

National Legislations and regulations for hazardous wastes

Hazardous Wastes (Management and Handling) Rules, 1989 Hazardous Wastes (Management and Handling) Rules, 1989, as amended to date, were notified in the country under the provisions of the Environment (Protection) Act, 1986, for management and handling, and import of hazardous wastes into the country. These rules were amended in 2000 and 2003, to bring the Rules in line with the requirements of the Basel Convention and also to improve the applicability and implementation aspects with regard to imports of hazardous waste. Apart from Ministry of Environment and Forests (MoEF), Central Pollution Control Board (CPCB), State Pollution Control Boards (SPCBs) / Pollution Control Committees (PCCs)

have been delegated certain powers for control and regulation of hazardous wastes. There are 36 types of industrial processes listed in Schedule-I of Hazardous Wastes (Management & Handling) Amendments Rule, 2003. These industrial processes generate various categories of hazardous wastes and main rules applicable for such wastes and related activities are described hereunder. As per Rule 11 of the Hazardous Wastes Rules, 1989, import of hazardous wastes from any country to India shall not be permitted for dumping. Import of hazardous wastes may be allowed for processing or re-use as raw material, after examining each case on merit by the Ministry of Environment & Forests. In Schedule 8 of Hazardous Wastes Amendment Rules, 2003, 29 categories of hazardous wastes, prohibited for import and export. Wastes containing Hg, As, Waste Asbestos (Dust or Fibres), waste oil etc., are in the list of banned wastes for import and export. Both Basel Number and OECD Numbers as applicable are mentioned for each of these 29 categories of hazardous wastes. After import or export permission is granted by the Central Government or the SPCB/ PCC, as the case may be, the same is intimated to the concerned Port Authority to take appropriate steps regarding the safe handling of the hazardous wastes at the time of off-loading the same. Any person importing hazardous wastes shall maintain the records of the hazardous wastes imported as specified in Form 6A, and the records so maintained shall be open for inspection by the MoEF / CPCB / SPCB / PCC, or an officer designated by these regulatory bodies

National Environment Policy on Hazardous wastes

The "National Environment Policy 2006" has brought out management aspects of hazardous wastes in the form of an action plan which includes:

Develop and implement viable models of public-private partnerships for setting up and operating secure landfills, incinerators and other appropriate techniques for the treatment and disposal of toxic and hazardous waste, both industrial and bio-medical, on payment by users, taking the concerns of local communities into account.

Develop and implement strategies for cleanup of toxic and hazardous waste dump legacies, in particular in industrial areas and abandoned mines, and reclamation of such lands for future sustainable use.

Survey and develop a national inventory of toxic and hazardous waste dumps and an online monitoring system for movement of hazardous wastes. Strengthen capacities of institutions responsible for monitoring and enforcement in respect of toxic and hazardous wastes.

Strengthen the legal arrangements and response measures for addressing emergencies arising out of transportation, handling and disposal of hazardous wastes, as part of the chemical accidents regime.

Give legal recognition to, and strengthen the informal sector systems of collection and recycling of various materials. In particular enhance their access to institutional finance and relevant technologies.

Develop and enforce regulations and guidelines for management of ewaste, as part of hazardous waste regime.

National Hazardous Waste Management Strategy

Hazardous Waste, bulk of which is generated by the industries, can cause environmental pollution and adverse health effects if not handled and managed properly. Its effective management, with emphasis on minimization of generation and recycling/ reuse, taking into account economic aspects, is therefore essential. With this objective, it is felt necessary to have an appropriate strategy for the regulatory bodies, generators of waste, recyclers and operators of the facilities to minimize, recycle, treat and dispose of hazardous waste in an environmentally sound manner. Various actions have been taken for environmentally sound management of hazardous wastes in the country. These include establishing regulatory and institutional framework, preparation of technical guidelines, development of individual & common facilities for recycle/recovery/reuse, treatment and disposal of hazardous wastes, inventory of hazardous wastes generation, identification & assessment of dump sites for the purpose of preparing remediation plans, and creating awareness amongst various stakeholders. However, these activities need to be expanded, reinforced and strengthened. The overarching objective of this strategy is to reach the goal of "Zero Disposal of Hazardous Waste", adopting a holistic approach encompassing reduction at source, reuse, recycle and recovery- in that order- through infusion of cost-effective innovative technologies, processes, and practices. Further, the management of 'end of life' consumer products, having hazardous constituents, such as used lead acid batteries, waste electrical & electronic equipment etc., must give primacy to reuse, recycling and recovery. Hazardous waste which is not amenable to reuse, recycling and recovery has to be subjected to physico-chemical/ biological treatment, incineration or disposal in the secured landfill. The Strategy also addresses the issue of import of recyclable, recoverable or reusable hazardous waste not only to meet the growing needs of certain materials like non-ferrous metals but also to reduce negative environmental footprints. Import of hazardous waste from any country to India for disposal shall not be permitted. The hazardous waste management strategy incorporates the essence of the 'National Environmental Policy 2006', relevant multilateral environmental agreements like Basel Convention and the National Regulations.

