# Hazardous Waste Management System in India- A Review

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**ABSTRACT**

***Hazardous waste is the waste that poses substantial or potential threats to public health or the environment. Therefore to reduce environmental hazardous proper attention is required during disposal of such waste, because it cannot be disposed of by common means like other by products of our daily lives. Rapidly growing industries in the country have contributed in the production of large part of hazardous waste material. The sources of hazardous waste are basically agricultural and agro industries, medical facilities, commercial centres, household and the informal sectors. In India though there are certain rules and regulation cited by the central government for reduction of hazardous waste and for the minimization of hazardous effect on the environment still hazardous wastes are stored, transported, disposed or managed unsystematically causing health and environmental (soil, water, air) related problems. To ensure safe management of hazardous waste, generated from different industrial sources, hazardous waste (Management & Handling) rules, 1989 have been framed by central government and was further amended in the year 2000 and 2003 and recently the hazardous waste (Management, Handling and Transboundry movement) Rule, 2008 were notified for effective management of hazardous waste related environmental problem and was further amended in year 2009 and 2010. This paper basically gives details about hazardous waste management system in India and steps required to improve the waste management system in India***

***Keywords: hazardous waste, informal sectors, E- waste, radioactive, incineration***

## 1. INTRODUCTION

Hazardous waste management is an important issue in our country now days. Unscientific disposal of hazardous waste and only few secured landfill sites available in the country for disposal of hazardous waste in an environmentally sound manner posed serious risk to the environment system. Rapid industrialisation in last few decades have led to the depletion of natural resources and increase in pollution in the country. These industrialization has also led to the generation of huge quantities of hazardous waste which causes sewer environmental problems. Therefore scientific treatment and systematic disposal of generated waste is required. Ministry of Environment and Forest (MoEF) promulgated hazardous waste (Management and Handling) Rules

on 1989 under the provision of the Environment Protection Act, 1986. In September 2008 the said rules were repeated and new rules entitled "Hazardous waste (Management Handling and transboundary Movement ) Rule, 2008" these rules were further amended in year 2009 & 2010 for proper management and handling of hazardous waste in the country ***(CPCB,2010-2011)***. India has also ratified the Basel convention on transboundary movement of hazardous waste in the year 1992 ***(Dutta SK,2006)*** . It is an international treaty that was designed to reduce the movements of hazardous waste between nations, except where it is perceived to be in accordance with principles of environmentally sound management. In this paper an attempt has been made to highlight actions required for effective management of hazardous waste so, as to avoid environmental pollution and adverse health effects due to its improper handling and disposal.

## 2. CHARACTERISTICS OF HAZARDOUS WASTES

HPC(2001) defines hazardous waste (HW) as any substance, whether in solid, liquid or gaseous form, which has no further use and due to physical, chemical, reactive, toxic, flammable, explosive, corrosive, radioactive or infectious characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or environment, and should be considered as such when generated, handled, stored, transported, treated and disposed off. This definition includes any product that releases hazardous substance at the end of its life, if indiscriminately disposed off. HWs can be classified into - (i) Solid wastes (ii) Liquid wastes (iii) Gaseous wastes (iv) Sludge wastes from various anthropogenic sources (**Babu and Gupta, 1997**). An efficient Hazardous Waste Management protocol needs to be executed; other-wise it may cause land, surface and ground water pollution (**Ramakrishna and Babu,1999a; Rao, 1999 ,Wentz, 1995; Parsa *et al*. 1996; Chakradhar *et al.,* 1999**). Any product that releases hazardous substance at the end of its life, if indiscriminately disposed off is know as hazardous waste. The general characteristics of hazardous wastes are given in table 1.

**Table 1: Characteristics of hazardous wastes**

| Sr.No. Hazardous characteristics | Potential hazards on living animals / environment |
|---|---|
| Flamable/ explosive | This type of waste may cause damage to the surroundings by Producing harmful gases at high temperature and pressure or by causing fire hazards. |
| Oxidizng | Types of wastes that may yield oxygen and thereby cause or contribute to the combustion of other materials. |
| Poisonous (Acute) | These waste have high potential to cause death, serious injury |

| | |
|---|---|
| | or to harm health if swallowed, inhaled or by skin contact. |
| Infectious substances | Hazardous wastes containing micro-organisms and their toxins, and responsible for diseases in animals or humans. |
| Corrosives | These wastes are chemically active and may cause severe damage to the flora and fauna, or to the other materials by direct contact with them. |
| Eco-toxic | These wastes may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems. |
| Toxic (Delayed or chronic) | These wastes, if inhaled or ingested or if they penetrate the skin, may cause delayed or chronic effects, including carcinogenicity. |
| Organic peroxides | These are organic waste containing bivalent-O-O- structure and may undergo exothermic self-accelerating decomposition. |

