Solids Dewatering Modernization

Replacing Plate & Frame Press Dewatering with Centrifuge at a Food Production Plant

NEWEA Annual Conference, January 25, 2016

Carl Wilcox, P.E., Partner, Woodard & Curran, Inc.

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Facility Description

- The gelatin plant operates a pretreatment system.
- pH Neutralization and primary clarification dating to the 1960s and 1970s.
- A dissolved air flotation system installed in 1989 for FOG removal.
- DAF float and primary solids (lime solids) shipped as slurry no on-site dewatering.
- 1996 secondary treatment commenced.
- 1996 two plate and frame presses installed to dewater DAF float and WAS.

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Wastewater Solids Produced

3 Waste Solids

1. **DAF Float – Is Dewatered in Press**
   - 4 to 6% solids, 14 to 30% FOG, the remaining solids are organic protein, very high nitrogen.
2. **Waste Activated Sludge – Is Dewatered in Press**
   - 3% to 12% solids, **volatile solids** range 22% to 72% **averages 43%, SVI averages 26**, max 76, inerts are from calcium carbonate and calcium phosphate
3. **Lime Slurry – Is Not Dewatered**
   - 12 to 14% solids, spent $Ca(OH)_2$ pH ~12, very sticky, high TDS, high organic nitrogen.

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Plate & Frame Press Pros & Cons

PROS

- Can dewater nearly everything thrown at it.
- Produced a cake of 25% to 39% with a 31.6% average solids.
- Very clean filtrate with little to no solids recycle.

CONS

- Very labor intensive, 12-hours labor per day, 7-days per week. 6 pushes/press/day, total of 12 pushes per day with a goal of 84 per week.
- Plant was dewatering bottlenecked. Could dewater 12 to 14 dry tons/day.

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Plate & Frame Press Cons

CONS

- High maintenance and operating cost for air diaphragm feed pumps. Once every 2-weeks needed to clean clothes for a shift.
- Precoat needed with high coagulant dose.
- High chemical costs that also result in more sludge shipped. 13% of solids shipped are dewatering chemicals.
- Insufficient dewatering capacity resulted in DAF float needing to be shipped as a slurry.

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Plate & Frame Press Cons

CONS

- Accumulated DAF float quickly turns ripe.
- Neighborhood odor complaints.
- Wet sloppy process - building corrosion.
- Insufficient dewatering capacity led to high mixed liquor solids, 50,000 mg/l, high aeration costs, secondary clarifier drive failure, odor complaints.
- Dewatering labor requires treatment staff labor 24 hours/7 days a week for facility that could otherwise be staffed 12-hours per day.

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Plate & Frame Press Cons

CONS

- Repetitive motion injury from scraping plates clean. One operator needed surgery to both palms. He was out on disability and light duty for months.

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Project Requirements

1. Reduce Dewatering and Disposal Costs.
2. Achieve a 3 –year project payback or better.
3. Need to maintain dewatering during construction.
4. Change from 30-CY roll-offs with 20-ton capacity to trailers with 32-ton capacity to receive dewatered cake, to allow more disposal competition and better pricing.
5. Raise second floor to provide more than the existing 10’-9” clearance for trailers.
6. Lengthen building to allow 42-foot trailers to replace the 28-foot roll-offs.

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Project Requirements

7. Replace existing building MCC that is on second floor with new MCC in an electric room. New Owner policy.
8. Must separately dewater lime slurry, DAF float, and waste activated sludge.
9. DAF float must be dewatered to >19% solids.
10. Reduce odors.
11. Have room for second centrifuge.

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Project Requirements

12. During design, dewatering of lime slurry was dropped.

    The existing and selected solids disposal company is set up to land apply the lime slurry as a slurry. A lime cake would require significant equipment expenditures and the high pH $Ca(OH)_2$ cake solids could burn vegetation. They would increase their disposal price if the lime sludge was dewatered.

