



Spring
Biosolids
Symposium
3/22/2015

Removing Phosphorus from Biosolids: AirPrex® Pilot Results from the Fond du Lac WWTP

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Fond du Lac Wastewater Facility



Fond du Lac Wastewater Facility

- 9.84 MGD Design (2015 average – 6.89 MGD)
- Co-thickening Primaries
 - WAS
 - Primary
- Single-stage nitrification
 - Denitrification
 - Chem Phos Removal (Alum)
 - Biological Phos Removal 50% of the time
- Anaerobic Digestion
 - TPAD
 - HSW Co-digestion
 - Centrifuge (26.5% Cake Solids)



Struvite



Struvite



- Magnesium Ammonium Phosphate (MgNH_4PO_4)
- 12.7% Phosphate – P and 5.7% Ammonia - N

What do we do – that Causes Struvite Formation

- Biological Phosphorus Removal

- Anaerobic Digestion



- High Strength Waste (HSW) Addition

- Phosphorus concentrations of 800 mg/L +



Anaerobic Digestion



Digestion:	2 Thermophilic (130°F) and 2 Mesophilic (95°F)
Tank Dimensions:	4 @ 65ft dia, 30ft SWD
Types of Covers:	2 fixed covers, 2 gas holding spiral floating cover
Types of Mixing:	Centrifugal horizontal chopper pumps & nozzles
Treatment Volume:	2,754,000 gal. or 368,156 cubic feet

