



ENVIRONMENTAL MANAGEMENT OF INDUSTRIAL HAZARDOUS WASTES IN INDIA

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ABSTRACT

Hazardous wastes are considered highly toxic and therefore disposal of such wastes needs proper attention so as to reduce possible environmental hazards. Industrial growth has resulted in generation of huge volume of hazardous wastes in the country. In addition to this, hazardous wastes sometimes get imported mainly from the western countries for re-processing or recycling. Scientific disposal of hazardous wastes has become a major environmental issue in India. Hazardous Wastes (Management and Handling) have been framed by the Central Government to deal with the hazardous wastes related environmental problems that may arise in the near future. This paper gives details about the hazardous wastes management in India. Health effects of the selected hazardous substances are also discussed in the paper.

Introduction

Environmental management of hazardous wastes has become a major concern in India as haphazard dumping of hazardous wastes results in severe environmental impairment. The adverse effects of hazardous wastes as well as the significant potential risks posed by them to the life and its supporting systems are increasingly recognized¹. Rapid growth of industries in India has resulted in generation of increasing volume of hazardous wastes. Both indigenously generated and imported from other countries for recycling or reprocessing need scientific treatment and disposal. However, only a few secured landfill sites are available in the country for disposal of hazardous wastes in an environmentally sound manner. An illegal dumping of hazardous wastes by the industries may cause severe environmental pollution. The Ministry of Environment and Forests (MoEF) has promulgated Hazardous Wastes (Management & Handling) Rules, 1989 and amended the same in 2000 and 2003 for proper management and handling of hazardous wastes in the country. These rules also deal with the ban for importing a few categories of hazardous wastes. India has also ratified the



Basel Convention on transboundary movement of hazardous wastes in 1992, which is a significant tool for controlling and monitoring of import and export of hazardous wastes and its proper management. However, various issues and the regulatory framework for hazardous wastes management in the country should elaborately be understood in proper perspectives by the regulatory agencies and industries to help the Government to develop environmentally sound management system. In this paper, an attempt has been made in this direction to highlight such aspects, which will help policy planners, decision makers, researchers etc. of the country.

Characteristics of hazardous wastes

Hazardous wastes, which may be in solid, liquid or gaseous form, may cause danger to health or environment, either alone or when in contact with other wastes. Hazardous wastes can be identified by the characteristics that they exhibit viz., ignitability, corrosivity, reactivity, or toxicity . The general characteristics of hazardous wastes are given in Table 1. Various agencies have defined hazardous wastes in different ways and as such, there is no uniformly accepted international definition so far. It is presumed that about 10 to 15 percent of wastes produced by industry are hazardous and the generation of hazardous wastes is increasing at the rate of 2 to 5 percent per year.

Process wastes

Hazardous wastes in India can be categorized broadly into two categories, viz., i) hazardous wastes generated in India from various industries, and ii) hazardous wastes imported into or exported to India. Hazardous wastes are being generated in the country by various industries. Inventorisation of hazardous wastes generating units and quantification of wastes generated in India are being done by the respective State Pollution Control Boards (SPCBs) or Pollution Control Committees (PCCs). Depending on the physical and chemical characteristics of hazardous wastes, these may be categorized into three categories, viz., recyclable, incinerable and landfill. The hazardous wastes may be categorized as recyclable when resource recovery is possible by reprocessing the waste, as incinerable when it is possible to incinerate the wastes for destruction and energy recovery, and as landfill waste when this is not suitable either for resource or energy



recovery, but suitable for dumping with or without any treatment¹. Reliable data on quantity of various categories of hazardous wastes generated is not available as yet. The processes of inventorisation of hazardous wastes generating industries and quantification of hazardous wastes in India are in progress. While observing data from various sources, the rate of generation of hazardous wastes in India could be above 6.7 MT/ year⁵. Apart from the above insitu hazardous wastes generation in the country, import of hazardous wastes is a matter of concern for India. Various types of hazardous wastes are being imported, mainly from the developed countries. Proper record of the same is still difficult to maintain in spite of due attention drawn by the Supreme Court Monitoring Committee (SCMC) on Hazardous Wastes. These wastes are being imported for recycling or dumped elsewhere, as such types of imported recycled wastes contain hazardous constituents.

