INDIA-EU ENVIRONMENT FORUM

‘Hazardous Waste Management in India: An Overview ’

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HW Generating Units & HW Generation Scenario

- HW generation in States - No uniform trend
- No. of Units generating Hazardous Wastes gone-up
- Factors responsible:
- Changes in regulatory classification:
  - Change over from 18 waste categories with annual threshold limits to 36 processes and corresponding waste streams
  - Emphasis on waste minimisation-zero discharge(Tanneries,textiles)
  - Fly-ash,gypsum sludge excluded
  - Units closed/New Units

CPCB GUIDANCE FOR INVENTORISATION

- **Published Sector Specific Waste Guidance Documents on Identification of HW Streams, Characterization and Waste Minimization Options:**

Study completed :

- Petrochemicals
- Dyes and Dye Intermediates
- Pesticides,etc(12 products)
- Bulk Drugs & Pharmaceutical.

Study under progress:

- Electroplating
- Textile Industry
- Solvents manufacturing sector, etc.
- Pesticides,etc(10 products)
- Iron & Steel, Chrome Ore Processing, Aluminium

Waste Stream wise Quantification of Hazardous Wastes

Product	Waste Stream	WGF (kg/tonne of product)
Ethylene/Propylene	Spent caustic from Caustic Tower	0.06
	Oil Soaked Carbonaceous Coke	0.017
	Spent Palladium Catalyst	0.007
Butadiene	Butadiene Polymer Waste	0.06
	Solvent regeneration residue	0.4
Benzene	Spent Nickel Catalyst	0.03
	Spent Nickel-Molybdenum Catalyst	0.003
	Spent Cobalt-Molybdenum Catalyst	0.007

Waste Stream wise Quantification of Hazardous Wastes

Product	Waste Stream	WGF (kg/tonne of product)
Xylene	Spent clay	0.50
Vinyl Chloride Monomer	Carbon Waste	0.02
	EDC Bottom Viscous	4.0
	Reactor Waste	0.014
Polyvinyl Chloride	PVC Wet resin	4.0
Ethylene Oxide/ Ethylene Glycol	Spent Silver catalyst	0.08
Polythylene	Polymeric waste	0.02
	Extruder waste	2.4
Maleic anhydride	Distillation bottoms	60
	ETP sludge	0.4

Waste Stream Contd. ……..

Product	Waste Stream	WGF (kg/tonne of product)
Phthalic Anhydride	Vanadium pentoxide catalyst	167
	Purge cut	24
	Tar residue	12
Dimethyl Terephthalate	Crude ester distillation residue	54
Linear Alkyl Benzene	Calcium fluoride sludge	6.0
	Spent alumina	0.32
	Spent catalyst	0.04
	Spent molecular sieve	0.35
	Spent carbon	0.02
	Oil soaked sand	0.8
Isopropyl Alcohol	Spent copper catalyst	45.0
Acetone	Distillation by product (Tarry waste)	8.0

Waste Stream Contd. ……..

Product	Waste Stream	WGF (kg/tonne of product)
Polyprolylene	Powder waste	4.0
	Polymeric oil	1.0
	Spent activated alumina	0.007
	Molecular sieve	0.030
	Spent activated carbon	0.062
Acrylonitrile	Polymerized cyanide with catalyst particles	0.04
2-Ethyl Hexanol	Spent zinc catalyst	0.53
	Spent nickel catalyst	0.08
Cumene	Cumene catalyst	0.3
	Cumene bottoms	60
Phenol	Solvent waste	5.0
Caprolactum	Waste liquor-I	964
	Waste liquor-II	155
	Bio sludge	3.0

Petrochemical Industry : Suggested Waste Recycling Options

Product	Waste	Recycling Measures
Ethylene/ Propylene	Polymeric waste	Refining and reuse
Benzene	Spent nickel catalyst	Metal recovery
	Spent nickel-molybdenum catalyst	Metal recovery
	Spent cobalt-molybdenum catalyst	Metal recovery
Polyvinyl chloride	PVC wet resin	Reuse for manufacturing useful items
Isopropyl alcohol	Spent copper catalyst	Recovery of acid
Acetone/Phenol	Solvent waste	Use as a fuel in the boiler
Polypropylene	Powder waste	Melting, extrusion and conversion to low-grade articles
Cumene	Cumene catalyst	Acid recovery
	Cumene bottoms	Use as a fuel

