CVEN 4474/5474 Haz Waste Outline

• RCRA Regulations
  – Regulation
  – Definition of hazardous waste
  – Excluded wastes - a good idea?
  – Hazardous Waste generators
  – Non-hazardous Sub-titles
• International treaties
  – Basel & Stockholm Conventions

Change in Industrial Strategy for Hazardous Wastes

• Pre 1970
  – Inconsistent waste management
  – unaware of risks?
  – Low cost options used ("dumping")
• 1970s-1980s
  – Regulatory compliance
  – End of pipe control
• 1990s-2010
  – Prevent waste generation
  – Life cycle and sustainability approaches

Quantities of Wastes Generated in US

• Solid Waste “industrial non-hazardous”
  – ~11.4B tons/yr
  – 67% industry, 1.6% municipal
• Hazardous Waste
  – 275M tons/yr [includes haz wastewater]
  • ~45M tons/yr “solid”
  – 71% from chemical and petrochemical industries
  – Largest 1% of producers ~97% total volume
1976 RCRA & 1984 HSWA  
*Resource Conservation & Recovery Act*  
*Hazardous and Solid Waste Amendments*  
- Defined Hazardous Waste (Subtitle C)  
- Cradle-to-Grave manifest system  
- Permit system for TSDs  
- Classified generators by quantity  
- Land ban on hazardous waste disposal  
- Other wastes covered  
  - UST (Subtitle I), Medical (Subtitle J),  
  - underground storage tanks  
  - Solid Waste (Subtitle D)

**RCRA Regs**

...solid, liquid, or contained gas fitting haz waste criteria  

**Three Criteria of Haz Waste**  
- Listed material  
  - F list: wastes from general chemical use  
    - Ex: spent halogenated solvents used in degreasing: PCE, TCE, MeCl, 1,1,1TCA, CT, chlorofluorocarbons  
  - K list: specific wastes from 17 specific industries  
    - Ex: bottom sediment sludge from treatment of wastewater from wood preserving processes that use creosote and/or PCP  
    - P list: 205 acutely toxic chemicals; ex: aldrin, acrolein,  
    - U list: 411 chemicals acutely toxic and characteristic of hazardous waste  
- 4 Characteristics (TRIC)  
- Not on exclusion list  
  *Also: any mixture with a hazardous material*

**RCRA Regs**

**4 Characteristics of Haz Waste**  
- **Toxic** (TCLP test)  
  - Adverse human or environmental effects  
  - Chemical concs in acid liquid extractant >100x drinking water limits  
- **Reactive**  
  - Reacts violently with water &/or explosive  
- **Ignitable**  
  - Capable of spontaneous combustion  
- **Corrosive**  
  - pH <2 or >12.5; rate of steel corrosion
Excluded Wastes therefore, Subtitle D Solid Waste

<table>
<thead>
<tr>
<th>POTW sewage</th>
<th>Ash from MSW incin</th>
<th>CWA point discharges</th>
<th>Agriculture waste</th>
<th>Irrigation return flow</th>
<th>Mining wastes</th>
<th>Radioactive waste</th>
<th>Oil &amp; gas drilling fluid</th>
<th>Municipal solid waste</th>
<th>Ash from coal combust</th>
</tr>
</thead>
<tbody>
<tr>
<td>M ton/yr</td>
<td>4.5</td>
<td>1000</td>
<td>1700</td>
<td>1400</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
<td>85</td>
</tr>
</tbody>
</table>

- What characteristics common to "hazardous" waste might these wastes have?
- Why are these wastes excluded if they have hazardous characteristics?
- What are the pros/cons for these exclusions (cost:benefit analysis)?

What about radioactive waste?

- It is "hazardous" based on toxicity to humans from the radiation & also potentially explosive if the quantity stored “goes critical”
- However, regulated by the Nuclear Regulatory Committee (NRC), not US EPA, under the Atomic Energy Act (& 6 other regulations)
  - we will still discuss rad waste in this class!

Cradle-to-Grave

- Everyone involved in the haz waste process (generators, transporters, treaters) can be held liable for problems even if they were not directly "at fault"
- The manifest system helps to ensure responsible waste management
  - everyone has a copy of the manifest from all stages
Land Ban

- No non-containerized liquid disposal (lagoons, etc.)
  - except deep well (>=2000') injection?
- Generally, no disposal of containerized liquids
  - Treat (generally by solidification/stabilization) to remove free liquid
- Specifically designed landfills for haz waste
  - liners, leachate collection, covers, leak detection,…

3 Categories of Haz Waste Generators

- LQGs (Large Quantity Generators)
  - >1000 kg/mo haz w or >1 kg/mo acutely haz
- SQGs (Small Quantity Generators)
  - 100-1000 kg/mo haz w
- CESQGs (Conditionally Exempt SQGs)
  - <100 kg/mo haz w & <1 kg/mo acutely haz

