Hazardous Wastes

- Scope of the Hazardous Waste Problem: 250 m________ per year in U.S. (300-500 world-wide)
- Hazardous Wastes Generators: 20,000
- Treatment Storage and Disposal Facilities (TSDF): 3000
- 93% of hazardous wastes managed by: 60 _____ TSDF’s
● Chemical Products Industry ($125b annually) contributes 50% of hazardous wastes

● Number of Chemicals – 70,000

● New Chemicals Manufactured every year: 1500

● Abandoned Hazardous Wastes Sites: 50,000
Superfund

- In 1980 Congress passed the Comprehensive Environmental Response, Compensation and Liability Act - Superfund (CERCLA - Superfund)
Superfund

- $1.6b from taxes on crude oil & commercial chemicals
- every state had to compile a list of hazardous waste sites and submit it to EPA
- National Priorities List (NPL)
Superfund

- EPA prioritized these sites based on the potential hazard from groundwater ($S_{GW}$), surface water ($S_{SW}$), and air exposure ($S_A$):

$$S_M = \frac{1}{1.73} \sqrt{S_{GW}^2 + S_{SW}^2 + S_A^2}$$

where $S_M$ is the composite score
Superfund

- There are 1,300 sites on the list
- Only 200 sites have been cleaned up
- There are 3 unique things about Superfund
  1) Ex post facto
     - party can be liable for actions that were previously legal
     - potentially responsible party
  2) Innocent landowner liability
     - anyone who buys property contaminated with hazardous wastes can be liable
     - only way to avoid liability is to make “appropriately inquiry” prior to purchase
Superfund

- **Joint & Several Liability**
  - Liability can be shared between parties or any one party may be liable for entire cleanup
  - “deep pockets”
    - EPA only needs to sue one party
    - That party must sue other parties to recoup cleanup costs
Figure 7: Superfund Remedial Actions: Source Control Treatment Projects (FY 1982 - 2002)*

**Ex Situ Technologies (499) 58%**
- Physical Separation (20) 2%
- Incineration (on-site) (43) 5%
- Bioremediation (54) 6%
- Thermal Desorption (69) 8%
- Chemical Treatment (10) 1%
- Incineration (off-site) (104) 12%
- Solidification/Stabilization (157) 18%
- Other (ex situ) (42) 5%

**In Situ Technologies (364) 42%**
- Soil Vapor Extraction (213) 25%
- Bioremediation (48) 6%
- Solidification/Stabilization (48) 6%
- Flushing (16) 2%
- Chemical Treatment (12) 1%
- Other (in situ) (27) 3%

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- In Situ Thermal Treatment (8)
- Multi-Phase Extraction (8)
- Neutralization (4)
- Phytoremediation (4)
- Vitrification (2)
- Electrical Separation (1)
dioxin

- dibenzo-ρ-dioxin
- over twenty different isomers
- byproduct of herbicide/pesticide manufacture
- created during incineration of hazardous wastes
- contaminant in 2,4-D, agent orange and others
- carcinogenic, teratogenic, mutagenic, embryo-toxic in animal studies
- bioaccumulate in fatty tissue
- no known link to human effects
polychlorinated biphenyl (PCB)

- over 200 isomers
- different chlorine composition (Araclor 1248)
- virtually indestructible - useful as transformer fluid (in every transformer: 1930 - 1970)
- toxic effects to exposed workers noted in 1937
- environmental contamination realized in 1969
- pounds produced prior to 1977
- led to Toxic Substances Control Act of 1976
What makes a waste hazardous?

- Potentially dangerous to human health or the environment
- Causes adverse physiological effects
- Official EPA definition
  - On EPA list (it must be discarded to be classified as a waste) or
  - Exhibits certain characteristics

Hazardous Waste Accumulation Area

Hazardous Waste in this area will be picked up on a regular basis.

- Don’t forget Special wastes: Batteries, aerosols, e-waste, sharps, lamps, ballasts, mercury thermometers. Visit our web site for more details: www.safety.uwm.edu
- US&A cannot pick up unknown chemicals!

Label container completely with the full name of the chemical (no abbreviations, symbols, or structures).

If your container is full before your scheduled pick up, call x4999 or 2883. Please give your name, building, room#, how many containers you need and a brief description of the waste.
Listed Wastes (Appendix C)

- **F Wastes**
  - from non-specific sources
    - e.g. chlorinated solvents
      - Trichloroethylene \(\text{TCE}\)
      - Methylene chloride
  - K Wastes
    - from specific sources
      - e.g. wood preserving wastes (contain creosote and possibly arsenic)
Listed Wastes (Appendix C)

- **P Wastes**
  - off spec products and intermediates
  - acuteley toxic
    - e.g. toxaphene

- **U Wastes**
  - off spec products and intermediates
    - generally toxic
    - DDT
DDT

- Organochlorine
The Panama Canal (1905-1910)

- The construction of the Panama Canal was possible only after yellow fever and malaria were controlled.
  - These diseases were a major cause of death and disease among workers.
- In 1906, there were over 26,000 employees working on the Canal.
  - 21,000 were hospitalized for malaria during their work.
  - By 1912, there were over 50,000 employees, and the number hospitalized decreased to 5,600.
  - They used an integrated program of insect and malaria control.
Biomagnification

- DDT in water: 0.000003 ppm, or 3 ppt
- DDT in zooplankton: 0.04 ppm
- DDT in small fish (minnows): 0.5 ppm
- DDT in large fish (needle fish): 2 ppm
- DDT in fish-eating birds (ospreys): 25 ppm
Characteristic Wastes

- Ignitibility
  - Liquid with < 24% alcohol
  - Has a flash point < 60°C
  - Capable of spontaneous combustion
  - Ignitable compressed gas
  - Oxidizer
Characteristic Wastes

- Corrosivity
  - Aqueous pH $\leq 2$ or $\geq 12.5$
  - Corrodes steel at a rate of 6.35 mm/y at 55°C
Characteristic Wastes

- Reactivity
  - Normally unstable
  - Reacts violently with water
  - Forms explosive mixtures with water
  - Generates toxic vapors
  - Cyanide or sulfur containing waste
Characteristic Wastes

- Toxicity (EP Toxicity test)
  - Liquid extract from acid extraction has to meet the required standard
    - e.g.:
      - $\leq 5.0$ mg/L arsenic
      - $\leq 0.5$ mg/L benzene
      - $\leq 0.20$ mg/L vinyl chloride
## EP Toxicity

<table>
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<th>EPA HW No.</th>
<th>Constituent</th>
<th>Regulatory level (mg/L)</th>
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<td>D004</td>
<td>Arsenic</td>
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<td>Barium</td>
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<td>D018</td>
<td>Benzene</td>
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<td>D006</td>
<td>Cadmium</td>
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<td>D019</td>
<td>Carbon tetrachloride</td>
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<td>Chloroform</td>
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<td>Chromium</td>
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<tr>
<td>D023</td>
<td>o-Cresol</td>
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<tr>
<td>D024</td>
<td>m-Cresol</td>
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<td>p-Cresol</td>
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<td>1,1-Dichloroethylene</td>
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<td>2,4-Dinitrotoluene</td>
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<td>D012</td>
<td>Endrin</td>
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<td>D031</td>
<td>Heptachlor (and its epoxide)</td>
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<tr>
<td>D043</td>
<td>Vinyl chloride</td>
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Cradle to Grave

- RCRA requires a manifest system to track hazardous wastes from its source of generation to ultimate disposal
- Generator required to maintain records and assume responsibility for the waste along the way
EPA Uniform Hazardous Waste Manifest
Hazardous Waste Landill