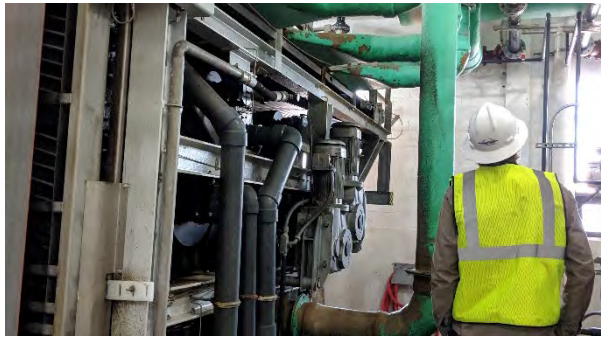
January 2020

An innovative approach to dewatering performance issues at Gresham, OR



Brown AND Caldwell

Christopher Muller
540-558-82085
cmuller@BrwnCald.com

Brown AND Caldwell

Tim Mills
503.977.6621
tmills@company.com

CITY OF GRESHAM OREGON

Michael Nacrelli
Michael.nacrelli@greshamoregon.gov

AGENDA

1. Acknowledgements
2. Overview of Gresham's Challenge
3. Dewatering principals: Did they answer the questions we have?
4. Overview of Orege
5. Trial design and results
6. Conclusions
7. Questions

ACKNOWLEDGEMENTS

Tim Mills, Portland, OR

John Willis, Atlanta, GA

Mike Nacrelli, Gresham, OR

Ron Gillenardo, Gresham, OR- Jacobs

Eddie Johnson

Armin Madani

Clémentine Justier

Gresham wastewater treatment plant

QUICK FACTS

Average Flow: 13 MGD

Population Served: 114,000

Area Served: City of Gresham, City of Fairview, City of Wood Village

Primary and Secondary Treatment

Class B Biosolids from Anaerobic Digestion

Reclaimed water production

2015 Energy Neutral (electrical)

- 420-kW Solar Panels
- FOG Receiving (30,000 gpd capacity)
- 2 400 kW Engine Generators

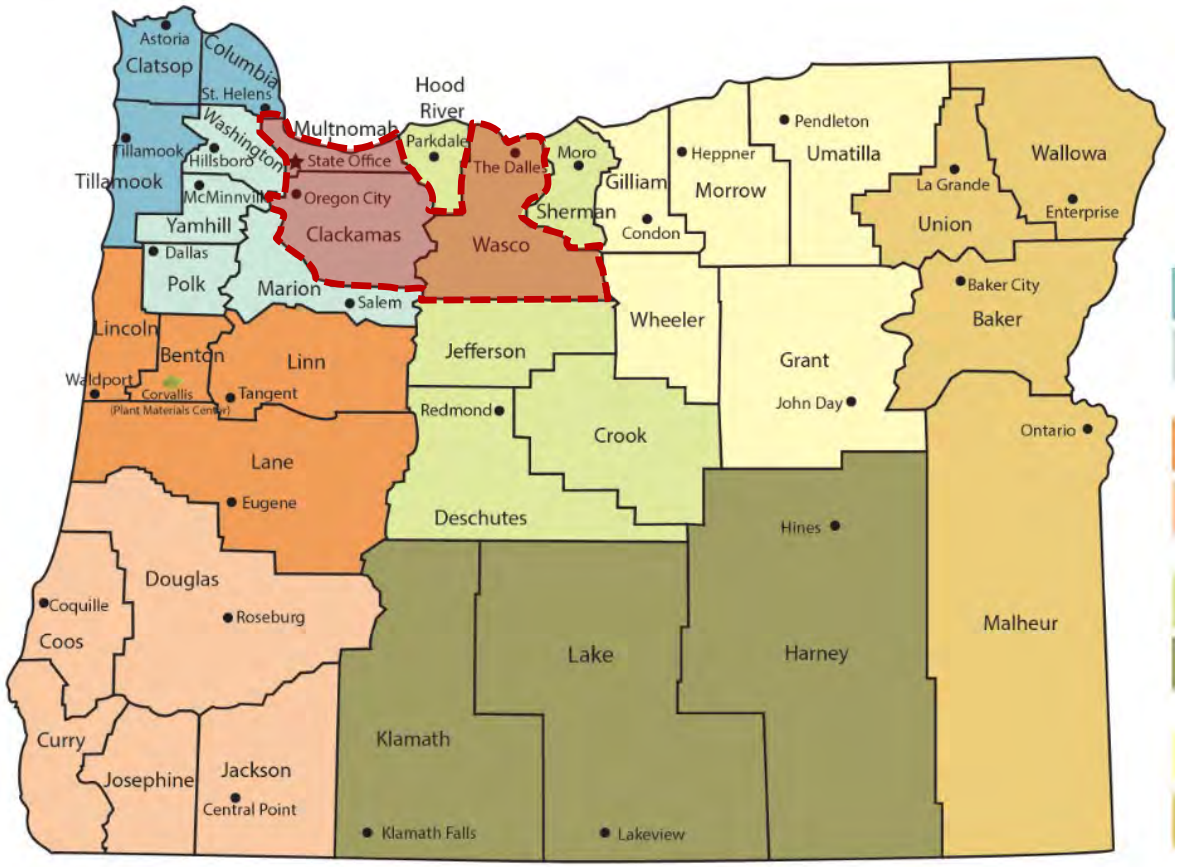
A snapshot of Gresham's biosolids program

QUICK FACTS

Class B biosolids

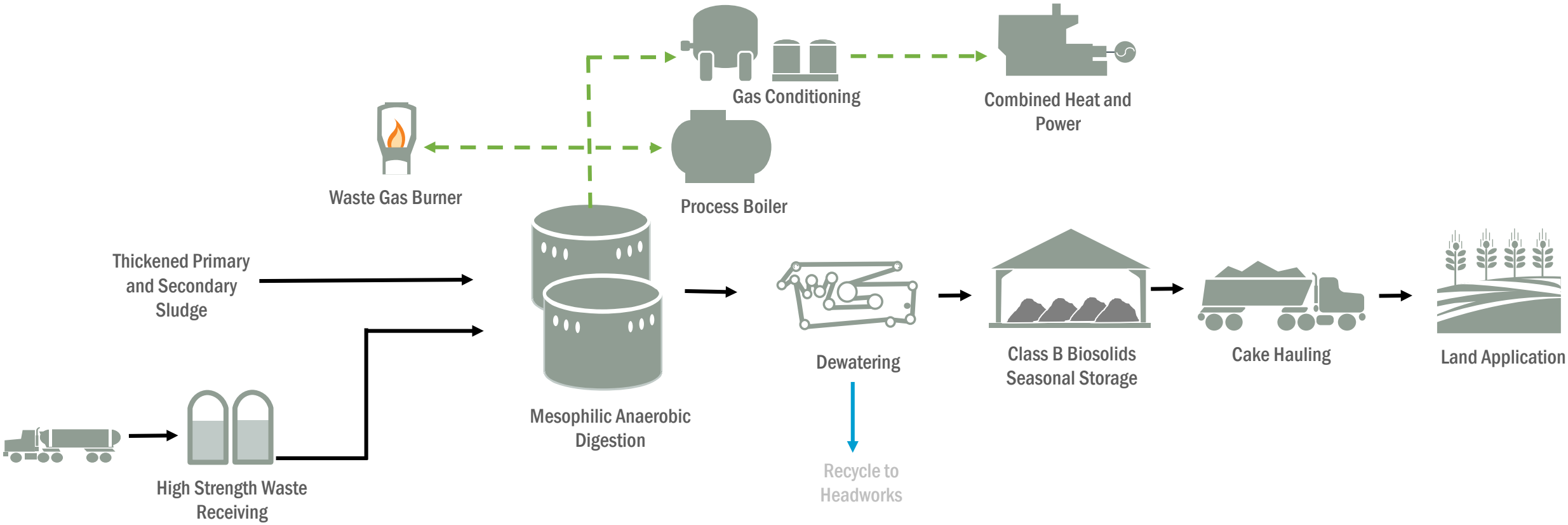
Cake applied to hay fields, pasture land primarily in 3 counties

3,331 acres permitted for land application



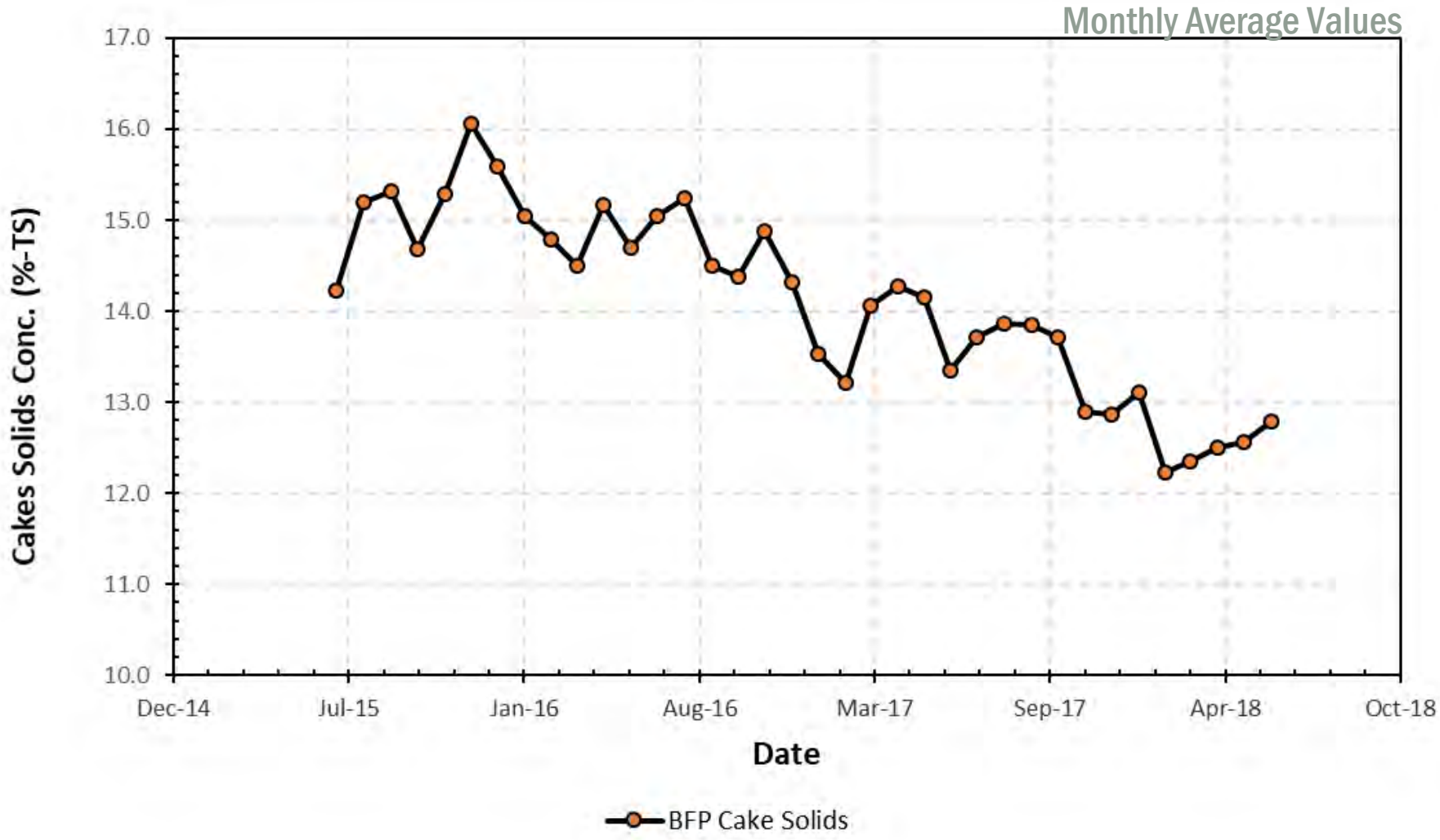
Source: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/or/programs/?cid=nrcs142p2_044022

