes under HW (M&H) Rules.
- Only low sulphur fuel, such as LDO/LSHS/Diesel shall be used as fuel in the incinerator.

(b) Operating Standards

1.	Combustion efficiency (CE) shall be at least 99%. <b>CE = % CO<sub>2</sub> ÷ [% CO<sub>2</sub> + % CO] X 100%</b>
2.	Temperature of the primary chamber shall be 800 ± 50°C.
3.	Secondary chamber gas residence time shall be at least 1 (One) second at 1050 ± 50°C, with minimum 3% oxygen in the stack gas.

- (iv) The TSDF Operator shall observe the following fuel consumption

S. No.	Type of fuel	Quantity/ month
01.	LDO	
02.	LSHS	
03.	Furnace Oil	

- (v) The TSDF Operator shall provide ports in the chimney/stack and facilities, such as ladder, platform etc., as per requirements for monitoring the air emissions and the same shall be open for inspection and use by the authorities.

The chimney / stacks attached to various sources of emission shall be designated by numbers such as S-1, S-2 etc. and these shall be painted / displayed to facilitate identification.

(vi) Noise: The TSDF Operator shall take adequate measures for control of noise from its own source particularly the generators set so as to comply with the standards notified under the Environment (Protection) Act, 1986.

(vii) Other Conditions:

(Please mention, if any)

**23. Conditions under the Bio-medical Wastes (M&H) Rules, 1998:**

The TSDF Operator shall comply with the provisions and standards / requirements regarding collection, transport, treatment and disposal of Bio-Medical Wastes as stipulated under the Bio-medical Waste (Management & Handling) Rules, 1998, notified under the Environment (Protection) Act, 1986.

**24.** General conditions presented in the Schedule - A of this order shall be complied with by the Operator / occupier of the TSDF.

**25.** All the conditions of this consent shall be strictly implemented and the consent order shall be displayed at a prominent location in the factory premises.

This is issued pursuant to the decision taken by the Consent Appraisal Committee of the concerned SPCB..

For and on behalf of the  
State Pollution Control Board

Date:

Place:

Member Secretary

Encl: Schedule - A



To

M/s. ABCD

.....  
.....

Copy to :

1. The Chief Executive Officer, .....State Industrial Development Corporation
2. The Joint Secretary, HSM Division, Ministry of Environment & Forests, 'Paryavaran Bhavan', C.G.O.Complex, Lodi Road, New Delhi - 110 003
3. The Member Secretary, Central Pollution Control Board, 'Parivesh Bhavan', East Arjun Nagar, Shahdara, Delhi - 110 032
4. The Collector, (Concerned District), .....
5. The Regional Officer, .....State Pollution Control Board, .....
6. Sub-Regional Officer, .....SPCB, .....
7. The Chief Accounts Officer, .....SPCB, .....

Received Consent fees of :

Amount (Rs)	DD No.	Date	Drawn on

8. Cess Branch, .....SPCB.
9. Master File

**SCHEDULE - A : OPERATING REQUIREMENTS FOR THE COMMON HAZARDOUS WASTE TREATMENT, STORAGE AND DISPOSAL FACILITY (CHWTSDF)**

**Ref.: Consent to establish / operate issued to the TSDF Operator / Occupier, namely .....**

1. All operations involving collection, transport, treatment, storage and disposal shall comply with the guidelines / regulations issued by CPCB / MoEF as may be adopted by the SPCB and stipulated in the authorisation under Rule 5 of the HW (M&H) Rules. The Operator should ensure that the wastes from the generators are accepted at the facility in compliance of the manifest notified under the said rules.

**2. Overall Responsibilities of the Operator**

- (a) Accepting hazardous wastes and bio-medical wastes at TSDF from the generators authorized by the **concerned** SPCB
- (b) Establishing a system for optimal movement of wastes transportation and treatment and disposal operations, which may include resource recovery / recycling, regarding as the case may be.
- (c) Operating the TSDF as per conditions stipulated in the authorization.
- (d) Undertaking cleanup operation in case of contamination resulting from TSDF.
- (e) Pollution and the odour arising out of TSDF operations and subsequent abatement.
- (f) Compliance of regulations concerning occupational safety and health of TSDF employees.