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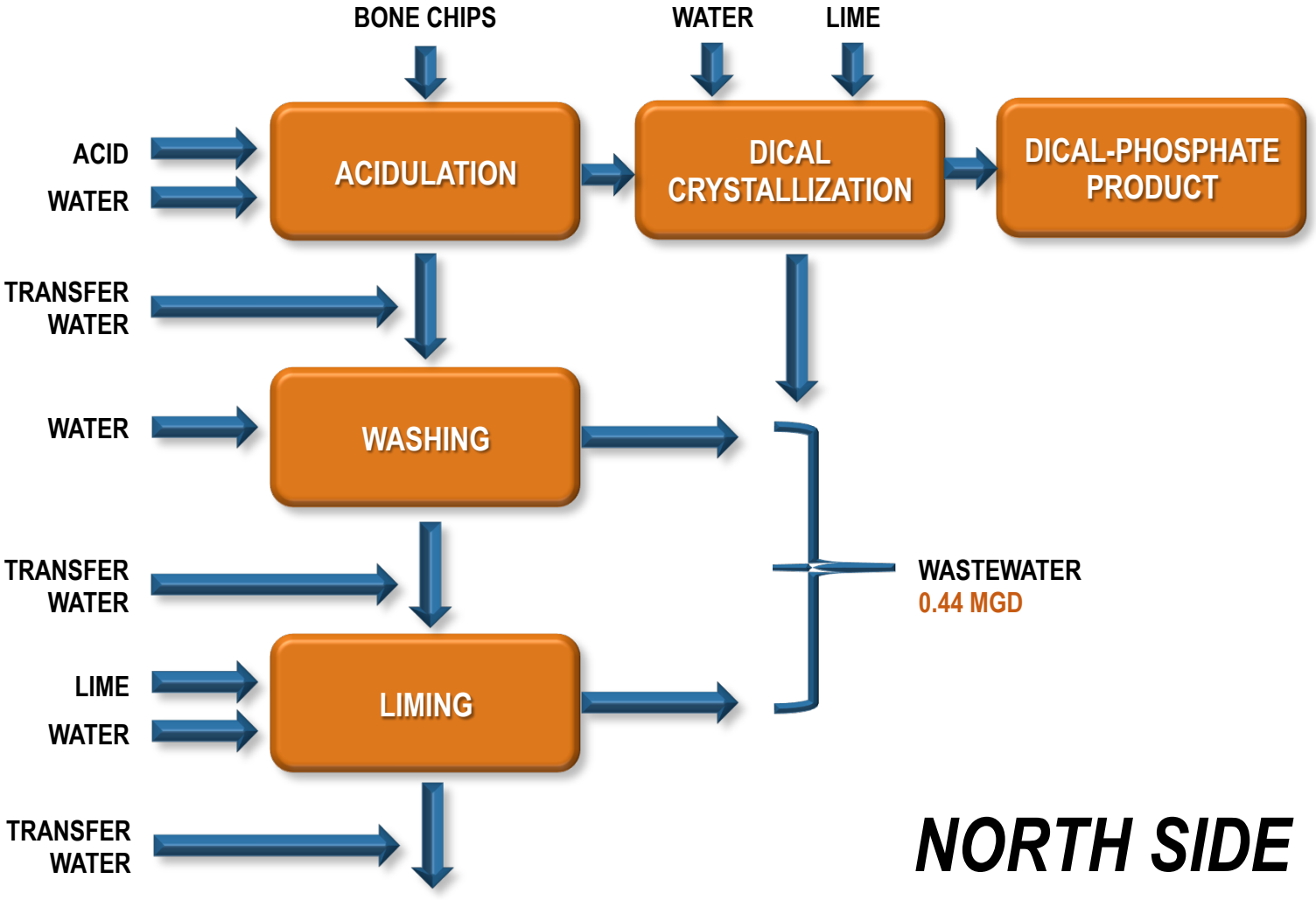
Gelatin Process Flow Chart



