

Fine Bubble Retrofit Does It Again

Presented at the
50th Annual Meeting of
Wisconsin Wastewater Operators Association
La Crosse, WI
October 12, 2016

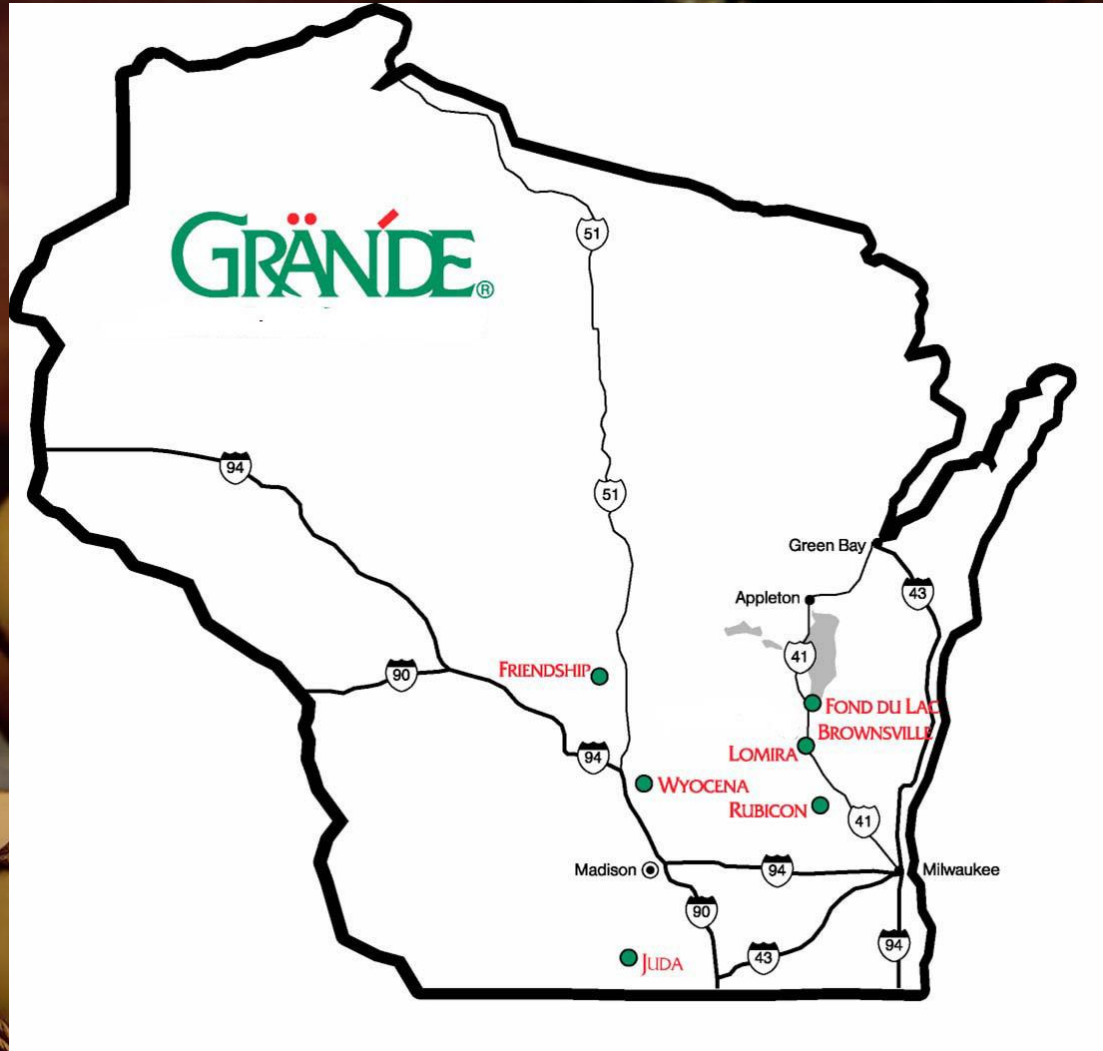
- Jon Butt, P.E., Symbiont



What do we plan to cover?