***Source: Report of the High Power Committee on Management of Hazardous wastes, 1999***

## 3. PRESENT HAZARDOUS WASTE GENERATION SCENARIO

The hazardous waste generated in the country per annum is estimated to be around 4.4 million tonnes (Table 2) while as per the estimates of Organization for Economic Cooperation and Development(OECD) derived from correlating hazardous waste generation and economic activities, nearly five million tonnes of hazardous waste are being produced in the country annually. This estimate of around 4.4 million MTA is based on the 18 categories of wastes which appeared in the HWM Rules first published in 1989.Out of this, 38.3% is recyclable, 4.3% is incinerable and the remaining 57.4% is disposable in secured landfills. Twelve States of the country (Maharashtra, Gujarat, Tamil Nadu, Orissa, Madhya Pradesh, Assam, Uttar Pradesh, West Bengal, Kerala, Andhra Pradesh, Karnataka and Rajasthan) account for 97% of total hazardous waste generation. The top four waste generating states are Maharashtra, Gujarat, Andhra Pradesh and Tamil Nadu . On the other hand, states such as Himachal Pradesh, Jammu & Kashmir, all the North Eastern States excepting Assam generate less than 20,000 MT per annum. Given the wide variations in quantity and nature of waste generated across states and union territories (UTs) and also considering the wide variations in climatic as well as hydro-geological conditions in different regions of the country, the approach to waste management has to be essentially state specific (***NEERI***).

**Table 2: Status of Hazardous Waste Generation in India**

| State / Union Territory | Code | Total Districts | Districts in which HW units located | Total units | Total HW generation TPA |
|---|---|---|---|---|---|
| Andhra Pradesh | AP | 23 | 22 | 501 | 111098 |
| Assam | ASS | 23 | 8 | 18 | 166008 |
| Bihar | BHR | 55 | 12 | 42 | 26578 |
| Chandigarh | CHN | 1 | 1 | 47 | 305 |
| Delhi | DEL | 9 | 9 | 403 | 1000 |
| Goa | GOA | 2 | 2 | 25 | 8742 |
| Gujarat | GUJ | 24 | 24 | 2984 | 430030 |
| Haryana | HAR | 17 | 15 | 309 | 32559 |
| Himachal Pradesh | HP | 12 | 6 | 116 | 2159 |
| Karnataka | KAR | 27 | 25 | 454 | 103243 |
| Kerala | KER | 14 | 11 | 133 | 154722 |
| Maharashtra | MAH | 33 | 33 | 3953 | 2007846 |
| Madhya Pradesh | MP | 61 | 38 | 183 | 198669 |
| Orissa | OR | 30 | 17 | 163 | 341144 |
| Jammu & Kashmir | JK | 14 | 5 | 57 | 1221 |
| Pondichery | PON | 1 | 1 | 15 | 8893 |
| Punjab | PUN | 17 | 15 | 700 | 22745 |
| Rajasthan | RJN | 32 | 26 | 332 | 122307 |
| Tamil Nadu | TN | 29 | 29 | 1100 | 401073 |
| Uttar Pradesh | UP | 83 | 65 | 1036 | 145786 |
| West Bengal | WB | 17 | 9 | 440 | 129826 |
| **India** | **IND** | **524** | **373** | **13011** | **4415954** |

***Source: Report of the High Power Committee on Management of Hazardous wastes, 1999***

## 4. HAZARDOUS WASTE SOURCES:

India is a developing country, and industries is a major source of hazardous waste in developing countries, but industrial hazardous waste sources presents greater risks in developing countries than in developed countries because of poor management and obsolete technologies, multinational companies often set their plants in developing countries so, that they can use technologies banned in their house country. The accident at the Bhopal plant in India, which belonged to union carbide of USA is a prime example of this situation (***Kahn Danielle J***). The major source of hazardous solid wastes in our country are industrial activities, agriculture and argo-industries, medical facilities, commercial centres, household and the informal sector. Small competitive and labour intensive businesses that are not regulated by government is the source of hazardous solid waste that is currently recognized as major problem in developing countries.

