

REINHOLD ENVIRONMENTAL Ltd.



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

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Belt Presses in Wastewater Applications

Prepared for : 2017 APC Wastewater Conference

Presented by: Joe Haligowski

July 18th, 2017



Presentation Outline

- High Level evaluation of 4 different Belt/Cloth pressure gradient filtration technologies, key features of each.
- Requirements of those technologies.
- Important parameters for designing a dewatering study.
- Relate the 4 pieces of equipment to 5 different Power industry waste water applications.
- Discuss capital, installed, and operating costs of each.
- Summary.
- Discussion and questions.

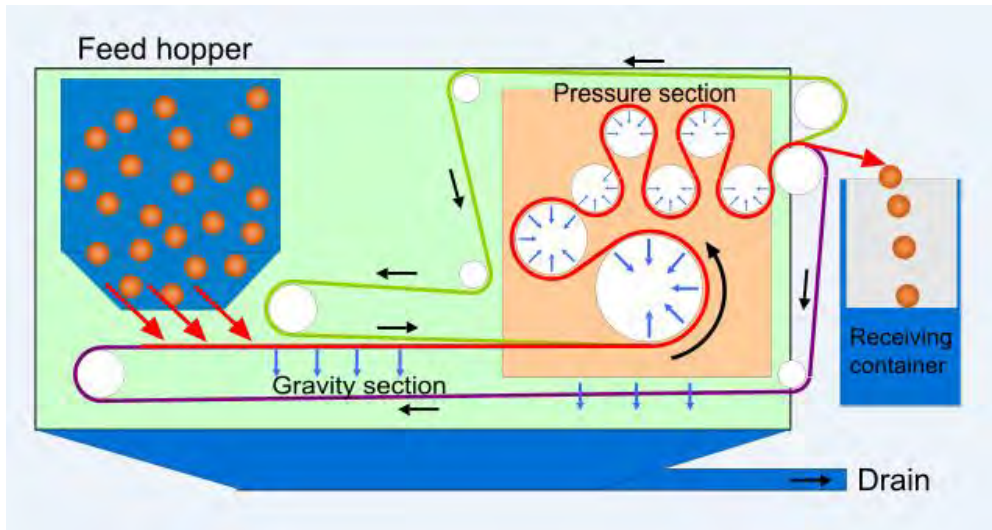
Equipment Evaluated (4 belt/cloth filter technologies)

- Belt Filter Press
 - Roll press
- Recessed Chamber Press
 - Plate and Frame Filter Press (vertical plates, stacked horizontally)
- Vacuum Belt Filter
 - Belt Filter
- Vertical Tower Filter Press
 - Automated Tower press (horizontal plates stacked vertically)

