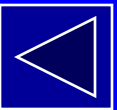


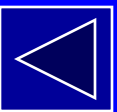
HAZARDOUS WASTE

- ◆ CHARACTERISTICS
- ◆ CLASSIFICATION
- ◆ LAWS/REGULATIONS
- ◆ TREATMENT METHODS



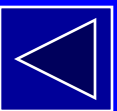
Hazardous Wastes

- ◆ Definition
- ◆ Sources
- ◆ Health Effects
- ◆ Regulations
- ◆ Minimization
- ◆ Treatment & Disposal
- ◆ Site Remediation



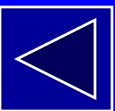
Introduction

- ◆ A special class of wastes: special handling and disposal required
- ◆ Materials which pose a certain threat to human health and the environment
- ◆ byproducts of 20th century industry and technology
- ◆ large amounts have been disposed of carelessly
 - Love Canal
 - Times Beach



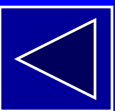
Haz. Waste Legislation

- ◆ Toxic Substances Control Act (TOSCA); 1976
 - toxic effects of new chemicals
 - testing of existing chemicals
 - warning labels to outright bans (e.g., PCBs)
- ◆ Resources Conservation and Recovery Act (RCRA); 1976, later reauthorized
 - designation of hazardous wastes
 - requirements for facilities that generate, transport, treat, store or dispose (TSDFs) of HW, “cradle to grave”
 - » uniform HW manifest
 - » permitting of TSD facilities
 - underground storage tanks



Legislation (cont.)

- ◆ Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA); 1980
 - “Superfund” to clean up abandoned sites
 - Hazard Ranking System (HRS)
 - National Priority List (NPL)
 - Reauthorized in 1986 (SARA)



Designation of HW under RCRA

- ◆ Ignitability

- ◆ Corrosivity

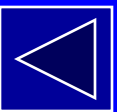
- pH 2 and below; or pH 12.5 and above
- corrodes steel 0.25 in/y at 55 C

- ◆ Reactivity

- reacts violently with or without water
- generates toxic gases

- ◆ Toxicity

- Toxicity Characteristic Leaching Potential (TCLP) and toxicity characteristics



Contaminants

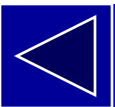
EPA NO.	CONTAMINANT	MAXIMUM CONC., MGL	EPA NO.	CONTAMINANT	MAXIMUM CONC., MG/L
D004	Arsenic	5.0	D008	Lead	5.0
D005	Barium	100.0	D009	Mercury	0.2
D018	Benzene	0.5	D010	Selenium	1.0
D006	Cadmium	0.1	D011	Silver	5.0
D019	Carbon tetrachloride	0.5	D012	Endrin	0.02
D020	Chlordane	0.03	D013	Lindane	0.4
D021	Chlorobenzene	100.0	D014	Methoxychlor	10.0
D022	Chloroform	6.0	D015	Toxaphene	0.5
D007	Chromium	5.0	D016	2,4-D	10.0
			D017	2,4,5-TP Silvex	1.0



Alternative Definition for HW

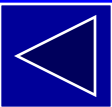
HW from Non-specific sources

Hazardous Waste No.	Waste Description	Hazard Code1
F001	Spent halogenated solvents used in degreasing, tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and the chlorinated fluorocarbons; and sludges from the recovery of these solvents in degreasing operations.	T
F006	Wastewater treatment sludges from electroplating operations.	T
F007	Spent plating bath sludges from electroplating operations.	R,T
F010	Quenching bath sludge from oil baths from metal heat treating operations.	R,T



HW from Specific Sources

Hazardous Waste No.	Waste Description	Hazard Code1
Wood Preservation:K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol	T
Inorganic Pigments:K005	Wastewater treatment sludge from the production of chrome green pigments	T
Organic Chemicals:K020	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production	T
Pesticides: K032	Wastewater treatment sludge from the production of chlordane	T
Explosives: K044	Wastewater treatment sludges from the processing of explosives	R
Petroleum Refining: K052	Tank bottoms (leaded) from the petroleum refining industry	T
Leather Tanning Finishing: K053	Chrome (blue) trimmings generated by the following subcategories of the leather tanning and finishing industry:	T
Iron and Steel: K060	Ammonia still lime sludge from coking production	T



HW from Discarded Products, etc.