**3. Sequence of Operations at the CHWTSDF**

- (a) Hazardous wastes / Bio-medical wastes and its analysis report shall be received by Operator from the generator.
- (b) The operator shall examine the report and plan pathway for waste treatment and disposal.
- (c) Upon confirmation of the same by the operator to the generator, the waste shall be dispatched to the TSDF accompanied by transport manifest.
- (d) Upon receipt at the facility, the wastes shall be weighed and properly logged.
- (e) Waste shall then undergo a visual inspection to confirm the physical appearance.

- (f) A representative sample of the waste shall be collected and sent to the on-site laboratory for analysis.
- (g) The results of the analysis shall be compared with the results of earlier analysis.
- (h) Upon confirmation, waste shall then be sent for TSD operations according to the identified pathway.

#### **4. Storage at Generator's Premises**

It is the responsibility of the Operator to inform the Generator about non-compatible wastes, so that the generator may take precautions against mixing or storing of such wastes. The Operator shall have to educate the Generator's staff to make on-site storages in colour-coded containers that are supplied by the Operator. The volume of specific type of waste and carting cycle shall govern the size of the containers, drums, trolleys etc. While considering this, the Operator shall see that problems, like odour, surface water contamination, groundwater percolation etc. do not occur.

#### **5. Characterization**

- 5.1 Generator shall provide declaration to the effect that hazardous wastes generated are as per authorisation by the Board.
- 5.2 Generators of hazardous wastes shall identify and provide analysis report including CRIT criteria of the waste consignments. The operator should ensure that the generator provides such information regarding:
  - (a) process that generates the waste, with quantities, and
  - (b) the physical and chemical description of the waste as per parameters.
- 5.3 The operator should ensure that hazardous waste codes are properly placed as per HW (M&H) Rules.

#### **6. Pretreatment at Site**

This aspect is basically for making the wastes more amenable for transport and further treatment. This can be done by way of incinerator neutralization, oil & grease removal, change in form, dewatering etc., so as to render such waste less hazardous. This activity should be done in an **engineered manner** and the pollution so generated would have to be treated, so as to meet the standards stipulated in this consent order.

#### **7. Pre-Transport**

- 7.1 The occupier / generator of the Hazardous waste shall send one copy (white) out of the six coloured copies of the manifest to the SPCB, retain one copy (light yellow) with dated signature of the waste transporter after handing over the waste. The remaining 4 copies to be

used for further necessary action as prescribed in the HW (M&H) Rules. The Operator of the TSDF shall not accept hazardous wastes from a generator (through the transporter), unless the four remaining copies (with colour codes) of the manifest are provided by the generator. The operator of the TSDF will retain a copy (pink), return a copy (orange) to the transporter after receipt of the waste, and forward a copy (green) to the SPCB and send a copy (blue) to the occupier after disposal of the waste as per HW (M&H) rules.

This aspect shall include the envisaged strength of fleet of hazardous waste transportation vehicles that the Operator desires to place in service. The transport vehicles shall be designed suitably to handle and transport the hazardous wastes of various characteristics. The transportation may include transferring of the containers or contents. In both the cases, however, it has to be seen that non-compatible wastes are not mixed. The wastes shall be transported in closed containers at all times. Necessary precautions should be taken as envisaged under the guidelines issued by MoEF in 1991, CPCB in 1998 and Central Motor Vehicles Rules, 1989. There should be a garage / workshop to inspect cushioning springs, sparking from silencer, engine getting hot, starting trouble, washing of vehicles, closing arrangement etc.

- 7.2 Pre-transportation operations shall include pre-inspection of tankers/containers before filling, to check for cleanliness/ washing followed by packaging, labelling and marking. Drivers should be trained and knowledge should be provided regarding TREM (Transport Emergency) Cards and the manifest books. Washing of the containers/vehicles shall be done at the CHWTSDF or transfer stations after unloading of wastes and not in the Generator's premises before loading of fresh waste. Old labels shall be removed to avoid misleading messages. Proper documentation shall be done as per HW (M&H) Rules.