Selected Applications in Power Plant Wastewater

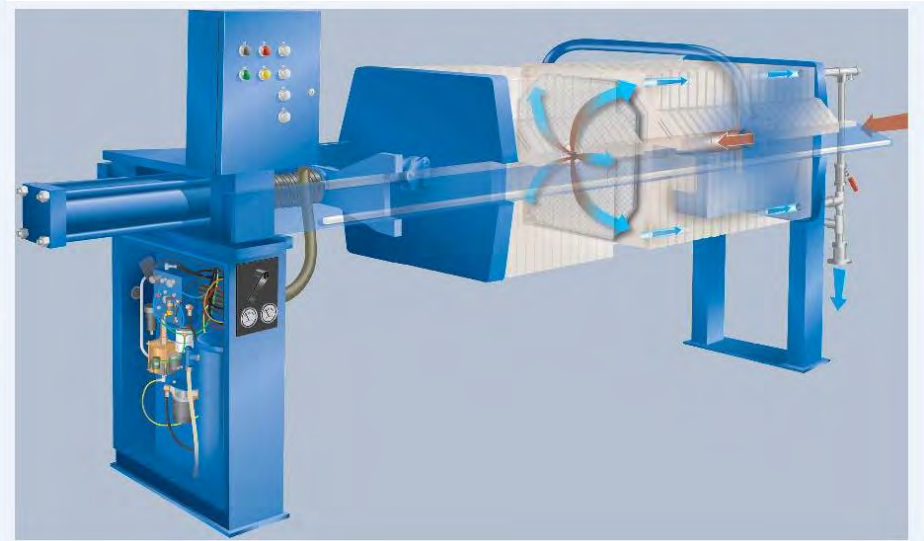
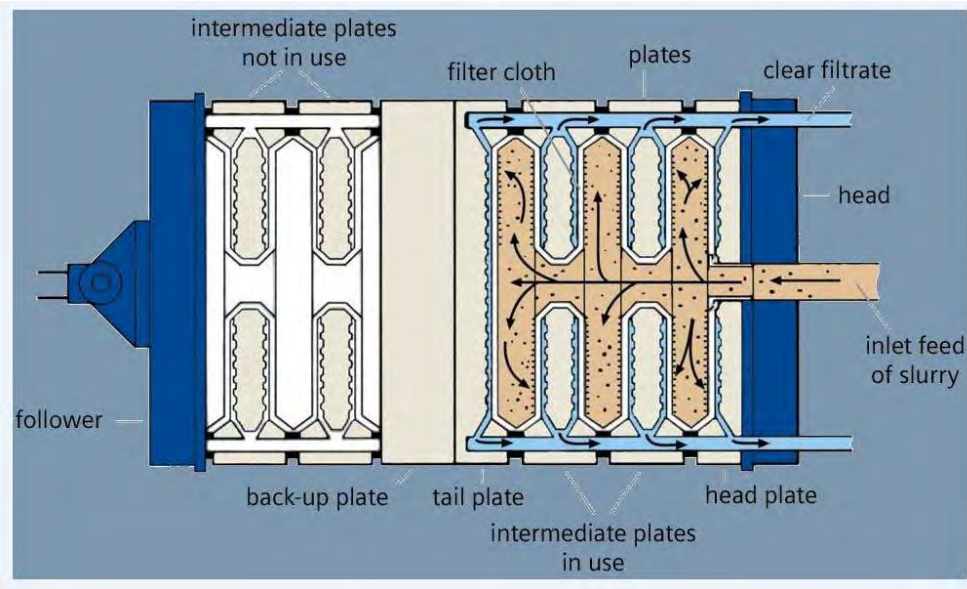
- Gypsum Production (pure Calcium Sulfate)
- FGD Wastewater Sludge (Calcium Sulfate, Magnesium Hydroxide)
- ZLD Sludge (Salt Crystals, Hot)
- Physical Chemical Water and Wastewater Treatment Sludge (TSS and Hydroxide Sludge)
- Biological Water and Wastewater Treatment sludge (Slimy proteins/solids, must be conditioned to process)

Belt Press



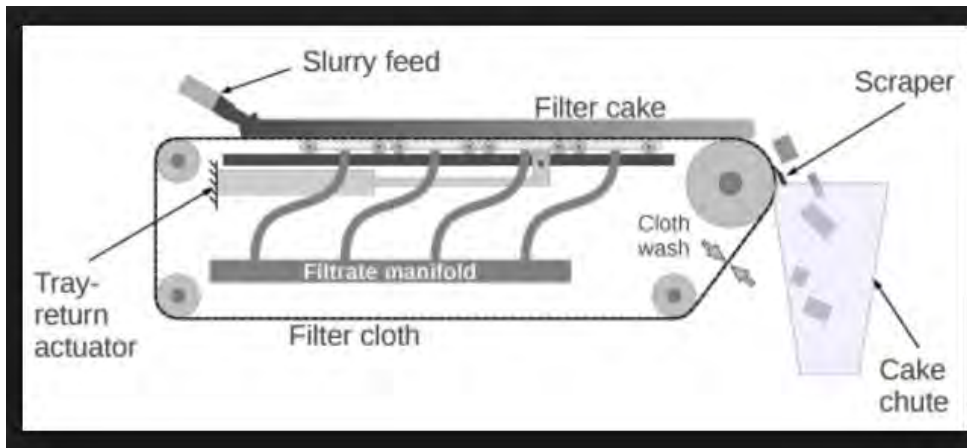
Key Feature: - Wedge zone or high pressure section, can squeeze compressible solids

