

Hazardous Waste: An Emerging Concern a Review

Namita Saxena

*Assistant Professor, Department of Chemistry,
Rustamji Institute of Technolgy Tekanpur,
Gwalior, MP-475005*

Abstract - Industrial policies, since independence fostered the growth of industries in India. The rapid industrialization has been key to the economic growth. Majority of these industries are inherently polluting in nature and have significant environmental consequences in terms of liquid effluents, air emissions and hazardous wastes. Hazardous waste is term applied to those wastes that because of their chemical reactivity, toxicity, explosiveness, corrosiveness, radioactivity or other characteristics constitutes a risk to human health or the environment. Hazardous waste management is a very important issue and is assuming significance globally. The adverse impacts caused due to the indiscriminate disposal of hazardous wastes are considered as technological disasters. Environmental policy encouraging hazardous waste reduction began in 1976 with an Environmental Protection Agency statement promoting source reduction as the preferred method of hazardous waste management. In order to best protect public health and the environment without unfairly burdening the people of developing countries, policy makers of all developed and developing nations must redesign the approach to hazardous waste management and to create awareness among them. Keeping the environment and people safe from harmful substances and hazardous wastes goes beyond management. It means working to avoid these dangers entirely by removing them, wherever possible, from production and use. This review article focuses on the current status, problems and challenges, policy issues, and future strategies for improvement in hazardous waste management system in India.

Key words: Hazardous waste management, waste disposal, environment, Indian scenario

I. INTRODUCTION

Being an industrializing country, India's contribution to the generation of hazardous wastes is considered significant. Growth in India's economy is intrinsically linked with performance of the industrial sector. According to the National Inventory of Hazardous Waste Generating Industries and Hazardous waste management in India, there is about 6.2 million metric tons of hazardous waste generated every year. According to the data provided by Central Pollution Control Board (CPCB), there are about 36,165 number of hazardous waste generating industries (CPCB 2010). Major portion of these industries are polluting in nature as designated by CPCB and have significant environmental consequences in terms of hazardous waste. High Powered Committee (HPC 2001) defines hazardous waste as any, whether in solid, liquid or gaseous form, which has no further use due to physical, chemical, reactive, toxic, flammable, explosive, corrosive, radioactive or infectious characteristics causes danger to health or environment, whether alone or when in contact with other wastes or environment. This definition includes any product that releases hazardous substance at the end of its life, if indiscriminately disposed off. Hazardous wastes can be classified (Babu and Gupta, 1997) into - (i) Solid wastes (ii) Liquid wastes (iii) Gaseous wastes (iv) Sludge wastes from various anthropogenic sources. 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). Emergency and disaster management (E&DM 2003) classified the hazards and disasters into four categories viz., natural events, technological events, manmade events and region wise events (Babu and Ramakrishna). The adverse impacts caused due to the indiscriminate disposal of hazardous wastes come under the category of technological disasters. 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 (Shantanu Dutta et al., 2006). Risks and threats to public health arising due to improper handling, storage and illegal dumping can be substantially reduced if scientific management practices of waste in designated facilities are adopted. It is hence imperative that improper handling of harmful materials cause serious problems due to the environment and as such, we do need to adopt proper hazardous waste management strategies.

II. 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. Most of the hazardous wastes can be identified by one or more of its dangerous properties or characteristics that they exhibit viz., ignitability, corrosivity, reactivity, or toxicity.

Ignitability: According to the Environment Protection Agency (EPA), "Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 600C.

Corrosivity: According to the EPA "Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels.

Reactivity: The EPA defines reactive wastes as, "wastes which are unstable under normal conditions. They cause explosions, toxic fumes, gases or vapours when heated, compressed, or mixed with water.

Toxicity: Toxic wastes are defined by the EPA as wastes that are "harmful or fatal when ingested or absorbed. When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute ground water.

In addition, materials can acquire hazardous waste status, if they are mixed with, or contaminated with, or are derived from, other wastes that are themselves hazardous.

III. QUANTIFICATION OF HAZARDOUS WASTES

The hazardous wastes are quantified based on their individual characteristics. The several options of compatibility of wastes with different characteristics should be studied and segregated. The quantity of hazardous wastes will be expressed in terms of each category for disposal (e.g. recyclable, incinerable or disposable etc) (HPC 2001). There are about 36,165 number of hazardous waste generating industries in India, which has to go for final disposal in secured landfill (SLF) is about 2.7 million metric tons (i.e. 43.78%), disposal by incineration is about 0.4 million metric tons (i.e. 6.67%) and recyclable waste is about 3.1 million metric tons (i.e. 49.55%) of total hazardous waste generation in the country (CPCB 2010). The amount of hazardous wastes generated in the country (6.2 million metric tons) is quite small in comparison to that of the USA, where as much as 275 million TPA of hazardous waste is generated, however, considering the fragile ecosystem that India has, even this low quantum of HW can cause considerable damage to the natural resources if not managed properly.

