A Multi-Sector Approach to Reduce Energy Consumption and Optimize Process Efficiency at the Upper Blackstone

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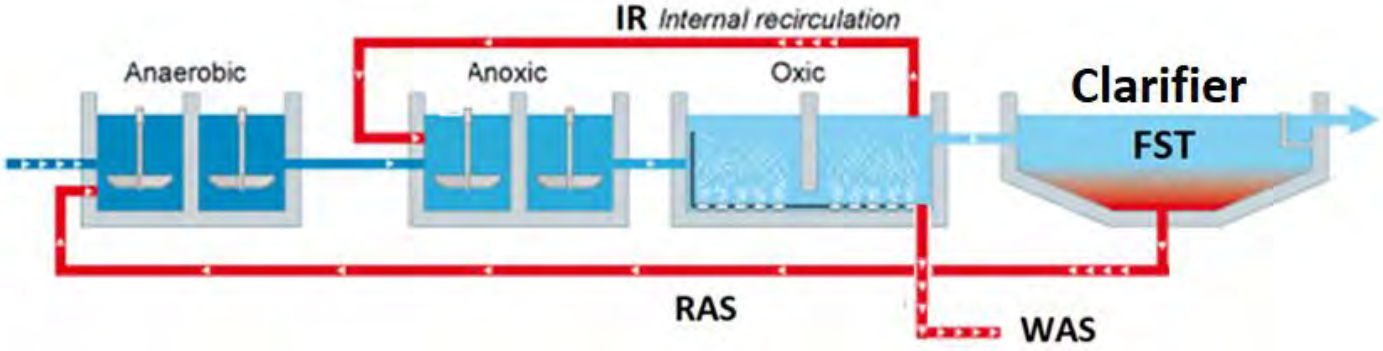
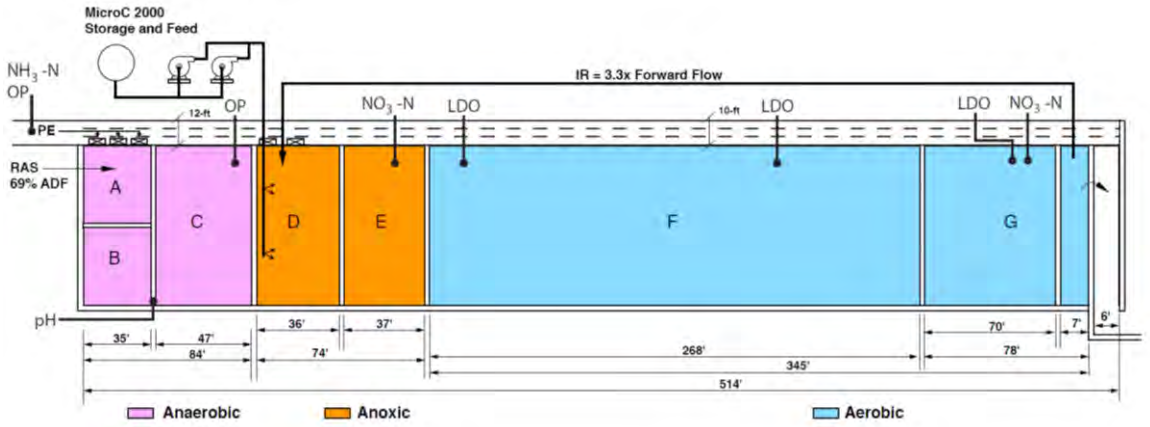
Upper Blackstone at a Glance

- Plant Information:
  - Influent characterization:
    - Avg Flow: 30 MGD
    - Avg CBOD: 154 mg/L
    - Avg TN: 28 mg-N/L
  - Process configuration
    - A2O
    - 4 trains
  - Regulation/Permit
    - Seasonal permit
    - TN: 5 mg-N/L
    - TP: 0.1 mg-P/L

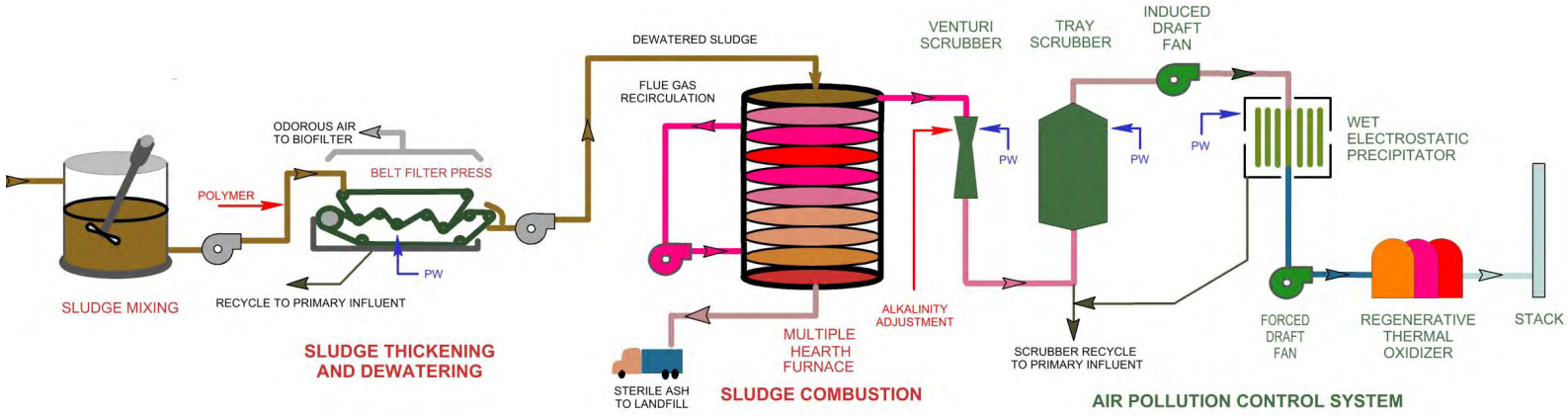


Energy Reduction and Optimization

- Aeration Upgrade (Electricity)



- RTO Upgrade (Gas)



