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Pilot Scale Evaluation of Belt Filter Press and Centrifuge for Dewatering WAS and TWAS in William E Dunn Water Reclamation Facility

FWEA Biosolids Seminar 2023

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Overview

- WEDWRF Background
- Pilot Testing Objective
- Pilot Testing Overview
- Pilot Testing Results
- Conclusion & Recommendations
- Questions and Discussion

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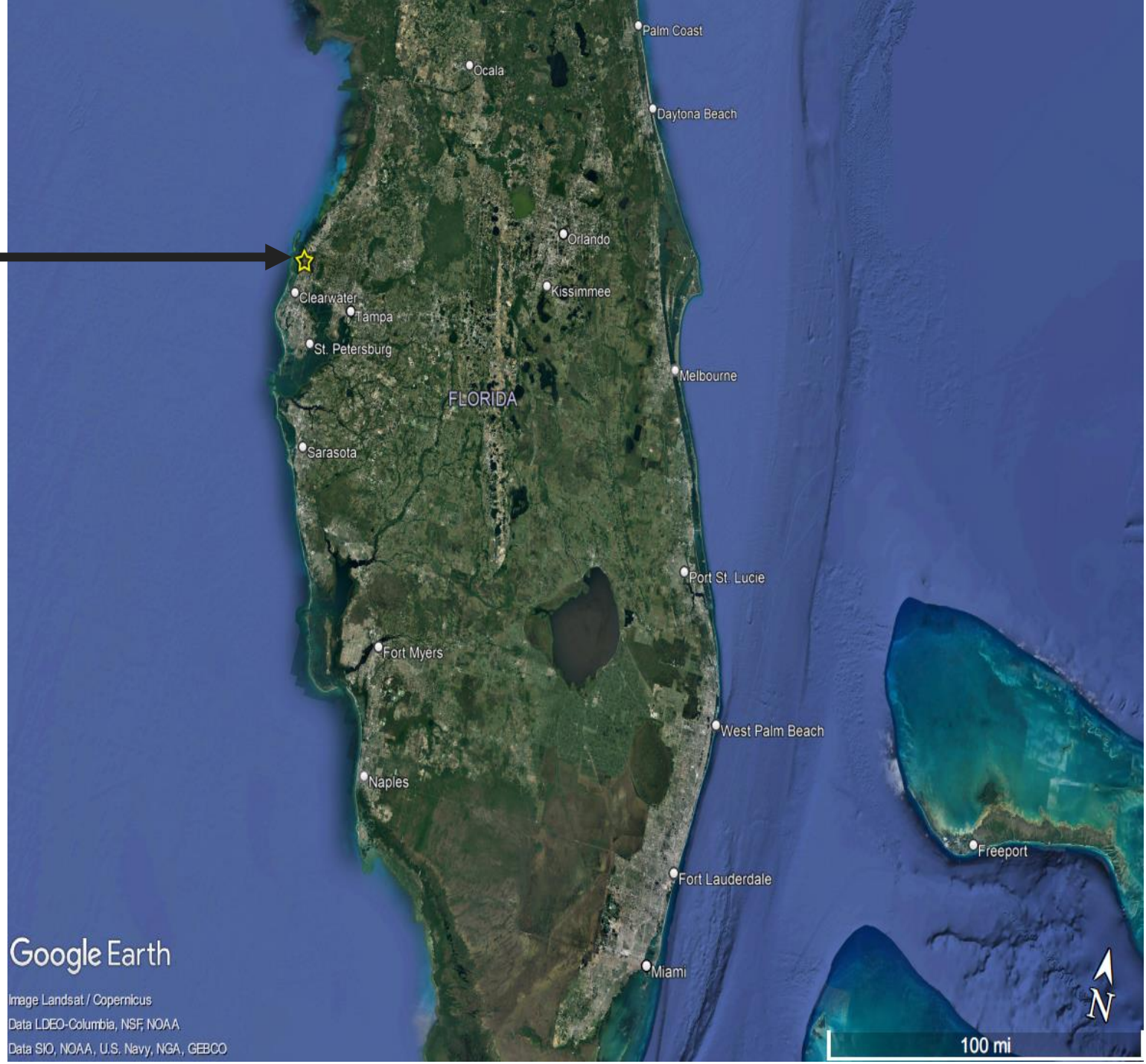
WEDWRF Facility Background

Facility Background

William E Dunn Water Reclamation Facility

Parameter	Value
Annual Average Daily Flow	6.5 MGD
Ultimate Design Capacity	9.0 MGD
Biological Nutrient Removal Process	5-stage-Bardenpho
Existing Solids Thickening	Rotary Drum Thickeners
Existing Solids Dewatering	Belt Filter Press



Pilot Testing Objective

Pilot Testing Objective

1. Evaluate the dewatering performance of new belt filter press and centrifuge.
2. Optimize the polymer dosage to maximize cake solids and solids capture.
3. Compare the dewatering performance of Waste Activated Sludge and Thickened Waste Activated Sludge
4. Compare the filtrate/centrate stream for WAS and TWAS based on concentrations of COD, P, and N

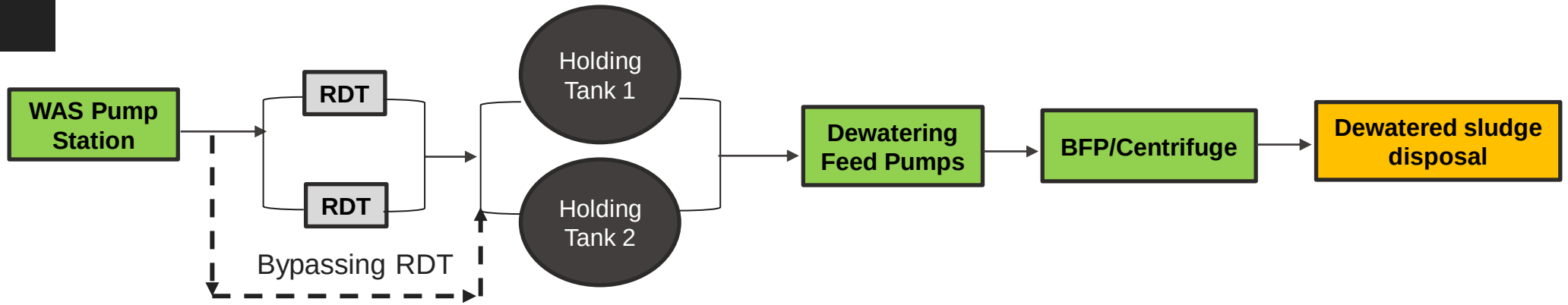
Pilot Testing Overview

Pilot equipment Set-up

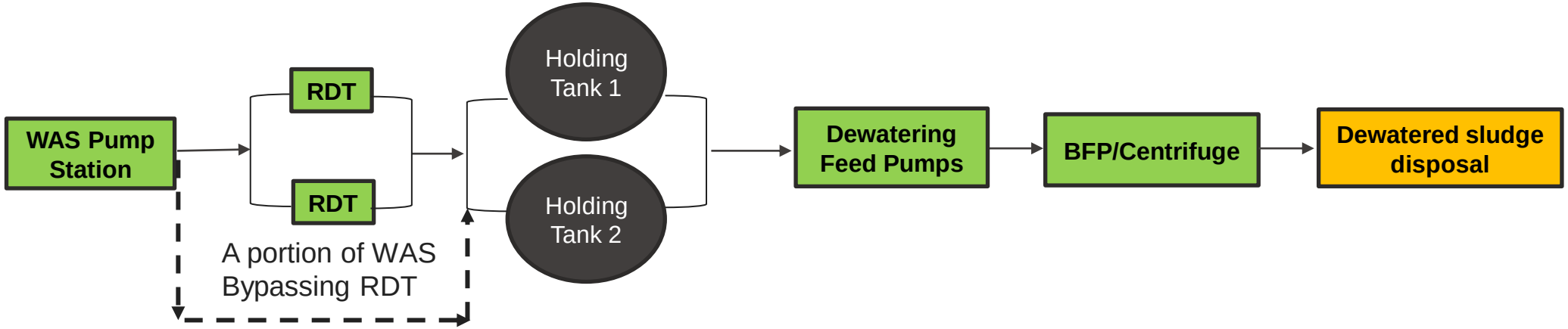
NOTE – This is to represent the generic staging of pilot trailer. The actual set-up was modified based on the BFP/Centrifuge to cater to site conditions during testing.

Pilot Evaluation
PFD

Option 1 – Dewatering Waste Activated Sludge



Option 2 – Dewatering Thickened Waste Activated Sludge



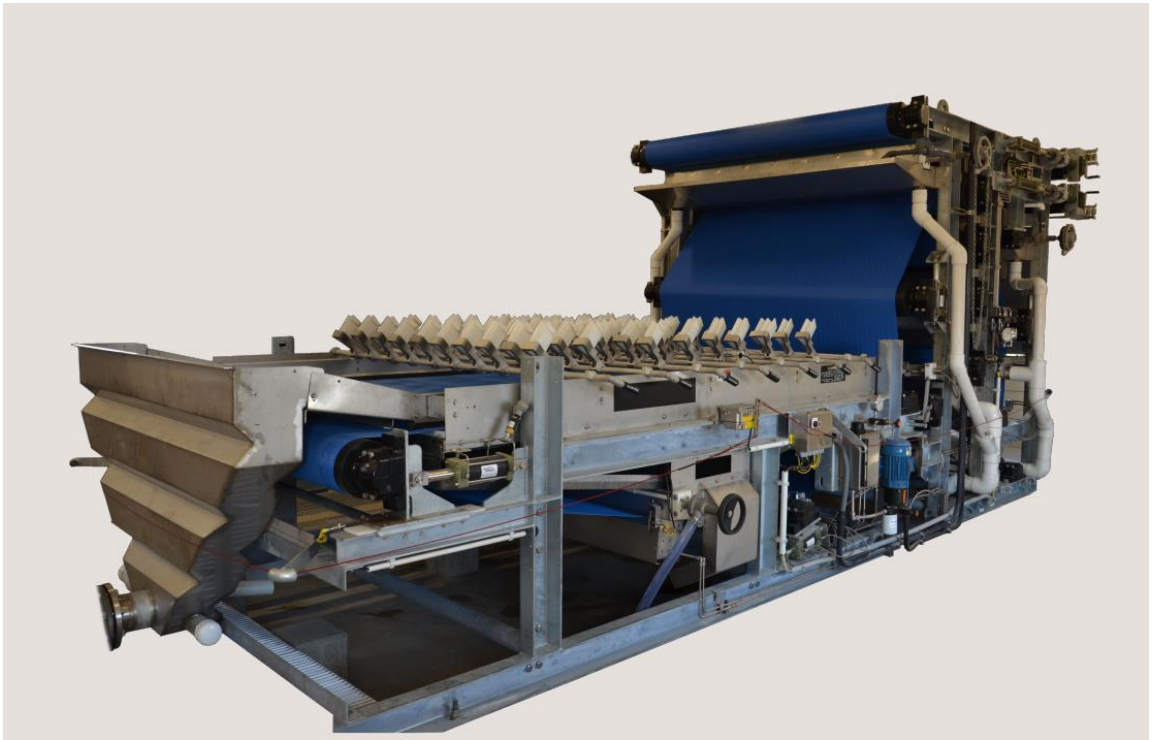
Pilot Testing Summary

Alfa Laval – 3-Belt Filter Press Summary

Pilot Testing Period - April 18 – April 27, 2023

- Equipment - Alfa Laval AS-H Belt Press KPZ (1.3 m)