Recessed Chamber Belt/Cloth Press



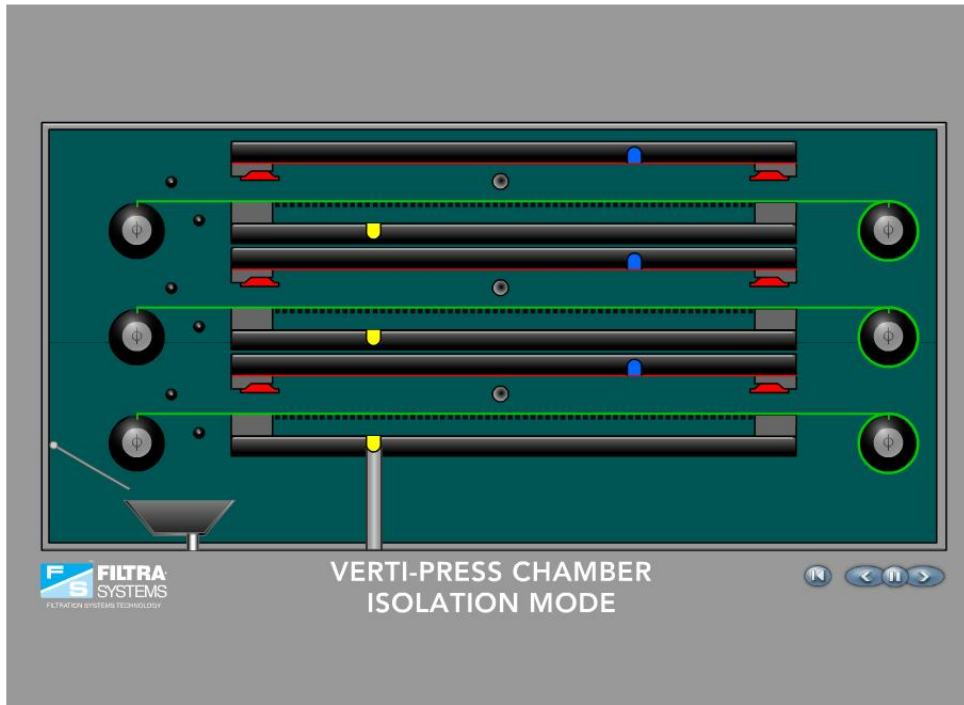
Key Feature: - Multiple vertical plates provide high filter area/floor space.

