

REINHOLD ENVIRONMENTAL Ltd.



**2017 APC & Wastewater Round Table  
& Expo Presentation**

July 17 & 18, 2017 in Charlotte, NC / Hosted by Duke Energy

All presentations posted on this website are copyrighted by Reinhold Environmental, Ltd (RE). Any unauthorized downloading, attempts to modify or to incorporate into other presentations, link to other websites, or obtain copies for any other uses than the training of attendees to RE's Conferences is expressly prohibited, unless approved in writing by RE or the original presenter. RE does not assume any liability for the accuracy or contents of any materials contained in this library which were presented and/or created by persons who were not employees of RE.



**eVOQUA**  
WATER TECHNOLOGIES

# “Wastewater Treatment Fundamentals for Coal Fired Power Plants”

## OUTLINE

- **Basics**
  - **Water Quality and Quantity**
  - **Bulk Solids Removal**
  - **Clarification**
  - **Filtration**
  - **Dewatering**
  - **Advanced Treatments**
- **Application Areas**
    - **Coal Pile Run Off**
    - **Low Volume Wastewater**
    - **Landfill Leachate**
    - **FGD Purge Water**
    - **Ash Basin Dewatering**

# THE BASICS

- **Location**
- **Available Space**
- **Weather**
  - Temperature
  - Wind
- **Seismic**
- **Utilities**
  - Electric
  - Compressed Air
  - Potable/Service Water
  - Waste Connection



# WATER QUALITY AND QUANTITY - INFLUENT

## Water Flows

- Meter Tests
- Plant Balance
- Min/Max



## Water analyses

- Grab Samples
- Composite Samples
- Seasonal Variation
- Production



# WATER QUALITY AND QUANTITY - EFFLUENT

**Surface water Discharge  
NPDES Permit**

**Municipal - POTW**

**Deep Well Injection**

**Recycle & Reuse**



# EQUALIZATION

- **Mixed Influent**
- **Surge Capacity**
- **Minimum – 5 hours**



# BULK SOLIDS REMOVAL

- Application
- High TSS Load
- > 2500 ppm
- Sedimentation
- 0.5-0.75 gpm/sq. ft.
- Hydrocyclones/Sieves
- Specific Gravity
- > 2.0
- Particle Size
- > 40 micron



