(A)

NO SEND

WITNESSED

REVIEW

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

ID NO.:	097190AFG	Test Date:	March 10, 11, & 12, 2020
Source Name:	Medline Industries		
Location	1160 South Northpoint Boulevard, Waukegan, Illinois 60085		
Permit No.	19020013	**TYPE OF TEST PROGRAM:**	
☐ FESOP ☐ Title V ☐ Lifetime ☑ Construction		☑ Initial Performance ☐ CEMS Certification	☐ Annual/Periodic ☐ Other: ________

Emission Unit(s):	Commercial Sterilizer	
Control Equipment:	• Permanent Total Enclosure • Glygen™ Scrubbers • Three Packed Bed Acid Scrubbers • One Catalytic Oxidizer • Dry Bed Scrubbers	
APPLICABLE RULE:	☑ 415 ILCS 5-9.16 ☐ 35 IAC PART ___ ☐ 40 CFR PART 60, SUBPART ___ ☑ 40 CFR PART 63, SUBPART O	
SOURCE	Contact	Jasper Titus
	Phone Number	847-837-2784
	Email	jtitus@medline.com
TESTING COMPANY	Company Name	Montrose Air Quality Services, LLC (Montrose)
	Contact	Don Chapman
	Phone Number	847-487-1580
	Email	dchapman@montrose-env.com
	Report No.	M928ET-663754-RT-415

Parameters		**USEPA REFERENCE METHODS**	Yes	No
☐ PM ☐ PM_{10} ☐ SO_2 ☐ NO_X ☐ Opacity ☐ CO ☐ VOM ☐ HCl ☑ DE ☐ CE ☐ Metals ☑ Ethylene Oxide		☑ 1 ☑ 2 ☑ 3A ☐ 4 ☐ 5_ ☐ 6_ ☐ 7_ ☐ 9 ☐ 10 ☐ 12 ☐ 18 ☐ 19 ☐ 20 ☐ 23 ☐ 24 ☐ 25 ☐ 25_ ☐ 26 ☐ 29 ☐ 201_ ☐ 202 ☐ 204 ☐ 204_ ☑ 320 ☐ ____		
Alternative method(s)	None			
Did Permittee propose or use proper method(s)?			✓	

Process Information		Yes	No
Process rate allowed in permit or unit capacity:	Construction Permit Condition 3.a.i. limits stack emissions to: 15 pounds/month and 150 pounds/year. There is no throughput limit.		
Process rate during stack test:	See tables below		
Was the process rate during stack test within 90 or 100% of allowable? (i.e. was stack test done under conditions representative of maximum emissions?)		✓	

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COMPLIANCE DEMONSTRATION			Yes	No
Protocol	Submitted?	Date: October 24, 2019 – Original January 27, 2020 – Revised	✓	
	Submitted timely?	45 days prior to test	✓	
	Approved?		✓	
Did testing follow the approved protocol?			✓	
Were raw field & laboratory sheets included with the final report?			✓	
Were three test runs performed?			✓	
Were runs performed for appropriate length of time?			✓	

	Pollutant	**Emission**				**Limit**	
		R1	**R2**	**R3**	**Ave**		
Emissions:	Capture Efficiency (%)	100				100%	415 ILCS 5-9.16
	Destruction Efficiency (%)	99.99	99.99	99.99	99.99	99.9%	
	Ethylene Oxide (ppb db)	36.70	33.61	28.03	32.78	200 ppb	
	Extrapolated Monthly Emissions (lbs./Month)	9.1	8.3	5.9	8.1	15 lbs./Month	Construction Permit 19020013 Condition 3.a.i.
	Extrapolated Yearly Emissions (lbs./Year)	110	99	82	97	150 lbs./Year	

Process Data			**Run 1**	**Run 2**	**Run 3**	**Average**
EtO Used	lbs.		815.3	773.7	787.1	792
Chamber 2	Capacity 3 Pallets	Pallets Sterilized	3	3	3	3
Chamber 4	Capacity 6 Pallets	Pallets Sterilized	6	6	6	6
Chamber 5	Capacity 6 Pallets	Pallets Sterilized	6	6	6	6
Chamber 6	Capacity 13 Pallets	Pallets Sterilized	13	13	13	13
Chamber 7	Capacity 13 Pallets	Pallets Sterilized	13	13	13	13
Chamber 8	Capacity 13 Pallets	Pallets Sterilized	13	13	13	13
Chamber 9	Capacity 13 Pallets	Pallets Sterilized	13	13	13	13
Chamber 10	Capacity 26 Pallets	Pallets Sterilized	26	26	26	26
Chamber 11	Capacity 26 Pallets	Pallets Sterilized	26	26	26	26
Chamber 12	Capacity 26 Pallets	Pallets Sterilized	26	26	26	26

