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# Industrial Hazardous Waste Management by Government of Gujarat

Anita S. Ahuja[1st]
Assistant Professor,
D. L. Patel Institute of Management & Tech.,
Himmatnagar, Gujarat (India)

Sachin D. Abda[2nd]
Assistant Professor,
SGJ Institute of Management and IT,
Mandvi, Gujarat (India)

***Abstract:*** ***Gujarat has emerged as one of the leading industrial state with tremendous growth in India. The state has attracted the most foreign direct investment and is now one of the favoured industrial investment destinations. FDI accounts for the 22 percentage of countries investment flow and Gujarat is leading FDI investment. By the initiative taken by Gujarat government recently vibrant Gujarat 7th global submit 2015 Gujarat has came forth with many investment plans and initiatives. The state's vision is to become the largest business hub in Asia. Any such development activity puts pressure on resources. With increase in industrial development the production of the industrial waste has increased on a rapid pace too. Gujarat has 7751 hazardous waste generating units contributing to 28.76 percentage of waste generation in India. With that the Hazardous waste management is issue of very importance, assuming significance globally, the adverse impacts caused due to indiscriminate disposal of hazardous material comes under environment disaster. Based on this the researchers here want to know various types of hazardous waste produced by industrial sector in Gujarat, To know the negative impacts on environment of this hazardous waste, to gain knowledge about various steps taken by Government of Gujarat to manage Hazardous wastes and To get an information about the best alternative selected by Government of Gujarat to manage Hazardous wastes by comparing all the options taken by Government of Gujarat to manage Hazardous waste as if all the steps for managing waste are not similar in their results, some of them produce good results while others are causing harm to environment. Researchers had focused on secondary sources for data, mainly from research papers, government articles, websites & literature, after collecting data researchers will try to analyze the data for achieving mentioned objectives. After this research researchers are expecting they will get information on types of hazardous waste and their consequences on environment, apart from this they are expecting to get information on initiatives by Government of Gujarat to manage waste and the best alternative applied by Government of Gujarat to manage Hazardous waste and with that the future proceeding planned by the Gujarat Governance for the further hazardous waste management. This observation will be helpful to Government of Gujarat for improving their prevailing practices, with that it can be helpful to the other state government bodies for managing hazardous wastes also further research work can be done on the basis of this study.***

***Keywords:*** ***Hazardous waste, incineration, secured landfill.***

## I. INTRODUCTION

With the rapid industrial growth and with the vision of becoming the largest business hub in Asia, Gujarat has emerged one of the leading industrialised states in India. The state has shifted its industrial policy form cluster and state based industries to special economic zones (SEZ's). Gujarat has become the fastest growing state in terms of industrial development with pharmaceutical, chemical, drugs, petrochemical, textiles, pesticide & fertilizer. Industries in Gujarat are categorized into Red, Green & Orange on the total quantity and Characteristic of different types of waste generated and production in industries. There are 16,770 red – high polluting industries which has increased three fold from 2006 to 2012. Similarly orange moderately flow industries too have raised three fold 2022 in 2006-07 to 6468 in 2012 , but green-non polluting industries 828 units in 2006-07 to 4654 in 2011- 12 which is fivefold that is a positive sign of green development. Gujarat is boon with 1600 km coastal line giving opportunity for port based development too. All these industrial developments put pressure on the natural resources, with increase in industrial development the production of the industrial waste has increased on a rapid pace too. As per current information obtained by SPCBs(State pollution control board), it is estimated that there are about 41,523* number of hazardous waste generating units in India and their waste generation is about 7.90 million tons per annum, Gujarat has 7751 hazardous waste generating units contributing to 28.76 percentage of waste generation in India.

### *A. Hazardous Waste (HW) definition:*

Hazardous waste is defined broadly under the rules to include any waste that, by virtue of its characteristics, "causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances". In addition to this broad definition, the rules identify certain wastes and wastes with certain characteristics as hazardous. Any waste, 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. Examples:

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| | |
|---|---|
| Example of hazardous waste | • Mercury bearing sludge<br>• Date-expired, discarded and off-specification drugs/medicines<br>• Toxic metals or organic complexes |
| Example of characteristic that would make waste hazardous | • Benzene concentration >= 50 mg/kg<br>• Flammable<br>• Toxic. |

### *B. The Legal Framework in India regarding HW:*

Hazardous Wastes (Management and Handling) Rules, 1989, notified under the Environment (Protection) Act, 1986 and subsequent amendments in 2000, 2003, 2008 and 2009 as the Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, regulate management of hazardous wastes generated within the country as well as export/import of such wastes. These rules refer to effective management of hazardous waste, mainly solids, semi-solids and other industrial wastes, which do not come under the purview of Water (Prevention and Control of Pollution) Act and Air (Prevention and Control of Pollution) Act, Municipal Solid Wastes (Management & Handling) Rules, Batteries (Management and Handling) Rules, Bio-Medical Waste (Management and Handling) Rules, and Merchant Shipping Act.

## II. OBJECTIVES OF THE RESEARCH

- To know various Types of hazardous waste produced by industrial sector in Gujarat.
- To know the negative impacts on environment of this hazardous waste.
- To gain knowledge about various steps taken by Government of Gujarat to manage Hazardous wastes
- To get an information about the best alternative selected by Government of Gujarat to manage Hazardous wastes by comparing all the options taken by Government of Gujarat to manage Hazardous waste.

