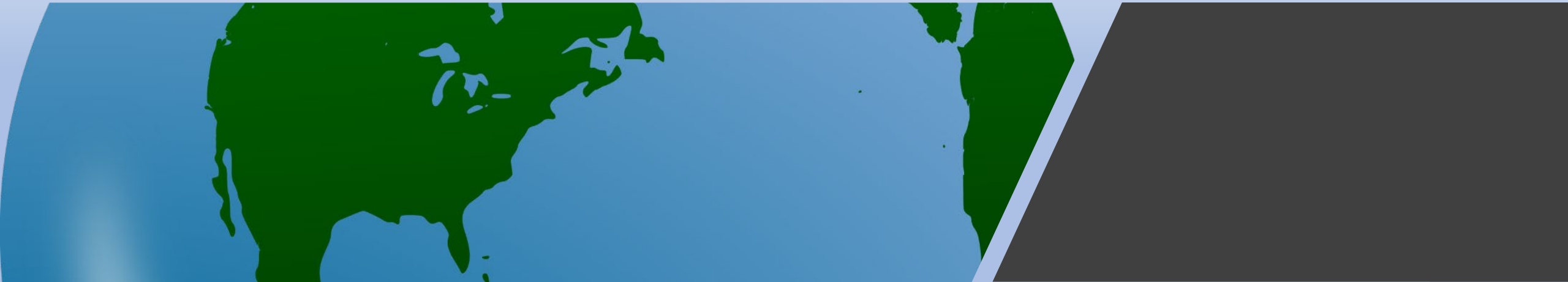




# Water Treatment in Today's World

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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.