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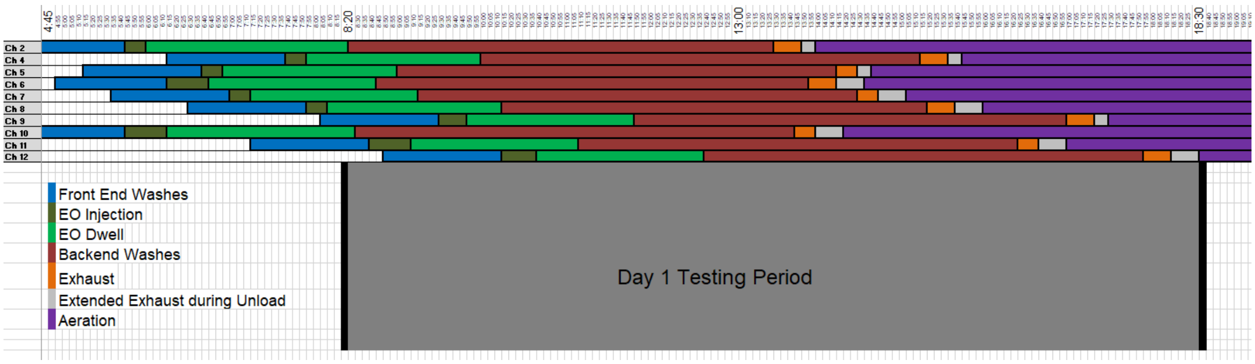
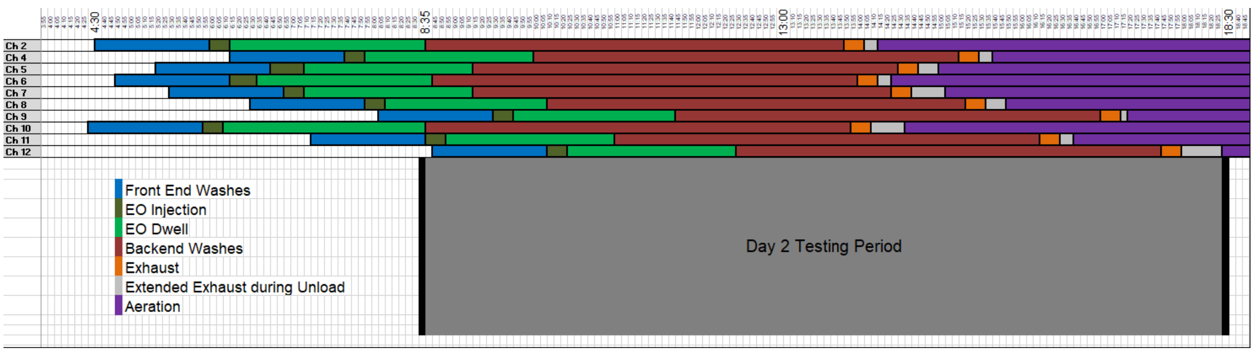
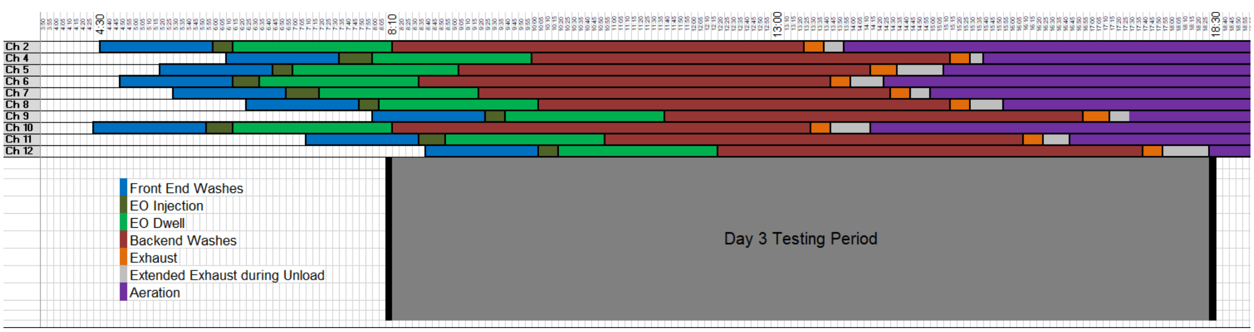
Chamber Operating Data







Aeration	% Full at Beginning of Test	% Full at End of Test
Run 1	58.19%	73.75%
Run 2	69.73%	88.13%
Run 3	83.78%	92.98%

The shipping area was full with sterilized product, representing worse case emissions from the PTE.