Recycling Options Contd. ……

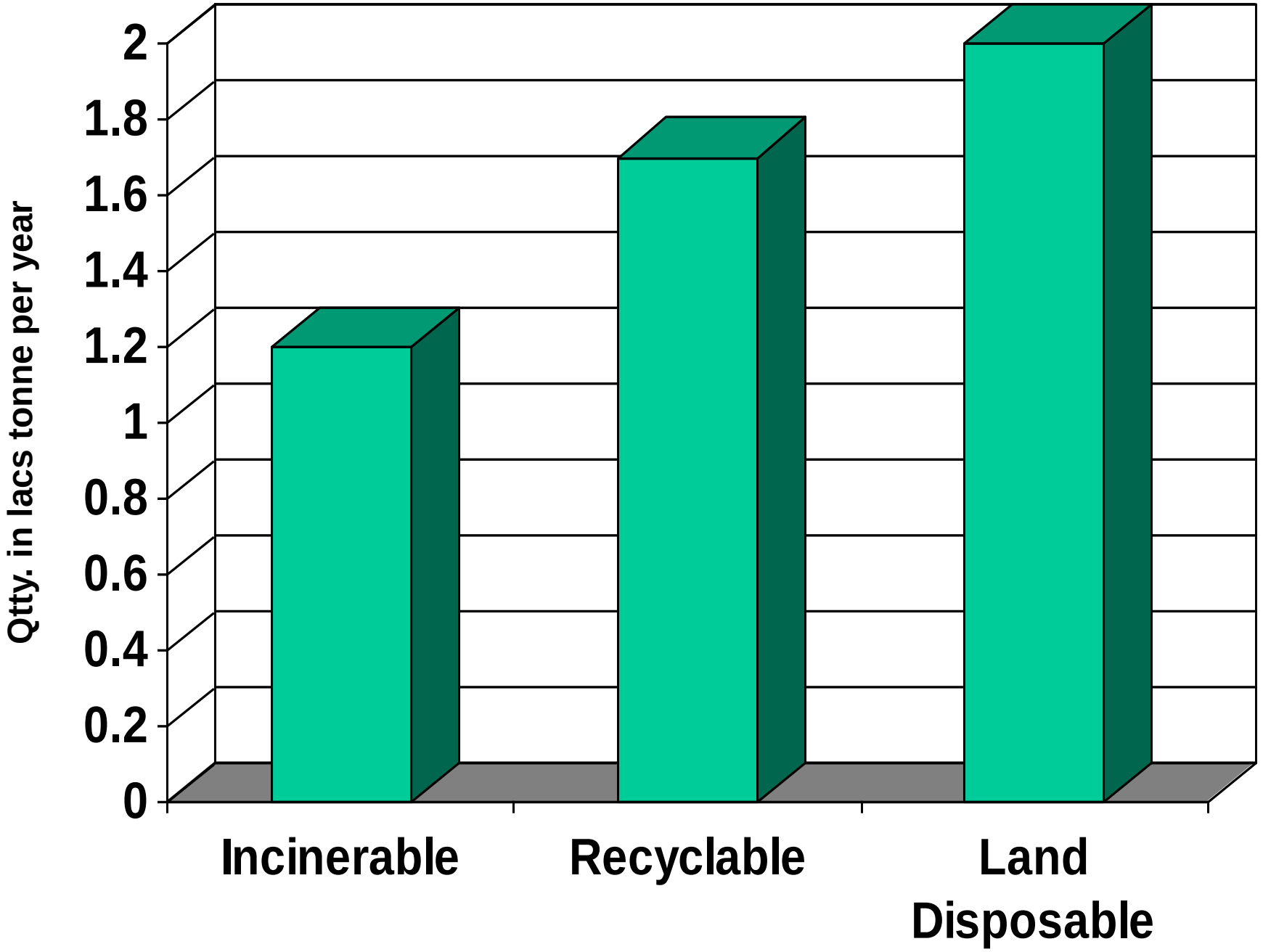
Product	Waste	Recycling Measures
Caprolactum	Waste liquor	Recovery of sodium salt
Maleic anhydride	Distillation bottoms	Resin manufacture
Phthalic anhydride	Purge cut	Use as a crude phthalic anhydride
	Tar residue	Aggregate in road building
	Spent catalyst	Metal recovery
Dimethyl terephthalate	Ester distillation residue	Use as a fuel for incineration
Acrylates	Esterification residue	Use as a fuel
Polybutadiene rubber	Waste polymer residue	Manufacture of utility article
Acrylic fibre	Waste fibre	Reuse in the process

Suggested Waste Minimisation Options

Product	Waste	Waste minimisation measures
Benzene	Spent nickel catalyst	Regeneration
	Spent nickel-molybdenum catalyst	Regeneration
	Spent cobalt-molybdenum catalyst	Regeneration
Xylene	Spent clay	Regeneration
Vinyl Chloride monomer	EDC bottom viscous	Increase in yield of EDC
Ethylene oxide/ ethylene gllycol	Spent silver catalyst	Regeneration
Isopropyl alcohol	Copper catalyst	Regeneration
Acrylonitrile	Polymerized cyanide alongwith catalyst particles	Use of more stabilized catalyst

Waste Minimisation Options Contd. …..

Product	Waste	Waste minimisation measures
Maleic anhydride	Distillation bottoms	Recovery of maleic anhydride
Phthalic anhydride	Spent catalyst	Regeneration
Acrylates	Esterification residue	Use of raw material of highest possible purity
Polybutadiene rubber	Reactor waste	Proper mixing of reactants in the reactor and completion of reaction
Acrylic fibre	Reactor scaling waste	Uniform mixing in the reactor
	Solidified solution waste	Proper maintenance of tanks, pumps, valves etc.
	Spent cation exchange resin	Regeneration



Hazardous Waste Suitable for Incineration, Recycling & Land Disposal

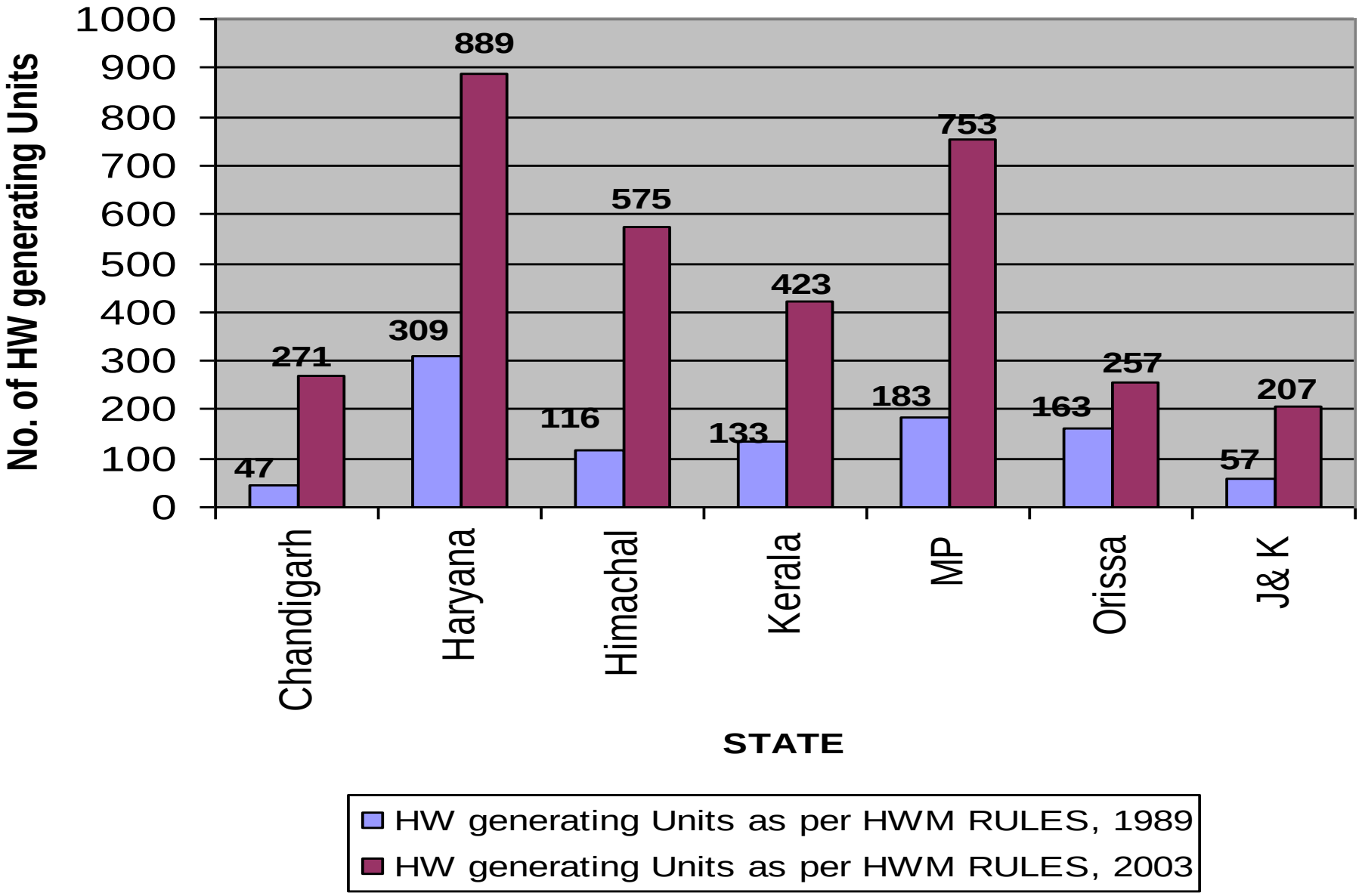
HW Generating Industries & HW Generation – Comparative Figures