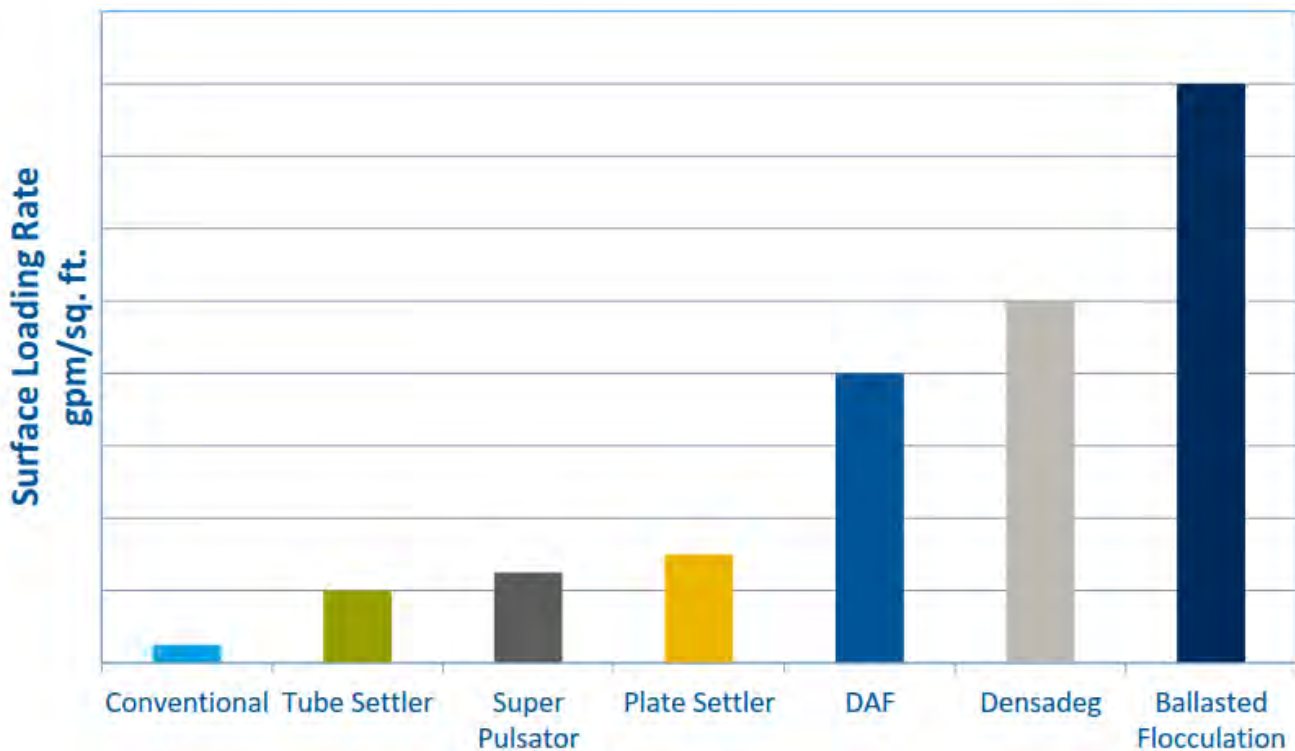
# CLARIFICATION

- **Application**
- **< 2500 ppm TSS**
  
- **Standard**
- **Lamella**
- **Ballasted Floc**
- **Solids Contact**
  
- **90-99% TSS Removal**
  
- **Metals Removal**



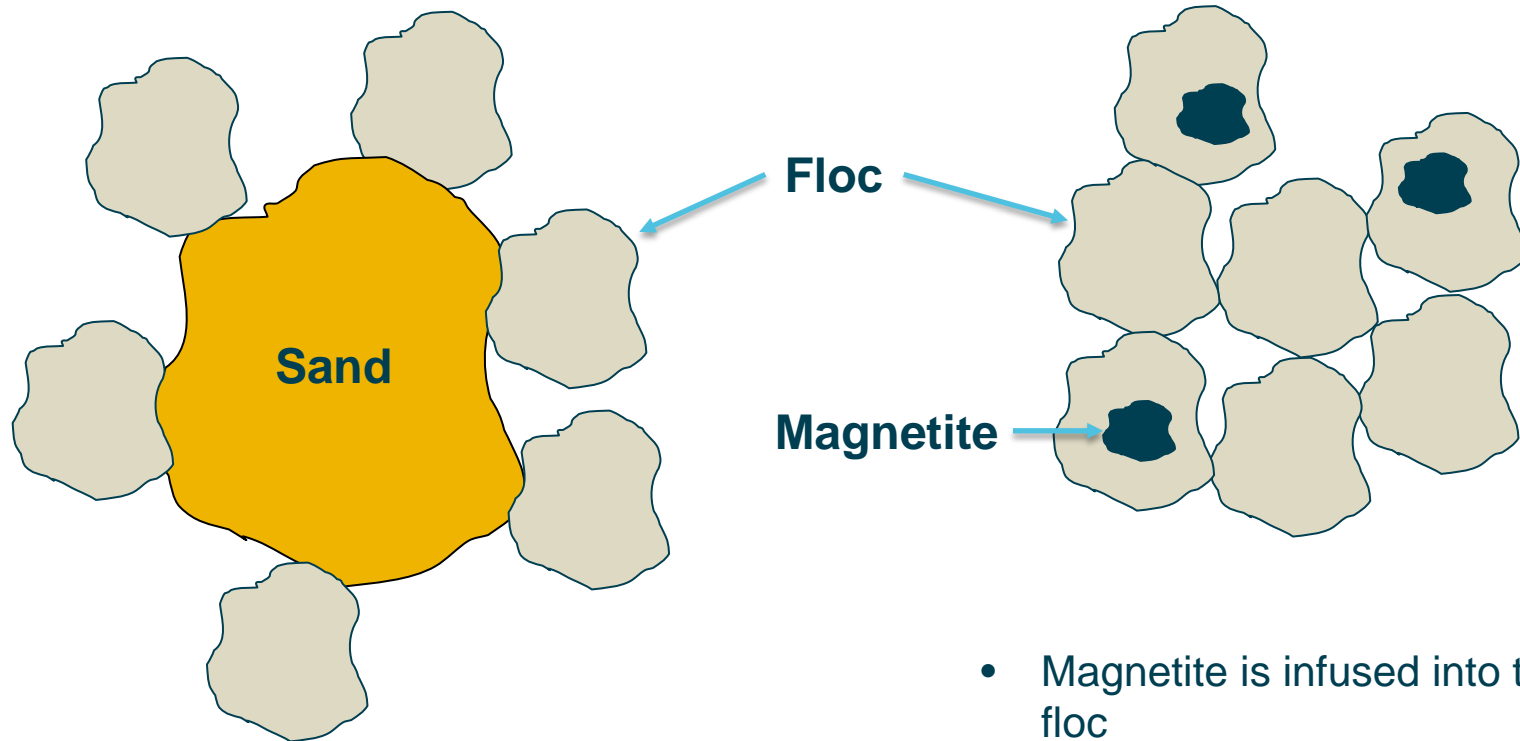
# LOOKING AT CLARIFICATION TECHNOLOGIES

## RELATIVE LOADING RATES