- Background
- Process Review
- New Process
- Focus on the Aeration
- Design Parameters
- Construction
- Results
- Can we do more?
- Next Steps
- Summary
- Questions

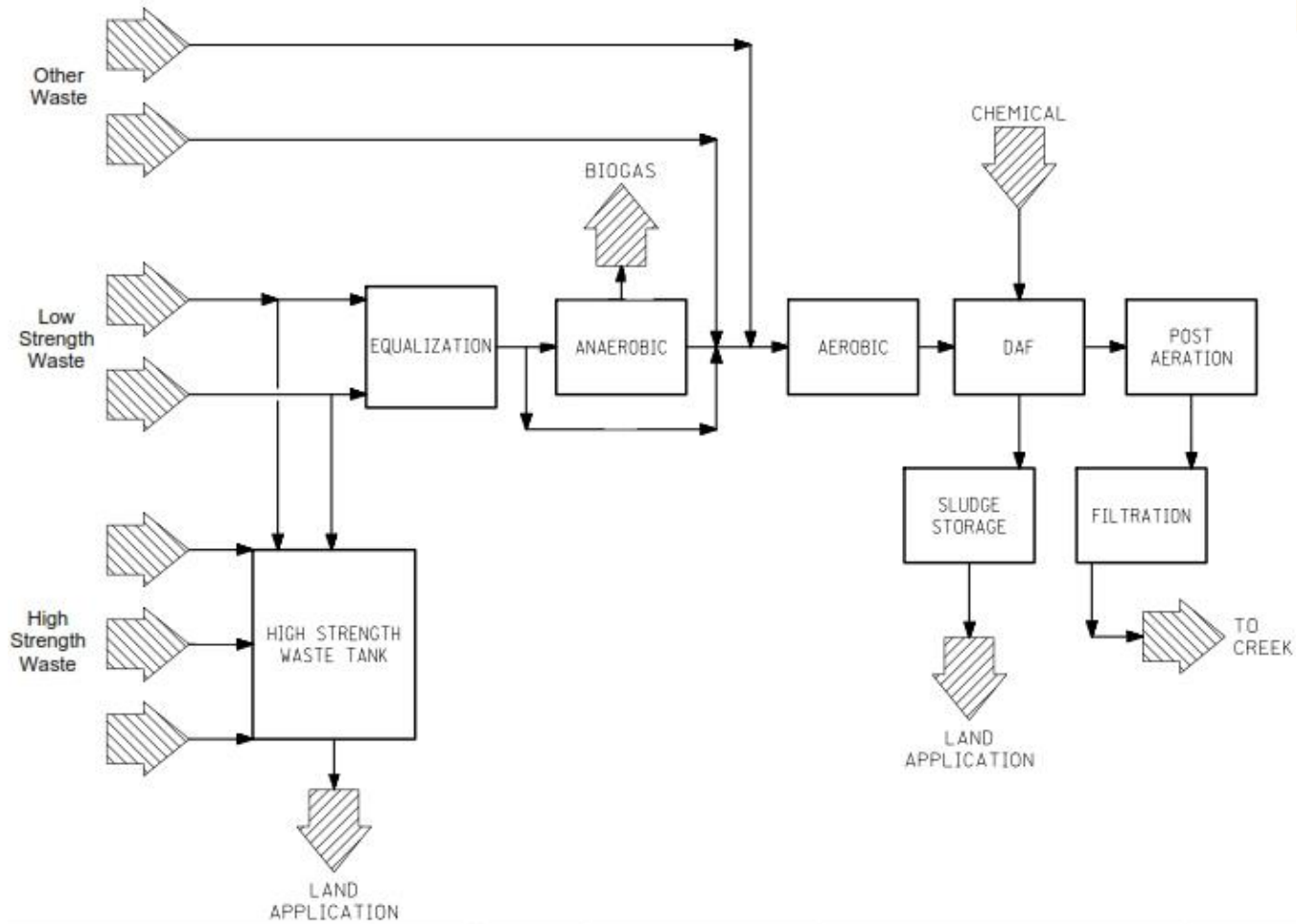
Background



Background - Grande Whey - Juda, WI



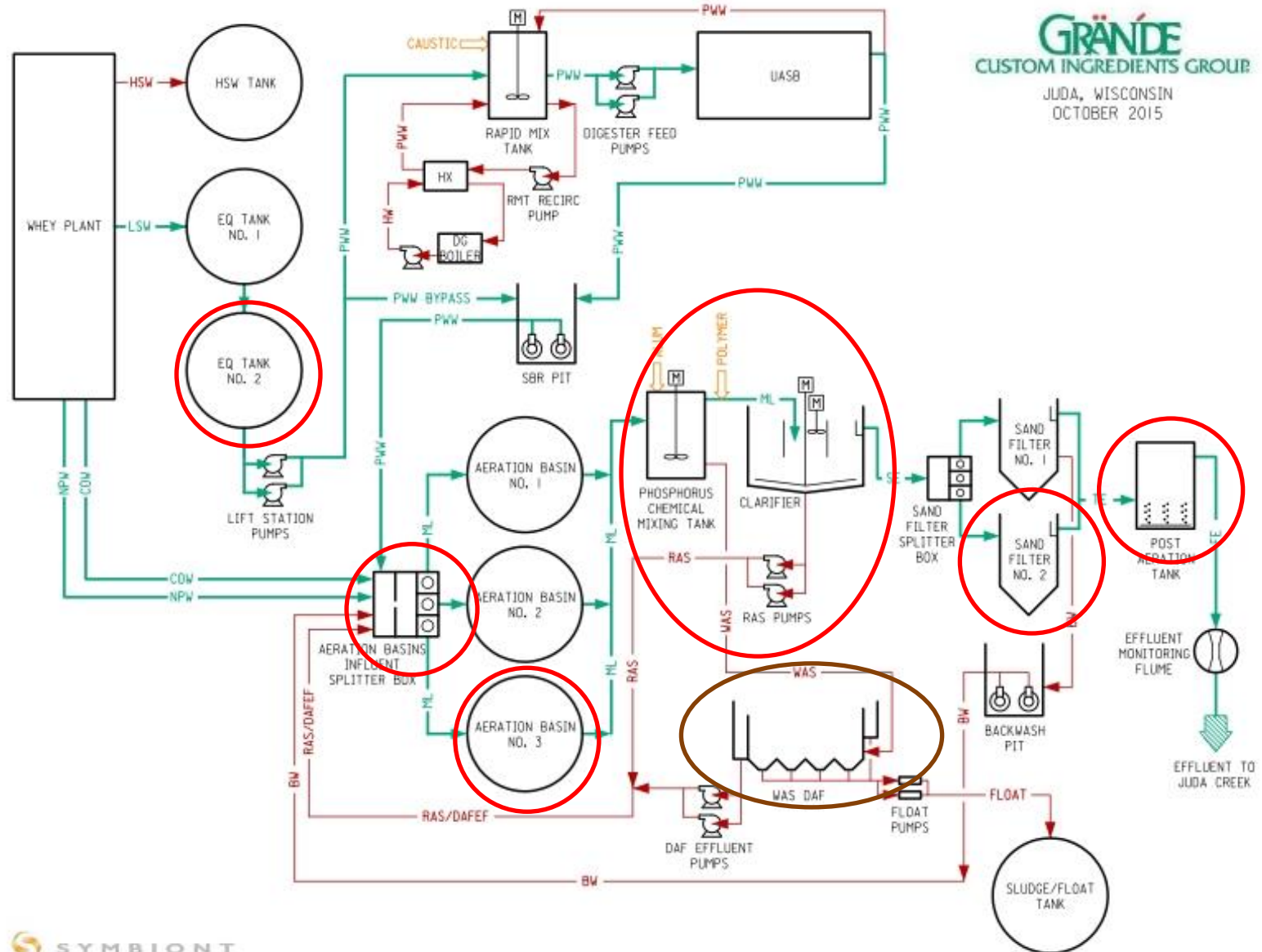
Process Review



Project goal

- Expand capacity
 - Provide redundancy
 - Reduce chemical consumption
-
- Can capacity increase without increasing HP and power consumption?

New process



Focus on aeration

Current per aeration tank

- 75 HP pump
- 75 HP blower

Proposed (3 tanks)

- 2 - 75 HP blowers

# of Tanks	Current	Vs.	Proposed
1	150 HP	Vs.	< 75 HP
2	300 HP	Vs.	< 150 HP
3	450 HP	Vs.	150 HP

Other Potential Reductions

- Clarifier vs. DAF
- RAS pump vs. Jet pump
- Diffused post air vs. mechanical aerator

Aeration Calculations

- Start with calculating the actual oxygen requirement (AOR)
 - SRT = 20 days, 1.2 lb O₂/lb BOD
 - Assume 100% removal of BOD
 - Assume nitrification, 4.6 lbs O₂/lbs NH₃
 - Assume all TKN converts to NH₃

$$\text{AOR} = 1.2 \times \text{BOD} + 4.6 \times \text{NH}_3$$

Calculations - Continued

- Next, convert to standard oxygen requirement

$$\text{AOR} = \text{SOR}(\alpha) \left[\frac{\left[\beta \left(\frac{P_f}{P_{MSL}} \right) C_{sat,1} \right] - \text{DO field}}{C_{sat,20}} \right]^{\theta^{T-20}}$$