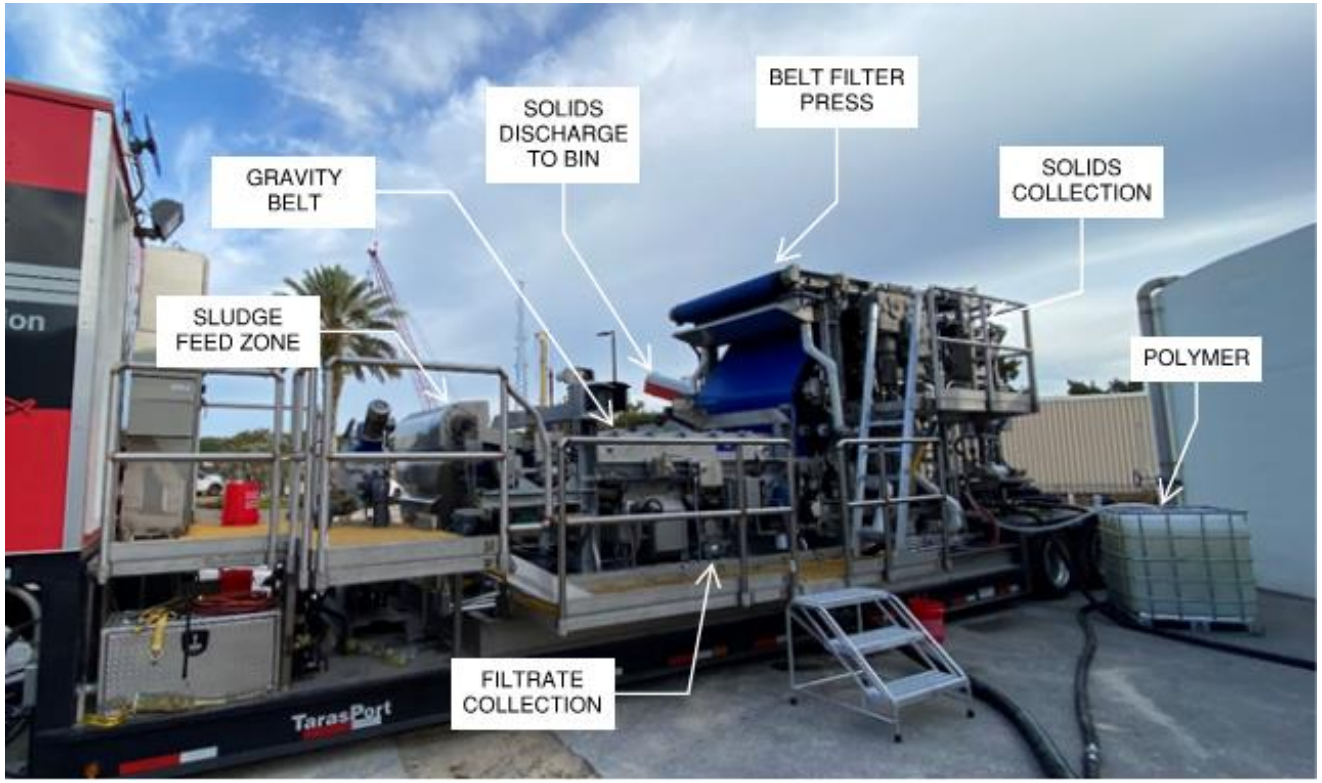
Parameter	WAS	TWAS
Testing Period	April 18 – 20, 2023	April 25 – 27, 2023
Hydraulic Loading (gpm)	170 – 225	50 – 73
Solids Loading (lb/hr)	436 – 942	600 – 1,000
Polymer	Clarifloc SE – 1692 (Existing plant polymer) and Clarifloc C-6266	Clarifloc C-6266
Polymer Dosage (lb/active ton)	10 – 17	7 - 12



Alfa Laval provided a KPZ Belt Press High Solids (HS) 1.3 m

Pilot Testing Summary

Alfa Laval – 3-Belt Filter Press



(a) TWAS gravity belt (b) Dewatering (c) Dewatered TWAS cake solids (d) Combined filtrate and wash water flowing into sump.

Pilot Testing Summary

Andritz – Centrifuge Summary

Pilot Testing Period - May 8 – May 17, 2023

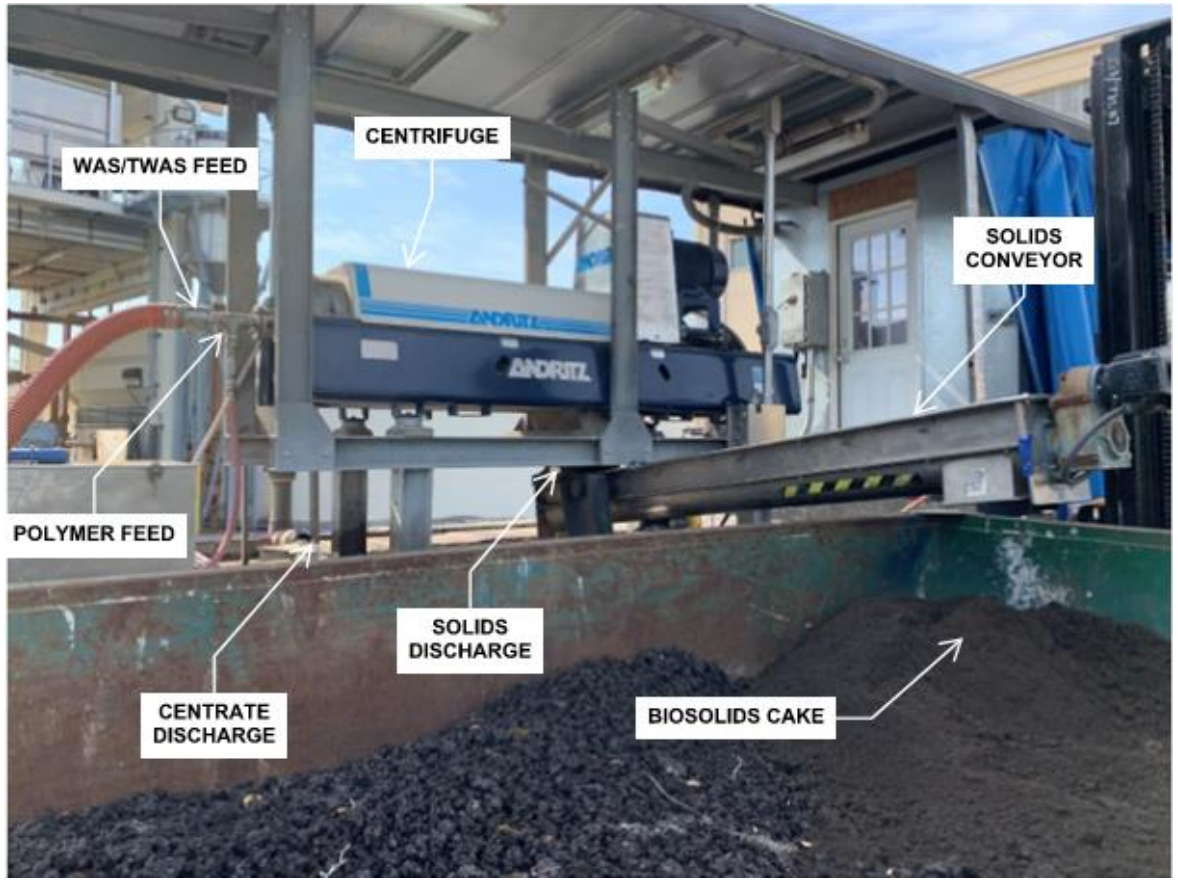
- Equipment - ANDRITZ Decanter High Performance Centrifuge (D4L)

Parameter	WAS	TWAS
Testing Period	May 8 – 10, 2023	May 15 – 17, 2023
Hydraulic Loading (gpm)	70 - 130	25 – 65
Solids Loading (lb/hr)	210 - 390	280 – 950
Polymer	Clarifloc C-6262, Clarifloc C-6266, and Zetag 8840 FS	Clarifloc C-6262, Clarifloc C-6266, and Zetag 8840 FS
Polymer Dosage (lb/active ton)	15 – 64	19 – 45

Andritz D4L Centrifuge

Andritz – Centrifuge

Pilot Testing Details



(a) (b)

Centrate from (a) WAS and (b) TWAS

(a) (b)

Dewatered cake from (a) WAS and (b) TWAS using Andritz D4L Centrifuge

Pilot Testing Summary

Alfa Laval – Centrifuge Summary

Pilot Testing Period May 23 – June 6, 2023

- Equipment - Alfa Laval ALSYS G3-75 Centrifuge

Parameter	WAS	TWAS
Testing Period	May 23 – 25, 2023	June 5 – 6, 2023
Hydraulic Loading (gpm)	100 - 140	100
Solids Loading (lb/hr)	235 - 350	1,400 – 1,500
Polymer	Clarifloc C-6266	Clarifloc C-6266
Polymer Dosage (lb/active ton)	13 - 36	28 – 32

Alfa Laval ALSYS G3-75 Centrifuge

Pilot Testing Summary

Alfa Laval – Centrifuge

(a) (b) (c)

(a) Alfa Laval ALSYS G3-75Centrifuge, (b) Centrate, and (c) Dewatered Cake

Analysis Summary

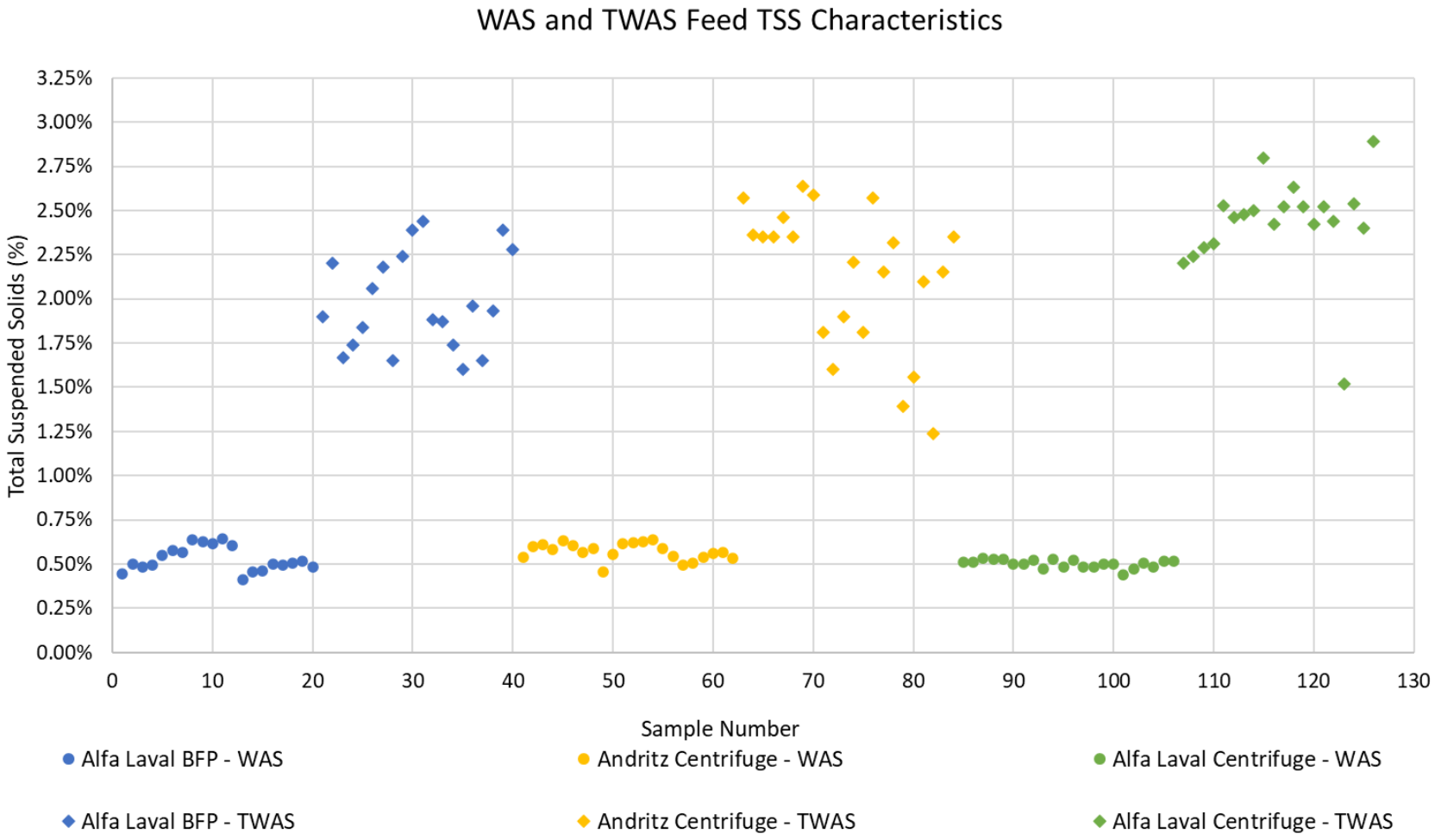
Pilot Testing Summary

- Lab Testing by PACE Analytical
  - 142 (126 Grab + 16 Composite) total samples
  - WAS / TWAS - TSS & VSS
  - Filtrate / Centrate - TSS &VSS
  - Cake - TS
  - Daily Filtrate Composite – N (Ammonia), P (Ortho P and Total P), COD (Soluble and Total)
- Equipment Manufacturer Data:
  - Polymer dosage
  - WAS/TWAS Throughput
  - Dewatering equipment operating parameters