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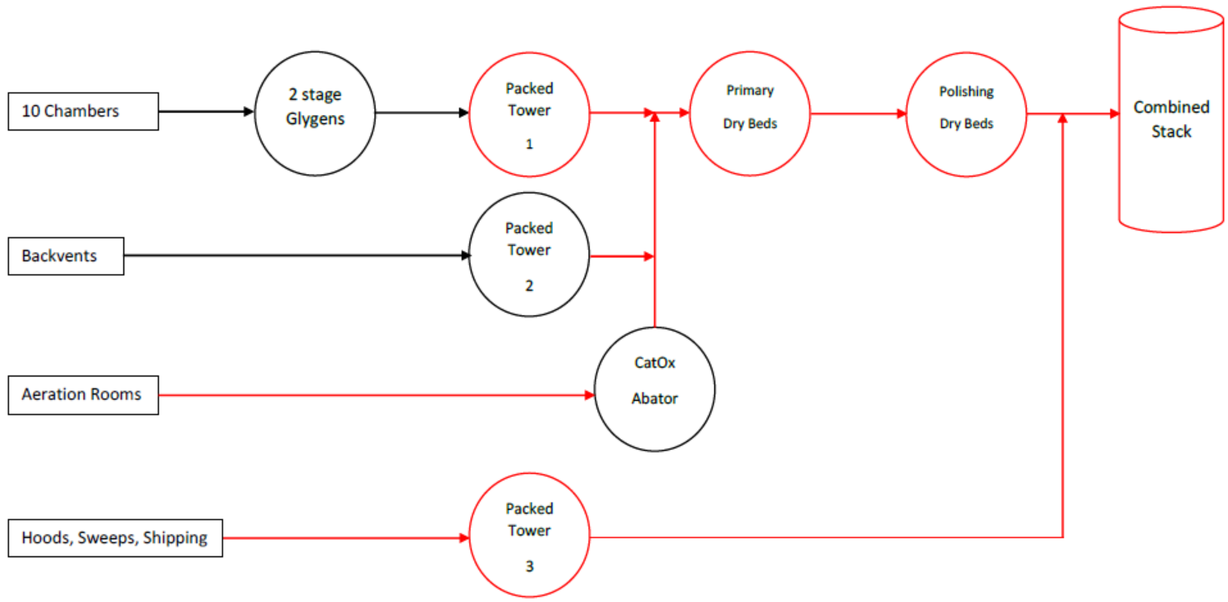
Control System



See attachment: "Control Device Operating Parameters" for detailed information on the operating parameters of each control system measured during the test program

Are test results in compliance with applicable requirements, permit special conditions, and Agency averaging policy/rule?	Yes	No

Comments:

Medline Industries contracted Montrose Air Quality Services, LLC (Montrose) to evaluate the ethylene oxide emissions and control efficiency of the control system. The entire test program was witnessed by the author.

Montrose utilize USEPA Methods 1, 2, 3A and 320.

The gas composition at Inlet 1 consisted of EtO and nitrogen. FTIR measurements were used for the EtO concentration, and the nitrogen content was calculated as the difference. The gas composition at Inlets 2, 3, and 4 is equivalent to ambient air; therefore, a dry molecular weight of 29.0 lb/lb-mole was used for the gas density and flow calculations, in accordance with Section 8.6 of USEPA Method 2.

Moisture content of the gas stream was determined using FTIR measurements in accordance with USEPA Method 320 and ASTM D6348-12, as allowed by USEPA Method 4, Section 16.3.

Ethylene oxide and moisture sampling at the Common Stack was conducted using a MAX Analytical FTIR system enhanced with StarBoost™ technology. StarBoost™ is a MAX Analytical add-on to an existing MKS Model 2030 FTIR analyzer, which combines infrared filtering, signal amplification, and advanced software algorithms to greatly increase the signal intensity, resulting in much lower detection limits. The StarBoost™ meets USEPA Method 320 and ASTM D6348 criteria. As part of the filtering, StarBoost™ systems measure fewer gases simultaneously than standard FTIR analyzers. The useable IR region is determined by the targeted analytes and selected filter. In addition, the Starboost™ was also equipped with MAX T.O.M. technology to aid in collecting zeroed background interference data to enhance accurate measurements at low-level concentrations of volatile organic compounds.

The following modifications to the test methods were noted and approved prior to the test program.

1. EtO cylinders were only available in ± 5% certifications without an alternative (Alt) testing procedure ALT-114 and ALT-118; "Alternative Approaches to NIST-Traceable Reference Gases".

   https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=336073

   Ryan, J. ALT-114 and ALT-118 Alternative Approaches to NIST-Traceable Reference Gases. Presented at "The 41st Stationary Source Sampling and Analysis for Air Pollutants Conference, Tucson, AZ, April 9 - 14, 2017."

