Sampling & Characterizing Waste
Introduction

- Defining waste materials
- Characterizing waste
- Sampling & testing waste
Is it Solid Waste?
Solid Waste defined (40 CFR 261.2)

Any garbage, refuse, sludge from a waste treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial mining, and agriculture operation and community activities, but does not include solid or dissolved material in domestic sewage.
4-Step Process:

1. Is the material excluded as per 40 CFR 261.4a? *Ex. Domestic Sewage*
2. Is the material a solid waste?
3. Is the solid waste excluded as per 40 CFR 261.4b? *Ex. Household garbage*
4. If the waste is a solid waste then is it a hazardous waste as per 40 CFR 261, Subpart C &D?
Relationships Among Discarded Materials, Solid Wastes & Hazardous Wastes

- Products used for their intended purpose
- Gaseous emissions from manufacturing
- Solid Wastes that are not listed or characteristic & 261.4(b) materials
- RCRA-regulated hazardous wastes
Accurate Waste Classification
40 CFR 262.11:

- Solid Waste?
- Listed Hazardous Waste?
  40 CFR 261 Subpart D
- Characteristic Hazardous Waste?
  40 CFR 261 Subpart C
- Sampling & analyzing the waste
- Process knowledge
Solid Waste → Hazardous Waste?

Generator’s Knowledge includes:

- Previous testing on similar wastes
- MSDS/Chemical makeup of products
Solid Waste → Listed Hazardous Waste?

Is the waste a “listed” waste?

- F waste - waste from non-specific sources. *Ex. Fo81 Spent halogenated solvents from degreasing*
- K waste - waste from specific industries/sources. *Ex. Ko51 API Separator sludge from the petroleum refining industry.*
- U waste - Chemicals identified as toxic. *Ex. Methanol, creosote*
- P waste - Chemicals identified as extremely hazardous. *Ex. Carbon disulfide, hydrogen cyanide*
Solid Waste $\rightarrow$

Characteristic Hazardous Waste?

Four Characteristics of Hazardous Waste:

- Ignitable (D001)
- Corrosive (D002)
- Reactive (D003)
- Toxicity Characteristic (D004-D043)
TCLP Chemicals

- 10 Volatiles
- 11 Semi-volatiles
- 10 Pesticides/Herbicides
- 8 Metals
A solid waste is a hazardous waste if:

It is a mixture of solid waste and one or more hazardous wastes

CFR 261.3(a)(iv)
Hazardous Waste- The Mixture Rule

1. Characteristic waste + Solid Waste
   • *Mixture only hazardous when an RT is exceeded*

2. ICR Only Listed Waste + Solid Waste
   • *Mixture is hazardous only when an RT is exceeded*

3. Listed Waste + Solid Waste
   • *Mixture is hazardous regardless of the amount*
Hazardous Waste-“Contained-In” Rule

- Hazardous waste mixed with environmental media
  Example: Soil or Groundwater never abandoned or discarded; therefore not a solid waste
- Mixture IS hazardous if:
  - Media exhibits a characteristic of hazardous waste
  - Hazardous COC is present above health-based levels.....RECAP Investigation.
Sampling & Testing
Representative Sample Defined
(40 CFR 260.10):

A sample of a universe or a whole that can be expected to exhibit the average properties of the universe or whole.
Appendix I to Part 261-
Representative Sampling Methods

The methods and equipment used for sampling waste materials will vary with the form and consistency of the waste materials to be sampled. Samples collected using the sampling protocols listed below, for sampling waste with properties similar to the indicative materials, will be considered by the Agency to be representative of the waste.