Overview of Gresham's solids stabilization system



What is the challenge?

Gresham's cake solids has deteriorated overtime



What factors influence dewatering of digested sludge

System Optimization

Polymer Dosing

Polymer Type

BFP Operations –belt, speed, etc.

Secondary Treatment

Phosphorus uptake and release

Monovalent to divalent cation ratio

Digester Operations

Loadings, sludge types etc.

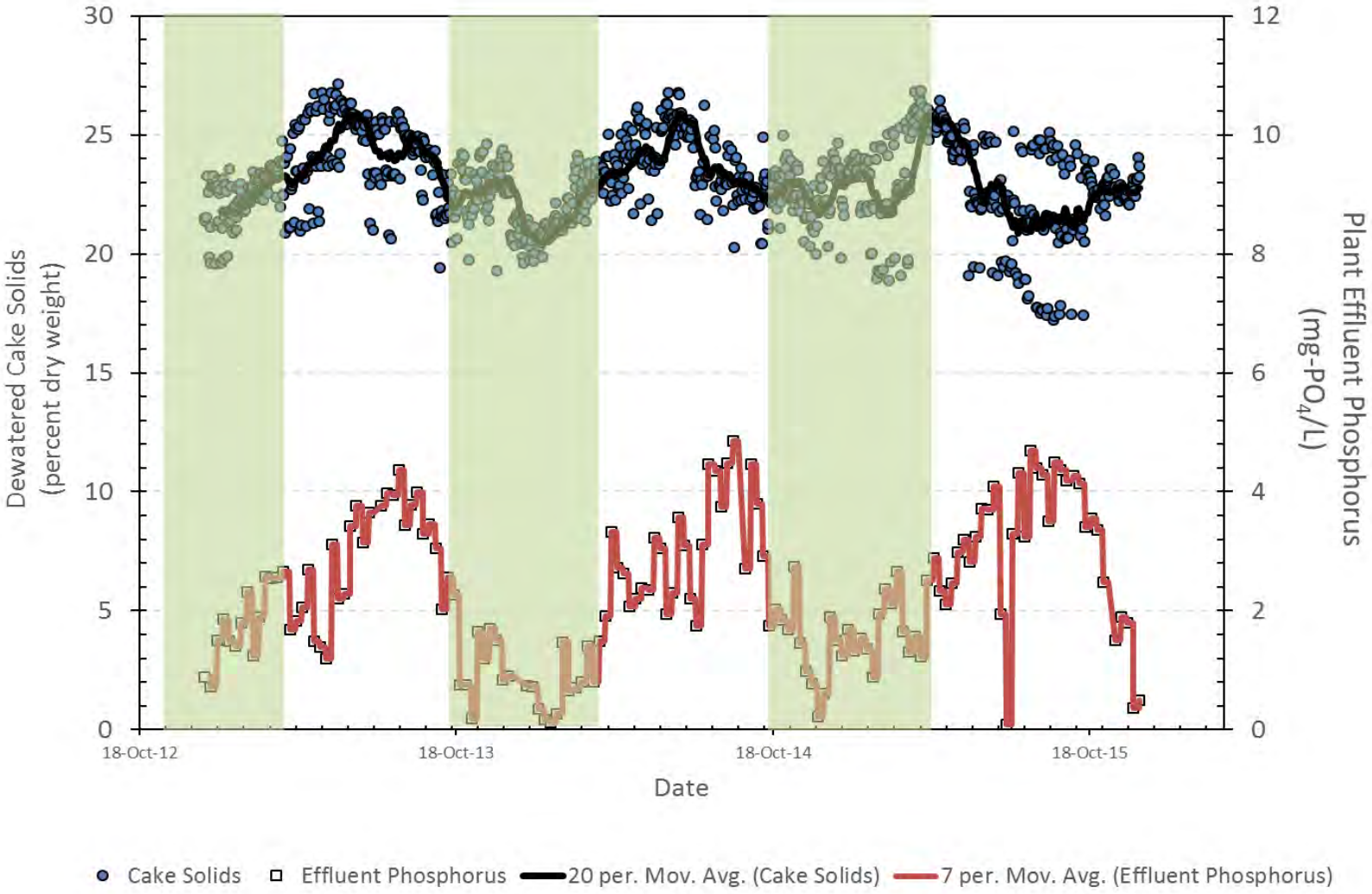
Process conditions/pretreatments (ex. thermophilic or THP)

Conversion to Bio-P can have an impact on cake quality- But Gresham is not a Bio-P plant!

Plant	Original Process	New Process	Original Cake Solids (% TS)	New Cake Solids (% TS)	Notes
Sun Prairie WPCF	RBC-AD-BFP	Bio-P Nitrifying AS-AD-BFP	22	12-13	
Beloit WPCF		Bio-P-AD-BFP		10-12 (Optimized to 15)	
Marquette (MI) WWTF	RBC-AD-BFP	Bio-P Nitrifying AS-AD-BFP		14-18	
Kiel WWTP	AS-AD-BFP-EnVessel Past	BioP-AD-BFP-EnVessel Past	15-19	15-16	*high primary sludge fraction
Nansemond-HRSD	VIP-MUCT w/Fe-AD-Cent	5-stage Bardenpho-Ostara-No Fe-AD-Cent	22-24	18-18.5	
Atlantic, HRSD	HPO-CEPT-AD-Cent	A/O-no CEPT, AGAD-cent	19	15-17	
Madison MSD	AS-AD-cent	BioP-AD-cent		19	22% in piloting

Source: Martin, B., E. Lynne"Bio-P, Digestion and Dewatering : Unexpected Consequences?" 33rd Annual Spring Biosolids Symposium, March 17,2017

Luxury uptake of phosphorous manifest itself seasonally giving significant shifts in cake solids



QUICK FACTS

South Treatment Plant, King County, WA

Average Flow: 90 MGD

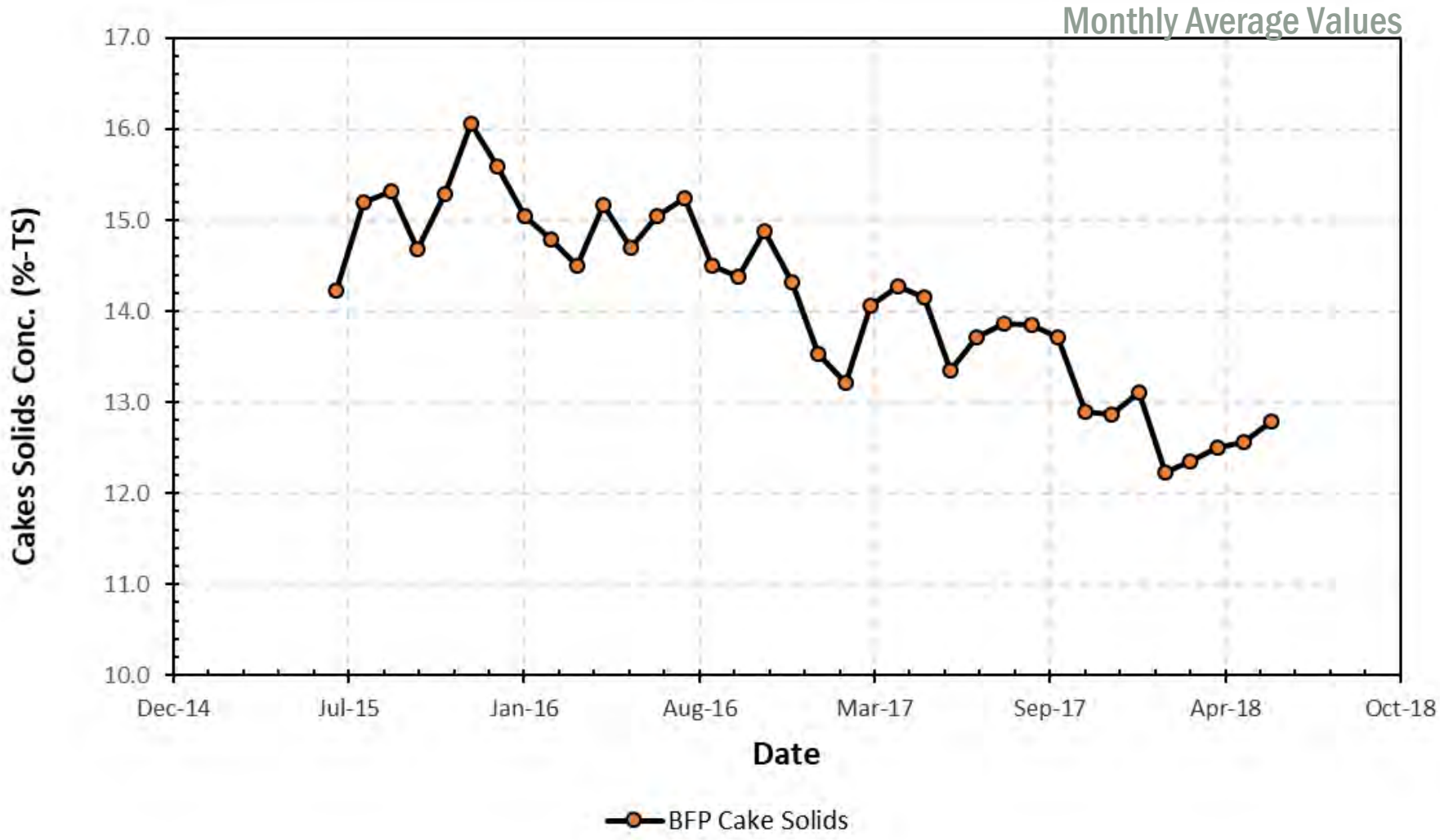
Increase secondary system SRT to maintain N removal during winter