**Higher Loading Rate = More Capacity**

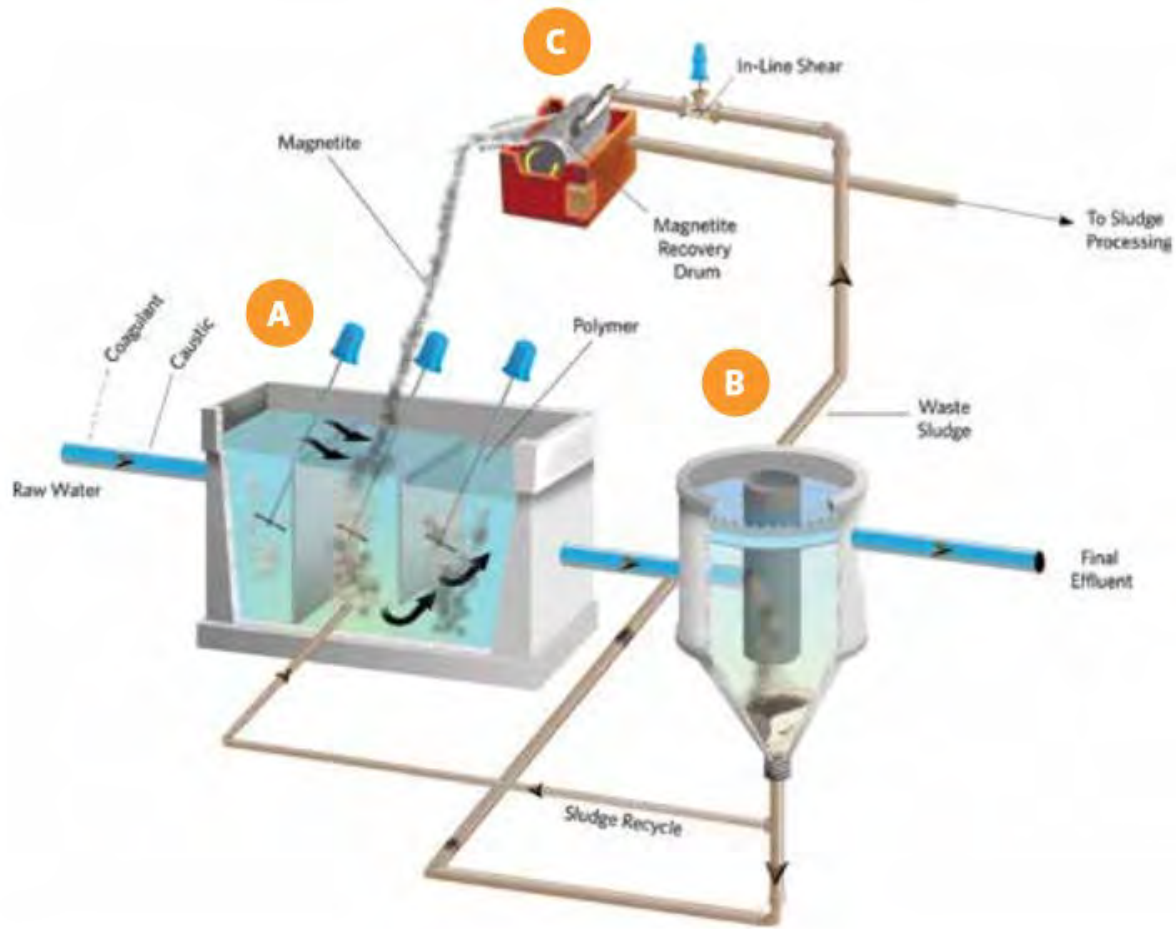
# BALLASTED FLOCCULATION KEY TO CLARIFICATION STEP



- Floc is force to grow on the surface of the sand
- Specific gravity is 2.6

- Magnetite is infused into the floc
- Internal sludge recycle – promotes nucleation
- Specific gravity is 5.2 – settles faster!