IV. INDIAN SCENARIO OF HAZARDOUS WASTE MANAGEMENT

The hazardous waste generation in Indian sites is given in Figure 1 and Figure 2 (HPC 2001; SNDP 2003). The data shows that in India, there are 36,165 nos. of hazardous waste generating industries, generating 62,32,507 metric tonnes of hazardous wastes every year. The category-wise classification of this quantity is as follows.

- Land Fillable HW – 27,28,326 MTA (Metric Tonnes/Annum)
- Incinerable HW - 4,15,794 MTA
- Recyclable HW - 30,88,387 MTA

It is obvious that the recyclable portion of HW is in the range of 49.55 % and is more than other two categories. The land disposable portion and incinerable portion are in the tune of 43.78 % and 6.67 % respectively. Gujarat, Maharashtra and Andhra Pradesh are the top three hazardous waste generating states. The relative contributions by these states are 28.76 %, 25.16 % and 8.93 % respectively. Thereafter, Chhattisgarh (4.74 %), Rajasthan (4.38 %), West Bengal (4.17 %) and Tamil Nadu (4.15 %) are found as major generators of hazardous waste. These seven states are together generating 80.29 % of country's total hazardous waste.

V. EFFECTS ON ENVIRONMENT AND HUMAN HEALTH

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 water (Misra V et. al., 2005). Hazardous wastes cause direct risk to health and the environment, resulting from release into the environment affecting soil, groundwater and air. All HW should be handled with great care. Improper storage, handling, transportation, treatment and disposal of HW results in adverse impact on ecosystems including the human environment. (Table1).

VI. LEGISLATIONS & REGULATIONS FOR HAZARDOUS WASTES

The Hazardous Wastes Management & Handling Rules, 1989 was introduced under sections of the Environment Protection Act of 1986. It provide for control of generation, collection, treatment, transport, import, storage and disposal of wastes. In 1991, the MoEF issued guidelines for management and handling of hazardous wastes to owners/operators for storing hazardous waste, transporting it to appropriate place for treatment and disposal facility. These guidelines also established the mechanisms for the development of a reporting system for the movement of hazardous waste and for the first time established procedures for closure and post-closure requirements for landfills (http://www.ppcb.gov.in/hazardous_waste.php). These rules were amended in 2000 and 2003, to bring the rules in line with the requirements of the basal convention and also to improve the applicability and implementation aspects with regard to imports of hazardous wastes. The MoEF enacted an umbrella act that is the nodal agency for environmental matters in India. It exercises control over imports of hazardous wastes under the Hazardous Wastes Rules. The MoEF is also a nodal authority in India for the purposes of implementing the legal provisions of the Basel Convention. Hazardous Substances Management Division (HSMD) of the MoEF deals with the management of hazardous wastes (both indigenous and imported), hazardous chemicals and major chemical accidents. Hazardous wastes can also be disposed off through Treatment, Storage and Disposal facility (TSDF) which includes a centralized location catering to the hazardous waste generated from the waste generators in the near vicinity. The planning for hazardous waste management comprises of several aspects ranging from the identification and quantification of hazardous waste to the development and monitoring of TSDF.

VII. POLICIES AND STRATEGIES FOR HAZARDOUS WASTE MANAGEMENT

Considering the severity of the problem, it is imperative that certain management option be adopted to handle the HWs. The Hon'ble Supreme Court of India has been playing a significant role for proper environmental safeguards in the country. A Public Interest Litigation (PIL) was filed in the Supreme Court of India by an NGO objecting to the import of hazardous wastes into the country (Shantanu K Dutta et al. 2006). The CPCB has prepared a ready reckoner in 1998 providing technical information on sources of hazardous wastes, their characterisation and the various methods for recycling and disposal (planningcommission.nic.in/plans/planrel/fiveyr/10th/volume2/v2_ch9_1.pdf). The action has been initiated by the Health and Family Welfare Department for identification of site and establishing common biomedical waste treatment facility for the wastes from Government hospitals (moef.nic.in/downloads/public-information/Roadmap-Mgmt-Waste.pdf).