## 5. LEGISLATIVE FRAMEWORK

Ministry of Environment & Forests (MoEF) promulgated Hazardous Waste (Management & Handling) Rules on 28 July 1989 under the provisions of the Environment (Protection) Act, 1986. In September 2008, the said rules were repealed and new rules entitled "Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008" (here after referred as HW (M, H & TM) Rules were notified. These rules were further amended in the year 2009 & 2010. According to the HW (M, H & TM) Rules, any waste, which by virtue of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances has been defined as „hazardous wastes" and includes wastes generated mainly from the 36 industrial processes referred under Schedule - I of the said Rules. In addition, some wastes become hazardous by virtue of concentration limits as well as hazardous characteristics listed under Schedule - II of the said Rules. Based on the data provided by the State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs), Central Pollution Control Board (CPCB) has compiled state-wise inventory of hazardous waste generating industries The hierarchy in management of hazardous waste is to reduce, reuse, recycle and re-process and final option of disposal of wastes having no potential for value addition, in disposal facilities in an environmentally sound manner. The disposal facilities may be having only a secured land fill (SLF) or may be having incinerator alone for organic wastes or combination of secured landfill & incinerator. At present, there are 26 common Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs) in operation spread across the Country in 12 States namely Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal as well as in UT namely Daman, Diu, Dadra & Nagar Haveli. 35 new sites for development of TSDF have been notified by the respective State Governments and these are at different stages of development (***Central Pollution Control Board,2010***).

### *5.1.The Basel Convention on hazardous wastes :*

India is a Party to the Basel Convention on transboundary movement of hazardous wastes. The Basel Convention is a tool for controling and reduction of transboundary movements of hazardous and other wastes subject to the Convention, prevention and minimization of their generation, environmentally sound management of such wastes and for active promotion of the transfer and use of cleaner technologies. As a party to the Convention, India is obliged to regulate and minimise the import of hazardous waste or other wastes for disposal or re-cycling and also to prohibit export of waste to parties, which have prohibited the import of such wastes. India is also required to

minimise generation of hazardous waste in the country taking into account social, technological and economic aspects (***NEERI***).

## 6. INDIAN SCENARIO OF HAZARDOUS WASTE MANAGEMENT:

### *6.1.Identification of Hazardous Waste Generation :*

HW generation is maximum in Maharashtra (45.47%) followed by Gujarat (9.73%). Minimum HW is reported in Chandigarh (0.0069%). The number of industries that generate HW are maximum in Maharashtra (30.38%) followed by Gujarat (22.93%) ***(Ramakrishna & Babu ; Agarwal & Gupta, 2011)***.

### *6.2.Waste Characterization :*

The HWs are categorized into three groups viz., Recyclable, Incinerable, and Disposable. The HW generation trends in Maharashtra and India (total) are similar. The quantity of disposable HW (inorganic in nature to be disposed off in landfill) is high compared to the other two categories (***Ramakrishna & Babu ; Agarwal & Gupta, 2011***).

### *6.3. Quantification of Hazardous Wastes:*

The quantity of HW generation reported in India is 4415954 TPA from 373 districts out of 524 districts. According to one estimate (SDNP, 2003), the land required to dispose 5.3 million tones of HW in an engineered landfill, assuming the average density of waste to be around 1.2 tonnes/$m^3$ and the depth of the landfill 4 m, would be around 1.08 $km^2$ every year. This information may be applied to future waste projections to arrive at future land requirements for the disposal of hazardous waste (***Ramakrishna & Babu ; Agarwal & Gupta, 2011***).

### *6.4. Identification of Sites for Disposal:*

The number of sites identified for disposal of HW in India is 89 out of which 39 sites are notified. The sites are ranked using a ranking methodology given in (**Lakshmi, 1999**). The Site Sensitivity Indices (SSIs) are prepared for ranking the available sites with respect to thirty-four (34) selected attributes. These attributes are based on the migration, characteristics, waste management practices for the wastes to be disposed at the TSDF ***(Ramakrishna & Babu ; Agarwal & Gupta, 2011)***

## 7. HAZARDOUS WASTE MANAGEMENT STRATEGY: (DR. SAROJ, MOEF)

### *7.1.Waste Avoidance and Waste Minimization at Source:*

In the hierarchy of waste management, waste avoidance and waste minimization have to be attempted first. For this a close look at the processes generating hazardous waste has to incorporate to find feasible processes and technologies for waste avoidance and minimization and this should be done on a regular interval. As far as possible cleaner processes needs to be considered.

