Waste Minimization and Recycling in Chemical Industry

Presentation by

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Introduction

- The "**waste minimization**" can be phrased differently:
  - Waste reduction or waste strength reduction
  - Application of clean technologies or green technologies
  - Pollution prevention
  - Environment-friendly technologies (LNWT)

Introduction

- The preference, naturally, will be reflected in the following order:

- No waste generation at all

- If waste is generated, it is recycled

- Residual wastes reduction v/w and in toxicity by treatment

- Disposal of treated residues should be so smooth that it does not adversely affect the recipient body (for example, dis-charge of treated effluent through an out fall diffuser).

Principles of HWM

- Source reduction
- Integrated life cycle of product – Cradle to Grave approach
- Precautionary principle
- Integrated pollution control principle
- Standardization principle
- Proximity principle
- Polluter pays principle
- Principle of public participation

Preparation of WM Program

A: Critical Steps

- Approach of 'out of site, out of mind' to be changed
- WM program to aim

Preparation of WM Program

A: Critical Steps

Reactors & Reactions

- Mixture of reactant raw materials & solvents in the reactor creates product, process waste and utility waste
- Minimize requirements of :
  - Quantity of input
  - Separation & purification
  - Utility inputs
  - Catalysts & work-up chemicals

Preparation of WM Program:

B:Initial Steps

- Waste Audit : Characterize waste streams
- Emission inventory : Quantification of release of waste
- Fugitive loss control
- Good operating practice
- Good Maintenance practice

Preparation of WM Program

C:WM Techniques

Technology selected depends on nature of waste and type of contaminants such as :

Contaminants	Type Break-up
1. Organic	• Organic liquids, soils, sludge sediments • Petroleum contaminated soils, sludge sediments • Solvent contaminated soils, sludge sediments • Rubber goods, tyre, belts, polymers, etc.
2. Inorganic	• Metal containing solutions • Metal containing soils, sludge sediments • Slag, bottom ashes, fly ash, foundry sands • Batteries, mercury containing materials, etc.
3. Misc.	• Chemical tanks, demolition debris, transformers, ballasts, etc.

Preparation of WM Program

C:WM Techniques

WR has to precede WM

- Raw material control
- Raw material stocks
- Process modifications
- Volume reduction

Preparation of WM Program

C:WM Techniques

Waste Recycling Technologies : a. Wastes containing organics

Waste type	Possible recycling technology
Organic solvent & petroleum product	Distillation, energy recovery, decanting
Soils-sludge-sediments, solvent/ petroleum contaminated or organic sledges	Energy recovery, decanting, thermal desorption, solvent extraction
VOCs	*In-situ* vacuum extraction,
Non-aqueous phase liquids (O & G)	Pump and recover
Dissolved organics	Freeze- crystallization
Propellant & explosives	Energy recovery, extraction, reuse
Lead acid battery cases	Energy recovery and/or reuse
Rubber goods (tyres, belts)	Energy recovery, size reduction, reuse
Liquid monomers	Distillation, energy recovery

Preparation of WM Program

C:WM Techniques

Waste Recycling Technologies : b. Wastes containing inorganics

Waste type	Possible recycling technology
Metal containing solutions	Crystallization, precipitation, ion-exchange, RO, evaporation, cementation, electrowinning
Metal containing soil, sludge, sediment, slag	Chemical leaching, solidification, vitrification,
Abrasive blasting material, foundry sand	Use as raw material for cement, vetrification
Lead acid & Ni-Cd batteries	Chemical leaching, pyro-metallurgical processing, physical separation

Preparation of WM Program

C:WM Techniques

Waste Recycling Technologies : c. Miscellaneous waste

Waste type	Possible recycling technology
Scrap chemical tanks, pipes	Decontamination and disassembly
Non-metal structures and demolition debris	Separation and disassembly, use as construction material
Wood debris	Energy recovery
Transformer & ballast	PCB flush and treat, metal recovery

Preparation of WM Program

D:Recycling Technologies

- Distillation
- Energy recovery (general)
- Energy recovery (cement kiln)
- Thermal desorption
- Solvent extraction
- Freeze crystallization
- Chemolysis
- Thermolysis
- Chemical precipitation
- Ion Exchange
- Liquid ion exchange (LIX)
- Reverse Osmosis (RO)
- Diffusion dialysis (DD)
- Electrolysis (ED)
- Evaporation
- Cement raw materials
- Physical separation
- Adsorption

Formulation of WM Program

A. Human Resources

Success depends on conviction of leader & motivator

B. Crossing Barriers

- Finance
- Procurement,
- Quality control
- Engineering & utilities
- Space, relocation
- Labour

C. Assessing options

- Wastes of interest and hierarchy
- Define objectives of WR
- Factors affecting WR
- Regulatory benefit

Formulation of WM Program

D. Evaluation

Project element	Evaluation criteria	
1. Management support	• Statement of support • Approval of project	• Providing ideas/input • Praise and publicity of successes
2. Team aspects / program initiation	• Employee enthusiasm • Using skills from training	• Supporting projects • Providing ideas
3. Understanding process	• Processes characterized • Flow diagram developed	• Wastes/sources identified • Waste accounting
4. Project implementation	• Budget compliance • Schedule compliance • Waste reduced • Cost saved	• Raw material saved • Product quality improved • Worker safety • Cost allocation system implemented
5. Continuing the program	• Follow-up and review procedures established	• Employees kept informed & involved. Pollution prevention team rotated

Formulation of WM Program

E. Approaches

- One approach is to look at the waste and try to decide which one to take up first