Vacuum Belt Filter



Key Feature: - Continuous Process – possible cake wash

Vertical Tower Filter Press

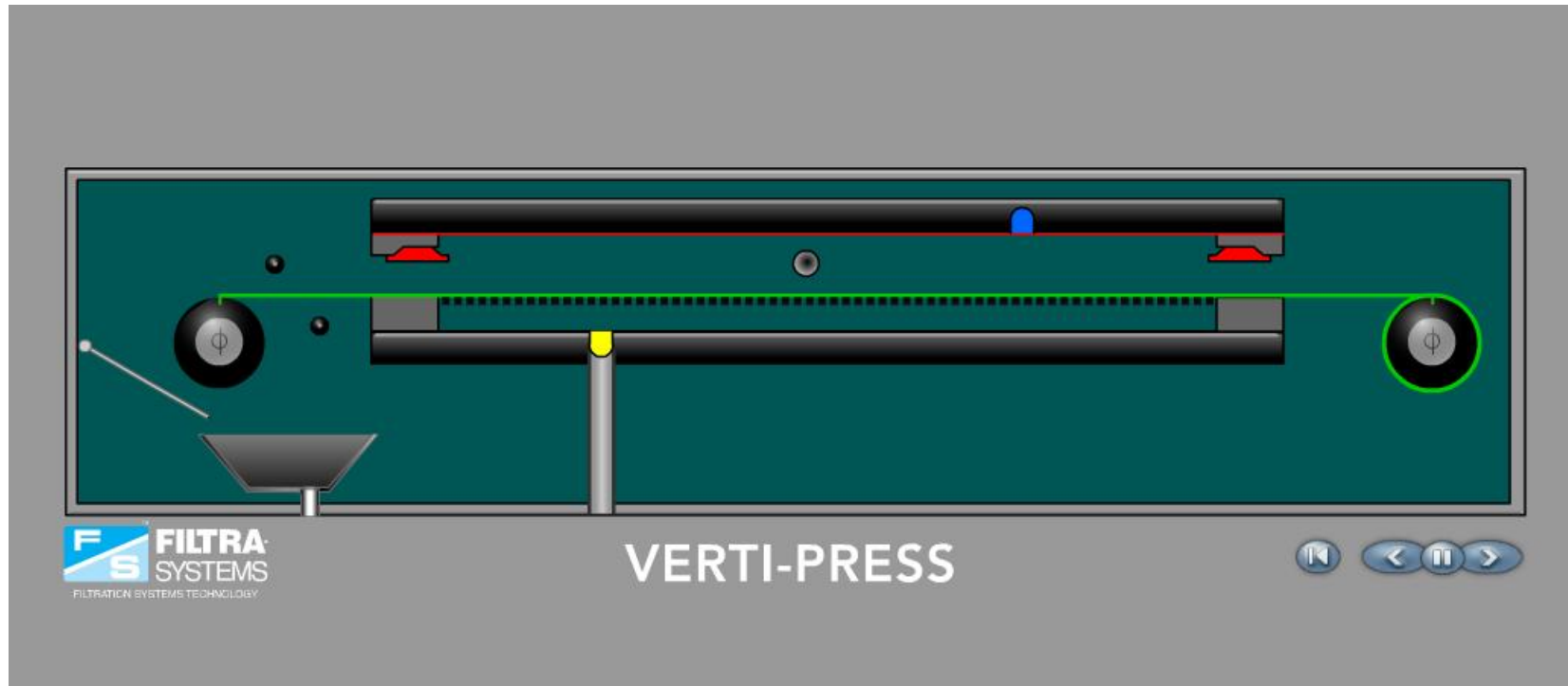


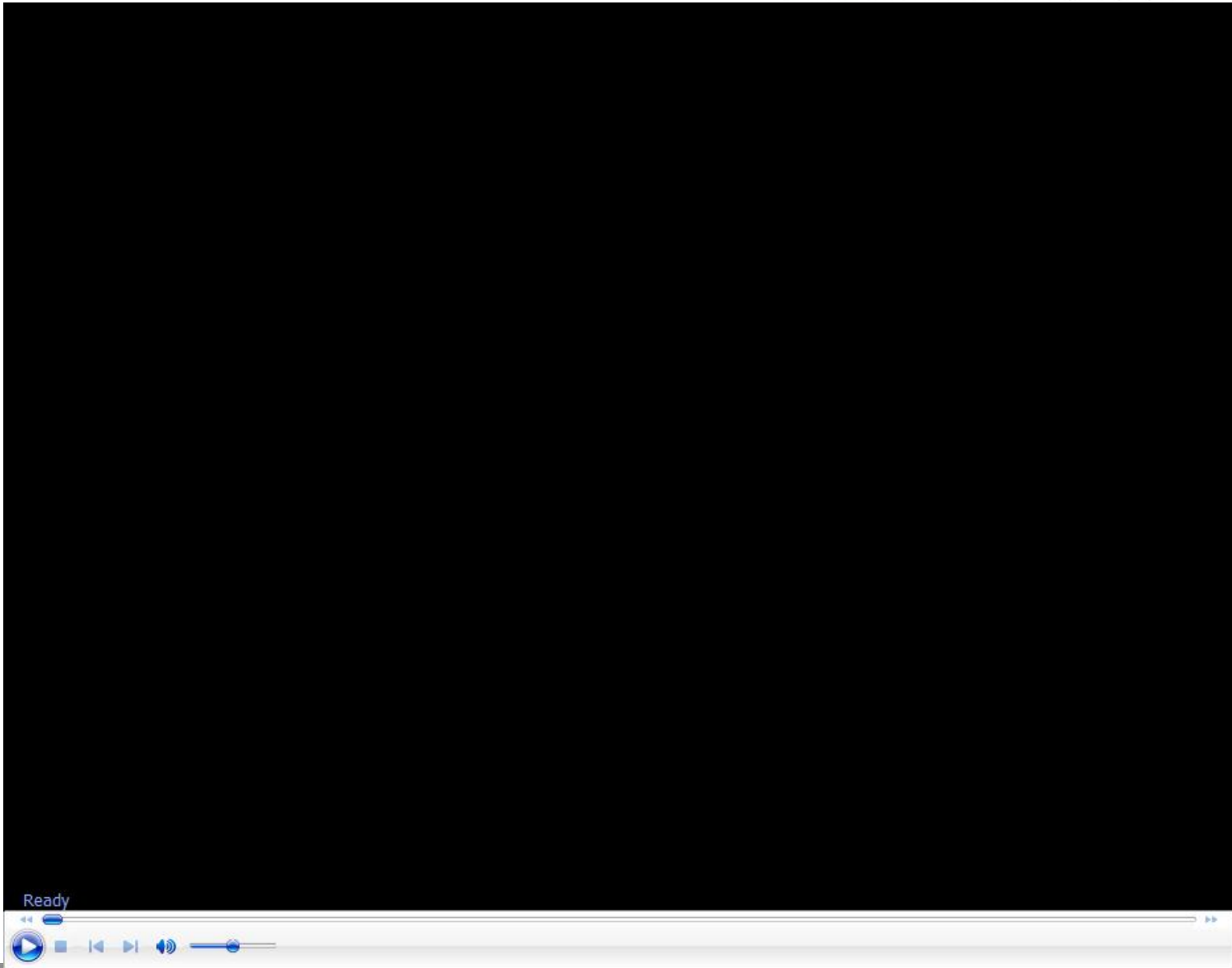
Key Features: - Full Automation – Cake Washing , Neutralization and Chemical Stabilization , Compressible Solids, Operate at turndown ratio, Vary cake height

In all applications, what steps need to occur?

- Slurry will be pumped.
- Solids will contact the belt.
- Cake is formed.
- Cake provides filtration.
- Water must flow through the cake and the belt.
- Belt must be cleaned/scraped/washed of solids.
- Water and Solids must meet the application specific targets.
- Some applications may require cake washing.

