BIOSOLIDS DEWATERING

Analysis: Process Optimization and Evaluation of *Hydro*FLOW™ Technology for Reduced Polymer Consumption and Drier Cake Solids

SOUTHWEST WATER RECLAMATION FACILITY

City of Cape Coral

Cape Coral, FL

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Summary

In February 2019, Enpure was engaged to implement a demonstration trial at the City of Cape Coral, Florida Southwest Water Reclamation facility to evaluate *Hydro*FLOW technology for polymer reduction and drier cake solids in biosolids dewatering. The trial was performed at no cost or risk to the City of Cape Coral. As part of the trial, Enpure initiated optimization procedures with Cape Coral Biosolids Management and personnel in order to provide baseline data for evaluation of the technology. The objective of the trial was twofold:

- Optimize dewatering operations to achieve maximum cake solids with minimum polymer consumption
- Utilize *Hydro*FLOW technology to reduce polymer consumption by 10% - 20%, while maintaining centrate capture over 95%, and equivalent or improved cake solids %.

Over the course of the trial, it was determined that the City can optimize its centrifuge-based dewatering operations by reducing solids throughput to 900 lbs/hr or less. In October 2019, Centrifuges #2 and #3 were operated within this range achieving a total dewatering cost of $258.44 per dry ton versus an average in 2019 of $281.05, a savings of $22.61 per dry ton, or annualized savings of $49,800 for 2020 based upon similar dry solids production of 2200 pounds. Overall, the data and Enpure project total savings ranging between $60,000 - $70,000 per year, representing over 10% of the total dewatering budget, just from optimization and improved efficiency.

For the first quarter of 2020 (October – December 2019), process optimization allowed the City to process 30 additional dry tons of sludge solids at the same cost as in 2019, saving approximately $8,000.

The *Hydro*FLOW technology was able to reduce polymer consumption from 31.8 lbs/ DT to 29.4 lbs/DT with an increase in cake % from 18.8% to 19.6%. These improvements, based upon annual dry solids of 2200 tons per year (current production of the Cape Coral Biosolids facility), would amount to about $28,650 in annual savings. ROI is estimated at about 9 months.

Biosolids Dewatering Operations

The City of Cape Coral, Florida Southwest Water Reclamation facility is designed to treat 15.1 MGD of wastewater from residents and businesses located within the City. Stormwater runoff is excluded from treatment by the facility. Contaminant removal is achieved with the activated sludge process and waste activated sludge dewatered utilizing three (3) Andritz D6LL centrifuges.

- The centrifuges are operated in a single 10-hour shift, effectively eight hours, five days a week, with one, two or all three centrifuges in operation for any given shift. Holidays shorten the working week to four days, often requiring the Biosolids Dewatering Department to get ahead of the WAS wasting process.

- The treatment and dewatering operations are subject to seasonality as the City's population swells during the High Season from Winter to early Spring.
- WAS is pumped into a single sludge holding tank that is aerated to keep solids in suspension and control odors. The tank is not decanted to remove excess water. Volatile solids as a percentage of total solids is relatively constant, ranging from about 83% to 87%.
- The centrifuges are fully automated with centrifuge setpoints, sludge feed rates, and polymer dosing rates all collected by the SCADA system. Operators sample feed total solids, cake solids and centrate solids from 1 – 3 times per shift per centrifuge and record the results on a daily monitoring sheet along with important centrifuge setpoints. Additionally, operators obtain grab samples of cake solids for evaluation by the Lab for regulatory reporting. Monthly reports to evaluate the performance of the dewatering operations are prepared, including total gallons dewatered, dry and wet cake solids, and polymer consumed.
- Each centrifuge possesses a dedicated Velodyne Polymer Make-up Unit (PMU), model MNT-10P-2400-Rwx, which is fully automated to activate and dilute the polymer. Target dilution for the neat polymer is 0.4%, resulting in activated polymer of 0.176%. Activated polymer is NOT aged and is injected directly into the sludge feed flow.
- Two polymer injection points are plumbed, both located upstream from the centrifuge feed tube: the first approximately 2 feet upstream (Point A), and the second 30 feet upstream (Point B). Only one injection point is in operation at a time. No injection ring or inline mixer is installed.
- Centrifuge Feed solids range between 1.0% to 1.5%, with peaks as high as 1.8% observed inconsistently in preparation for or during the High Season.
- Dewatered solids are moved by a single conveyor serving all three centrifuges and discharged into a 20 ton open top container trailer.
- During the period of the trial, tipping fees for disposal of dewatered sludge amounted to $35.22 per wet ton and polymer cost $0.99 per pound, neat.