Mesophilic anaerobic digestion with centrifuge dewatering

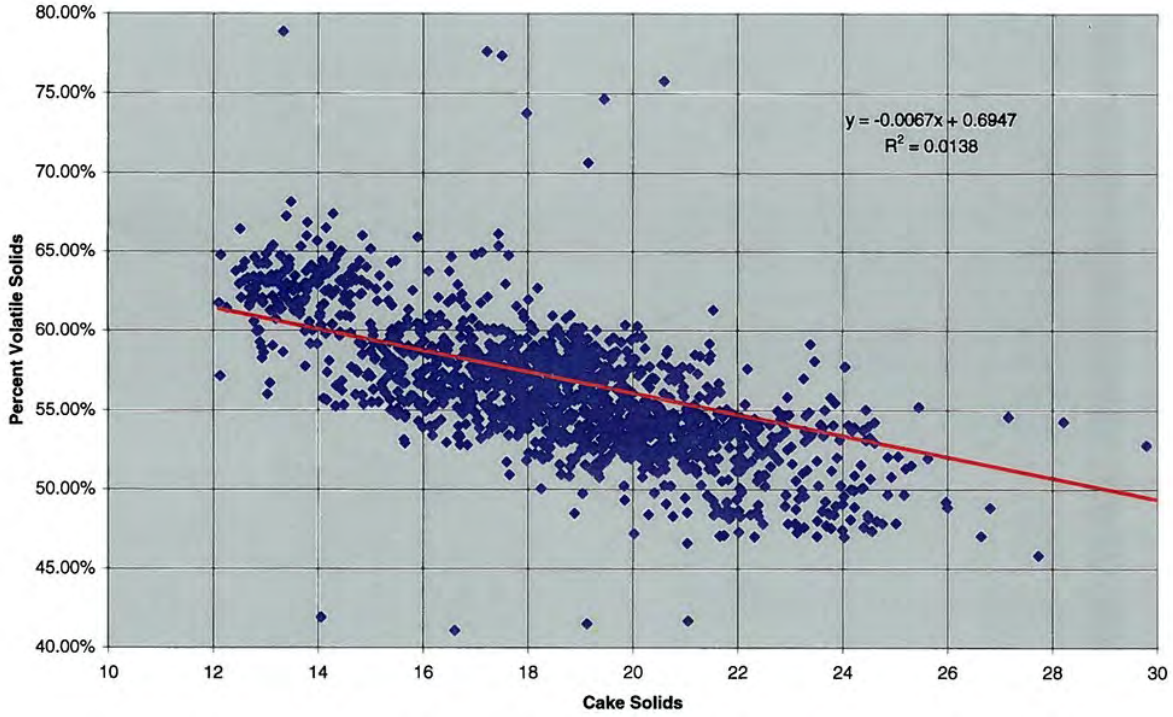
Impact

Get reduced effluent P during winter but get wetter cake (~2-4 points)

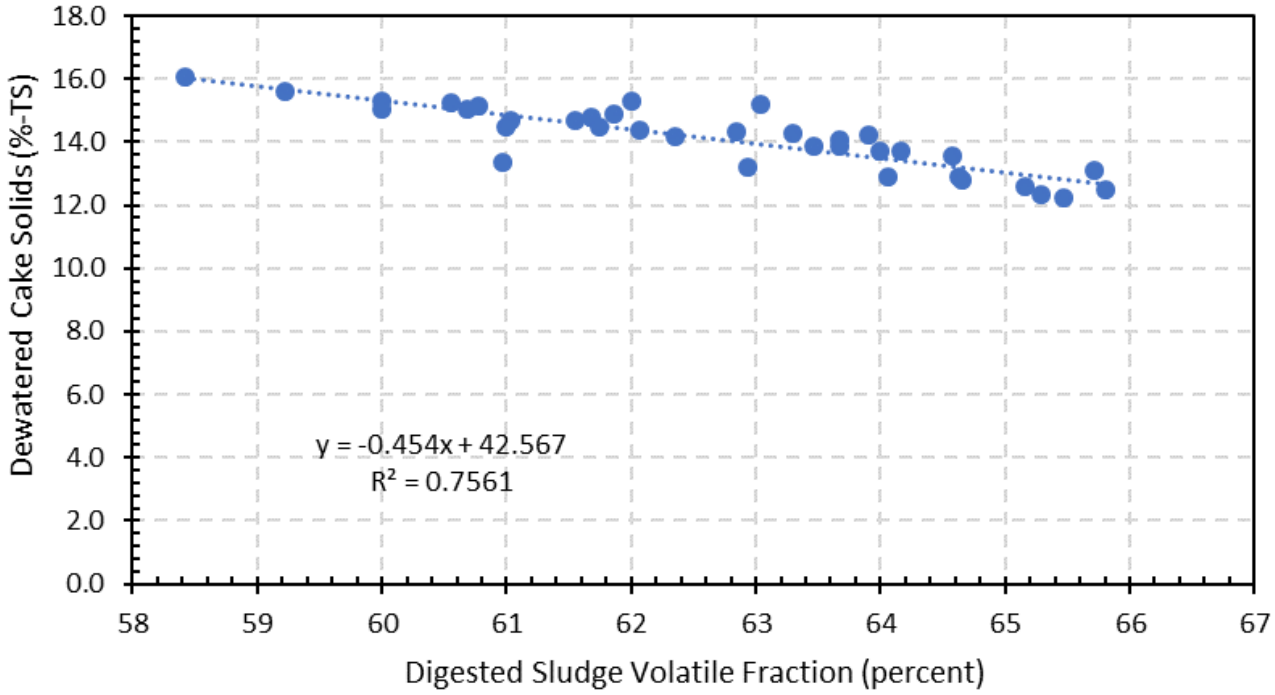
Monthly average trends do not reflect King County's