The terms in the formula are:

AOR = actual oxygen requirement (field conditions)

SOR = standard oxygen requirement (standard conditions)

Alpha = 0.55

Temp = 80°F

Beta = 0.95

Site elevation = 700'

D.O. = 2 mg/L

Copied from Sanitaire *Diffused Aeration Design Guide*

Calculations - Continued

- Calculate air required and horsepower

- Air based on 1.8%/ft

$$\text{SCFM} = \frac{SOR}{0.25056 \times SOTE}$$

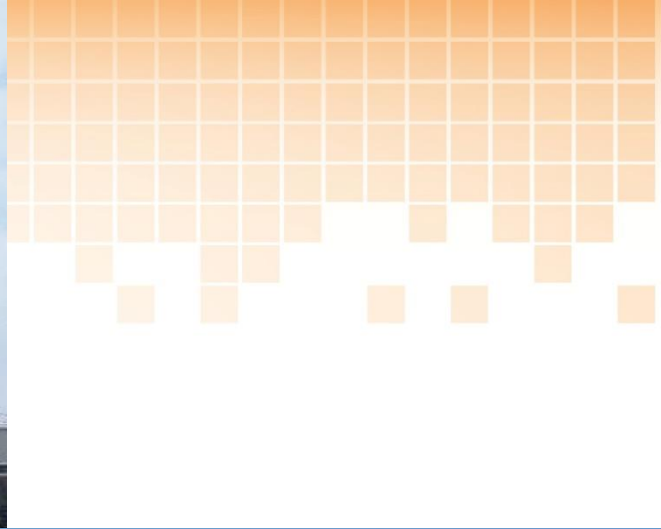
- Estimates between 1,650 and 3,200 SCFM
- Horsepower

$$\text{BHP} = \frac{0.23 \times \text{SCFM}}{\text{Mech Eff}} \times \left[\left(\frac{14.7 + P}{14.7} \right)^{0.283} - 1 \right]$$

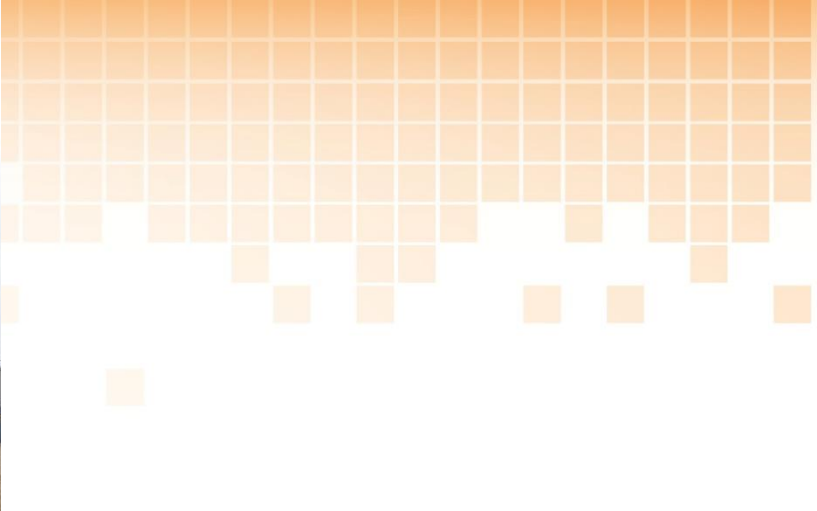
- Estimates between 80 and 155 HP

Construction Sequence

- Build new aeration & clarifier
- Retrofit aeration tank 1
- Retrofit aeration tank 2