Pilot Testing Results

Feed TSS

WAS and TWAS Feed Characteristics

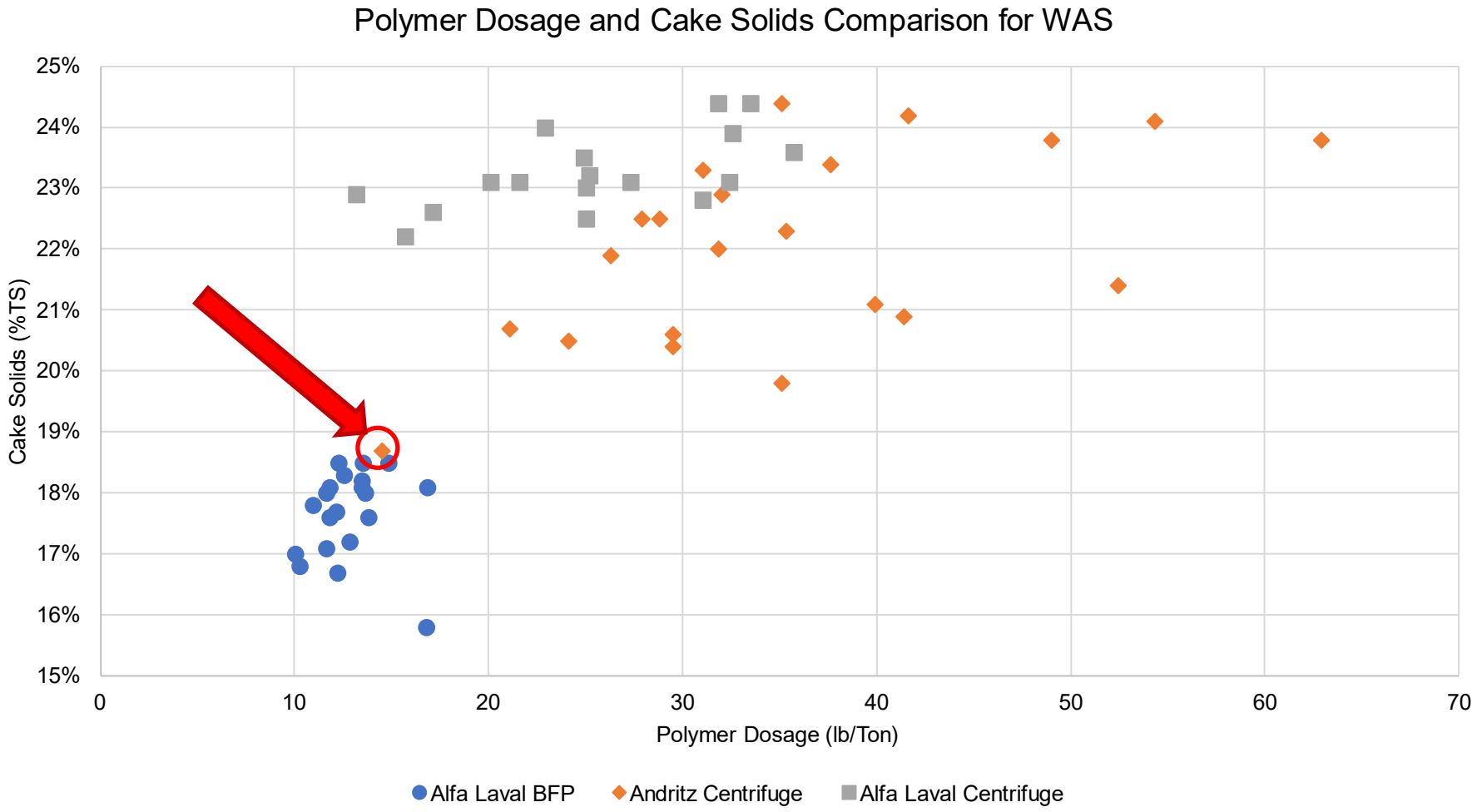


Manufacturer	Equipment	Average WAS Feed TSS (%)	Average TWAS Feed TSS (%)
Alfa Laval	Belt Filter Press	0.52	1.88
Andritz	Centrifuge	0.57	2.13
Alfa Laval	Centrifuge	0.50	2.43

Cake solids vs Polymer Dosage

WAS

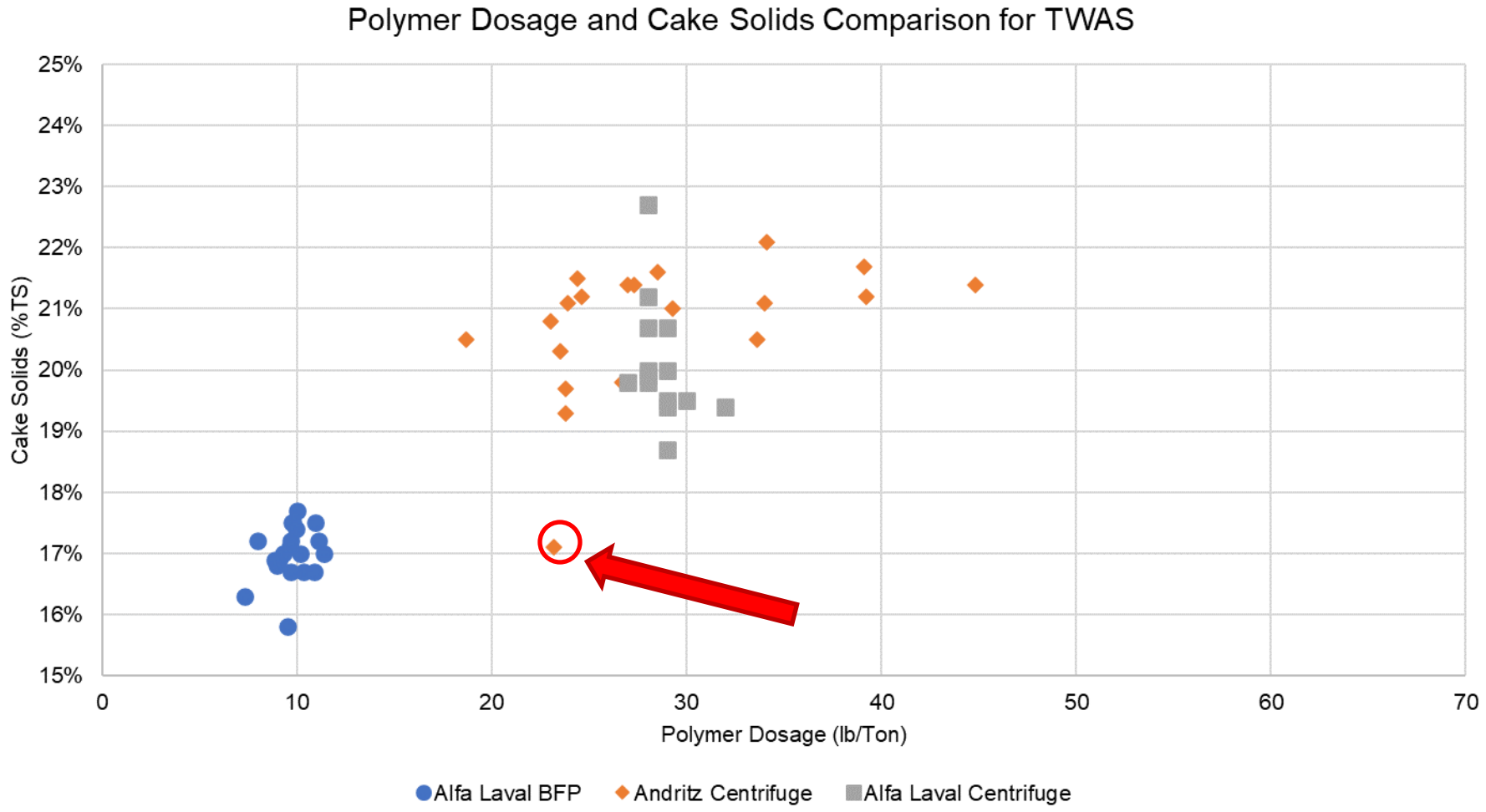
Cake Solids and Polymer Dosage



Manufacturer	Equipment	Average WAS Cake Solids (%TS)		Average WAS Polymer Dosage Active (lb/Ton)	
Alfa Laval	Belt Filter Press	17.7	+24.1%	12.8	+177.3%
Andritz	Centrifuge	22.1	+31.1%	35.5	+100.0%
Alfa Laval	Centrifuge	23.2		25.6	

TWAS

Cake Solids and Polymer Dosage

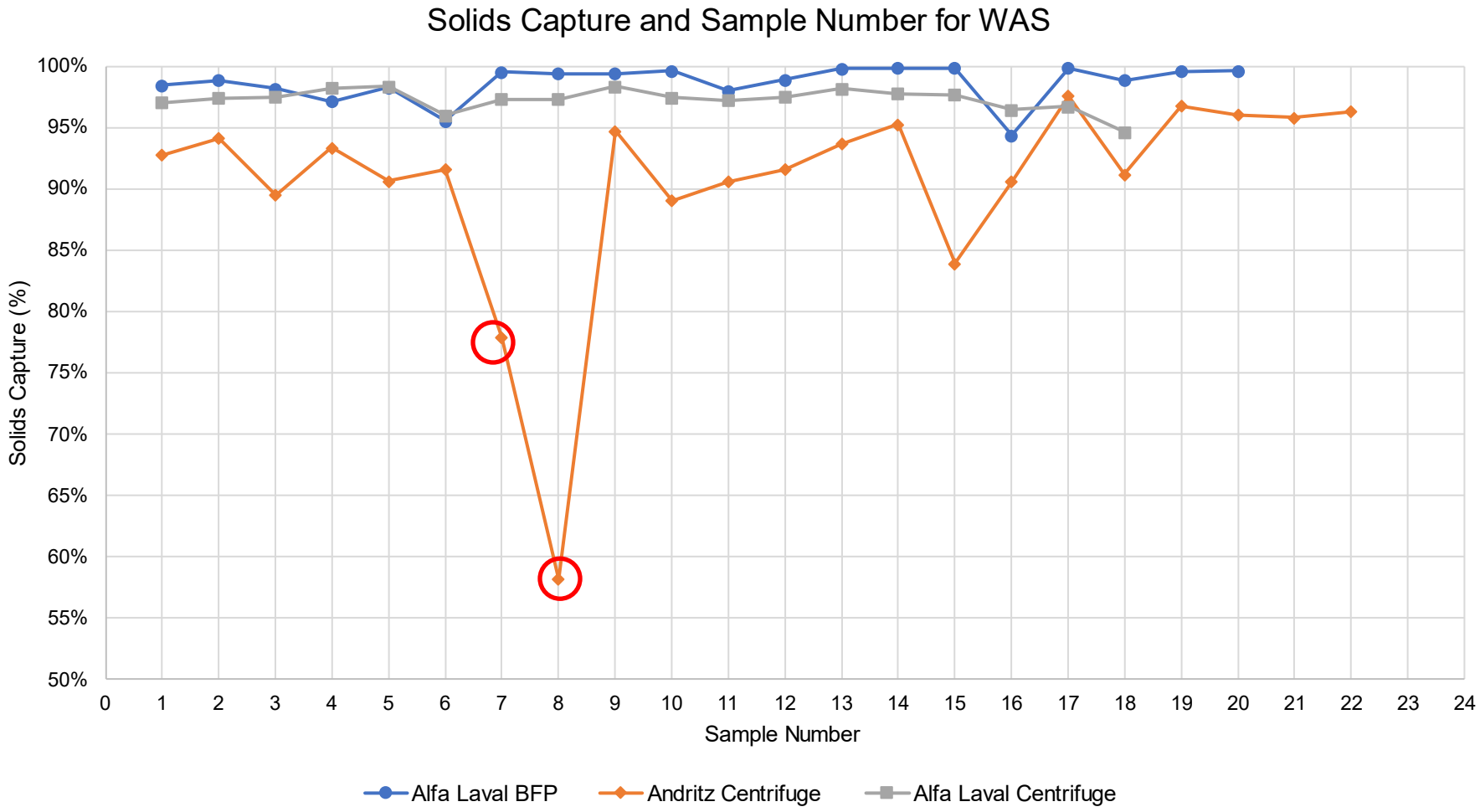


Manufacturer	Equipment	Average TWAS Cake Solids (%TS)	Average TWAS Polymer Dosage Active (lb/Ton)
Alfa Laval	Belt Filter Press	17.0	9.7
Andritz	Centrifuge	20.9	28.6
Alfa Laval	Centrifuge	20.0	28.7