Changes in sludge characteristics can impact dewatering: volatile content

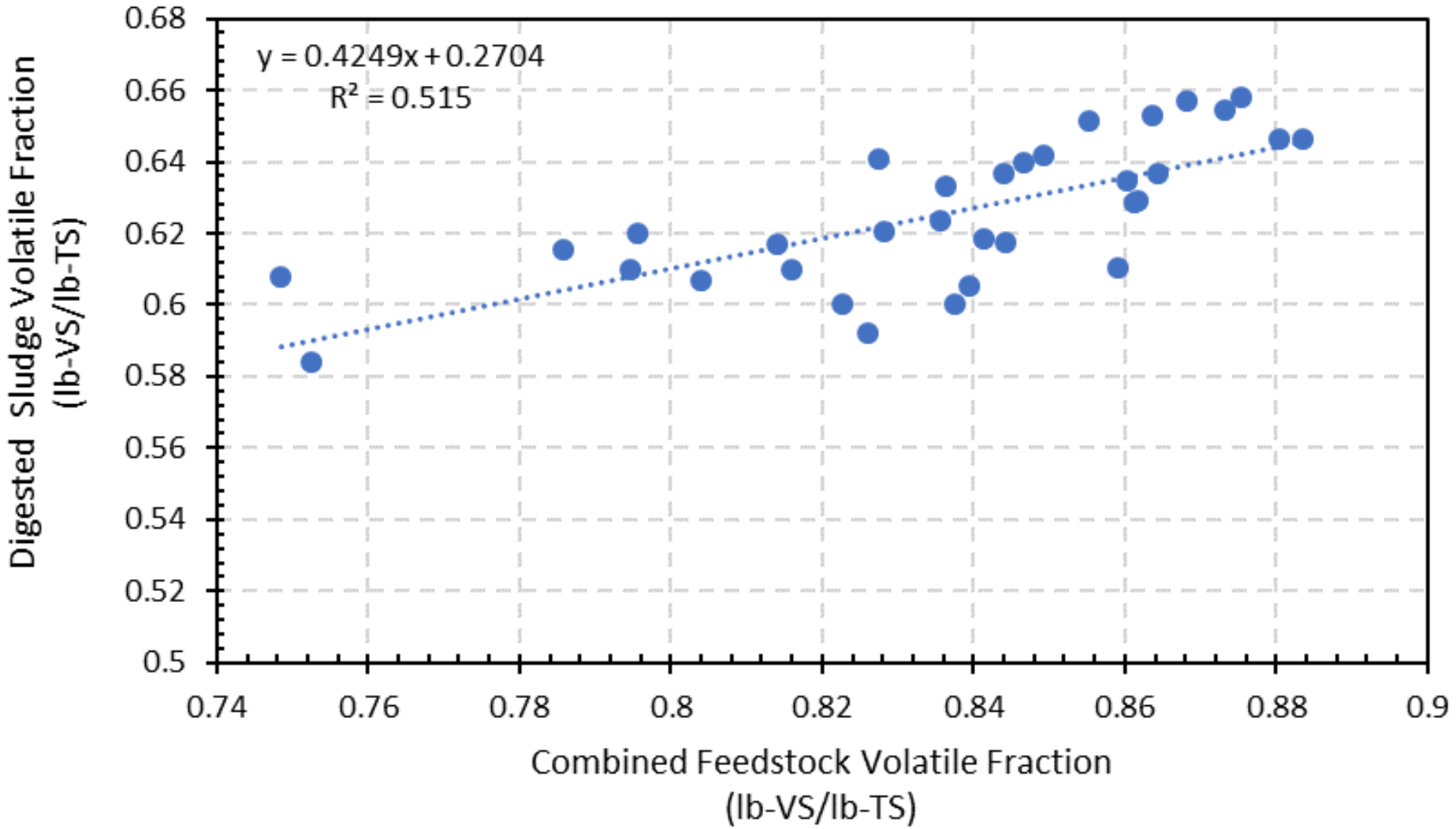


Source: City of Lincoln, NE -2010

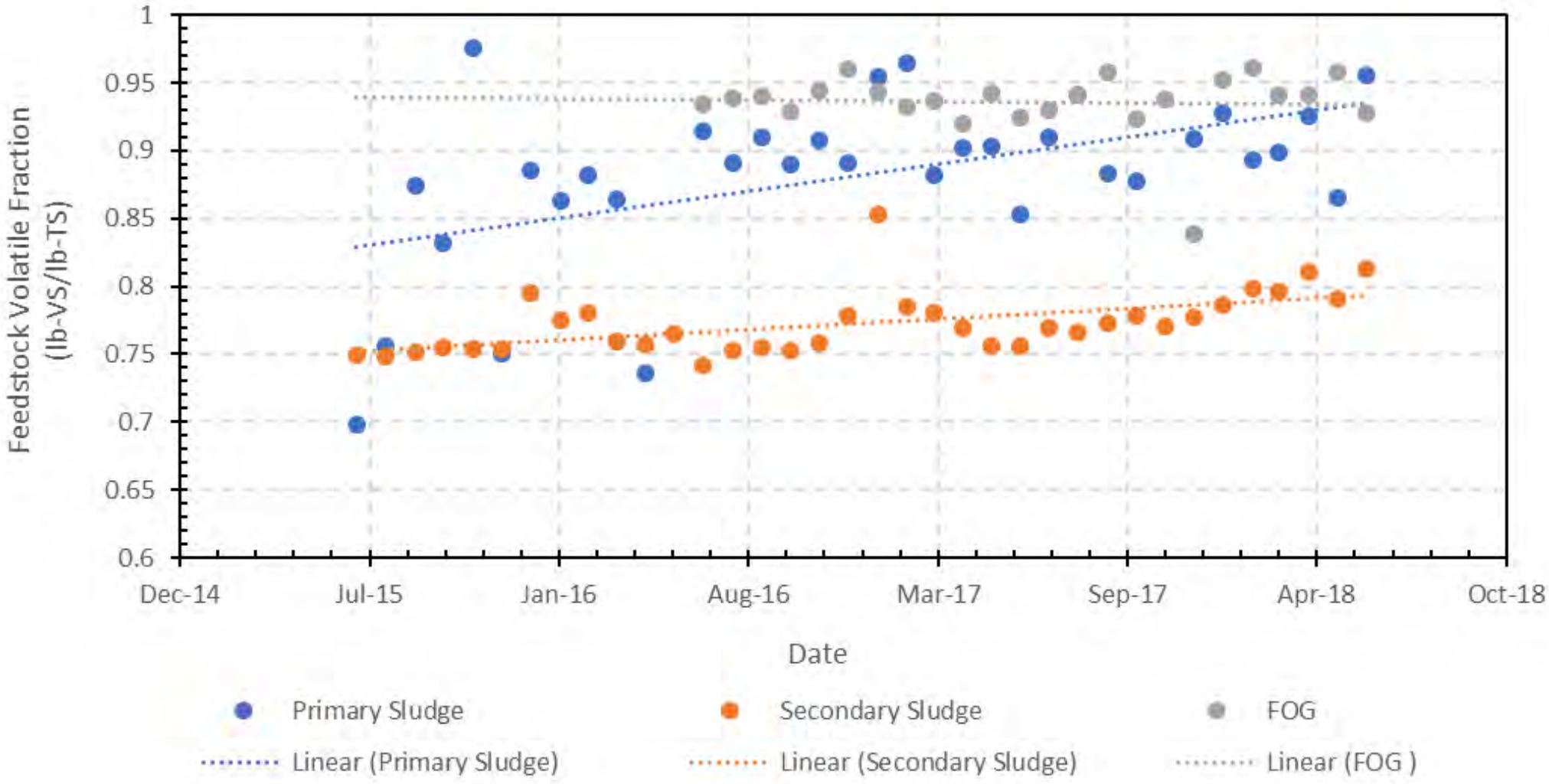


Good correlation between VS and cake solids

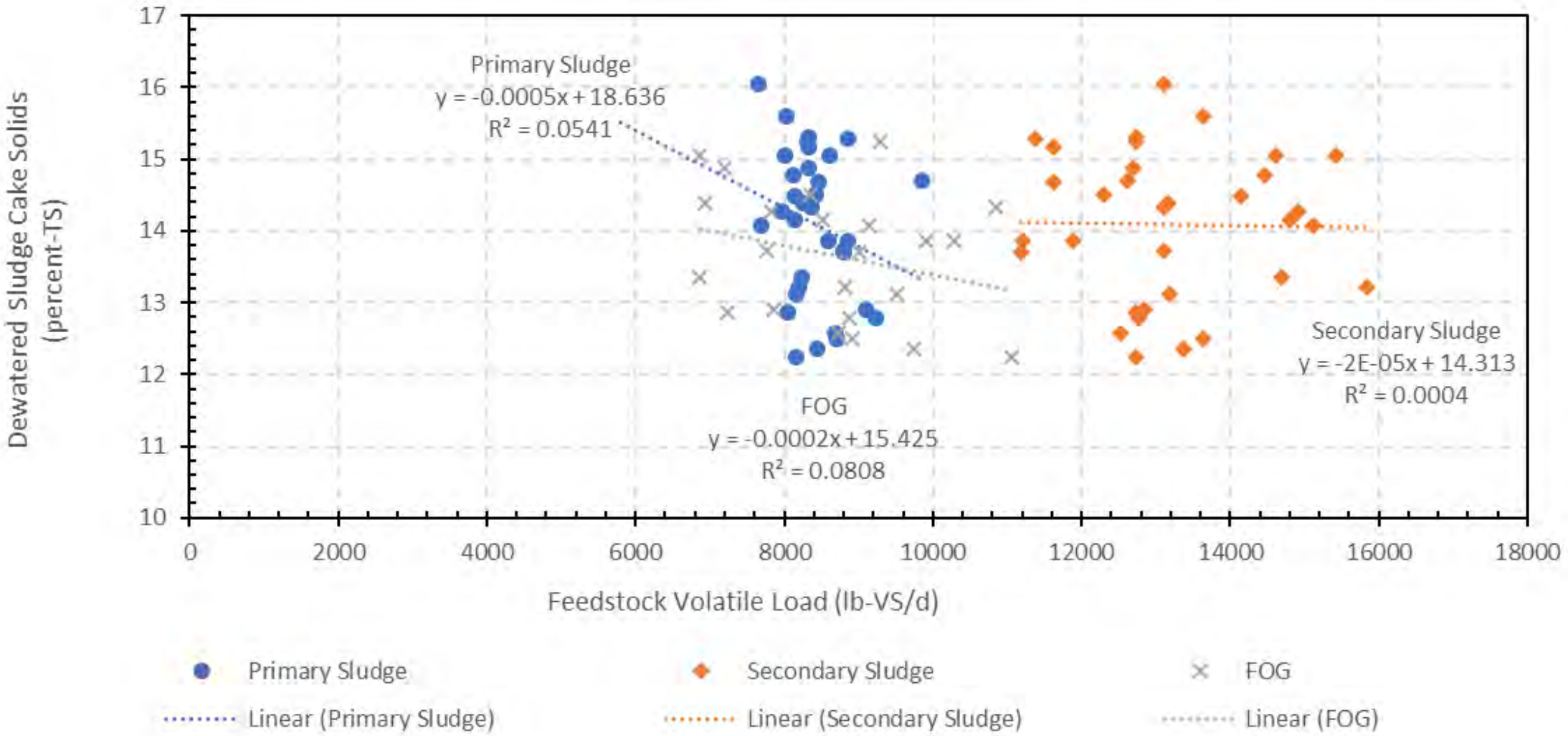
Increased digested sludge VS correlates well with feed VS content



