Washing 101

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Product Manager Washing/Classifying
History
Why Do We Wash

• **Concrete**
  – Fines requires extra water.
  – Excess water causes shrinkage.
  – Extra water requires more cement.
  – Possible Chemical contaminants
  – Cement is 14% of volume but 62% of cost

• **Asphalt**
  – Excess Fines increase the Surface area which increases Binder required.
  – Fines increase viscosity of Binder. Making mixture more brittle.
  – Binder is 8% of volume but 82% of cost.

Why Do We Wash

• To alter the feed gradation to meet mix design specs.
• Remove deleterious particles.
• Remove lightweight particles.
• Blend multiple feeds
Concrete and Asphalt

How Do We Wash

• Terms to Remember
  – Specific Gravity (density of material vs. water)
  – Hindered Settling (falling solids in a viscous liquid)
  – Hydraulic Classification (using water to separate particles by size)
  – Deleterious Material (particles to be removed from feed)
  – Benefication (improving a feed based on a desired outcome)
Basics of Washing

- Washing removes dissolved material
- Removes low specific gravity particles
- Removes small and flat particles

Hindered Settling

- To remove different size particles, upward velocity must be varied
- Velocity is varied by changing amount of water flowing in
Silt Dilution

- In order to assure proper settling, silt cannot build up
- Minimum silt dilution is required

Fine Material Washers
Fine Screw Washers

- Large overflow area designed to retain fine particles
- Max Material size ¾” most 3/8”.
- Twin or single Shafts
- Low Horsepower per tph approximately 0.2 hp/tph
- Some scrubbing due to rolling and rubbing of aggregate

Fine Screw Washers

- Classifies material by specific Gravity
- Light material (i.e. silt) is washed over the rear overflow area.
- Heavy material is augured up the incline and dewatered.
Fine Screw Washer

- Good at removing -100 mesh to bring feed into specification
- Wear parts Cast, urethane and rubber
- Discharge moisture between 10% and 25% depending on gradation

Cyclones
Cyclones

- Sorts particles by specific gravity
- Feed tangentially with outlets at the top and bottom of cone
- Heavy particles slung to the outside and slide down
- Water and light particles rise up center of cyclone

Cyclones

- The size of separation is determined by
  - Cyclone base diameter
  - Exit diameter (apex)
  - Feed pressure
  - Nature of the feed material (differences between light and heavy particles)
- Discharge moisture is approximately 30% - 40%.
- Precise splits can be made if feed material is homogenous
Cyclones

- Wear parts are cast alloys and urethane
- Requires proper pump sizing
- May need further processing depending on moisture content prior to stockpiling
- Some scrubbing done in cyclone and pumping process due to rubbing particles together

Dewatering Screen/Cyclone
Dewatering Screen/Cyclone

- Dewatering screen can be run with or without the cyclone
- Dewatering screen discharge moisture is about 10%
- Screen media is urethane with 1mm to ¼ mm slots
- Screen-thru’s sent to sump and pumped to cyclone
- Cyclone discharges back onto screen

Dewatering Screen/Cyclone

- Screen works by “blinding” screen and creating a filter bed
- High frequency motors shake material breaking surface tension of water
- Water drains down thru screen
- G-force and screen openings determine discharge moisture
Dewatering Screen/Cyclone

- Cyclone re-deposit's fine sand thru's back on top of filter bed
- Filter bed prevents fines from going back thru screen
- High horsepower about 0.9 hp/tph
- Wear parts urethane, cast steel & ceramic

Screen/Screw Dewaterer
Screen/Screw Dewaterer

- Unit uses dewatering screen and Fine screw washer to wash and dewater
- Has large settling area to split sand and silt
- Auger carries sand up incline allowing most of the water to drain out
- Some scrubbing done by rolling particles against each other
- Auger deposits sand onto dewatering screen
- High overflow capacity

Screen/Screw Dewaterer

- Dewatering screen uses High frequency motors and screen media to separate water from sand
- Fine sand that goes thru screen is gravity fed back into screw settling area to be redeposited onto screen
- Low horsepower/tph about 0.3 hp/tph
- Discharge moisture about 10%
- Wear parts are cast alloy, urethane or rubber
- Fits same footprint as standard Fine Screw washers
- No pump required
Bucket Wheels

- Use large settling area and slowly revolving wheel with scoops to separate sand from silt
- Very low horsepower/tph about 0.05 hp/tph
- Makes relatively coarse splits approx. 100 mesh
- Sometime employ drag screws to pull material back to wheel
Bucket Wheels

- Buckets have fine mesh screens in the bottom to help with dewatering
- Splits determined by bucket size and screen opening used
- Parts move very slowly so wear parts are usually minimal using A/R and Urethane