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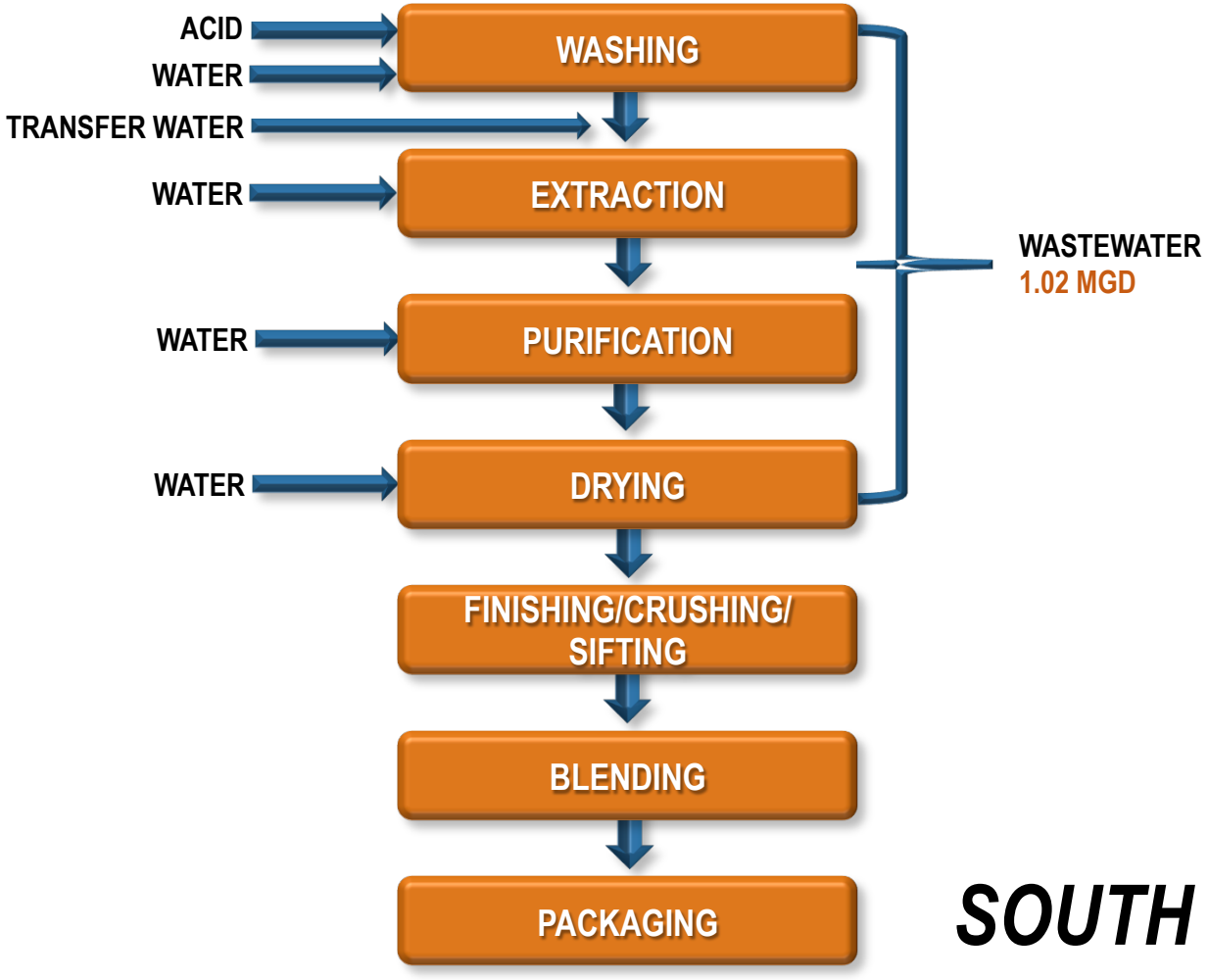
Gelatin Process Flow Chart