S.No.	State	No. of Industries as per HWM Rules, 1989	Total HW generation in TPA	HW generating Industries (No.s) as per HWM Rules, 2000/2003	Total HW generation in TPA
1.	AP	501	1,11,098	1532	507046
2.	Assam	18	1,66,008	23	4,000
3.	Bihar	42	26,575	31	Not given
4.	Chandigarh	47	305	271	8,425
5.	Delhi	403	1,000	1777	17,000
6	Goa	25	6,598	49	Not Provided
7.	Gujarat	2984	4,30,030	6052	12, 07,000
8.	Haryana	309	31,046	889	14,972
9.	Himachal	116	2159	575	Not given
10.	Karnataka	454	1,03,243	1589	92,013
11.	Kerala	133	1,54,722	423	83,530
12.	Maharashtra	3953	20, 07,846	4571	14,07,480
13.	MP	183	1,98,669	753	Not given
14.	Orissa	163	3,41,144	257	74,918
15.	J & K	57	1221	207	Not provided

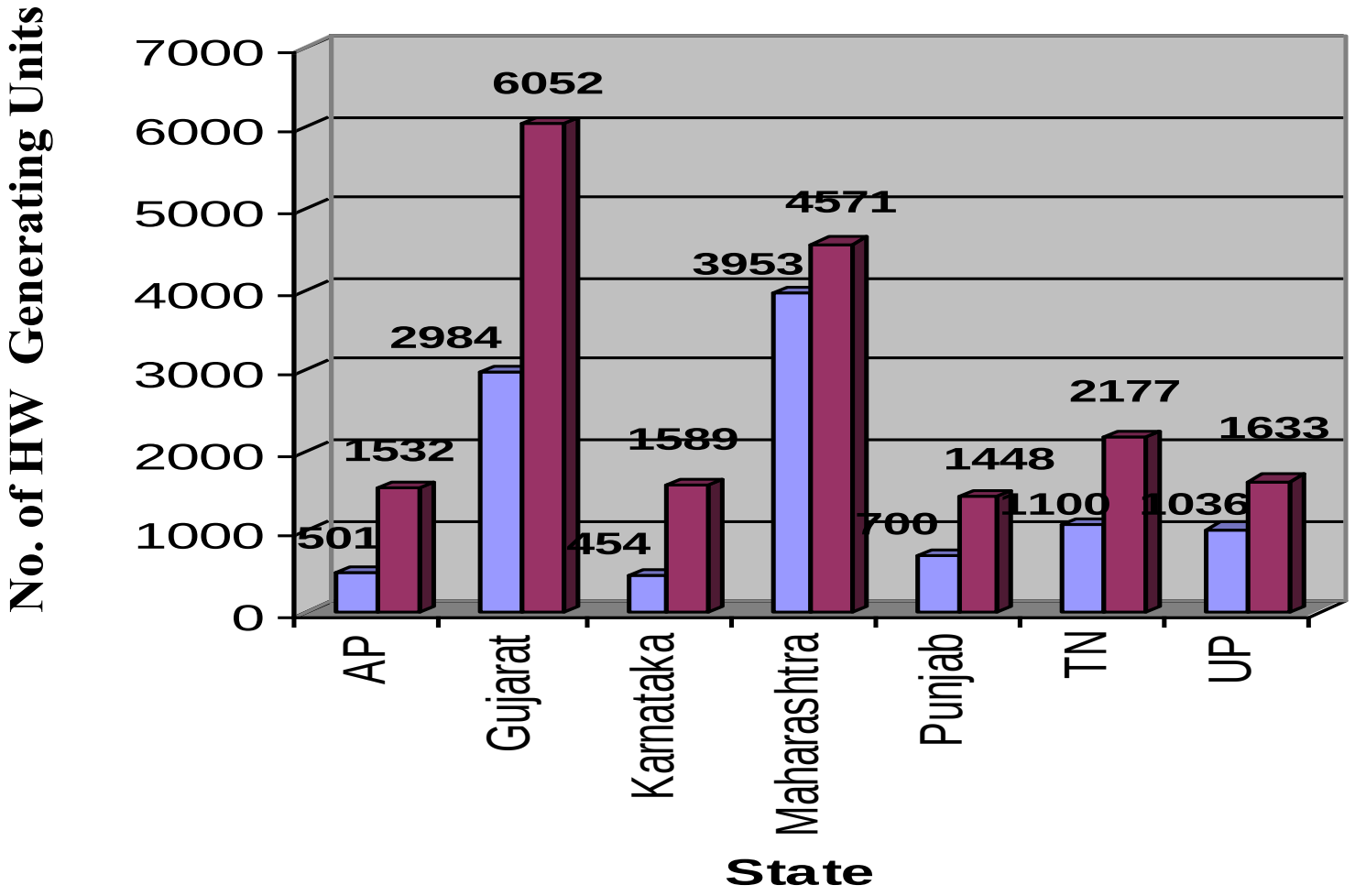
HW Generating Industries & HW Generation – Comparative Figures