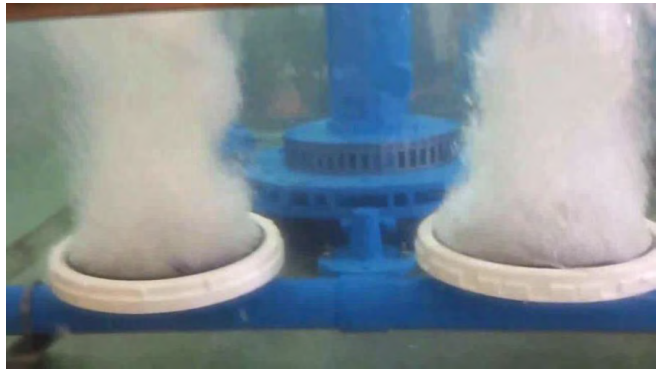
Aeration Upgrade

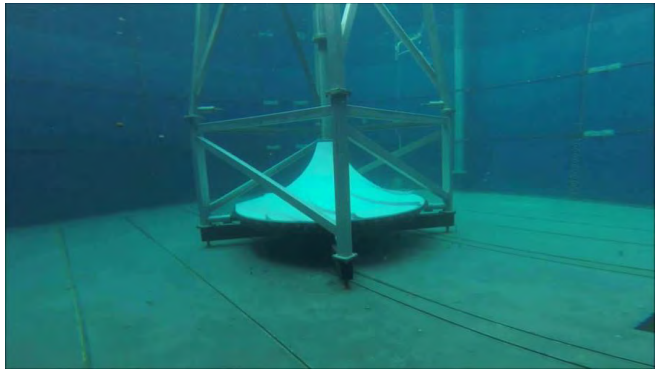
- **Most Open Valve Aeration Control**

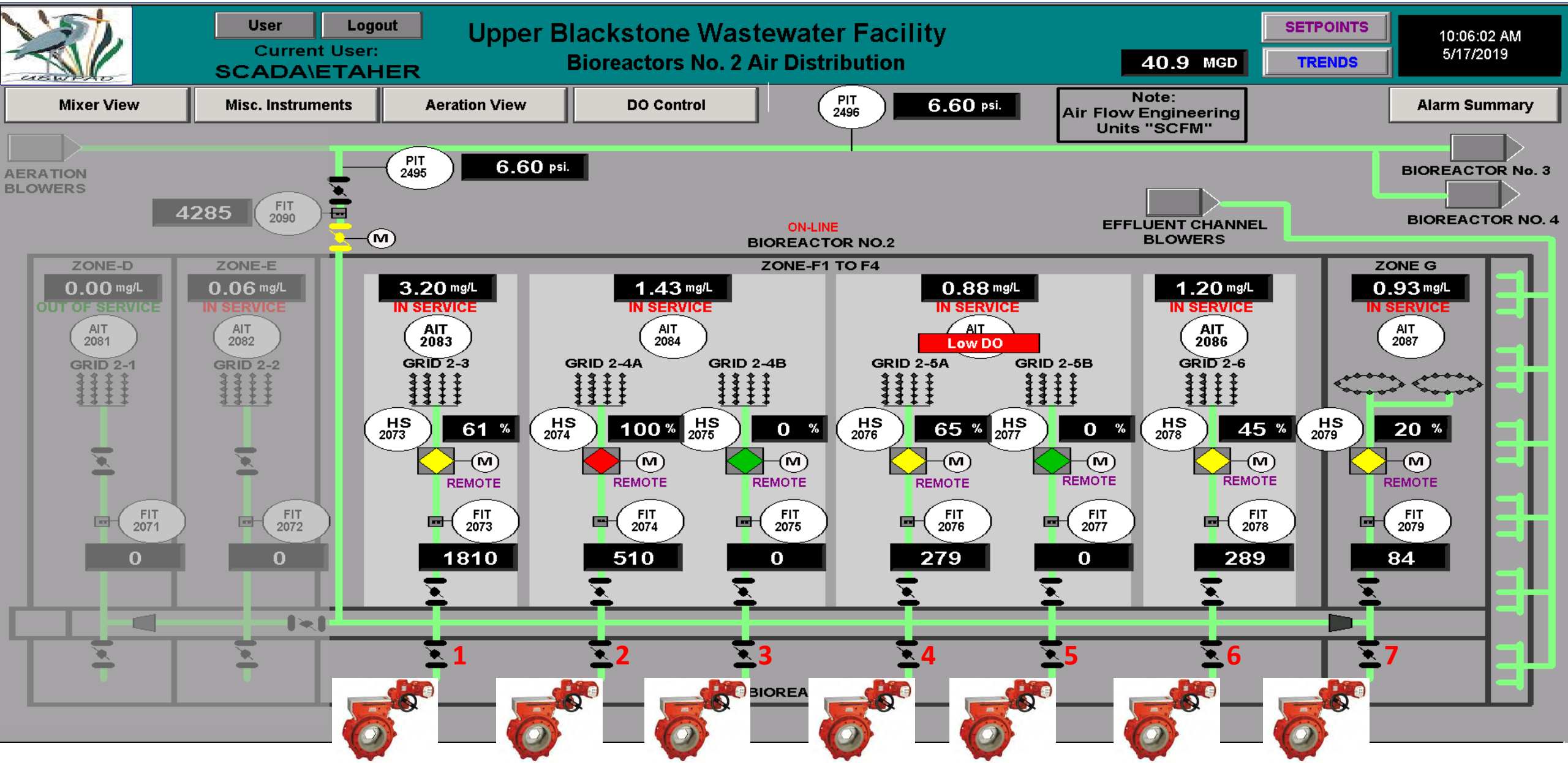
  Includes replacement of manual butterfly valves on aeration system with actuated IRIS valves to improve and provide more precise control of dissolved oxygen and reduce blower energy costs.

- **Modifications to Existing Aeration Tanks**

  Includes mixer/aerators, platforms, and associated piping modifications necessary to decouple aeration from mixing in Zone G and achieve a better denitrification performance in the anoxic zone.






User
Logout
Current User:
SCADA\ETAHER
Upper Blackstone Wastewater Facility
Bioreactors No. 2 Air Distribution
40.9 MGD
SETPOINTS
TRENDS
10:06:02 AM
5/17/2019
Mixer View
Misc. Instruments
Aeration View
DO Control
PIT 2496
6.60 psi.
Note:
Air Flow Engineering
Units "SCFM"
Alarm Summary
AERATION BLOWERS
PIT 2495
6.60 psi.
BIOREACTOR No. 3
BIOREACTOR NO. 4
4285
FIT 2090
M
ON-LINE
BIOREACTOR NO.2
EFFLUENT CHANNEL BLOWERS
ZONE-F1 TO F4
ZONE-D
ZONE-E
ZONE G
0.00 mg/L
OUT OF SERVICE
0.06 mg/L
IN SERVICE
3.20 mg/L
IN SERVICE
1.43 mg/L
IN SERVICE
0.88 mg/L
IN SERVICE
1.20 mg/L
IN SERVICE
0.93 mg/L
IN SERVICE
AIT 2081
AIT 2082
AIT 2083
AIT 2084
AIT
Low DO
AIT 2086
AIT 2087
GRID 2-1
GRID 2-2
GRID 2-3
GRID 2-4A
GRID 2-4B
GRID 2-5A
GRID 2-5B
GRID 2-6
HS 2073
61 %
HS 2074
100 %
HS 2075
0 %
HS 2076
65 %
HS 2077
0 %
HS 2078
45 %
HS 2079
20 %
REMOTE
FIT 2071
FIT 2072
FIT 2073
FIT 2074
FIT 2075
FIT 2076
FIT 2077
FIT 2078
FIT 2079
0
0
1810
510
0
279
0
289
84
1
2
3
4
5
6
7
BIOREA