Hazardous Waste No.	Description
P012	Arsenic trioxide
P089	Parathion
P110	Tetraethyl lead
U051	Creosote
U151	Mercury
U226	1,1,1-trichloroethane

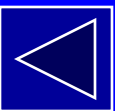
RCRA Classifications

◆ Four Program Areas

- Hazardous Waste Program
- Solid Waste Program
- Underground Storage Tanks (UST) Program
- Medical Waste Program

◆ Generators

- Small Quantity (SQG): 100-1000 Kg
 - » 180-270 days storage
- Large Quantity: >1000 Kg
 - » 90 days storage; many obtain TSDf permits for longer times
- Must initiate a manifest; Special labeling and handling; training required



RCRA (cont.)

◆ Transporters

- must have EPA ID number and take responsibility

◆ Treatment, storage and disposal facilities

- administrative standards

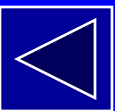
- » rules on waste analysis, site security, inspections, training emergency preparedness and manifests

- general standards

- » record keeping, groundwater monitoring, closure, postclosure monitoring & maintenance (30 yrs for landfills), financial considerations

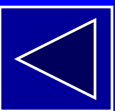
- permit-specific standards

- » specific to type of facility, e.g., landfills must have double liners and double leachate collection systems



CERCLA

- ◆ Also known as Superfund or SARA
- ◆ Intended as a solution to those previously contaminated sites with no-one to pay (no PRPs)
- ◆ Two levels
 - emergency response
 - » immediate threat to human health or environment
 - long term remediation
 - » if Hazard Ranking System (HRS) shows a score over 27.5, it is added to the National Priorities List (NPL) for Superfund cleanup
 - » 1300 sites on NPL in 1990, more to come



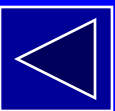
Waste Minimization

◆ Recycling

- reuse of a waste product
- example: electroplating and recovery of heavy metals by ion exchange, reverse osmosis, etc.

◆ Source Reduction

- process modification to reduce the use of toxic materials
- example: electroplating and movement away from cyanide-based processes.



Treatment and Disposal Methods

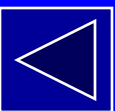
- ◆ Physical and Chemical Treatment

- Precipitation and Coagulation
- Filtration
- Neutralization
- Oxidation and Reduction
- Adsorption Processes

- ◆ Landfill Disposal

- ◆ Incineration

- ◆ Chemical Fixation

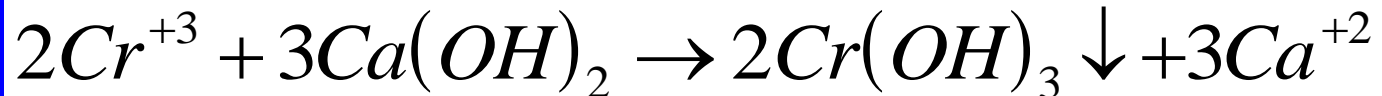
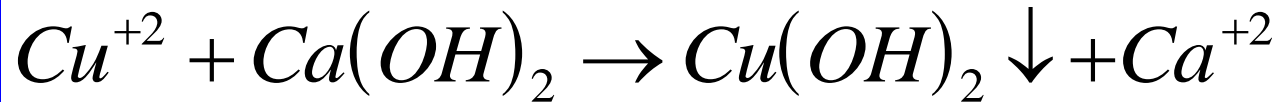


Precipitation and coagulation

Used mostly to remove metals from wastewater

Many metals become insoluble at pHs from 8 to 10

Addition of lime for raising pH



See example 12.1