Sequence Of Operation





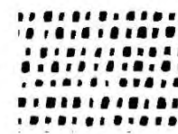
Important Data when evaluating the dewatering process.

- Physical properties of the Solids you are dewatering
 - Particle size
 - Particle distribution (narrow is easy, wide is difficult)
 - Weight, SG
- Nature of the Solid
 - Crystals/granular
 - Hydroxides (compressible)
 - Bio Sludge/Protein
- Mass and flow balance (equipment limitations).
- Does the solids load vary, and what is the range?
- Performance metrics for solids (Paint filter – Product)
- Performance metrics for liquids (how clean is the filtrate)
- Process conditions (MOC)

Design the dewatering study

- Belt or cloth permeability and type
 - Philosophy is to build cake, achieve cake filtration, and be able to be washed to meet repeatable clean DP, and have longevity.
 - Must also meet filtrate clarity objectives.
- Operating Pressure (vacuum-> pressure)
- Will the cake require compression to meet the target?
- Choose a scale for the study
 - Lab Scale
 - Fully operational pilot

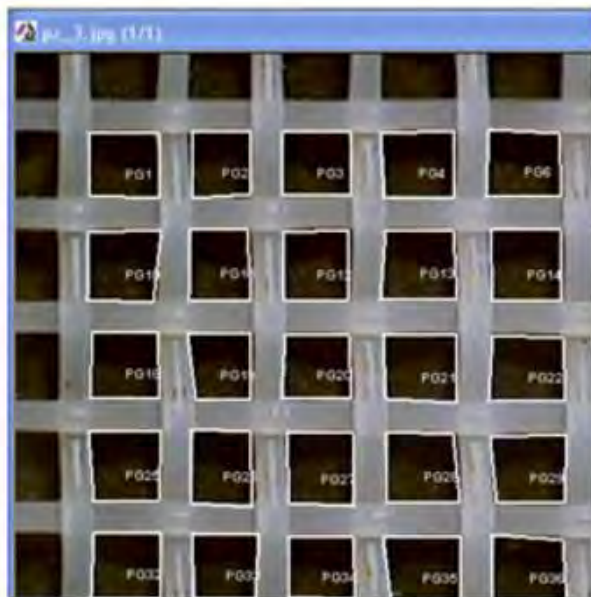
Belt Selection - Optimization



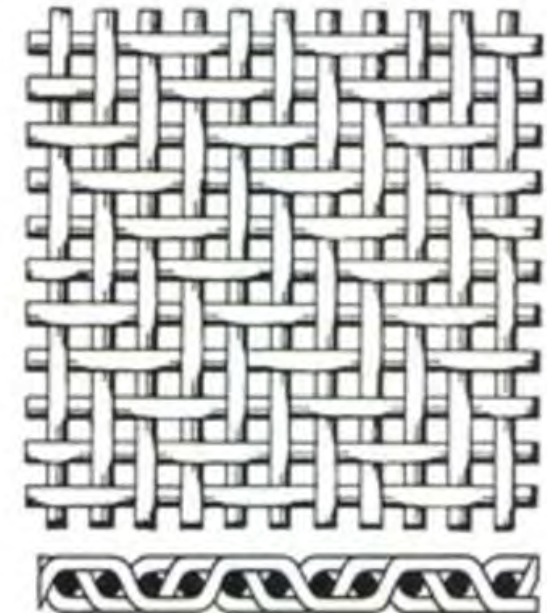
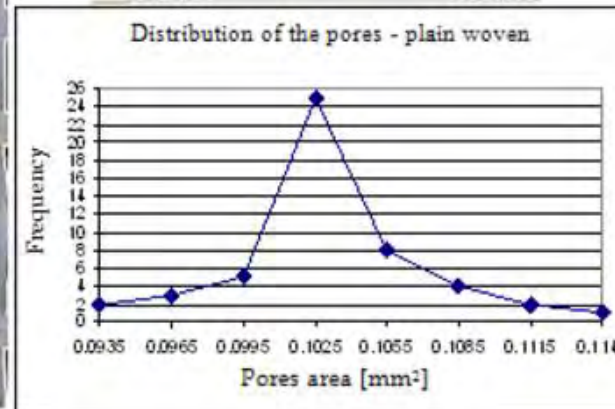
plain, 21/16 threads/cm