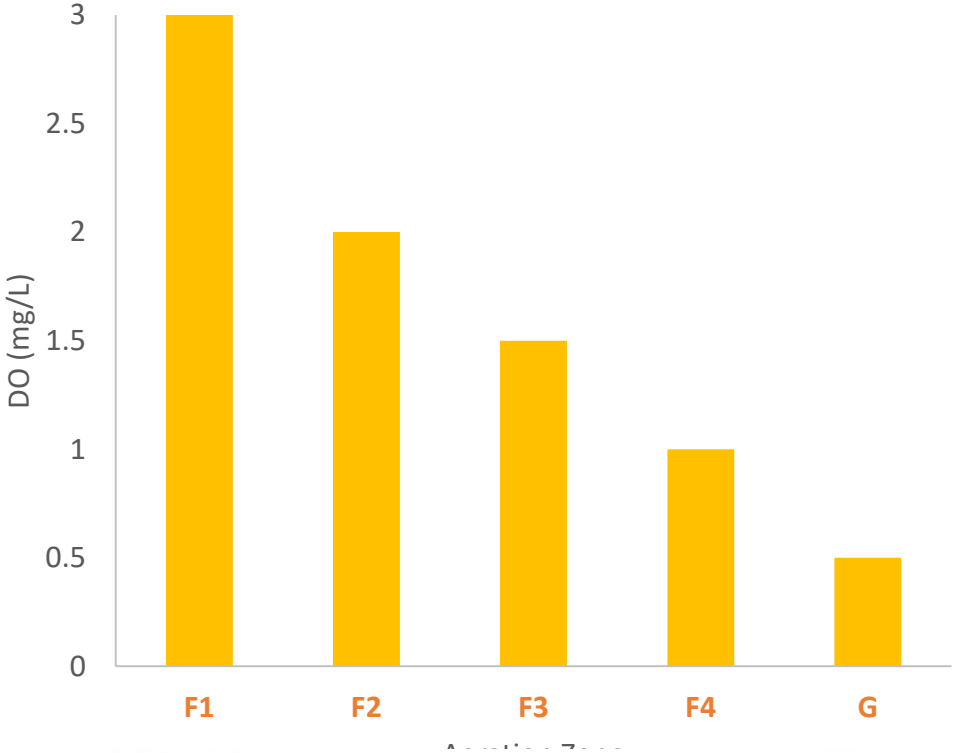
Key Parameter on Electricity Usage

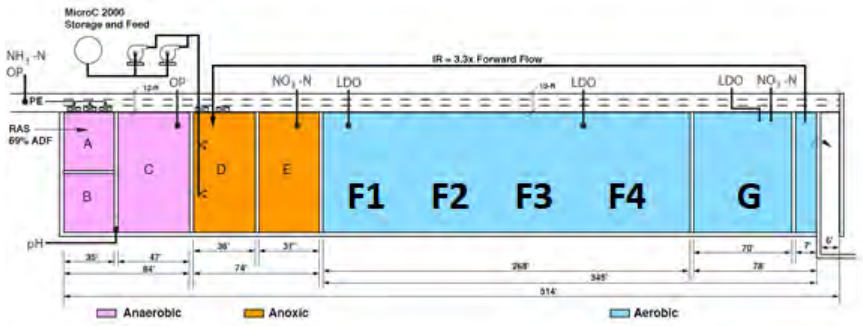
I. DO Demand & Set-points

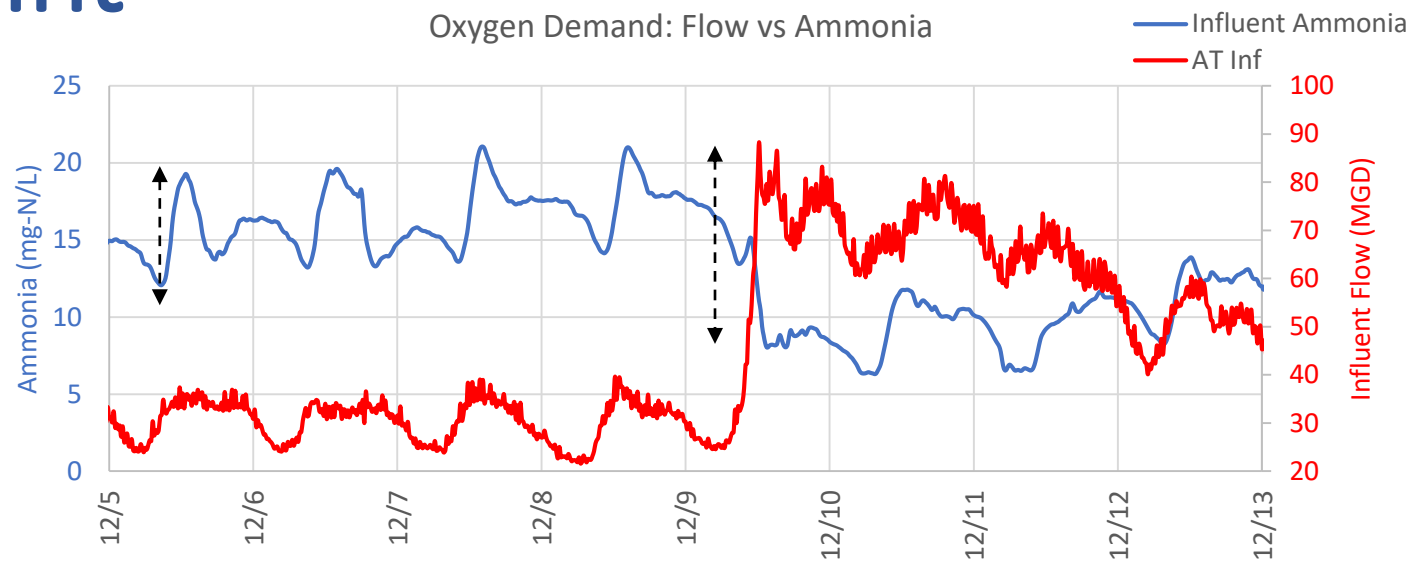
II. Temperature & Oxygen Solubility

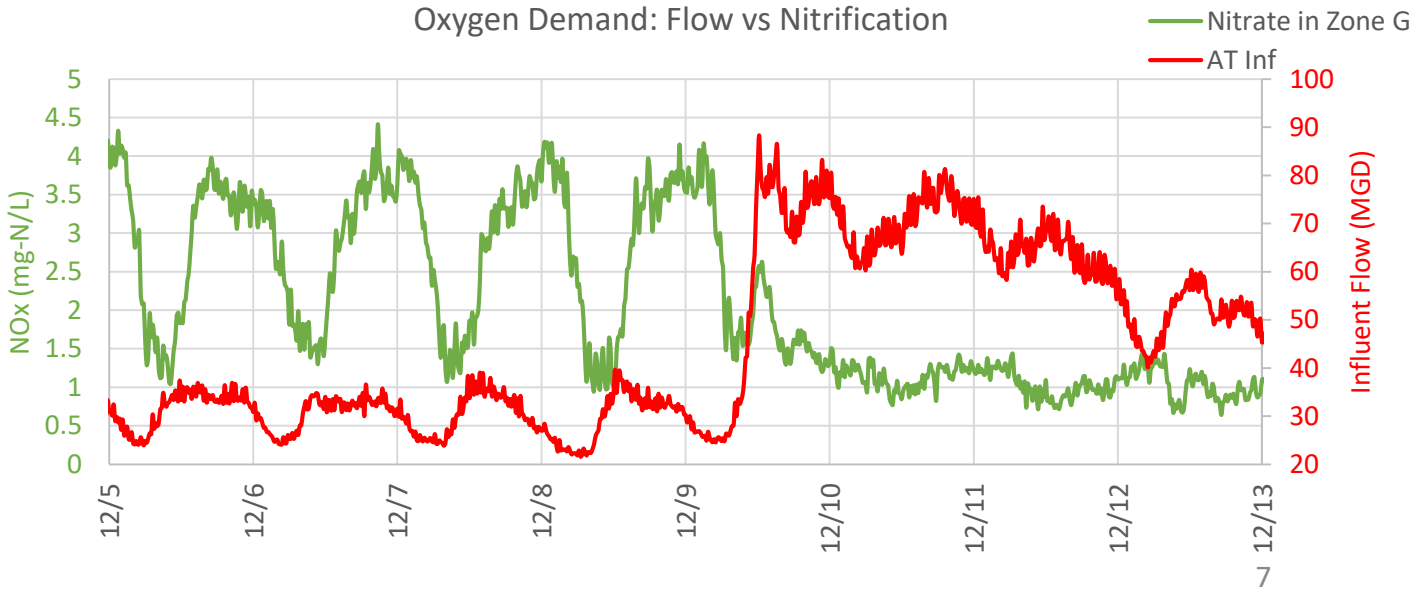
III. Nutrient (CBOD & TKN)