   A calibration gas manufacturer could not be obtained that would blend an EtO cylinder in the ppm range required for this test program and at the required EPA protocol gas accuracy certification of ± 2%. The best the gas vendor was able to supply was an EtO gas cylinders ± 5%. In addition, a vendor was unable to be located that would be able to perform Alt 114 procedures for certification of the EtO gas concentrations. Therefore, it was requested that the EtO cylinders accuracy of ± 5% be accepted in lieu of the protocol gas requirement of ± 2%. Additionally, calibration cylinders of many organic compounds are not commercially available at ± 2% accuracy due to stability, vapor pressure, or reactivity issues of the specific compound. Based on experience with EtO and discussions with EPA Office of Air Quality Planning and Standards (OAQPS), who also indicated instability of EtO in cylinders below 2 ppmv, a 50 ppmv cylinder was used to determine calibration stability as per PS-15, Sections 10 and 11. Another 2 ppmv cylinder of EtO with a tracer gas of 500 ppm ethane was used to determine the dynamic spike dilution factor (Method 320) and was transported directly to the FTIR sample cell initially to provide an accurate cylinder tag value for the cylinder used for the dynamic spiking.

2. The CTS used for the path length and associated quality control measurements in Method 320 was 50 to 500 ppm methane. This was not a modification to the method; however, it is noted to point out the difference between CTS and the tracer gas used. Additionally, the CTS for the inlet locations was ~ 100 ppm ethylene.

3. Due to the variable EtO concentrations and high EtO concentrations at all inlet test locations, dynamic spiking as required by Method 320 was conducted into ambient air and not into the sample stream. Since the sample streams are essentially ambient air, the sample streams have similar potential interferences.

4. Due to the variable nature of the flow rate from the sterilization chambers and back vents, the gas velocity at all test locations was continually monitored using a permanently mounted pitot tube and digital pressure transducer. A preliminary flow traverse was conducted at the start of each test day following EPA Methods 1 and 2. The pitot tube was then placed at the point of average velocity. Gas velocity readings were recorded every minute during each test run using an electronic Data Acquisition System (DAS). A preliminary flow traverse was conducted prior to the test program (not at the start of each test day) following EPA Methods 1 and 2.

5. A dilution probe in line with the Method 320 sampling system at the inlet location was utilized due to the high readings of EtO from the sterilization chamber. The dilution ratio was verified using a high-range methane calibration gas.

Notable comments addressed in the test report. Illinois EPA comments italicized.

1. Inlet 1 – The extremely low gas flow of concentrated ethylene oxide at the inlet could not be measured because it was well below the detection limits of the pitot and DP cell gas velocity system. It should be noted that the gas flow of less than 24 cfm is below the available commercial process gas flow measuring devices for this type of gas matrix.

   The ethylene oxide gas flow rate was calculated based on the material balance of the weight of ethylene oxide entering the system during each test run.

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The actual weight of ethylene oxide for each run was measured using Medline's process scale. The removal efficiency of the EO removal systems was also calculated for each run using the weight of ethylene oxide measured by the scale.

The Illinois EPA requested the inlet be tested in order to provide the most accurate ethylene oxide loading to the control system. Based on the data obtained during the test program, a theoretical flow rate was calculated to match the amount ethylene oxide used by the process. It became evident that performing accurate flow measurements at the inlet was not currently possible; therefore, Illinois EPA agreed to allow the amount of ethylene oxide used during the test run to be used for the removal efficiency calculation.

2. Inlet 1 – The FTIR and dilution system was purged with nitrogen to zero the instrument because of possible liquid buildup in the dilution system for 5 minutes during Test Run No. 1. No other dilution system issues were observed during the testing.

   A loss of 5 minutes of data is insignificant as the test runs were over ten (10) hours in length. Additionally, this data was not used in the efficiency calculations.

3. Inlet 2 – The FTIR interferometer did not scan for 44 minutes during Test Run No. 2 due to cooling issues. The detector was filled with liquid nitrogen and no other issues were observed during the testing. All pre-test and post-test calibrations passed during each of the test runs.

   First, a loss of 44 minutes of data is insignificant as the test runs were over ten (10) hours in length. Second, inlet 2 is an insignificant source of EtO into the control system thus it would not adversely affect the efficiency calculation. Third, the missing data resulted in underreporting the inlet loading to the control system; thereby resulting in a more conservative calculation of removal efficiency.

4. The scrubbant flow rate for Packed Bed 3 did not record on the plant's data system during parts of Test Run Nos. 1 and 2. This was noticed during Test Run No. 1; therefore, process screen shots of the scrubbant flow rate were taken to estimate the liquid flow. The process graphs for these runs were extrapolated based on the data points available. The data acquisition was fixed during Test Run No. 2, and the scrubber flow rate was successfully recorded on the data system for the rest of the compliance testing

   It should be noted that the average Packed Bed 3 scrubbant flow rate was very consistent on the packed bed during the test program.