High Strength Waste Addition

Monday through Friday

- VS: 11,116 lbs/day
- COD: 15,710 lbs/day
- Total Phos: 159 lbs/day

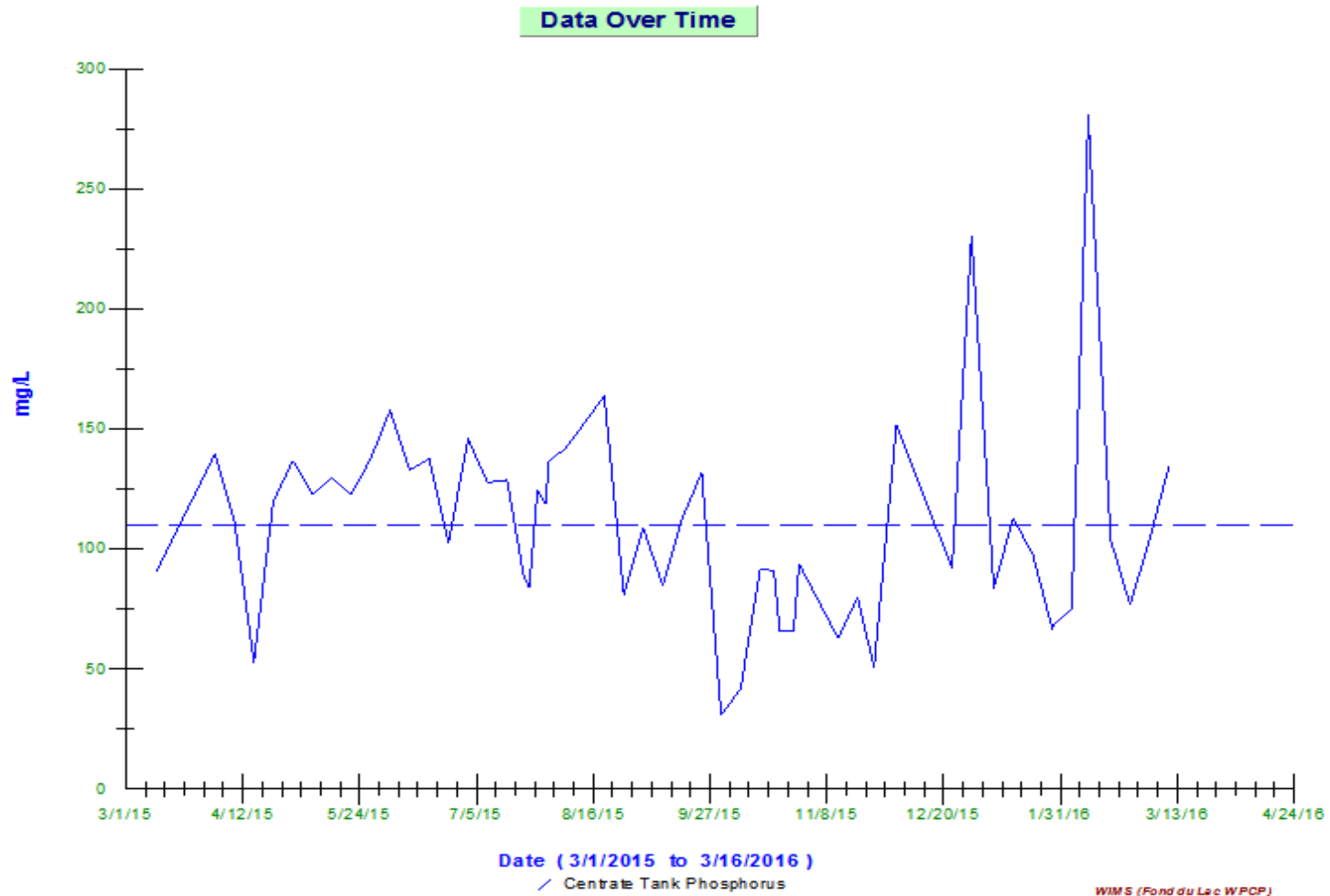
Saturday and Sunday

- VS: 8,804 lbs/day
- COD: 11,572 lbs/day
- Total Phos: 120 lbs/day



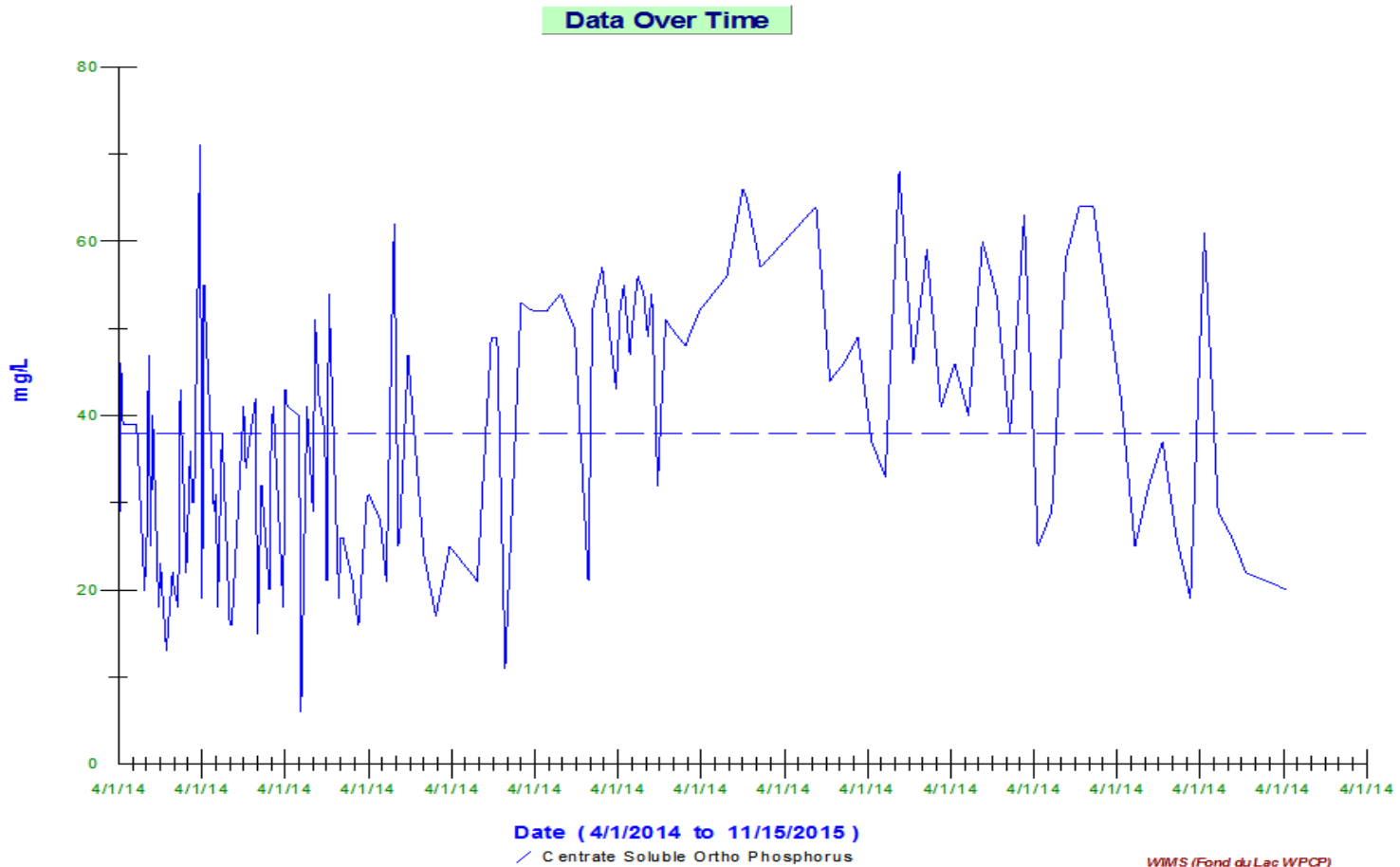
Side-stream (Recycle/Centrates) Total Phosphorus