***7.2. Reuse, Recovery and Recycling of Hazardous Waste:***

Second in the hierarchy of waste management is reuse, recycle and recovery of useful resources from wastes, in that order. MoEF may, therefore, consider constituting dedicated waste specific Task Forces so as to explore options/opportunities of reusing, recovery and recycling of the hazardous wastes in an environmentally sound manner.

***7.3. E-Waste (Electrical and Electronic Equipments/Assemblies):***

The recycling of e-waste such as components of waste electrical and electronic assemblies comprising accumulators and other batteries, mercury- switches, activated glass cullets from cathode- ray tubes and other activated glass and PCB capacitors etc. is also required to be regulated due to the presence of hazardous constituents. The guidelines in this regard have already been issued so as to ensure environmentally sound recycling of e-waste. The producers of electronic equipment may be required to have a centralized facility for e-waste of their brand as extended producer responsibility. In such cases, the import and export of e- waste would become necessary and should be allowed if the facility has environmentally sound processing technology. The State Governments should encourage e-waste recycling projects under the public private- partnership mode.

***7.4. Safe disposal of hazardous waste:***

Waste which cannot be reused or recycled has to be disposed of in an environmentally sound manner. Depending on the waste category, physico-chemical/bio-logical treatment, secured land disposal, incineration or any other mode of safe and environmentally sound disposal should be adopted. Design and operational norms of such facilities, either captive or common should strictly adhere to the guidelines framed by the Central pollution Control Board. Supervision of such facilities during construction stage would be necessary to ensure quality of the construction of the disposal facilities as per guidelines of Central Pollution Control Board. Post-closure monitoring of the disposal facilities would also be necessary.

***7.5. Setting-up of the Common Treatment, Storage and Disposal Facilities:***

Currently there are 25 Common Hazardous Waste Treatment, Storage and Disposal Facilities in operation in 12 States. In addition to this, 64 sites have been identified and 35 sites have been notified for setting up of the disposal facilities. The notified sites are at different stages of development. The annual capacities of the TSDFs range from 10,000 T/annum to 1.2 lakhs T/annum with an operating life span of 15-30 years. At the initial stages, a certain level of assistance from the State Governments could significantly accelerate the process of setting up of these facilities and also ensure their viability in the initial years which is vital.

### *7.6. Disposal of date-expired drugs and pesticides:*

There are significant quantities of date –expired drugs and pesticides lying in various States, which need to be disposed of. The options available are (i) to have these reprocessed wherever possible by the industry which supplied them (ii) to appropriately incinerate them either through dedicated incinerators of individual industries or through incinerator available with common facilities (TSDF).

## 8. CONCLUSION

Developing countries should learn from the experiences of developed nations regarding their hazardous waste management system and its related problems and also keep looking for new and innovative solutions that achieve a better fit with the limited resources available to developing countries. The MoEF has elaborately identified various treatment and disposal options of different hazardous waste streams that include physical/chemical treatment, landfill, biological, treatment, incineration etc. still secured landfill is the most used option for disposal of waste. The rules framed by MoEF regarding hazardous waste should be followed strictly by the industries and regulatory body should be assigned for regular monitoring purpose. Proper treatment, storage prior to treatment or disposal and safe disposal of hazardous waste is essential for environmental health.

## REFERENCES

[1] CPCB, Performance Evaluation and Monitoring of the Common Hazardous Waste Treatment Storage and Disposal Facilities including Common Hazardous Waste Incinerators, May 2010.

[2] Babu, B.V. and Ramakrishna, V., Hazardous waste management in India.

[3] Agarwal, D and Gupta, A.K, Hazardous Waste Management : Analysis of Indian and Perspective Governance (2011).

[4] Dutta,S.K , Upadhyay, V.P & Sridharan, U., Environmental Management of Industrial Hazardous Wastes in India (2006).

[5] Khan, D.J , Kaseva, M.E & Mbuligue S.E., Hazardous waste issues in developing countries.

[6] Khanna, P., Kumar, R., Kulkarni, V., Hazardous waste issues in india.

[7] http://en.wikipedia.org/wiki/Hazardous_waste.

[8] H.P.C, Report of the High Powered Committee on Management of Hazardous Wastes, Volume I (p351),Volume II (p569 ) and Volume III (p245) (2001)

[9] Jeevan Rao K. (1999). “Environmental issues in developing countries”, Environment & People.

[10] Lakshmi R. (1999). “Remote Sensing application in siting of waste disposal facilities with special reference to hazardous wastes”.

[11] Babu S. and Gupta, J.P. (1997). Waste characterization and treatment.