Categories of hazardous waste and their characteristics

India is the first country that has made constitutional provisions for protection and improvement of the environment. In the Directive Principles of State Policy of the Constitution, Article 48-A of Chapter IV enjoins the state to make endeavor for protection and improvement of the environment and for safeguarding the forest and wild life of the Country. In Article 51 A (g) of the Constitution, one of the fundamental duties of every citizen of India is to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures.

In order to manage hazardous waste (HW), mainly solids, semi-solid and other Industrial wastes which are not covered by the Water & Air Acts, and also to enable the authorities to control handling, treatment, transport and disposal of waste in an environmentally sound manner, Ministry of Environment & Forests (MoEF). Government of India notified the Hazardous Waste (Management & Handling) Rules (HWM Rules) on July 28, 1989 under the provisions of the Environment (Protection) Act, 1986 and was further amended in the year 2000 & 2003. These amendments enable to identify hazardous wastes by means of industrial processes and waste streams in Schedule I and also by way of concentrations of specified constituents of the hazardous waste in Schedule II. Categories of wastes banned for export and import have also been defined (Schedule-8) The procedure for registration of the recyclers /reprocessors with environmentally sound facilities for processing waste categories such as used lead acid batteries, non-ferrous metal and used oil as contained in schedule-4 and schedule-5 respectively has also been laid down.

Further, separate Rules have also been notified in continuation of the above Rules for bio-medical wastes as well as used lead acid batteries

Hazardous waste categories:

Waste Categories	Type of waste	Regulatory Quantities
Waste Category No 1	Cyanide waste	1 kilogrammes per year calculated as cyanide
Waste Category No 2	Metal finishing waste	10 kilogrammes per year the sum of the specified substance calculated as per metal
Waste Category No 3	Waste containing water soluble chemical compounds of lead, copper, zinc, chromium and antimony	10 kilogrammes per year the sum of the specified substance and calculated as per metal
Waste Category No. 4	Mercury, Arsenic, Thallium and Cadmium bearing wastes.	5 kilogrammes per year the sum of the specified substance calculated as pure metal.

- Waste Category No. 5 Non-halogenated hydrocarbons including solvent. 200 kilogrammes per year calculated as non-halogenated hydrocarbons.
- Waste Category No. 6 Halogenated hydro-carbon including solvents 50 kilograms per year calculated as halogenated hydrocarbons.
- Waste Category No. 7 Wastes from paints, pigments, glue, varnish and printing ink. 250 kilogrammes per year calculated as oil or oil emulsions.
- Waste Category No.8 Wastes from Dyes and Dye intermediate containing inorganic chemical compounds. 200 kilogrammes per year calculated as inorganic chemicals.
- Waste Category No. 9 Wastes from Dyes and Dye intermediate containing organic chemical compounds. 50 kilogrammes per year calculated as organic chemicals.
- Waste Category No. 10 Waste oil and oil emulsions. 1000 kilogrammes per year calculated as oil and oil emulsions.
- Waste Category No. 11 Tarry wastes from refining and tar residues from distillation or prolytic treatment. 200 kilogrammes per year calculated as tar.
- Waste Category No. 12 Sludges arising from treatment of waste waters containing heavy metals, toxic organics, oils emulsions and spent chemical and incineration ash. Irrespective of any quantity.
- Waste Category No. 13 Phenols. 5 kilogrammes per year calculated as phenols.
- Waste Category No. 14 Asbestos. 200 kilogrammes per year calculated as asbestos.
- Waste Category No. 15 Wastes from manufacturing of pesticides and herbicides and residues from pesticides and their formulations, herbicides formulation intermediate products. 5 kilogrammes per year calculated as pesticides and herbicides.
- Waste Category No. 16 Acid/Alkaline/Slurry 200 kilogrammes per year calculated as Acids/Alkalies.
- Waste Category No.17 Off-specification and discarded products. Irrespective of any quantity.
- Waste Category No.18 Discarded containers and liners of hazardous and toxic wastes. Containers Irrespective of any quantity.