- Total Phosphorus (ave) - 110 mg/L



Side-stream (Recycle/Centrates) Soluble Ortho-P

- Soluble PO₄-P (Reactive P) – 48 mg/L



Benefits of Producing_(controlled) and Harvesting Struvite

- Chemical savings
- Reduces solids production due to chemical P removal
- Reduces sidestream loadings – helps bio-P
- Achieves lower biosolids P content (more land application opportunities)
- Potential revenue source
- Minimizes maintenance and downtime due to nuisance struvite formation

Struvite Recovery Technologies

■ Ostara

- Centrate or Filtrate
- Fluidized bed reactor
- 80-90% P recovery and 10-40% NH₃-N recovery

■ Multiform Harvest

- Centrate or Filtrate
- Fluidized bed reactor
- 80-90% P recovery and 10-40% NH₃-N recovery

■ Crystalactor

- Centrate or Filtrate
- Fluidized bed reactor
- 85-95% P recovery and 10-40% NH₃-N recovery

■ Phospaqa

- Centrate or Filtrate
- Completely stirred tank reactor with diffused air
- 80% P recovery and 10-40% NH₃-N recovery

■ NuReSys

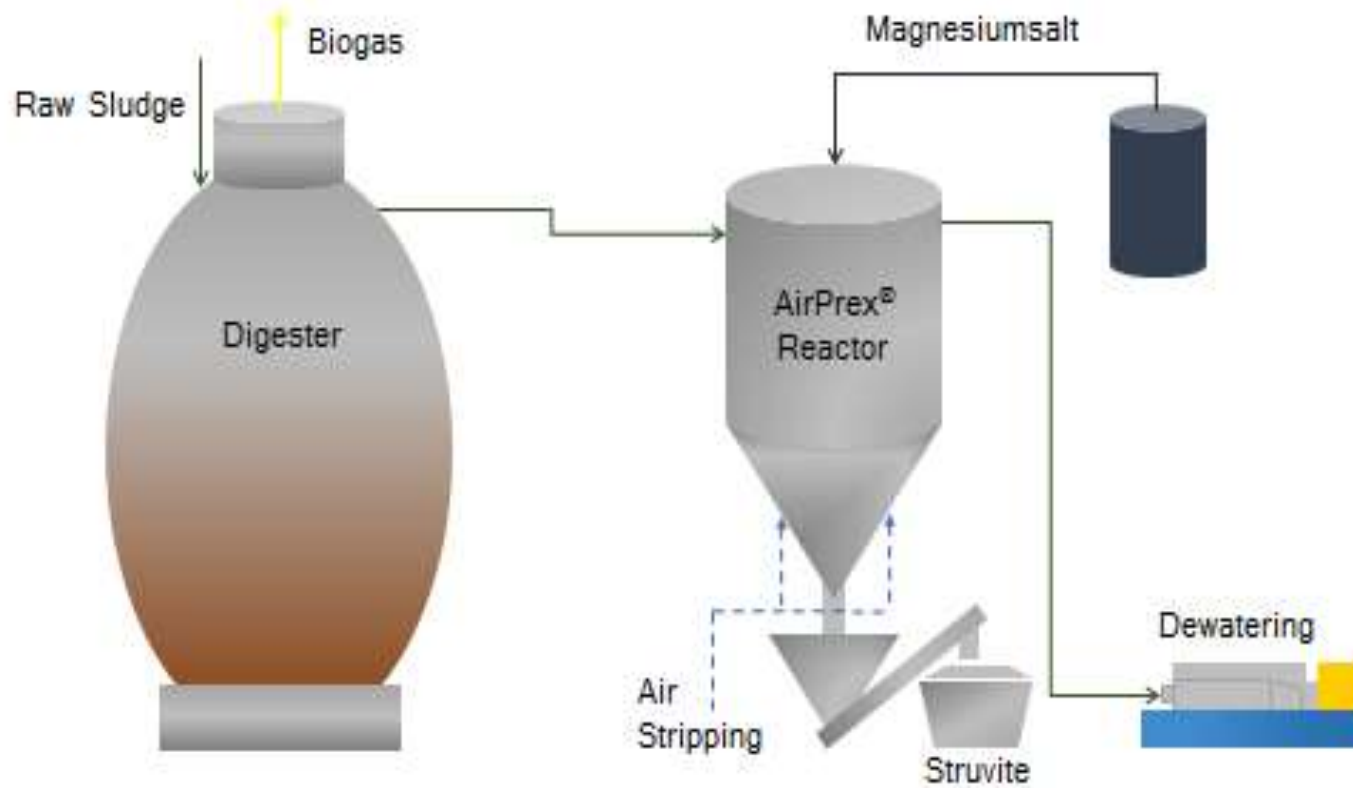
- Centrate or Filtrate
- Completely stirred tank reactor
- >85% P recovery and 5-20% NH₃-N recovery