S. No.	Name of the State	No. of Industries as per HWM Rules, 1989	Total HW generation in TPA	No. of HW Industries as per HWM Rules, 2000/2003	Total HW generation in TPA
16.	Pondicherry	15	8,893	66	30,320
17.	Punjab	700	22,709	1448	15,769
18.	Rajasthan	332	1,22,307	512	1,83,737
19.	Tamilnadu	1100	3,94,208	2177	1,81, 624
20.	Uttarpradesh	1036	1,45,786	1633	82,375
21.	West Bengal	440	1,29,826	568	Not given
22	Chattisgarh	-	-	149	Not given
23.	Mizoram	-	-	Nil	Nil
24.	Meghalaya	-	-	39	37, 412
25.	Nagaland	-	-	03	448
26.	Daman, Diu & DNH	-	-	598	Not given
27.	Jharkhand	-	-	169	Not given
28.	Uttaranchal	-	-	137	Not given
29.	Manipur	-	-	Nil	-
30.	Tripura	-	-	187	Not given

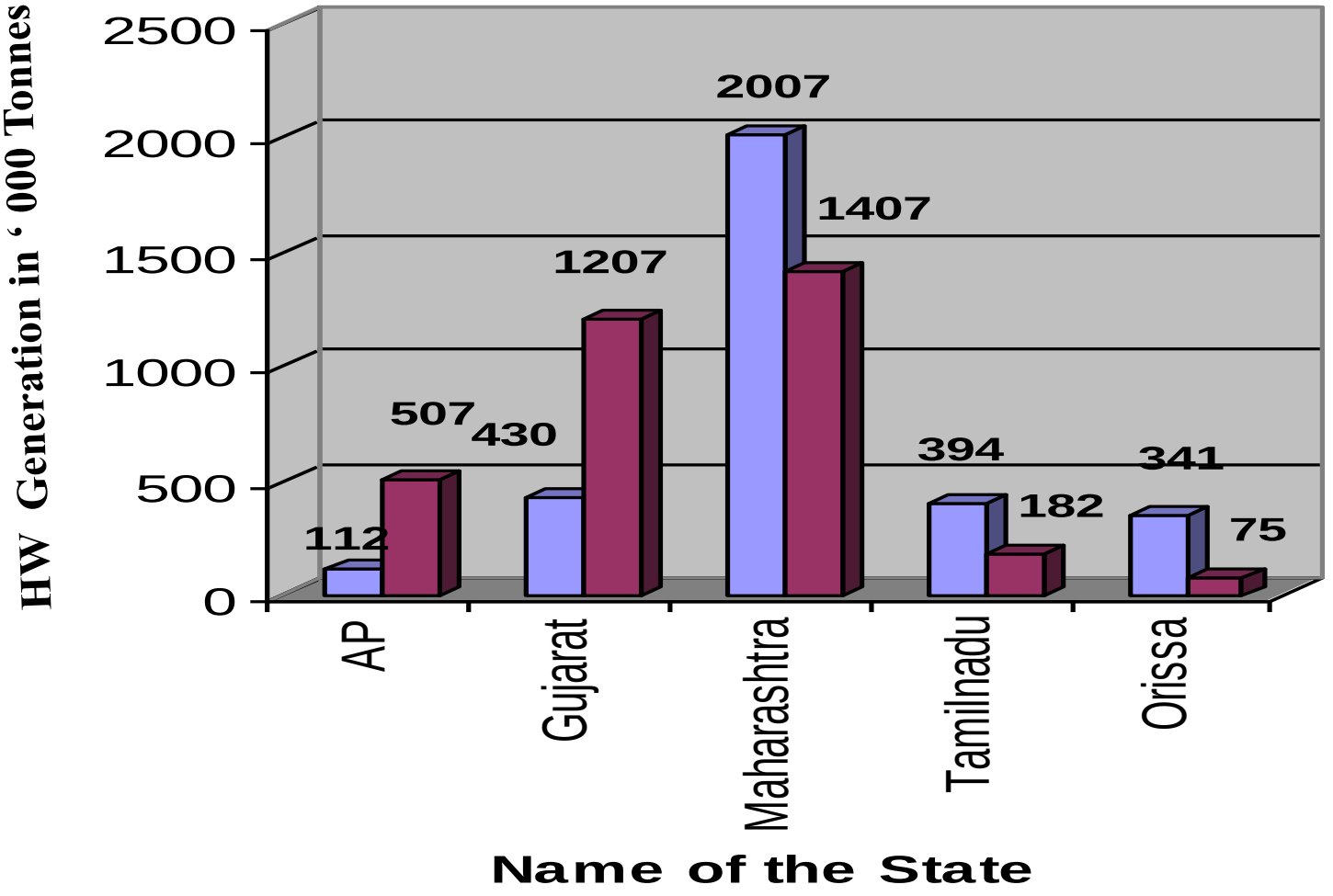
STATE-WISE COMPARATIVE HW GENERATING UNITS AS PER HWM RULES, 1989 & 2003



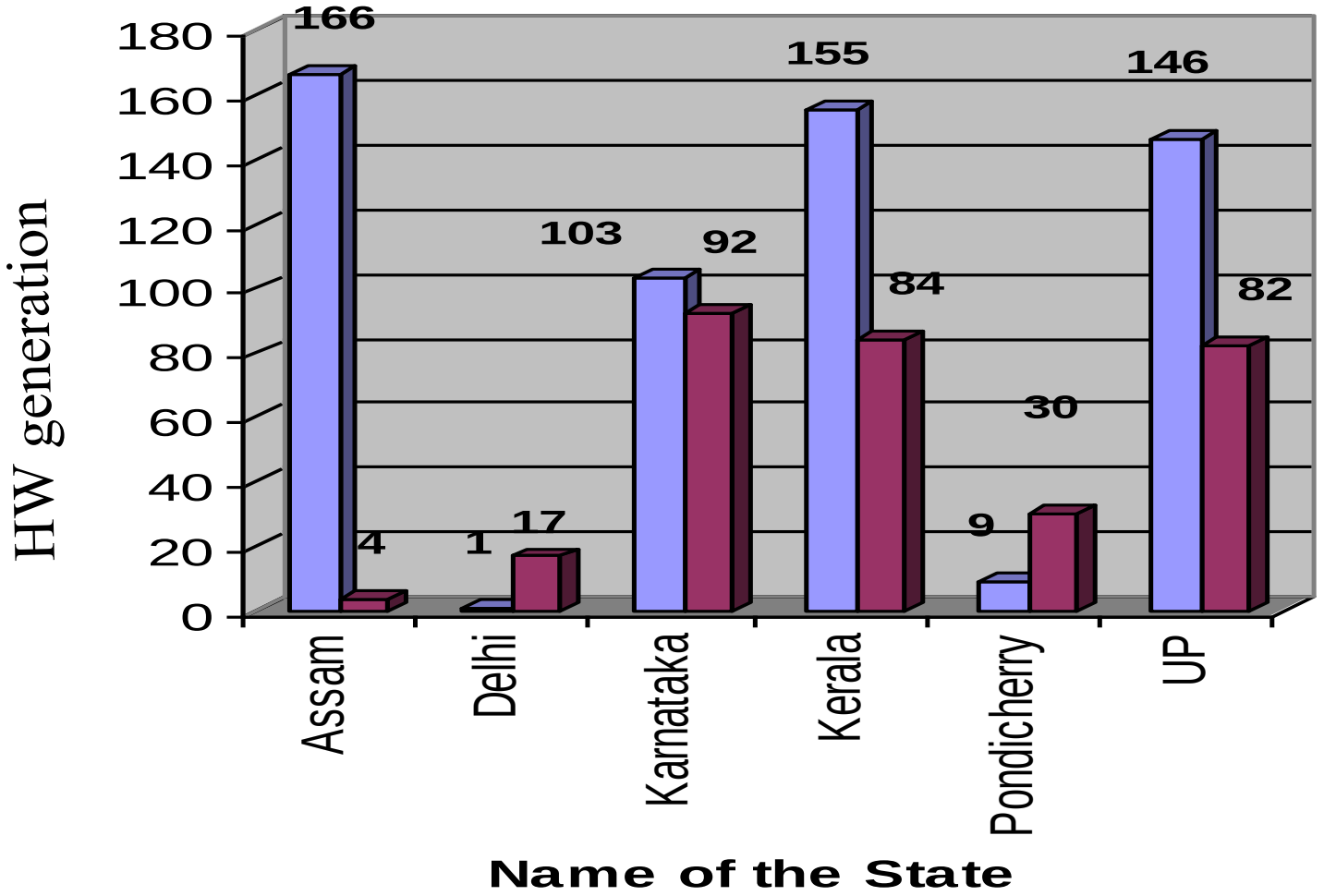
Comparative HW generating Units as perHWM Rules, 1989 and 2003



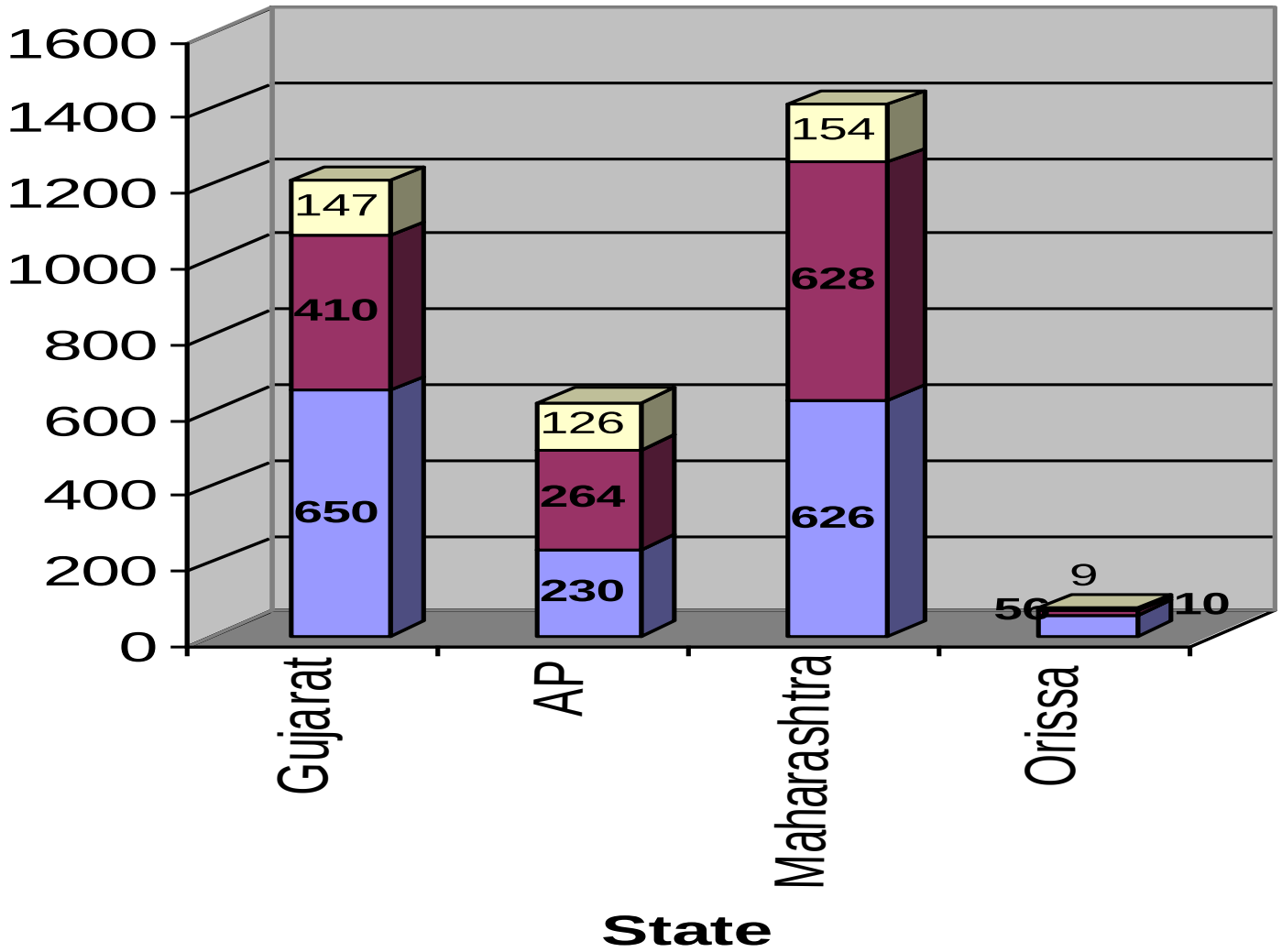
Comparative HW gneration as per HWM Rules, 1989 and 2003 in '000 Tonnes



Comparative HW genertion as per HWM Rules, 1989 and 2003 in ' ooo Tonnes



HWs - Landfillable, Recyclable, Incinerable as per HWM Rules, 2003



COMMON HAZARSDOUS WASTE TREATMENT, STORAGE & DISPOSAL FACILITIES (TSDF):

