FGD Water Treatment R&D Summary

ORSANCO

190th Technical Committee Meeting

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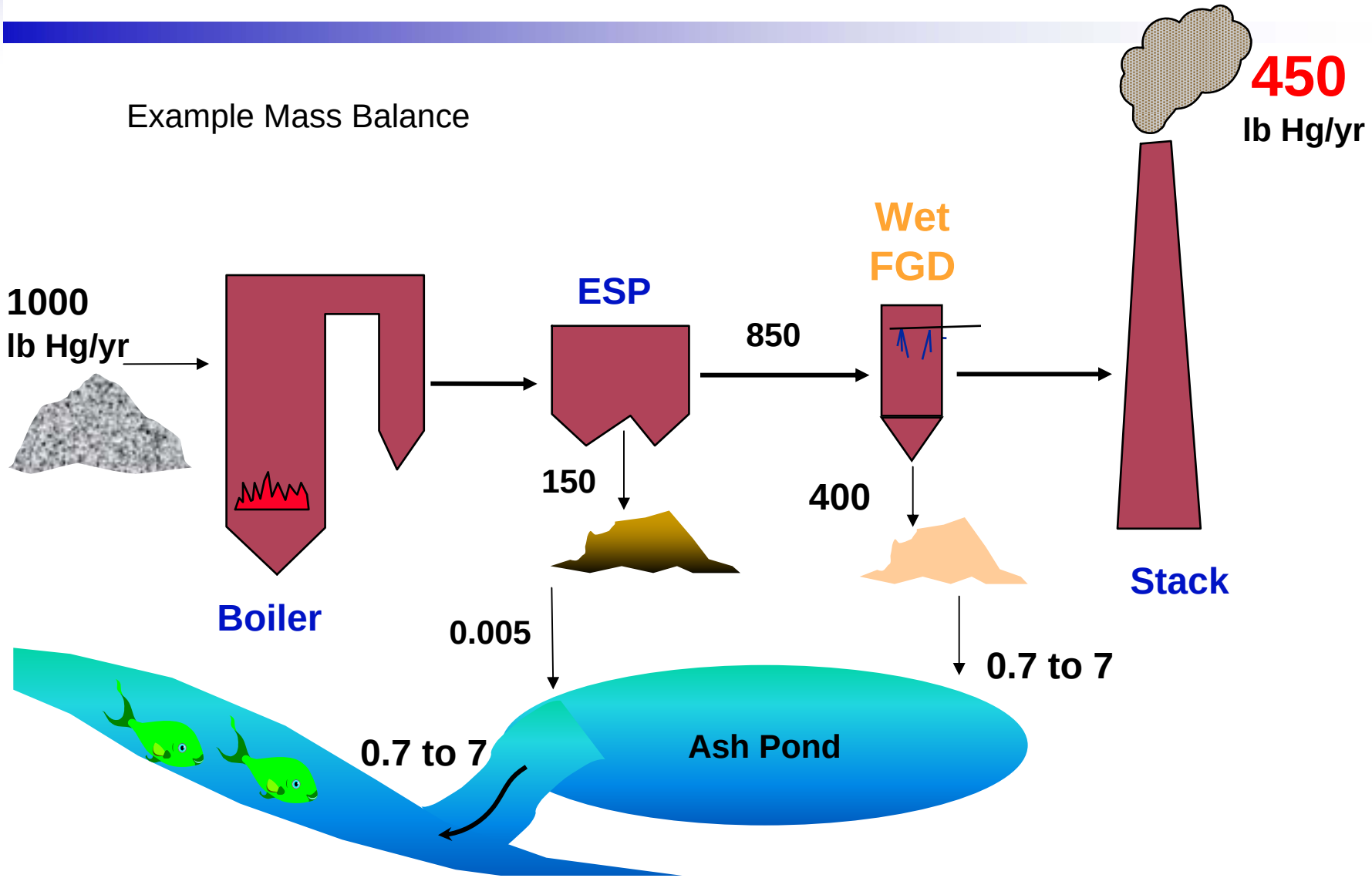
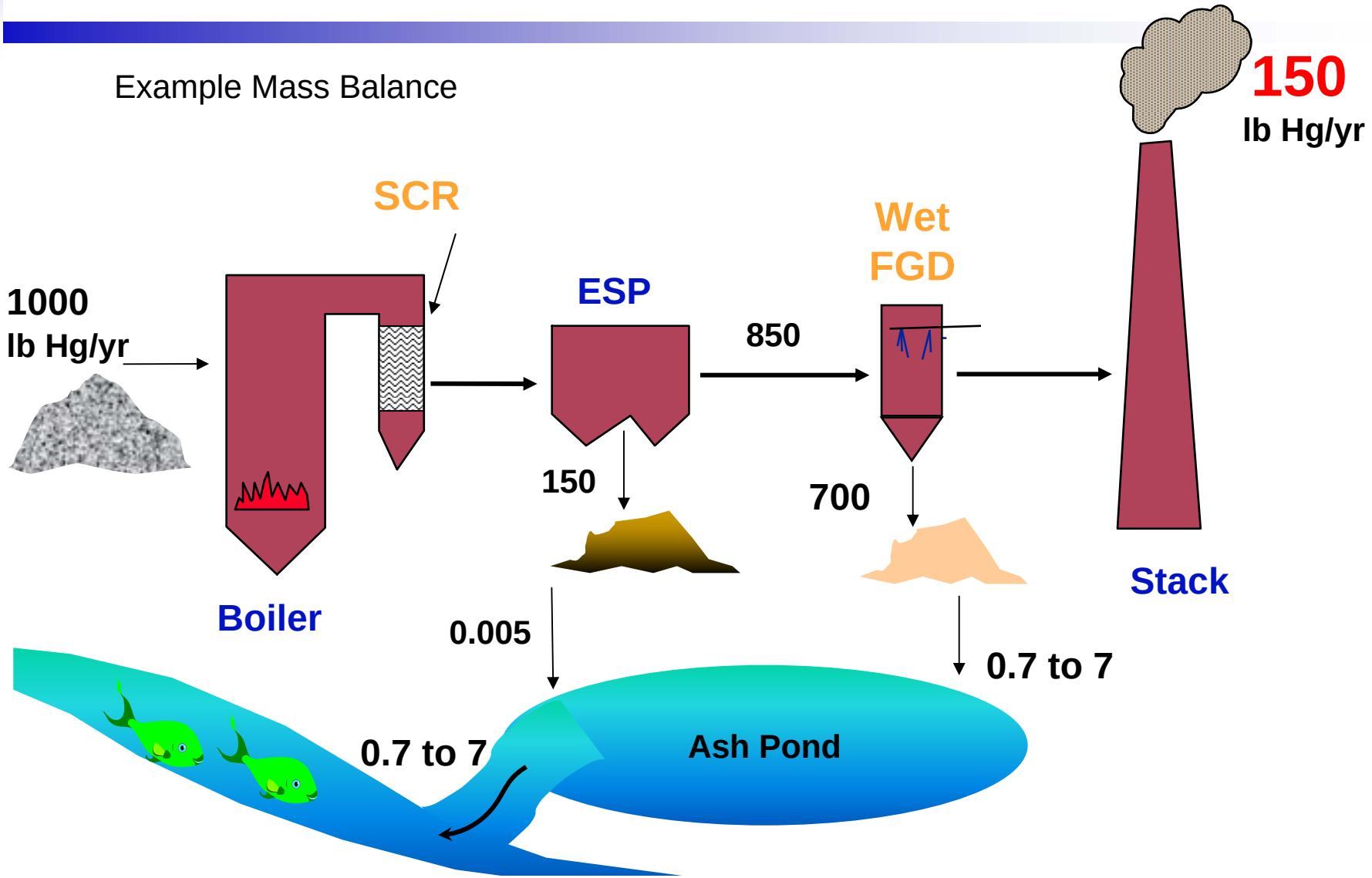
Multimedia Fate of Mercury