DO Demand & Set-point

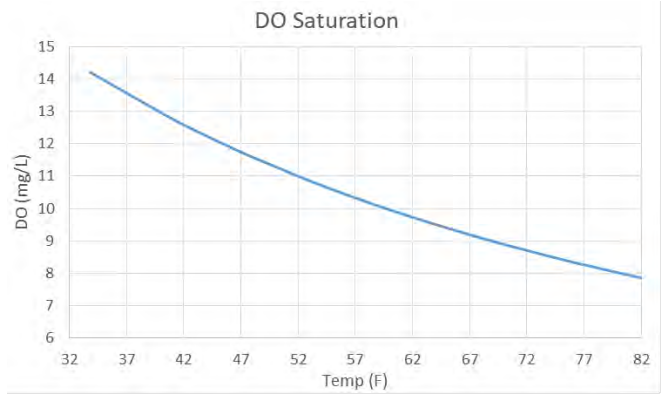


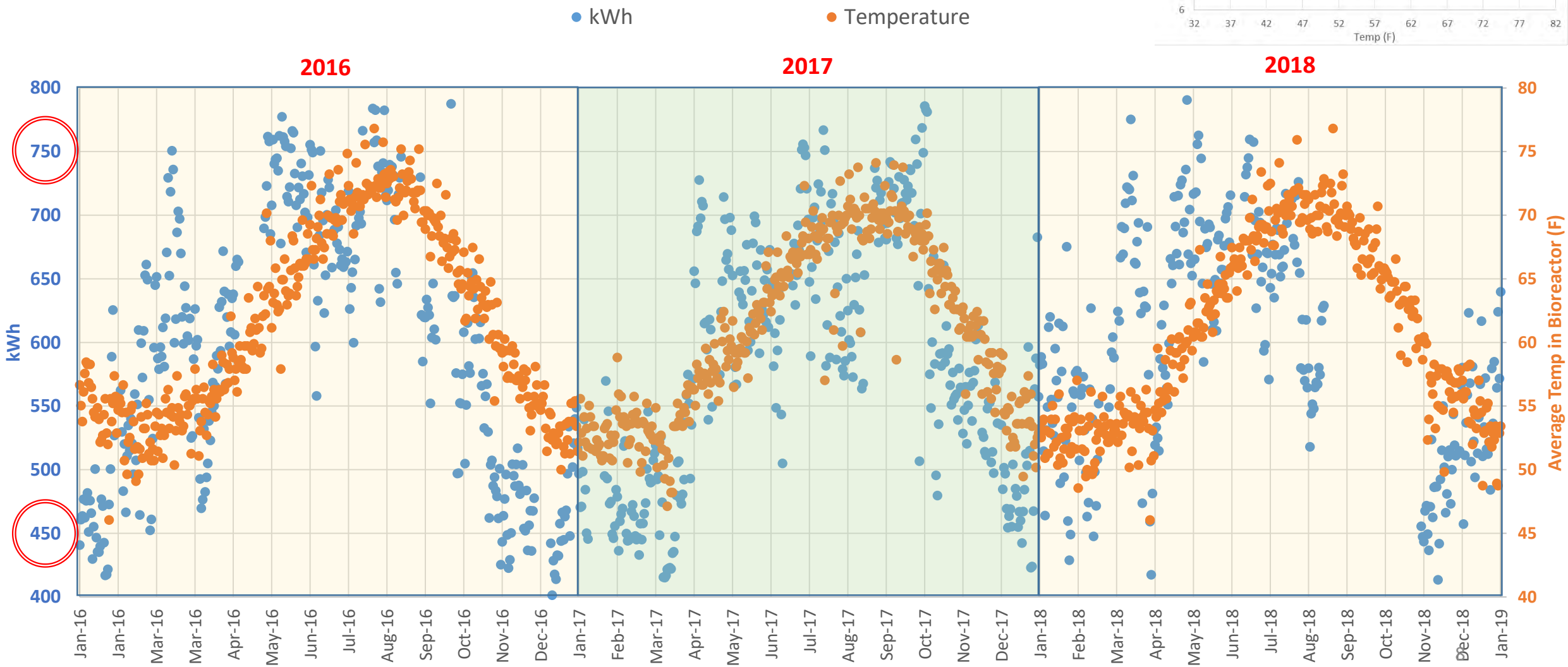




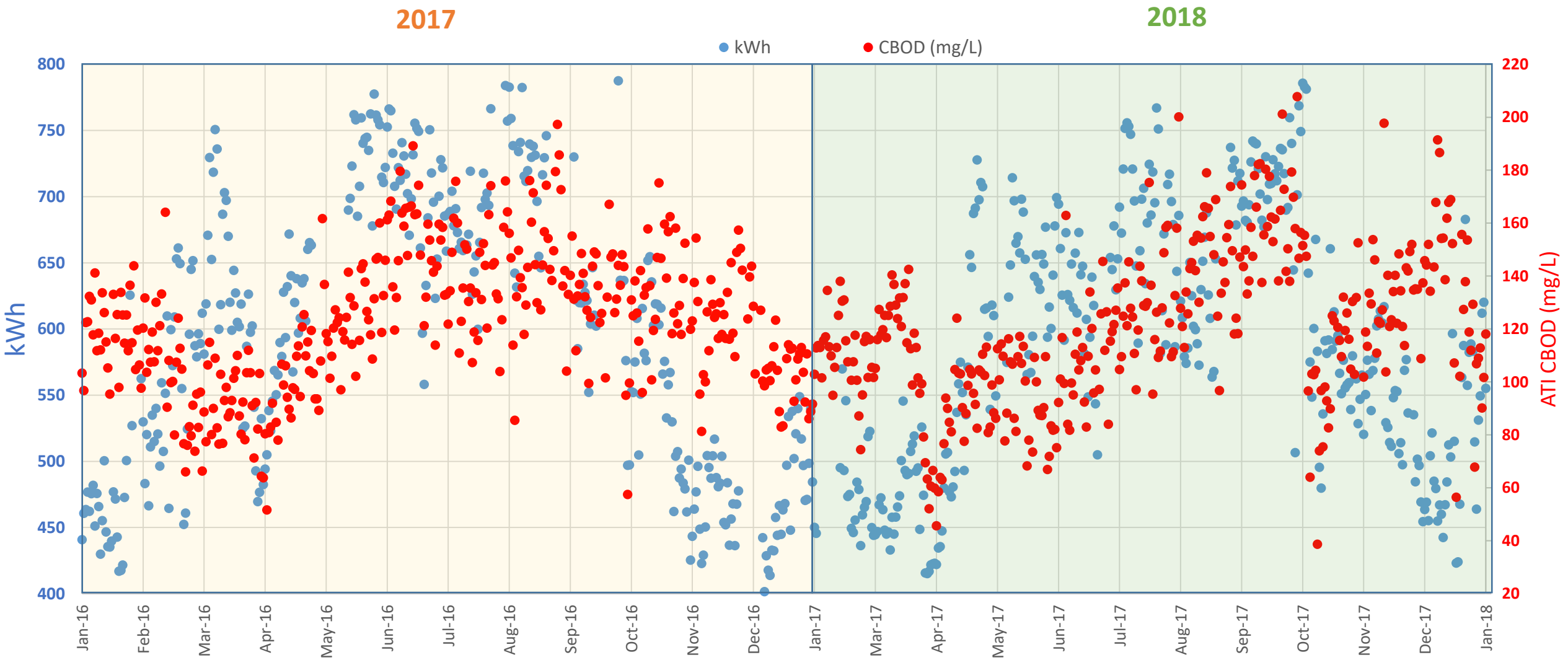


Temperature & Oxygen Solubility

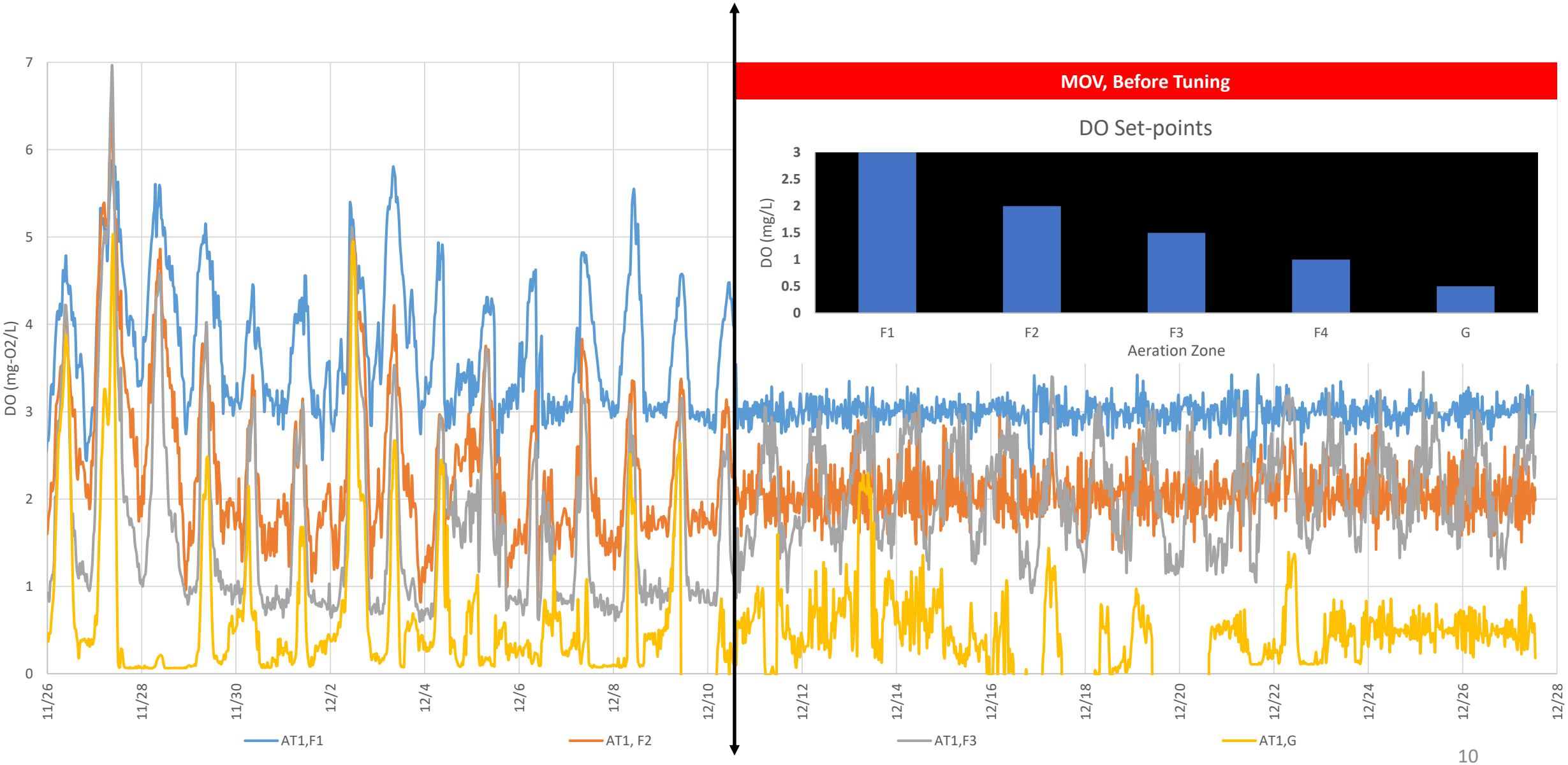


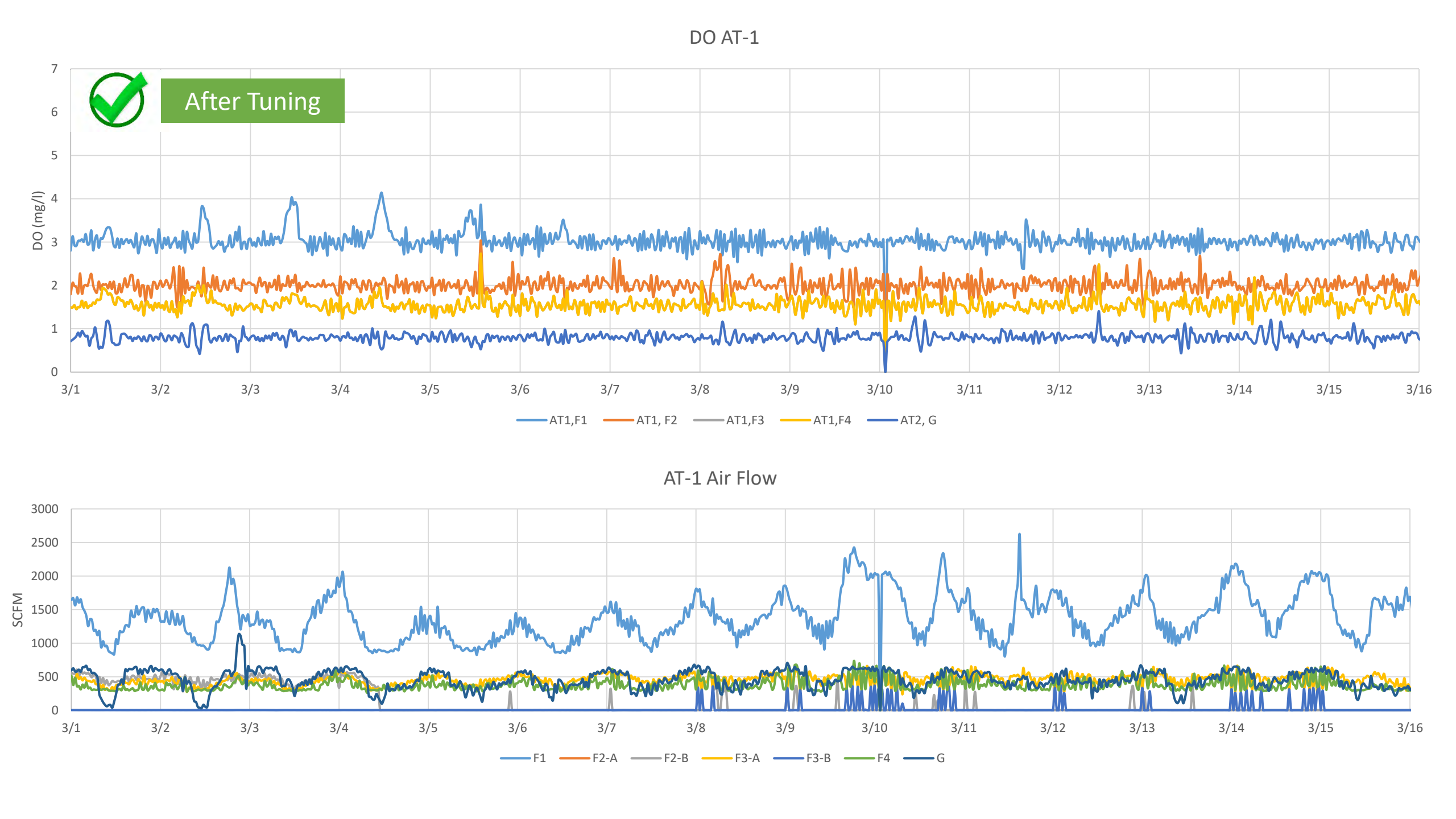


Nutrient Concentration (CBOD & NH3)