RCRA Regs

Generator Requirements

- LQGs:  - EPA ID number
  - ID and track all haz waste
  - Storage and safety req’s (contingency plan)
  - Hazardous Waste Manifests to reg TSDFs
  - Biennial reporting
- SQGs - EPA ID number, store no more than req’d amts on site using approved methods,
  - safety precautions, send waste to regulated TSDF w/ manifest
- CESQGs - store <1000 kg, deliver for tmt or disposal (to haz w. TSDF NOT req’d)
Number of Generators and Quantity of Waste Produced

LQGs: least #, highest quantity

CO 119 LQGs w/ 95K tons

<table>
<thead>
<tr>
<th>yr</th>
<th># LQGs</th>
<th>tons/yr HazW</th>
<th>where</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>214M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>20,316</td>
<td>40.7M</td>
<td>Tx 19M, LA 4.6M, Il 2.2M, OH&amp;Miss 1.7M</td>
</tr>
<tr>
<td>1999</td>
<td>20,083</td>
<td>40.0M</td>
<td>Tx 15M, LA 4.4M</td>
</tr>
<tr>
<td>2005</td>
<td>16,191</td>
<td>38.3M</td>
<td>Tx 15M, LA 5.5M</td>
</tr>
</tbody>
</table>

?: real, significant decrease 1995-1997

65-71% in 5 states

1995 vs 1997:

- 81% decrease in LQG mass of haz waste generated shown
- …due to wastewater!
  ⇒ Solid mass haz waste increased 11%
  ⇒ 1997 – 1999 solid mass decreased 1.5%

Source: EPA Biennial Report based on generator reports to EPA (publ. 1999; 2001)

Number of Generators and Quantity of Waste Produced

SQGs:
- many more SQGs ~236,000 in 1997
- generate ~1% qty of LQGs ~5M tons

CESQGs:
- 455,000 generated 202K tons/yr [1994]
  Lead-acid batteries, spent solvents/still bottoms, PCE, & photographic wastes
- 34 states have CESQG regs > EPA
  note: same amount of data is not provided to EPA for tracking as LQGs
Treatment, Storage, Disposal Facilities (TSDs)

- 2025 vs 1575 vs 1550 in 1997/1999/2005
  - (1078/1049/1023 storage only)
- 37.7M/26.3M/43.9M tons managed
- Disposal options used
  - 76-54% Land disposal (26-16M deep well inj, 2-5M LF)
  - 10-5% recovery: 22% other tmt
  - 11-7% thermal (half w/ energy recovery, half incin)
  - 1-8% other disposal
- 18,029 / 17,914 / 16.082 shippers in 1997/99/05
  - 7.3-8.1M tons...4.2-5.7M tons between states

Underground Storage Tanks (USTs) - Subtitle I

- Added to RCRA in 1984
- ~1.4 M leaking USTs required remediation
- Includes petroleum products and hazardous substances
- Requirements:
  - Design & installation; operation
  - Leak detection
  - Release response
  - Corrective Action
  - Closure

Medical Waste: Subtitle J

- lots of recent activity & regulatory changes
- "hazardous" due to infection
- most control at state level
- EPA regulated medical waste incinerators
  - ~2400 MWIs in 1997... 50-80% expected to shut down due to more stringent regulations
- 1988 Medical Waste Tracking Act
  - required cradle-to-grave accounting
  - expired June 1999... ??

Global problem! Developing countries too....
Subtitle D: Solid Waste

- 6500M ton/yr manufacturing
- 1700M tons/yr mining
- 1400M tons/yr oil & gas
- 1000M tons/yr agriculture (pesticides?)
- ~200M tons/yr MSW (municipal SW)
  - May include hazardous materials, so-called household hazardous waste
- 85M tons/yr coal combustion residuals
  - Fly ash, bottom ash,..... Metals, radiation
  - Examples: boron, arsenic, selenium
- 4.5M tons/yr MSW ash (metals?)

International Treaties

- Basel Convention 1989/92
  - Controls haz & e-waste export to nonOECD countries
  - Prior informed consent required to receive the materials
  - List A Annex VIII hazardous wastes
  - US has not ratified (so exports e-waste to China, etc)
- Stockholm Convention 2001
  - UNEP Governing Council
  - Persistent Organic Pollutants (POPs)
    - Persist in environment; enter food chain; pose adverse risks
    - Global action to reduce/eliminate release of POPs
    - Starting list of 12 chemicals: Pesticides, PCBs, dioxins and furans
US ~917 kg/capita/yr Haz Waste
+ ~38,000 kg ind waste/cap/yr

Estonia ~10,000 kg/cap/yr

Figure 3: Hazardous Wastes and Other Wastes Generated per Capita in 1997

www.basel.int