Baseline with FGD only



Flue Gas Mercury Generally Captured with Combined SCR and FGD

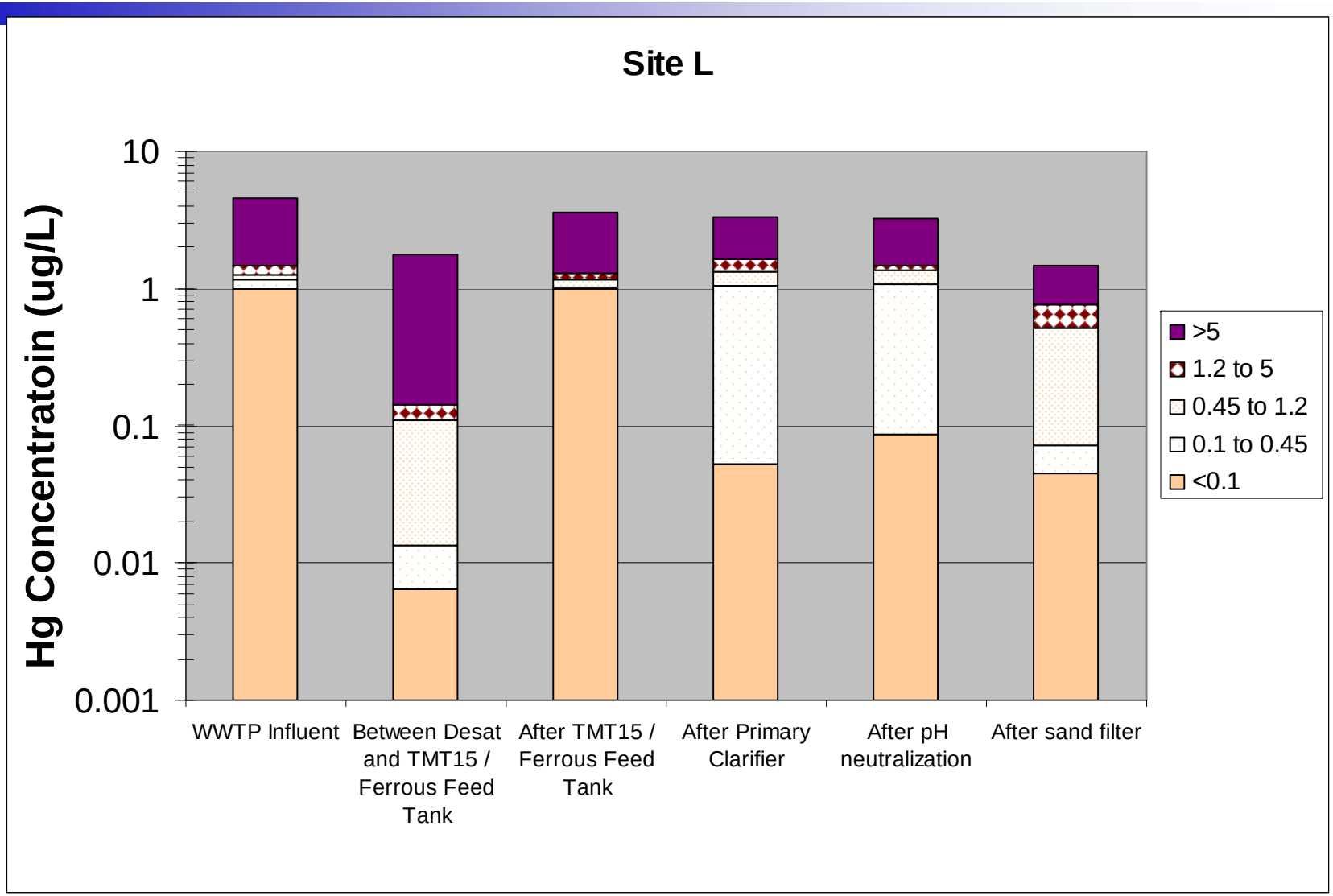


Full-Scale FGD Water Treatment Technologies

Installed/Operating at US Power Plants

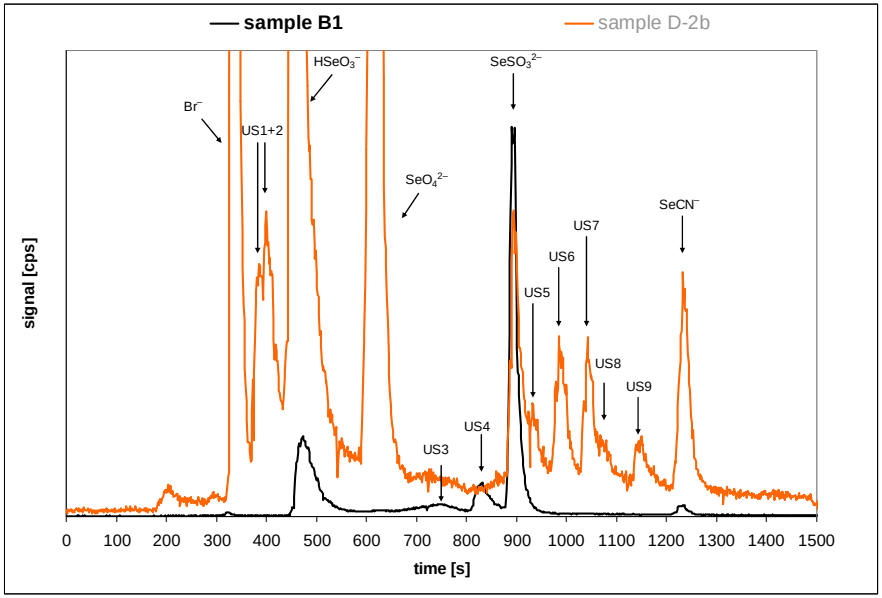
- Physical/Chemical
  - Iron coprecipitation (metals)
  - Organo-sulfide precipitation (mercury)
- Biological/wetlands (selenium, metals)
  - Polishing, downstream of physical/chemical system

Traditional Sulfide Precipitation: May Yield Submicron Particles *(Based on Limited Data)*

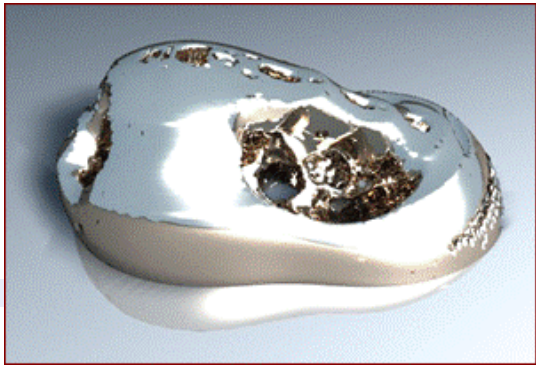


Selenium May Be Present in Several Chemical Forms in FGD Waters

- Different treatment implications
- Selenite – Se(IV)
- Selenate – Se(VI)
  - Difficult to treat
- Elemental selenium – Se(0)
  - dissolved
  - colloidal
- Selenocyanate
- Selenosulfate – $SeSO_3^{2-}$
- Unknown/unaccounted-for forms