# COMAG BALLASTED FLOCCULATION



# METALS REMOVAL IN CLARIFICATION

- **Oxidation and pH Adjustment**
  - **Iron and Manganese**
- **Co-precipitation with Iron Salts**
  - **Arsenic and Selenite**
- **Caustic Addition/pH Adjustment**
  - **Zinc, Cadmium, Lead**
- **Metal Precipitants**
  - **Mercury, Copper**
- **Chemical Softening**
  - **Calcium and Magnesium**



# FILTRATION



## Applications

Direct – Up to 100 ppm TSS

Post Clarification

Membrane Pretreatment

- **Sand/ Dual Media**  
70% of particles > 20 micron  
5-10 gpm per square ft.
- **Multi Media**  
80% of particles > 10 micron  
3-5 gpm per square ft.  
Separate Source Backwash 15 gpm/sq. ft.
- **Continuous Backwash**  
4-6 gpm per square foot
- **Oxidative Media**  
Iron and Manganese
- **Activated Carbon**  
Organics

# FINE FILTRATION/MEMBRANES

- **Cartridges**

Nominal  
Absolute

- **Ultrafiltration**

Sub- Micron  
20-30 gfd

- **Nano filtration**

Hardness  
Sulfates

- **Reverse Osmosis**

Volume Reduction



# DEWATERING / SOLIDS MANAGEMENT

- **Thickeners**

2-4 pounds TSS / hr. / square ft.

3-5 % Solids

Storage to match press

- **Filter Press**

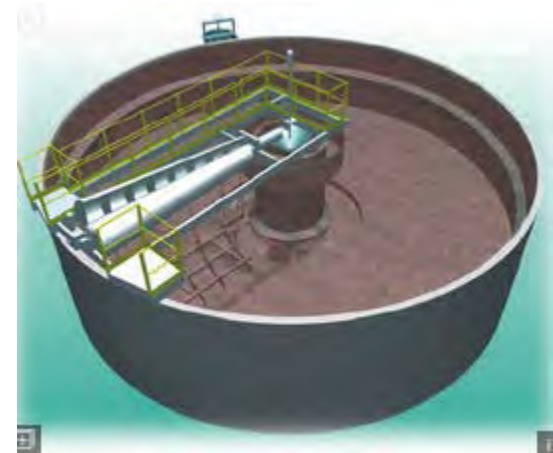
70-90 Pounds/ cu. ft.

30-50% Solids

Typical 3 hr. cycle time

- **Belt Press**

- **Centrifuge**



# ADVANCED TREATMENT

- **Trace Metals**

Pironox -Hybrid ZVI

Bioreactors

Adsorbents

- **Nitrates/ Ammonia**

Denitrification

0.14 pounds 1000 sq. ft.

- **Boron**

Ion Exchange

- **Whole Effluent Toxicity**



# COAL PILE RUN OFF

- **Highly Variable Flow Rates**
- **High Solids Loading**
- **Iron/ Manganese**
- **pH Swings**
- **Sedimentation/Clarification**
- **Dewatering**



# LOW VOLUME WASTEWATER

- **Highly Variable Flow Rates**
- **Moderate Solids Loading**
- **Possible Oil & Grease**
- **pH Swings**
- **Clarification – Ballasted Flocculation**
- **Dewatering**



# LANDFILL LEACHATE

- **Variable Flow**
- **Metals**  
Fe, Mn, As, Se, Hg
- **Nitrates/ Ammonia**
- **Organics**
- **Direct Filtration**