## 8. Loading & Transportation

Since the transportation cargo would be hazardous, it is essential that mechanical loading of containers take place with the help of mobile or in-built cranes/ loading equipment in the transportation vehicles meant for transporting the hazardous wastes. Portable or inbuilt cranes should be engaged to lift the containers and place them on the transporting vehicles. Spillages should be avoided through measures, such as checking shock absorbing capacity of vehicles, road surfaces, free board in the containers, curvature of the roads, unsecured fastenings of the drums etc. Manifest / shipping documents or a change of custody receipt books is essential. A location map may be prepared on a daily basis where every entry of hazardous waste load is shown.

## 9. Spillage Handling

- 9.1 Spillages during handling should be avoided by adopting good housekeeping practices and upkeep of storages/handling equipment. Operator would have to train transporting staff and provide them with instructions to use the TREM (Transport Emergency) Cards to deal with fires and accidents and should equip them with road signs, placards, etc. This aspect should also be covered under the insurance scheme.
- 9.2 The Operator shall immediately inform the **concerned SPCB** and other regulatory authorities in case of spillage, leakage or other accidents during transportation.

## 10. Waste Treatment / Stabilization

10.1 Waste Treatment/Stabilisation is a process designed to convert hazardous wastes in the form of non-aqueous liquids, semi-solids or reactive solids into less leachable solids that can be then deposited directly into the secured landfill. The treatment/stabilisation operations will be carried out for all wastes identified for the purpose so as to minimise their contaminant leaching potential. This will change the nature of these wastes to a less hazardous category. Treatment/ stabilisation could involve immobilisation of leachable materials by fixation of non-reactive solids, reduction of volume, reducing contaminant level of organic/inorganic components. etc. Selection of technology would depend on the nature of waste, physical properties, options for technology applications cost etc. The treated wastes will be assessed for compatibility with other wastes as with liner system used before being land-filled.

10.2 The term treatment/stabilisation is intended to cover a number of mechanisms including:

- (a) Immobilization/Chemical Fixation: The chemical binding of contaminants within a cementing structure to reduce the mobility or leachability of the waste constituents
- (b) Encapsulation: The occlusion or entrapment of contaminant particles within a solid matrix
- (c) Solidification: The conversion of slurries that do not readily de-water into solids, by addition of solidification and absorption agents.

10.3 General Operations for waste treatment /stabilisation may include:

- (a) Receiving waste and its storage at designated place
- (b) Reagent addition as per the pre-estimated quantities
- (c) Mixing and curing
- (d) Thermal treatment to remove moisture, organics etc.
- (e) Analysis of the stabilized sample
- (f) Transfer of stabilized material to landfill

The above process operations generally have the potential to create gaseous and particulate emissions into the air. This can be controlled by proper management practices including masking (and would have to be properly managed).

10.4 Ambient odour due to TSDF operations has to be neutralised by the operator.

11.0 Placing bulk, containerised, or non-containerised liquid hazardous wastes containing free liquids (whether or not absorbents have been added, liquids that have been absorbed in bio-degradable materials and liquids that have been stabilised by adsorbents but will release liquids when compressed under normal pressure that might occur during and after land filling) in the landfill is prohibited regardless of the length of time, presence of liners or leachate collection system.

11.1 Hence, the Operator shall use the Paint Filter Liquid Test (PFLT) to comply with this requirement. This test determines whether the waste can be accepted to landfill. If the work does not pass the PFLT, it must be treated before it can be placed in the landfill.

12.0 Waste treatment/stabilisation would have to be performed on all wastes that find their final disposal into the secured landfill but do not meet the landfill disposal criteria (placed at Annexure I of this schedule).

**13.0 Identification of Parameters for Waste Treatment / Stabilization**

Waste treatment/stabilisation parameters shall include both physical and chemical tests. Physical tests shall be performed to characterise wastes before and after stabilisation / solidification / treatment. The chemical tests shall primarily be the leaching tests, which will be conducted to evaluate the performance of specific treatment processes.