+22.9%
+17.6%
+194.8%
+195.8%

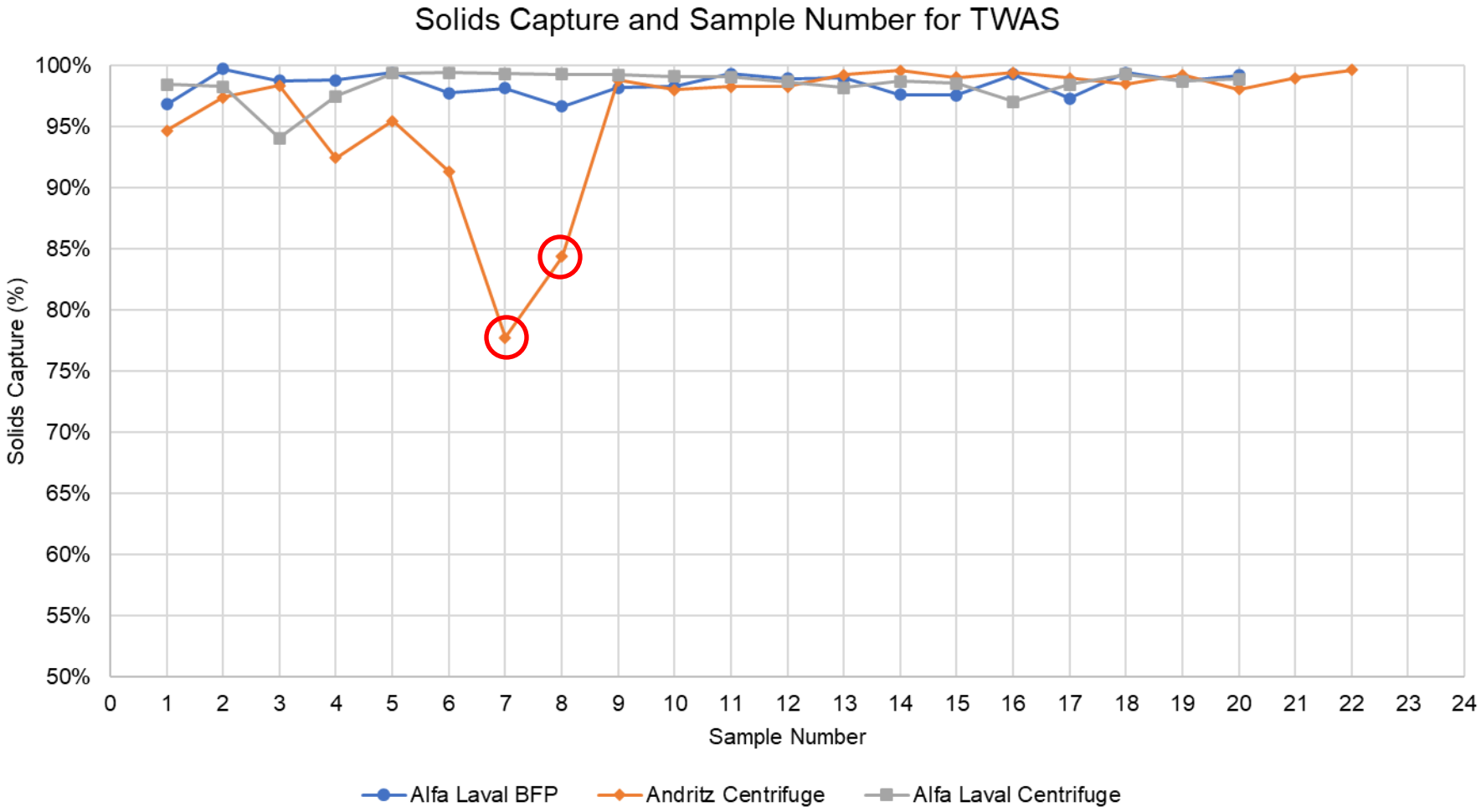
Solids Capture

WAS
Solids Capture



Manufacturer	Equipment	Average Solids Capture for WAS
Alfa Laval	Belt Filter Press	98.7%
Andritz	Centrifuge	90.5%
Alfa Laval	Centrifuge	97.2%

TWAS
Solids Capture



Manufacturer	Equipment	Average Solids Capture for TWAS
Alfa Laval	Belt Filter Press	98.4%
Andritz	Centrifuge	96.2%
Alfa Laval	Centrifuge	98.5%

Filtrate Composite Analysis

Filtrate/Centrate Analysis

Filtrate Analysis - Summary

Filtrate Analysis for WAS

Equipment	Centrate / Filtrate Stream	COD (mg/L)	COD, Soluble (mg/L)	Nitrogen, Ammonia (mg/L)	Phosphorous, Total as P (mg/L)	Orthophosphate as P (mg/L)
Alfa Laval BFP	WAS	60-126	16-23	0.1-0.2	1.9-3.3	1.9-2.2
Andritz Centrifuge	WAS	167-468	16	0.2-0.3	6-48	3.5-3.8
Alfa Laval Centrifuge	WAS	93-159	21-25	0.15-0.17	4-5	2.3-3.7

Filtrate Analysis for TWAS

Equipment	Centrate / Filtrate Stream	COD (mg/L)	COD, Soluble (mg/L)	Nitrogen, Ammonia (mg/L)	Phosphorous, Total as P (mg/L)	Orthophosphate as P (mg/L)
Alfa Laval BFP	TWAS	102-133	38-43	0-46	133-166	106-166
Andritz Centrifuge	TWAS	497-2,440	100-142	93-117	410-490	333-387
Alfa Laval Centrifuge	TWAS	668	91	150	461	716

NOTE - The results are reported as received from PACE laboratory

Pilot Testing
Data Analysis

Filtrate Analysis - Key Observations

Key Observation #1:

Concentrations of analytes for TWAS appear to be significantly higher than for WAS potentially indicating there is release of nutrients in the holding tank.

Key Observation #2:

The P concentration in filtrate for TWAS appears to be higher which could lead to formation of struvite and decrease dewaterability.

Date	COD, Soluble (mg/L)	COD (mg/L)	Nitrogen, Ammonia (mg/L)	Orthophosphate as P (mg/L)	Phosphorous, Total as P (mg/L)
Avg. WAS	19.2	195	1.7	2.8	12.7
Avg. TWAS	80.6	648	75.7	317	323

Conclusion & Recommendations

Conclusion

Conclusion & Recommendations

- Both belt filter press and centrifuge can exceed the 17.5% cake solids requirement
- With the exception of few data points, both centrifuge and belt filter press can attain >= 95% solids capture

Belt Filter Press: Recommended Performance Requirements

3-Belt Filter Press		
Parameter/Feed	**WAS**	**TWAS**
Cake Solids (%TS)	18%	17.5%
Polymer Dosage (Active) (lb/Ton)	15	12
Solids Capture (%)	95%	95%

Centrifuge: Recommended Performance Requirements

Centrifuge		
Parameter/Feed	**WAS**	**TWAS**
Cake Solids (%TS)	22%	21%
Polymer Dosage (Active) (lb/Ton)	35	30
Solids Capture (%)	95%	95%

Acknowledgements

Acknowledgements

- Jeovanni Ayala – Lugo – Principal Process Engineer, Stantec
- Manuel Moncholi – Senior Process Engineer, Stantec
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- Rebekah Stalvey – Plant Operations, WEDWRF

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Pinellas County

ALFA LAVAL

ANDRITZ

Questions and Discussion

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APPENDIX

Cake Solids and Polymer Dosage Comparison between WAS and TWAS

Comparison of Cake Solids (%TS) for WAS and TWAS

Manufacturer	Equipment	Average WAS Cake Solids (%TS)	Average TWAS Cake Solids (%TS)	Cake Solids (%TS) decrease from WAS to TWAS
Alfa Laval	Belt Filter Press	17.7	17.0	3.9%
Andritz	Centrifuge	22.1	20.9	5.4%
Alfa Laval	Centrifuge	23.2	20.0	23.2%

Comparison of Polymer Dosage (lb/Ton) between WAS and TWAS

Manufacturer	Equipment	Average WAS Polymer Dosage Active (lb/Ton)	Average TWAS Polymer Dosage Active (lb/Ton)	Polymer dosage decrease from WAS to TWAS
Alfa Laval	Belt Filter Press	12.8	9.7	24.2%
Andritz	Centrifuge	35.5	28.6	19.4%
Alfa Laval	Centrifuge	25.6	28.7	12.1% (Increase)

Pilot Testing Data Analysis

Composite Filtrate / Centrate Analysis

Pilot Testing
Data Analysis

WAS - Filtrate Composite Analysis

Date	COD, Soluble (mg/L)	COD (mg/L)	Nitrogen, Ammonia (mg/L)	Orthophosphate as P (mg/L)	Phosphorous, Total as P (mg/L)
4/18/2023	18.9	126	0.2	2.1	3.3
4/19/2023	23.1	62.5	0.12	2.2	2.5
4/20/2023	16.1	60.8	0.1	1.9	1.9
5/9/2023	16.1	468	0.22	3.6	38.1
5/10/2023	16.1	464	0.26	3.8	48.8
5/11/2023	16.1	167	0.28	3.5	6.1
5/23/2023	20.8	158	0.17	3.7	5.1
5/24/2023	25.2	159	0.17	2.3	4.0
5/25/2023	20.8	92.6	0.15	2.5	4.2

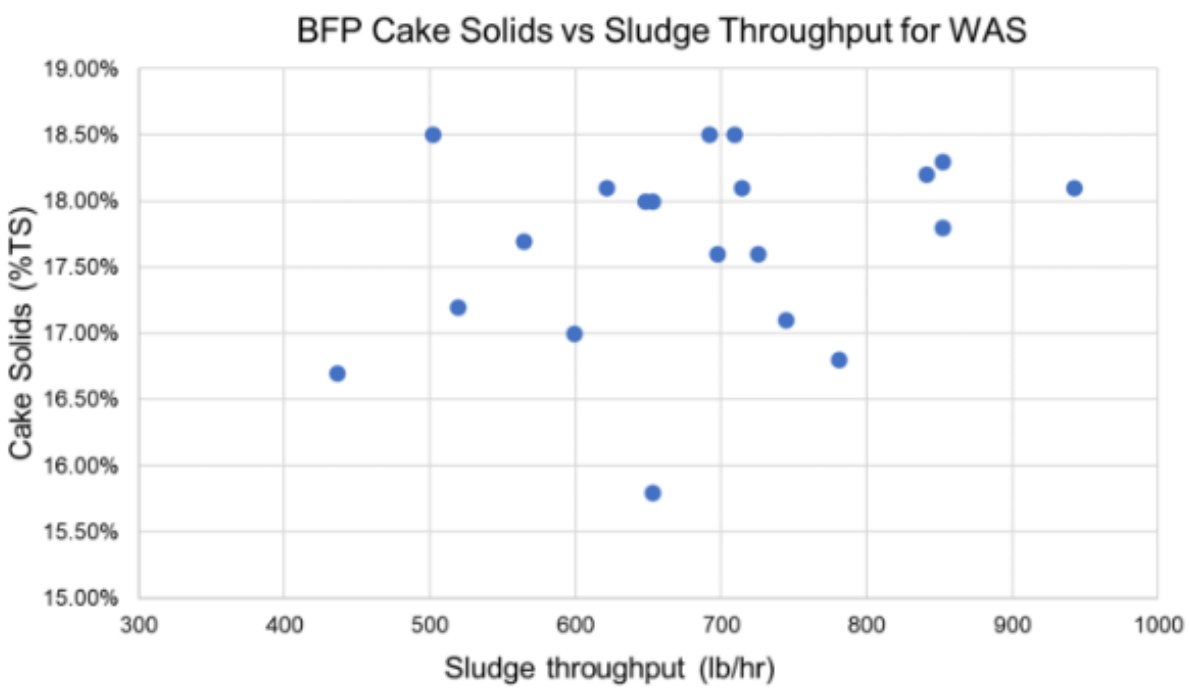
Pilot Testing
Data Analysis

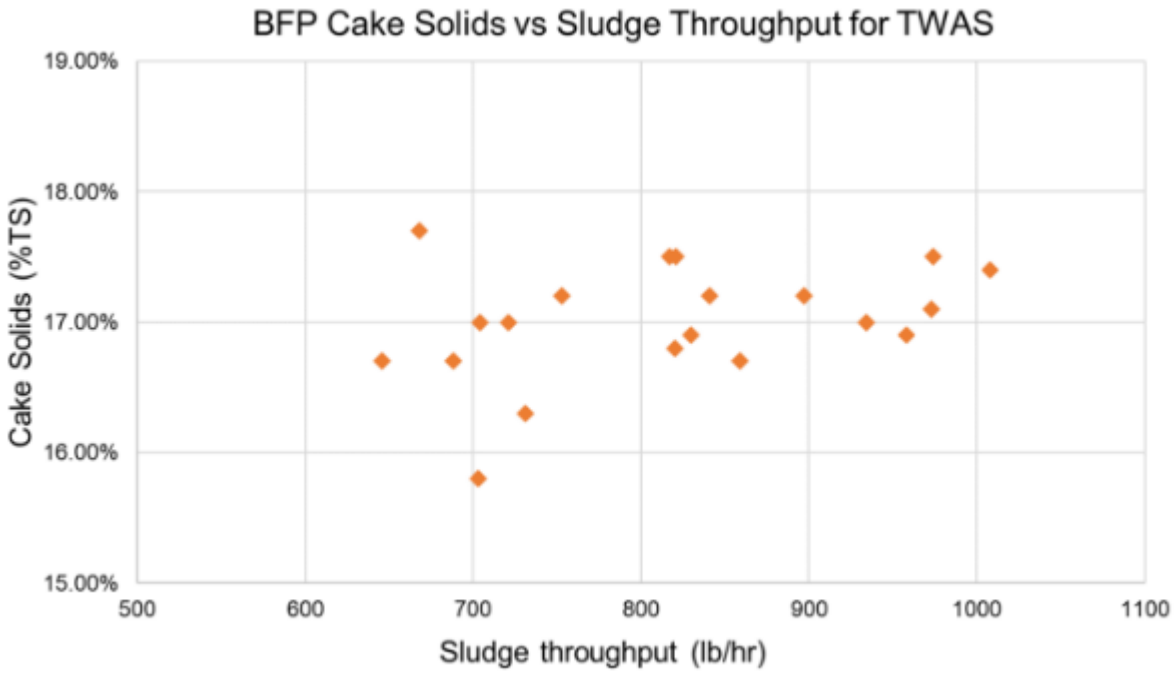
TWAS - Filtrate Composite Analysis

Date	COD, Soluble (mg/L)	COD (mg/L)	Nitrogen, Ammonia (mg/L)	Orthophosphate as P (mg/L)	Phosphorous, Total as P (mg/L)
4/25/2023	38	104	22.6	106	136
4/26/2023	38	102	0.035	130	133
4/27/2023	42.3	133	45.4	166	166
5/15/2023	113	2440	112	381	489
5/16/2023	99.9	592	92.9	333	410
5/17/2023	142	497	107	387	469
6/5/2023	N/A	N/A	N/A	N/A	N/A
6/6/2023	91.3	668	150	716	461