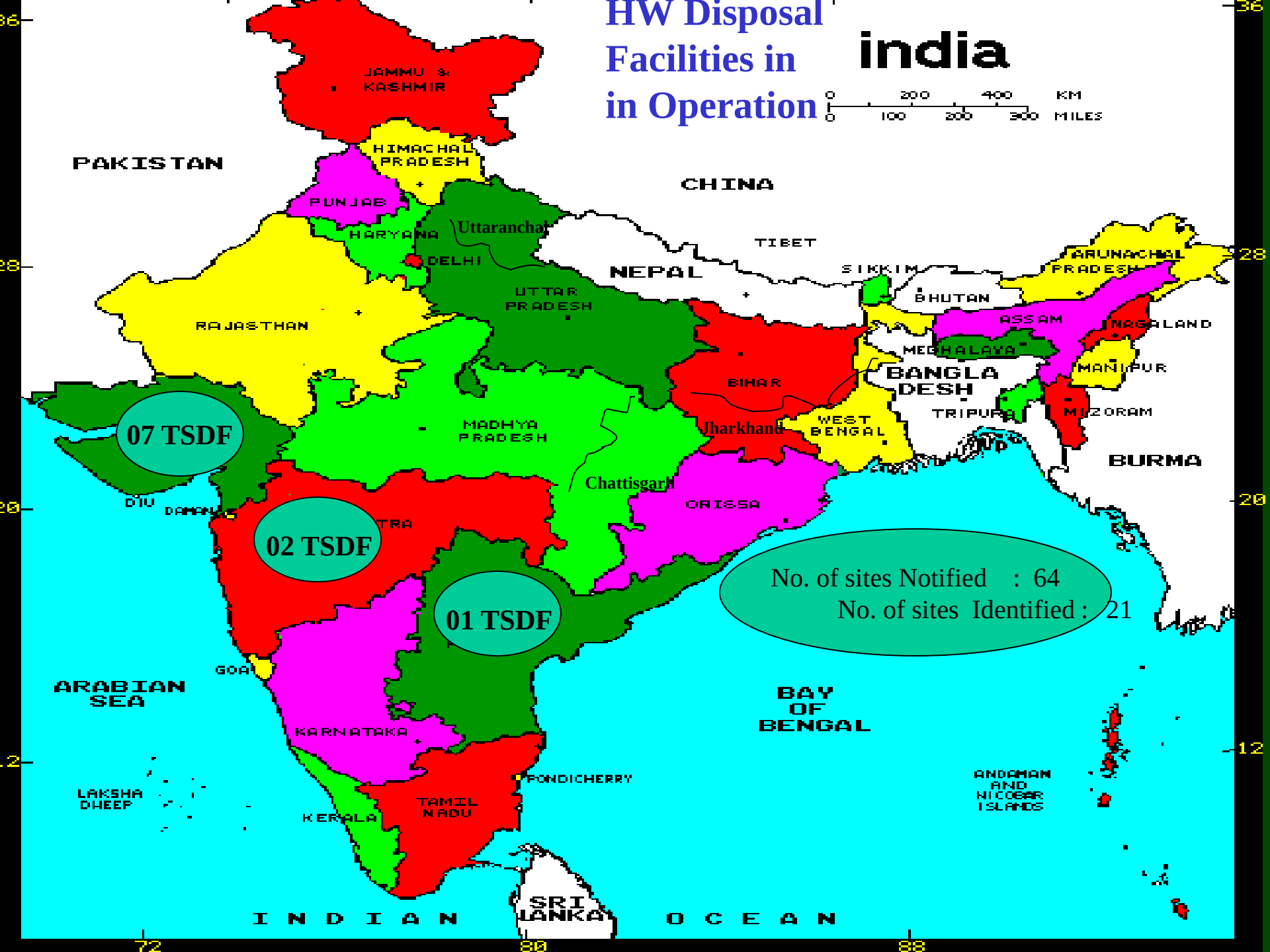
- **Absence of common facilities-temporary storage**
- **1998 : World Bank study on setting up of CETPs in India**
- **1998 : World Bank study on Development of TSDF.**
- **IX Five Year Plan: Central Support Initiated.**
- **States Support : help to accelerate the process**
  - **Subsidized Allotment of Land (Punjab, HP, TN, WB Maharashtra)**
  - **Cash Subsidy (AP, Maharashtra)**

Financial Viability of TSDFs

- Viability to be ensured at reasonable user charges
- Central / State Support

- Waste Assurance (Zonation & Enforcement)
  - Maharashtra-zonation
  - Gujarat-left to market forces

- User Charges
  - Charges fixed at tendering stage-Maharashtra
  - Fixation - Tripartite consultation –A.P
  - Market forces to determine-Gujarat
  - Escalation in line with WPI
- Scale of Operation and operating area- determine user charges


HW Disposal Facilities in in Operation
india
0 200 400 KM
0 100 200 300 MILES
JAMMU & KASHMIR
HIMACHAL PRADESH
PUNJAB
HARYANA
DELHI
Uttaranchal
UTTAR PRADESH
RAJASTHAN
MADHYA PRADESH
Chattisgarh
Jharkhand
BIHAR
WEST BENGAL
ORISSA
GUJARAT
DIU
DAMAN
GOA
MAHARASHTRA
KARNATAKA
KERALA
TAMIL NADU
PONDICHERRY
LAKSHA DHEEP
ANDAMAN AND NICOBAR ISLANDS
SIKKIM
BHUTAN
ARUNACHAL PRADESH
ASSAM
NAGALAND
MEGHALAYA
MANIPUR
TRIPURA
MIZORAM
BANGLA DESH
BURMA
PAKISTAN
CHINA
TIBET
NEPAL
SRI LANKA
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
07 TSDF
02 TSDF
01 TSDF
No. of sites Notified : 64
No. of sites Identified : 21
36
28
20
12
72
80
88