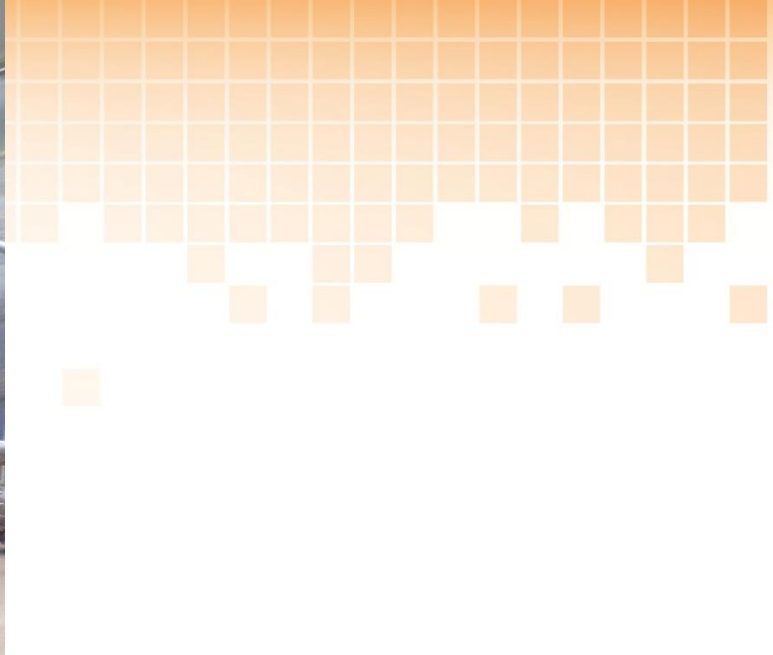












Results

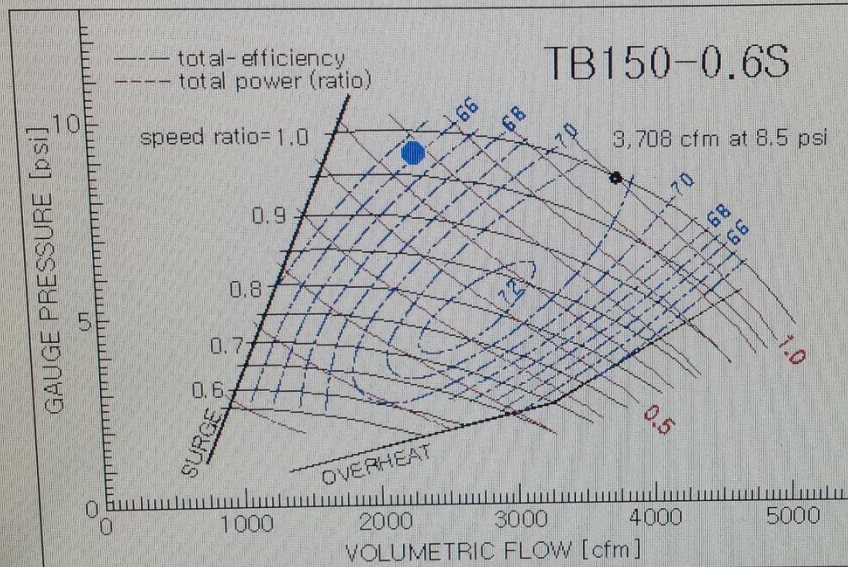
- The aeration basins are operating as anticipated.
- Verified that the plant could operate with 2 tanks
- Two blowers were able to supply air to three tanks maintaining DO > 4 mg/L.

Can we do more?