Table 1 Characteristics of hazardous wastes

Sr. No	Hazardous characteristics	Potential hazards on living animals / environment
1.	Flammable/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.
2.	Oxidizing	Type of wastes that may yield oxygen and thereby cause or contribute to the combustion of other materials.
3.	Poisonous (Acute)	These wastes have high potential to cause death, serious injury or to harm health if swallowed, inhaled or by skin contact.
4.	Infectious substances	Hazardous wastes containing micro-organisms and their toxins, are responsible for diseases in animals or humans.
5.	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.
6.	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.
7.	Toxic (Delayed or chronic)	These wastes, if inhaled or ingested or if they penetrate the skin, may cause delayed or chronic effects, including carcinogenicity.
8.	Organic peroxides	These are organic waste containing bivalent-O-O- structure and may undergo exothermic self-accelerating decomposition

Recycling of hazardous wastes regenerates hazardous wastes, which are often more toxic in concentration than the material recycled. Such wastes have a detrimental impact on public health and the natural environment, including wildlife, if disposed of unscientifically.



Recycling of hazardous wastes

Hazardous wastes having the resource values are recycled or reprocessed for value recovery. Used oil, battery wastes and other non ferrous wastes like zinc, lead are commonly recycled in India. Used oil is generated in the industrial sectors and from the automobiles, transformer or capacitor oil etc. Used oil contains high levels of various heavy metals like lead, cadmium, arsenic and chromium etc. It also contains contaminants such as chlorinated solvents, polychlorinated bi-phenyls and other carcinogens. It is estimated that one gallon of used oil is sufficient to contaminate one million gallons of ground water. Import of used oil/waste oil is banned in India due to its potential pollution hazard. However used oil is a precious and non-renewable resource and can be recycled back to pure lube oil again and again. USA generates 1.4 billion gallons of used oil every year, of that only 12 percent is recycled back into high quality products and rest is either burnt (56 percent) or disposed illegally (32 percent).

The Hazardous Wastes (Management & Handling) Amendment Rules, 2003 recommend Environmentally Sound Technologies (EST) for recycling of used oil in our country. These technologies include : i) Vacuum distillation with clay treatment, ii) Vacuum distillation with hydro-treating and manufacturing. In developed countries, municipalities, public and private organizations accept used / waste computers and other electronics for recycling. Now electronics manufacturers like Dell and HP are offering recycling services in some countries. The retailers and dealers of electronic items may be made responsible to ensure proper end-of-life disposition of E-wastes.

It is reported that 1.6 million kg of material each month are recovered in recovery centres of HP in the US and Europe, which is 98% by weight of all material received from customers and from within HP. The waste and the constituent parts must be sent to specialists, who can deal with the components to recover reusable materials and then safely dispose of the rest. CRTs, LCDs, printed circuit boards, power supplies and batteries must all be processed individually to ensure that the respective materials are handled safely. The recycling programmes of Dell and HP have encouraged the Irish people to take advantage of E-recycling. Through Dell, Irish customers recycled over 22 tons of computer equipments in 2004. Looking at this Irish trend, continued and concerted effort on behalf of government, producers and environmental groups is needed in each state level and country as a



whole to ensure proper management of increasing volume of E-waste in India.

Reusing and recycling the raw materials from obsolete E-products help in conserving natural resources and reducing the air and water pollution as well as reducing greenhouse gas emissions, which are caused during manufacture of such products. As being followed in many countries, donating electronics for reuse extends the life of the electronics as well as keeps the valuable products out of the waste management system. By donating used electronics to the schools, NGOs, and lower income families, which can not afford the new-purchase, the society can be benefited. USA provides tax incentives for computer donations.

