REINHOLD ENVIRONMENTAL Ltd.

2016 APC-Wastewater Round Table & Expo Presentation

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O&M Considerations for Treatment of Coal Plant Wastewaters

From the Engineer's Perspective:

1. General considerations for new system design
2. Technology specific considerations

1. General Considerations for New System Design

Plant-Wide Interactions

- Effects on upstream and downstream systems
- Adaptable to changes in fuel
- Effects on fly ash composition and reuse
- Effects on gypsum composition and reuse
- Effects on plant-wide water balance
- WWTP functionality during outages
- NPDES Outfalls

Labor and Staffing

- Operational complexity
- Staff availability
- Training and certifications
- Automation
- Sampling and analysis

Worker Safety

- Equipment/sampling access
- Cranes and hoists
- Fall protection, platforms, stairs
- Confined spaces
- Hazard detection systems
- Chemical storage/feed areas
- Traffic areas

Mechanical Maintenance

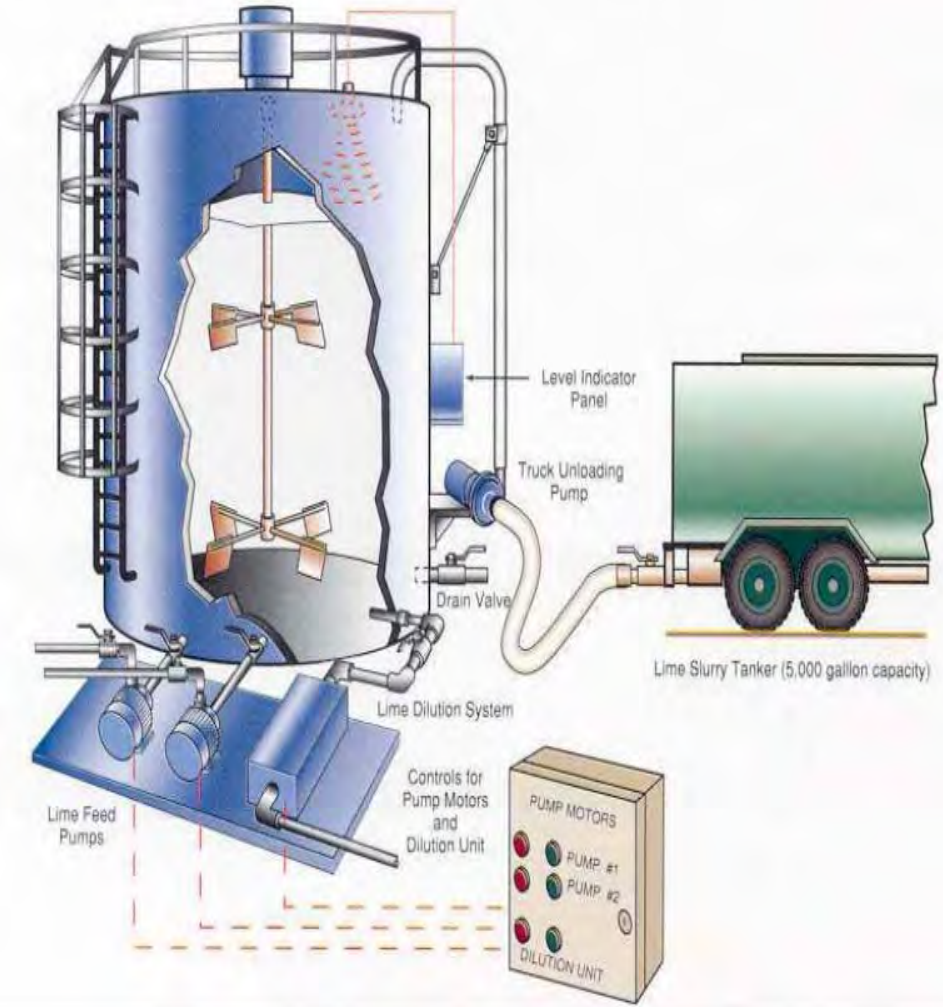
- Planned maintenance
  - System capacity during maintenance
- Equipment redundancy
  - Where and when is it valuable
  - It isn’t always practical
- Spare parts
  - Similar equipment = shared parts
  - Common and available
  - Online spare or shelf spare?
  - Shelf life