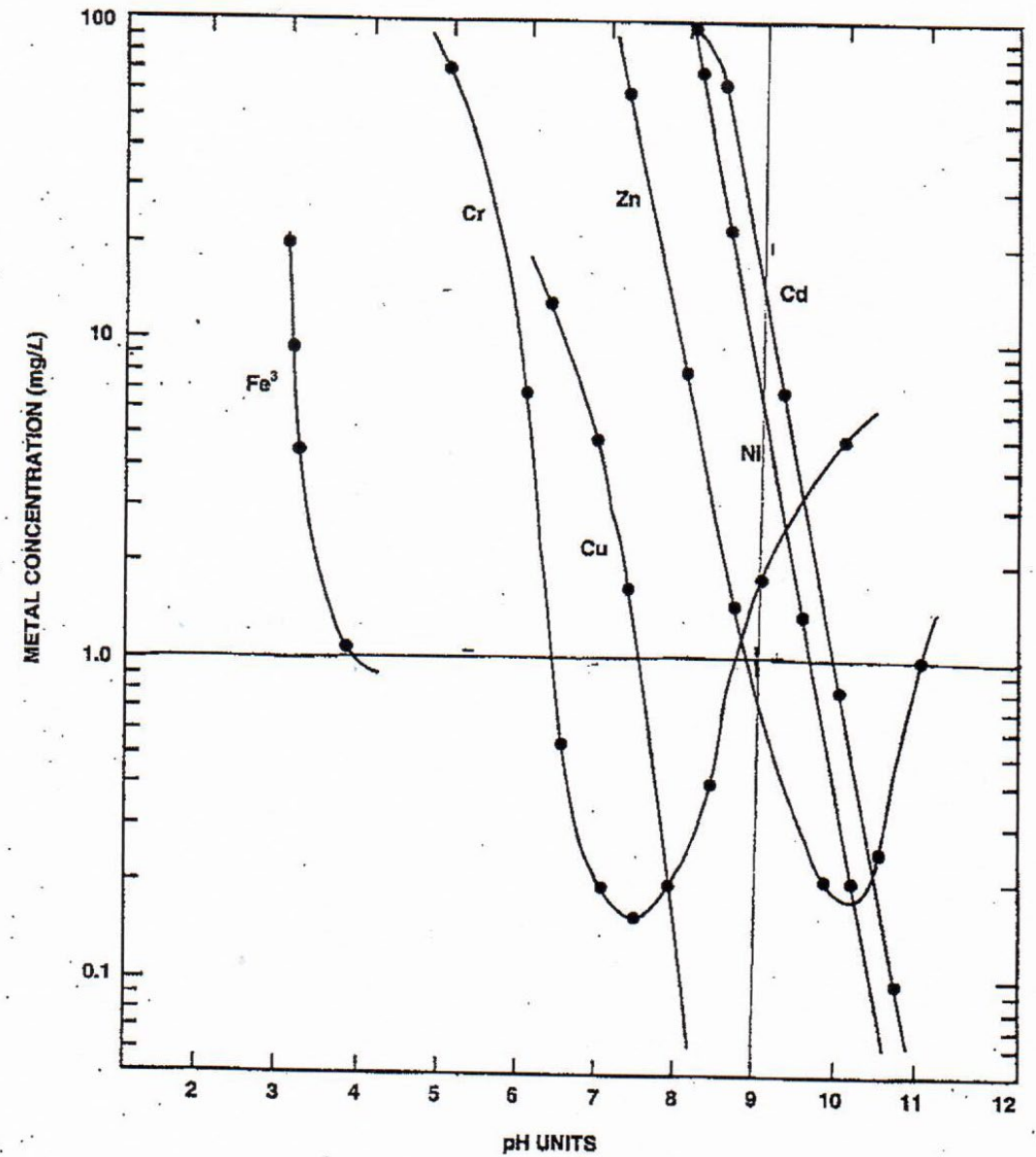


Fig. 9 Precipitation of metal salts versus pH  
(From METAL FINISHING WASTES, EPA Technology/Transfer, U.S. Environmental Protection Agency, Washington, D.C.)

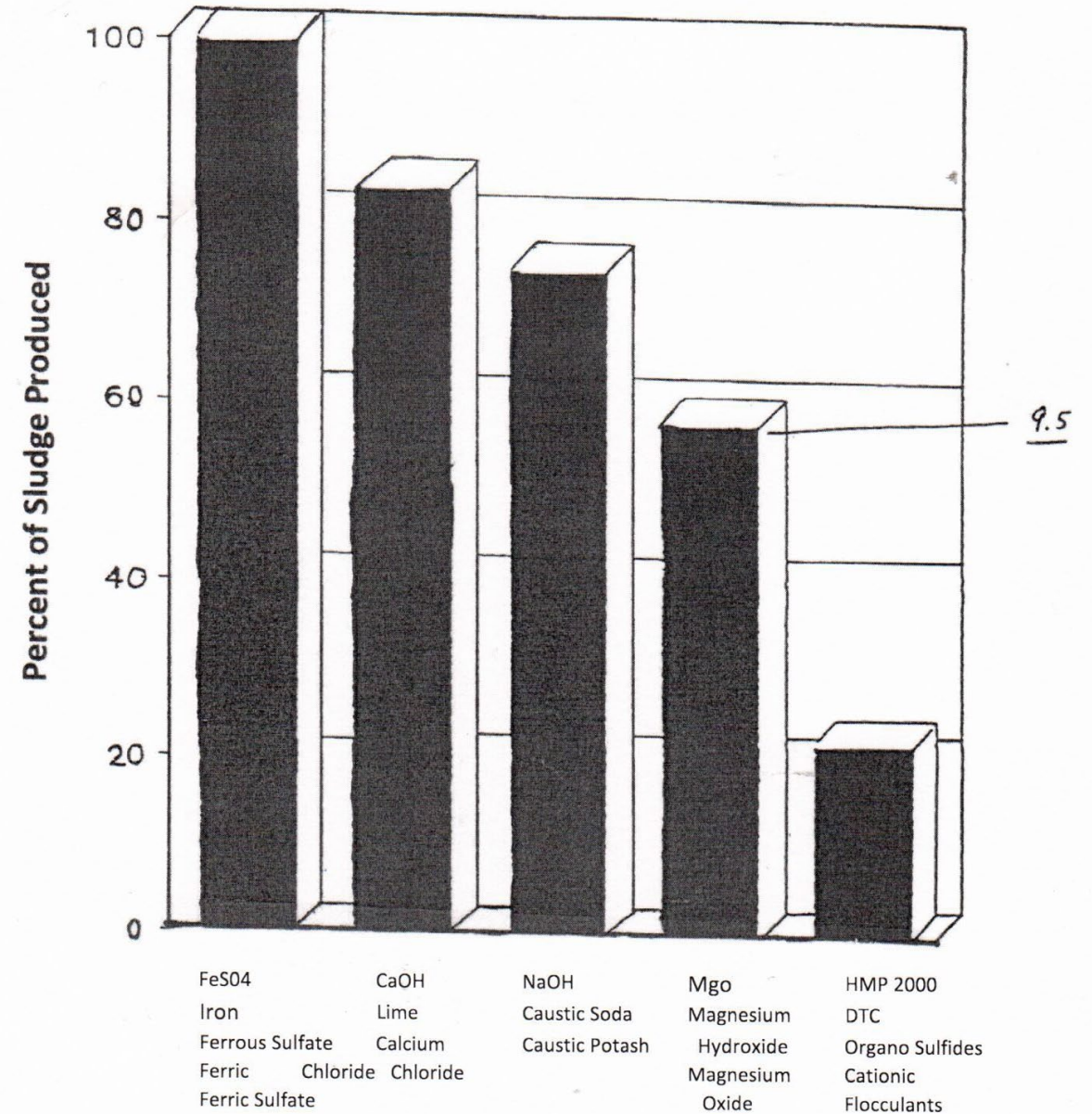
# Liquids/Solids Separation

- Hydroxide donated by
  - Sodium Hydroxide
  - Calcium Hydroxide
  - Potassium Hydroxide
  - Magnesium Hydroxide



