Objectives of Wet Frac Sand Processing

- Liberate Individual Silica Particles
- Remove Non Silica Contaminants
- Liberate and Remove Clay Impurities
- Remove Non Frac Sand Size Fractions
  (Depends of Processors Requirements)
- Break Up Clusters
Basically Take Raw Sand and Prepare it for Feed To Dryer and Dry Screening Plant
Frac Sand
Mining Methods:

- Dredging
- Harvest w/ Earthmoving Equipment (Liberated Sands)
- Blasting and Harvest w/ Earthmoving Equipment (Not Liberated Sands)
Primary Crushing and Tertiary Impactors for materials over 6 to 8” size

- Use of Jaw Crusher followed by Either Horizontal Shaft Impactors (HSI) or Vertical Shaft Impactors (VSI)
- It is important to only liberate and not crush the individual silica particles during liberation
- Can be operated in closed circuit with Primary screen with circulating load returning to tertiary impactors
Non Liberated Sands Over 6-8" (Primary Jaw)
Non Liberated Sands Over 6-8” (Tertiary Impactor)
Preparation of Non Liberated Sands (less than 6-8")

Single Stage Crushing for materials typically 6 to 8” size or less

- Use Either Horizontal Shaft Impactors (HSI) or Vertical Shaft Impactors (VSI)
- It is important to only liberate and not crush the individual silica particles during liberation
Vertical Shaft Impactors (VSI)
Primary Screen w/ Sluice Box & Sprays
Primary Screen w/ Sluice Box & Sprays
Single Stage Frac Sand Plant (No Clays)
Cyclone (Principles of Operation)

Bulk of liquid with solids finer than “cut” size exits through vortex finder.

Tapered tangential inlet accelerates slurry entry velocity.

Vortex finder

Feed box

Solids flung to wall spiral down to apex.

APEx VALve

OVERFLOW

FEED

UNDERFLOW

FIG. 1

McLanahan
Single Stage Frac Sand Plant (No Clays)
Hydrosizer (Principles of Operation)

A square or round hydraulic chamber that makes separations via an upward streaming column of water (tweeter water) that separates particles based on their hindered settling rate differential. Separation efficiencies are same as high efficiency wet screening machines (90%) however footprint is smaller and capital costs are lower. To change cut point (separation) simply calculate water quantity required and change teeter water flow rate. Pump that supplies Teeter water is designated for that duty only.
Recessed Plate & Frame Press (Pros & Cons)

- Feed enters the top of the unit via a central feed well.
- Water is injected through a series of pipes to cause an upward rising current.
- A zone of suspended or “teetered” solids is established.
- Fines flow over a weir at the top of the unit.
- The slurry density of the teetered bed is monitored by a pressure transmitter.
- A PID controller maintains the teetered bed density by adjusting the underflow valve, which releases coarse material.
Hydrosizer (How they Work)
Hydrosizer (Teeter Water Feed System)
Hydrosizer (Two Cell Installation)
Hydrosizer (Installation)
Flat Bottom Classifier Style Hydrosizer
Flat Bottom Classifier Style Hydrosizer (Installation)
Single Stage Frac Sand Plant (No Clays)
HOW DEWATERING SCREENS WORK

1. Slurry feeds onto a steeply inclined screen surface to achieve rapid drainage
2. A pool of water forms in the valley as sand builds up on the inclined surface
3. Counter rotating motors create a linear motion that forces solids uphill while water drains through the screen media
4. The uphill slope of the screen along with a discharge weir creates a deep bed that acts as a filter medium, allowing retention of material much finer than the screen openings

Dewatering Screen Installation typical discharge of Frac Sand; 8 mesh (2.36mm) by 70 mesh (212 micron) is between 10 & 15% moisture)
Dewatering Screen (Linear Motion)
Horizontal Belt Filter (Compositech)

Typical discharge of Frac Sand; 8 mesh (2.36mm) by 70 mesh (212 micron) is between 4 & 5 % moisture)
Horizontal Belt Filter
Dewatering Screen (Discharge to Stockpile)
Attrition Cells

- Used to liberate clays from silica particles
- Rotating shaft with paddles causes particle on particle scouring
- Feed should be about 68 to 78% solids
  - Too dilute and the particles glide past one another
  - Too dense and the pulp won’t flow through system
Standard Components

Motor

Gearbox

Shell

Baffles

Paddles

Inlet

Outlet

Shaft

Hubs

Drain
• Paddles pump up or down
• Alternating arrangement
• Four paddles per blade arrangement
• Five (5) sets of blade arrangements
• 60 HP motor
• No Belts or Sheaves
• All surfaces rubber lined
After recovering the Frac sand material producers are typically left with the minus 70 mesh (212µ) or minus 50 mesh (300µ) material along with the majority of process water.