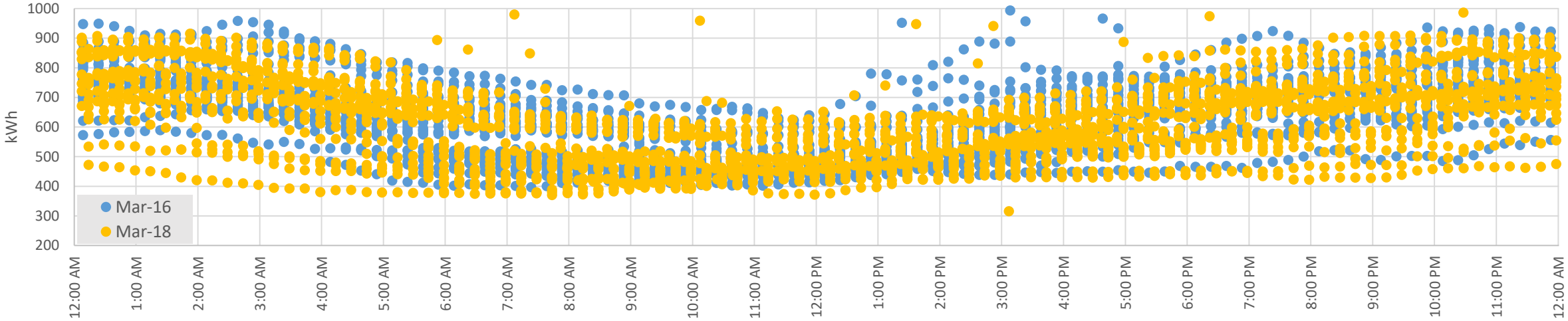


Results & Achievement:

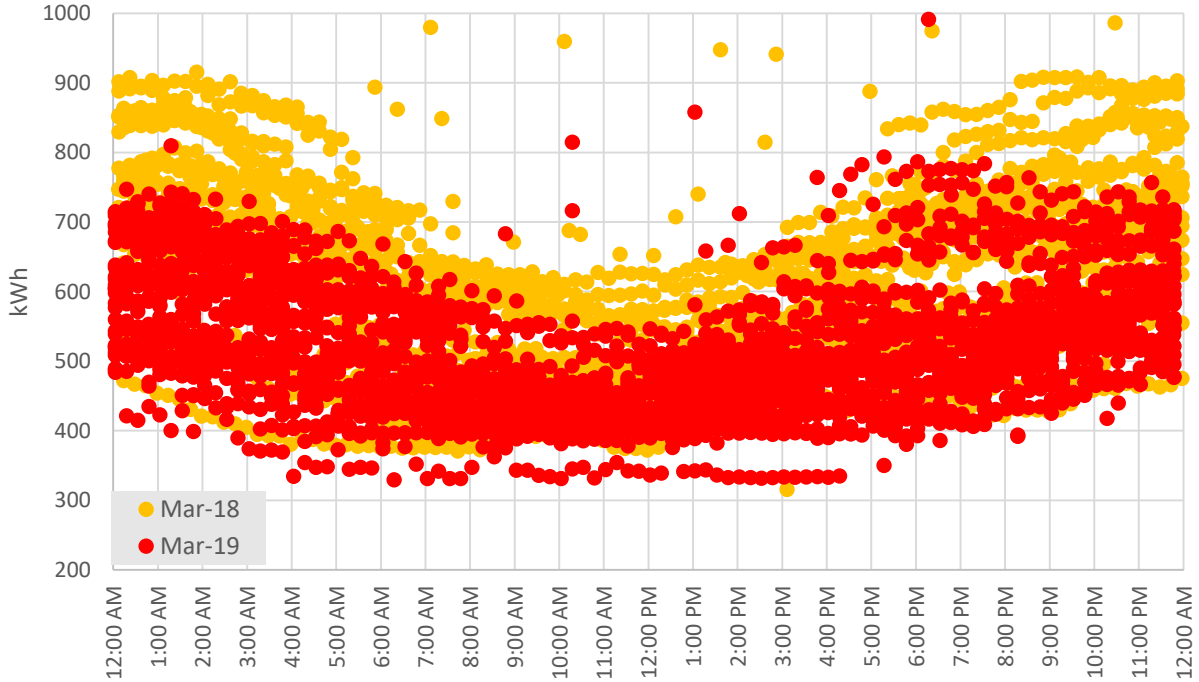



DO AT-1
After Tuning
DO (mg/l)
7
6
5
4
3
2
1
0
3/1
3/2
3/3
3/4
3/5
3/6
3/7
3/8
3/9
3/10
3/11
3/12
3/13
3/14
3/15
3/16
AT1,F1
AT1, F2
AT1,F3
AT1,F4
AT2, G
AT-1 Air Flow
SCFM
3000
2500
2000
1500
1000
500
0
F1
F2-A
F2-B
F3-A
F3-B
F4
G