- Turbo to the rescue?
- Close fit, but not perfect.
- Horsepower dropped



GRAPH



SPEED
23000

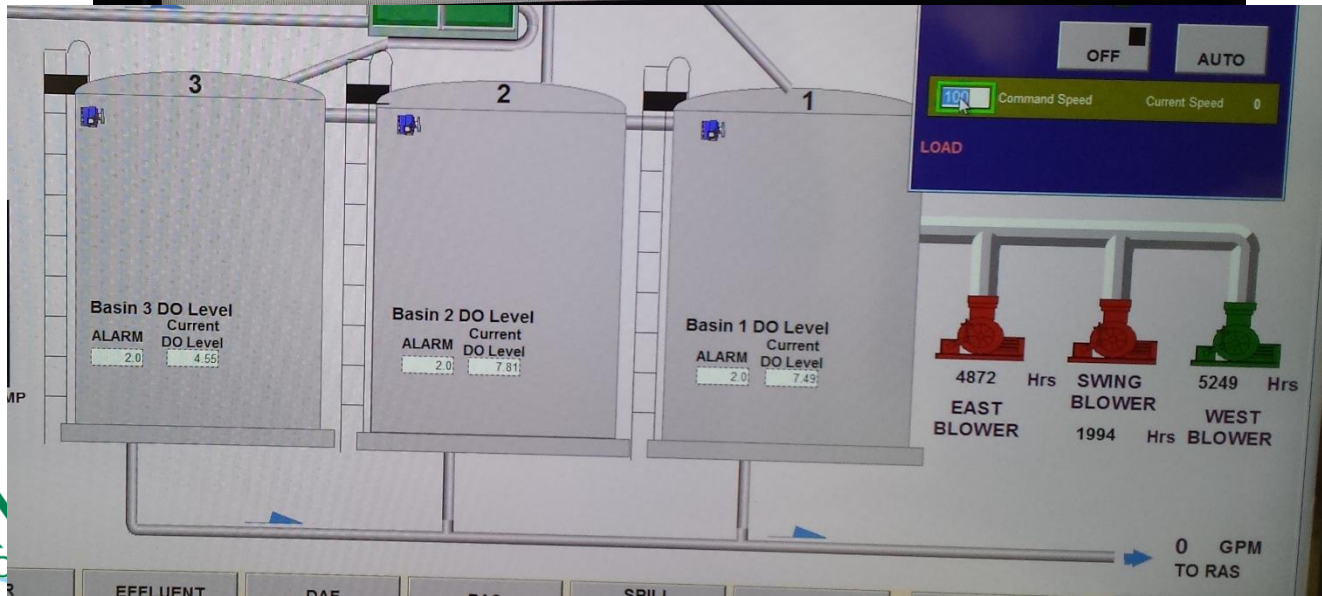
P
9.1

FLOW
2183

ERROR
0

Return

SV 65 % **+** **-**



TB150-0.6

Performance Data



Mode: **Current Set**

Site: **REMOTE**

Status: **Loaded**

2016/03/10

09:44:14

ΔP filter	0.022 psi	T1	50 °F
P	9.0 psi G	T2	158 °F
Q	2060 cfm	N	23200 rpm
RUN TIME ON-OFF	13652 Hr	POWER	81 kW
DCLink	642 V	ERROR CODE	0

SV **63** %



Actual vs. Initial Estimates

ΔP filter	0.022	psi
P	9.0	psi G
Q	2060	cfm
RUN TIME ON-OFF	13652	Hr
DCL ink	642	V

Total Number Diffusers in Plant	1392		
Total Number Grids in Plant	3		
Number Trains in Operation		3	3
Total Aerated Volume	ft ³	169,304	169,304
Total AOR	lbs-O ₂ /plant-d	4,680	10,515
AOR/SOR		0.346	0.401
Total SOR	lbs-O ₂ /plant-d	13,536	26,238
Total Air Rate	SCFM/plant	1,506	3,146
Diffuser Air Rate	SCFM/diff	1.08	2.26
SOTE		35.88%	33.29%
Max Dropleg Pressure	Psig	8.26	8.59
Est. Blower Pressure	Psig	8.56	8.89
Est. Blower Efficiency		0.7	
Est. Blower Power	BHP	69.1	149.3
Est. Motor Load	KW	56.1	121.0
Est. SAE	lbs-O ₂ /KWH	10.1	9.0
Oxygen Transfer Safety Factor		0.0%	

Energy Comparison - Before vs. After

Year	Organic loading to Aeration (#/Day BOD)	Nitrogen loading to Aeration (#/Day TKN)	Estimated HP	Energy Consumption (HP/BOD/day)
2013	2,140	155	270	0.126
2016*	2,780	330	135**	0.049
2016***	2,780	330	110**	0.040

*Based on using the existing PD blowers

**Aeration basin DO > 4 mg/L

***Based on using the Turbo blower

30% increase in organic load

110% increase in nitrogen load

50% reduction in HP

60% reduction in HP/BOD

Energy Comparison – Turbo Blowers

Year	Organic loading to Aeration (#/Day BOD)	Nitrogen loading to Aeration (#/Day TKN)	Estimated HP	Energy Consumption (HP/BOD/day)
2013	2,140	155	270	0.126
2016*	2,780	330	135**	0.049
2016** *	2,780	330	110**	0.040

*Based on using the existing PD blowers

**Aeration basin DO > 4 mg/L

***Based on using the Turbo blower

18% reduction
in HP

18% reduction
in HP/BOD

Some additional savings

- Current
 - Using 7.5 HP for post air instead of 25 HP mechanical aerator.
 - Using 4 HP RAS pump instead of 75 HP Jet motive pump
- Future
 - Use turbo blower to aerate sludge tank
 - Use turbo blower to aerate post Air

Summary

- Grande completed improvements that:
 - Increased capacity of WWTP
 - Provided redundancy to the aeration basins
 - Improved coagulant usage efficiency and reduced polymer consumption
- In doing so **Goals Met**
 - Power consumption has been reduced while providing a 30% increase in loading
 - High efficiency turbo blower reduced power consumption an additional 18%

Thank you!

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