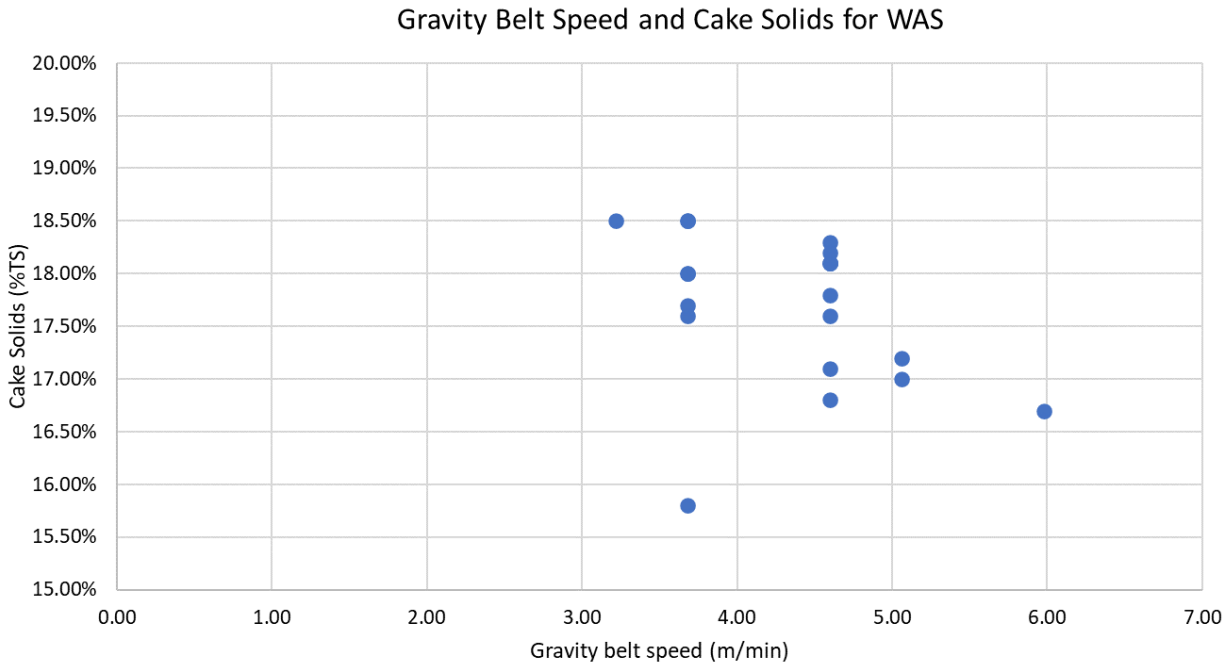
Alfa Laval Belt Filter Press Analysis

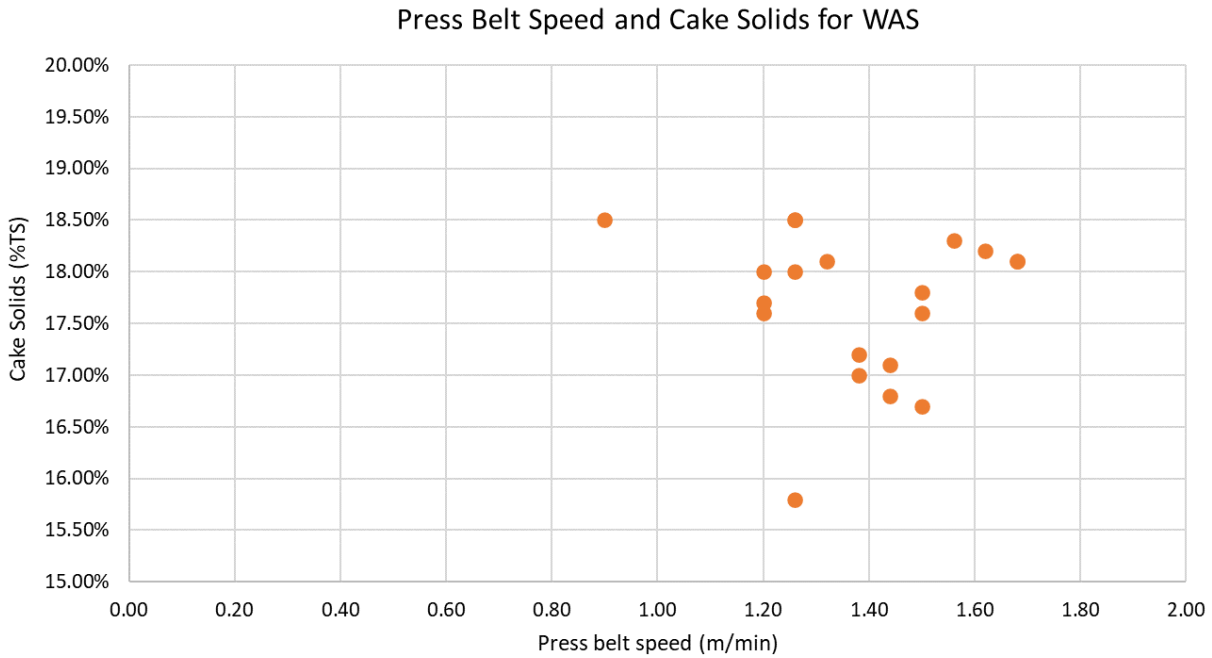
Alfa Laval BFP – Sludge Throughput





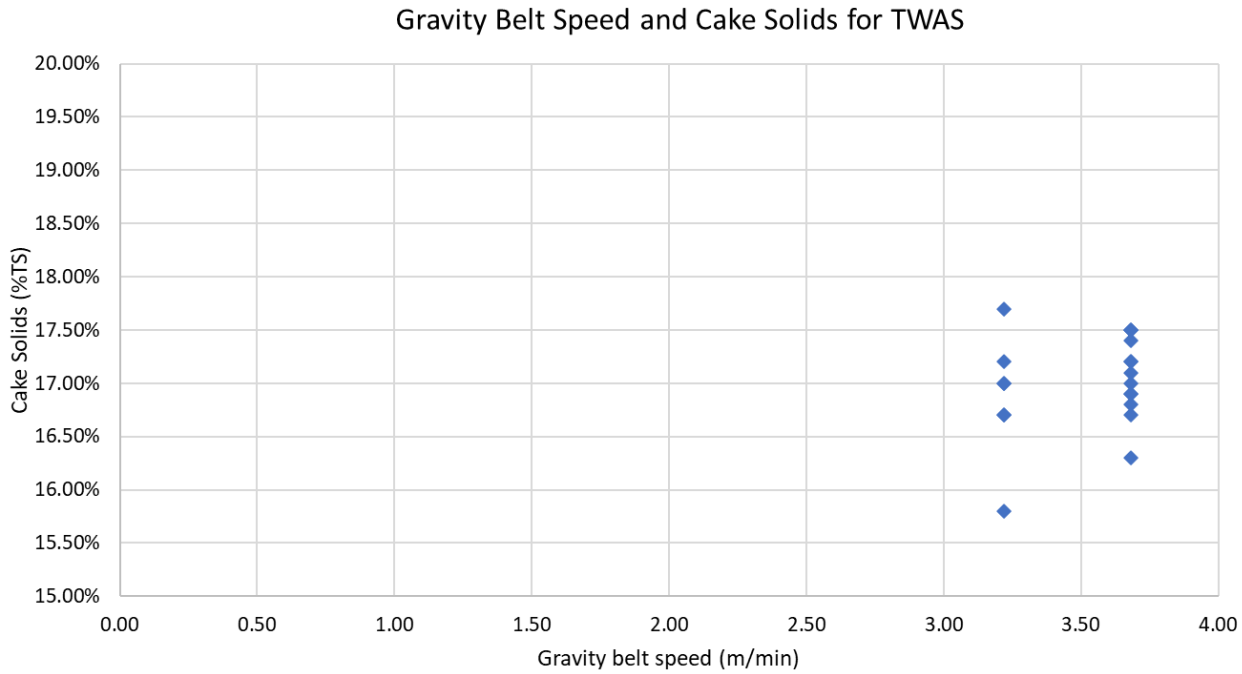
Alfa Laval BFP - Belt Speed and Cake Solids comparison for WAS

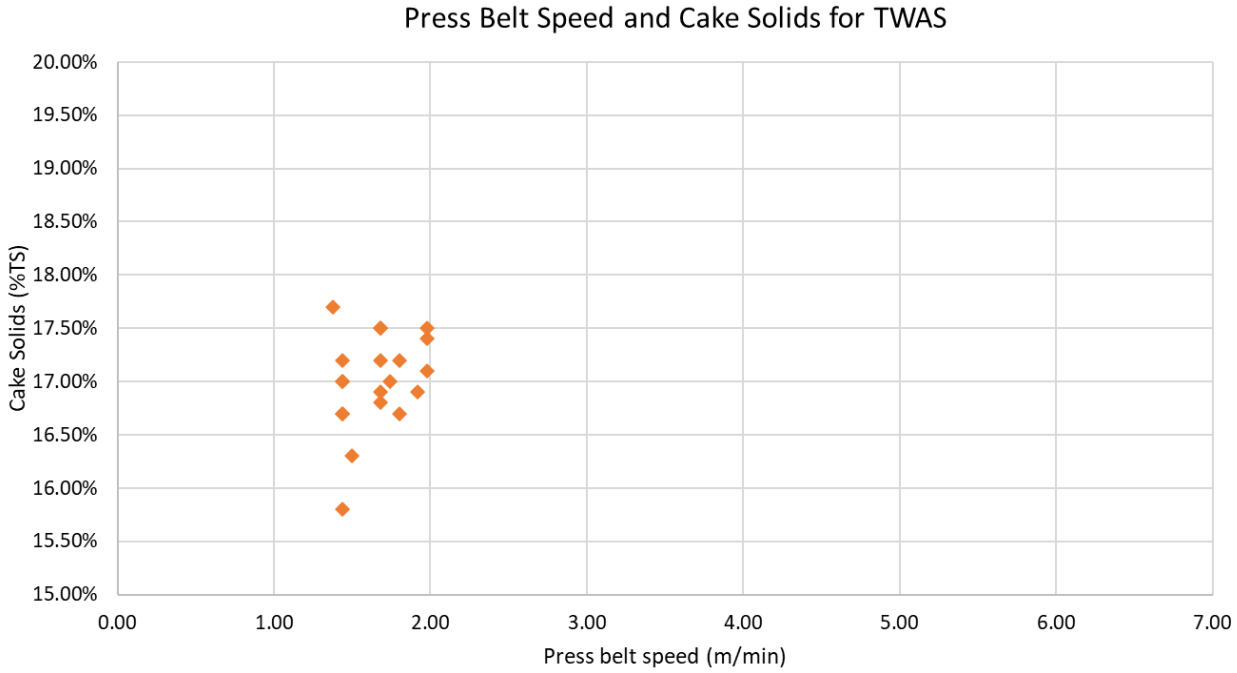




Parameter	Minimum	Average	Maximum
Gravity Belt Speed (m/min)	3.22	4.32	5.98
Press Belt Speed (m/min)	0.90	1.38	1.68
Cake Solids (%TS)	15.8	17.7	18.5