The solids are basically fine sands, silts and clays.

It is desirable to minimize the amount of solids reporting to settling ponds in order to minimize pond size and cleaning costs.

Producers should find marketable uses for these discarded solids such as:

- Foundry sands
- Flowable fills
- Industrial Fillers
- Landfill cover
- Soil Augmentation

Remote locations of plants makes finding economically feasible uses for byproducts difficult.
Single Stage Frac Sand Plant W/ UFR (Ultra Fines Recovery)
Single Stage Frac Sand Plant W/ UFR (Ultra Fines Recovery)
Two Frac Sand Fractions

Diagram showing the process flow for two frac sand fractions, including feed, water, hydrosizers, dewatering screens, sumps, pumps, and final output as tails.

- Feed
- Water
- Hydrosizer 1
- Dewatering Screen 1
- Sump & Pump 1
- Water
- Hydrosizer 2
- Dewatering Screen 2
- Sump & Pump 2
- Water
- UFR
- 8 X 40
- 40 x 70
- 70 x 400
- Tails
Two Frac Sand Fractions W/ Attritioning
Frac Sand & Foundry Sand Fractions w/ UFR
Thickener/Clarifier

- Reduce Settling Pond Size
- Reduce Energy Requirements for Pumping of Tailing to Settling Ponds
- Allow Immediate Reuse of Water in Process
- Allow for Use of Other Technologies to totally Eliminate Settling Ponds
THICKENER/CLARIFIER
POLYMER ADDITION SYSTEM (Dry to Liquid)
Thickener Discharge
SETTLING POND ELIMINATION

Environmentally responsible while also allowing easy reclamation of the process site after reserves are depleted
Reasons for Settling Pond Elimination

– Government restrictions on ponds
– No space available for ponds
– Immediate reuse of water in process
– Ponds would be on sand reserves
– Eliminate costs of maintaining ponds
– Potential for monetary value via recovery of clays in a consistent form (very rare)
OPTIONS (Settling Pond Elimination)

- Centrifuges
- Belt Filter Press
- Recessed Plate & Frame Press
- Others being developed
Pretreatment for Total Pond Elimination
DECANTER CENTRIFUGE (SWECO)
DECANTER CENTRIFUGE (Principle of Operation)
Advantages

- Compact
- Able to adjust discharge moisture
- Quick set up time
- Very mobile
- Easy to clean

Disadvantages

- Requires full time skilled attendant
- High capital cost
- Requires polymer addition
- Requires mechanics who can maintain and fix equipment with extremely tight tolerances
- When things go wrong repairs can be extremely expensive
BELT FILTER PRESS
BELT FILTER PRESS (Principles of Operation)
Belt Filter Press (Cross section)
Belt Filter Press (Pros & Cons)

Advantages

• Inexpensive

Disadvantages

• Requires full time skilled attendant
• Requires a large quantity of polymer (cationic) addition
• Inconsistent product discharge
• Hard to adjust discharge moisture
• Extremely messy
• Ask someone who has had one in their facility
Recessed Plate & Frame Press
Recessed Plate & Frame Presses
Composition of Recessed Chamber Filter Plates

A Typical Feed Pump Curve For A Filter Press

Termination Pressure Exerted Only Near Feed Port And Diminishes In Cake Closer To Seal Face
Filtrate Discharge from Filter Plate
Cake Discharge (Recessed Plate & Frame)
Recessed Plate & Frame Press (Pros & Cons)

Advantages

• No attendant required
• No additional polymer required
• Can adjust cake dryness (cycle length)
• Clean site around press
• Few moving parts easy to maintain
• Easy to clean

Disadvantages

• Large not mobile
• Higher capital cost
Misinformed Public
Frac Sand Stockpile

Damp Frac Sand Stockpile Ready for Dryer and Final Sizing