**14.0 Analysis Protocol to Confirm Treatment / Stabilization of Waste**

The operator has to conduct and document the results of the following physical tests applicable to incoming waste as well as on treated/stabilized hazardous waste. The physical tests shall be classified into the following categories:

<b>Test</b>	<b>Purpose</b>
Index Property Test – Particle size analysis (PSA)	To determine the particle size distribution of a material
Moisture Content – Paint filter liquid test (PFLT)	To determine the presence of free liquids in a representative sample of bulk of non-containerized waste
Density Testing – Bulk Density	To determine the in-place density
<b>Compaction Testing</b>	<b>To minimize volume of the waste</b>
Moisture Density Relations	To determine the relation between moisture content and density of the waste
Permeability Testing – Falling head permeability / constant head (FHP/CH)	To measure the rate at which water will pass through a stabilized waste
Strength Testing – Unconfined compressive strength (UCS)	To evaluate how cohesive the stabilized materials behave under mechanical stress
Flexure Strength (FS)	To evaluate a stabilized waste’s ability to withstand loads over a large area
Cone Index (CI)	To evaluate a stabilized waste’s stability and bearing capacity
Durability Testing – Wet dry durability (WDD)	To determine how the stabilized waste behaves or degrades after repeated wet-dry cycles

- 14.1 Chemical Tests: Leaching tests shall be used in evaluating the performance of treatment / stabilisation / solidification processes for wastes as per the recommended TCLP procedure for the identified chemical constituents in the stabilised waste. The waste stabilised shall meet the BDAT standards of USEPA before their disposal to the secured landfill till the Indian Standards i.e., “**Criteria for Direct Disposal of HW in Secured Landfill** ” for BDAT are notified.

## 15. Storage at TSDF

Separate area **shall** be earmarked for storing the waste at TSDF. The storage area may consist of different cells for storing different kinds of hazardous wastes. In designing these cells, the following points may be taken into consideration:

- (a) That ignitable, reactive and non-compatible wastes **shall** be stored separately.
- (b) That wastes containing volatile solvents or other low vapour pressure chemicals shall be adequately protected from direct exposure to sunlight
- (c) The storage area **shall** have a proper containment system. The containment system shall have a collection area to collect and remove any leak, spill or precipitation.
- (d) It **shall** be designed in such a way that the floor level of the storage area is at least 150 mm above the maximum flood level.
- (e) The operator **shall** put in place a system for inspection of the storage area to check the conditions of the containers, spillages, leakages etc and maintain proper records as may specified by the concerned SPCB in the authorization to operate TSDF.
- (f) The hazardous wastes should not be stored for more than 2 weeks at this temporary storage area.
- (g) In case the waste is not in accordance with the authorization issued by the concerned SPCB to the generator, the operator shall inform immediately to the concerned SPCB for advice and **necessary action**.

## 16. Post-treatment

Even after complete treatment there may be some residues left and care of this post-treatment residue has to be taken through physico-chemical, biological treatment, i.e. separation of oil, de-water sludge, mother liquor during solvent recovery reappearance of leachates, incinerator’s ash. Safe treatment and disposal of these wastes shall be done within the TSDF.

## 17. Secured Landfill

- 17.1 Prior to the placement of wastes in the secure landfill, an engineered capping over the surface shall be placed after completion of work daily so as to minimise the infiltration of rainfall.

17.2 During rains, the secured landfill shall have to be capped provisionally in order to prevent entry of rain into the landfill and storage areas and avoid leachate generation. The Operator shall maintain a run on control system capable of preventing flow on to the active portion of the landfill as well on the storage areas. The run off from the areas in proximity to the TSDF site shall have to be diverted away from the site. Location map of the landfill showing disposed wastes shall have to be prepared and continuously updated for monitoring and precautionary purposes.