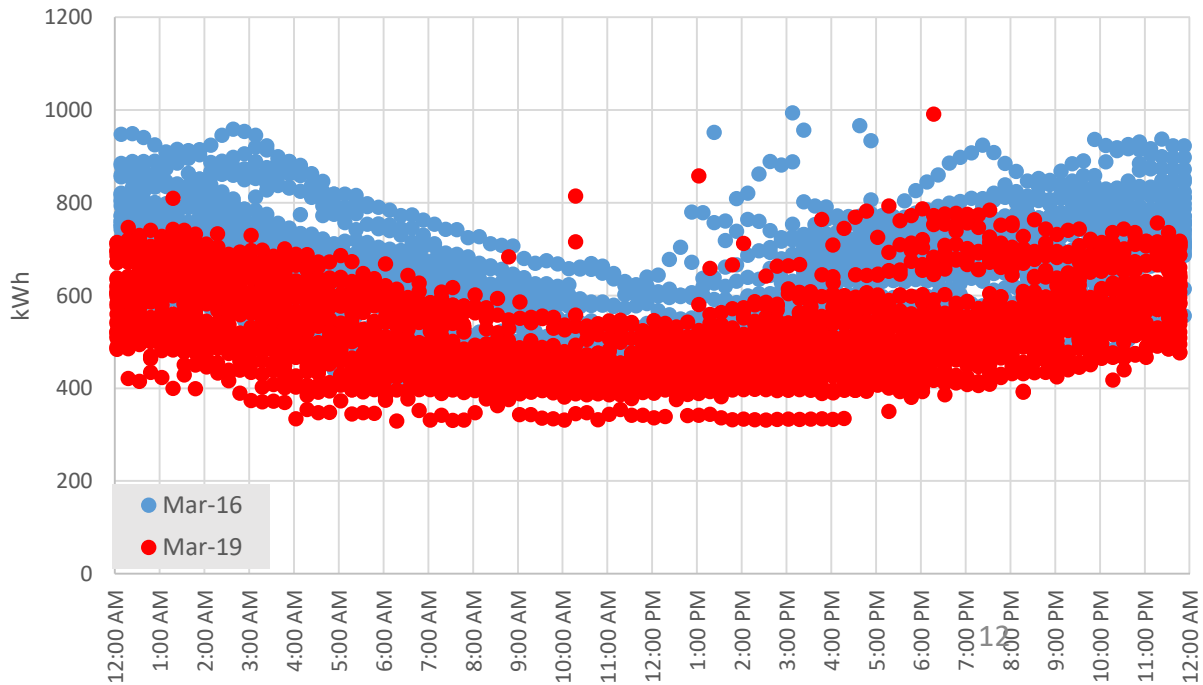
Hourly kWh 2016 vs 2018



Hourly kWh 2019 vs 2018

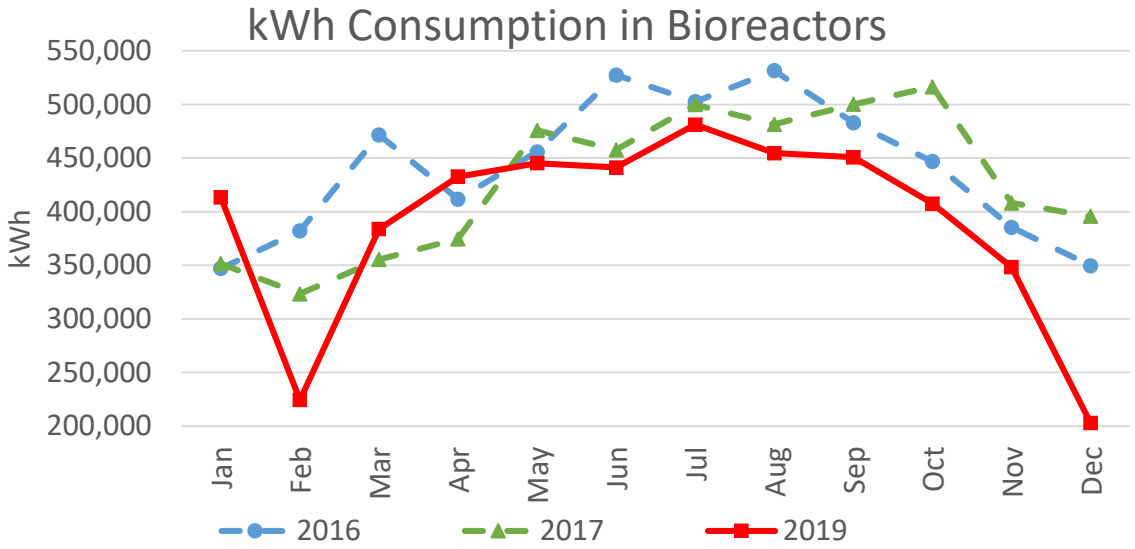


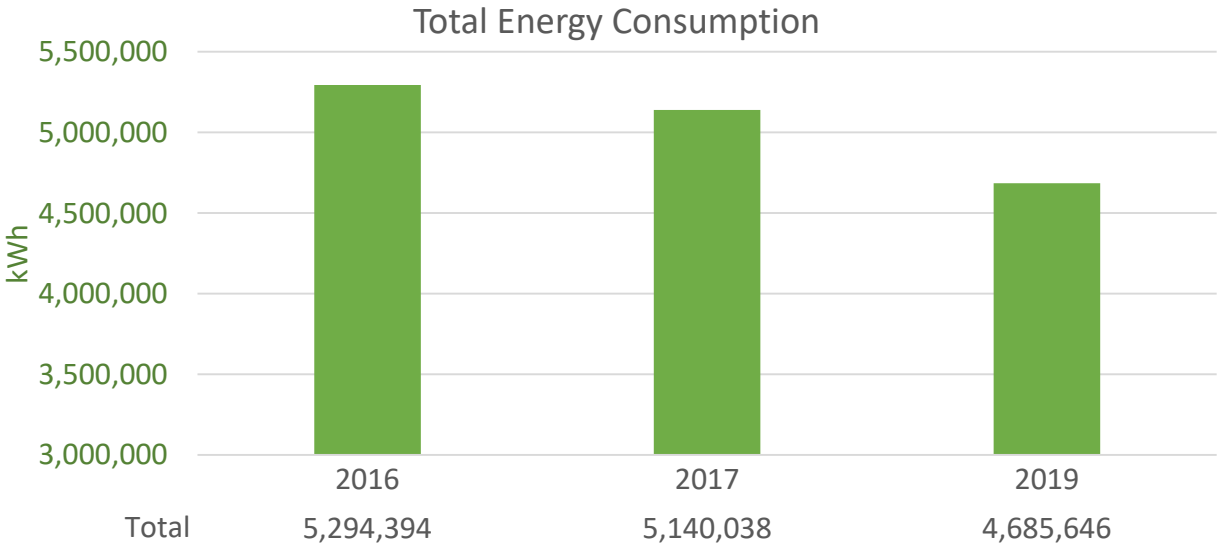
Hourly kWh 2019 vs 2016

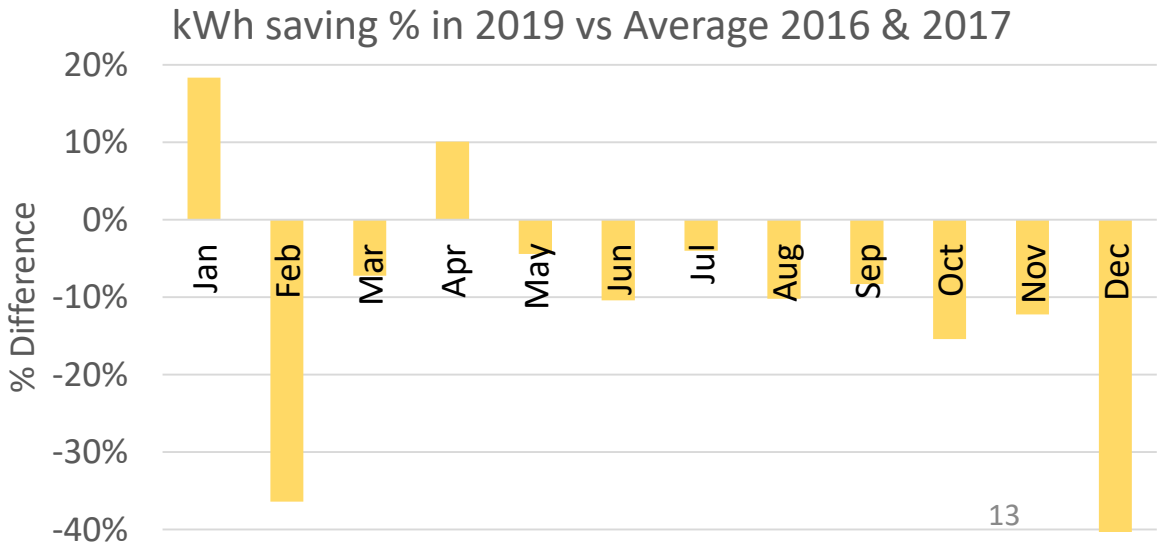


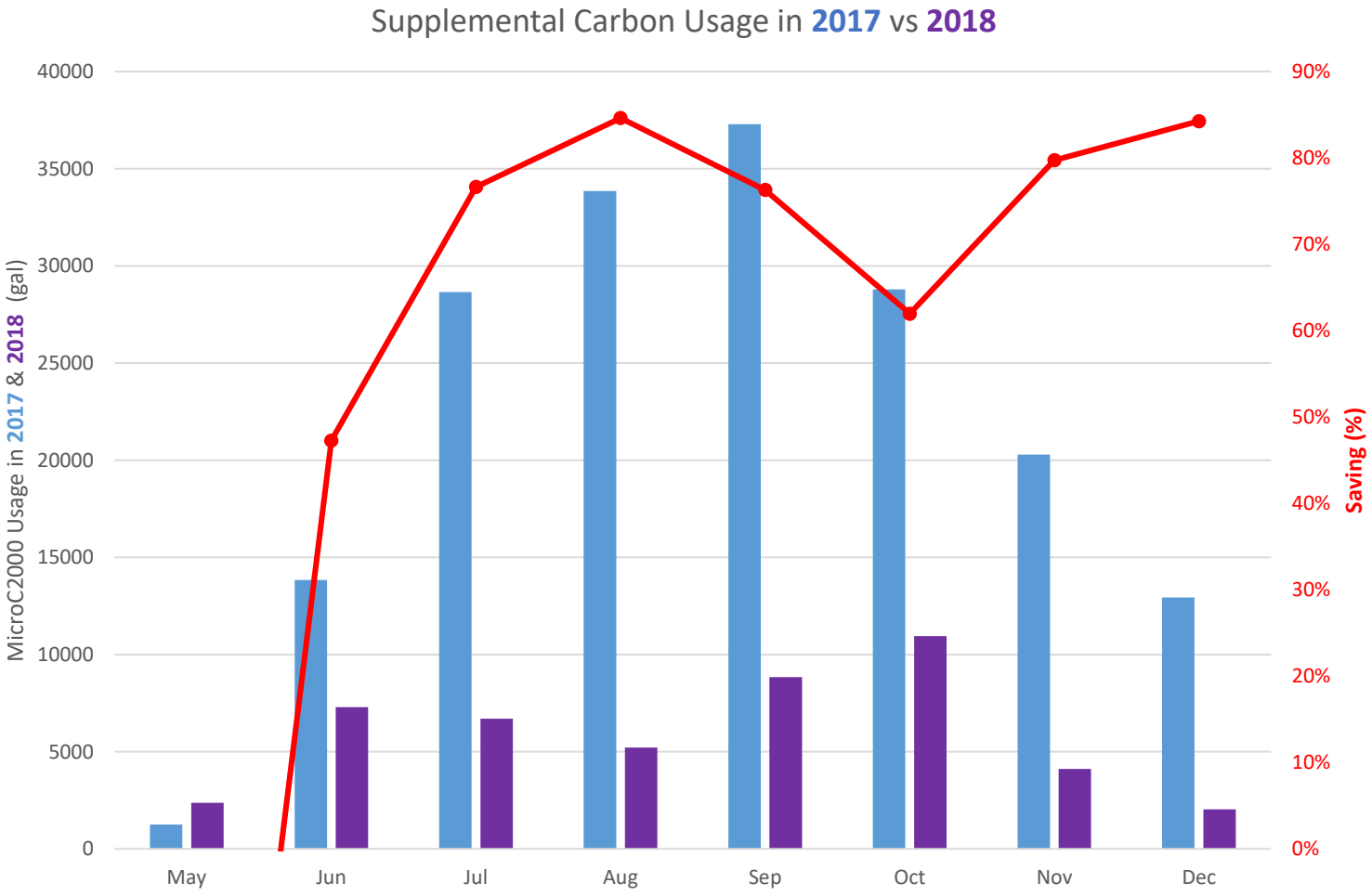
- The Electricity usage for aeration in 2019 reduced 10% compare to 2016 & 2017