EPRI Treatment Project Objectives



- Independent, 3rd party evaluation
- Evaluate technologies:
  - Mercury (Hg): 1-10 ppt
  - Selenium (Se): 50-100 ppb, including all species

‘08 Pilot EPRI Water Treatment Studies

- Pilot studies: most promising technologies
  - Short-term feasibility evaluation
- Powder River Basin (PRB) site
  - Metallic Fe cementation (targeting selenium)
  - Fe/Sulfide + microfiltration
  - Two (2) adsorption approaches
- Eastern bituminous site
  - Vertical flow wetland (subsurface)
- Full-scale evaluation of GE ABMet biological reduction (eastern bituminous site)

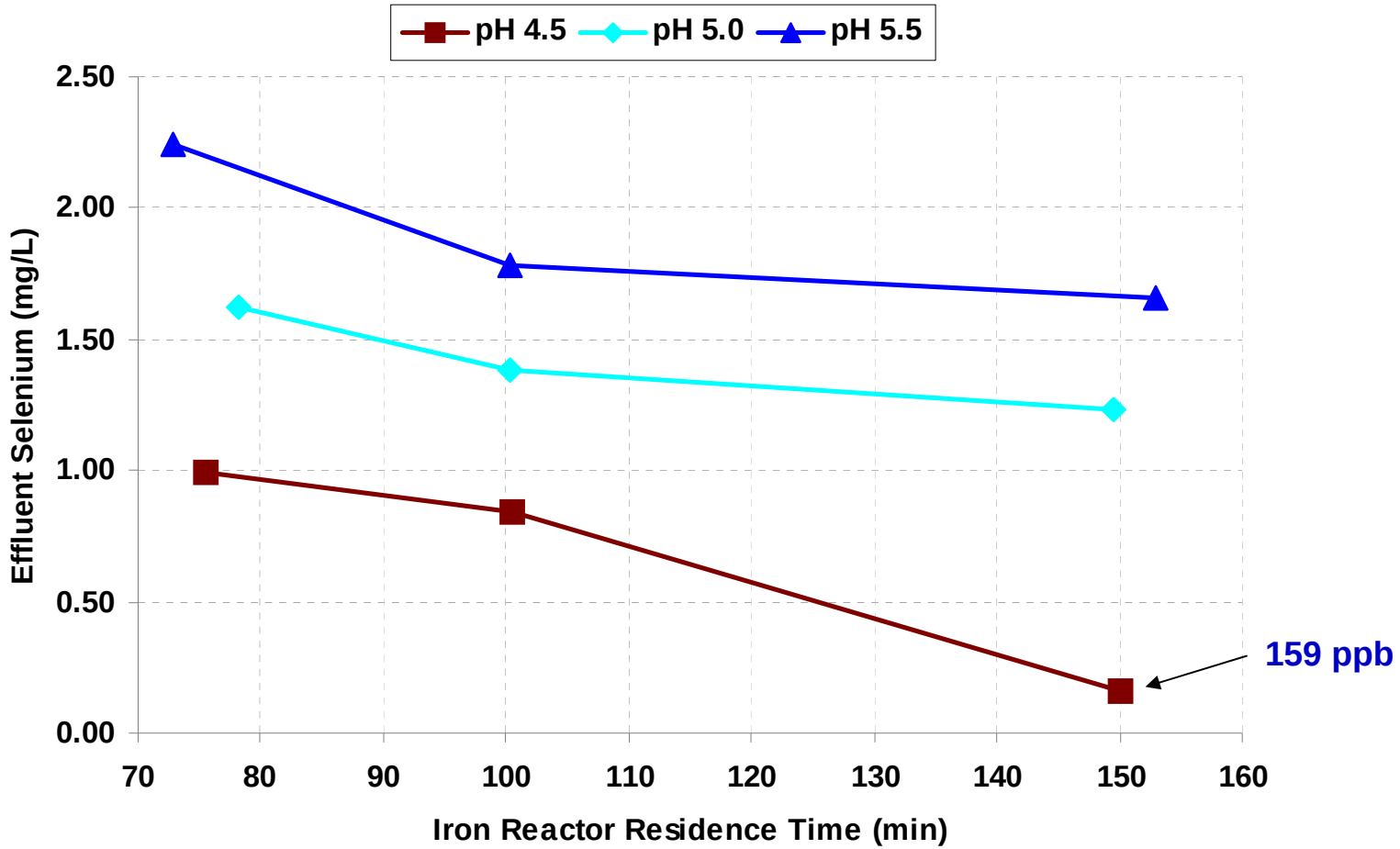
Metallic Iron Cementation Pilot (PRB site)