With time there has been in an increase in the volatility in the feed sludge

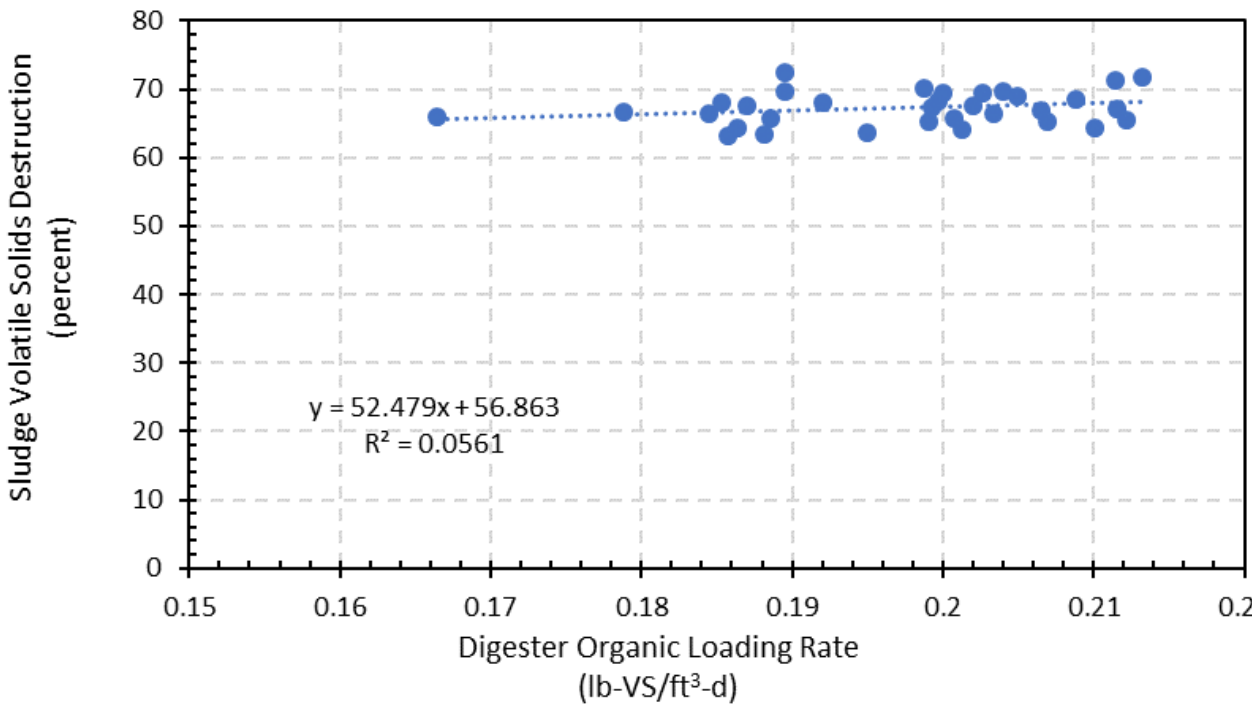


No correlation between feedstock components and deterioration in cake solids – FOG is not the problem

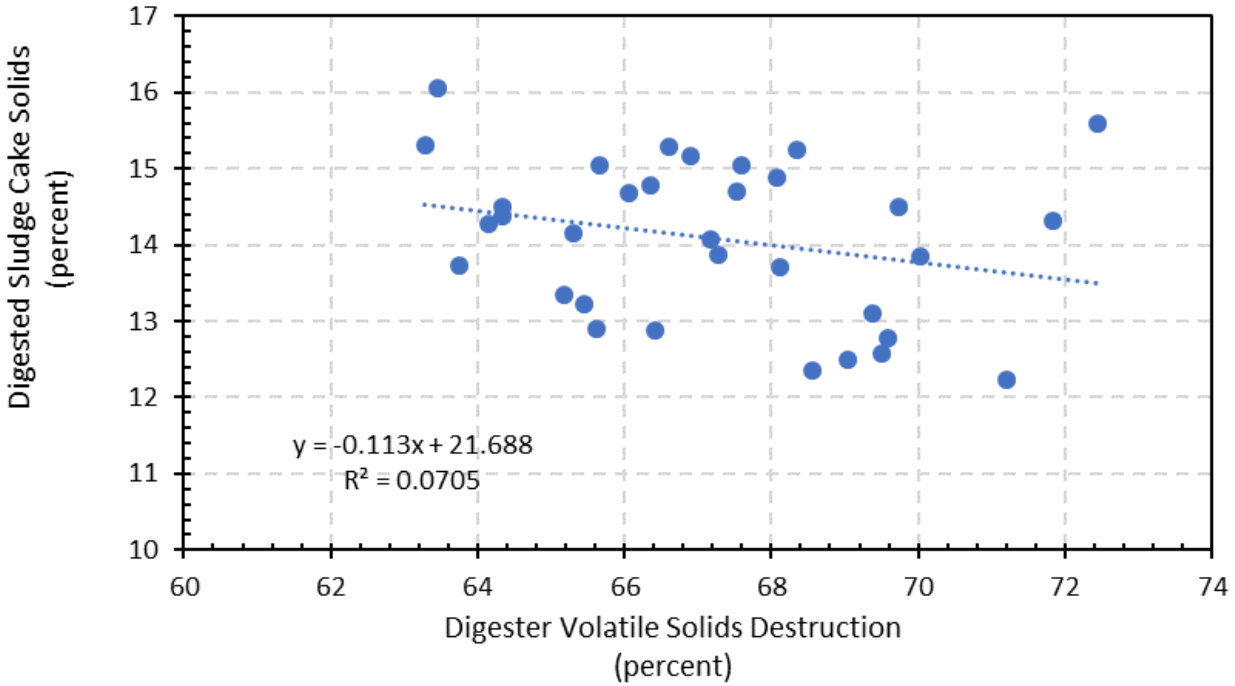


Maybe digester performance?

Loading too high?



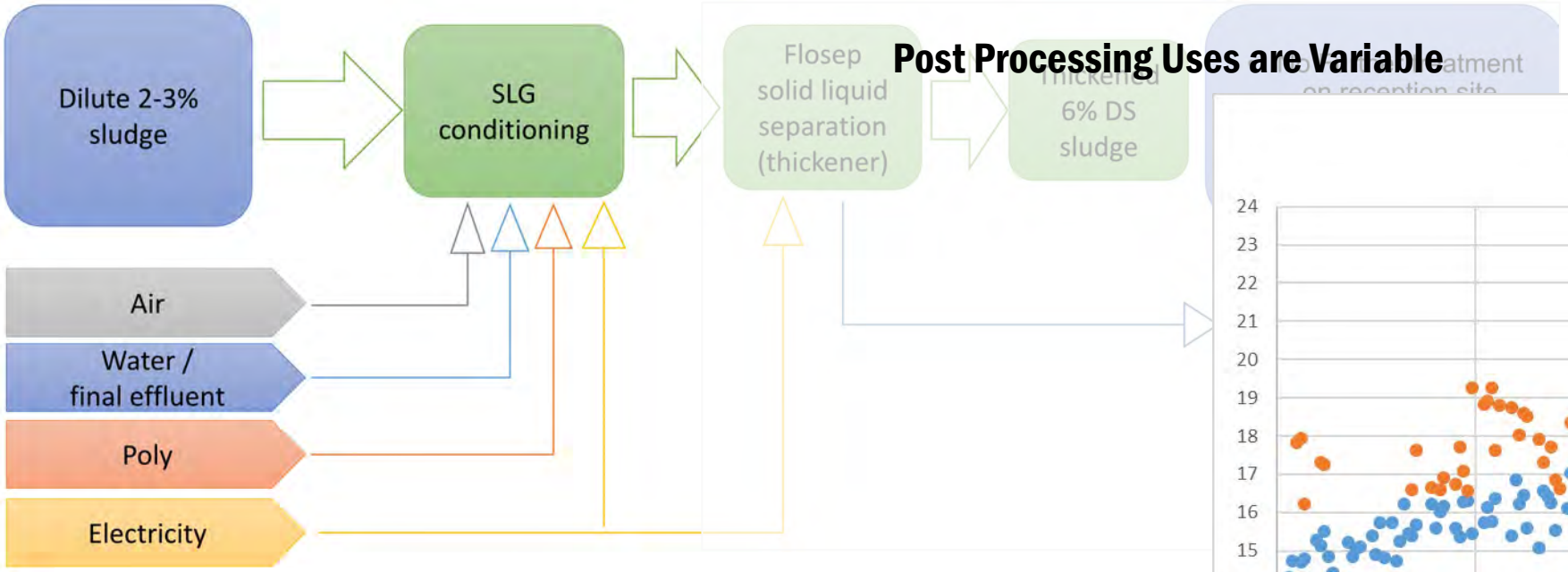
Is the sludge not breaking down?



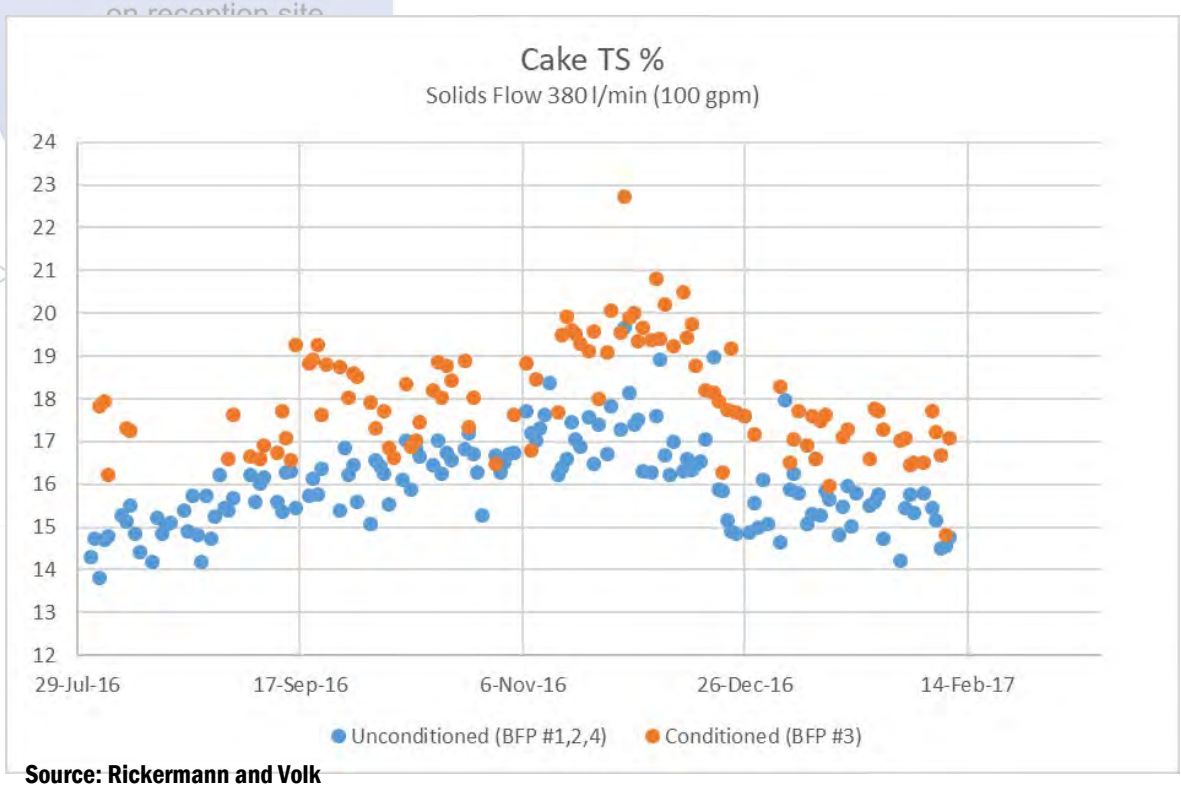
Is there something else we can do?