## **18. Leachate Treatment and Disposal**

Having considered leachate quantity, quality and the variations associated, it is essential to identify the components of the leachate that are to be treated or removed such as:

- (a) Removal of high concentrations of degradable organic compounds
- (b) Removal of high concentrations of non-degradable organic compounds
- (c) Removal of varying concentrations of specific hazardous organics
- (d) Removal of varying concentrations of specific hazardous inorganic
- (e) Removal of ammonia
- (f) Denitrification of nitrates/nitrites
- (g) Removal of odours including sulphides
- (h) Removal of suspended solids
- (i) Disinfection (if required)

## **19. Incineration**

19.1 The primary aim of incineration is to completely destroy the toxicity of wastes and to get products (solids and gases) of combustion that are harmless. To achieve these aims, attention must be given to the “Three T’s of Combustion”:

- ❖ Temperature
- ❖ Time
- ❖ Turbulence

19.2 Availability of oxygen is an additional parameter, which forms an integral part of the incineration system. When the waste is burnt at the higher temperature destruction would be complete and formation of un-burnt waste, formation of organic by-products etc. would also be eliminated. The longer the waste is held at high temperature, the greater will be the degree of destruction and the less-likelihood of formation of PICs / POPs.



19.3 Turbulence relates to the degree of mixing between the waste and oxygen in the combustion air to the absence of temperature gradients within the furnace. Greater turbulence provides better control, better access to air and more complete oxidation **and** destruction of the wastes being burnt.

#### 19.4 Operating Requirements

- (a) Temperature of 900 - 1100 °C for hydrocarbon wastes and 1100 - 1200 °C for certain wastes like PCBs, waste oil residues etc. For certain halogenated organics this has to be decided on a case-to-case basis.
- (b) Time: Minimum gas phase residence time shall be of 2 seconds. Residence time of hearth solids is measured in hours and this control would be on complete destruction of solids
- (c) Combustion Air: 100% in excess of stoichiometric requirements
- (d) Turbulence: is achieved through good incinerator design.

### 20. Monitoring

20.1 Monitoring is essential because it gives a final signal about the success of treatment in converting the hazardous waste to a non-hazardous waste. It also allows timely intervention in case of leakages of pollutants before they could lead to serious accidents.

20.2 Monitoring shall be done with benchmarking the present environment in its original state i.e. before CHWTSDF is brought into construction or operation. Monitoring will continue during the operation and will go on during the post closure phase too. Monitoring shall have to be designed for various environmental facets such as:

- (a) Air - Regular monitoring at upwind, downwind and at three stations at 120° angle around the CHWTSDF is necessary. The locations of these stations depend on the stack height and location of any particular ecologically sensitive feature. Samples should be collected from stacks, vents and ducts as per emission regulations stipulated by CPCB.
- (b) Surface waters - Monitoring of waters at locations upstream, downstream and in adjoining local nullah/ river is necessary. It is also necessary to collect the sample of surface waters of the impoundment as well as the benthic deposit of the stream.
- (c) Groundwater - Samples should be collected from specially dug wells one on the upgradient and at least three on the down gradient and deep enough.
- (d) Soil - Samples of surrounding soil at ground level should be collected in a circular grid as per CPCB guidelines.

- (e) Vegetative cover - To assess the ill effect occurrence, inspection of vegetative cover is necessary along the periphery of the site.
- (f) Biological indicator - By planting sensitive plants in all directions and at different distances and to note periodically the health of each plant.
- (g) Complaint - Complaint oriented monitoring and redressal will have to be done from time to time before it becomes an issue throttling the entire project under public pressure or with the public interest litigations. The complaints may be on aesthetics, such as odour, hazardous accidents, noise, colouration or imparted tastes to well waters and ill-health effects in residential areas around the CHWTSDF.

## **21. Closure & Post-Closure Facilities**

21.1 The landfills have certain design capacity, and hence are bound to get filled up in certain period. They will have to be guarded thereafter for a period of 30 years after closure. Monitoring would have to be continued to check for leakages and remedial measures.

21.2 The closed site will have to be looked after to avoid any disturbances created by run- on and run-off storm waters, stray cattles and ignorant humans. A fenced area with security is an essential part along with routine monitoring and rectification efforts. A closure and post-closure plan will have to be prepared which will include the following:

- (a) A description how each of this unit in the CHWTSDF will be closed.
- (b) A description of how final closure of the entire CHWTSDF will be conducted.
- (c) An estimate of the leachates and other hazardous wastes residues that may be generated on site at any time during the closure/post-closure life of CHWTSDF.
- (d) A description of the steps needed to remove or decontaminate all hazardous waste residues generated during post-closure period of the operations.
- (e) A sampling and analysis plan to know as to how much decontamination will be necessary.
- (f) A timetable of commencement of closure prospects and completion.