# KEY DESIGN CONSIDERATIONS FOR FGD WASTEWATER TREATMENT SYSTEM DESIGN

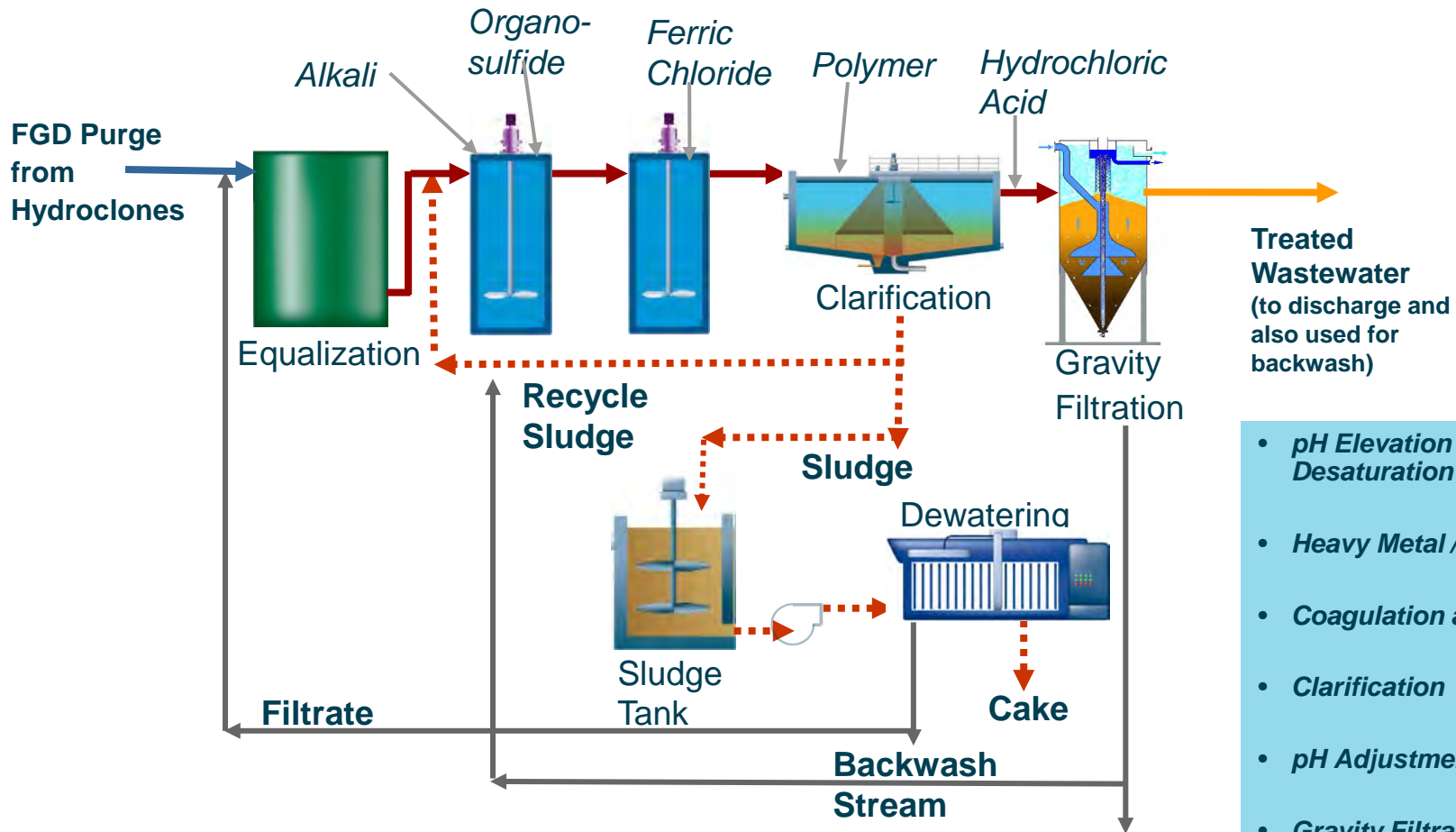
- Influent composition
- Discharge requirements
- Solids handling
- Materials of construction
- Unique owner's requirements

## MAJOR COST DRIVERS

- Flow
- Solids load
- Specific discharge requirements for Se, As, Hg, Nitrogen, etc.