Target: Selenium Removal

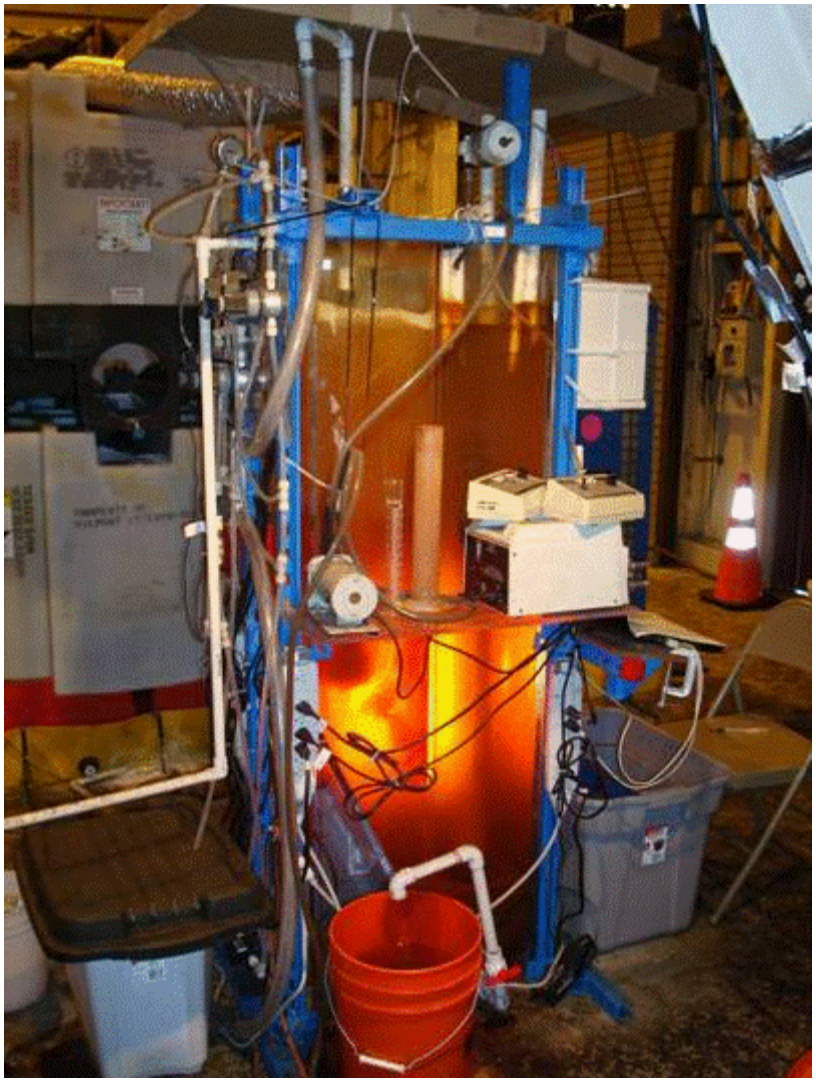
Metallic Iron Cementation: Se removal

Need for More Residence Time, Lower pH

- Influent ~6000 ppb dissolved Se; 2000 ppb Se^{+6}