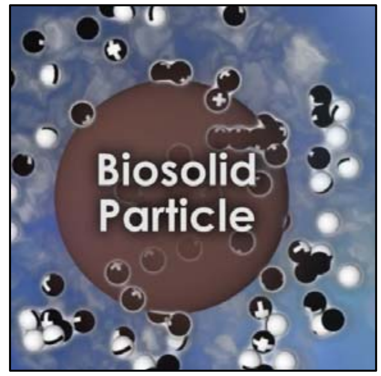
*Hydro*FLOW Technology

Developed over twenty-five years ago to control lime scale in domestic hot water applications, the *Hydro*FLOW technology has been extended to biosolid dewatering applications, including:

- Reduction of polymer consumption by 10% - 20%, with equivalent solids capture
- Drier cake solids of 1% - 3% cake points
- Struvite scale control: Inhibition of new scale and remineralization of existing scale

- Phosphorus recovery as part of existing dewatering systems

Easily installed on the exterior of any piping system or pipe material, without the need to cut or weld the piping, the *Hydro*FLOW transducer employs a ferrite ring to apply an oscillating 150 kHz radio frequency signal that penetrates the pipe wall and travels both upstream and downstream from the point of installation. The wastewater within the piping system, acts as a conduit to propagate the signal throughout the system, conditioning the water and suspended solids, whether moving or stationary.



In dewatering applications, the oscillating signal suppresses the surface charge of the suspended particles by disrupting the diffuse double layer of counter-ions surrounding the particles, allowing them to coagulate and agglomerate with less polymer, and often as a drier cake. In struvite scaling applications, the *HydroFLOW* signal induces the dissolved magnesium, ammonium, and phosphorus ions to cluster and precipitate as stable struvite crystals that remain in suspension and do not adhere to piping and equipment surfaces. The ability of *Hydro*FLOW to control the precipitation of struvite in suspension allows for the high recovery of phosphorus as micron-sized crystals within dewatered biosolids. Lastly, the signal disrupts the growth of bacteria, causing the cell walls to rupture, aiding in the mineralization of waste activated sludge.

*Hydro*FLOW Trial and Process Optimization – *Hydro*FLOW Installation

Several configurations of the *Hydro*FLOW technology were tested on Centrifuge #2 to determine the most effective arrangement for reducing polymer and improving cake dryness:

1. *Hydro*FLOW Model 120i installed on the vertical leg feeding the centrifuge, about 5’ upstream from the feed tube, with the polymer injection point at Point B, 30’ upstream. (Figure 1 and 2)
2. *Hydro*FLOW Model 120i installed on the vertical leg feeding the centrifuge, about 5’ upstream from the feed tube with a second jumper wire installed on the sludge feed line, about 5’ upstream from injection Point B.
   (Figure 1 and 2)
3. *Hydro*FLOW Model 120i installed on the vertical leg feeding the centrifuge, about 5’ upstream from the feed tube, with

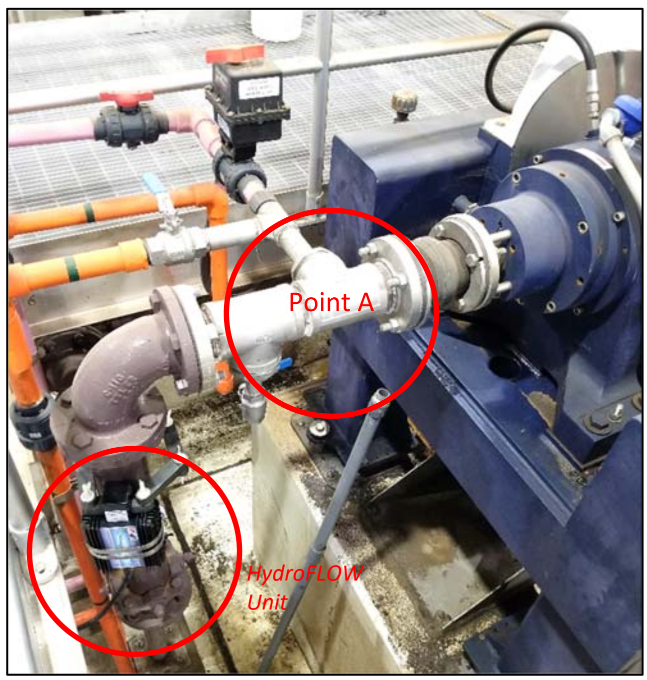


Figure 1: HydroFLOW unit / Polymer Injection, Point A

polymer injection at Point A, about 4' downstream from the *Hydro*FLOW unit. A second jumper wire was installed on the dilution water feed to the PMU. (Figure 1 and 3)

Figure 2: Second Ferrite Ring / Polymer Injection, Point B

Figure 3: Third Ferrite Ring, Dilution Water

*Hydro*FLOW Trial and Process Optimization – Operations and Testing

Prior to commencement of the *Hydro*FLOW Trial, sludge was dewatered based upon hydraulic loads, not solid loads. Centrifuge feed flow and the number of centrifuges in operation (or available for operation) was set to process the liquids (including suspended solids) wasted into the sludge holding tank such that the tank level was maintained within an acceptable range. Polymer dosing was set based upon cake and centrate appearance.