■ AirPrex

- Digested sludge
- Completely stirred tank reactor with diffused air
- 80-90% P recovery and 10-40% NH₃-N recovery

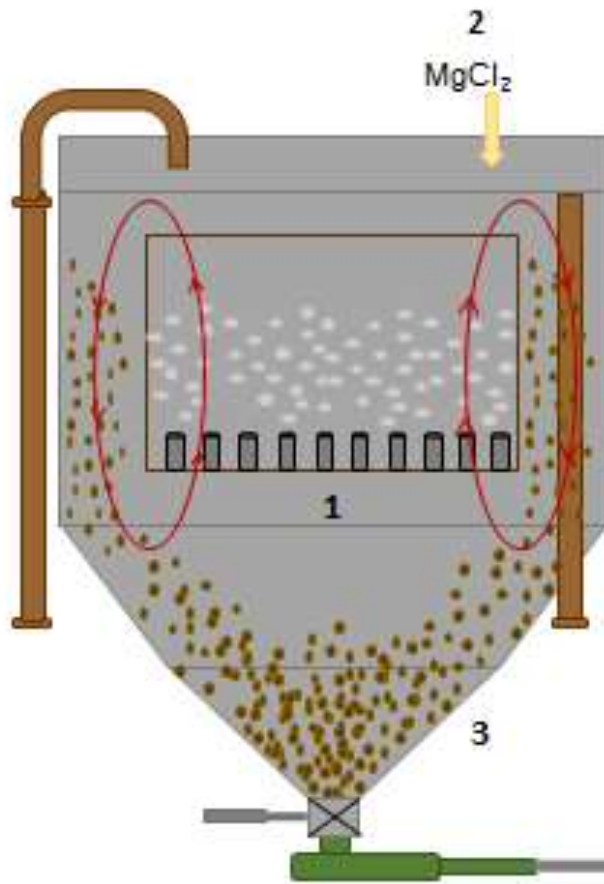
AirPrex[®]

AirPrex[®] - Process Overview



AirPrex[®]

AirPrex[®] - Process Overview



1. Aeration to strip CO₂ out + recirculate sludge
2. Addition of Magnesium Chloride (MgCl₂)
3. MAP- Crystallisation and sedimentation
4. MAP- Separation and washing

Why did Fond du Lac look at AirPrex®

- High Phosphorus content in HSW (0.04 mg/L effluent phos limit)
- Reduction in unwanted struvite formation (lower maintenance costs)
- Potential lower polymer usage (improve dewatering performance)
- Increase cake % solids (lower hauling costs)
- Want to go away from chemical phosphorus removal and move towards 100% biological removal (lower chemical phosphorus removal costs)
- Ammonia reduction (possible energy savings and better for Bio-P)

Why did Fond du Lac look at AirPrex®

■ Curiosity

- Created struvite crystals in prior experience in anaerobic digesters and harvested it (but not easy)
- Wanted to know if struvite crystals can be removed out of 1.5% solids





Soluble Ortho-Phosphorus – Reactive P

- **Fond du Lac WWTP** Soluble PO₄-P (in our digested sludge)
 - 60 mg/L
- **Ideal** Soluble PO₄-P range
 - 150 mg/L +