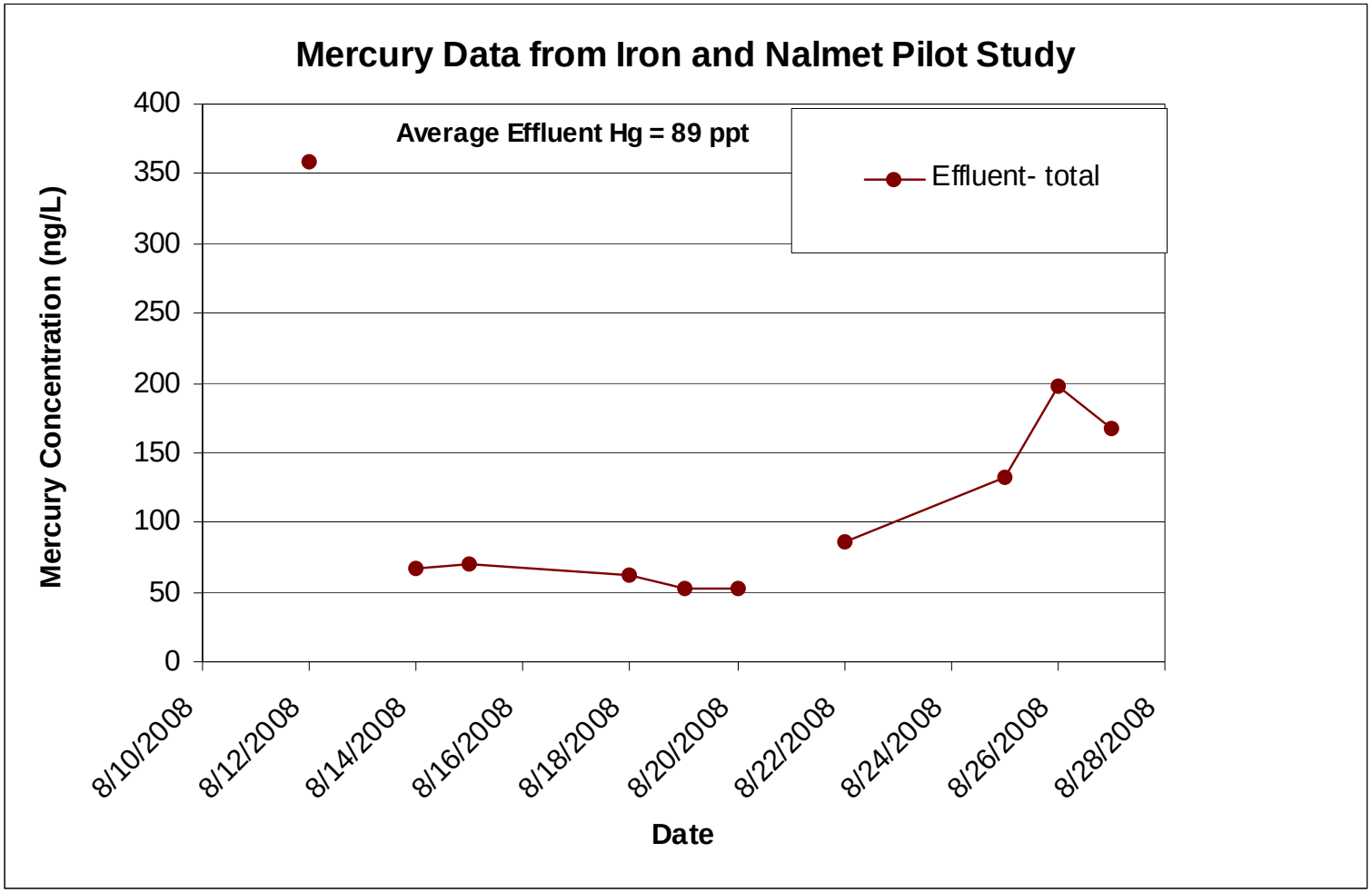


Iron/Sulfide + Microfiltration Pilot (PRB site)



Iron/Sulfide + Microfiltration

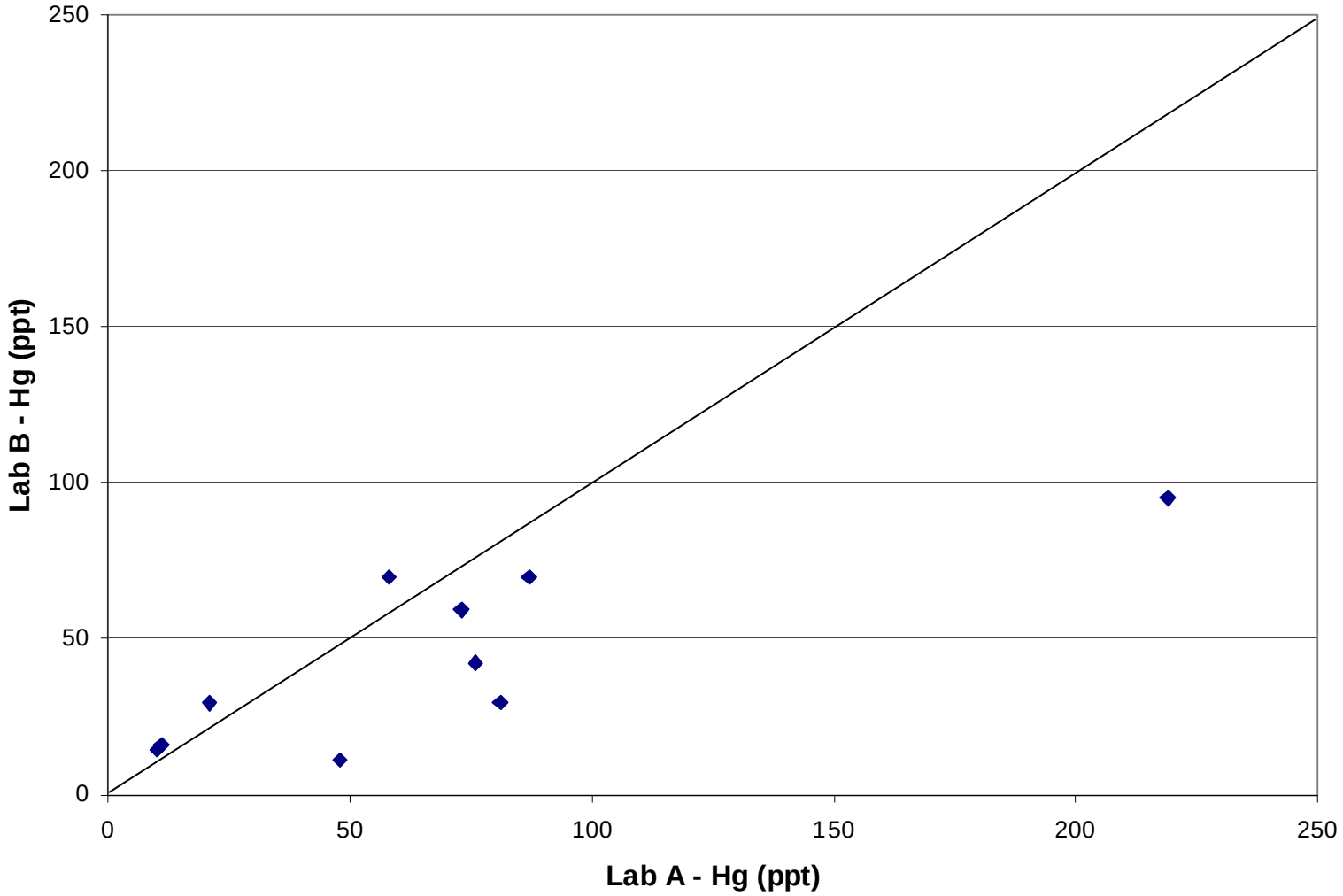
Pilot results indicate modest Hg removal improvement