twill, 27/22 threads/cm

satin, 30/24 threads/cm

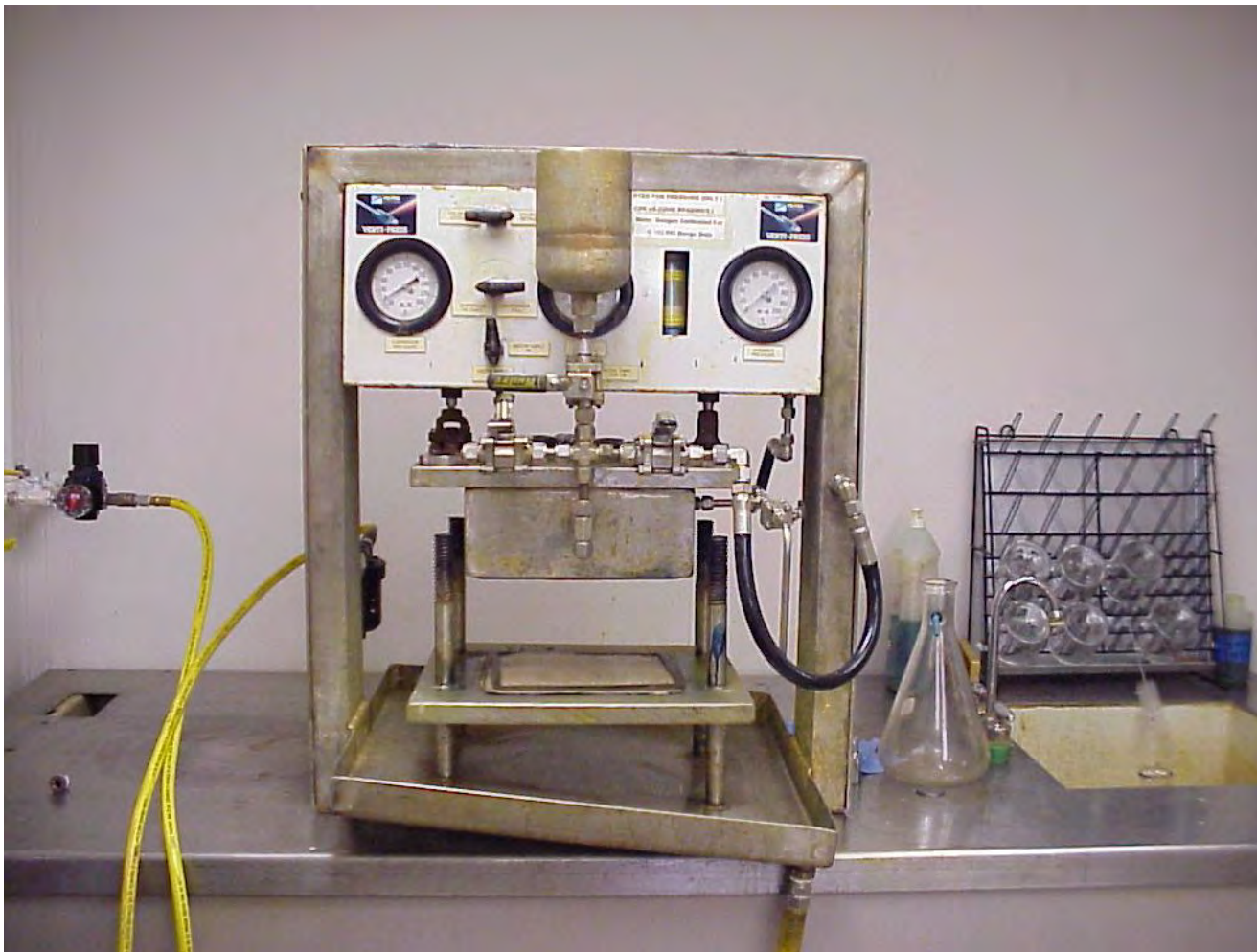


Statistic	Area
Min. Val.	.0841335
Max. Val.	.1120637
Range	.0279301
Mean	.1021164
Std. Dev	.0064476



TWILL

Lab Testing Equipment (0.5 ft²)



Fully Representative

Complete Mass
Balance

Modify Pressure
gradient (vacuum –
pressure) (-15 inches
Hg-250 psi)

Evaluate Cake Squeeze

Size equipment

Results quickly (days)

Fully Operational Pilot Equipment (10 ft²)