Convention of Hazardous waste

Hazardous waste management is a new concept for most of the Asian countries including India is a Party to the Basel Convention on transboundary movement of hazardous wastes. The basic objectives of the Basel Convention are control and reduction of transboundary movements of hazardous and other wastes subject to the Basel Convention, prevention and minimization of their generation, environmentally sound management of such wastes and 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 sham re-cycling and also to prohibit export of waste to Parties, which have prohibited the import of such wastes. Further, hazardous waste generated in the country is also required to be managed in an environmentally sound manner. India, as a Party, can prevent the import of hazardous waste or other waste if it has reason to believe that the waste in question will not be managed in an environmentally sound manner.

The lack of technical and financial resources and the regulatory control for the management of hazardous wastes in the past had led to the unscientific disposal of hazardous wastes in India, which posed serious risks to human, animal and plant life.

Health risk associated with Hazardous waste:

Uncontrolled disposal sites containing hazardous waste and other contaminants have created national environmental problems. Because of potential health problems associated with the more than 33,000 hazardous-waste sites in the United States, the Agency for Toxic Substances and Disease Registry (ATSDR) mention some toxic impact on human health. Since 1986, ATSDR has conducted public health assessments for more than 1200 of the nearly 1300 sites identified on the Environmental Protection Agency's National Priorities List (NPL) and has conducted more than 85 health-study activities. In addition, ATSDR has evaluated the chemicals that pose the greatest human health hazards at NPL sites; the list of 275 hazardous substances was selected for their toxicity.

According to exposure of hazardous chemicals human health effect can be divided into two was

- Occupational health hazards
- health hazards due to environmental contaminations

Occupational hazards associated with waste handling

Infections

- Skin and blood infections resulting from direct contact with waste, and from infected wounds.
- Eye and respiratory infections resulting from exposure to infected dust, especially during landfill operations.
- Different diseases that results from the bites of animals feeding on the waste.
- Intestinal infections that are transmitted by flies feeding on the waste.

Chronic diseases

Incineration operators are at risk of chronic respiratory diseases, including cancers resulting from exposure to dust and hazardous compounds.

Accidents

- Infecting wounds resulting from contact with sharp objects.
- Poisoning and chemical burns resulting from contact with small amounts of hazardous chemical waste mixed with general waste.
- Burns and other injuries resulting from occupational accidents at waste disposal sites or from methane gas explosion at landfill sites.
- Bone and muscle disorders resulting from the handling of heavy containers.

Health hazards associated with environmental contaminations

Toxicants	Source of contamination	Health effect
Pesticides	<ul style="list-style-type: none">• Run-off from farms, backyards, and golf courses contain pesticides such as DDT• Leachate from landfill sites is another major contaminating source. Its effects on the ecosystems and health are endocrine and reproductive damage in wildlife.	The organophosphates and the carbonates present in pesticides affect and damage the nervous system and can cause cancer. Some of the pesticides contain carcinogens that exceed recommended levels. They contain chlorides that cause reproductive and endocrinal damage.

	<ul style="list-style-type: none"> • Groundwater is susceptible to contamination, as pesticides are mobile in the soil. 	
Synthetic organics	Many of the 100 000 synthetic compounds in use today are found in the aquatic environment and accumulate in the food chain. POPs or Persistent organic pollutants, represent the most harmful element for the ecosystem and for human health, for example, industrial chemicals and agricultural pesticides. These chemicals can accumulate in fish and cause serious damage to human health. Where pesticides are used on a large-scale, groundwater gets contaminated and this leads to the chemical contamination of drinking water.	Benzene and other petrochemicals can cause cancer even at low exposure levels.
Lead.	Pipes, fittings, solder, and the service connections of some household plumbing systems contain lead that contaminates the drinking water source.	Lead is hazardous to health as it accumulates in the body and affects the central nervous system. Children and pregnant women are most at risk.
Fluoride.	Fluoride in the water is essential for protection against dental caries and weakening of the bones, but higher levels can have an adverse effect on health. In India, high fluoride content is found naturally in the waters in Rajasthan.	Excess fluorides can cause yellowing of the teeth and damage to the spinal cord and other crippling diseases
Arsenic	Arsenic occurs naturally or is possibly aggravated by over powering aquifers and by phosphorus from fertilizers. High concentrations of arsenic in water can have an adverse effect on health. A few years back, high concentrations of this element was found in drinking water in six districts in West Bengal. A majority of people in the area was found suffering from arsenic skin lesions. It was felt that arsenic contamination in the groundwater was due to natural causes.	Arsenic poisoning through water can cause liver and nervous system damage, vascular diseases and also skin cancer.