Microfiltration followed with Adsorption Technology (PRB site)

Microfiltration + Adsorption Draft Results

<100 ppt possible; lab comparisons "just ok"

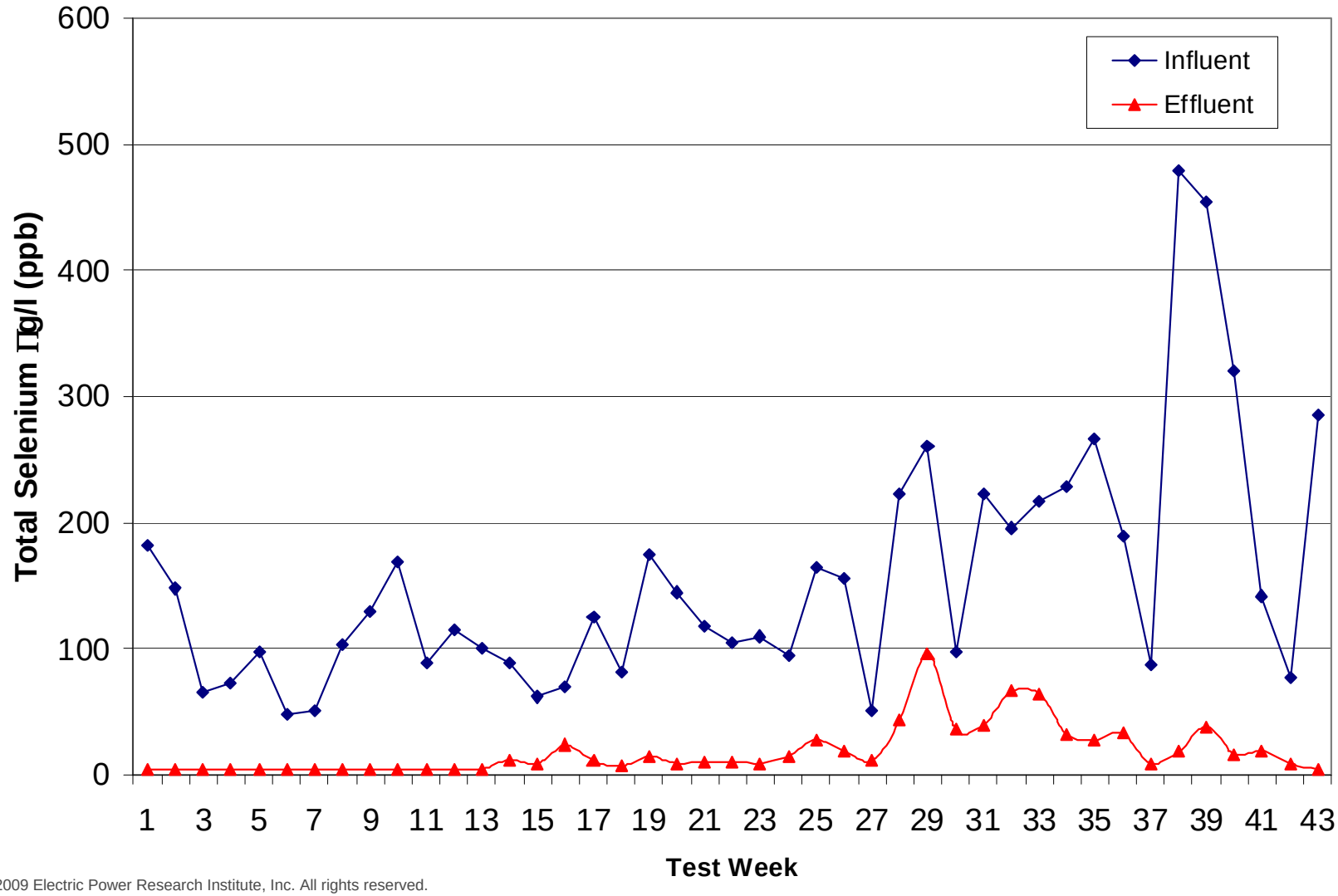


Vertical Flow Wetland Pilot: Eastern Bituminous

Anaerobic, Reducing Wetland

Selenium Removals Appear Promising

Note: Influent Se Levels are Low, Primarily Se^{+4}

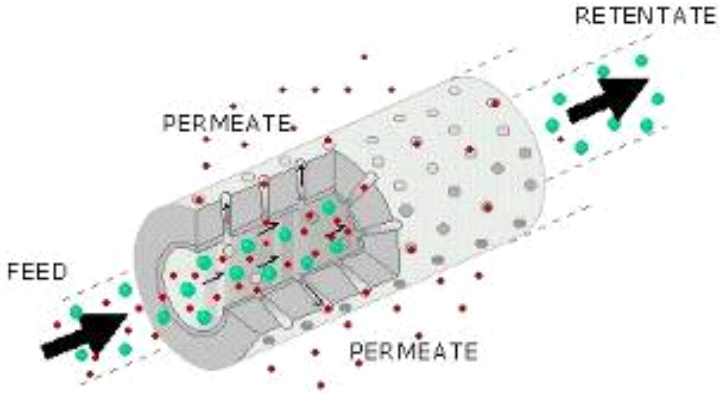


GE ABMet Biological Evaluation

- Microbial reduction and precipitation of Se (and other metals)
- Sampling/analytical studies ongoing
- Much of the Hg and Se are being removed in the physical/chemical system upstream of the bioreactor
  - Inlet Hg/Se levels are very low, but are being successfully treated in the bioreactor
  - Primarily selenite (Se^{+4}); but the selenate (Se^{+6}) is being removed
- Speculate whether this FGD water matrix is easier to treat

Total Dissolved Solids (TDS) Water Treatment

- Possible treatment considerations
- Underground injection
  - Geology consideration
- Microfiltration/Ultrafiltration
- Evaporation
  - Ponds
  - Brine Concentrator/Crystallizer
  - Spray dryer



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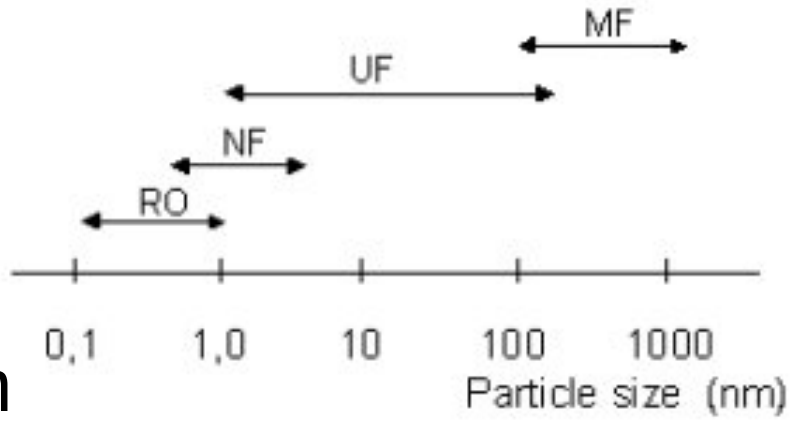
Will Filtration Remove TDS?

- TDS are primarily salts
- Microfiltration (MF), ultrafiltration (UF) – several studies indicate little removal