Piping Systems

- Valve location and height
- Valve types
- Actuator types (in 3D model)
- Cleanouts / flush points
- Buried pipe vs. pipe trenches
- Direct bury valves vs. vaults
- Floor drains vs. trench drains
- Winterization

Chemical Areas

- Capital vs. chemical costs
- Storage volumes
- Effects on solids/sludge generation
- Chemistry impacts
- Secondary containment complications
  - Precipitation
  - Confined space
- Effects on building classification
- Temperature effects
- Lime system considerations



Lime Systems; Unloading/Tank Area

- Offloading at <12 psi, short pipe runs
- May need booster blower
- Size tank or silo for full bulk shipment
- Automation of make-down of lime from silo or super sacks
- Slurry >20% has less settling/mixing
- Design tank for cleanout (side manways, etc.)
- Delivery of pre-made slurry for low consumption applications

Lime Systems; Preventing Line Fouling

- Percent Solids Matters!
  - <15% leads to fouling
  - 20-28% good for recirc loop (4-10 fps)
  - 28-32% used in dead-end piping, and can have lower velocities
- Eliminate stoppages in loops (<28%)
- Optimal line size >2-inch. Install cleanouts, disconnects, flush points
- Use open troughs where possible
- Mineral dispersants (i.e. acrylic acid)
- Consider pre-made slurry

Design for Operations

- Operability is a key design parameter
- Always use 3-D BIM design (Building Information Modeling) when practical.
- Critical to setting aside access space, clearances, etc.
- Milestone meetings throughout design; Invite ops, maintenance, safety folks.

Planning for the Future

- Variable or constant speed motors
- Equipment sizing
  - Pump impeller and motor sizing
  - VFD sizing and pump duty point
- Space
- Tie-in points

2. Technology Specific Considerations

Phys/Chem Treatment

- Multiple applications
  - FGD Wastewater, raw water, misc.
- Chem additives
  - Softening = sludge
  - Polymer overdose
- Clarifiers
  - Standard vs. high rate
  - Cleaning settling tubes/plates
  - Maintaining appropriate sludge bed
- Tertiary filtration
- Dewatering & solids handling

FGD Wastewater: Biological Treatment

- Nitrate and selenium removal
- Several different designs
  - GE ABMet (Fixed bed)
  - Frontier (Fluidized bed)
  - Degremont iBio (Suspended growth)
- O&M concerns
  - Complexity: Maintain biology, nutrients, ORP
  - Sensitivity: Low flow, temp, outages, upsets
  - Off-gassing
  - Re-seeding
  - Solids handling
  - Materials of construction

FGD Wastewater: Chemical Reduction

- A possible alternative to biological treatment for selenium
- Most commonly uses reducing media such as zero valent iron
- Reduces and immobilizes selenium
- Converts nitrate to ammonia. Does NOT denitrify. Must follow with ammonia removal (full denitrification)
- Packed or Fluidized Bed
- Media is disposed, not regenerated. Consider the media usage and operating costs. Pilot test! Plus, handling issues.