Alfa Laval BFP- Belt Speed and Cake Solids comparison for TWAS

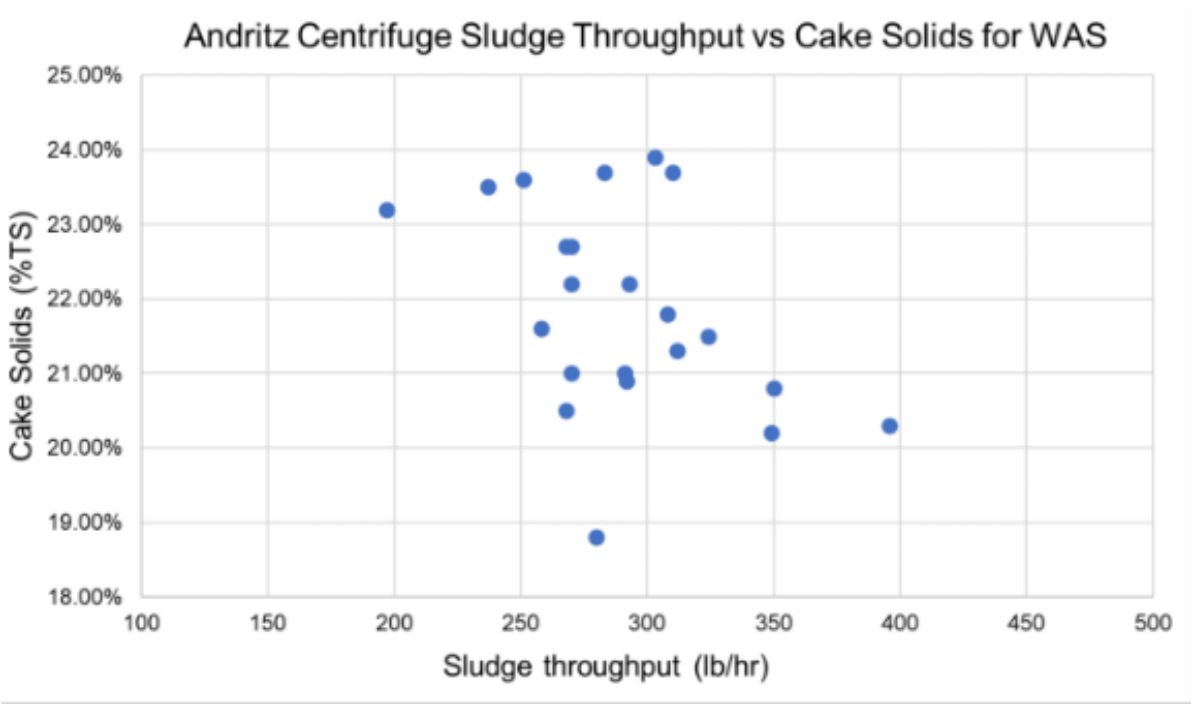


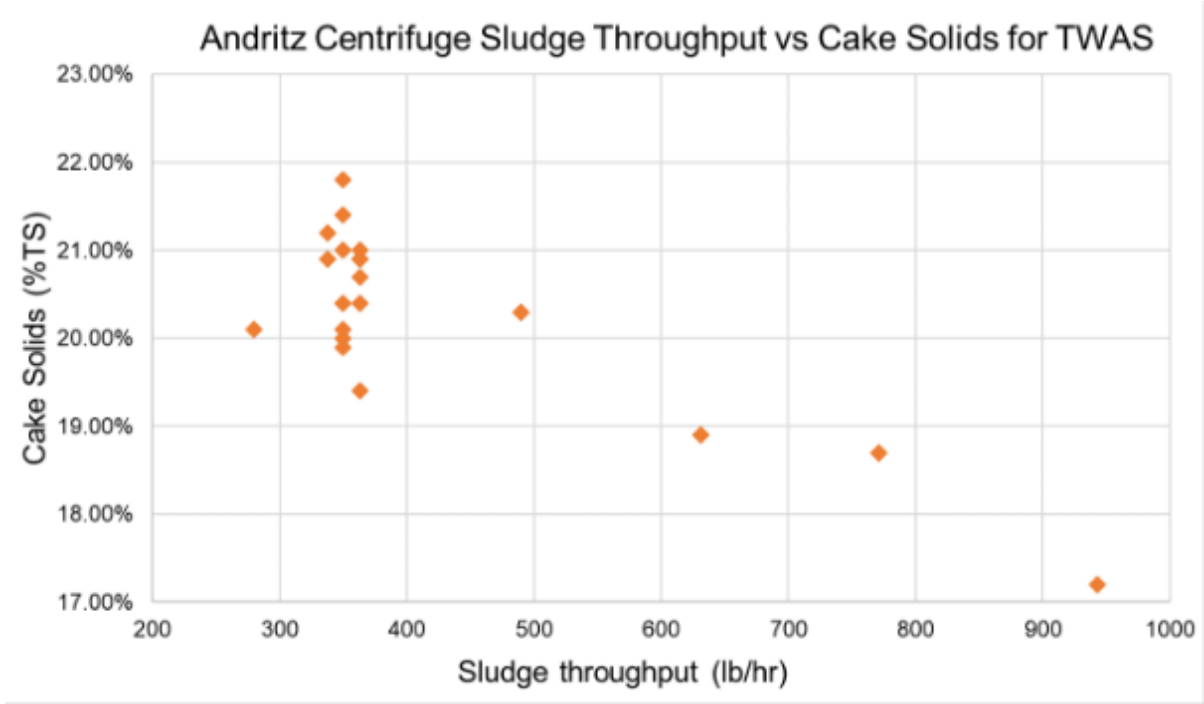


Parameter	Minimum	Average	Maximum
Gravity Belt Speed (m/min)	3.22	3.52	3.68
Press Belt Speed (m/min)	1.38	1.66	1.98
Cake Solids (%TS)	15.8	17.0	17.7