- Reverse osmosis (RO) would remove TDS
  - Concentrated water stream to manage
  - Operability issues



Evaporative Approaches

- Evaporation Ponds
  - More common, applicable in arid, western applications
- Reinjection into flue gas
  - Corrosion issues
  - Nozzle pluggage, solids deposition
  - Particulate emission increases (flue gas)
- Brine Concentrator + Crystallizer/spray dryer
  - “ZLD”: capital/operating costs are significant

Brine Concentrator/Crystallizer

- Thermal evaporation
- Full-scale systems recently started up in Italy
  - KCPL Iatan system to come online in ‘09
- Generally consists of:
  - Salt conversion (with sodium)
  - Brine concentrator (to reduce water volume)
  - Crystallizer (produce solid waste)
- Capital costs likely several times greater than current physical/chemical water treatment
- Thermal energy requirements ~several % of plant load
- Solid wastes: unclear on leachability

Summary

- Much ongoing work by EPRI and others
- Each power plant - somewhat unique in terms of coal, limestone/lime, power plant and FGD design
- Water treatment
  - Limited pilot screening data, generally 1 data point
  - Several promising technologies for Hg and/or Se
  - Achieving 1-10 ppt Hg ??
  - More data needed
- Believe/speculate that some water matrices are easier (or more difficult) to treat
- TDS: likely difficult, costly to treat