   This issue was brought to the attention of Illinois EPA while on-site. Based on observations made while on-site, the consistency of the data noted, and the fact this parameter is one of several parameters used to document the individual scrubber operating condition, the ultimate determination of the effectiveness of the control system is the EtO measured by the CEMS at the common stack location.

A check of the instrument calibrations and calculations was performed; no issues were noted.

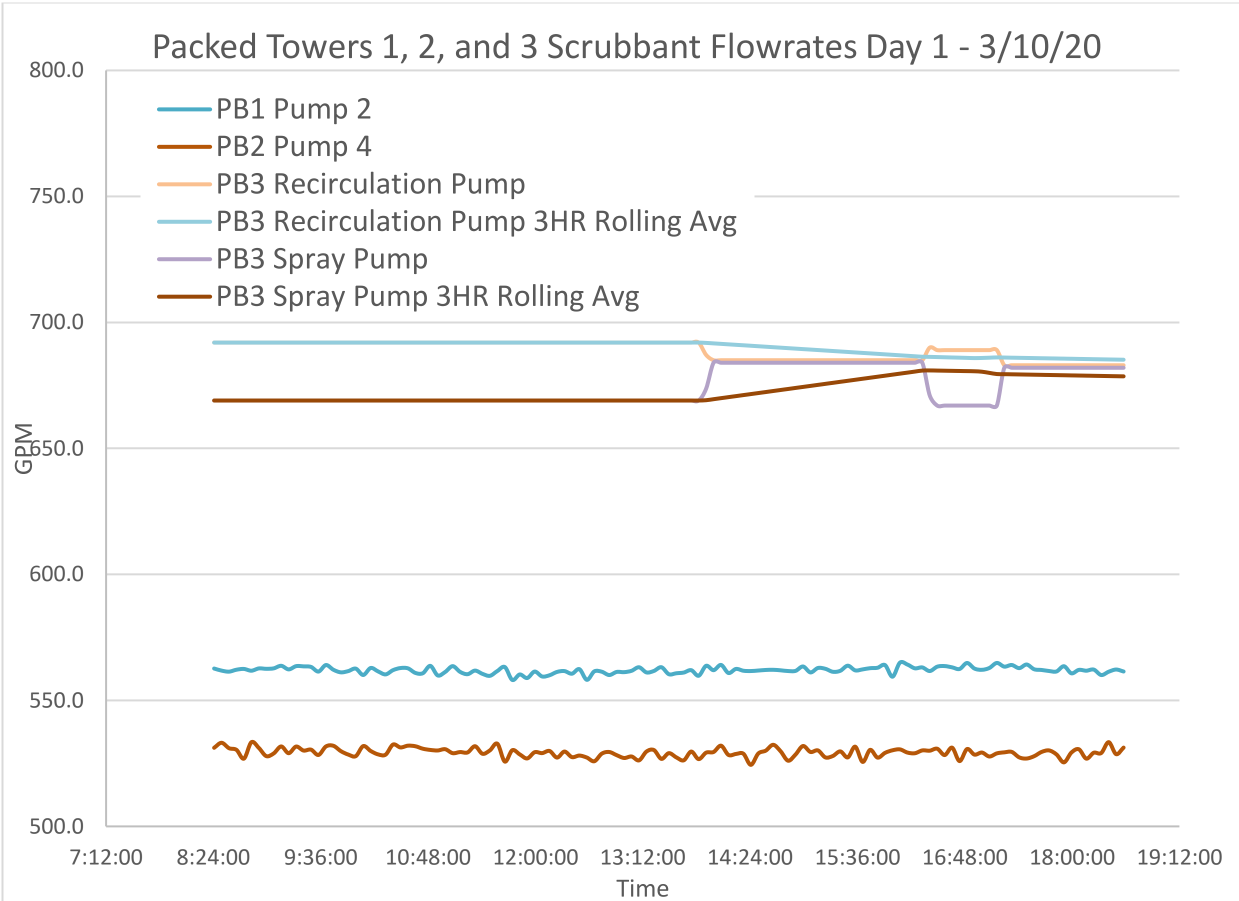
It is recommended that the Illinois EPA accept the test report, which indicates control system is in compliance.