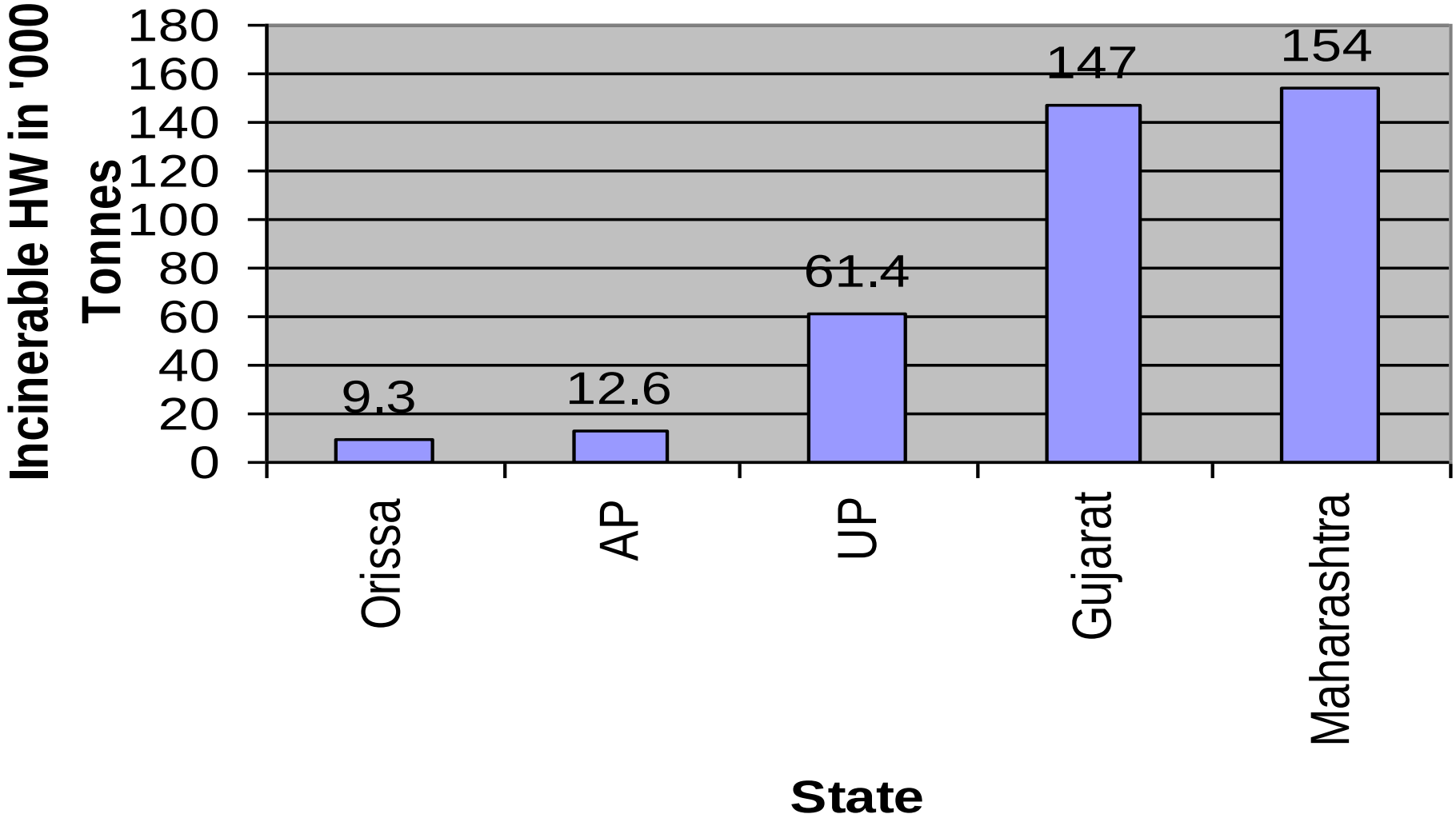
Status on HW Generation & TSDF in Operation in Major States

S.No.	State	Total HW generation in '000 TPA	No. of TSDF in operation/under construction	No. of sites notified	No. of sites identified
1.	AP	507	01	02	02
2.	Assam	4	-	-	-
3.	Chandigarh	8	-	-	-
4.	Delhi	17	Nil	Nil	03
6	Goa	-	Nil	Nil	Nil
7.	Gujarat	1207	07	16	22
8.	Haryana	15	-	01	01
9.	Himachal		-	-	02
10.	Karnataka	92	Nil	02	02
11.	Kerala	84	Nil	01	01
12.	Maharashtra	1407	02	02	06
13.	MP	-	Nil	Nil	03
14.	Orissa	75	Nil	01	01
15.	Pondicherry	30	Nil	Nil	Nil
16.	Punjab	16	Nil	01	01
17.	Rajasthan	184	Nil	01	08
18.	Tamilnadu	182	Nil	01	03
19.	Uttarpradesh	82	Nil	03	05
20	West Bengal		1		

Common TSDF – Multi State

- Flexibility for Industries located on Inter State Border
- Problem facing smaller States/UTs
- Incinerable waste – Min. Scale of operation - about 1.0 ton per hour
- Practical Difficulties: Delhi, Chandigarh, Daman, Goa

Incinerable HW as per HWM Rules 2003



Steps Taken For Effective Implementation Of HW (M & H) Rules Contd……

Published Guidelines :

- Guidelines for Transportation of H. Waste
- Guidelines for Consent to Establish or Operate - HW Treatment Storage and Disposal Facility
- Guidelines for Proper Functioning and Up-keep of HW Disposal Sites
- Guidelines for conducting Environmental Impact Assessment : Site selection for TSDF and Guidelines for "Setting-up of Operating Facilities.
- Criteria for Hazardous Waste Landfills.
- Guidelines for Common HW Incinerators.
- Manual on "Sampling, Analysis & Characterization of HW.
- Standards for Treatment of Leachate and Criteria for direct disposal of HW to TSDF.
- Environmentally Sound Recycling of HW .

Finalized Guidelines contd…

Guidelines for Transportation of Hazardous Waste:

- Regulatory requirement – Rule 7 (Manifest System)
- NOC requirement for interstate transportation
- Type of containers to be used for transportation
- Packaging and labeling requirement
- Transportation vehicle registration & safety aspects
- Educational qualifications & experience of the driver

Guidelines for Consent to Establish or Operate HW Treatment Storage and Disposal Facility.

