Water Treatment in Today’s World

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Liquids/Solids Separation
• Hydroxide insolubility
• Sulfide insolubility
• Valence conversion
• Adsorption

Liquids/Solids Separation
Liquids/Solids Separation

This Solubility Chart demonstrates hydroxide insolubility.
Liquids/Solids Separation

- Hydroxide donated by:
  - Sodium Hydroxide
  - Calcium Hydroxide
  - Potassium Hydroxide
  - Magnesium Hydroxide
Liquids/Solids Separation
Liquids/Solids Separation

- Sulfide Insolubility
  - Doesn’t have a curve
  - More insoluble than hydroxide
  - TCLP
Liquids/Solids Separation

• Sulfide Insolubility
  
  • pH needs to be 8.0 or higher
  
  • Use sulfide as a “polishing step”
  
  • More toxic than hydroxide insolubility
• Products available – sulfide based
  • DTC
  • NASH
  • Trithiocarbonate
  • Organo Sulfides
  • Special blends for lead precipitation
Liquids/Solids Separation

- Sulfide precipitation
  - Stoichiometry is important!
Liquids/Solids Separation

Stoichiometric Additions

<table>
<thead>
<tr>
<th>Metal</th>
<th>Dimethyl Dithiocarbamate (PPM as Product)</th>
<th>Polyythiocarbonate (PPM as Product)</th>
<th>Trithiocarbonate (PPM as Product)</th>
</tr>
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<tbody>
<tr>
<td>Cd²⁺</td>
<td>5.6</td>
<td>14.0</td>
<td>6.25</td>
</tr>
<tr>
<td>Co²⁺</td>
<td>10.4</td>
<td>26.0</td>
<td>12.3</td>
</tr>
<tr>
<td>Cr³⁺</td>
<td>17.6</td>
<td>44.0</td>
<td>20.8</td>
</tr>
<tr>
<td>Cu²⁺</td>
<td>9.6</td>
<td>24.0</td>
<td>11.0</td>
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<tr>
<td>Fe²⁺</td>
<td>11.2</td>
<td>28.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Hg²⁺</td>
<td>3.2</td>
<td>8.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Ni²⁺</td>
<td>10.4</td>
<td>26.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Pb²⁺</td>
<td>2.8</td>
<td>7.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Zn²⁺</td>
<td>9.6</td>
<td>24.0</td>
<td>11.0</td>
</tr>
</tbody>
</table>
Liquids/Solids Separation
Liquids/Solids Separation

• Change of valence must occur for certain elements to precipitate
  • pH change
  • Coagulation
  • Addition of metal salts
  • Reduction chemistry additions
  • Oxidant additions
Liquids/Solids Separation

- Elements or metals of concern
  - Hexavalent chrome
  - Antimony
  - Cyanide
Liquids/Solids Separation

- Elements or metals of concern
  - Arsenic
  - Selenium
  - Iron (Fe+2)
Liquids/Solids Separation

True? or False?

Lead must achieve a change in valence in order for precipitation to occur.
Liquids/Solids Separation

Lead precipitates as insoluble:
- Hydroxide
- Sulfide
- Carbonate
- Phosphate
Liquids/Solids Separation

True? or False?

Zinc, trivalent chrome and lead are amphoteric.
Liquids/Solids Separation

False

Lead is not amphoteric.
Liquids/Solids Separation

- Adsorption occurs in water treatment
  - Carbon – Granular, Powder
  - Iodine value important
  - Wood, coal, coconut based carbons
  - Pulls organics out of water
Liquids/Solids Separation

- Adsorption
  - Carbon will adsorb mercury
  - Carbon will adsorb trihalomethanes
Liquids/Solids Separation

• Bentonite Clay
  • Will adsorb quaternary amines
  • Will adsorb emulsified oil
  • Will line lagoons
• Magnesium
  • Divalent cation in nature
  • Excellent in removal of organic bound phosphorus
  • Ties up chelators
Liquids/Solids Separation

• Magnesium products
  • Magnesium Hydroxide
  • Alka2 40 Powder
  • Magnesium Bisulfite for complexed cyanide/chrome reduction/dechlorination
• Adsorption media
• Chelating resins
• Ion exchange

• Technology getting better every day!
Odors
Odors

• Big issue for employees

• Big issue for the community

• The Mayor **will** show up!
• Hydrogen Sulfide - Thiobacillus
• Organic Sulfur compounds
• Ammonia and Nitrogen compounds
• Volatile organic compounds
Odors

- Environment
  - Low dissolved oxygen
  - High BOD/COD
  - pH too high/low
  - Temperature
• Environment
  • Hydrogen Sulfide levels greater than 10 ppm is an OSHA violation
  • A penny is a canary!
  • Anaerobic conditions form mercaptans
  • Biological matter/anaerobic conditions – BAD!!
Odors

• So what do we do?

  • Alternative food sources
    • Calcium Nitrate
    • Sodium Nitrate

  • Path of least resistance
Odors

• Precipitation with Iron Salts
  • Ferric or Ferrous Sulfate
  • Ferric or Ferrous Chloride
Odors

- Oxidation is effective
  - Permanganates
  - Sodium Hypochlorites
  - Hydrogen Peroxide – Peracetic Acid
• Biological treatment – biochemical process
  • Autotrophic
  • Heterotrophic
  • Biological
Odors

• Special blends of nutrients available

• Special blends of bio bugs available

• Pat Beamon and John Dailey are great!!
• Carbon can adsorb organic sulfur compounds
  • In the waste water
  • Air scrubbers
• Chemical scrubbers work
  • Wet scrubbers
  • Carbon adsorption
  • Thermal oxidation
Questions?