- Another approach is to prioritize in terms of efficiency of technology

Implementation of WM Program

A. Training

B. Raw material control

C. Managing utilities

- Boiler performance
  - A/F ratio
  - Flue gas analysis
  - Temperature
  - O&M
- Combustion in oil fired boiler
  - Energy
  - Pumps
  - Fans
  - Air compressors

Implementation of WM Program

D. Hardware & Machinery
   - Efficiency
   - Mechanical separation
   - Equipment modifications

E. Process Modification
   - Reactors
   - Effectiveness of catalysts
   - Heat exchangers : cause of waste due to reduced efficiency
   - Distillation columns : cause of waste due to reduced efficiency

D. Catalyst : Hastens reaction, increased conversion, reduced waste

MPCB WM Program

Act on Prevention of Water Pollution, 1974 : Prevention, abatement and control of pollution

Maharashtra Scenario

- 55,911 industries
- 15.45% red, 17.08% orange and 67.47% green category
- Of water polluting industries, 5987 industries with adequate treatment; of air polluting – 6637 have adequate facilities, of HW generating industries – 2960 have adequate treatment & disposal facilities
- Of 872 units under CAP, 592 complying with standards
- 22 CETPs catering to 4,034units treating 164.35 MLD (2.38% of total effluent generated)

MPCB WM Strategy

1. Data Collection & Analysis
   - Questionnaire, Consent renewal, Annual environment Statement, Annual returns, Inspections
2. Finding WM Potential and spreading awareness
   - Comparative study, Literature, Training industries forming group of MPCB officials, consultants, researchers, etc.
3. Voluntary Commitment by Industry
   - CREP
4. Technical assistance to industries
   - Combined efforts; modifications in consent with application of WM strategy; conducting workshops; sharing success stories; disseminating information, knowledge & guidelines
5. Removing bottlenecks
6. Review failures & reframe strategy

Results of MPCB WM Strategy

- Utilisation of TSDF

Sr. No.	Particulars	2003	2004
1	Membership	62	1263
2	Direct landfill MT	17824	29793
3	Landfill after treatment MT	2443	22766
4	Incineration MT	1081	4681
5	Total waste so managed MT	21348	57240

- Inventory of waste
  - Authorized HW waste – 11,09,241 MTA
  - Non-industrial sources – 87,343 MTA
  - Illegal waste dumps – 40,950 MT
  - Waste from CETP – 28,764 MTA

MPCB WM Strategy : Prevention better than Cure

Continuing Initiatives

- Disseminate information to generators, engineers, operators on WM
- Encourage industries to implement WM methods
- Indentify funds & incentives
- Assist overcoming regulatory barriers
- Ensure new/expanding industries develop WM plan and implement
- Determine HWTSD stations for SSI
- Co-ordinate with other Govt departments like Factory Inspectorate, Health Services, Transport, Traffic and Law

MPCB WM Strategy : Planning

Planning

- Strict implementation of HW Rules
- Through checking of membership of common facility
- Working of CETP & HWTSDS is examined frequently
- Detection of Illegal dumps
- Check on unauthorized/night time dumping
- Expansion / new industry to be allowed with efforts on WM

MPCB WM Strategy : Planning

Action Taken as per SC directives

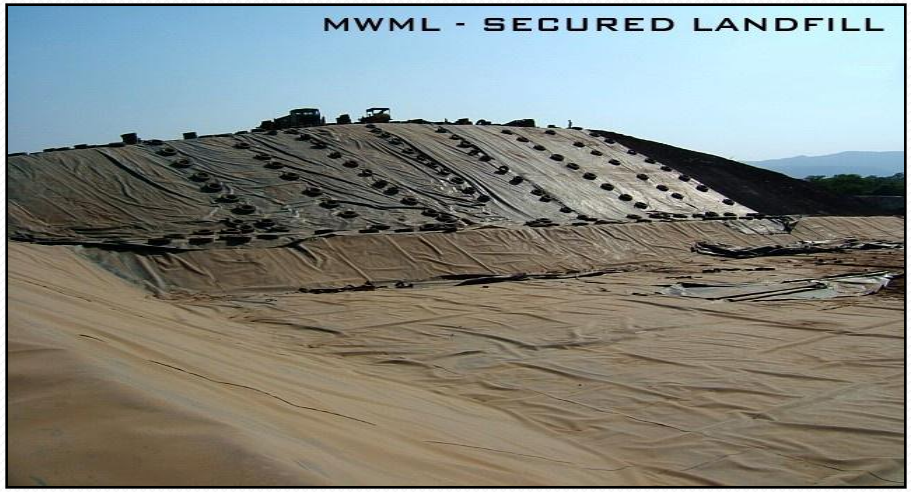
- Inspection of CETP & HWTSDF with time bound rectification program
- Electronic waste handling
- Hazardous cargo at airport
- Action against industries without authorization
- Inventory of illegal dumps
- Within same industry premises, MIDC area, outside MIDC, auctioned out to unauthorized vendors
- BG from industries as a bond of collective good behavior
- A watch dog committee (LAEC)
- Remote sensing by NRSA for indentifying illegal dumps

MPCB – WM Program : Illegal dumps of HW

Scientific disposal of illegal dumps

Hazardous Waste TSDF at Taloja

Hazardous Waste TSDF at Taloja



Conclusion

- SC Order, 2003
- National Conservation Strategy and Policy Statement on Environment & Development, 1992
- Policy Statement on Abatement of Pollution, 1992
- National Productivity Council Study (100 stories)
- HW (MH&TM) Rules, 2008

Thanks very much!