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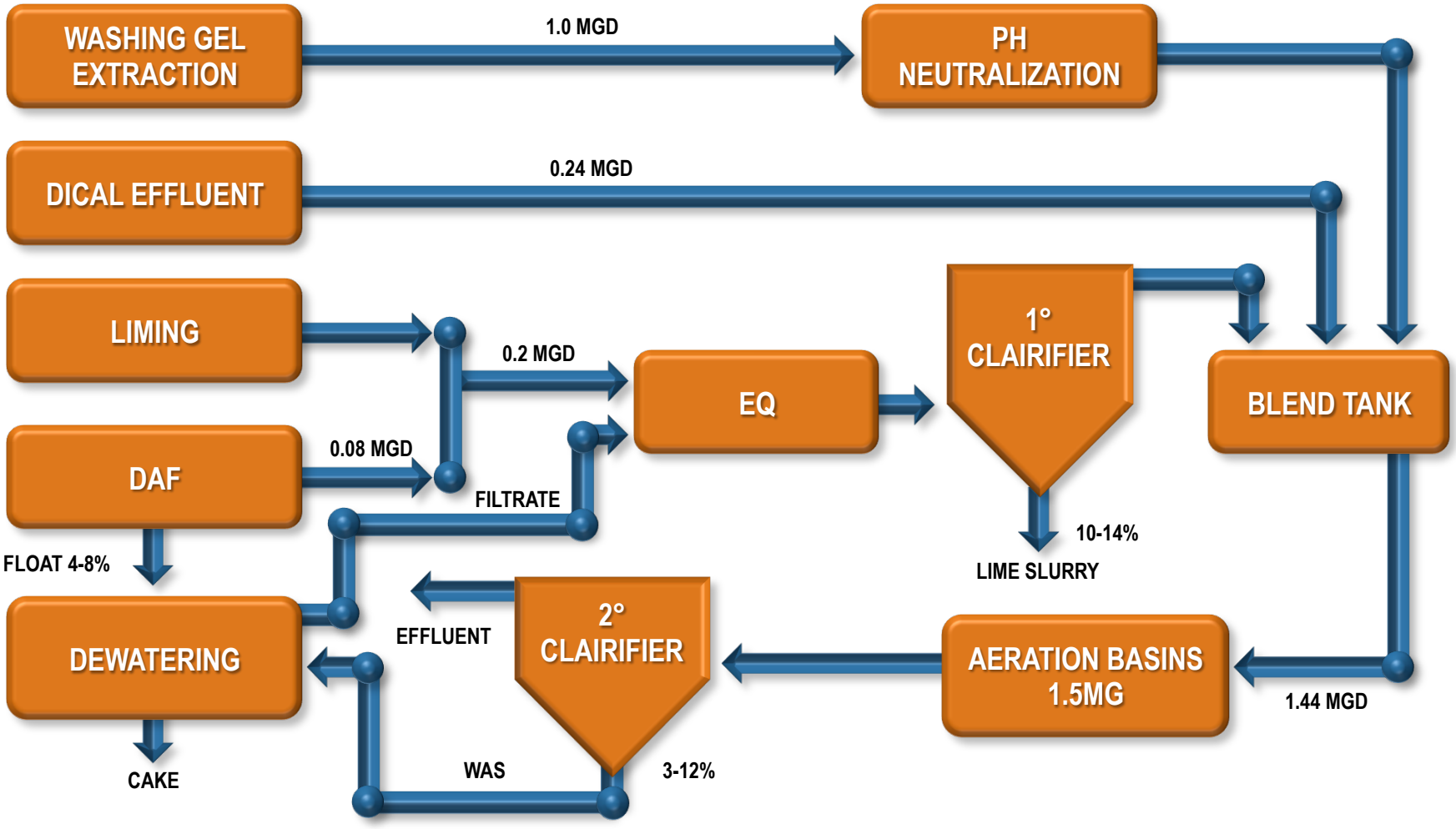
SOUTH SIDE

Wastewater Pretreatment PFD



Centrifuge Pilot Test Results

- 3-1/2 Day pilot test with Centrisys 10-inch machine.
- Average pilot results.

Waste Solid	Feed Solids %	Active Polymer lb/DT	Cake Solids %	Solids Recovery %
WAS	4.7	10.6	38	99.3
DAF Float	5.0	7.0	22	98.1
LIME Slurry	5.6	13.7	37.6	87.3