Fully Representative

Complete Mass
Balance

Modify Pressure

Evaluate Cake Squeeze

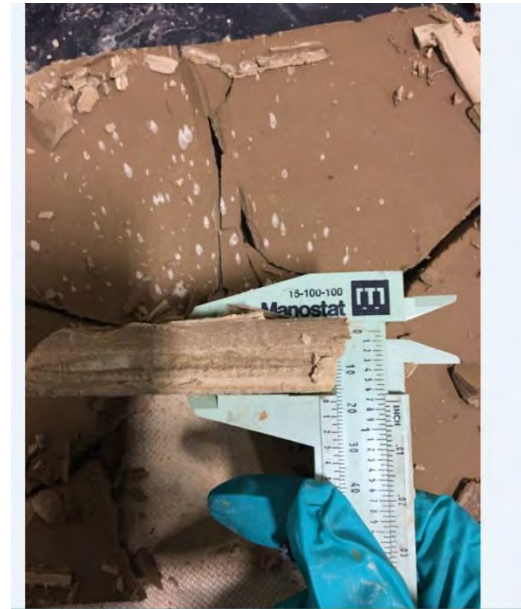
Size equipment

Results over long term

Requires More
Integration

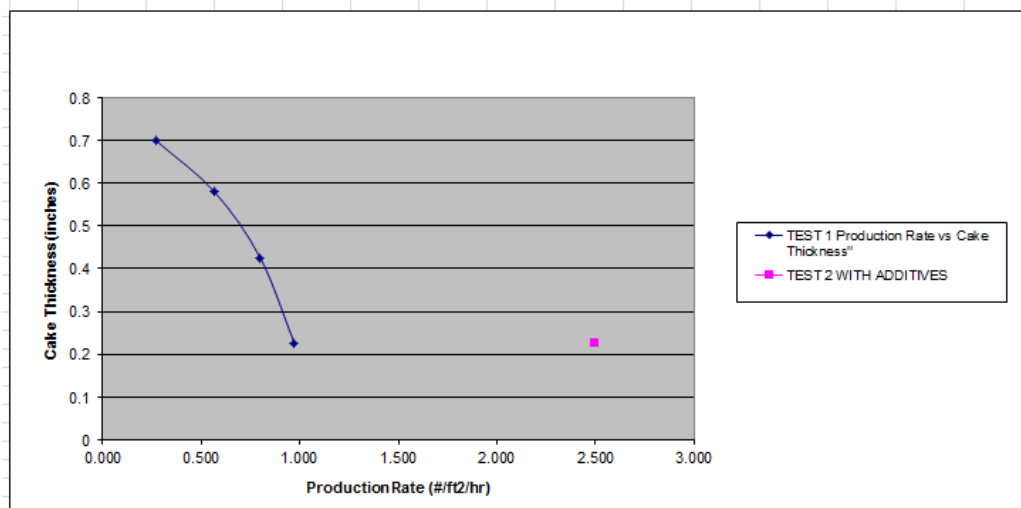
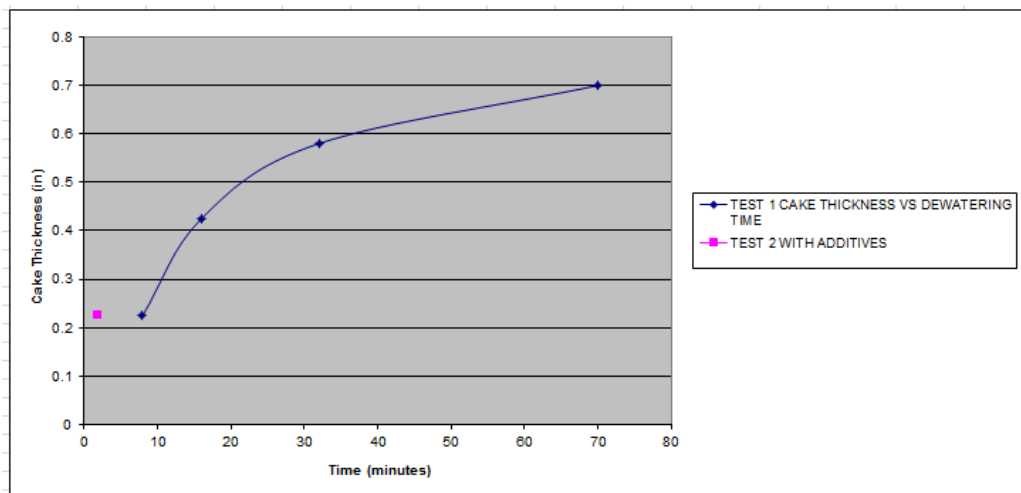
Delivers More
Operational Data

Lab Analysis (getting hands dirty).