## III. METHODOLOGY

The researchers had focused on secondary sources for data, mainly from research papers, government articles and websites on waste management, after collecting data researchers will try to analyze the data for achieving mentioned objectives.

## IV. DATA ANALYSIS AND DISCUSSION

For above said objectives researchers collected data from various sources and tried to analyze and discuss them, the data analysis and interpretation is in this manner:

### *A. Types of hazardous waste produced by industrial sector.*

Hazardous waste generated by industrial sector for different processes are listed below:

**Table-1**
**List of hazardous waste generating processes**

| Process | Hazardous Waste |
|---|---|
| Petrochemical processes and pyrolytic operations | 1.1 Furnace/reactor residue and debris<br>1.2 Tarry residues<br>1.3 Oily sludge emulsion<br>1.4 Organic residues<br>1.5 Residues from alkali wash of fuels<br>1.6 Still bottoms from distillation process<br>1.7 Spent catalyst and molecular sieves<br>1.8 Slop oil from wastewater |
| Drilling operation for oil and gas Production | 2.1 Drill cuttings containing oil<br>2.2 Sludge containing oil<br>2.3 Drilling mud and other drilling wastes |
| Cleaning, emptying and maintenance of petroleum oil storage tanks including ships | 3.1 Oil-containing cargo residue, washing water and sludge<br>3.2 Chemical-containing cargo residue and sludge<br>3.3 Sludge and filters contaminated with oil<br>3.4 Ballast water containing oil from ships. |
| Petroleum refining/re-processing of used oil/recycling of waste oil | 4.1 Oily sludge/emulsion<br>4.2 Spent catalyst<br>4.3 Slop oil<br>4.4 Organic residues from process<br>4.5 Spent clay containing oil |
| Industrial operations using mineral/synthetic oil as lubricant in hydraulic systems or other applications | 5.1 Used/spent oil<br>5.2 Wastes/residues containing oil |
| Secondary production and/or industrial use of zinc | 6.1 Sludge and filter press cake arising out of production of Zinc Sulphate and other Zinc Compounds.<br>6.2 Zinc fines/dust/ash/skimmings |



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| | |
|---|---|
| | (dispersible form)<br>6.3 Other residues from processing of zinc ash/skimmings<br>6.4 Flue gas dust and other particulates |
| Primary production of zinc/lead/copper and other non-ferrous metals except aluminium | 7.1 Flue gas dust from roasting<br>7.2 Process residues<br>7.3 Arsenic-bearing sludge<br>7.4 Non ferrous metal bearing sludge and residue.<br>7.5 Sludge from scrubbers |
| Secondary production of copper | 8.1 Spent electrolytic solutions<br>8.2 Sludges and filter cakes<br>8.3 Flue gas dust and other particulates |
| Secondary production of lead | 9.1 Lead bearing residues<br>9.2 Lead ash/particulate from flue gas |
| Production and/or industrial use of cadmium and arsenic and their compounds | 10.1 Residues containing cadmium and Arsenic |
| Production of primary and secondary aluminium | 11.1. Sludges from off-gas treatment<br>11.2. Cathode residues including pot lining wastes<br>11.3. Tar containing wastes<br>11.4. Flue gas dust and other particulates<br>11.5. Wastes from treatment of salt slags and black drosses |
| Metal surface treatment, such as etching, staining, polishing, galvanising, cleaning, degreasing, plating, etc. | 12.1 Acid residues<br>12.2 Alkali residues<br>12.3 Spent bath/sludge containing sulphide, cyanide and toxic metals<br>12.4 Sludge from bath containing organic solvents<br>12.5 Phosphate sludge<br>12.6 Sludge From staining bath<br>12.7 Copper etching residues<br>12.8 Plating metal sludge |
| Production of iron and steel including other ferrous alloys (electric furnaces; steel rolling and finishing mills; Coke oven and by product plant) | 13.1 Sludge from acid recovery unit<br>13.2 Benzol acid sludge<br>13.3 Decanter tank tar sludge<br>13.4 Tar storage tank residue |
| Hardening of steel | 14.1 Cyanide-, nitrate-, or nitrite-containing sludge<br>14.2 Spent hardening salt |
| Production of asbestos or asbestos-containing materials | 15.1 Asbestos-containing residues<br>15.2 Discarded asbestos<br>15.3 Dust/particulates from exhaust gas treatment. |
| Production of caustic soda and chlorine | 16.1 Mercury bearing sludge<br>16.2 Residue/sludges and filter cakes<br>16.3 Brine sludge containing mercury |
| Production of mineral acids | 17.1 Residues, dusts or filter cakes<br>17.2 Spent catalyst |
| Production of nitrogenous and complex fertilizers | 18.1 Spent catalyst<br>18.2 Spent carbon<br>18.3 Sludge/residue containing arsenic<br>18.4 Chromium sludge from water cooling tower |
| Production of phenol | 19.1 Residue/sludge containing phenol |
| Production and/or industrial use of Solvents | 20.1 Contaminated aromatic, aliphatic or napthenic solvents may or may not be fit for reuse.<br>20.2 Spent solvents<br>20.3 Distillation residues |
| Production and/or industrial use of paints, pigments, lacquers, varnishes, plastics and inks | 21.1 Process wastes, residues & sludges<br>21.2 Fillers residues |
| Production of plastic raw materials | 22.1 Residues of additives used in plastics manufacture like dyestuffs, Stabilizers, flame retardants, etc.<br>22.2 Residues and waste of platicisers<br>22.3 Residues from vinylchloride monomer production<br>22.4 Residues from acrylonitrile production<br>22.5 Non-polymerised residues |
| Production and/or industrial use of glues, cements, adhesive and resins | 23.1 Wastes/residues (not made with vegetable or animal materials) |
| Production of canvas and textiles | 24.1 Chemical residues |
| Industrial production and formulation of wood preservatives | 25.1 Chemical residues<br>25.2 Residues from wood alkali bath |
| Production or industrial use of synthetic dyes, dye-intermediates and pigments | 26.1 Process waste sludge/residues containing acid or other toxic metals or organic complexes<br>26.2 Dust from air filtration system |
| Production of organo-silicone compounds | 27.1 process residues |
| Production/formulation of drugs/ pharmaceuticals & health care | 28.1. Process Residues and wastes<br>28.2 Spent catalyst / spent carbon |