Lime slurry was diluted to be pumpable by pilot equipment

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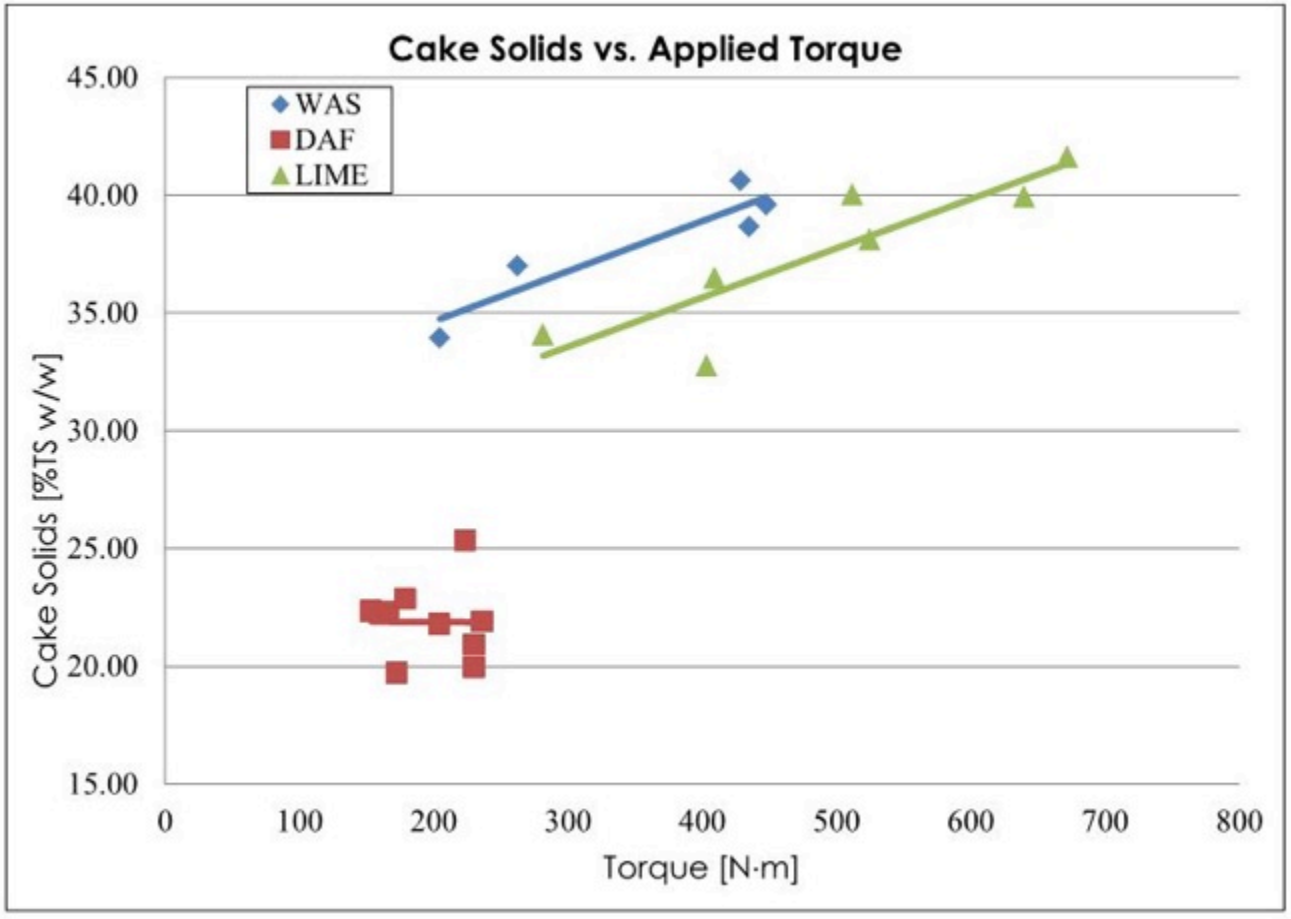
Pilot Centrifuge Torque Curves



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Sticky Gel Lime Slurry - Video

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Solids Disposal Cost w/Press

Solids Source	Feed % Solids Range	Produced DT/Yr	Shipped WT/Yr	Annual Disposal Cost $
WAS	3 to 12	3,540	11,200	$470,000
DAF to Press	4 to 8	390	1,230	$52,000
DAF Float to Truck	4 to 8	97	2,420	$102,000
Dewatering Chemicals		510	1,600	$67,000
Lime solids	12 to 14	819	6,300	$139,000
Total			**21,780**	**$830,000**

Dewatered solids hauling and disposal @ $42/wet ton and 31.6% cake solids.
Lime slurry hauling and disposal @ $22/ wet ton

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Solids Disposal Cost w/Centrifuge

Solids Source	Feed % Solids Range	Produced DT/Yr	Shipped WT/Yr	Annual Disposal Cost $
WAS	3 to 12	3,540	9,440	$340,000
DAF to Centrifuge	4 to 8	487	1,300	$47,000
DAF to Truck	4 to 8	0	0	$0
Dewatering Chemicals		36	96	$3,500
Lime solids	12 to 14	870	6,690	$147,000
Total			**17,500**	**$538,000**

Dewatered solids hauling and disposal @ $36/wet ton and 37.5% cake solids
Lime slurry hauling and disposal @ $22/ wet ton

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Operating Cost Comparison

	Plate & Frame Operating Cost $/DT	Centrifuge Operating Cost $/DT
Chemicals	$151.51	$60.96
Maintenance	$14.36	$6.23
Power	$4.29	$8.33
Labor	$40.29	$13.10
Centrate TSS Recycle Cost	NA	$2.60
Total	**$210.45**	**$91.22**

