Facilities Recommendations: Liquid Supply Systems

Some Recommendations from Sub Fab Experiences

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  – System Design Requirements
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Overview

• Review and recommend some upfront questions
  – Topics to consider for any system investment
  – Areas to focus on when designing in a new capital purchase
    • Recommendations to layout
    • Scale of the system
    • Surrounding connections
Slurry Review

• Three major ingredient types
  – Silica
    • Shear sensitive
      – Particle growth in certain operational circumstances
    • Environment considerations
      – Low pH: Dried aggregates (cement-like)
      – High pH: Soft aggregates
  • Most prone to require filtration
    – Drum
    – Blend
    – Point of Use
Slurry Review

• Three major ingredient types
  – Alumina
    • Sediment potential
      – Long term operation can cause serious line clogging
      – Poor agitation in tank leads to varied removal rates
    • Environment considerations
      – Soft aggregates
  – Ceria
    • Sediment potential (some cases)
      – Long term operation can cause serious line clogging
      – Poor agitation in tank and drum/tote leads to varied removal rates
    • Environment considerations
      – Soft aggregates
Process Planning

• WHEN to Consider:
  – High use production scenarios
    • Multiple tools
    • High throughput of product
  – Custom recipes
    • Tight tolerances of a blend
    • Potlife issues with tertiary chemicals
  – Removal of bottlenecks
    • Drum/tote
    • Labor
Process Planning

• **WHAT to Consider:**
  – **GROWTH:**
    • Will this process grow in production scale?
      – Sizing global systems
        » Piping
        » Pump Engine
        » Day Tank
    • Will there be more tools in the near future?
      – Sizing blending make-up rates
        » Blend tank
        » Flow meters or scales
    • Are there dedicated support systems?
      – Additional Blend chemicals
      – DI, N2, etc
      – Waste handling facilities
Process Planning

• WHAT to Consider:
  – RECIPE:
    • How many chemicals will be used?
    • Delivery to systems?
    • How critical are upper/lower control limits?
    • Adjustments to recipe?
  – Instrumentation
    • Will the batch require a pass/fail prior to delivery?
      – Affects make up rates and production
    • Will there be a need to control process functions?
      – Critical versus process warnings
Process Planning

• WHERE to Consider:
  – Layout:
    • Where to locate with respect to production
      – Minimize power requirements for pump engine
      – Minimize global loop lengths and rises
        » Reduce slurry agglomeration
        » Reduce volume of unused product
      – Avoid serpentine loops
        » Slurries with sedimentation issues
    • Environmental surroundings
      – Minimize temperature fluctuations between system placement with respect to production tools
Process Planning

- Best
  - Tools directly below
    - Less energy required by pump
    - Less long term pressure associated wear
  - Imparts the least amount of stress to the chemical and components
  - Requires pressure regulation at VMB
Process Planning

• Better
  – Tools and system on same level
    • Good for long loops
  – Uses more power than previous application, but does not stress pump
Process Planning

- Good (but could get worse)
  - Systems below tools
    - Standard ideology for...ever
  - Changes that impart more stress to pump engine
    - Addition of filtration
    - Additional tools
      - Longer loops
      - More VMB additions
      - Changes to input pressures
    - May require increase in pump engine size
  - Requires the most power to dispense chemical to processes
Waste Streams

• Usually not well planned
  – Typically viewed in same manner as normal waste water streams
    • Slurry is sensitive to dry air conditions
    • Eddies tend to be nucleation points for buildup to occur

• Typical to have cabinet and process drains tied to the same waste stream
  – Keep cabinet drains to 1” minimum opening
  – Consider hydraulic head of Process
    • Avoid back flow
  – Have your engineer certify calculations
    • Keep slopes at ¼ to ½ inches per foot ALWAYS!
Waste Streams

- Small upfront investment can avoid the costly interruptions down the road
  - Keep it WET
    - High flow, timed auto-flush with industrial water
    - OR, Dedicated stream, 100 ml or more, at each waste stream starting point
Component Specifics

• Dispense Engines
  – Positive Displacement Pumps
    • Bellow/Diaphragm
    • Efficient method for transfer of liquids
    • Simple to replace allowing for a low cost redundancy in any system
    • Lifetime based on application
      – 3 months to 18 months
    • Contributes to shear induced particle growth
      – Pump style and geometry dependent
    • Will add slight increases in the temperature of slurry
      – Thermodynamic fact
Component Specifics

• Dispense Engines
  – Centrifugal Pump
    • Efficient method for transfer of liquids
    • Simple to replace allowing for a low cost redundancy in any system
    • Additional automation controls to enhance system operation
    • Best lifetime of all engines
    • Pressure/flow dependent
      – As head increases, flow decreases requiring more power
    • Do not contribute to shear induced particle growth
      – Shear flow
    • Will add slight increases in the temperature of slurry
      – Mechanic/Thermodynamic fact
Component Specifics

• Dispense Engines
  – Pressure Vessel
    • Inefficient method for transfer of liquids
    • Consists of a myriad of sensors, valves, and logic to operate
      – Trouble shooting issues
    • Leads to evaporation of liquid medium in slurry base
      – Air-liquid interface
      – Sensor drifts
    • Contributes to shear induced particle growth
      – Low to No RH in gas
    • Difficulty in handling slurries with sedimentation issues
Peripherals

• Automation Platforms
  – Multitude of offerings each delivering a level of complexity and cost
    • Many different styles of communication protocols
  – Depend on how much automation the user requires
    • Instrumentation
      – Control processes
      – Communicates to other systems
      – Detailed decision making
    • Can be tied into a SCADA system for global monitoring
      – Paging technicians to alarm specific issues
      – Track and trend data for quality and integrity
Maintenance Programs

• More important than thought
  – Wear and tear of slurries
    • Valves
    • Instruments

• System-wide flush
  – Highly recommended for any slurry type
  – Annual program
  – Couple with complete system validation
    • Finely inspect major components
Summary

• Capital Investment
  – Typically reviewed as an afterthought

• Important Investment
  – Delivering the chemicals to the tool
    • Blending
    • Handling
  – Quality of delivered chemical is affected by quality of the system design

• Avoid time-bombs to production
  – Focus on a long term needs and growth
  – Select a system design that delivers flexibility

• Enforce maintenance programs