Universal waste

This is a new term, generally applied for the hazardous wastes generated in the households. E-waste may be considered as part of the universal waste. Batteries, lamps, aerosol cans, mercury thermometer, rubber floorings, electronic devices, etc. categorize under the universal waste. Although most of the hazardous management rules do not apply on these items, yet these are required to be segregated and disposed of at waste facilities. Many of the universal wastes can be recycled. These wastes may pose serious health hazards, if accumulated for longer duration in houses. California Environmental Protection Agency (CEPA) has framed rules for managing universal wastes, which prohibit disposal at an unauthorized sites like roadside or ditches, which is termed as an illegal and a serious crime and environmental threat. Issues of concern Management and disposal The major issues of concern for hazardous wastes in India are import, illegal dumping sites and in-complete data on generation and disposal of hazardous wastes in the country. Industrial incinerators in use are generally not efficient and are merely a combustion chamber and source of emission of dioxins and furans. Environmentally sound management of hazardous wastes would require Common Hazardous Waste Management Facility (CHWMF) for industrial clusters spread all over the country, as it is not possible to have hazardous waste management facility for each unit, particularly in the case of small and medium scale units. Health effects of hazardous wastes / substances Hazardous wastes are considered very harmful to man and environment. These wastes pose a severe environmental hazard to the human health and to various components of environment, viz. soil, air or water¹². Various possible effects of hazardous wastes on human health are given in Table 2. Health impacts of hazardous pollutants have been studied in great detail by many organizations and individuals including the Government Organizations



in India and other countries. In addition to research on health impacts, there are impact-related guidelines advocating for a full-fledged Health Impact Assessment (HIA) developed by several organizations.

Table-2 Health effects of hazardous wastes

Hazardous waste	Source	Health effects
Heavy metals		
Arsenic	Mining, non anthropogenic	Carcinogenic, cardiac disorders, anemia
Cadmium	Mining, fertilizer industry battery waste	Carcinogenic, damage to livers and kidneys, chronic obstructive pulmonary diseases, cardiovascular and skeletal disorders.
Chromium	Mining areas, Tanneries	Kidney damage, skin disease, acute tubular damage
Lead	Lead acid battery smelters	Lead poisoning, neurotoxic, mental impairment in children, damage to brain, kidney and live
Manganese	Mining areas	Respiratory disease, neuropsychiatric disorder
Mercury	Chlor-alkali industries, health	Hg poisoning affects human brain, central nervous system, kidneys care institutes
Nickel	Mining, metal refining	Lung and nasal cancer, damage to gastrointestinal system, cerebral edema, respiratory failure
Hydrocarbons		
Benzene	Petrochemical industries, solvents	Headaches, nausea, leukemia, damage to bone marrow Vinyl chloride
Pesticides	Insecticide	Cancers, genetic damage, stillbirths, immune system disturbances, embryo damage
Organic chemicals		
Dioxins	Waste incineration	Cancer, birth defects, skin disease
PCBs, Skin	Fluorescent lights, E-waste, Hydraulic fluid	Skin damage, possibly carcinogenic, gastro-intestinal damage



World Initiatives

After the Bhopal Gas Tragedy in 1984, USA enacted the 'Emergency Planning and Community Right to Know Act, 1986', which may be considered as a pioneering legislation regarding 'Community Right to Know'. Industries must prepare emergency response plans with discussion and due representation of the local community. As in USA, in our country also Toxic Release Inventory (TRI) should be made available to the public by way of printed reports, computer disks and on-line telephone support services and such a database should be in the public domain. Agenda 21 of United Nations Conference on Environment and Development (UNCED) in 1992 focused on pollutant release and transfer register. It prompted the Organization for Economic Cooperation and Development (OECD) to host a series of workshops to design such a register. The HPC has strongly recommended that the information on such areas where hazardous chemicals / materials are being used should be made available, and suitable legal steps should be taken to enact an Emergency Planning and Community Right to Know Act or a similar law for use in India. One of the achievements in the above aspects, as India's initiative, is that all industrial facilities shall put up two signboards of 6 x 4 ft each at a publicly visible place at the main gate. The first signboard shall provide information regarding the facility-specific Consent to Establish and Consent for Operate conditions. The second signboard shall provide information on releases to the environment, including air emissions, water discharges and solid wastes. If the facility handles hazardous materials, display information to the public would also include the maximum range of the vulnerable zone, if a catastrophic accident occurs in a worst case scenario.

Management options

Use of hazardous wastes as fuel

There are 250 cement works located in the European Union (EU), which, altogether are using around 3 million tons of hazardous waste as alternate fuels. This is over 10 percent of the fuels used and the figure is rising steadily across the European Union with countries such as Germany leading the way.