| | |
|---|---|
| Product | 28.3 Off specification products<br>28.4 Date-expired, discarded and off specification drugs/ medicines<br>28.5. Spent organic solvents |
| Production, and formulation of pesticides including stock-piles | 29.1 Process wastes/residues<br>29.2 Chemical sludge containing residue pesticides<br>29.3 Date-expired and off-specification Pesticides |
| Leather tanneries | 30.1 Chromium bearing residues and Sludges |
| Electronic Industry | 31.1 Process residues and wastes<br>31.2 Spent etching chemicals and solvents |
| Pulp & Paper Industry | 32.1 Spent chemicals<br>32.2 Corrosive wastes arising from use of strong acid and bases<br>32.3 Process sludge containing adsorbableorganic halides [AOx] |
| Disposal of barrels / containers used for handling of hazardous wastes / chemicals | 33.1 Chemical-containing residue arising from decontamination.<br>33.2 Sludge from treatment of waste water arising out of cleaning / disposal of barrels / containers<br>33.3Discarded containers / barrels / liners contaminated with hazardous wastes/chemicals |
| Purification and treatment of exhaust air, water & waste water from the processes in this schedule and common industrial effluent treatment plants (CETP's) | 34.1 Flue gas cleaning residue<br>34.2 Spent ion exchange resin containing toxic metals<br>34.3 Chemical sludge from waste water treatment<br>34.4 Oil and grease skimming residues<br>34.5 Chromium sludge from cooling water |
| Purification process for organic compounds/solvents | 35.1 Filters and filter material which have organic liquids in them, e.g. mineral oil, synthetic oil and organic chlorine compounds<br>35.2 Spent catalyst<br>35.3 Spent carbon |
| Hazardous waste treatment processes, e.g. incineration, distillation, separation and concentration techniques | 36.1 Sludge from wet scrubbers<br>36.2 Ash from incineration of hazardous waste, flue gas cleaning residues<br>36.3 Spent acid from batteries<br>36.4 Distillation residues from contaminated organic solvents |

Though all industries are not producing HW there are certain non polluting industries too, here in the above table we can see those processes which are forming HW.

With that most hazardous wastes in Gujarat are generated by highly polluting industries that fall into 17 categories. The details of which with main HW they produced are shown in below table.

**Table-2**
**Categories of highly polluting industries, with the main hazardous wastes they produce**

| Industry | Main Hazardous Wastes Produced |
|---|---|
| Aluminum Smelter | Sludges from off-gas treatment; cathode residues including pot-lining wastes; tar containing wastes; flue gas and other particulates; wastes from the treatment of salt slags and black drosses |
| Caustic Soda | Mercury bearing sludge; residues/sludges and filter cakes/ brine sludge containing mercury |
| Cement | Wastes/residues; metal compound emissions from cement kilns and use of waste materials as fuel |
| Copper Smelter | Flue gas dust from roasting; process residues; arsenic-bearing sludge; non-ferrous metal bearing sludge and residue; sludge from scrubbers; spent electrolytic solutions; sludges and filter cakes |
| Distilleries | Sludge from wet scrubbers; ash from incineration of hazardous waste; flue gas cleaning residues; spent acid from batteries; distillation residues from contaminated organic solvents |
| Drugs & Pharmaceuticals | Process residues and wastes; spent catalyst/spent carbon; off specification products; date-expired, discarded and off-specification drugs/medicines; spent organic solvents |
| Integrated Iron and Steel | Sludge from acid recovery unit; benzol acid sludge; decanter tank tar sludge; tar storage tank residue |
| Leather Processing including Tanneries | Chromium bearing residues and sludges |
| Oil Refineries | Oily sludge/emulsion; spent catalyst; slop oil; organic residues from process; spent clay containing oil |
| Pesticides | Process wastes/residues; chemical sludge containing residue pesticides; date-expired and off specification pesticides |
| Petrochemicals | Furnace/reactor residue and debris; tarry residues; oily sludge emulsion; organic residues; residues sieves; slop oil from wastewater; drill cuttings containing oil; sludge containing oil ; drilling mud and other drilling wastes; oil-containing cargo residue; washing water and sludge; chemical containing |

| | |
|---|---|
| | cargo residue and sludge; ballast water containing oil from ships; oily sludge/emulsion; spent catalyst; slop oil; spent clay containing oil |
| Pulp & Paper | Spent chemicals, corrosive wastes arising from use of strong acid and bases; process sludge containing adsorbable organic halides (AOx) |
| Sugar | Sugar processing wastewater with a high content of organic material and high biochemical oxygen demand (BOD) |
| Thermal Power Plants | (oil and grease copper, iron), cooling tower low down (chlorine, zinc, chromium, phosphate, corrosion inhibiting materials), ash pond effluent (pH), suspended solids, oil and grease |
| Zinc Smelter | Sludge and filter press cake arising out of production of zinc sulphate and other zinc compounds; Zinc fines/dust/ash/skimming (dispersible form); other residues from processing of zinc ash/skimmings; flue gas and other particulates |
| Fertilizer | Spent catalyst; spent carbon; sludge/residue containing arsenic; chromium sludge from water cooling tower |
| Dyes and Dye Intermediates | Process waste sludge/residues containing acid or other toxic metals or organic complexes; dust from air filtration system |