During the first two months of the trial, operation of the centrifuges was standardized as follows:

- The operators were trained in the standardized procedures. Recording of trial data did not begin until April 8.
- Bowl speed was set at 2600 RPM.
- Differential speed between the bowl and the scroll varied according to the solids loading. The maximum recommended auto-torque setpoint of the machines is 65%. To reduce bearing wear and vibration on the machines, the Biosolids Manager determined with testing that maintaining the auto-torque setpoint in the 45%-50% range provided the best trade-off between cake dryness and machine wear and tear.
- Feed solids were measured twice or thrice daily, depending upon the length of the shift, with the feed flow adjusted to maintain solids loading in the range between 900 – 1400 lbs/hour, depending upon the daily required hydraulic load.
- Polymer dosing levels were adjusted and tested for the effect on cake solids % and centrate capture % across a range of solids loads.
- On April 19, Centrifuge #1 was taken out of service and not returned until the first week of December. All data on process optimization and the *Hydro*FLOW trial was collected on Centrifuges #2 and #3, beginning on April 9.

*Hydro*FLOW Trial – Data Collection and Results

Procedures for data collection and results are as follows:

- To eliminate variance between machine performance, data from Centrifuge #2 and Centrifuge #3 was recorded and analyzed separately.
- The *Hydro*FLOW technology was energized and de-energized for a week or a month at a time, to capture data sets with similar characteristics. The status of the *Hydro*FLOW unit, On or Off is recorded.
- To eliminate noise within the data, the data sets were collected with similar feed characteristics: throughput and polymer dose (lbs/DT). Cake and centrate solids were measured for variance to evaluate the effectiveness of the *Hydro*FLOW technology and process optimization techniques for reducing polymer consumption while maintaining similar cake and centrate solids %.
- Data sets:

i) Graphical plots of all data for Centrifuge #2 and Centrifuge #3 from April 9 through November 2 are presented as follows.

   (1) Appendix A: Centrifuge #2, Dewatering performance April - November 2019
   (2) Appendix B: Centrifuge #3, Dewatering performance April - November 2019
   (3) Appendix C: *Hydro*FLOW Trial results, April - November 2019

ii) For evaluation of the *Hydro*FLOW technology, the following data sets were obtained:

   (1) From 7/11 – 8/5, Centrifuge #2 was operated with the *Hydro*FLOW OFF with consistent solids loading of 900 lbs/hr and polymer dosing of 31.8 lbs/dry ton.
   (2) From 10/2 – 10/28, Centrifuge #2 was operated with the *Hydro*FLOW ON with consistent solids loading of 900 lbs/hr with polymer dosing at 29.4 lbs/dry ton.
   (3) During the intermediate period, attempts were made to reduce the polymer dosing below 29.4 lbs/DT at the same throughput of 900 lbs /hr. While polymer dosing was lower, the polymer savings were offset by declines in cake %.
   (4) The results of these three data sets are illustrated in Appendix C, demonstrating the effectiveness of the *Hydro*FLOW technology to improve dewatering operations.

Trial Evaluation: All data points from April 8 through November 6 at 900 lbs/hour for Centrifuge #2 were plotted on the graph, Appendix C. The *Hydro*FLOW technology was able to reduce polymer consumption from 31.8 lbs/ DT to 29.4 lbs/DT with an increase in cake % from 18.8% to 19.6%. These improvements, based upon annual dry solids of 2200 tons per year (current production of the Cape Coral Biosolids facility), would amount to about $28,650 in savings, based upon $35.22 per wet ton hauled, and $0.99 per pound polymer neat. ROI is estimated at 9 months, which will shorten due to increases in tipping fees and polymer.

Process Optimization – Discussion of Results

In addition to evaluating the effectiveness of the *Hydro*FLOW technology, the trial yielded several key insights into process optimization for biosolid dewatering operations for the City.

Appendix D contains a modified form of the City's monthly summary of the Biosolid dewatering operations. The report summarizes operations for the fiscal year 2019 which runs from October 2018 through September 2019, and the first three months of fiscal year 2020, October through December 2019. Also included is a projection of costs and savings for fiscal 2020.

The modified report is identical to the report prepared by the City with the following additions and clarifications.

1. The report summarizes the monthly activity of the dewatering operations to allow comparison from month to month, including a column to show total costs per dry ton to provide comparison on processing efficiency from month to month.
2. Dry tons are calculated using the solids processed not the sampled cake %, due to a discrepancy between calculated and sampled cake % in the first half of the year. The average cost for dewatering solids in 2019 was $281.05 per dry ton, which includes sludge disposal and polymer costs.
3. Total monthly solids are expressed in tons, not pounds, to simplify comparison to the wet tons hauled each month.
4. A column is added to show dry solids processed, which is less 1% for centrate losses and 2.5% for start-up and CIP losses (Total feed solids x 96.5%), since the centrifuges are only operated for one shift.
5. Columns are presented to compare dry solids processed with dry solids hauled (based upon sampled cake %). During the first six months there is a discrepancy between calculated and sampled cake%, which was narrowed in the last six months of the year after changes to the sampling techniques were implemented.
6. Columns have been added to calculate polymer lbs/dry ton based upon dry solids processed (calculated) and dry solids (cake %) sampled.
7. Cost data for polymer consumption and sludge disposal costs, based upon $0.99 per pound neat polymer, and $35.22 per wet ton hauled are presented.
8. The results for October, November, and December 2019 (fiscal 2020) are presented on the same report with an annualized projection for 2020, based upon the optimal results in October 2020.