# Liquids/Solids Separation

SLUDGE VOLUME COMPARISON



- Sulfide Insolubility

- Doesn't have a curve
- More insoluble than hydroxide
- TCLP

Liquids/Solids Separation

# 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

# Liquids/Solids Separation

- Sulfide precipitation
  - **Stoichiometry is important!**

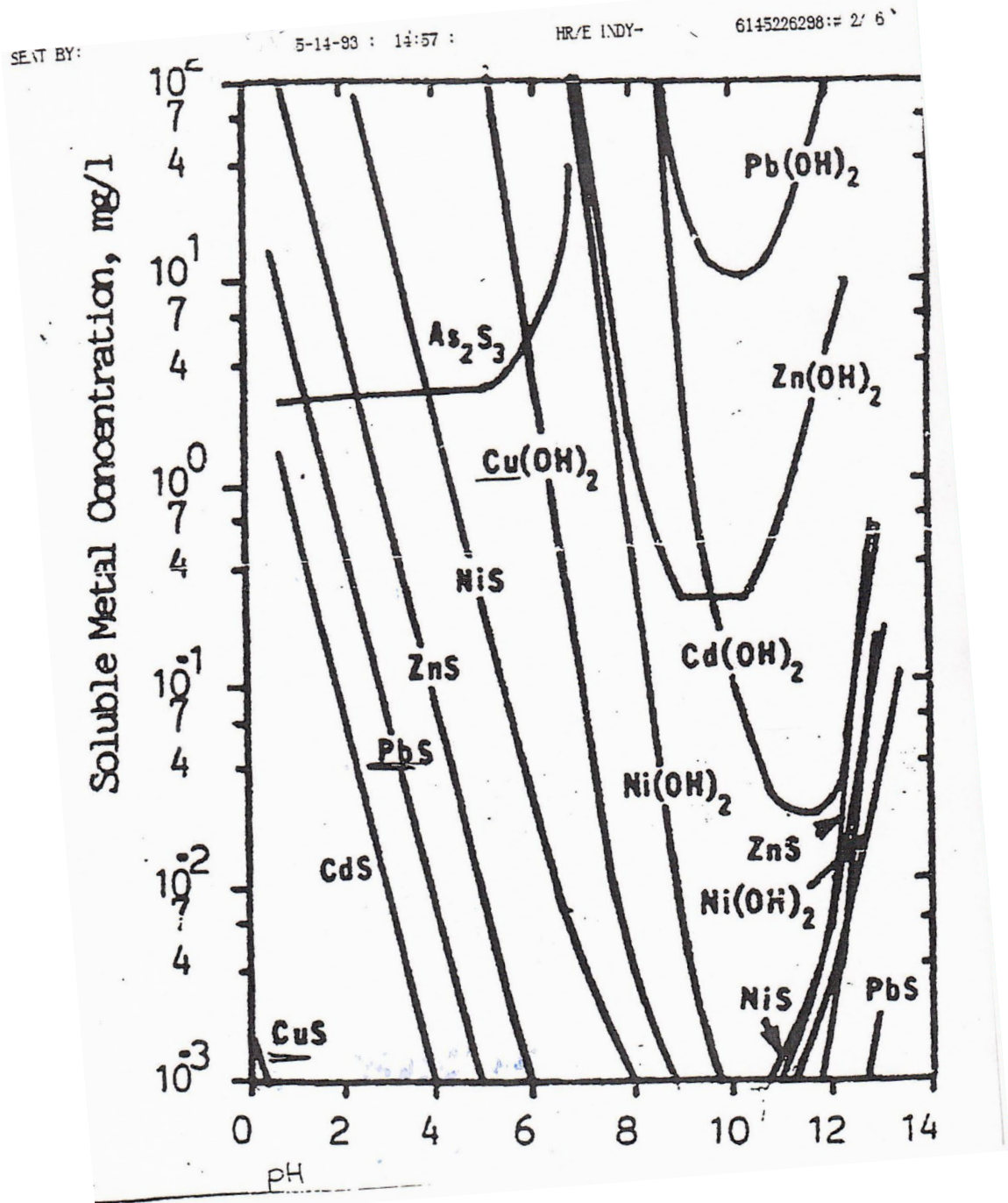
# Liquids/Solids Separation

Stoichiometric Additions

Precipitant Dosage per PPM of Metal

Metal	Dimethyl Dithiocarbamate PPM as Product	Polythiocarbonate PPM as Product	Trithiocarbonate PPM as Product
Cd <sup>++</sup>	5.6	14.0	6.25
Co <sup>++</sup>	10.4	26.0	12.3
Cr <sup>++</sup>	17.6	44.0	20.8
Cu <sup>++</sup>	9.6	24.0	11.0
Fe <sup>++</sup>	11.2	28.0	12.8
Hg <sup>++</sup>	3.2	8.0	3.5
Ni <sup>++</sup>	10.4	26.0	12.0
Pb <sup>++</sup>	2.8	7.0	3.5
Zn <sup>++</sup>	9.6	24.0	11.0