***B. Issues of concern:***

After knowing the various types of hazardous waste we need to know the effect of such hazardous waste on human and environment. As all the waste is needed to be disposed of the same goes with the hazardous waste. But here if this waste is not disposed properly it can cause harm to the environment as land, water and air pollution causing effects on agricultural water supplies ultimately those chemicals leads to serious effects that are shown in the below table:

**Table-3**
**Hazardous Waste and their effect on health**

| **Substance** | **Potential Health Effects** |
|---|---|
| Arsenic | Carcinogenic to humans (skin, lung, bladder, liver) – stomach and intestinal irritation, nausea, vomiting – decreased production of red and white blood cells – damage to blood vessels – skin changes – abnormal heart rhythm |
| Benzene | Carcinogenic to humans (leukemia) – harmful to bone marrow, decreased red blood cells, anemia – vomiting, stomach irritation – drowsiness dizziness, rapid heart rate, headaches, tremors, convulsions, unconsciousness |
| Cadmium | Likely to be carcinogenic to humans – kidney, bone, and lung damage – stomach irritation, vomiting, diarrhea – birth defects in some animal studies |
| Chloroform | Likely to be carcinogenic to humans – liver and kidney |
| Lead | Likely to be carcinogenic to humans – damage to the brain and nervous system (adults, children, unborn children) – miscarriage, premature births, neonatal mortality due to decreased birth weight, decreased male fertility – diminished learning abilities in children – increased blood pressure – kidney damage |
| Mercury | Brain, kidney, and lung damage – serious harm to neural development of fetuses and young children – chest pains, nausea, vomiting, diarrhea – skin rashes and eye irritation – increased blood pressure and heart rate – irritability, sleep disturbances, tremors, coordination problems, changes in vision and hearing, memory problems |
| Perchlorate | Inhibition of iodine uptake – hypothyroidism, which may adversely affect the skin, heart, lungs, kidneys, gastrointestinal tract, liver, blood, neuromuscular system, nervous system, skeleton, reproductive system, and numerous endocrine organs |
| Polychlorinated Biphenyls | Likely to be carcinogenic to humans – liver damage – skin rashes and acne – decreased birth weight – short-term behavioral and immune system impacts in children exposed via breast milk |
| Polycyclic Aromatic Hydrocarbons | Likely to be carcinogenic to humans – irritation of skin, lungs, and stomach – reproductive and birth defects in animal studies |
| Tetrachloroethylene | Likely to be carcinogenic to humans – dizziness, headaches, sleepiness, confusion, nausea, difficulty speaking and walking, unconsciousness |
| Trichloroethylene | Carcinogenic to humans – liver, kidney, and nervous system damage – impaired immune system and heart function – impaired fetal development – skin rashes, lung irritation, headaches, dizziness, nausea, unconsciousness |

**Table-4**
**Table showing the hazardous characteristic and potential hazard on living animals**

| Hazardous characteristics | Potential hazards on living animals / environment |
|---|---|
| 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. |
| Oxidizing | Type of wastes that may yield oxygen and thereby cause or contribute to the combustion of other materials |
| Poisonous (Acute) | These wastes 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 |

## V. HAZARDOUS WASTE (HW) GENERATION IN INDIA

After knowing the effect of the hazardous waste we should here estimate the importance of hazardous waste management. Here the researcher has tried to find out that what are the estimate of such hazardous waste production in India figures are:

**Table-5**
**Hazardous Waste generation in States/UT of the country**

| S.No. | Name Of State/UTs | Year | No. of units generating HW | Quantity of Hazardous waste generation (MTA) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Landfillable | Incinerabe | Recyclabe | Total |
| 1 | Andhra Pradesh | 01.04.2010 | 3222 | 414747 | 42826 | 629167 | 1086740 |
| 2 | Assam | 2011 | 47 | 3835 | 269 | 14386 | 18490 |
| 3 | Bihar | 2010 | 53 | 3612 | 8 | 725 | 4345 |
| 4 | Chhattisgarh | 2010 | 189 | 83055 | 7436 | 196069 | 286560 |
| 5 | Delhi | 2008 | 1995 | 3338 | 1740 | 203 | 5281 |
| **6** | **Gujarat** | **2011** | **7751** | **1107130** | **108622** | **577037** | **1792789** |
| 7 | Goa | 2009 | 509 | 12955 | 30579 | 12964 | 56498 |
| 8 | Haryana | 2010 | 1646 | 14862 | 6745 | 7952 | 29559 |
| 9 | H.P. | 31.10.2011 | 1909 | 9202 | 652 | 20143 | 29997 |
| 10 | J.& K. | 2008 | 291 | 9946 | 141 | 6867 | 16954 |
| 11 | Jharkhand | 2008 | 435 | 23135 | 9813 | 204236 | 237184 |
| 12 | Karnataka | March-Oct, 2011 | 3103 | 47266 | 38239 | 96334 | 181839 |
| 13 | Kerala | 2009-10 | 442 | 46295 | 184 | 16750 | 63229 |
| 14 | Madhya Pradesh | 2010 | 1024 | 36397 | 4709 | 324371 | 365477 |
| 15 | Maharashtra | 31.03.2011 | 5428 | 514866 | 236156 | 1054363 | 1805385 |
| 16 | Manipur | 2008 | 264 | 0 | 115 | 137 | 252 |
| 17 | Meghalaya | 2011 | 34 | 13 | 241 | 3935 | 4189 |
| 18 | Mizorum | 2010 | 213 | 31 | 186 | Nil | 217 |
| 19 | Nagaland | 2010 | 2 | 0 | 0 | 10 | 10 |
| 20 | Orissa | 2010-11 | 431 | 81076 | 13201 | 28041 | 122318 |
| 21 | Punjab | 30.09.2011 | 3323 | 18432 | 17515 | 54280 | 90227 |
| 22 | Rajasthan | 30.06.2011 | 535 | 545396 | 38465 | 179179 | 763040 |
| 23 | Tripura | 2010 | 0 | 4 | 21 | 255 | 280 |
| 24 | Tamil Nadu | 31.03.2011 | 2869 | 240939 | 17976 | 138347 | 397262 |
| 25 | Uttar Pradesh | 31.10.2011 | 2159 | 34975 | 15986 | 161025 | 211986 |
| 26 | Uttarkhand | 2011 | 471 | 3957 | 3942 | 10110 | 18009 |
| 27 | West Bengal | 2011 | 914 | 44389 | 5629 | 146516 | 196534 |
| U.T. | | | | 0 | | | |
| 1 | Daman, Diu, Dadra & NH | 2008 | 1937 | 17219 | 421 | 56350 | 73990 |
| 2 | Pondicherry | 2011 | 90 | 133 | 25 | 35093 | 35251 |
| 3 | Chandigarh | 2009 | 237 | 3942 | 0 | 5794 | 9736 |
| | **Total** | | **41523** | **3321147** | **601842** | **3980639** | **7903628** |

The above information pertaining to year other than 2008, have not been scrutinized and verified by CPCB.*
*http://www.cpcb.nic.in/Updated_Inventory_HW_Generation.pdf

## VI. HAZARDOUS WASTE MANAGEMENT IN INDIA

Hazardous waste management is a very important issue to be dealt with the increase in industrialisation, the government of India has laid rules which were ammdened with effect in 2008, the rules lay down corresponding duties of various authorities under MoEf, CPCB, State/UT govt, SPCBs/PCCs, port Authority and custom authority. Under the hazardous waste management rules are notified to ensure that safe handling, generation, processing, treatment, package. Storage, transportation, use reprocessing, collection, conversation & offering for sale, destruction & disposal of hazardous waste. The table under would show the list of authorities and their corresponding duties for HWM( Hazardous waste Management)

**Table-6**
**List of authorities and corresponding duties**

| Sr .no. | Authority | Corresponding Duties |
|---|---|---|
| 1 | Ministry of Environment and Forests under the Environment (Protection) Act, 1986 | i. Identification of hazardous wastes<br>ii. Permission to exporters of hazardous wastes<br>iii. Permission to importers of hazardous wastes<br>iv. Permission for transit of hazardous wastes through India<br>v. Sponsoring of training and Awareness programme on Hazardous Waste Management related activities. |
| 2 | Central Pollution Control Board constituted under the Water (Prevention and Control of Pollution) Act, 1974 | i. Co-ordination of activities of State Pollution control Boards/ Committees<br>ii. Conduct training courses for authorities dealing with management of hazardous wastes<br>iii. Recommend standards and specifications for treatment and disposal of wastes and leachates Recommend procedures for characterization of hazardous wastes.<br>iv. Sector specific documentation to identify waste for inclusion in Hazardous Wastes Management, Handling and Transboundary Movement ) Rules, 2008.<br>v.Prepare guidelines to prevent/reduce/ minimize the generation and handling of hazardous wastes<br>vi. Registration and renewal of registration of Recyclers/Re-processors<br>vii. Any other function under Rules delegated by the Ministry of Environment & Forests |
| 3 | State Government/Union Territory Government/Administration | Identification of site(s) for common Hazardous Waste Treatment Storage and Disposal Facility (TSDF)<br>ii. Assess EIA reports and convey the decision of approval of site or otherwise<br>iii. Acquire the site or inform operator of facility or occupier or association of occupiers to acquire the site<br>iv. Notification of sites<br>v. Publish periodically an inventory of all disposal sites in the State/Union Territory |
| 4 | State Pollution Control Boards or Pollution Control Committees constituted under the Water (Prevention and Control of Pollution) Act, 1974 | i. Inventorisation of hazardous wastes<br>ii. Grant and renewal of authorization<br>iii. Monitoring of compliance of various provisions and conditions of authorization including conditions of permission for issued by MoEF exports and imports<br>iv. Examining the applications for imports submitted by the importers and forwarding the same to Ministry of Environment and Forests<br>v. Implementation of programmes to prevent/reduce/minimize the generation of hazardous wastes<br>vi. Action against violations of Hazardous Wastes Management, Handling and Transboundary Movement) Rules, 2008<br>vii. Any other function under these Rules assigned by MoEF from time to time. |

The stages to handle HW can be grouped into three main categories: (1) establishment of the facility; (2) operation of the facility; and (3) disposal.