heavy metals	Industrial waste, mining waste	Some heavy metals like mercury can be able to biomagnify through their food chain
Electronic waste	Discarded part of computer, electronic appliances, burning of mother board for harvesting heavy metals like gold and silver. The ash contains several persistent pollutants like chlorinated and brominated compounds contaminate soil and also ground water. Dioxin originates from incineration contaminate air	Short-term exposure of humans to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and altered liver function. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions.

Risks of indirect contact with hazardous wastes can be reduced by appropriately containing the wastes in sealed drums, which are appropriately labelled. Vector control should be applied, such as covering waste and containing within strong vector resistant drums. Water sources should be protected from contamination from hazardous wastes. Good hygiene practice should be implemented by those handling and dealing with the wastes, such as hand washing and not taking contaminated personal protective equipment home

International incident of hazardous waste

- Large amounts of dioxins were released in a serious accident at a chemical factory in Seveso, Italy, in 1976. A cloud of toxic chemicals, including 2,3,7,8-Tetrachlorodibenzo-p-dioxin, or TCDD, was released into the air and eventually contaminated an area of 15 square kilometres where 37 000 people lived. Extensive studies in the affected population are continuing to determine the long-term human health effects from this incident.
- In 1999, high levels of dioxins were found in poultry and eggs from Belgium. Subsequently, dioxin-contaminated animal-based food (poultry, eggs, pork), were detected in several other countries. Several fatal risks like adverse birth outcomes in populations living near landfill sites of Great Britain were observed
- In July 2007, the European Commission issued a health warning to its Member States after high levels of dioxins were detected in a food additive - guar gum - used as thickener in small quantities in meat, dairy, dessert or delicatessen products. The source was traced to guar gum from India that was contaminated

with pentachlorophenol (PCP), a pesticide no longer in use. PCP contains dioxins as contamination.

- In the year of 2001, Polybrominated diphenyl ether has been detected among workers at an electronic waste dismantling region in Guangdong, China.
- Beside this Minamata incident due to accumulation of methyl mercury in food chain is well known hazardous waste in early sixties.

Hazardous waste management:

Waste Avoidance and Waste Minimisation	<p>Technology shifting</p> <ul style="list-style-type: none"> • The paper and pulp industry can shift to elemental chlorine free bleaching • Mercury cell based caustic soda plant can shift to membrane cell process unit • Dye manufacturing, pesticide industries can recover solvent for further production
Recycling of Hazardous Waste	<ul style="list-style-type: none"> • Electronic waste can be recycled • Recycling of non-ferrous metallic wastes such as zinc dross, brass dross, used lead acid batteries, copper oxide mill scale and used lubricating oil offer attractive options for resource recovery
Safe disposal of Hazardous Waste Generated	<p>Depending on the waste category, land disposal or incineration could be adopted. Design and operation of such facilities, either captive or common need to strictly adhere to the guidelines.</p>
Setting up of Common Facilities	<p>Interstate transportation of Hazardous Wastes Use of Cement Kilns for HW incineration</p> <p>Installation of common effluent treatment plant for small scale red categories industry</p>

Existing waste management status in India

Existing treatment strategies	Company used	e-address
Liquid and solid waste Incineration- industries like dyes, dye-intermediates, pharmaceutical industries, waste oil, slaughter house, animal carcasses and biomedical waste	Dr. Reddy's Lab, Hetro Drugs Ltd, Cipla Ltd, Nuclear Power Corporation Ltd, Nuclear Power Corporation Ltd.	info@ incineratorsystem.com, info@kalpvruksh.com
Cement, Alcohol, fertilizer, soap detergent, bottling, dairy, petrochemicals,	J.K.Cement, Gujrat Ambuja, Binani Cement, Ashok organics, Ratlam Alcohol, Amit Alcohol	www.environengg.com
Textiles, hatcheries, food processing, waste originating from housing and shopping malls.	SAFDeK, Bio Reactors, membrane bioreactors, reverse osmosis, nano filtration, ultra filtration	gpawan@vsnl.com