21.3 In practice, the post-closure care shall include:

- (a) Elimination all free liquid by either removing the liquid wastes / residues from landfill / impoundment or by solidifying them
- (b) Stabilization of the remaining waste and waste residues to a bearing capacity sufficient to support a final cover
- (c) Installation of a final cover that provides long-term minimization of infiltration into the closed unit

- (d) In course of time, the material inside a landfill is likely to face settling or subsidence in a small way. The cover be such that **under** all such subsidence of support, it should not get cracked and its integrity be maintained.
- (e) Provide drainage diversions to prevent any run-on.
- (f) To grow an appropriate vegetation on the top of the cover.

## 22. Record-keeping

A day-to-day record with weekly, monthly, quarterly and annual extracts is required. Operator shall have to devise a separate format for daily record or logbook. This shall include:

- (a) Hazardous waste generation
  - category number
  - category
  - origin of manufacturing activity
- (b) Description of hazardous waste
  - physical form
  - chemical form
  - quantity (volume & weight)
- (c) Description of
  - daily method of storage of hazardous waste
  - daily method of treatment of hazardous waste
- (d) Details of transportation
  - name and address of consignee of package
  - mode of packing
  - mode of transportation
  - date of transportation
  - quantity transported
- (e) Details of disposal of hazardous waste (date wise)
  - date of disposal
  - Concentration of hazardous material in the final waste form
  - site of disposal (identify the location on the relevant layout drawing for reference)
  - method of disposal
- (f) Data on environmental surveillance
  - Date of measurement

- Groundwater (sampling location, depth of sampling, results)
  - Soil (sampling location, depth of sampling results)
  - Air (sampling location, data)
  - Any other (keep record)
- (g) Details of hazardous waster reused / recycled
- Quantity of waste received to site
  - Quantity of waste minimized by reuse and recycle
  - Final quantity of waste subjected to final landfill or incineration mode of disposal.
- (h) Details of waste disposal operations
- (i) Description of hazardous waste
- Physical form and contents
  - Chemical form
  - Total volume of hazardous waste disposed
  - No. of packages
- (j) Mode of transportation to the site of disposal
- (k) Site of disposal
- (l) Brief description of method of disposal
- (m) Date of disposal
- (n) Remark (like discrepancy in manifest etc)
- (o) Details of environmental surveillance
- Date of measurement
  - Groundwater (sampling location, depth of sampling, results)
  - Soil (sampling location, depth of sampling, results)
  - Air (sampling location, data)
  - Any other (keep record)
- (p) Accident Reporting
- Date and time of accident
  - Sequence of events leading to accident
  - Name of hazardous waste involved in the accident
  - Chemical datasheet assessing effect of accident on health and environment
  - Emergency measure taken
  - Step to prevent recurrence of such wastes

- (q) The operating agency shall also maintain a record of inspections and visits of officials from SPCB/PCC, CPCB, Factory Inspector, SIDC, MoEF & local authorities. This should be followed by compliance report.

## 23.0 Safety, Security, Contingency Plans, Risk Management & Emergency Procedures

- 23.1 Safety: Safe work environment **shall** be considered, provided and maintained for the staff by Operator. Safety and security considerations **shall** be made for all facets, like pre-treatment at Generator's site, loading, transportation and unloading of hazardous waste, spill control, treatment and disposal, laboratory and also in the post-closure period. Personal protection equipment, and fire control systems **shall** be provided at site (e.g. fire extinguishers, sand pails etc., water tanks). Training and mock drills **shall** be conducted with staff for emergency situations. A complete primary health unit with medicines/antidotes **shall** have to be provided as per the provisions of the Factory Act, 1948 and 1987. Aspects like ventilation, illumination and safe duration of limited working hours shall also have to be considered. Periodical check-up of health shall be undertaken and the persons be kept rotated. This **shall** also cover other emergencies, like snake bites or sabotage. EIA recommendations, statutory rules and regulations, Acts etc., **shall** be considered while providing for this aspect of operations.
- 23.2 Security: Entry of persons or livestock shall be prevented both during operation and post-closure period. Artificial barriers, like fence, watchtowers, shall be provided. Entry gates shall be minimum, and preferably one only, apart from emergency gates. Cautionary boards in appropriate languages and in readable letter size shall be displayed at various locations within and on the periphery of the CHWTSDF. Register of entry and exit shall be maintained.
- 23.3 Risk management, contingency plans & emergency procedures: An onsite contingency plan and emergency procedure shall be prepared and approved from the district emergency officer who in turn will prepare the off-site management plan. The contingency plan shall describe the responses in case of fires, explosion, unforeseen acts or events, sudden releases due to natural calamities. The strategic administrative arrangements with local police, fire department or medical facilities of the area, **departments** dealing safety, health & environment, offices of SIDC and revenue authorities shall be designed. Latest phone and fax numbers of concerned authorities shall be printed and distributed. Mock drills **shall** demonstrate evacuation plan with evacuation routes. Documentation shall be immediately prepared for benefits of future planning. Other considerations as per EIA have to be integrated within this aspect of the operations of the CHWTSDF.