To start, any person who is involved in handling hazardous waste must apply to an SPCB for a grant of authorization. This includes any person involved in the "generation, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for sale, transfer or the like. SPCB can grant or deny authorization by considering (1) appropriate facilities (2) technical capabilities and (3) equipment to handle hazardous waste safely. Grant is given to Treatment storage and disposal facility (TSDFs) for five years by SPCBs.

Under the operations of facility SPCBs need to maintain inventory of hazardous wastes, Renew grant of authorization, Transport of hazardous waste main things to be taken care in transportation are 1.Authorization 2. Packaging 3. Labeling 4. Transportation. The waste generator should 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. The transport of hazardous waste containers shall be in accordance with the provisions of the Hazardous Waste (Management, Handling and Tran boundary Movement) Rules, 2008

Interstate transfer of HW waste: the person intending to dispose of hazardous waste must obtain a "No Objection Certificate" from the SPCB where the waste was generated and from the SPCB where the waste will be disposed



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Transboundary Movement- The Basel Convention on hazardous wastes India is a Party to the Basel Convention on transboundary movement of hazardous wastes. The basic objectives of the Basel Convention are for the control 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 minimize 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. As a party India is also required to minimize generation of hazardous waste in the country taking into account social, technological and economic aspects Implement programs to minimize waste generation, Monitor operations, Take action against violators is done.

**Chart-1**
**Flow path of wastes**

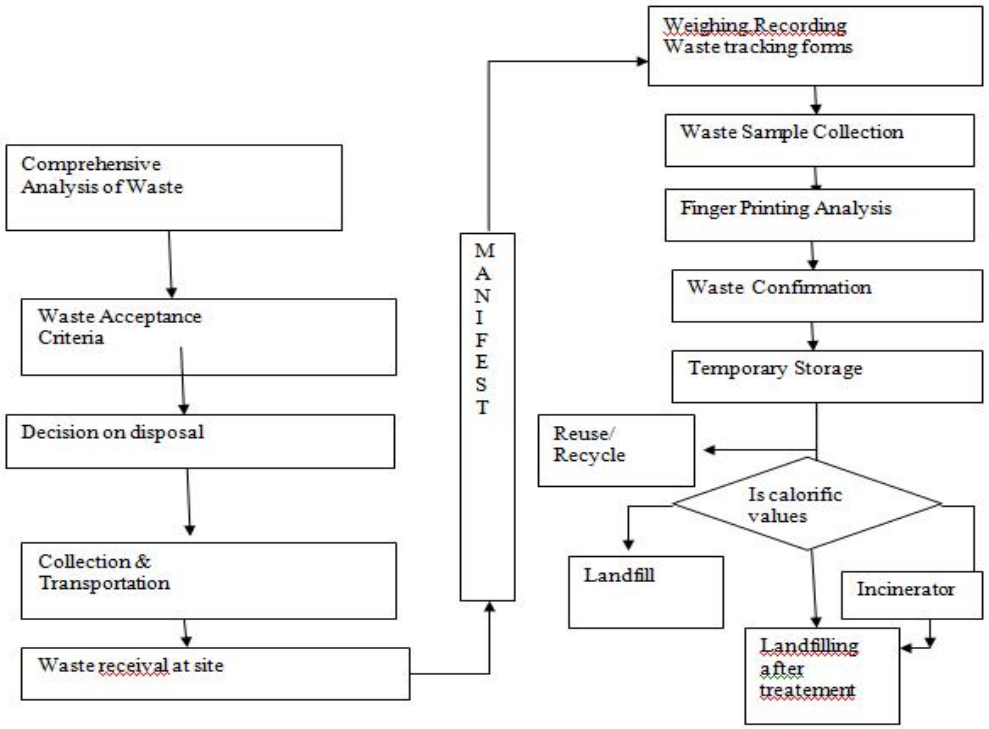
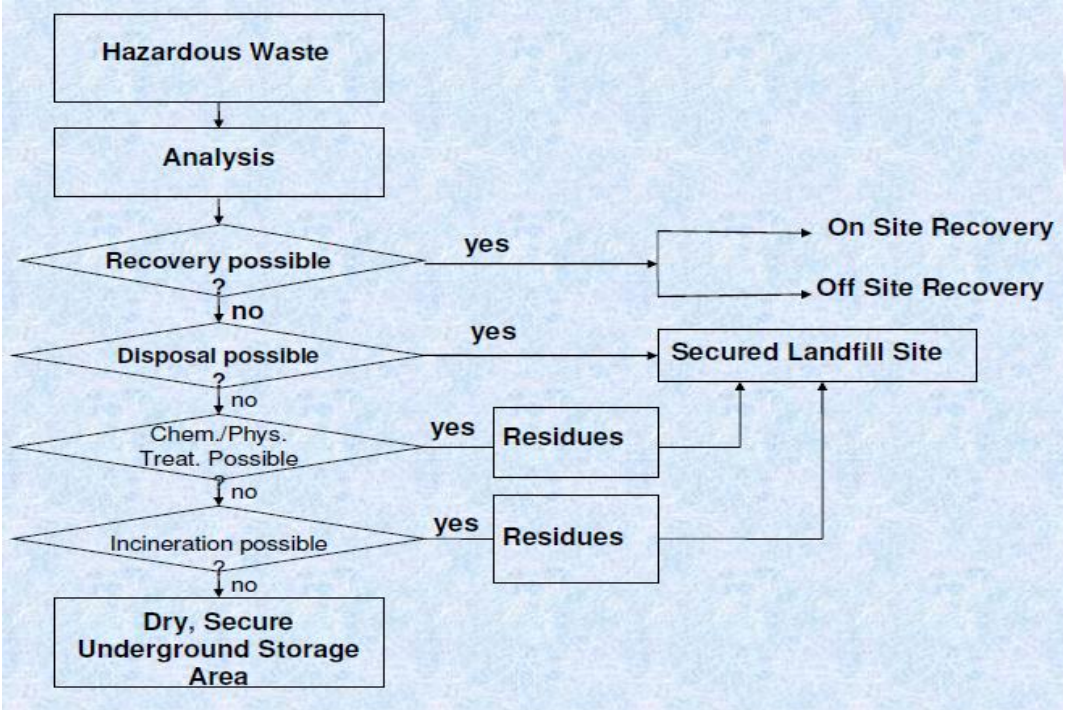