New technology installed in Allentown, PA was enhancing the dewaterability of cake from BFP!

SLG Process- pretreatment system



Post Processing Uses are Variable



Source: Rickermann and Volk

Allentown Results

Change in Cake: +14 percent drier **(+2 points)**

Change in Polymer: ~-18 percent

Dewatering Capacity: ~+40 percent

Orege SLG

QUICK FACTS

Capacity: ≤ 400 gpm per unit

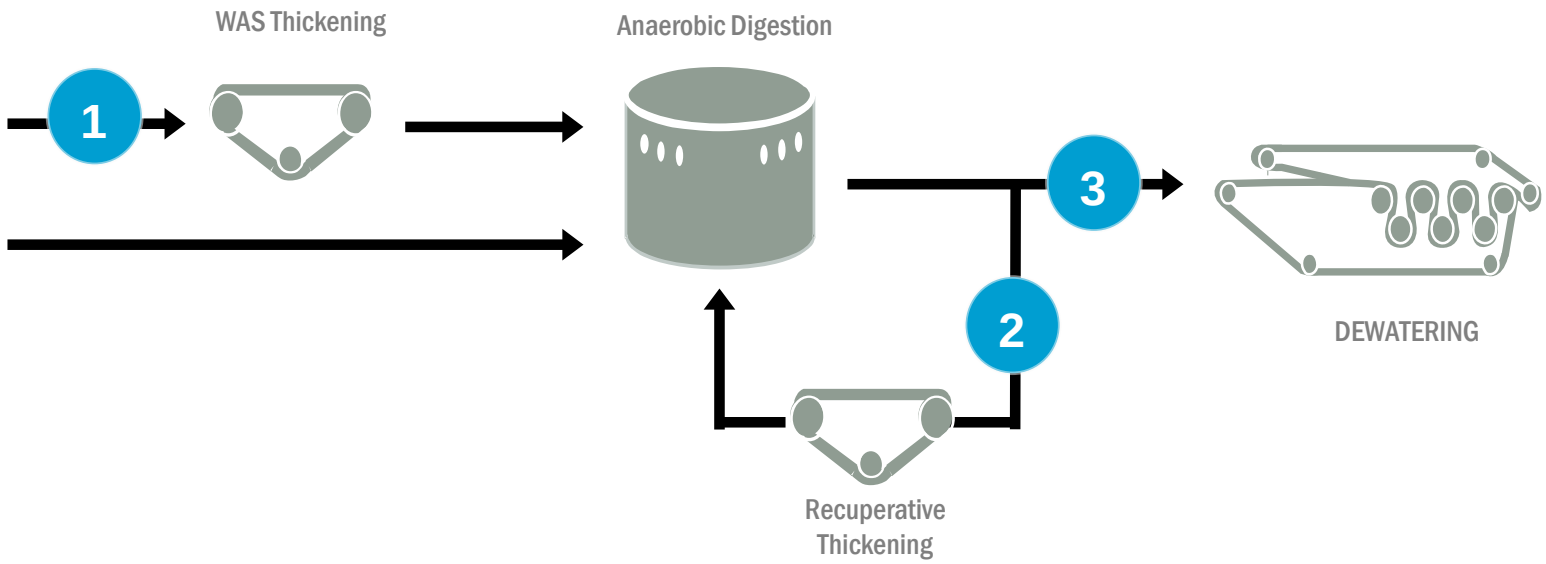
SLG Power: 5 A (480 V 3 PH)

Supplemental Air

Gresham Base Quote 15 HP

Installed: House Air

Application points of OREGE SLG

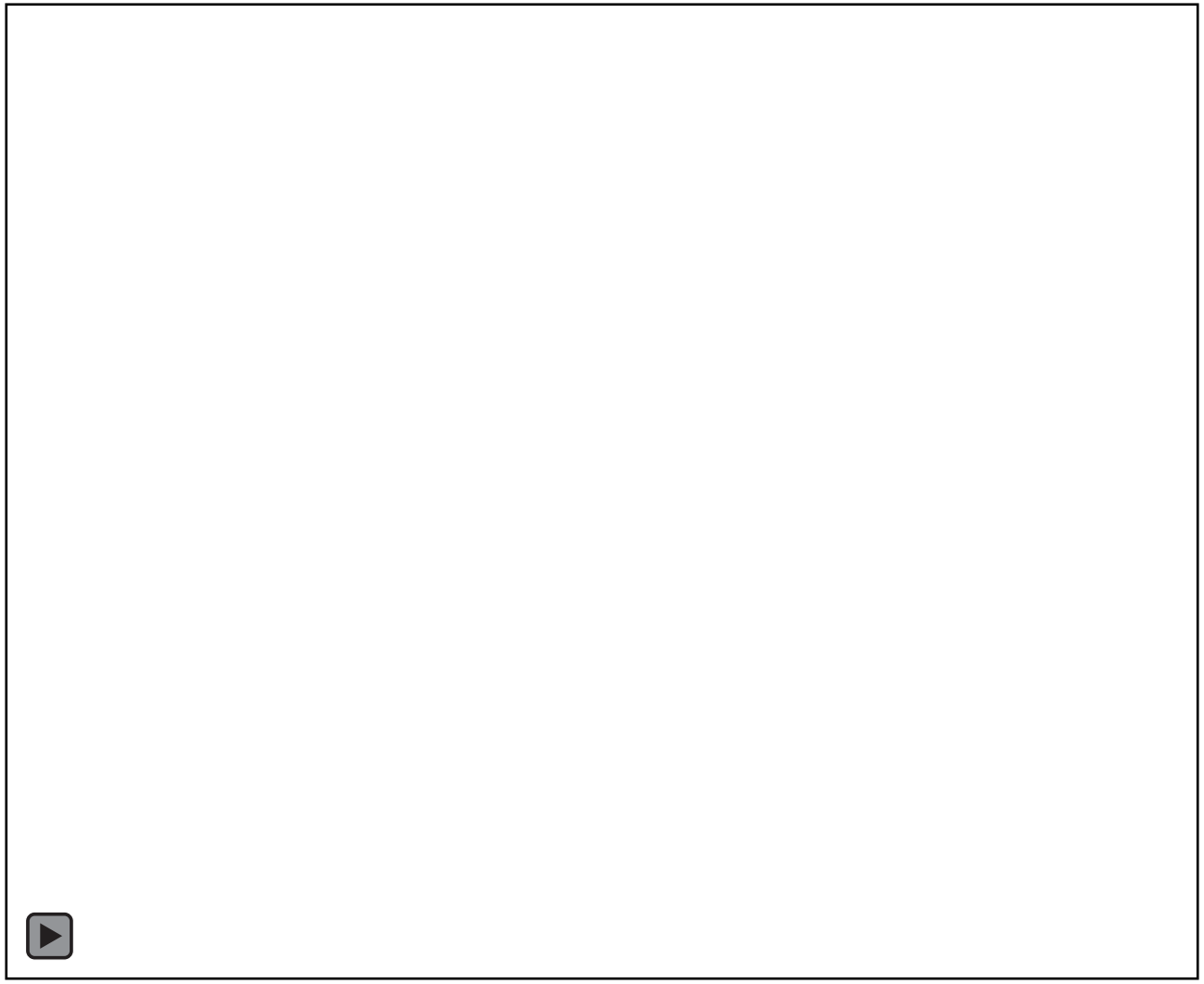


1 **WAS Thickening-** reduces water flow to digester, reducing heat demand (gas) and nitrogen load (polymer) to digester. Maximizes available capacity of conventional digestion system.

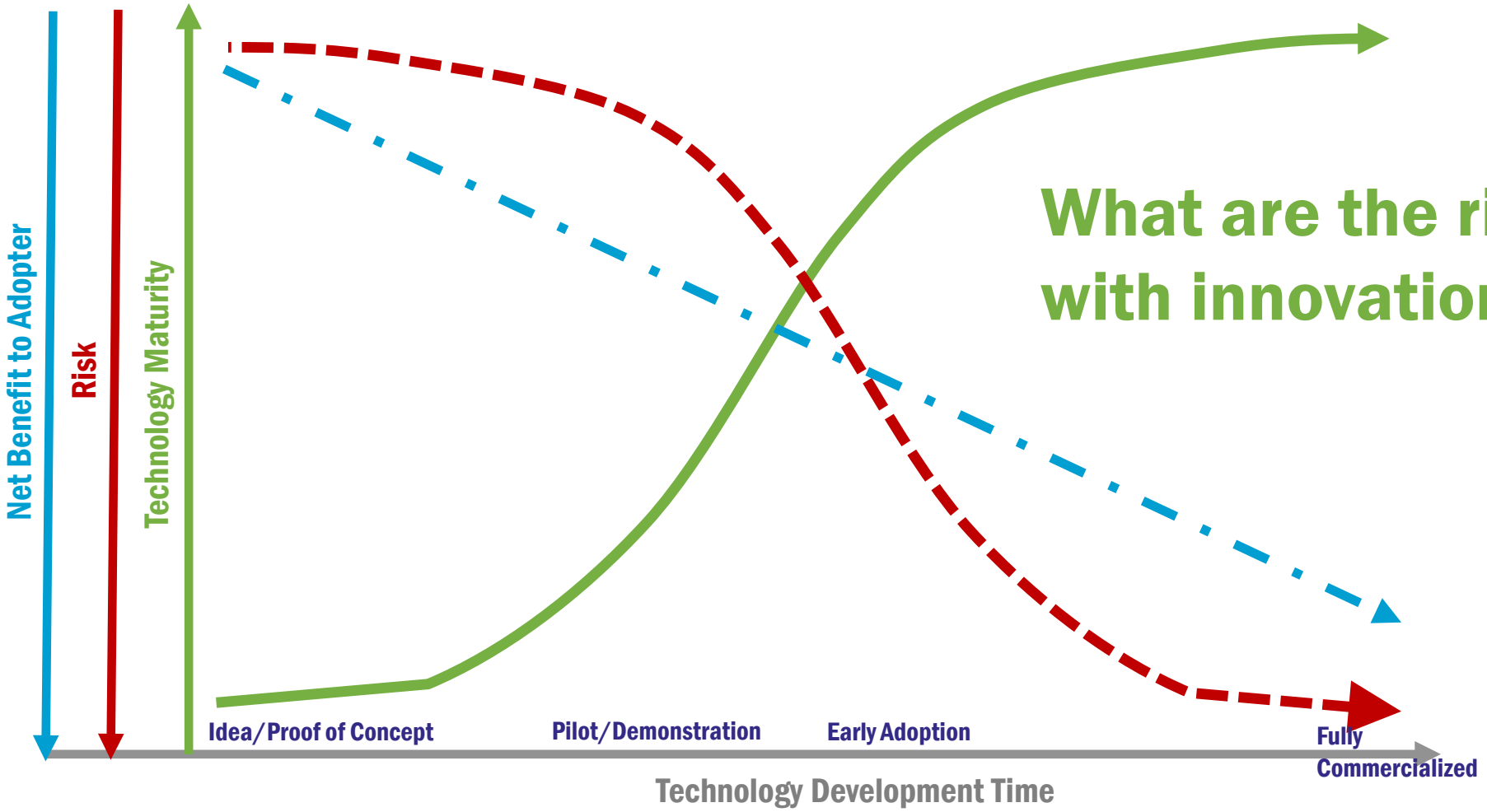
2 **Recuperative Thickening-** decouples HRT and SRT, increasing organic loading capacity by ~38%, allows for receiving of low solids wastes without impact to biosolids classification. High shear system enhances sludge digestibility.