- Extremely viscous liquid- ASTM Standard D140-70; Crushed or powdered material ASTM Standard D346-75; Soil or rock-like material ASTM Standard D1452-65
- Fly Ash-like material-ASTM Standard D2234-76
- Containerized liquid waste- COLIWASA
- Liquid waste in pits, ponds, lagoons and similar reservoirs- Pond Sampler
[Comment: Since the Appendix I sampling methods are not being formally adopted by the Administrator, a person who desires to employ an alternative sampling method is not required to demonstrate the equivalency of this method under the procedures set forth in §§260.20 and 260.21.]
Sampling & Testing


- SW-846 contains the analytical test methods
Additional Considerations:

- Costs
- Choosing a Lab
- Containers & preservatives
- Equipment
- Lab Hours
- Split Sample
## TCLP Sample Maximum Holding Times (Days)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>From: Field Collection To: TCLP Extraction</th>
<th>From: TCLP Extraction To: Preparative Extraction</th>
<th>From: Preparative Extraction To: Determination Analysis</th>
<th>Total Elapsed Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatiles</td>
<td>14</td>
<td>N/A</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>Semi-Volatiles</td>
<td>14</td>
<td>7</td>
<td>40</td>
<td>61</td>
</tr>
<tr>
<td>Mercury</td>
<td>28</td>
<td>N/A</td>
<td>28</td>
<td>56</td>
</tr>
<tr>
<td>Metals (except Mercury)</td>
<td>180</td>
<td>N/A</td>
<td>180</td>
<td>360</td>
</tr>
</tbody>
</table>

N/A = Not applicable
Sampling Equipment

- Sludge Judge
- Coliwasa
- Soil Auger
- Bailer
- Bailer
- Graduated Dipper
- Sediment Sampler
Sampling Equipment (cont.)

Encore Sampler

VOA Vial
40mL

Wide Mouth
Glass Sample Jar
Solid Waste Sampling
Aqueous Sample Size

Oxidation Pond – 12 acres

Sample Size - 40 mL
Glass thieving tubes or COLIWASA

layering or stratification
Random Sample Plan
Preliminary Study of Barium Levels

\[ \bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{86+90+98+104}{4} = 94.50, \text{ and} \]

\[ s^2 = \frac{\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2 / n}{n-1} = \frac{35,916.00 - 35,721.00}{3} = 65.00 \]
Based on preliminary estimates & RT for barium = 100 ppm:

\[ n_1 = \frac{t^2_{0.20} s^2}{\Delta^2} = \frac{(1.638^2)(65.00)}{5.50^2} = 5.77 \]

Samples to be collected
Random Sample Plan
New values for $x$ and $s^2$ and standard deviation are calculated:

\[
\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{86+90+87+96+93+113}{6} = 94.67, \text{ and}
\]

\[
s^2 = \frac{\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2 / n}{n-1} = \frac{54,224.00 - 53,770.67}{5} = 90.67
\]

\[
s = \sqrt{s^2} = 9.52, \text{ and}
\]

\[
s_{\bar{x}} = \frac{s}{\sqrt{n}} = \frac{9.52}{\sqrt{6}} = 3.89
\]
The new value for X is less than the RT (100)

However:

\[
CI = \bar{x} \pm t_{0.20} s_{\bar{x}} = 94.67 \pm (1.476)(3.89) = 94.67 \pm 5.74
\]

\[
t_{20.20}^2 s^2 = \frac{(1.476^2)(90.67)}{5.33^2} = 6.95
\]

Samples to be collected
Extra samples are analyzed...
93, 90, 91 ppm barium

\[ \bar{x} = 93.56, \text{ and} \]
\[ s^2 = 60.03 \]
\[ s = 7.75, \text{ and} \]
\[ s_{\bar{x}} = 2.58 \]
\[ CI = 93.56 \pm 3.60 \]
References:

http://www.epa.gov/epawaste/hazard/testmethods/index.htm

http://www.deq.louisiana.gov/portal/DIVISIONS/PermitSupportServices/LaboratoryAccreditation.aspx

*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA Publication SW-846*

*McCoy's RCRA Unraveled, 2011 Edition*
QUESTIONS?

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