Soluble Ortho-Phosphorus Analysis

- **Particulate**
 - Species retained by a 0.45 μm filter
- **Soluble/dissolve/filterable**
 - Passes through a 0.45 μm filter
- **Difference in methods/options**
 - Vacuum filtration
 - Syringe filtration
- **Difficulties in sampling**
 - Dirtier the sample, longer the filtration takes
 - Centrifuge prior to filtration
 - At times – pre filtering necessary with a 1.5 μm filter (TSS filter pad)
- **Analysis**
 - Syringe filtration
 - Ascorbic acid
 - Spectrophotometry





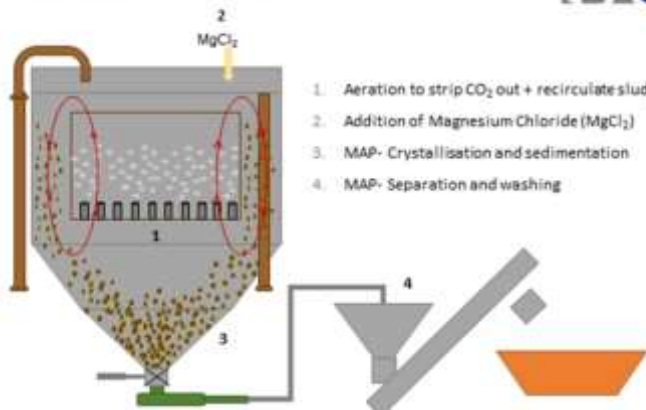


Pilot Trailer and Reactor



Pilot Reactor

AirPrex® - Process Overview



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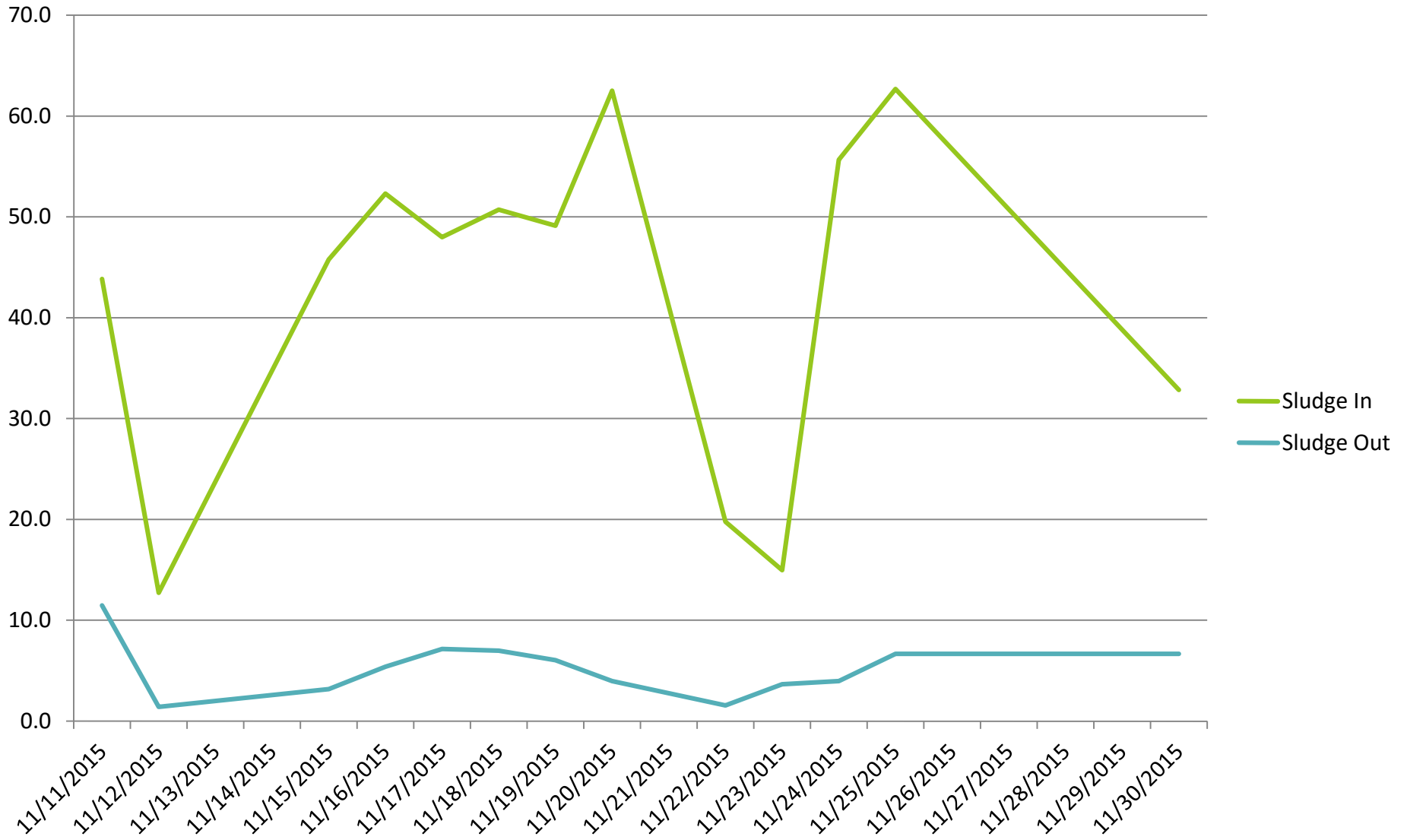
Struvite Crystals