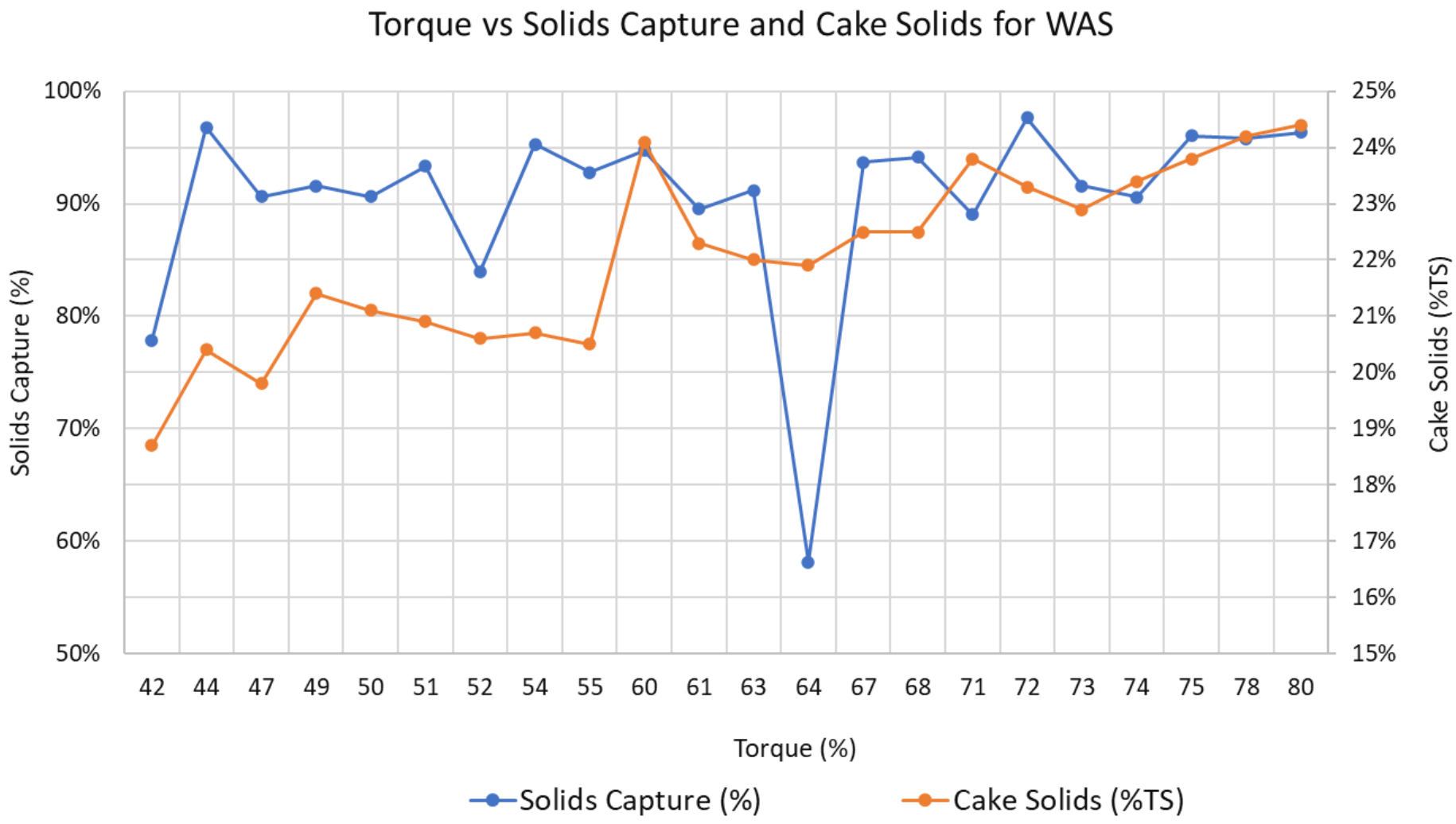
Andritz Centrifuge Analysis

Andritz Centrifuge – Sludge Throughput

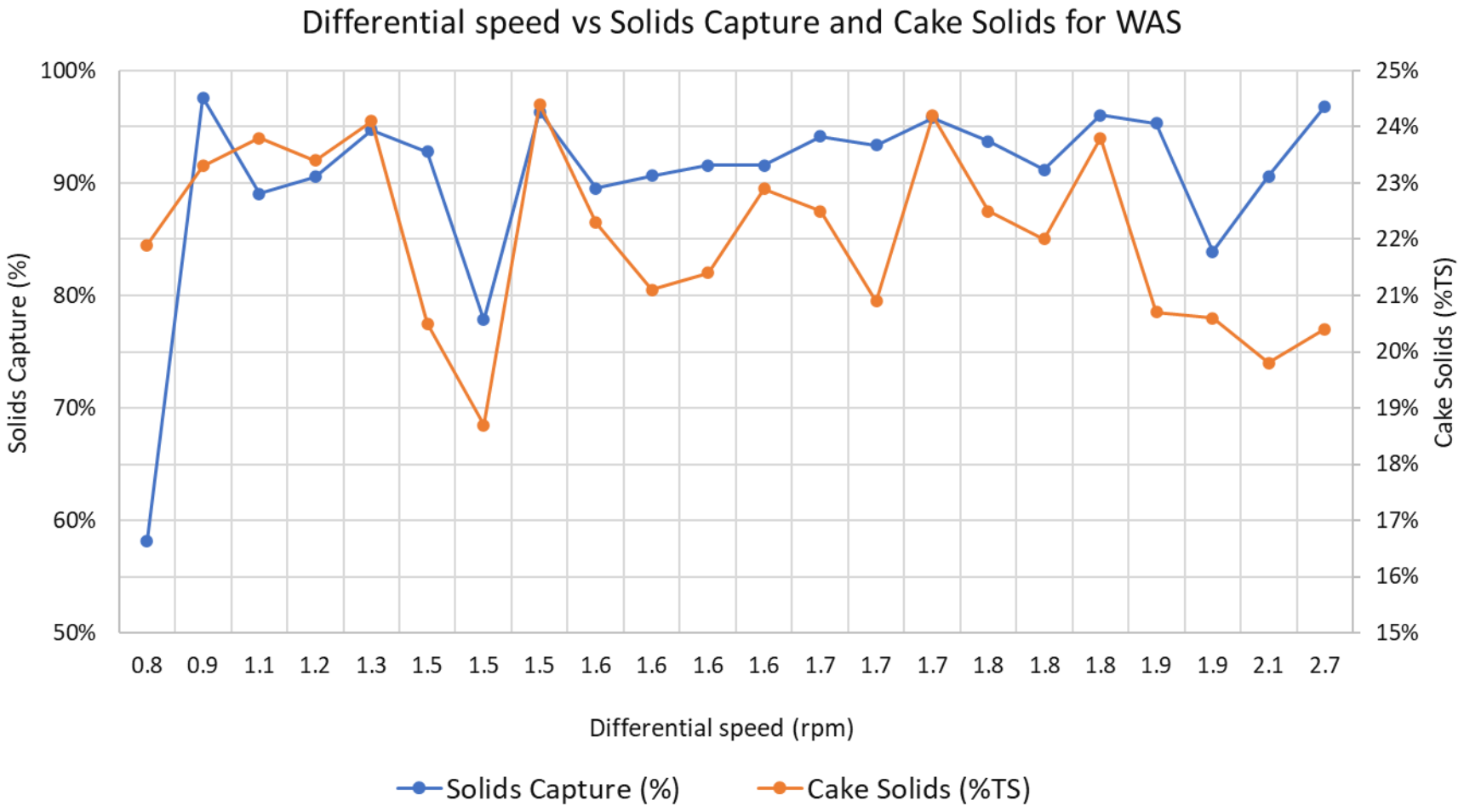




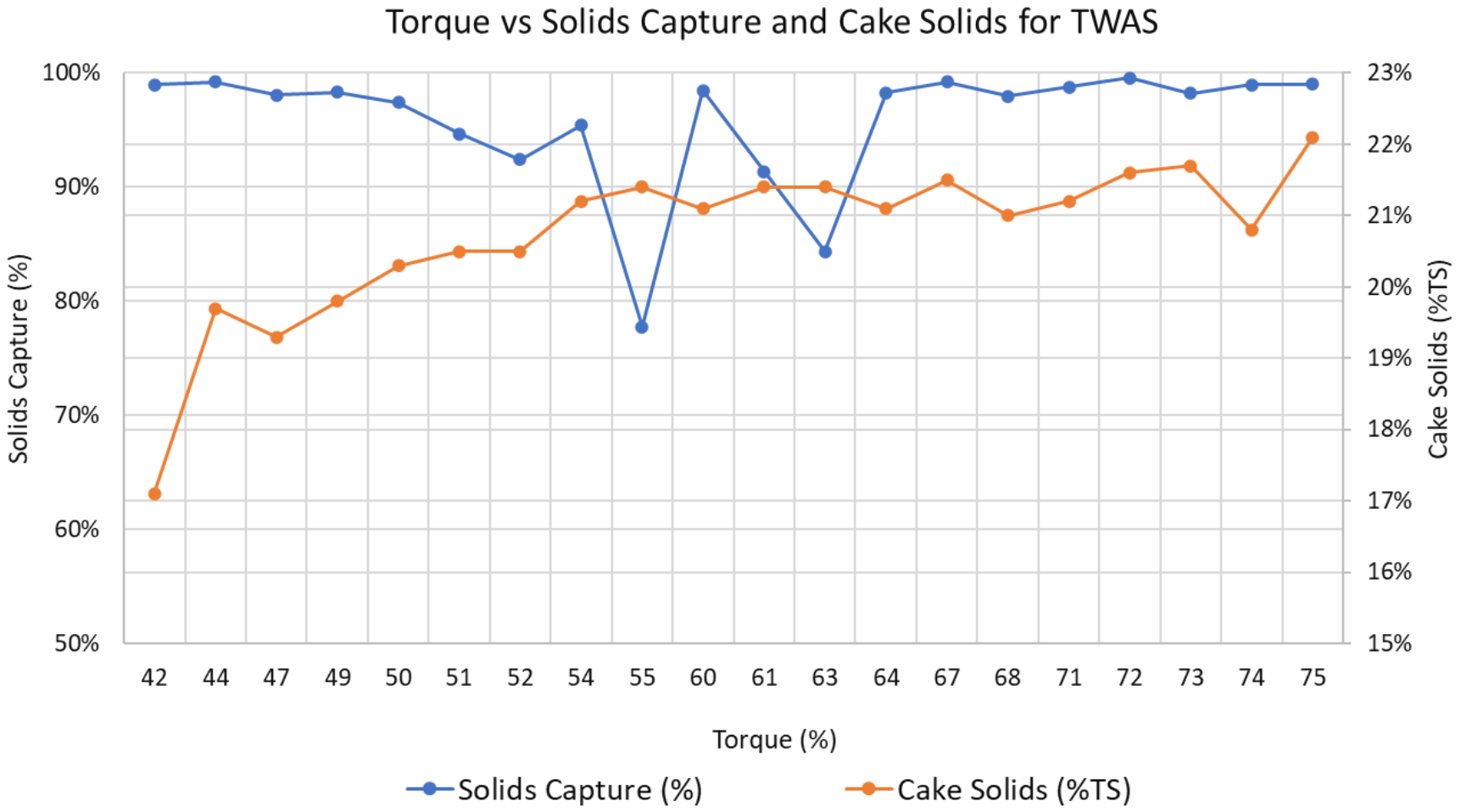
Andritz Centrifuge- Torque effect on Solids Capture and Cake Solids for WAS



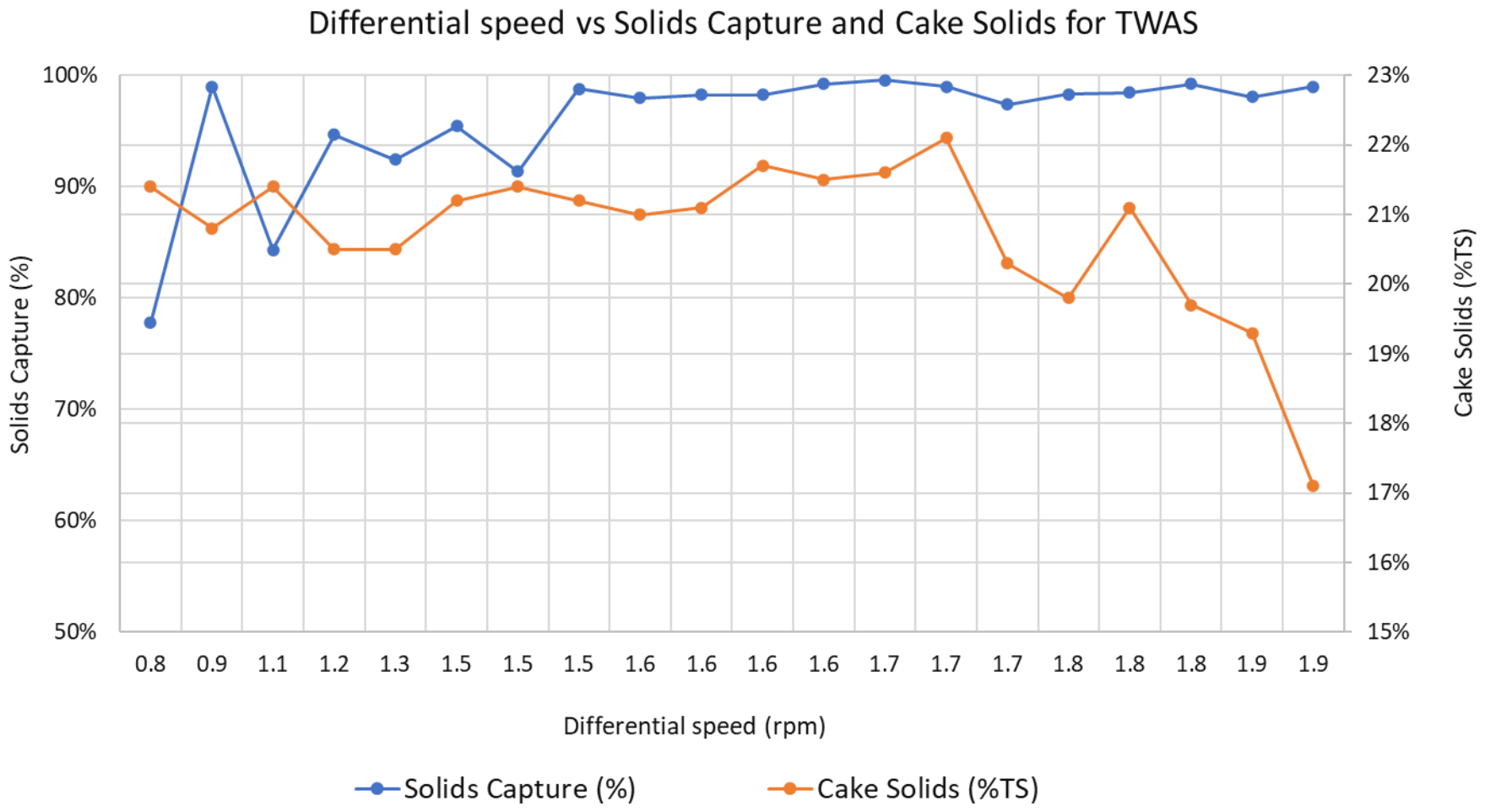
Andritz Centrifuge- Differential Speed effect on Solids Capture and Cake Solids for WAS



Andritz Centrifuge- Torque effect on Solids Capture and Cake Solids for TWAS

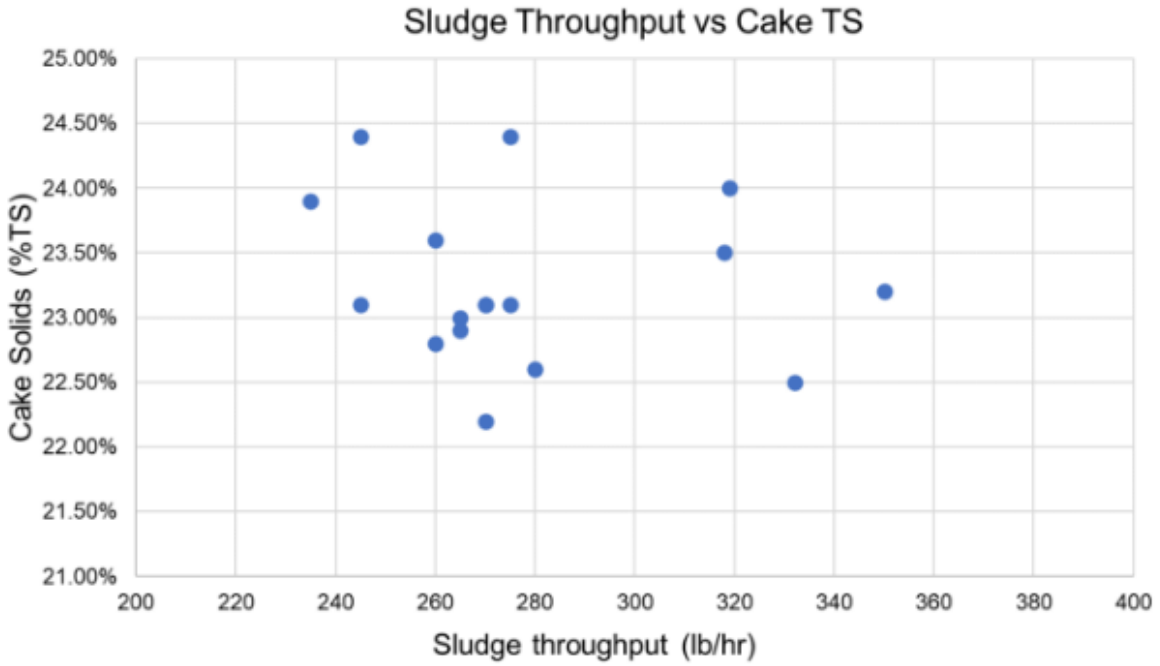


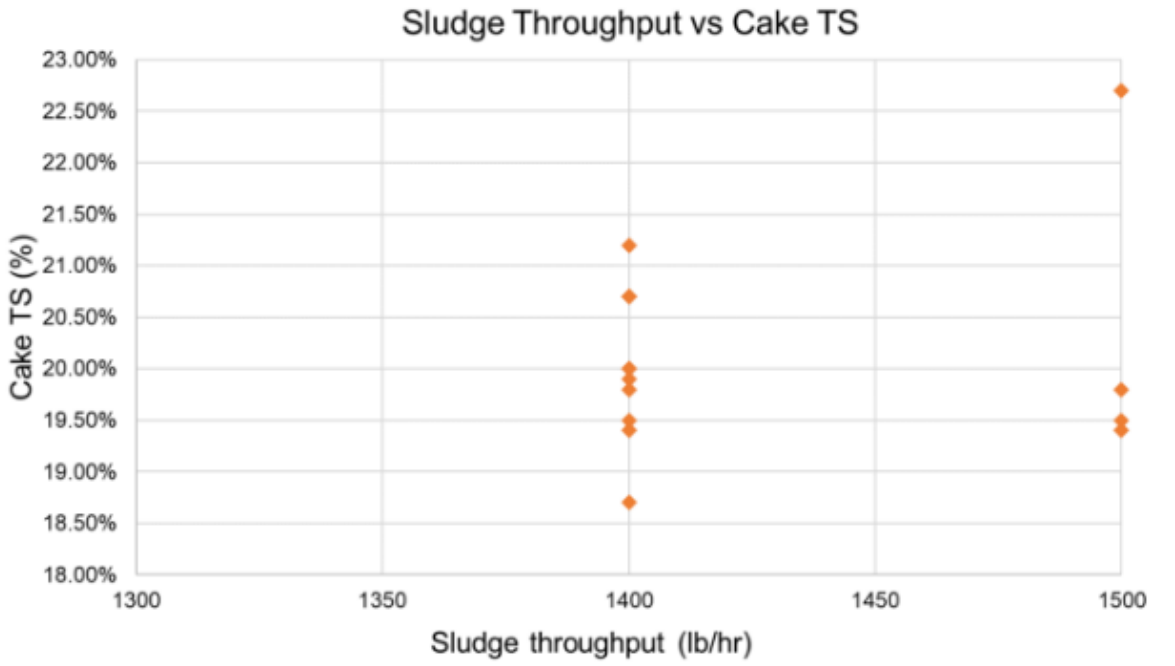
Andritz Centrifuge- Differential Speed effect on Solids Capture and Cake Solids for TWAS