FGD Wastewater: ZLD – Brine Concentrator

- Pretreatment is sedimentation for TSS removal, but partial or no softening.
- Stabilize resulting salt slurry with fly ash & other amendments. Affected by fly ash composition.
- Suitable product for landfilling/encapsulation
- Steam for startup
- Complex/lengthy startup & shutdown
- Specialized operator training
- Low TDS water recovery, add minerals prior to reuse

Solidification/Stabilization

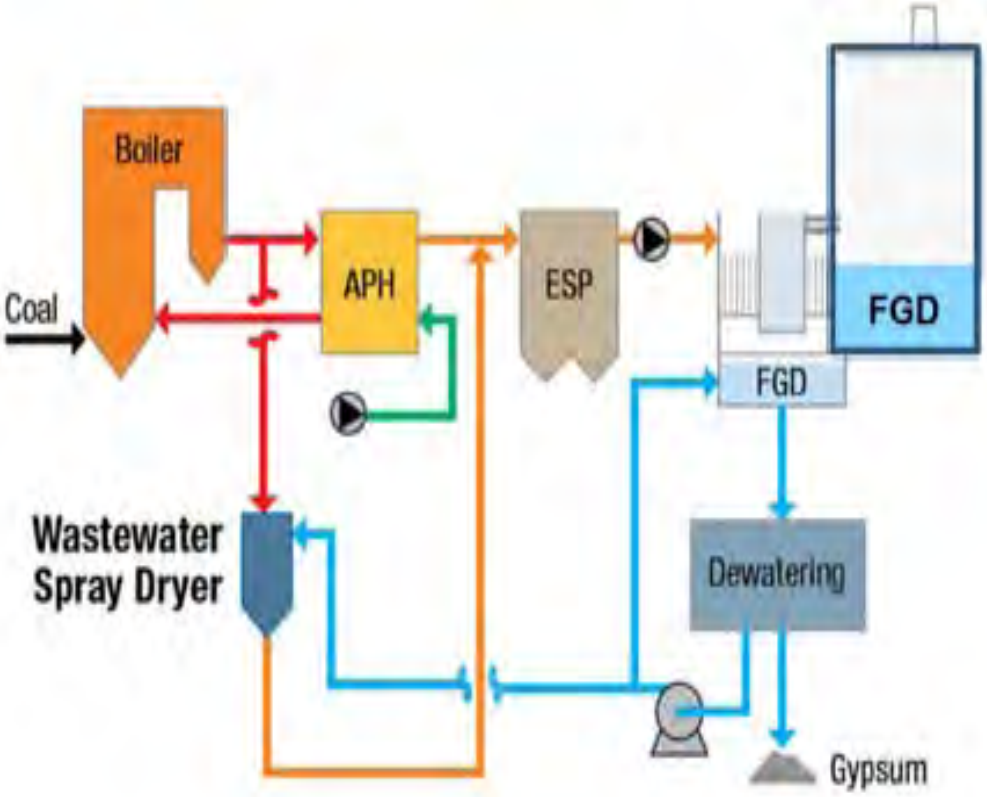
- Prevent leaching of solid waste generated from flue gas desulphurization (FGD) unit
- Highly pH-dependent process
- Complications with landfill leachate system?
- Reuse opportunity – using reject fly ash with FGD waste and $Ca(OH)_2$ retards the leaching of heavy metals[1]

[1]Qiao et al. 2006

FGD Wastewater: ZLD – Spray Dryer

- Flue gas from boiler to side-stream spray dryer (Mitsubishi WSD, Alstom SDE)
- Two streams in; hot flue gas and FGD purge. No softening or pretreatment.
- Atomizes at high temp in spray dryer (no wetness or corrosion)
- Existing ESP systems remove solids.
- Easy startup, operation, & shutdown
- Operation depends on power block. Outage = no purge treatment
- Effects on fly ash?

Mitsubishi WSD



Reuse of Waste Streams

- High purity RO reject to cooling tower
- Re-circulate process waste streams (if water quality appropriate) to cooling towers
- Re-circulate oil/water separator effluent to cooling towers
- Re-circulate boiler blowdown to cooling towers
- Recycle storm water as service water (rooftop drains, not filtered)

Other Operations Practices

- Condensate polishing for units with intermediate dispatch (frequent starts/stops)
- Continuous water quality monitoring for cooling tower and boiler chemistry control for real-time adjustments

Thank you!

Questions?