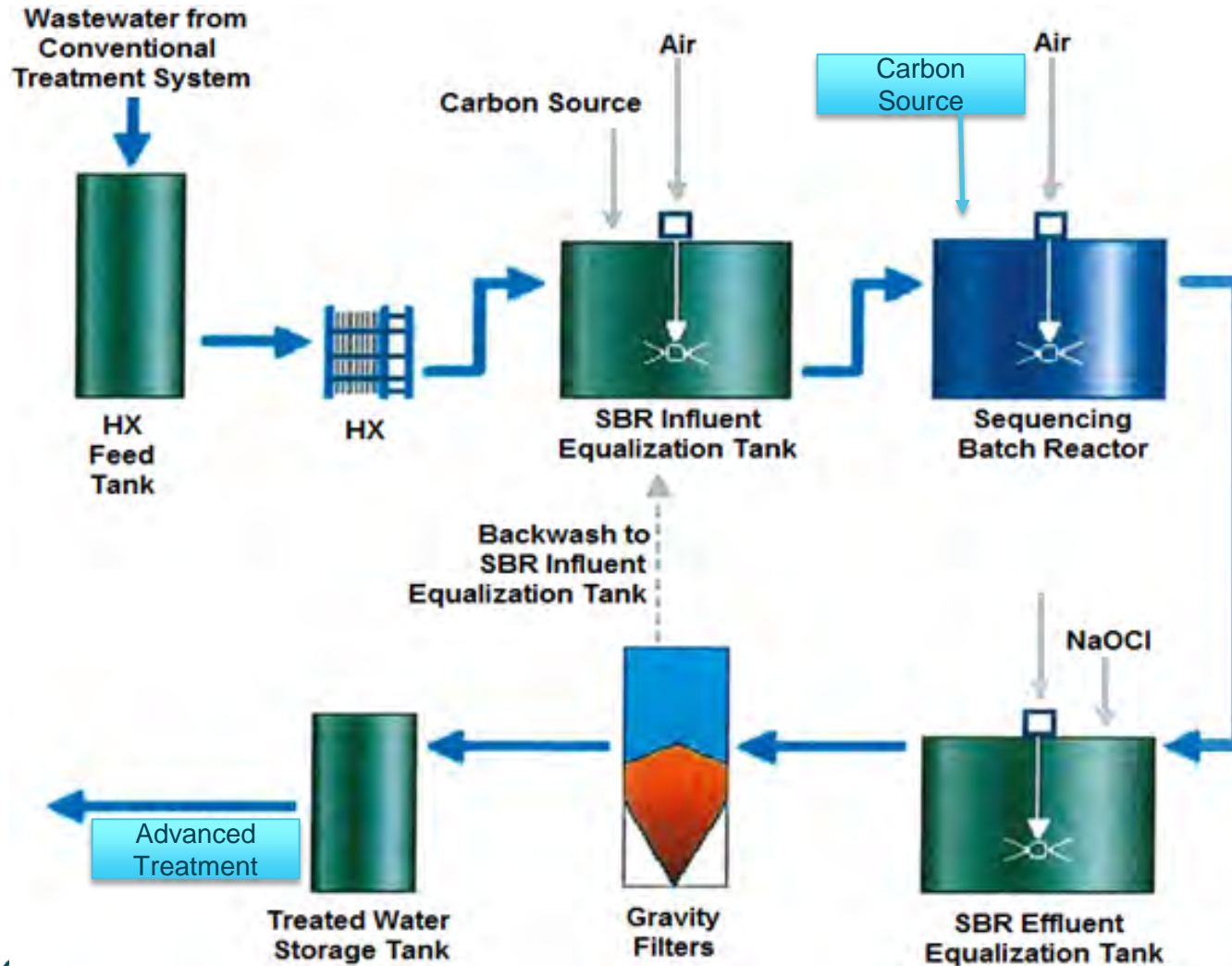


# PRIMARY - PHYSICAL CHEMICAL TREATMENT SYSTEM



- *pH Elevation / Gypsum Desaturation*
- *Heavy Metal / TSS Reduction*
- *Coagulation and Flocculation*
- *Clarification*
- *pH Adjustment*
- *Gravity Filtration*
- *Sludge Dewatering*

# SECONDARY - TOTAL NITROGEN REDUCTION



# FGD PURGE – REMOVAL OF METALS AND OTHER TRACE CONTAMINANTS TO MEET ELG

- Advanced Zero Valent Iron (ZVI) – Pironox
- Biological treatment for Se-removal
  - Fixed Film
  - Fluidized Bed
- Physical Incorporation
- Thermal - Evaporation



# ASH BASIN DEWATERING

- FREE WATER
- PORE WATER
- EXTRACTION WELLS
- LANDFILL LEACHATE



# Pond Closure Treatment Technologies



<b>Variables</b>	<b>High Solids Removal</b>	<b>Final Solids Removal</b>	<b>Metals Removal</b>	<b>Advanced Treatment</b>	<b>Polishing</b>
Water volumes, flows and discharge Restrictions	Settling systems, knock-out tanks, sludge dewatering	Mobile clarification, filtration, sludge dewatering	Clarification, activated media filtration	Removing selenium, arsenic, mercury and nitrate/nitrate as N to meet NPDES permit	Adsorbents or ion exchange media as required

# WHAT COAL FIRED POWER PLANTS NEED TO DO NOW

- Engage resources early for planning
- Evaluate options that match the operating profile of each plant.
- Pilot equipment is the key step for proof-of-concept testing and conceptual design verification
- Knowledgeable engineering resources are critical for equipment selection and sizing, budgetary estimates and final designs





**THANK YOU**