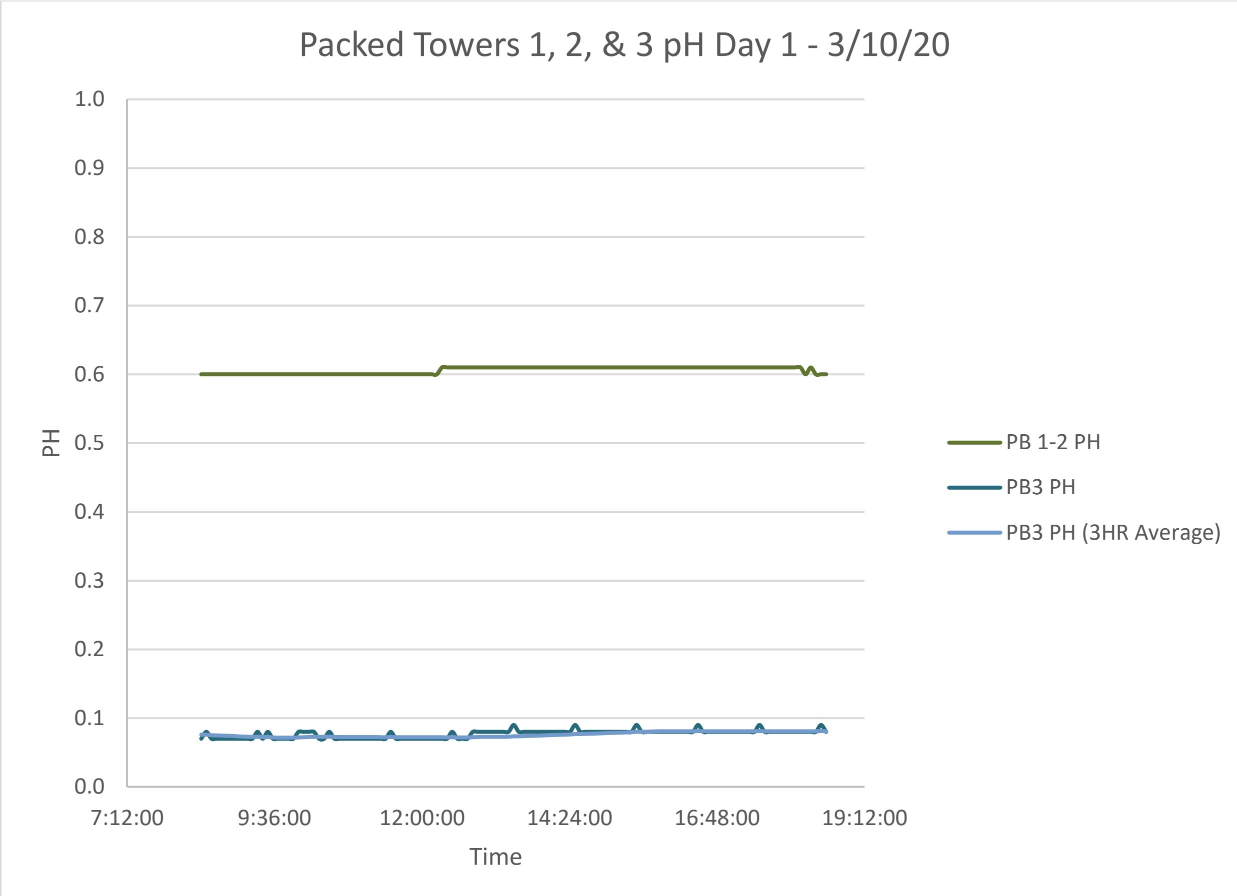
Please contact the undersigned if you have any questions.