# 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



# Liquids/Solids Separation

- Elements or metals of concern
  - Hexavalent chrome
  - Antimony
  - Cyanide

- Elements or metals of concern
  - Arsenic
  - Selenium
  - Iron (Fe<sup>+2</sup>)

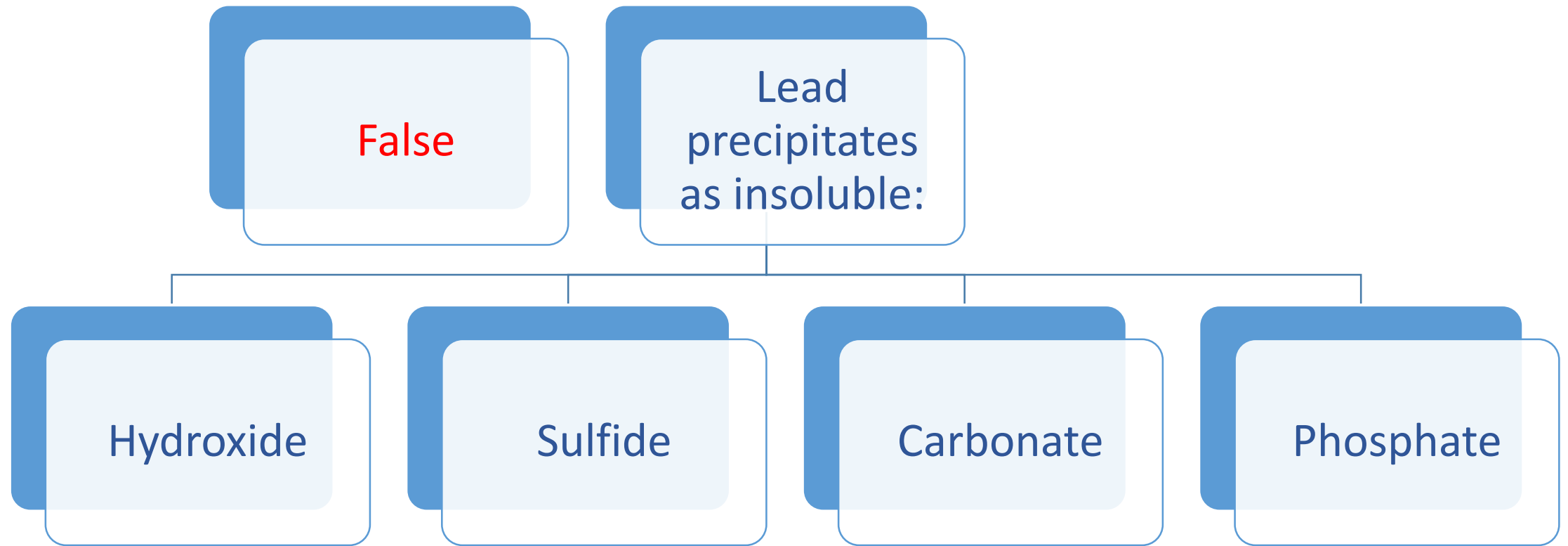
Liquids/Solids Separation

# Liquids/Solids Separation

True? or False?

Lead must achieve a change in valence in order for precipitation to occur.

# Liquids/Solids Separation



# 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

- Adsorption
  - Carbon will adsorb mercury
  - Carbon will adsorb trihalomethanes

Liquids/Solids Separation

# 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



# 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!

Liquids/Solids Separation

# 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



# 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

# Odors

- So what do we do?
  - Alternative food sources
    - Calcium Nitrate
    - Sodium Nitrate
  - Path of least resistance

- Precipitation with Iron Salts

- Ferric or Ferrous Sulfate
- Ferric or Ferrous Chloride

Odors

# Odors

- Oxidation is effective
  - Permanganates
  - Sodium Hypochlorites
  - Hydrogen Peroxide – Peracetic Acid

- Biological treatment – biochemical process
  - Autotrophic
  - Heterotrophic
  - Biological

Odors

# 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

Odors



# Odors

- Chemical scrubbers work
  - Wet scrubbers
  - Carbon adsorption
  - Thermal oxidation

Questions?