There are a large number of hazardous wastes generating units located in the Country. 11,138 units have been given authorization by SPCBs under Hazardous Waste (Management and Handling) Rules, 2003, mostly for temporary storage of hazardous wastes within the plant premises. In India, about 4.43 million tons of hazardous wastes are generated annually, out of which 71,833 tons are incinerable (as per the reports of SPCBs submitted to the Hon'ble Supreme Court). There is a need to explore the possibility of using such wastes by other industries.

Incineration

Incineration is the process of destruction of all high calorific and highly toxic wastes by burning the waste at high temperature. Incineration at 12000 C mineralises (breaks down into basic non-toxic components) all kinds of organic matter in the waste. However, the process of incineration releases toxic air pollutants like dioxins, furans, etc., if the waste is not incinerated at very high temperature. Therefore, destruction efficiencies of toxic compounds during incineration (effectively 99.99%) with no generation of persistent organic pollutants (POP) should be the prime criteria for design of an incinerator system. Incineration serves the dual purpose of reduction of both the toxicity and the volume of the waste, which is an important consideration when the disposal of wastes is finally destined for landfills. Most of the process wastes from chemical unit operations can very well be treated in properly designed incinerators.

Hazardous wastes (secured) landfill ‘

Hazardous wastes landfill’ refers to a waste disposal unit, which is designed and constructed with the objective of minimum impact to the environment. The hazardous wastes landfill site is designed scientifically to have an impervious stratum at bottom to stop leachates percolation, and thus to avoid soil and water pollution/contamination in the vicinity of the landfill site. HDPE lining is used in making the landfill impervious. There are arrangements made for collection and treatment of leachates from the hazardous wastes. Once the landfill is filled up, it is covered with HDPE lining to make the landfill impervious from the top. The top is again covered with thick layer of soil and finally the site is covered with vegetation cover. However, continuous monitoring of reclaimed site is necessary for longer



period. Various reports indicate that more than 19 Treatment, Storage & Disposal Facility (TSDf) have been created in Gujarat alone. Many other states are following the similar action to establish such facilities. However, some kind of risk will always be there for the people and ecosystem by these operating and closed TSDf. Therefore, before deciding hazardous wastes disposal in TSDf, we must make sure that all other environmental friendly options, like recycle and reuse of such wastes are not possible. Reduction and minimization of hazardous wastes is absolute requirement in today's world. Option of storing of dangerous wastes would not be a long solution and could be considered for bridging period only. There are more than 30,000 chemical and radioactive disposal sites in USA and of these 1200 2000 sites are considered threat to human health, as reported by the Environmental Protection Agency (EPA).

Conclusion

It is difficult to develop alternative technology for total elimination of hazardous wastes generation. In developing countries, the thrust on economic development is often given priority to production costs than the best available technology and this results in more wastes generation. The cost of treatment and disposal of such wastes becomes a liability on the society. The MoEF has elaborately identified various treatment and disposal options of different hazardous waste streams that include physical / chemical treatment, landfill, biological treatment, incineration, recycle and recovery and solidification etc. As on today, the most often used option for disposal of wastes is secured landfill. Several publications define criteria for selection of such sites keeping in mind hydrogeological factors, land use-cover, ecological and human values¹⁶. The other options should be given also equal weightage to reuse and recycle of such wastes for resource recovery before deciding for a landfill. Environmental Impact Assessment (EIA) is being practiced all over the world to decide a site of secured landfill to ensure less negative impact of such facility on human and ecological systems. In spite of the above technical knowledge available in the country, development of such facilities has not taken at desired pace. As in other sectors of development where private ventures are entering in a big way, waste management, treatment and disposal programmes offer a good scope for private entrepreneurs to benefit with this sector of development. This will not only



enable a facility provider to sustain his industry with profit but also the society will be benefited from these developmental activities in terms of getting cleaner environment and employment. Secured landfill and incineration projects have enormous scope to become an organized sector in Environmental Management Programme of the country. Regional Hazardous Waste Facility shall be more economical, profitable and will serve the requirement of a region, thus, eliminating the scope of scattered impact of many such facilities of smaller scale.