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Dewatering Cost Comparison

	Plate & Frame Operating Cost / Yr	Centrifuge Operating Cost / Yr
Cake Disposal	$42/WT	$36/WT
Cake Solids	31.6%	37.5%
Cake Shipped WT/Yr	14,030	10,840
DAF Slurry Shipped WT/Yr	2,420	0
Lime Slurry Shipped WT/Yr @ $22/WT	819	870
Disposal Costs Cake & Slurry	$830,000	$538,000
Operations & Maintenance	$934,000	$371,000
Total Disposal and O&M	**$1,764,000**	**$909,000**

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Realized Centrifuge Benefits

- Annual Savings on Disposal and O&M $855,000/Yr.
- All DAF float is dewatered as it is produced.
- Odor is much reduced in the buildings.
- Building is much dryer and less corrosive environment.
- Aeration basin mixed liquor has been reduced to 7,000 mg/l instead of its typical 20,000 to 25,000 mg/l.
- Lower aeration cost due to lower SRT age.

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Realized Centrifuge Benefits

- Waste activate sludge solids reduced from 8% to 12% to current 4% solids.
- Lower torque on clarifier drive – reduce potential for drive failure and odor catastrophe.
- Dissolved oxygen in aeration basins is higher with less odors.
- Much lower labor required. Operators are available to do other plant tasks such as operate the DAF.

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Equipment Utilized

- Owner pre-procured the equipment.
- Centrisys CS21-4HC skid unit – 21” machine with a 4.5:1 bowl ratio. 1 dry ton/hour capacity.
  - On the skid is a Velodyne polymer unit and the system control panel.
  - Off the skid, though supplied by Centrisys, is a Borger grinder and Netzsch progressive cavity feed pump.
- Spirac Shaftless Spiral Conveyors.
- Rubb fabric building to house roll-off for odor containment during construction dewatering.

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Construction Bidding

- Owner bid to three trades: mechanical, electrical, and building structural/site work contractors that do work at the plant with Owner to GC.
- Owner also bid to general contractors that would do the project in its entirety.
- The lowest GC bid was $1.97 million.
- The sum of the three trades was $1.2 million.
- The Owner acted as GC and saved $770,000.

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Building Before Addition

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Roof Blower Corrosion System Photos

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Upstairs Twin Presses

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Upstairs Old Exposed MCC

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Location of Future Electric Room

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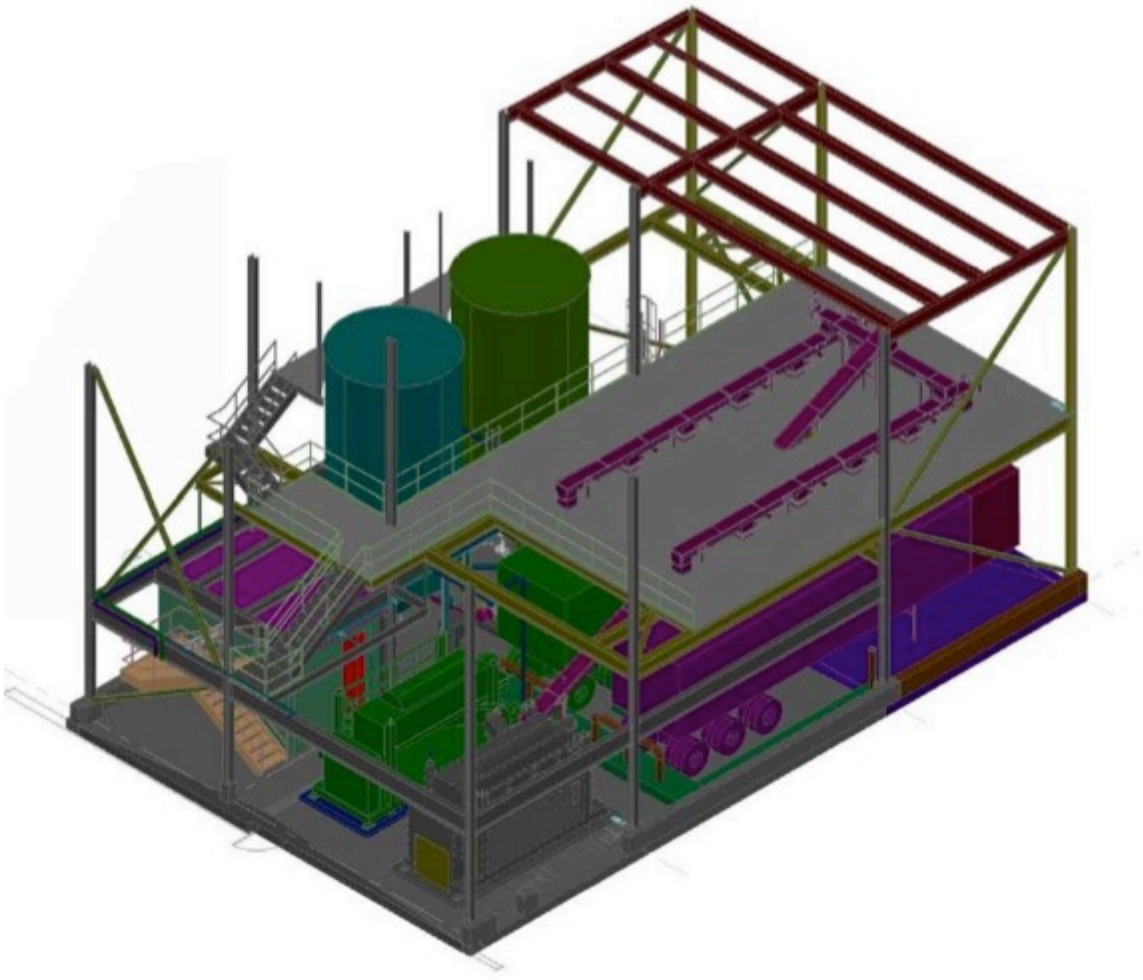
3D CAD Model Used for Design