Pilot Results

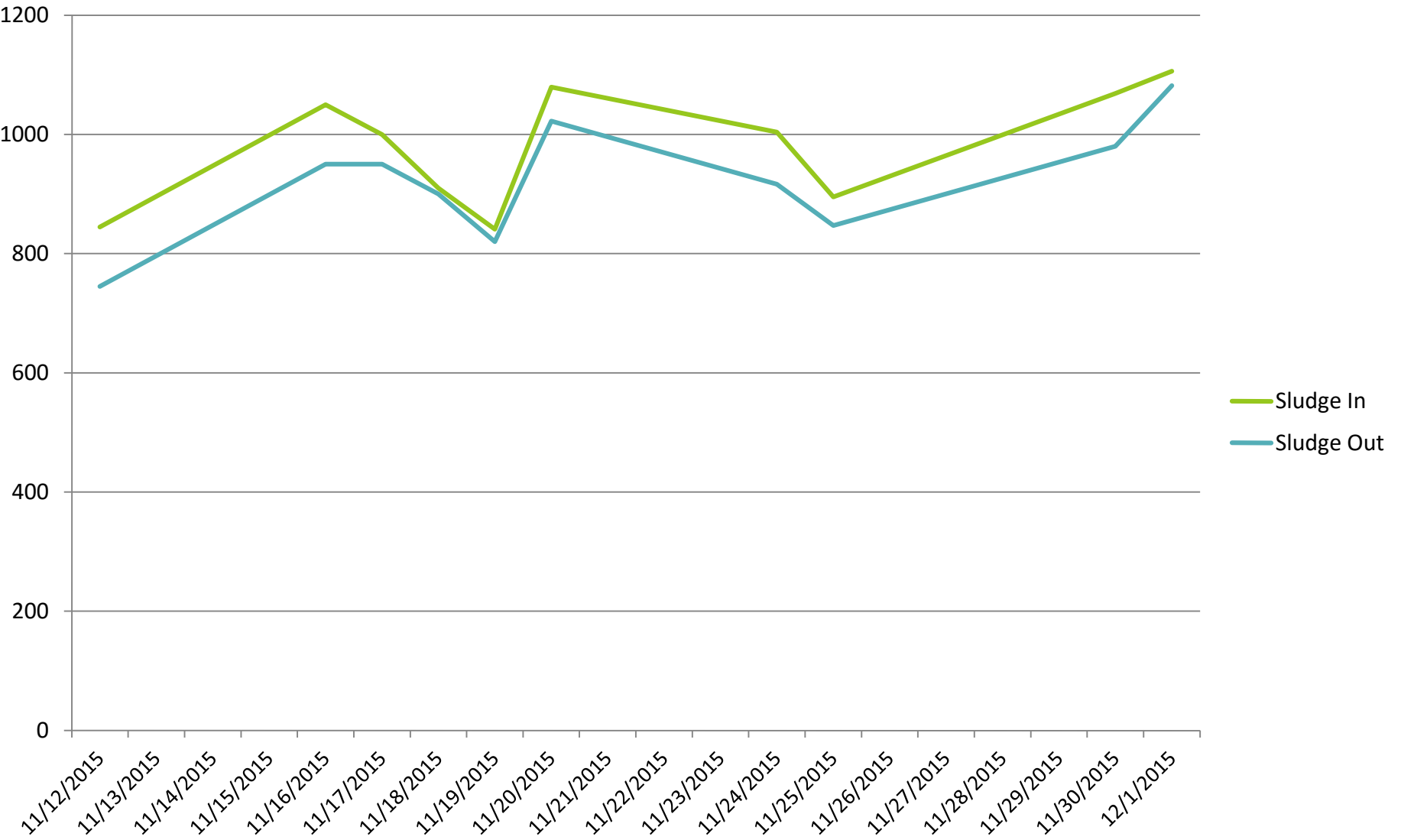
- Soluble PO₄-P (Reactive P)
 - 41.8 mg/L average in
 - 5.4 mg/L average out