3 **Dewatering-** increases cake solids, reduces polymer and equipment processing capacity, resulting in reduced costs.

What adding air, polymer, shear does to sludge prior to dewatering



Orege addressed risk associated with being an innovative technology: try and buy



What are the risks and rewards with innovation?

What does the OREGE SLG system need to achieve for Gresham to purchase it?

QUICK FACTS

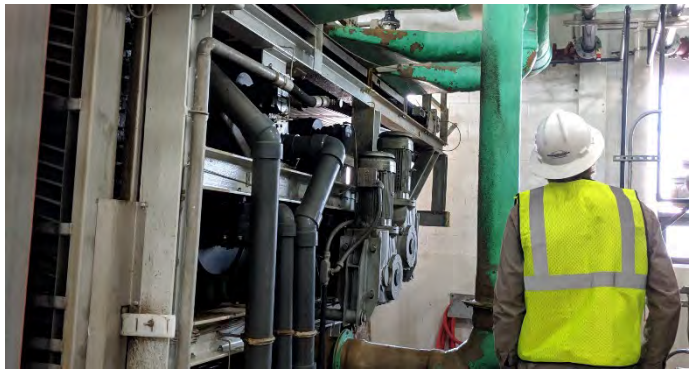
Performance Metric 1: achieve an average +3 percentage point increase in cake solids

OR

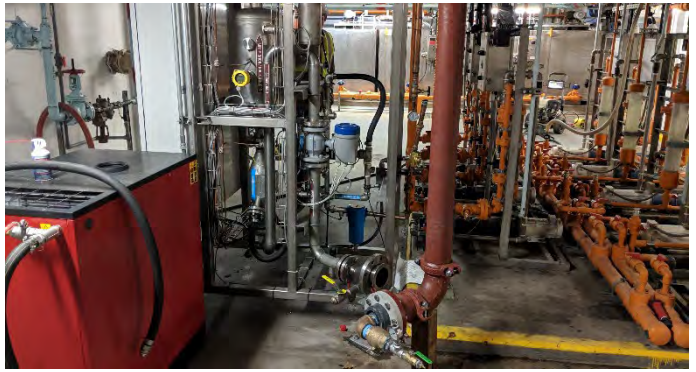
Performance Metric 2: demonstrate a return on investment (ROI) of ≤ 5 years

-mix of cake reduction and polymer savings

Non-conformance: Orege removes technology from site, no recovery of installation costs

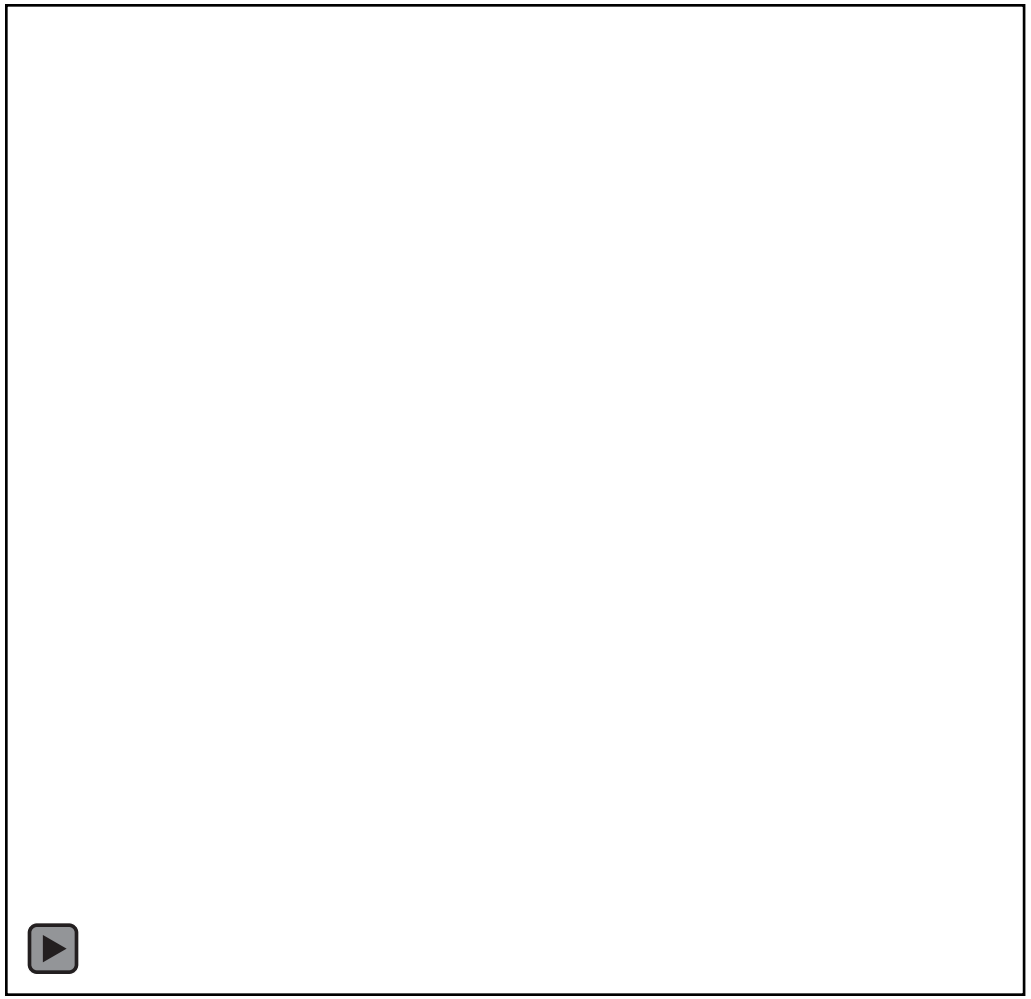


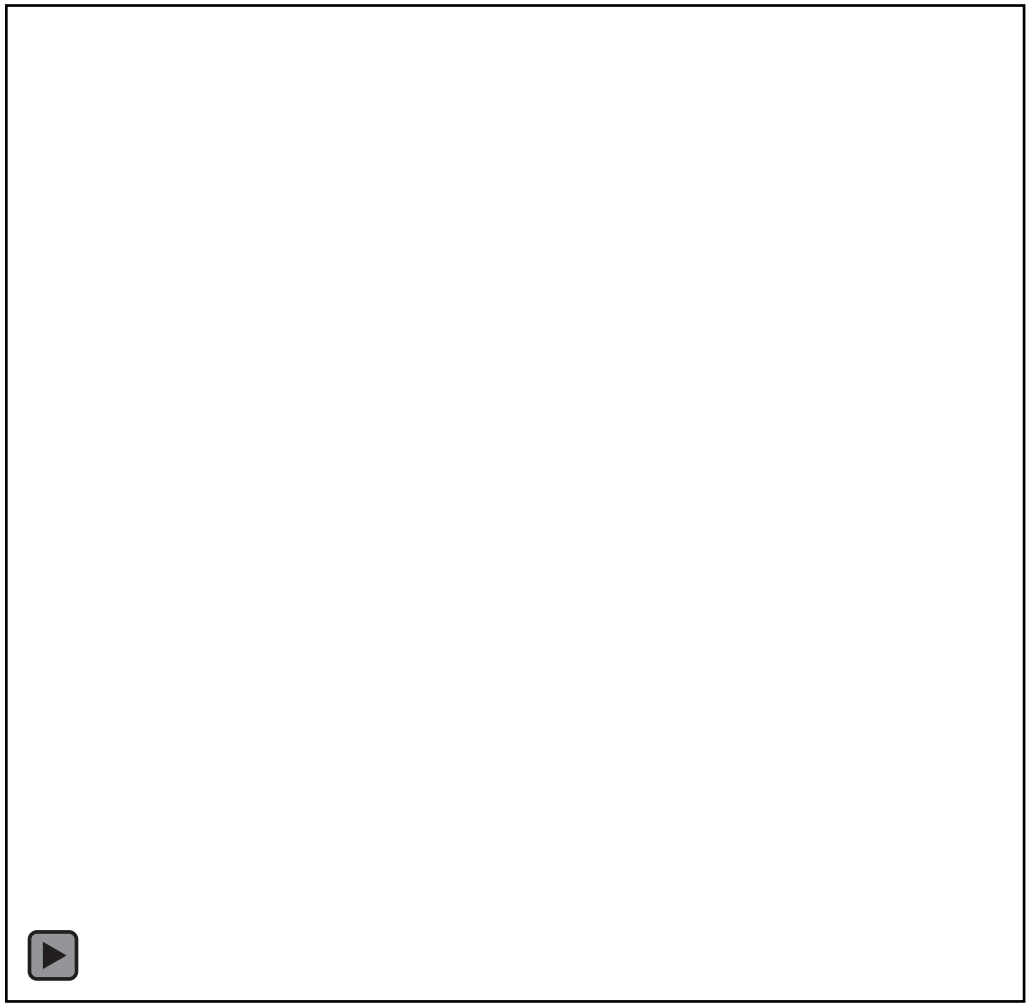
2-M belt filter press at Gresham WWTP



Temporary SLG installation feeding one belt press at Gresham (115 gpm capacity)

Does the improved drainage observed earlier translate into better cake?