**Chart-2**
**Schematic Hazardous Waste Management Strategy**




Here Above is the process of HW Management once the HW is collected SPCB think as to what are the options available for them to handle them out as per this diagram its best to reduce the HW , reuse , recycle the HW using it as a resource for some other industrial or manufacturing processes, waste for that there are common treatment stabilization and disposal facility (TSDF) totally almost India has 27 TSDF, which does the disposal of HW. Also a new concept of Co processing which is the best method for HW treatment with zero residual is introduced, incineration is the process of destruction of all high calorific and highly toxic wastes by burning the waste at high temperature, Lastly landfill is disposing off.

As per the inventory data submitted to CPCB in 2011, Gujarat generated 1,08,622 MTPA of incinerable (destroy by burning), 11,07,130 MTPA of land-fill able and 577,037 MTPA of recyclable hazardous wastes*

*http://www.thehindubusinessline.com/news/states/gujarat-gets-greener-as-hazardous-waste-use-in-cement-kilns-up-35-times-in-5-years/article6082316.ece

## VII. ROLE OF GOVERNMENT OF GUJARAT IN HAZARDOUS WASTE MANAGEMENT

Gujarat Pollution Control Board plays a highly efficient role in the management of hazardous waste in Gujarat.

a. Gujarat was the first state to address hazardous waste issue and brought about a novel concept of common treatment stabilization and disposal facility (TSDF) for the cluster of Industries. Gujarat is leading the country in development of TSDF sites. Among 27 TSDF sites in country Gujarat has 8 TSDF sites.

b. ***Common Hazardous Wastes Incineration Facility (CHWIF)*** Certain non biodegradable waste water and liquid hazardous waste (toxic) are advisable to dispose off in environmentally sound manner. Process of detoxification for the treatment of non biodegradable waste water is economically not viable. In late 1990, the concepts of individual common incinerators for safe disposal of toxic hazardous waste were adopted. As of now, State is having five common hazardous incineration facilities and 83 individual incineration facilities.

c. Realising the importance of waste management Gujarat pollution control board with conferdation of Indian industry jointly with KPMG organised 2 days summit and expo for4R principle of waste management in vibrant Gujarat event.*
*http://www.vibrantgujarat.com/Portal/Event_Images/Attachment/307/1_1_Final-Brochure.pdf

***d. eXtended Green Node (XGN)***
Online live tracking of transportation and disposal of hazardous waste has been made by The extended Green Node (XGN) List of Registered industries & daily quantity (MT) by all TSDFs (being generated through XGN). More than 18000 Industries, Common Effluent Treatment Plants, TSDFs-Hazardous Waste Handlers and Registered Re-cyclers is covered under XGN. Unloading of Trucks only after respective industry (for large & medium scale) generates Manifest from XGN. While in case of small scale units, manifest entry on behalf of the industry being done by TSDF. Manifest register and party wise summary from XGN is verified by concerned TSDF and submitted to Regional Office.

***e. Waste Minimization through Co-Processing***
The concept on "Utilization of Hazardous waste" as a supplementary resources or for energy recovery, or processing in line with Hazardous Waste (Movement, Handling & Transboundary Movement) Rules,2008. Central Pollution Control Board (CPCB) has been empowered to accord approval for utilization of different categories and type of Hazardous Waste Co-processing recovers energy, recycles and conserves materials and contributes to reduced environmental footprint. It represents a sustainable solution for many waste streams which can't be recycled and shouldn't be land filled. It offers significant potential for reducing pollution and landfill space caused by the waste disposal. Co-processing is thus a preferred solution in the waste management hierarchy.

***f. Clean Up Of Old Waste Dump Sites In Gujarat***
Gujarat Pollution Control Board had taken on hand the problem of old dump sites and its impact on environment Board had carried out Inventory of illegal dumpsite and undertook Clean up activity of such Sites in the year 2004. Subsequently

34395.40 MT of Hazardous waste was lifted and shifted to landfill site (TSDF). The Board continues cleanup of illegal dump sites across the State; shifting about 9172 MT of illegally dump waste.