Soluble Reactive P Reduction



Average 87% Removal

Ammonia Reduction



Average 4 % Removal

Pilot Centrifuge



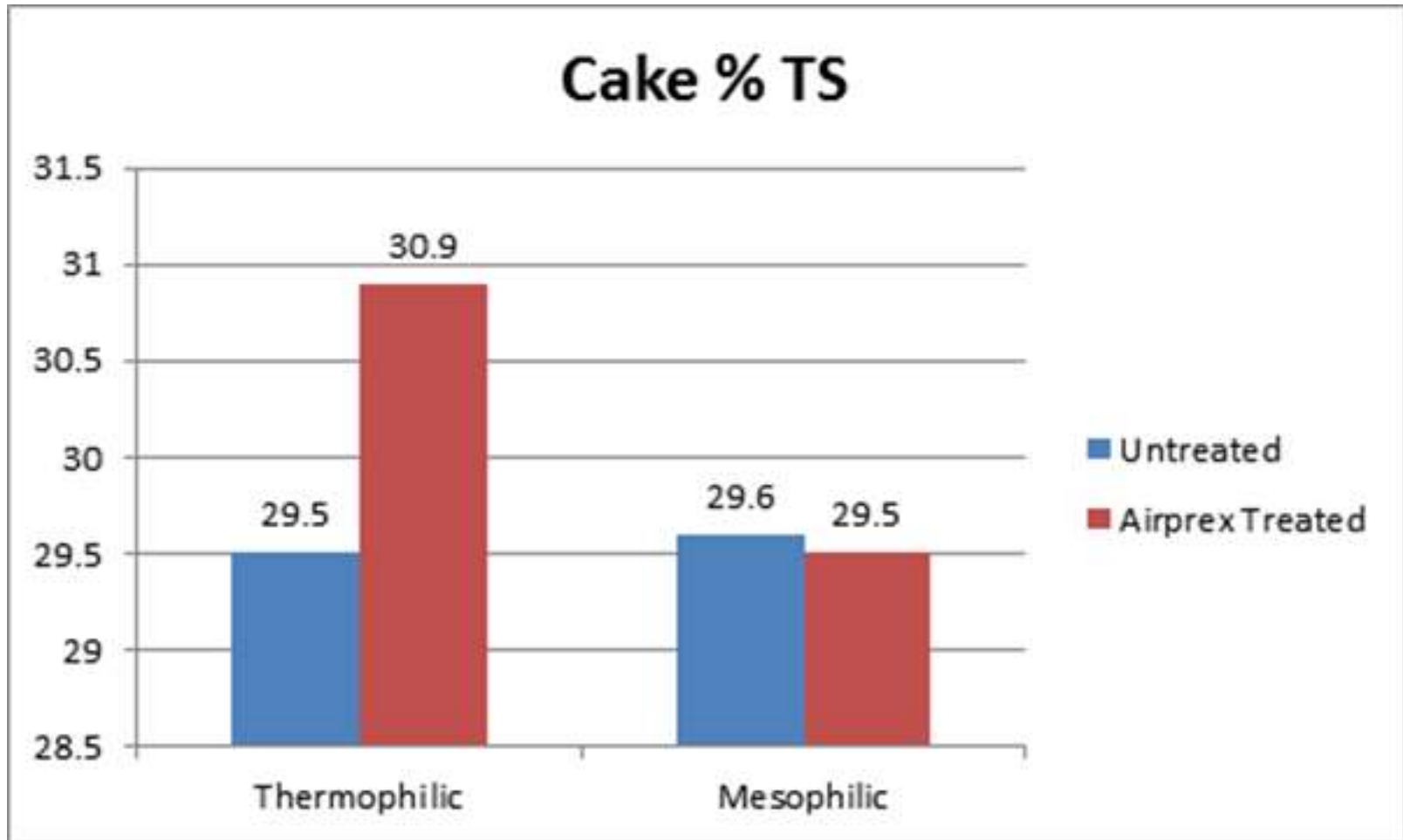
Pilot Centrifuge



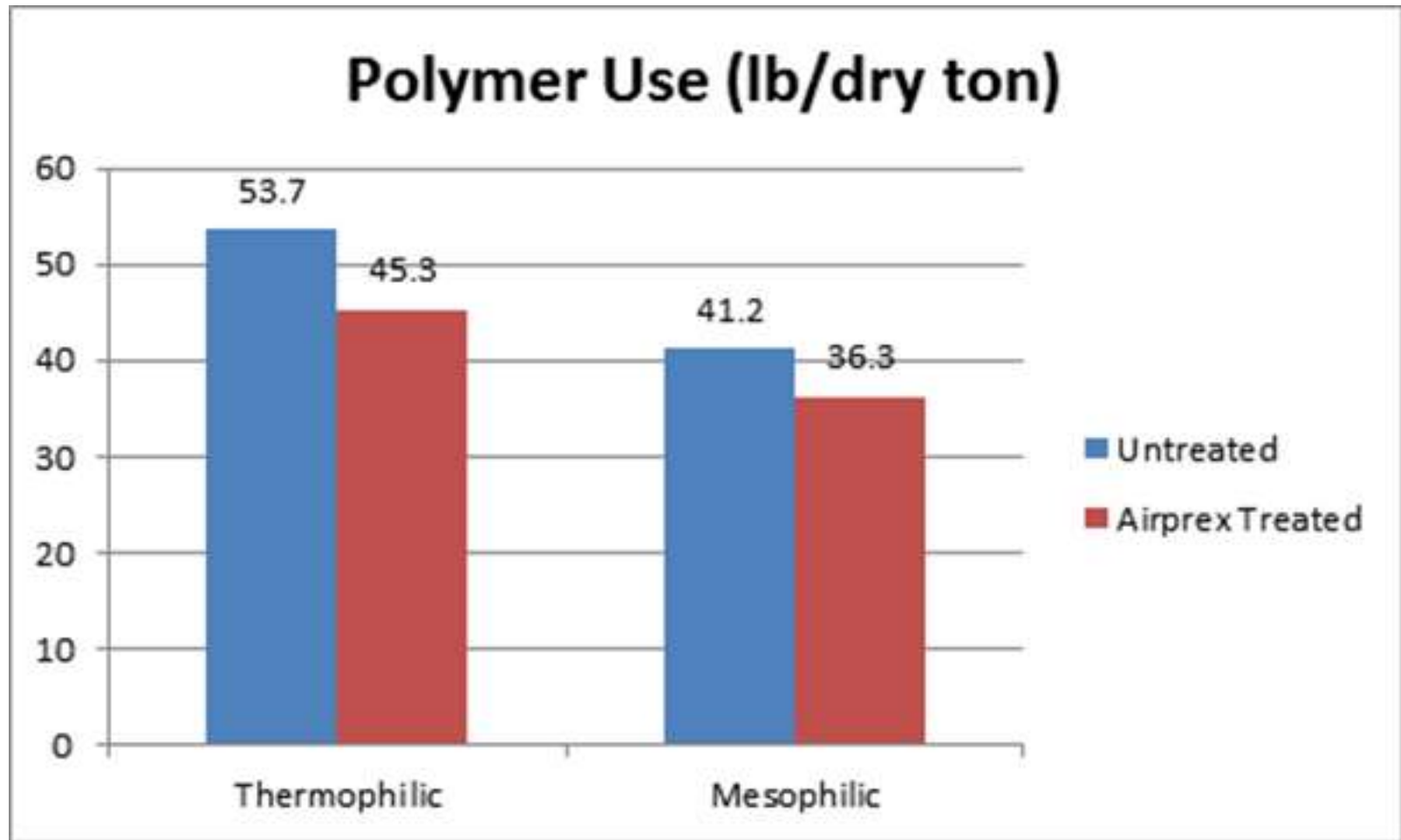
Pilot Centrifuge Results

- Thermophilic (ave results)
 - Cake Solids - 29.5% TS
 - **AirPrex Treated** Cake Solids – 30.9% TS
 - Active Polymer Dose – 53.7 lb/dry ton
 - **AirPrex Treated** Polymer Dose – 45.3 lb/dry ton
- Mesophilic (ave results)
 - Cake Solids – 29.6% TS
 - **AirPrex Treated** Cake Solids – 29.5 % TS
 - Active Polymer Dose – 41.2 lb/dry ton
 - **AirPrex Treated** Polymer Dose – 36.3 lb/dry ton

Pilot Centrifuge Results



Pilot Centrifuge Results



Future



Thank You!

- Questions?