TEST DATA – Vertical Tower Press

Customer:	CUSTOMER A			
Application:	SLUDGE DEWATERING			
Date:	5/7/2010		F/S # :	FREE
	T1	T2		T3
RUN #				
SLURRY QUANTITY (kg)	2.826	3.862		1.853
FEED SOLIDS (%)	2.28	2.25		3.27
WASH QUANTITY (g)				
SLURRY FEED TIME (MIN)	1.0	1.0		1.0
DEWATERING TIME	16.0	32.0		8.0
SQUEEZE TIME	2.0	2.0		2.0
AIRBLOW TIME	1.0	1.0		1.0
WASH FEED TIME	0.0	0.0		0.0
2nd DEWATERING TIME	0.0	0.0		0.0
2nd SQUEEZE TIME	0.0	0.0		0.0
2nd AIRBLOW TIME	1.0	1.0		1.0
DEAD TIME	3.5	3.5		3.5
TOTAL CYCLE TIME (MIN)	24.5	40.5		16.5
CYCLES / HOUR	2.45	1.48		3.64
CAKE HEIGHT (in.)	0.425	0.580		0.225
CAKE SOLIDS (%)	14.4%	14.2%		20.5%
WET CAKE Wt. (kg)	0.45	0.61		0.30
DRY CAKE Wt. (kg)	0.06	0.09		0.06
Lb. / sq. ft. / cycle	0.28	0.38		0.27
Lb. / sq. ft. / hour	0.70	0.57		0.97
	2000	143.5	176.4	102.8



Selected Applications in Power Plant Wastewater

- Gypsum Production (pure Calcium Sulfate)
- FGD Wastewater Sludge (Calcium Sulfate, Magnesium Hydroxide)
- ZLD Sludge (Salt Crystals, Hot)
- Physical Chemical Water and Wastewater Treatment Sludge (TSS and Hydroxide Sludge)
- Biological Water and Wastewater Treatment sludge (Slimy proteins/solids, must be conditioned to process)

What Drives Economics:

- Capital costs
 - Size of the application (Mass flow)
 - Materials of construction
 - Number of units/systems
 - Level of automation
 - Design basis, equipment availability
- Installed Costs
 - Support infrastructure
 - Buildings/Structures
 - Belt wash pumps/feed pumps
 - Piping, valves
- Operating Costs
 - Operational Labor
 - Polymer or chemical treatment
 - Cost of utility (wash water, electricity)



Level of Automation

	Belt Filter Press	Recess Chamber Press	Vacuum Belt Press	Vertical Tower Press
APPLICATIONS				
Gypsum Production			Automatic	Automatic
FGD Wastewater Treatment Sludge	Automatic	Semi-Manual	Automatic	Automatic
ZLD Salts				Automatic
Physical Chemical Water and Wastewater Treatment Sludge	Automatic	Semi-Manual		
Biological Water and Wastewater Treatment Sludge	Automatic	Semi-Manual		

Water conditioning – Polymer/chemical addition

	Belt Filter Press	Recess Chamber Press	Vacuum Belt Press	Vertical Tower Press
CHEMICAL CONDITIONING				
Gypsum Production			None	None
FGD Wastewater Treatment Sludge	Polymer	None	None	None
ZLD Salts				None
Physical Chemical Water and Wastewater Treatment Sludge	Polymer	None		
Biological Water and Wastewater Treatment Sludge	Polymer & Lime	Polymer & Lime		

Economics – Capital Costs (Linear with Pressure Gradient and level of automation) (low to high)

- 1) Belt Filter Press (0 psi + Wedge)
- 2) Vacuum Belt Filter (low vacuum P)
- 3) Recessed Chamber Press (Feed pump + Membrane)
- 4) Vertical Tower Filter Press (Feed pump, Air Dewater, + Membrane)

Economics – Installed Cost(Dependent on Equipment Size, Quantity of units, and Ancillary processes) (low to high)

- 1) Vertical Tower Filter Press (single unit, small footprint, built in capacity, short cycle times)
- 2) Belt Filter Press (many units)
- 3) Vacuum Belt Filter (many units,)
- 4) Recessed Chamber Press (many units, long offline cycle times, large footprint)

Economics – Operating Cost (Dependent on labor, utility) (low to high)

- 1) Vertical Tower Filter Press (fully automated)
- 2) Vacuum Belt Filter (much wash water)
- 3) Belt Filter Press (much wash water, polymer)
- 4) Recessed Chamber Press (will require manual attention, polymer)

Possible Best Practices – But Every Application can have nuance

	Belt Filter Press	Recess Chamber Press	Vacuum Belt Press	Vertical Tower Press
APPLICATIONS				
Gypsum Production			+++	+++
FGD Wastewater Treatment Sludge	++	+++	+	++
ZLD Salts				+++
Physical Chemical Water and Wastewater Treatment Sludge	+	+++		++
Biological Water and Wastewater Treatment Sludge	+++	+++		

Summary



- Every Application is unique, no one piece fits all.
- Equipment selection is driven by many factors.
- Factors (economics/regulations) can change over time, leading to equipment changes/process optimizations.
- The only method to optimize is to conduct pilot trials/dewatering studies.
- End users, engineering companies, equipment companies will need to work together to develop and optimize processes and equipment.
- Questions? Comments?

References:



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