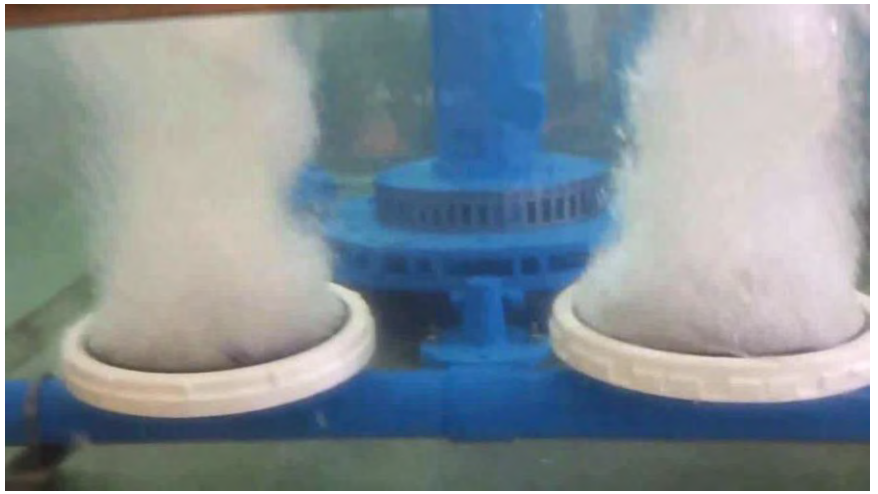
- Energy Saving was more significant in colder temperature

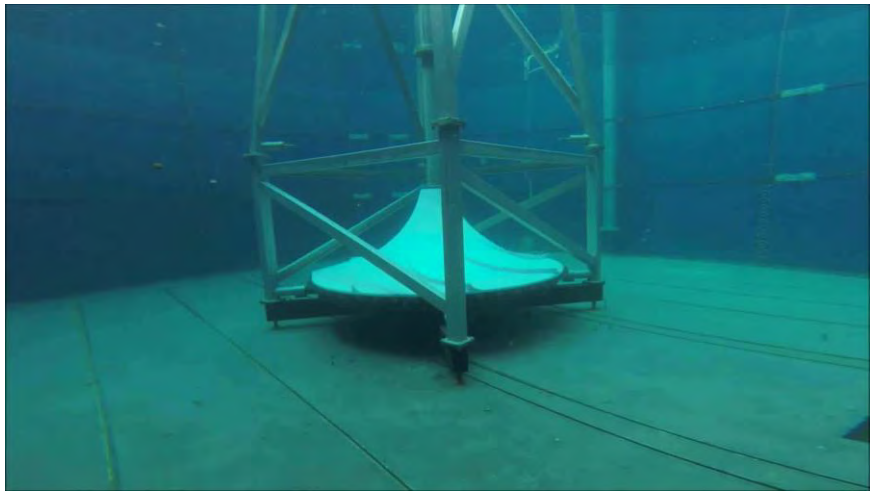






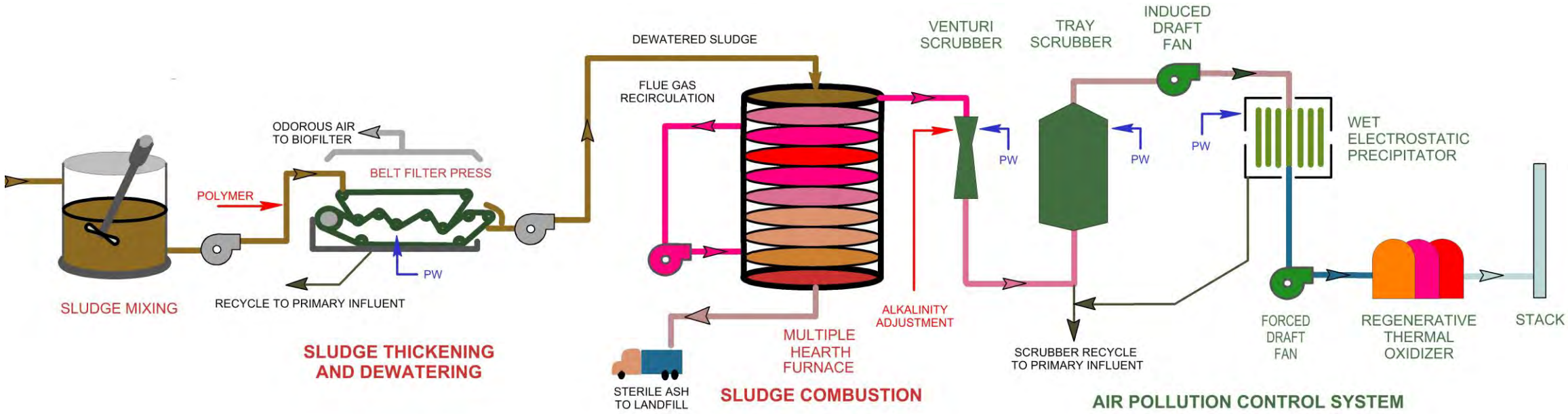






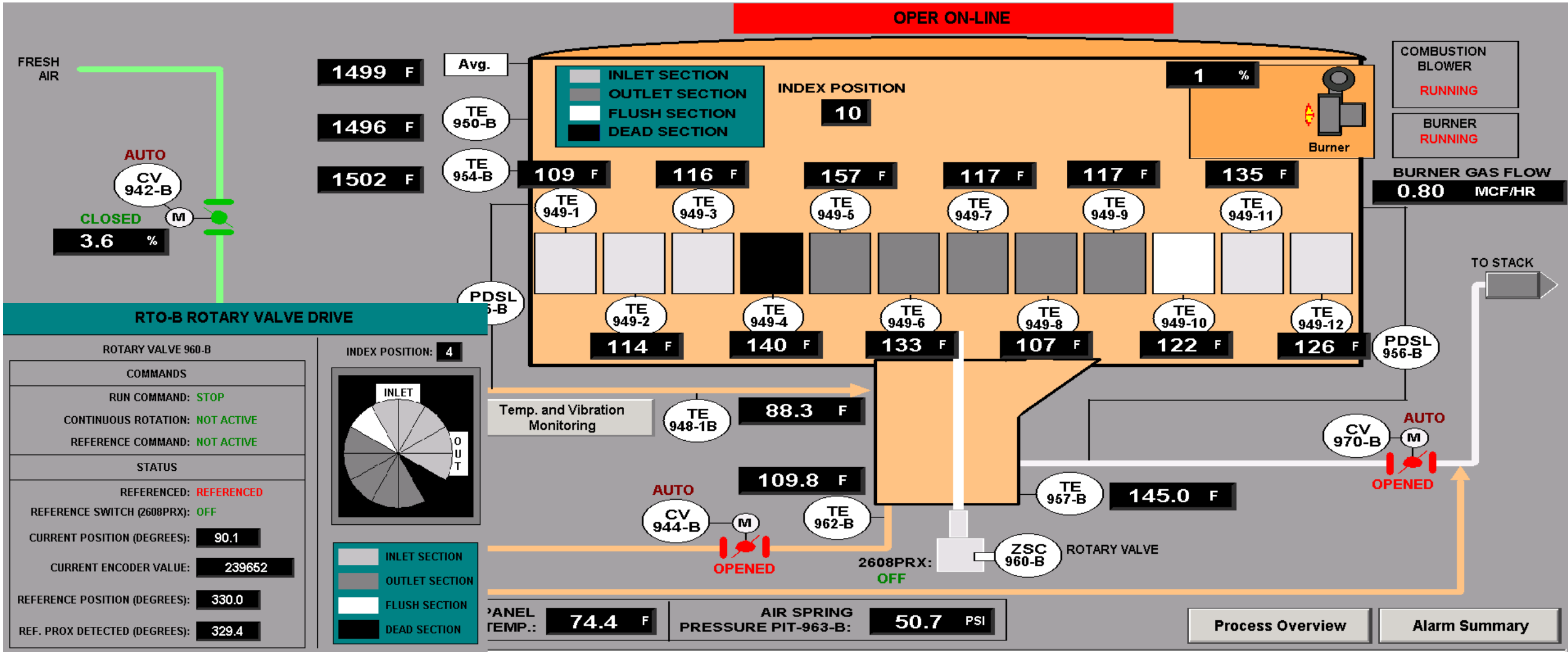
Replacing the disk diffuser in Zone G led to reduce MicroC usage from 177,000 to 48,000 gallon (73% reduction or $258,000 saving).