Company name	Main working areas	contacts
Steam-O-Tech engineers(I)Pvt Ltd		www.steamotech.com
Membrane Engineering (P) Ltd	Membrane bioreactors	www.membranegroup.com
Triveni Engineering and Industries	Positive algal control	www.trivenigroup.com
Southern Cogen system Pvt Ltd	BOD and COD testing effluent analysis	scgen@scogenindia.com
Genesis Membrane Sepratech Pvt.Ltd	Tertiary effluent treatment for zero discharge	www.genesismembrane.com
Subhash Industries	Soil vapour extraction, fluid bed combustion	Subhash_industries@rediffmail.com
Mazda Ltd	Jet ventury fume scrubber, packed tower scrubber	www.mazdalimited.com
Envirocare consultants (I) Pvt Ltd	Plasma Thermal destruction and Recovery System for E-waste	envirocareconsultants@yahoo.com
Auric Technoservice Pvt Ltd		www.auricent.com
Filter concept	Polymer Filtration	www.filter-concept.com
Sachin Filtech Pvt Ltd	Effluent treatment plants	www.sachininternational.com
Khosla profil Pvt Ltd	filter	www.puritytex.com
Mc Clelland Engineering Pvt Ltd	Ship Board / marine Waste	www.mcclellandincinerators.com

State-wise Status of Common Hazardous Waste Treatment, Storage and Disposal Facilities - Landfill Capacities vis-à-vis HW Generation

S. No.	Name/Location of TSDF	Secured landfill (SLF) Capacity in MPA	Total SLF Capacity in MTA**	General Land Disposal HW in MTA	Surplus Capacity / Deficit in capacity
I. Andhra Pradesh					
1	TSDF Dundigal	150000	350000	211442	138558 (Surplus)
2	TSDF, Visakhapatnam*	200000			
II. Gujarat					
3	NEIL, Nandesari, Vadodara	21667	447401	1107128	-659727 (Deficit)
4	GEPIL, Surat	100000			
5	TSDF, Odhav, Ahmedabad	71667			
6	TSDF at Vatva, Ahmedabad	63067			
7	BEIL, Ankleshwar	120000			
8	TSDF, Vapi	48000			
9	TSDF, Alang	23000			
III. Karnataka					
10	TSDF, Debaspet	40,000	40,000	18,000	22000(Surplus)
IV. Kerala					
11	TSDF, Ambalmughal, Eernakulam	50,000	50,000	51,524	-1524 (Deficit)
V. Himachal Pradesh					
12	TSDF at Baddi	50000	50000	35519	14481 (Surplus)
VI. Madhya Pradesh					
13	MP Waste Management Project , Pithampur	90000	90000	34945	55055 (Surplus)
VII. Maharashtra					
14	Mumbai Waste Management Ltd. at Talaja	120000	250000	568135	-318135 (Deficit)
15	Trans Thane Creek Waste Management Association TSDF at New Mumbai	10000			
16	TSDF at Butibori	60000			
17	TSDF at Ranjangaon	60000			
VIII. Punjab					
18	Punjab Waste Management Project TSDF at Nimbua, Derabassi	13000	13000	13601	-601 (Deficit)
IX. Rajasthan					
19	Rajasthan Waste Management Project TSDF at Gudli, Udaipur	20000	20000	165107	-145107 (Deficit)

S. No.	Name/Location of TSDF	Secured landfill (SLF) Capacity in MPA	Total SLF Capacity in MTA **	General Land Disposal HW in MTA	Surplus Capacity / Deficit in capacity
X. Tamil Nadu					
20	Tamil Nadu Waste Management Ltd. TSDF at Gummadipoondi	100000	100000	157909	-57909 (Deficit)
XI. Uttar Pradesh					
21	Uttar Waste Management Project TSDF, Kumbhi, Kanpur Dehat	17500	60167	36370	23797 (Surplus)
22	TSDF at Banthar, Unnao	20667			
23	TSDF at Rooma, Kanpur	22000			
XII. West Bengal					
24	West Bengal Waste Management Ltd. TSDF, Purba Shrikrishnapur, East Midnapur	120000	120000	120598	-598 (Deficit)
XIII. Daman, Diu, Dadra & NH:					
25	TSDF, Motarandha, Silvassa, Dadra & Nagar Haveli	7500	7500	17219	-9719 (Deficit)
Total		1,598,068	1,598,068	2,537,497	-939429 (Deficit)