23.4

## 24.0 Public Consultation

Precaution **shall** have to be taken by the Operator to satisfy any peculiar situation as may be demanded by the people relating to aesthetics, discomfort etc. Regular public consultation and awareness programme shall be undertaken.

## 25.0 Greenbelt

A greenbelt of 20 m **width** shall be provided at the periphery of the site to have better visual impact, to protect the surrounding environment by abating gaseous and particulate pollution as well as to reduce the noise levels and to protect the area from the cyclonic winds. The plant species should be as per EIA, and MoEF/CPCB guidelines.

## 26.0 Occupational Health

- 26.1 This is a CHWTSDF where all kinds of hazardous waste are getting collected. Workers and staff are exposed to high levels of toxins, pollution and pathogenic environment. There is high risk of occupational hazards at such sites, it is, therefore, essential to formulate a health policy / plan for the workers by the Operator. Periodical checking of workers **shall** not show any deterioration in their immunity levels. A medical room, concession for workers in working hours, not employing the people of tender age or old age, early retirement benefits, daily nutritional support, group insurance schemes and other such measures shall have to be adopted.
- 26.2 All above aspects inter-alia as prescribed under the Factory Act, 1948 amended in 1987 and the rules framed thereunder **shall** have to be complied with. The detailed risk analysis as per the technology adopted, and an on-site risk mitigation plan **shall** be prepared and the impact on the occupational health of the workers **shall** be mitigated as identified in the plan.
27. Waste acceptance criteria for disposal of hazardous wastes into the secured land is placed at Appendix-I of this schedule.

MEMBER SECRETARY

Date:

Encl.: Appendix I.

**CONCENTRATION LIMITS/CRITERIA FOR ACCEPTANCE OF  
HAZARDOUS WASTES FOR DIRECT DISPOSAL TO SECURED LANDFILL**

<b>Leachate Quality *</b>	<b>Concentration</b>
pH	4 - 12
Total Phenols	< 100 mg/l
Arsenic	< 1 mg/l
Lead	< 2 mg/l
Cadmium	< 0.2 mg/l
Chromium-VI	< 0.5 mg/l
Copper	< 10 mg/l
Nickel	< 3 mg/l
Mercury	< 0.1 mg/l
Zinc	< 10 mg/l
Fluoride	< 50 mg/l
Ammonia	< 1,000 mg/l
Cyanide	< 2 mg/l
Nitrate	< 30 mg/l
Adsorbable organic bound Chlorine	< 3 mg/l
Water soluble compounds except salts	< 10%
<b>Calorific value</b>	<b>&lt; 2500 K.Cal/kg</b>
<b>Strength</b>	
Transversal strength (Vane Testing)	> KN/m <sup>2</sup>
Unconfined Compression Test	> KN/m <sup>2</sup>
Axial Deformation	< 20%
<b>Degree of Mineralization or Content of Organic Materials (Original Sample)</b>	
Annealing loss of the dry residue at 550°C	< 20% by weight (for non-biodegradable waste)  < 5% by weight (for biodegradable waste)
Extractible Lipophilic contents (Oil & Grease)	< 4% by weight

\* *Leachate quality is based on Water Leach Test*