Conclusions: An analysis of the Monthly Report Summary yields the conclusion that the City can optimize its dewatering operations by reducing solids throughput on the Centrifuges to 900 lbs/hr or less. ***Biosolid dewatering performance in October 2019 is the best evidence that the City should transition to 24/5 processing of biosolids.***

1. The total cost of production in October 2019 was $258.44 per dry ton versus an average of $281.05 in 2019, a savings of $22.61 per dry ton. Operating the centrifuges at 900 lbs/hr resulted in annualized savings of $49,800, based upon projection of 2019 annual dry solids production of 2200 into 2020.

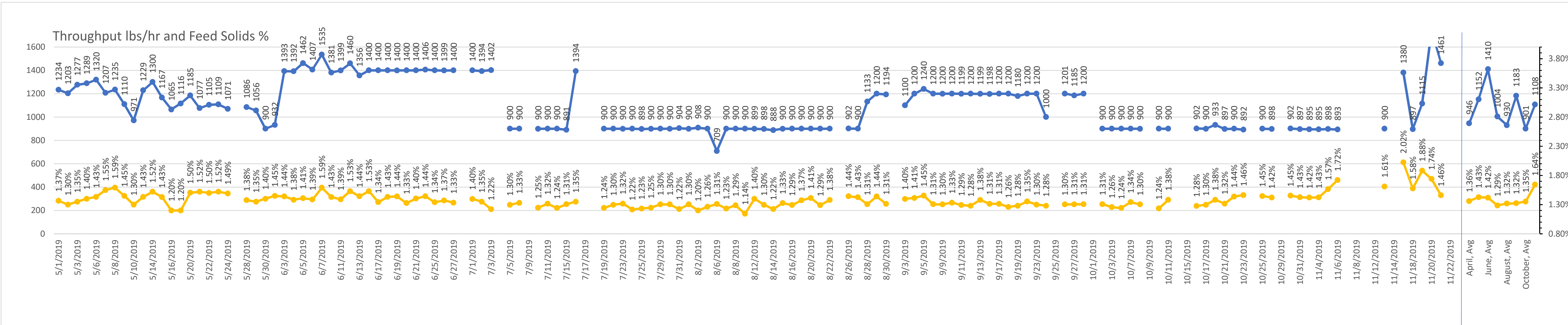
2. For the first quarter of 2020 (October – December 2019), process optimization yielded the following results:
   a. A reduction in wet sludge processed of 210 tons or $7400, while processing 30 tons more of dry solids.
   b. Polymer consumption increased by about 5 lbs / dry ton to achieve the reduced sludge disposal costs.
   c. Overall, the net cost to dewater 30 tons more in 2020 was processed at the same cost in 2019. Had process optimization not been implemented, dewatering costs would have been about $8000 higher.

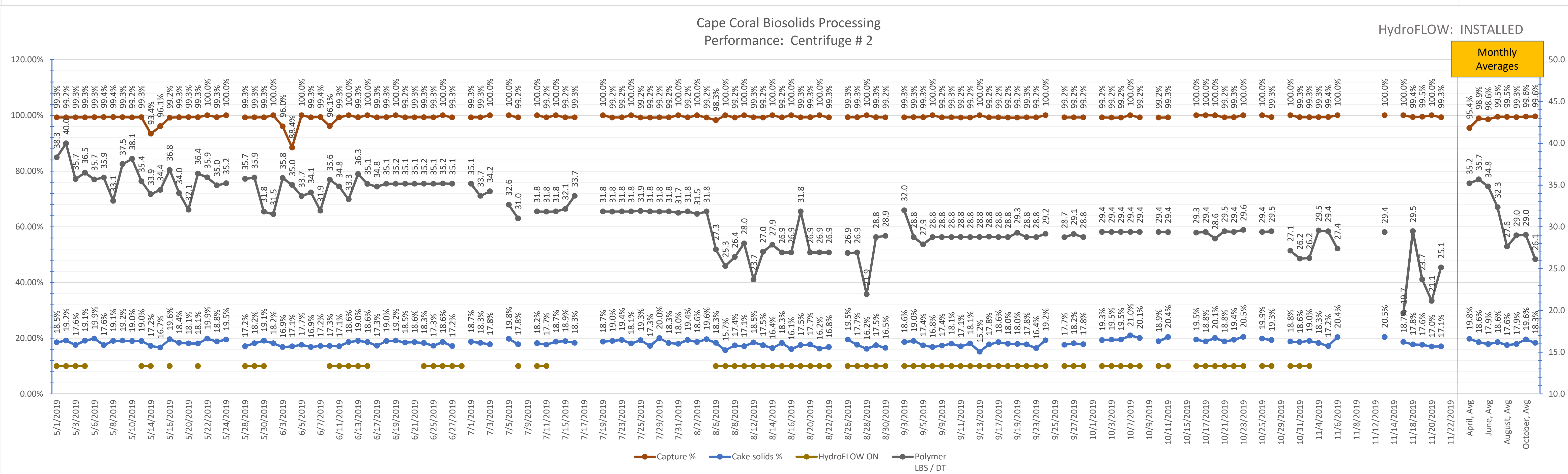
3. Additional savings are also available:
   a. About 60% of the savings is due to operation of the centrifuges at a consistent 900 lbs/hour. At this setting both polymer consumption and cake % is optimized, while also allowing the city to handle daily hydraulic loading with one machine.
   b. During October 2019, two machines were in operation (#2 and #3) with shift lengths of no more than 8 hours of actual run time. Total capacity during October 2019 amounted to about 14,400 dry tons per day (900 x 8 x 2). With 24/5 operation, the same 14,400 could be processed in 24 hours at a solids-loading of 600 lbs/hour. Running the machines at a lower solids loading will result in lower polymer consumption per dry ton, as well as improved cake %, which would be partially offset by higher electrical costs.
   c. Some of the savings (about 35%) is due to the HydroFLOW technology, which has already been discussed. The technology was only applied to the biosolids dewatered by Centrifuge #2, which represents about 50% of the total solids dewatered.
   d. The calculated polymer consumption per dry ton exceeds the centrifuge settings by about 8%-9% (32 lbs/DT based upon the polymer flow totalizers versus 29.4 lbs / DT based upon the centrifuge settings). About 2/3 of this discrepancy is due to polymer losses at start-up and CIP. Enpure has calculated these losses at about $5000 per year, which should offset the additional cost of a shift differential to move to 24/5 processing.
   e. Overall, the data and Enpure project total savings ranging between $60,000 - $70,000 per year, over 10% of the total dewatering budget, just from optimization and improved efficiency.