VIII. CONCLUSION

The industry driven economy of India's has resulted in hazardous waste problems, which are difficult to manage in an environmentally friendly manner. Problems, due to hazardous wastes are likely to become serious in near future in India. There exists an urgent need for a detailed assessment of the current and future scenario including quantification, characteristics, existing disposal practices, environmental impacts etc. Proper treatment, storage prior to treatment or disposal of hazardous waste is the need of the hour. Guidelines are available in India for management and Handling of HWs. Reduction and minimization of hazardous wastes is absolute requirement in today's world. Historically, some hazardous wastes were disposed of in regular landfills, oceans, open dumping etc. which resulted in unfavourable amounts of hazardous materials seeping into the ground. Another important role that the MoEF has to play is to create awareness in society and other stakeholders at large, and to ensure educational training programs. The latter should certainly cover those directly concerned with implementation programs, e.g. environmental scientist, officials' etc. There is an urgent need for formulating proper hazardous waste management strategies, implementation of hazardous wastes management regulations and establishment of proper hazardous waste treatment and disposal facilities (HWTDF) for controlling the unscientific disposal of hazardous wastes. The impending waste management crisis should be approached holistically. While formulating integrated solutions, it is important that we consider the time period associated with various technologies and methods, and their applicability. Planning at the national and local levels to deliver long term solutions should maintain focus on addressing the immediate problems.

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Figure: 1 Percentage Contribution towards HW generation by different states/UTs (Largest to Smallest) (2008).

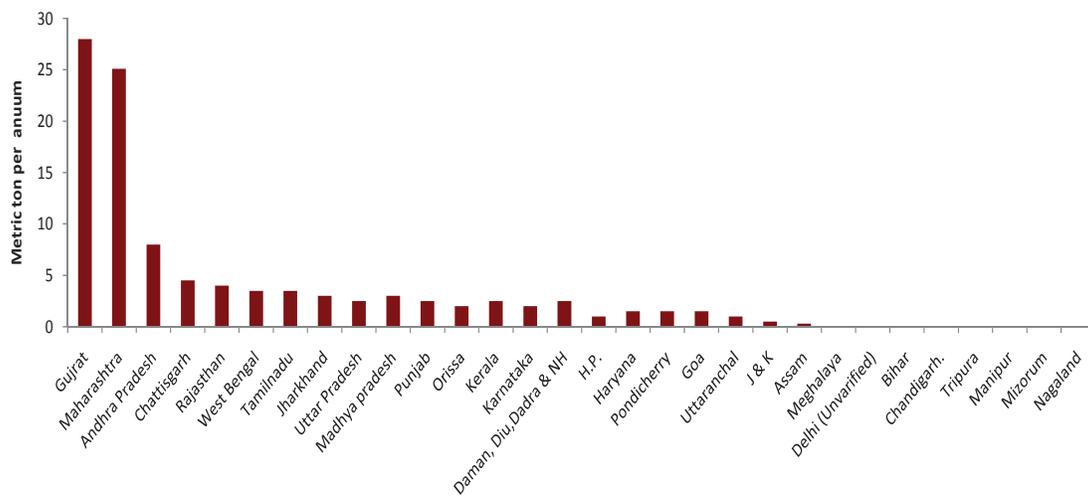


Figure: 2 Category wise Hazardous Waste generation in India (2008) Total HW generation 6232507- MTA

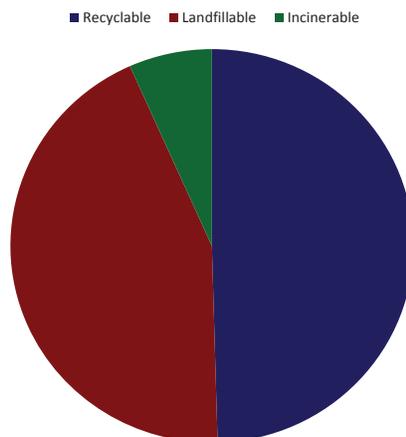


Table: 1 Health Effect of Hazardous Waste

Hazardous waste	Source	Health effects
Arsenic	Mining, non anthropogenic geo-chemical formation	Carcinogenic, cardiac diseases, anaemia
Cadmium	Mining, fertilizer industry, battery waste	Carcinogenic, damage to liver and kidney, chronic obstructive pulmonary diseases, cardiovascular and skeletal disorders
Chromium	Mining areas, Tanneries	Kidney damage, skin diseases, acute tubular damage
Lead	Lead acid battery smelters	Lead poisoning, neurotoxic, mental impairment in children, affects kidney and liver
Manganese	Mining areas	Respiratory diseases, neuropsychiatric disorder
Mercury	Chlor-alkali industries, health care institutes	Hg poisoning affects human brain, central nervous system, kidney and liver. High Hg exposure causes vision, speech and hearing impairment, May lead to death
Nickel	Mining, metal refining	Lung and nasal cancer, damage to gastrointestinal system, cerebral oedema, respiratory failure
Benzene	Petrochemical industries, solvents, plastics	Headaches, nausea, leukemia, damage to bone marrow, Carcinogenic, depression of central nervous system, embryotoxic
Pesticides	Insecticides	Cancer, birth defects, skin diseases
Dioxins	Waste incineration, herbicides	Cancer, birth defects, skin diseases
PCBs	Fluorescent lights, E-waste, Hydraulic fluid	Skin damage, possibly carcinogenic, gastro-intestinal damage