***g. Public private partnership Common TSDFs have come up***

The common sites in Gujarat are remarkable examples of public private partnership. Common TSDFs have come up with capital investment subsidy provided by the State Government and in some cases with assistance from the Government of India. Land at concessional rates allotted by State Industrial Development Corporation and financial participation by industrial units and institutional financial support helped this development.

h. ***Alang Ship Breaking Yards*** – Environmentally Sound Management Facilities The ship breaking industry performs two major roles. It adjusts ship tonnage for the shipping industry by way of disposal of old ships and it also supplies substantial quantities of re-rollable and scrap steel. It also increases the availability of some finished material which otherwise would have to be produced by the iron and steel industry using the natural ore. Thus, the ship breaking industry helps in conservation of natural resources. Also it reduces the environment pollution compared to steel industry, which can be concluded from following data.Alang Sosiya Ship Recycling Yard developed by Gujarat Maritime Board in 1982 is amongst the largest ship recycling yards across the globe. 169 plots are spread over a 10 km stretch along the coast of Alang aligned from NE to SW direction. The beaching method is employed to dismantle about 400 ships per year. This generates about 3.5 million tons of steel that can be re-rolled per annum. Before January-2006, ship recyclers were sending their wastes to TSDF operated by Naroda Enviro Protection Ltd, Ahmedabad –Hazardous waste quantity handled about 3873.049 MT

i. ***Common effluent treatment plants:*** in Gujarat CETP treatment is divided into two stages first initial in which raw effluents of the waste from small and medium industries is treated. Then that waste is treated in final effluent treatment plant. There are total 34 CETPs in Gujarat in which 28 are in operational and 6 are proposed. Of these CETPs, 15 are in GIDC estates and 19 are outside the GIDC estates.

j. ***Green industries formation in Gujarat:*** A list of 100 small and cottage Industries having no pollution potential was published under the circular of the Gujarat Pollution Control Board. hese industries are exempted from obtaining NOC (No Objection Certificate) from the Board for establishing such industries and for conversion of land to 'non agricultural' use

## VIII. THE BEST TECHNIQUE USED BY GUJARAT GOVERNMENT FOR HWM

The best technique used by the government of Gujarat for HWM is co processing Co-processing is the use of waste as raw material, as a source of energy, or both to replace natural mineral resources and fossil fuels such as coal, petroleum and gas (energy recovery) in industrial processes, mainly in energy intensive industries (EII) such as cement, lime, steel, glass, and power generation. Waste materials used for Co-processing are referred to as alternative fuels and raw materials (AFR).

As per the latest data from the state regulator, the Gujarat Pollution Control Board (GPCB), utilisation of hazardous waste as alternative fuel and raw material (AFR) in cement kilns has witnessed mammoth jump of 35 times since 2009-10 from 15,693 tonnes per annum (TPA) to 5,43,569 TPA in 2013-14.Interestingly, during the past one year alone, the quantum of waste utilised by cement plants jumped 185 per cent from 1,90,707 TPA in 2012-13.

Benefits of co processing are To conserve natural (non-renewable) resources of energy and materials, To reduce emissions of greenhouse gases in order to slow global warming and demonstrate a positive impact on integrated environmental indicators, such as the ecological footprint, To reduce the environmental impacts of the extraction (mining or quarrying), transporting, and processing of raw materials, To reduce dependence on primary resource markets, To save landfill space and reduce the pollution caused by the disposal of waste, To destroy waste completely eliminating potential future liabilities, Cost Saving : No need for investment in incinerators, Conservation of non renewable fossil . Overall lower CO2 and methane emissions by replacement of fossil fuel – Otherwise leading to burning of hazardous wastes in incinerators and fossil fuels in kilns. (A substitution by 50% in EU is equivalent to saving emission from 10 million cars), Conservation of raw materials for cement industry as hazardous wastes partially replaces some of the raw materials like silica, iron etc.

## IX. CONCLUSION

As Summary it can be said that in the developing countries, the thrust on economic development is often given priority to production costs than the best available technology and this result in more wastes generation. It is difficult to develop alternative technology for total elimination of hazardous wastes generation yet we can take measures for using alternative resource as solar energy, wind energy in the production process instead of using the electricity for the production, as that can cause less emission of hazardous waste their by moving towards green – non pollution. With that we can formulate policies and strategies towards prioritizing waste reduction and minimization rather than mere disposal. Remediation strategy needs to focus on the ‘polluter pays principle‟ with the polluter being asked to pay penalty as well as costs of cleaning up the pollution. Industries causing pollution repeatedly should be blacklisted. Where polluters are not traceable, a dedicated fund needs to be created by SPCB/ PCC for remediation. With that Waste exchange Banks / Collection Centres should be developed to provide information on wastes as on

the types of waste and the methods to manage waste, to provide information on wastes and promote reuse, recovery and recycling technologies which upscale the quality of resource recovery.

Government of Gujarat does many potential for HWM in effective manner, certain such steps that are taken are being used by other states to improve their HWM system as XGN as online inventory of HW, co-processing for utilising HW as raw material for cement industry, with that the Gujarat government can think of the tie ups with the permission of CPCB for greater scope of co-processing and pre processing and other steps for the utilization of HW, rather than concentrating on the disposal. Indian government has concern for hazardous waste management and the country is looking for cooperation from European countries in the area. "Our co-processing of hazardous waste is not even 1 per cent. And, there is a tremendous scope of co-operation with the European countries," Additional Secretary, Ministry of Environment, Susheel Kumar. That way India is taking initiation for HWM with tie ups.

The government needs to concentrate more on reuse, recycle, reduce and co process then for the incineration and disposal through landfill for HWM.

*http://www.niticentral.com/2015/02/25/government-seeks-ties-with-european-nations-on-hazardous-waste-management-303571.html

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