- Regulatory regime for HW
- Authorization requirement as per provisions
- Conditions to be imposed in the authorization
- Special conditions w.r.to treatment, incineration
- Closure and post closure monitoring requirements

Finalized Guidelines contd…

Guidelines for Proper Functioning and Up-keep of HW Disposal Sites

- Regulatory definitions of Hazardous Waste
- Responsibilities of the Operator of a facility
- Requirements for setting up of TSDF as per HWM Rules
- Comprehensive analysis for waste acceptance
- Criteria to be followed for direct disposal to SLF
- Gaseous emission standards for Incineration
- Standards for leachate prior to its disposal

Guidelines for Conducting EIA : Site selection for Common HWTSDF and Setting up of Operating Facilities

- Preliminary Impact assessment for selection of site
- Detailed site assessment and evaluation based on weightage
- Prediction of Impact on Environment
- Ranking criteria

Criteria for Hazardous Waste Landfills:

- Location criteria for selection of site for TSDF.
- Criteria for selection of liner system
- Specifications for liner system
- Probable impacts due to the TSDF
- Location for Ground water monitoring wells
- Post closure monitoring requirements

Manual on “Sampling, Analysis & Characterization of HW.

- Procedure for sampling of Hazardous wastes
- Analysis procedures for analysis of HW listed under Schedule 2.

Finalized Guidelines contd…

Standards for leachate from SLF, for final disposal and Criteria for disposal of HW:

- Possible Methods of treatment of Leachate
- Standards for leachate before its disposal
- Waste Acceptance Criteria for disposal of wastes into SLF
- Criteria for direct disposal of HW into landfills (based on 1:10 water eluate)

Environmentally Sound Recycling of HW :

- Suggested Environmentally Sound Processes for recycling of I) Used Oil, ii) Waste Oil, iii) Non-ferrous metal wastes & iv) Lead bearing wastes

COMMON HW INCINERATOR GUIDELINES: SPECIFIC POINTS

- ✓ Transportation,
- ✓ Storage,
- ✓ Analytical Laboratory Requirements,
- ✓ Waste Feeding Mechanisms
- ✓ Combustion Chambers – General
- ✓ Rotary Kiln
- ✓ Secondary Combustion Chambers
- ✓ Air Pollution Control Devices
- ✓ Monitoring
- ✓ Ash/slag Management
- ✓ Quench/scrubber Liquor Management
- ✓ Organizational Structure
- ✓ Others

FLUE GAS EMISSION STANDARDS - HW INCINERATORS

Parameter	Emission standard	
Particulates	50 mg/Nm^3	Standard refers to half hourly average value
HCl	50 mg/Nm^3	Standard refers to half hourly average value
SO_2	200 mg/Nm^3	Standard refers to half hourly average value
CO	100 mg/Nm^3	Standard refers to half hourly average value
	50 mg/Nm3	Standard refers to daily average value
Total Organic Carbon	20 mg/Nm^3	Standard refers to half hourly average value
HF	4 mg/Nm^3	Standard refers to half hourly average value
NO_x (NO and NO_2 expressed as NO_2)	400 mg/Nm^3	Standard refers to half hourly average value

Contd…

Total dioxins and furans	0.1 ng TEQ/Nm^3	Standard refers to 6-8 hours sampling. Please refer guidelines for 17 concerned congeners for toxic equivalence values to arrive at total toxic equivalence.
Cd + Th + their compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Hg and its compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.

Note: All values corrected to 11% oxygen on a dry basis

INDIVIDUAL INDUSTRY-SPECIFIC INCINERATION FACILITIES

Industry specific incinerators handle known composition of either single or combination of liquid waste/solid waste/ and off-gases.

Unlike common incineration facilities where only rotary kilns are in use, the individual industry incinerators may have

- **Fixed hearth**
- **Fluidized bed incinerators**
- **Rotary Kilns**
- **Drum pyrolysers followed by combustion chambers *etc.***

As industry-specific incineration facilities are to be designed for incineration of specific wastes, all the controlling parameters & operating conditions as in case of common incineration facilities may not be applicable for all the industries.

Hence, a study on individual incineration facilities in following industrial sectors taken up:

- ✓ Pesticides,
- ✓ Bulk-drugs,
- ✓ Dyes & dye intermediates and
- ✓ Basic organic chemical industries

In-depth studies including performance evaluation of incineration facilities being conducted at 3 facilities each.

Operational Issues

Calorific value of the HW :

Calorific value of the wastes received is much higher than the designed average calorific value forcing reduction in feed rate.

Injection of special wastes in drums is causing shoot –up of CO

Feeding mechanism :

- **Not all facilities can handle drums**
- **Injection of lime and activated carbon for dry scrubbing before bag filter is yet to be standardised.**
- **Monitoring & analysis of Dioxins & Furons**
- **Specific control measures of heavy metals in air emissions yet to be explored.**

Co- Incineration of Hazardous Waste Having High Calorific Value

International Practices:

250 Cement Works in Europe utilize HW

Total about 3 Million Tonnes of Hazardous Wastes

Suitability in Indian context:

Cement Industry : 125 Units, spread across India

High potential for use as secondary fuel subject to suitability

Hazardous Wastes Considered Suitable

- Spent solvent from pesticide industry
- Paint sludge
- Sludges from oil refinery and petro -chemical industry
- Spent solvent from pharmaceutical units'
- Coal tar from coke oven plants
- Used tyres etc.,

Benefits:

- Integrated solution to waste Management
- Conservation of fossil fuel resources.
- Immobilization of toxic and heavy material.
- Reduction in energy / cement production costs.

Field Trials:

- Project on " Use of High Calorific Value Hazardous Waste as fuels in Cement Kilns" involving CPCB, NPC, NCBM, CMA & GTZ initiated

- Three Cement plants selected for trail run in Karnataka (Paint Sludge), Tamilnadu (Used Tyres) & Rajasthan(CETP sludge).

- Trial runs have been initiated – to assess:

  - Impacts, if any on quality of Cement and clinker
  - concentration of various pollutants (including Dioxins & Furans) being monitored.

- Guidelines to be evolved – Category –wise for use of HW in Cement Kilns

Recycling of Hazardous Waste

- Import of specified categories permitted for Recycling using environmentally sound technology
- Recycling of hazardous waste is permitted for units registered with CPCB and having ESM Facilities.
- Guidance Document prepared on ESM of following Recyclable wastes : Used Oil, Waste Oil, Non-ferrous metals wastes
- Technology Up gradation: linked to scale of operation
- Large Gap between Demand and Supply w.r.t Lead , Copper and Zinc wastes.
- India favours free movement of recyclables.

Recycling of Hazardous Waste contd…

- **Recyclable Wastes for which State of Art Facilities are needed**
  - **Mercury Bearing wastes.**
  - **Nickel Cadmium Batteries**
  - **Spent Catalyst**

- **E- Waste:**

  Guidance document under preparation covering

  i) Informal sector
  ii) leaded glass
  iii) precious metals recovery etc.,

Thank You