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Electric Room Construction

Permanent Electric Room Constructed while
Plate & Frame Dewatering Continues

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Pumping to Construction Dewatering

Grinder and Centrifuge Feed Pump Installed
Between Press Feed Pumps and Piping

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Dewatering During Construction

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Odor Control During Construction

Rubb Building to House Sludge Cake Roll-Off with Biofilter

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Permanent Installation

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Loadout Conveyors

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Centrifuge Installation

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32% Solids Cake

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Start Up

- Started with very high WAS solids 12% and low volatile solids.
- Too gung-ho on making dry cake. Achieved 48% cake solids. Plugged the centrifuge discharge ports.
- Flocculant supplier chemistry did not work as well as flocculant used in pilot. Changed to another supplier. Floc strength improved. Centrate solids much lower.

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Start Up

- Very variable dissolved solids in waste stream.
- A few weeks after startup, south side of production plant was off-line for maintenance. Only the acidulation and liming processes were on line.
- TDS of centrifuge feed was ~100,000 mg/l, nearly 3X higher than sea water.
- High TDS was neutralizing the flocculant. Only 60% solids recovery. Machine running poorly.
- Diluted the sludge with plant water to lower TDS to 50,000 mg/l. Greatly improved solids recovery.

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Start Up

- With plant production fully back online, sludge TDS has reduced to 6,600 mg/l. Sludge is no longer being diluted with water to lower the TDS.
- Centrifuge was consistently producing 37% to 38% cake at a 12% DAF float to 88% WAS solids blend.
- With greater sludge dewatering capacity, the aeration basin MLSS has dropped from 25,000 mg/l to 7,000 mg/l with increase in volatile solids.
- Dewatered cake has recently lowered to 32% solids. Believed to be due to higher volatile solids in WAS.

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Conclusions and Steps Forward

- The project came in $10,000 under the its $2.6 million budget. At current operating costs, the project payback is 3.0 years
- Higher flocculant dose results in $120,000 in higher dewatering cost than pilot test.
- If the flocculant dose can be reduced to what was achieved in the pilot, the project will have a 2.7 year payback.
- Lengthening the building by 23-feet and raising the second floor to allow trailers, allowed more disposal competition. Resulted in 15% lower wet ton disposal cost.

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Conclusions and Steps Forward

- This reduces the disposal cost by $65,000/yr.
- With the exception of higher than anticipated polymer use, the project has met all of the Owner's objectives and expectations.
- The project has exceeded the Owner's expectations regarding odor reduction.

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Conclusions and Steps Forward

- Now, with sufficient dewatering capacity, the Owner wants to use waste lime slurry in their neutralization basin. Previously, waste lime added too much solids to the aeration basins and dewatering could not keep up.
- Currently, they spend up to $100,000 per year on virgin lime for neutralization and $139,000 per year on waste lime slurry disposal.
- Total potential savings by using waste lime slurry for neutralization, $239,000/yr minus added aeration cost and added biomass disposal from high protein in waste lime slurry.

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THANK YOU!

QUESTIONS?

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