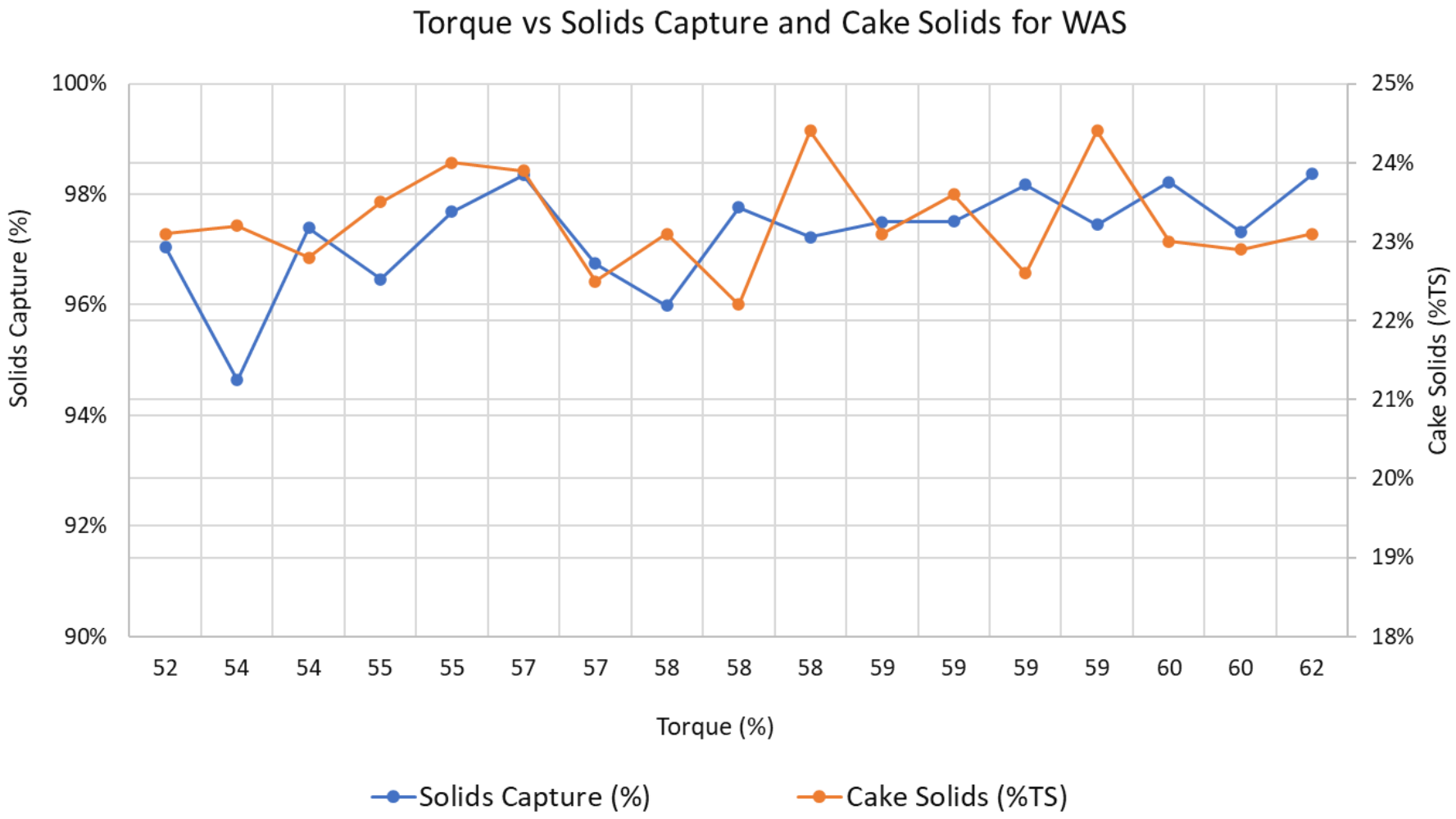
Alfa Laval Centrifuge Analysis

Alfa Laval Centrifuge – Sludge Throughput

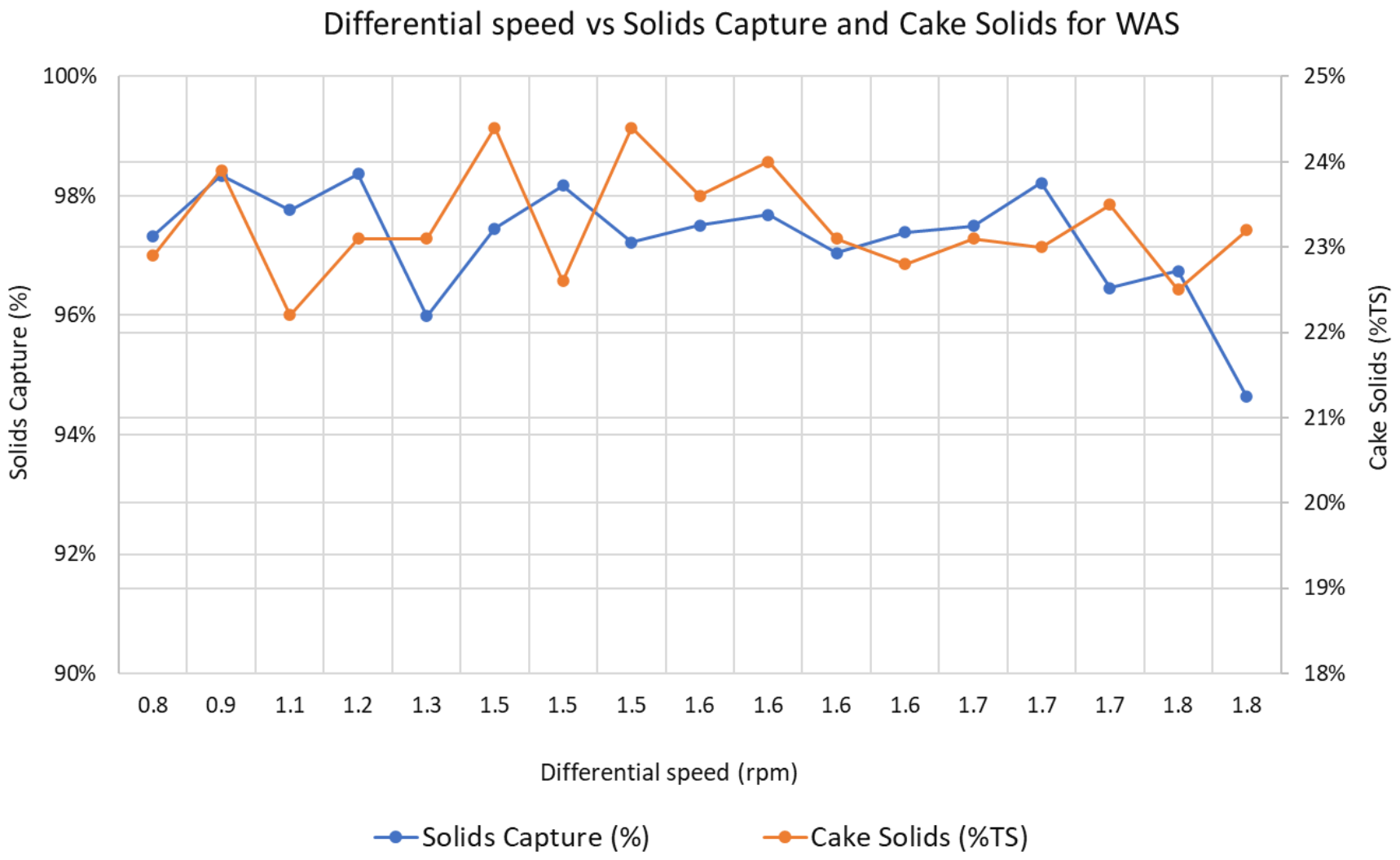




Alfa Laval Centrifuge- Torque effect on Solids Capture and Cake Solids for WAS



Alfa Laval Centrifuge- Differential Speed effect on Solids Capture and Cake Solids for WAS



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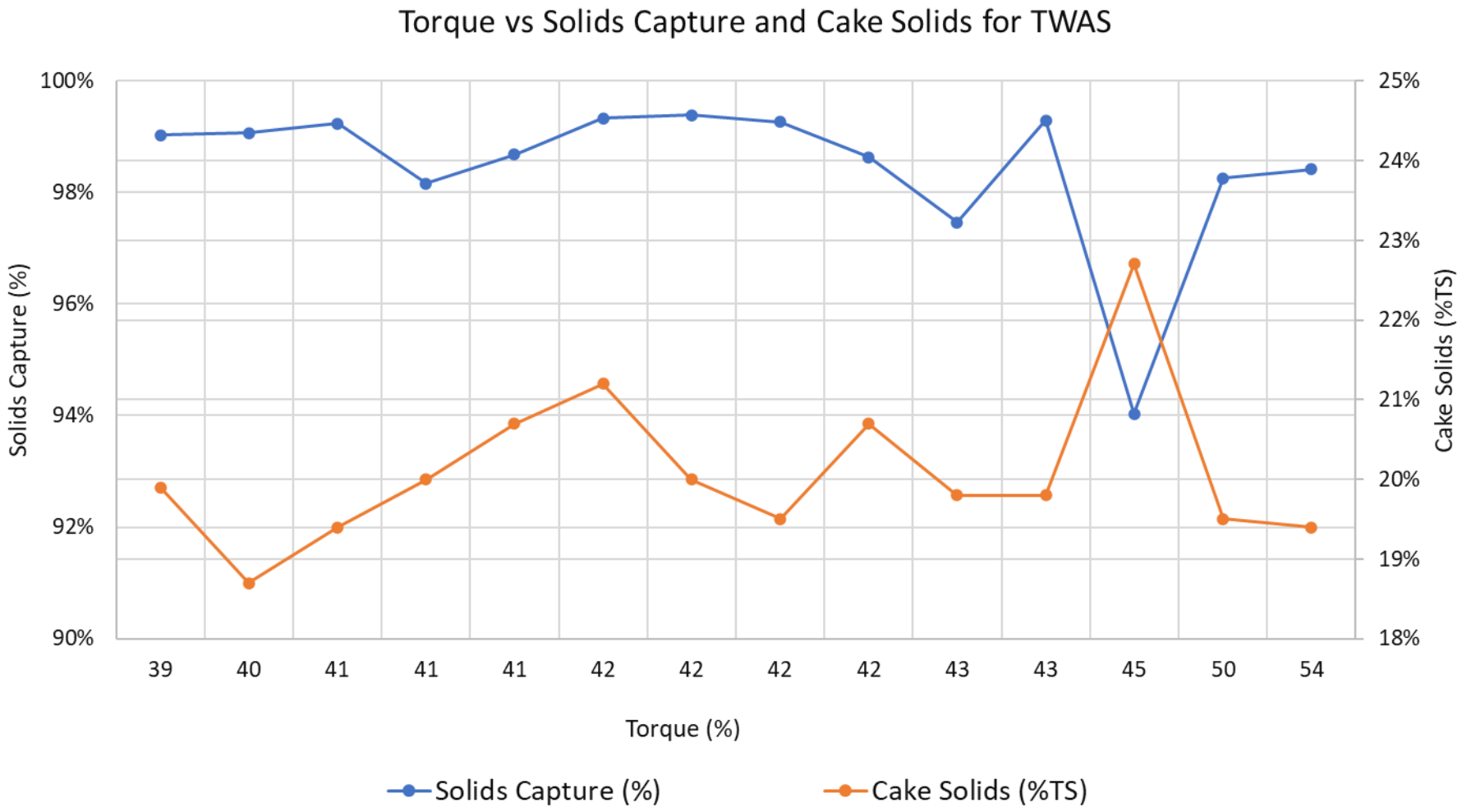

Alfa Laval Centrifuge- Differential Speed effect on Solids Capture and Cake Solids for TWAS