4. Other benefits from a transition to 24/5 dewatering are as follows:
   a. Greater flexibility to meet wasting supply from the plant, without overtime
   b. Less wear and tear on the centrifuges due to fewer starts and stops.
   c. Greater opportunity to implement preventative maintenance on standby machines.
   d. Reduction in capital costs to maintain capacity. Only two centrifuges are required to meet the daily hydraulic loads of the WWTP at any given time, not three. Capital purchases to improve efficiency need only be applied to one or two centrifuge process streams to realize the savings, not all three.

Cape Coral Biosolids Dewatering
HydroFLOW Trial Data: Centrifuge #2

11/24/2019





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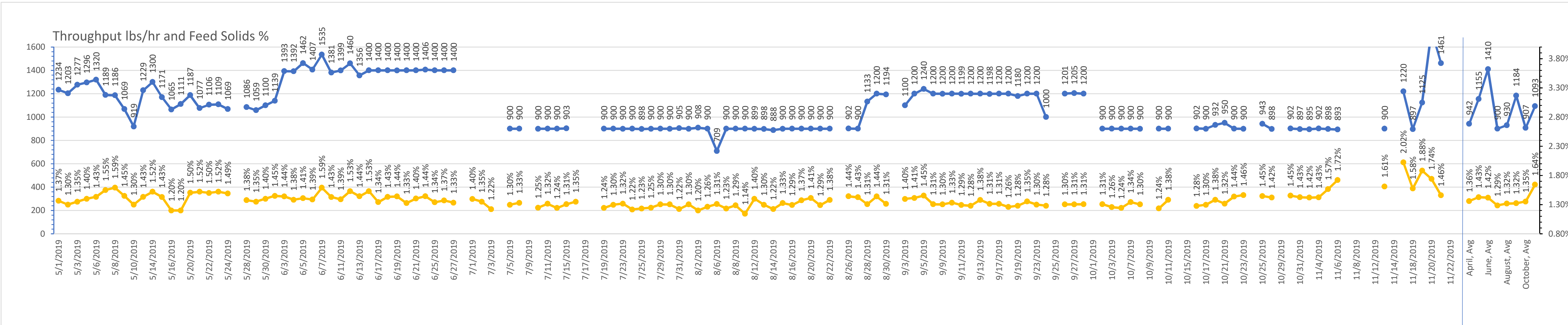
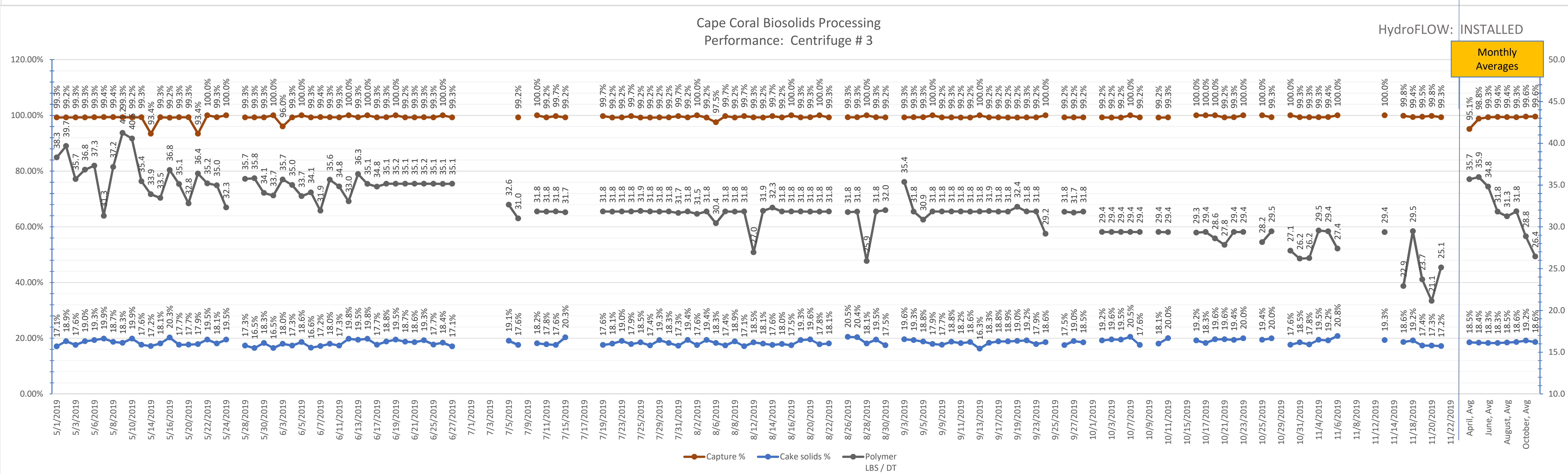
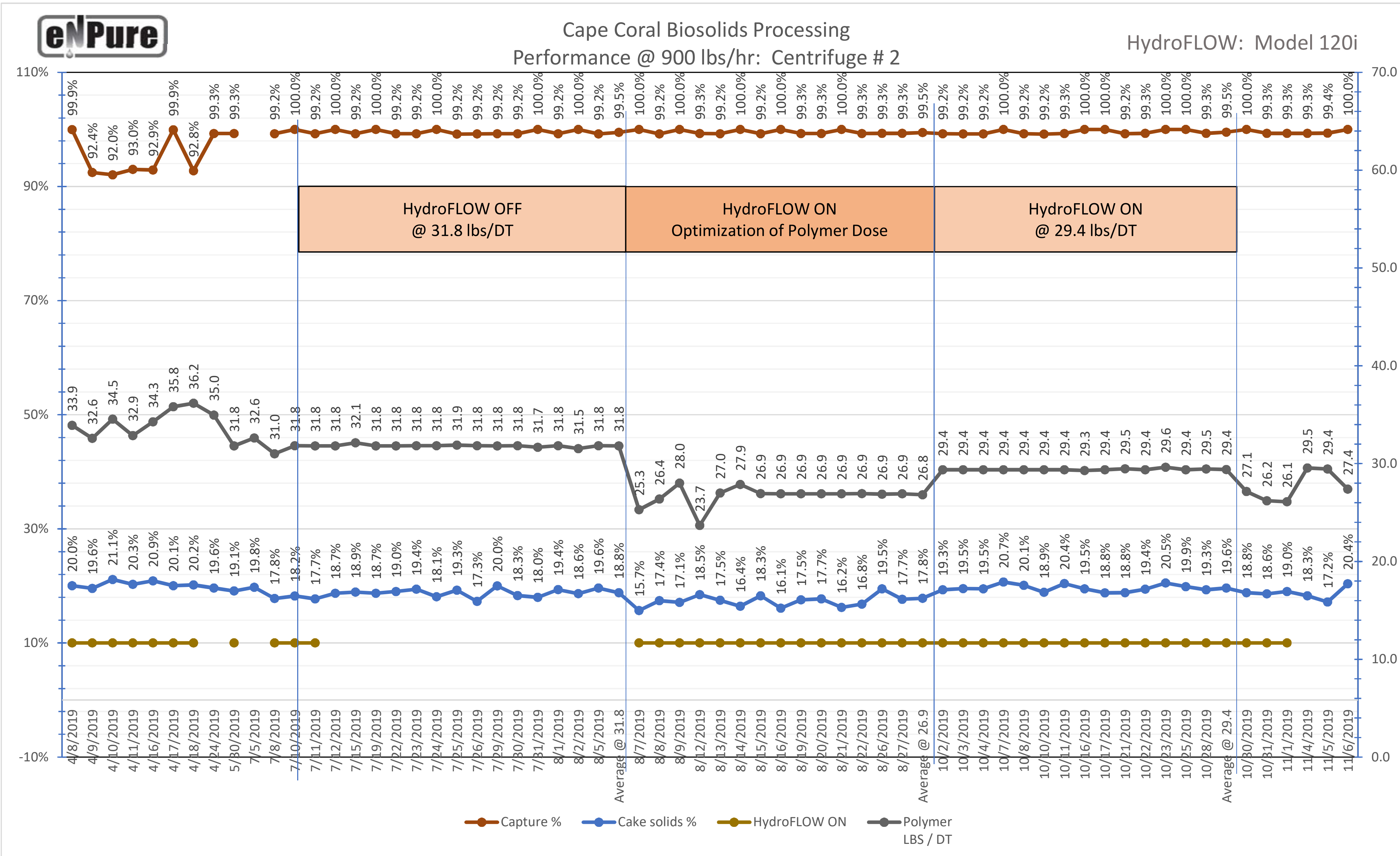
Cape Coral Biosolids Dewatering
HydroFLOW Trial Data: Centrifuge #3