Results of performance testing

Performance Metric 1: achieve an average +3 percentage point increase in cake solids

	Cake Dryness	Polymer Treatment Rate (lbs/DT)
Gresham Baseline	12.8	22.7
ORGE-SLG Pretreatment	15.1	16.3
SLG Performance	2.3% increase (<+3%)	28% Reduction

Performance Metric 2: demonstrate a return on investment (ROI) of ≤ 5 years

-mix of cake reduction and polymer savings

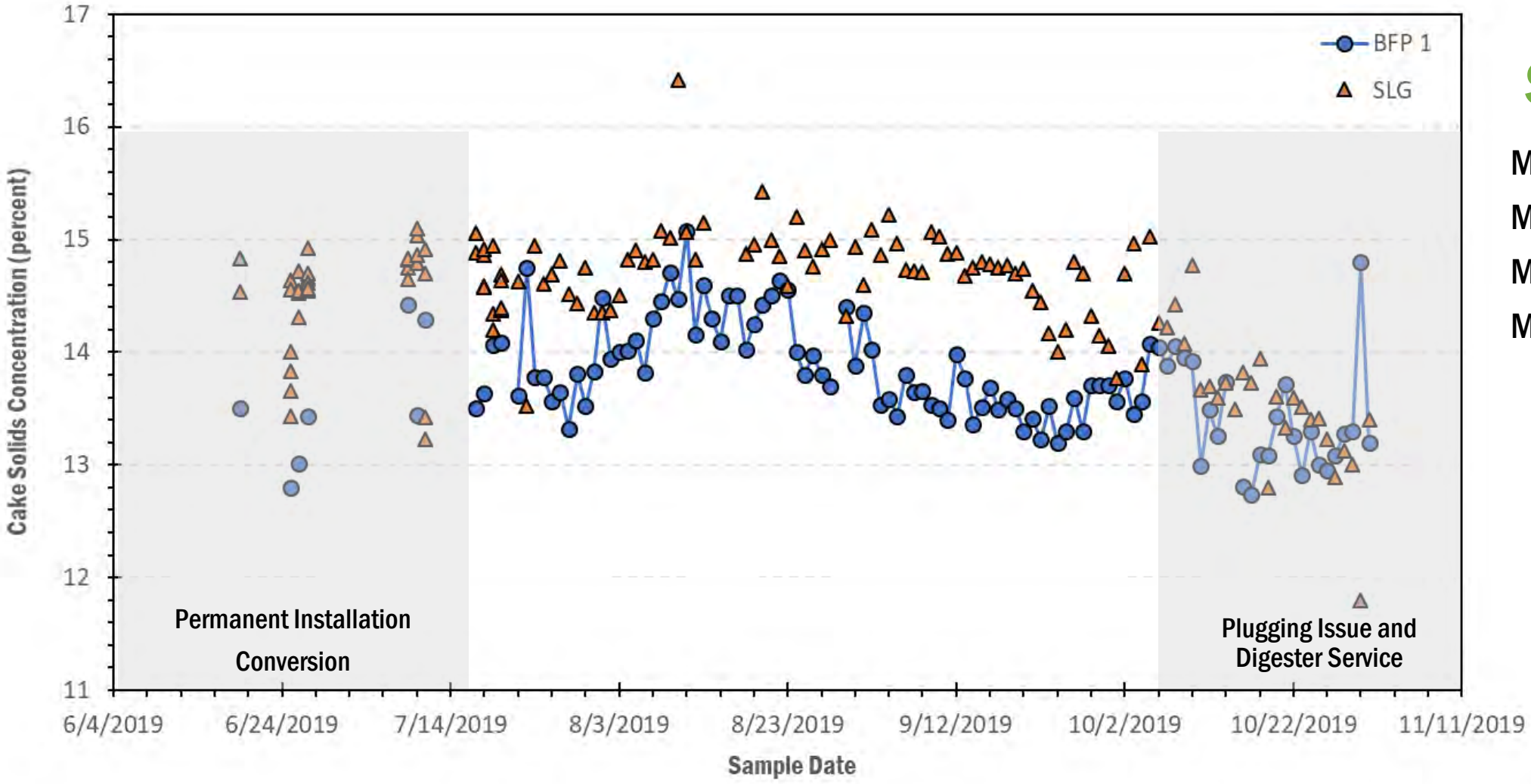
Key Data:

Hauling: 40 $/wet ton

Polymer: C-3295 at $1.63/pound

Est. ROI : 3.65 years

How has it gone to date? – CAKE SOLIDS



STATS

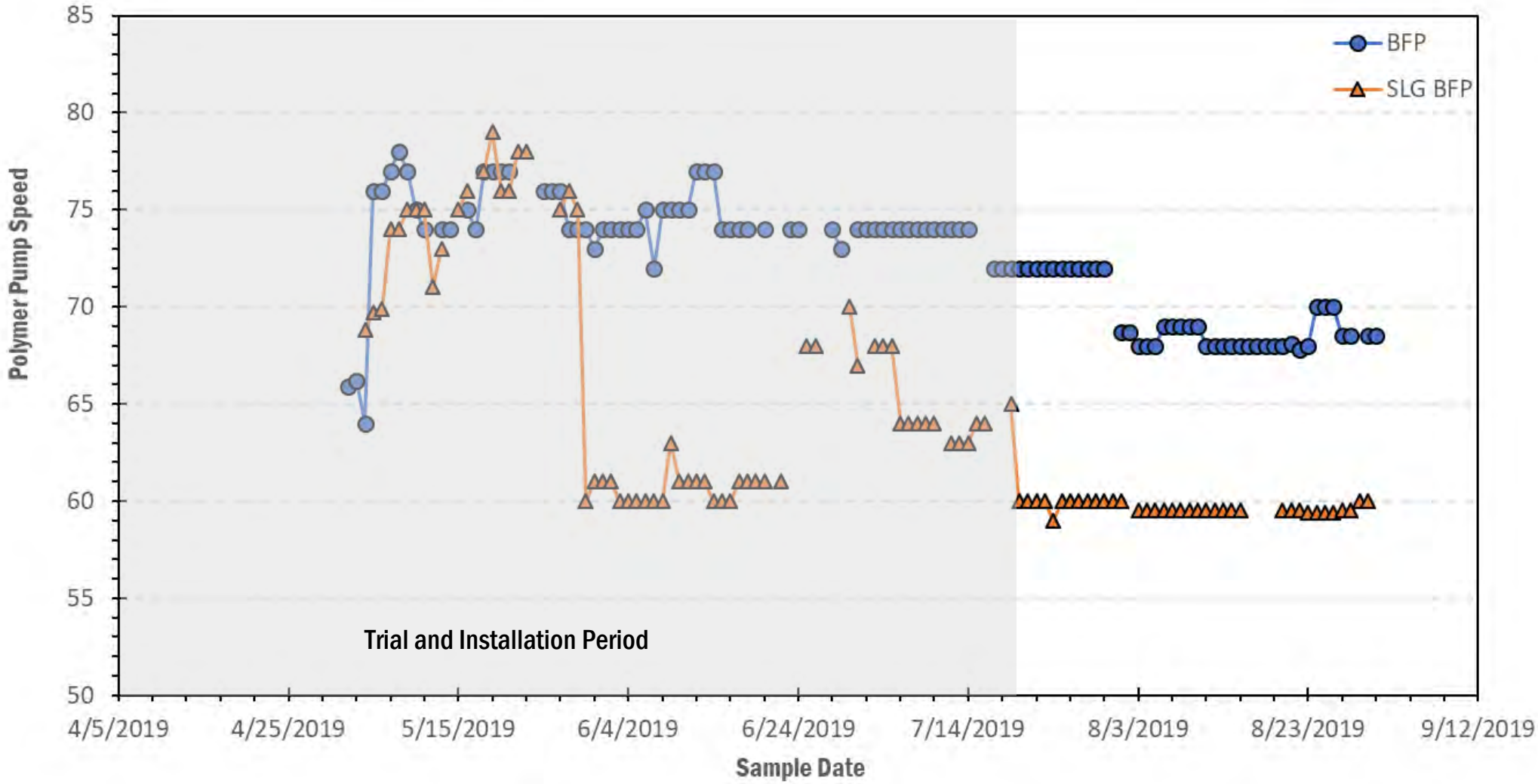
Mean: +0.83%

Median: +0.93%

Max: +1.95 %

Min.: -1.23%

How is it going? - POLYMER



Summary

PERFORMANCE

- Achieved performance metrics during testing
- Performance since trial impacted by digester cleaning and plugging issue
- Cake being held consistently above 13.5 percent solids – no impact to end-users spreading operation
- Polymer reduction appears to be holding

Lessons Learned and Observations

- Increased familiarity and capability to optimize equipment with time
- Sludge characteristics are going to be variable with time, digester cleaning impacted sludge
- Understand the sensitivity of the payback to variable performance changes
- Consider the benefit of non-monetized factors in assessment – “can my users spread it”
- FOG did not impact dewatering
- Increased understanding of the fundamental relationship between biology, chemistry and biochemistry associated with dewatering is needed.

QUESTIONS?

it's about connecting

- Christopher Muller , PhD, P.E. (WA)
- 978-983-2059
- cmuller@brwncald.com

Brown AND Caldwell essential ingredients®