Fine Washing Applications

- Fine Screw Washers
  - Remove -150 mesh and dirt from feed
  - Very light scrubbing
  - Low horsepower/tph
- Cyclones
  - Very sharp cuts
  - Tonnage capacity dependent on split point
  - Require secondary dewatering
  - Medium to high horsepower/tph
- Dewatering Screen/Cyclone
  - Drip free Stockpile
  - Light scrubbing in pumping process
  - Medium horsepower/tph
- Bucket wheels
  - Remove -100 mesh material
  - Relatively dry product
  - Some fines losses
  - Very low horsepower/tph
- Screen/Screw Dewaterer
  - Drip free stockpile
  - Low horsepower/tph
  - Removes -150 mesh material
Controlled Velocity Separator

• Slurried sand is fed into pyramidal tank
• Inflow velocity and in tank slurry density are controlled by computer automation
• Varying velocity and density allows adjustments to the split point
• Splits from 25 mesh to 200 mesh
• Tonnage Capacity depends on Split point
• Lower split point lower thru put
Controlled Velocity Separator

- Max Capacity 800 tph at 30 mesh split
- Secondary dewatering required
- Pressure and quality of feed water essential to proper operation
- Tonnage Capacity depends on Split point
- Low horsepower/tph almost zero
- Multiple units allow for blending of spec products

Coarse Materials Washing
Coarse Screw Washer

- Abrasion Resistant Steel Alloy shoes and Paddles
- Designed to wash light soils and crusher dust off coarse aggregate
- Low Horsepower .2 to .3 HP/Tph
- 3 to 5 gpm/tph
- Work better with rinse screen after washer
- 4 inch to ¼ inch capacities
- 60 tph to 550 tph throughputs

Log Washers
Log Washer

- Designed for heavy scrubbing to remove plastic clays.
- Can handle up to 10% clay content
- Max material size 4 inch
- Capacities up to 225 tph
- Always twin shafts and paddles are interlocked
- Cast or abrasion resistant paddles

Log Washer

- Named by gold miners in CA gold rush
- High Horsepower per tph 0.7 hp to 2 hp per tph
- Low water usage .5 to 1 gpm per tph. (Limestone 3 gpm/tph)
- De-sand prior to log washer.
- Operate 3 to 10 degrees
Log Washer

- Recommend rinse screen after Log Washer
- Can remove some light or friable material (chert, sandstone, etc.)

Prep Screws
Prep Screws

- Also known as Blade Mills.
- Single or twin shafts
- Scrub up to 4” mat’l and up to 720 tph
- Designed to take raw feed and prepare it to be fed to a secondary screen and further processing.
- Can increase screening efficiency up to 15%.

Prep Screw

- Removes Light soils and soluble clays
- Low horsepower 0.2 to 0.3 hp/tph
- Water added to Blade mill can be deducted from water required for screening
Prep Screw

- Shaft is mostly paddles with a few flights
- Paddles are NOT interlocked
- Cast or abrasion resistant paddles and shoes
- Water and aggregate all discharged to screen.

Coarse Applications

- **Coarse Screw Washer**
  - Remove Crusher Dust and light soils
  - Removes -4 mesh material
  - Light Scrub
- **Log Washer**
  - Removes heavy plastic clays
  - Large Horsepower usage
  - Feed must have sand removed
- **Prep Screws**
  - Pre-Screen Processing
  - Improves screening efficiency
  - Removes light soil and soluble clays
  - Medium scrubbing
Water Scalping Classifying Tanks

• Separates particles by size and specific gravity
• Coarse mat’l falls at feed end of tank and fines fall at the end
• Silt overflows side of tank
• Takes high water volume variable feed and puts out lower water volume steady feed
• 100 tph to 1200 tph with 1200 gpm to 8400 gpm capacities
Water Scalping Classifying Tanks

- Series of valves allow re-blending of 3 products
- Low horsepower/tph nearly zero
- Requires secondary dewatering
- Allows removal of -8 mesh to +100 mesh
- Wear parts cast alloys, Uhmw and urethane

Water Scalping Classifying Tanks

- Valve rods and structure reduce classifying efficiency
- Rising current cells increase classifying efficiency
- Multiple control types, Mechanical to computerized
Classification Applications

- **Controlled Velocity Separator**
  - Makes precise cuts in the 80 to 20 mesh range
  - Medium capacity
  - Computer Controlled
  - Multiple units to make blended spec product
  - Dewatering required

- **Water Scalping Classifying Tanks**
  - Hydraulically separate sand by size and reblend into spec products
  - Large water capacity, good on dredge applications
  - Manual to Computerized controls
  - Dewatering Required

- **Whirlsizer**
  - Make less precise cuts in the 16 to 80 mesh range
  - High tonnage capacity
  - Multiple units to make blended spec product
  - Dewatering Required

- **High Frequency Screens**
  - Very precise cuts as low as 85 mesh
  - Multiple units to make blended spec product
  - Cut point and tonnage determines screen size
  - Require very dry feed
  - No dewatering required
Misc. Benefication

Jig

Slurry Refuse Separator

Misc. Benefication

Sieve Bins

De-Ligniter
Thank You For Attending!