11/24/2019



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Cape Coral Biosolids Processing
Performance @ 900 lbs/hr: Centrifuge # 2
HydroFLOW: Model 120i
HydroFLOW OFF
@ 31.8 lbs/DT
HydroFLOW ON
Optimization of Polymer Dose
HydroFLOW ON
@ 29.4 lbs/DT
Capture %
Cake solids %
HydroFLOW ON
Polymer LBS / DT

APPENDIX D

City of Cape Coral
Monthly Summaries
Fiscal Year 2019 versus Projected Fiscal Year 2020

Date	Feed Sludge mg/l	Centrifuge #1		Centrifuge #2		Centrifuge #3		Total Centrifuges			%Cake		Wet Tons Hauled (note 5)	Dry Tons Month (note 3)	Dry tons Processing Variance	Polymer Gallons Per Month				Polymer LBS/Dry Ton			Actual Costs			
		Total Gal/Mon	%Cake	Total Gal/Mon	%Cake	Total Gal/Mon	%Cake	Gallons / Month	Tons / Month	Dry Solids Processed (note 1)	Processed (note 2)	Sampled, Daily AVG				CENT #1 POLY	CENT #2 POLY	CENT #3 POLY	TOTAL POLY	Wet Tons	Solids Processed		Polymer	Hauling	Total	Cost per Dry Ton (note 4)
Fiscal Year 2019																							$ 0.99	$ 35.22		
Oct-18	1.18%	1,018,900	20.95	1,424,300	20.29	925,080	20.25	3,368,280	164.0	158.3	17.07	19.69	927.5	188.6	30.3	383	580	344	1,261	24.55	29.25		$ 10,417	$ 32,667	$ 43,085	$ 272.20
Nov-18	1.21%	1,477,880	20.68	1,491,160	21.07	459,370	20.90	3,428,410	175.6	169.4	16.91	20.97	1,001.9	209.5	40.1	520	540	182	1,243	21.77	26.93		$ 10,266	$ 35,287	$ 45,553	$ 268.86
Dec-18	1.28%	1,240,370	20.46	1,305,460	19.49	1,141,680	21.48	3,687,510	193.8	187.0	15.56	19.94	1,201.6	243.9	56.8	446	512	409	1,367	20.58	26.84		$ 11,292	$ 42,320	$ 53,612	$ 286.69
Jan-19	1.30%	1,258,930	20.12	1,911,500	20.65	1,603,860	21.28	4,774,290	256.2	247.3	16.15	20.81	1,530.6	319.1	71.8	568	853	705	2,126	24.47	31.58		$ 17,568	$ 53,906	$ 71,474	$ 289.06
Feb-19	1.20%	1,396,250	18.30	1,507,290	18.06	1,460,940	18.50	4,364,480	216.3	208.8	16.30	18.25	1,280.7	233.7	24.9	575	633	583	1,792	28.15	31.51		$ 14,802	$ 45,105	$ 59,907	$ 286.96
Mar-19	1.16%	1,410,130	18.81	1,257,972	18.67	1,397,243	18.01	4,065,344	196.6	189.7	17.87	18.50	1,061.6	195.2	5.5	722	620	718	2,061	38.76	39.89		$ 17,025	$ 37,390	$ 54,415	$ 286.85
Apr-19	1.26%	816,650	18.98	1,448,400	19.77	1,450,740	18.70	3,715,790	195.9	189.0	19.05	19.12	992.4	189.6	0.5	471	827	791	2,090	40.47	40.59		$ 17,263	$ 34,951	$ 52,214	$ 276.23
May-19	1.32%	-	-	1,858,180	18.29	1,897,580	17.76	3,755,760	205.7	198.5	18.90	18.02	1,050.1	188.3	(10.2)	-	1,091	1,014	2,105	41.06	38.95		$ 17,394	$ 36,983	$ 54,377	$ 273.99
Jun-19	1.24%	-	-	1,764,118	17.63	1,738,193	17.90	3,502,311	181.5	175.1	17.61	17.76	994.4	176.5	1.4	-	997	974	1,970	40.99	41.32		$ 16,279	$ 35,022	$ 51,301	$ 292.96
Jul-19	1.20%	-	-	1,693,153	18.42	1,481,897	17.69	3,175,050	158.1	152.6	18.60	18.12	820.4	147.4	(5.2)	-	813	691	1,504	37.47	36.20		$ 12,429	$ 28,896	$ 41,325	$ 270.83
Aug-19	1.19%	-	-	1,705,620	17.30	1,701,680	18.35	3,407,300	169.7	163.7	17.83	17.82	918.2	164.6	0.8	-	721	795	1,516	33.83	34.00		$ 12,526	$ 32,338	$ 44,864	$ 274.02
Sep-19	1.18%	-	-	1,652,800	17.73	1,654,440	18.06	3,307,240	162.4	156.8	16.97	17.89	923.8	163.8	7.0	-	726	794	1,520	34.08	35.60		$ 12,558	$ 32,534	$ 45,093	$ 287.65