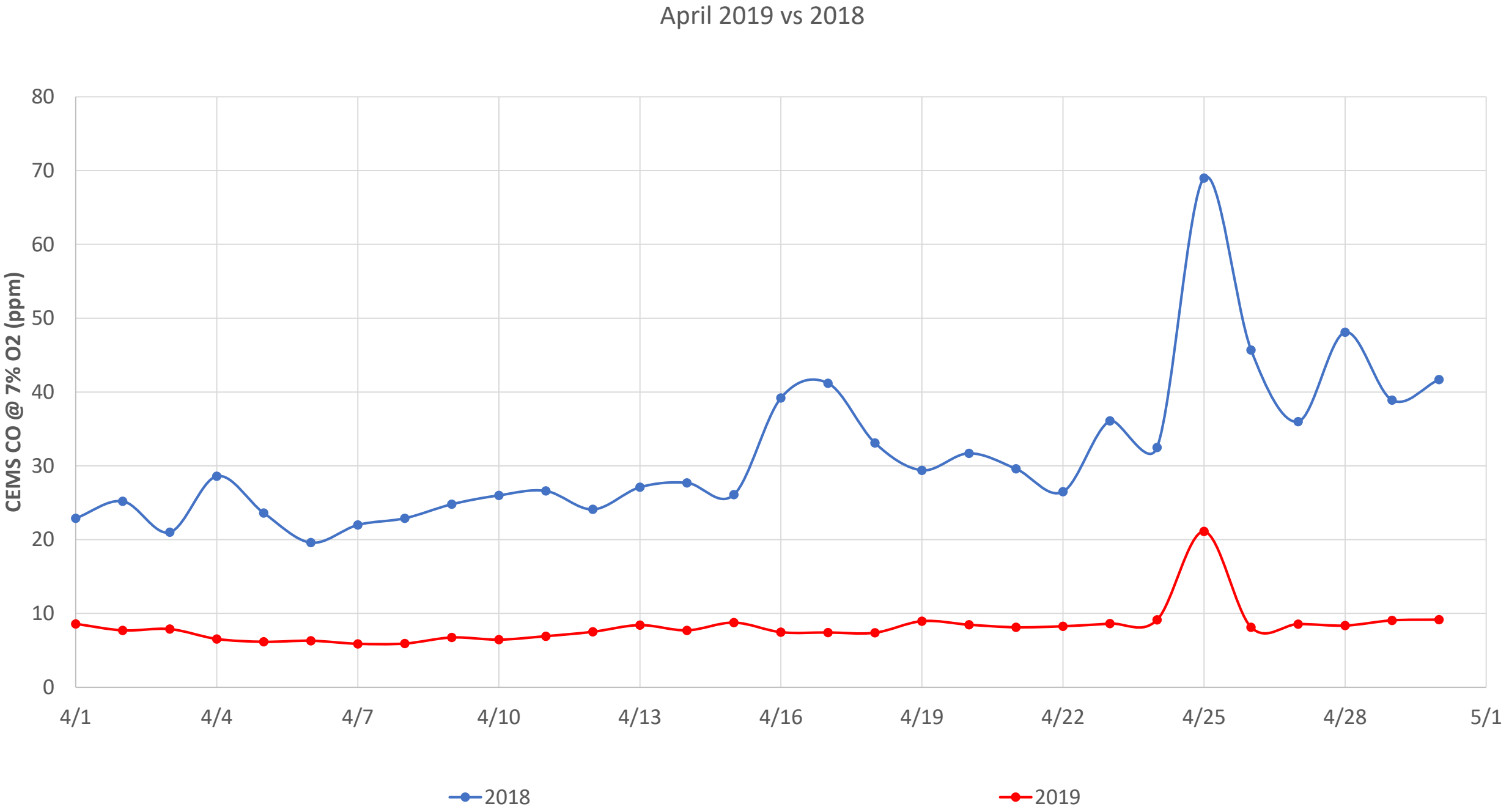
The Regenerative Thermal Oxidizer (RTO) Upgrade

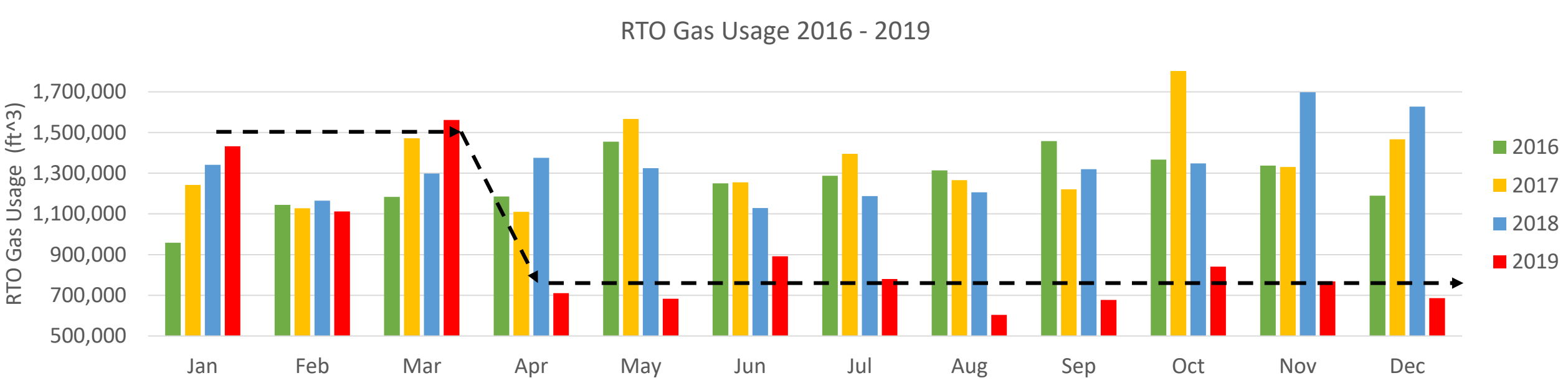


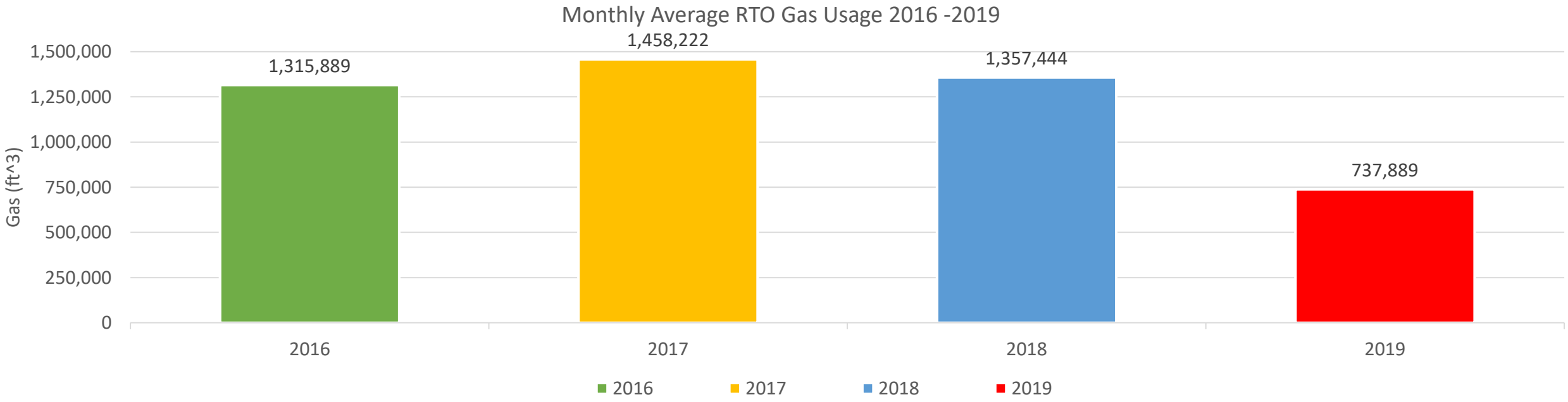
SMITH

DÜRR


OPER ON-LINE
FRESH AIR
AUTO
CV 942-B
M
CLOSED
3.6 %
1499 F
Avg.
1496 F
TE 950-B
1502 F
TE 954-B
INLET SECTION
OUTLET SECTION
FLUSH SECTION
DEAD SECTION
INDEX POSITION
10
1 %
Burner
COMBUSTION BLOWER
RUNNING
BURNER
RUNNING
BURNER GAS FLOW
0.80 MCF/HR
109 F
116 F
157 F
117 F
117 F
135 F
TE 949-1
TE 949-3
TE 949-5
TE 949-7
TE 949-9
TE 949-11
TE 949-2
TE 949-4
TE 949-6
TE 949-8
TE 949-10
TE 949-12
114 F
140 F
133 F
107 F
122 F
126 F
PDSL 956-B
TO STACK
PDSL 6-B
RTO-B ROTARY VALVE DRIVE
ROTARY VALVE 960-B
COMMANDS
RUN COMMAND: STOP
CONTINUOUS ROTATION: NOT ACTIVE
REFERENCE COMMAND: NOT ACTIVE
STATUS
REFERENCED: REFERENCED
REFERENCE SWITCH (2608PRX): OFF
CURRENT POSITION (DEGREES): 90.1
CURRENT ENCODER VALUE: 239652
REFERENCE POSITION (DEGREES): 330.0
REF. PROX DETECTED (DEGREES): 329.4
INDEX POSITION: 4
INLET
OUT
INLET SECTION
OUTLET SECTION
FLUSH SECTION
DEAD SECTION
Temp. and Vibration Monitoring
TE 948-1B
88.3 F
109.8 F
AUTO
CV 944-B
M
OPENED
TE 962-B
TE 957-B
145.0 F
AUTO
CV 970-B
M
OPENED
2608PRX: OFF
ZSC 960-B
ROTARY VALVE
PANEL TEMP.: 74.4 F
AIR SPRING PRESSURE PIT-963-B: 50.7 PSI
Process Overview
Alarm Summary


April 2019 vs 2018
CEMS CO @ 7% O2 (ppm)
80
70
60
50
40
30
20
10
0
4/1
4/4
4/7
4/10
4/13
4/16
4/19
4/22
4/25
4/28
5/1
2018
2019


RTO Gas Usage 2016 - 2019
RTO Gas Usage (ft^3)
1,700,000
1,500,000
1,300,000
1,100,000
900,000
700,000
500,000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2016
2017
2018
2019


Monthly Average RTO Gas Usage 2016 -2019
Gas (ft^3)
1,500,000
1,250,000
1,000,000
750,000
500,000
250,000
0
1,315,889
1,458,222
1,357,444
737,889
2016
2017
2018
2019
2016
2017
2018
2019

Achievements:

✓Significant reduction on energy consumption

- 50% drop on RTO gas usage
- 10% Saving on Electricity

✓73 % reduction on Supplemental carbon usage ($258,000 saving)

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