Total	**1.22%**	**8,619,110**	**19.75**	**19,019,953**	**10.76**	**16,912,702**	**9.83**	**44,551,765**	**2,275.8**	**2,196.13**	**17.29**	**19.05**	**12,703.0**	**2,420.0**	**223.9**	**3,686**	**8,914**	**8,001**	**20,555**	**31.19**	**34.37**		**$ 169,820**	**$ 447,400**	**$ 617,220**	**$ 281.05**
Oct-Mar	1.22%	7,802,460	19.89	8,897,682	19.71	6,988,173	20.07	23,688,314	1,202.5	1,160.4	16.57	19.69	7,003.8	1,389.9	229.5	3,215	3,740	2,941	9,849	26.02	31.16		$ 81,370	$ 246,675	$ 328,046	$ 282.69
Apr- Sep	1.23%	816,650	3.16	10,122,271	18.19	9,924,530	18.07	20,863,450	1,073.3	1,035.7	18.17	18.12	5,699.2	1,030.1	(5.6)	471	5,175	5,060	10,706	38.16	37.96		$ 88,450	$ 200,725	$ 289,175	$ 279.21
YTD Dec-19	**1.22%**	**3,737,150**	**20.69**	**4,220,920**	**20.28**	**2,526,130**	**20.88**	**10,484,200**	**533.4**	**514.7**	**16.44**	**20.20**	**3,131.0**	**642.0**	**127.3**	**1,349**	**1,633**	**935**	**3,870**	**22.14**	**27.61**		**$ 31,976**	**$ 110,274**	**$ 142,249**	**$ 276.36**
Fiscal Year 2020																										
Oct-19	1.27%	-		1,460,590	19.12	1,438,970	18.80	2,899,560	153.9	148.5	18.92	18.96	785.0	148.9	0.4	-	651	648	1,299	32.03	32.12		$ 10,733	$ 27,649	$ 38,382	$ 258.44
Nov-20	1.39%	-		1,372,650	18.12	1,420,860	17.63	2,793,510	162.3	156.6	17.97	17.88	871.7	154.3	(2.3)	-	629	680	1,310	31.16	30.70		$ 10,819	$ 30,702	$ 41,521	$ 265.08
Dec-19	1.44%	1,109,320	18.46	1,539,510	18.12	1,544,690	18.34	4,193,520	248.9	240.2	18.99	18.26	1,264.3	230.4	(9.8)	583	813	814	2,210	35.22	33.79		$ 18,260	$ 44,530	$ 62,790	$ 261.45
YTD	**1.37%**	**1,109,320**	**18.46**	**4,372,750**	**18.46**	**4,404,520**	**18.26**	**9,886,590**	**565.1**	**545.3**	**18.67**	**17.25**	**2,921.1**	**533.6**	**(11.7)**	**583**	**2,094**	**2,142**	**4,819**	**33.16**	**32.45**	**0**	**$ 39,813**	**$ 102,881**	**$ 142,694**	**$ 261.67**
YTD Variance	**0.14%**	**(2,627,830)**	**(2.23)**	**151,830**	**(1.83)**	**1,878,390**	**(2.62)**	**(597,610)**	**31.7**	**30.6**	**2.23**	**(2.95)**	**(209.9)**	**(108.3)**	**(138.9)**	**(765)**	**461**	**1,207**	**949**	**11.02**	**4.84**	**0**	**$ 7,837**	**$ (7,393)**	**$ 444**	**$ (14.69)**
Annualized 2020									**2,275.78**	**2,196.13**	**18.92**	**18.96**	**11,608.4**			**-**	**-**	**-**	**19,211**	**32.03**	**32.12**		**$ 158,713**	**$ 408,849**	**$ 567,562**	**$ 258.44**
Projected Savings									-	-	(1.63)	0.09	1,094.6						1,344	(0.84)	2.25		$ 11,107	$ 38,551	$ 49,658	

Notes
1) Dry Solids processed per month less 3.5% from solids feed, 1% capture loss and 2.5% CIP loss.
2) Cake % calculated based upon Dry Solids Processed / Wet Tons Hauled.
3) Dry Tons calculated based upon Cake %, daily averaged sampled.
4) Cost per dry ton calucaled based upon dry solids processed.
5) Wet tons hauled based upon diposal tickets
6) November 15, 2019 feed solids corrected from 2.15% to 1.32 % due to sampling error
7) December 31, 2019 wet tons hauled adjusted for partial truck on site with approximately 10 tons wet solids