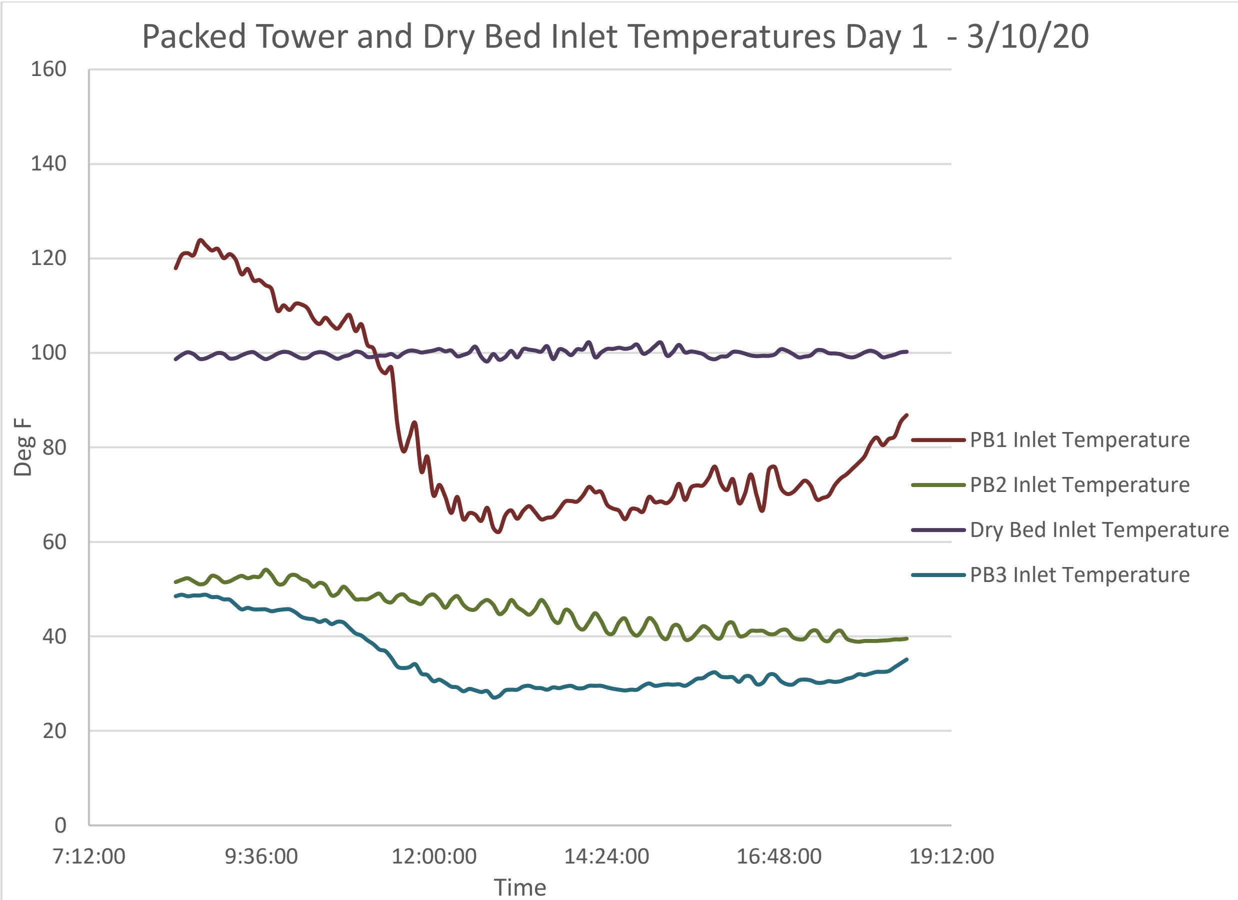
				Yes	No
Kevin J. Mattison (signature)		March 27, 2020	Test Plan Approved	✓	
REVIEWED BY:	Kevin J. Mattison	Date	Compliance Demonstrated? (See comments above)	✓	

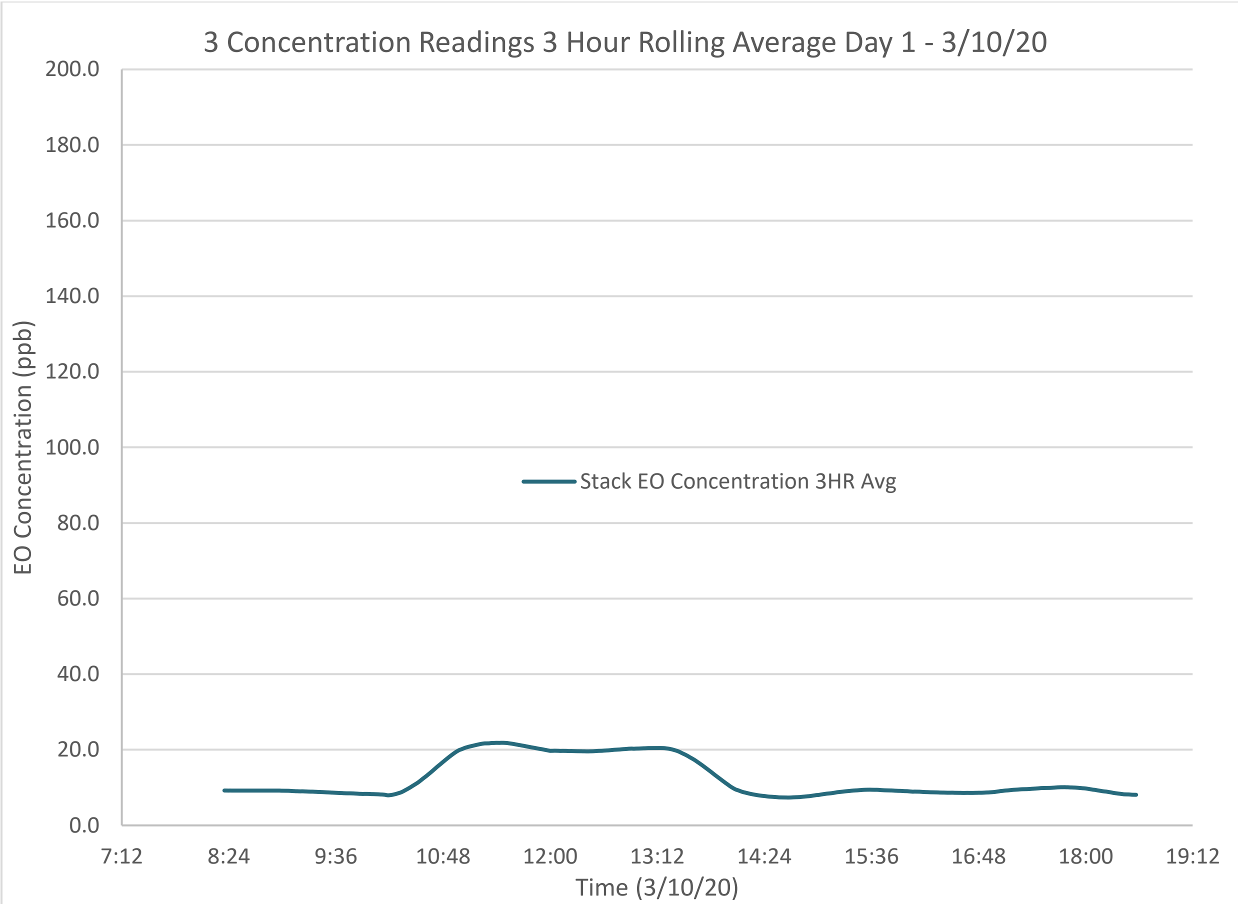
Attachment:

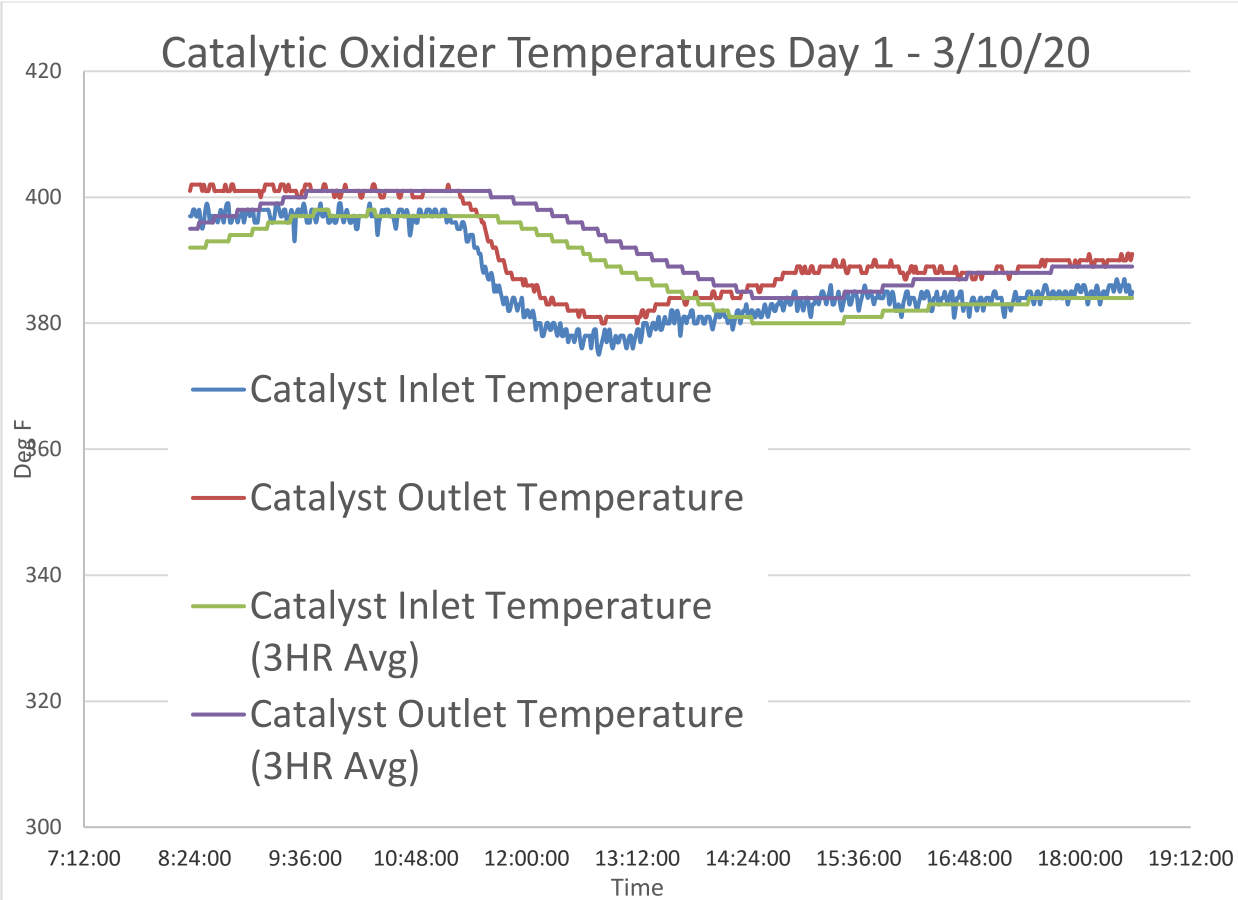
1. Control Device Operating Parameters

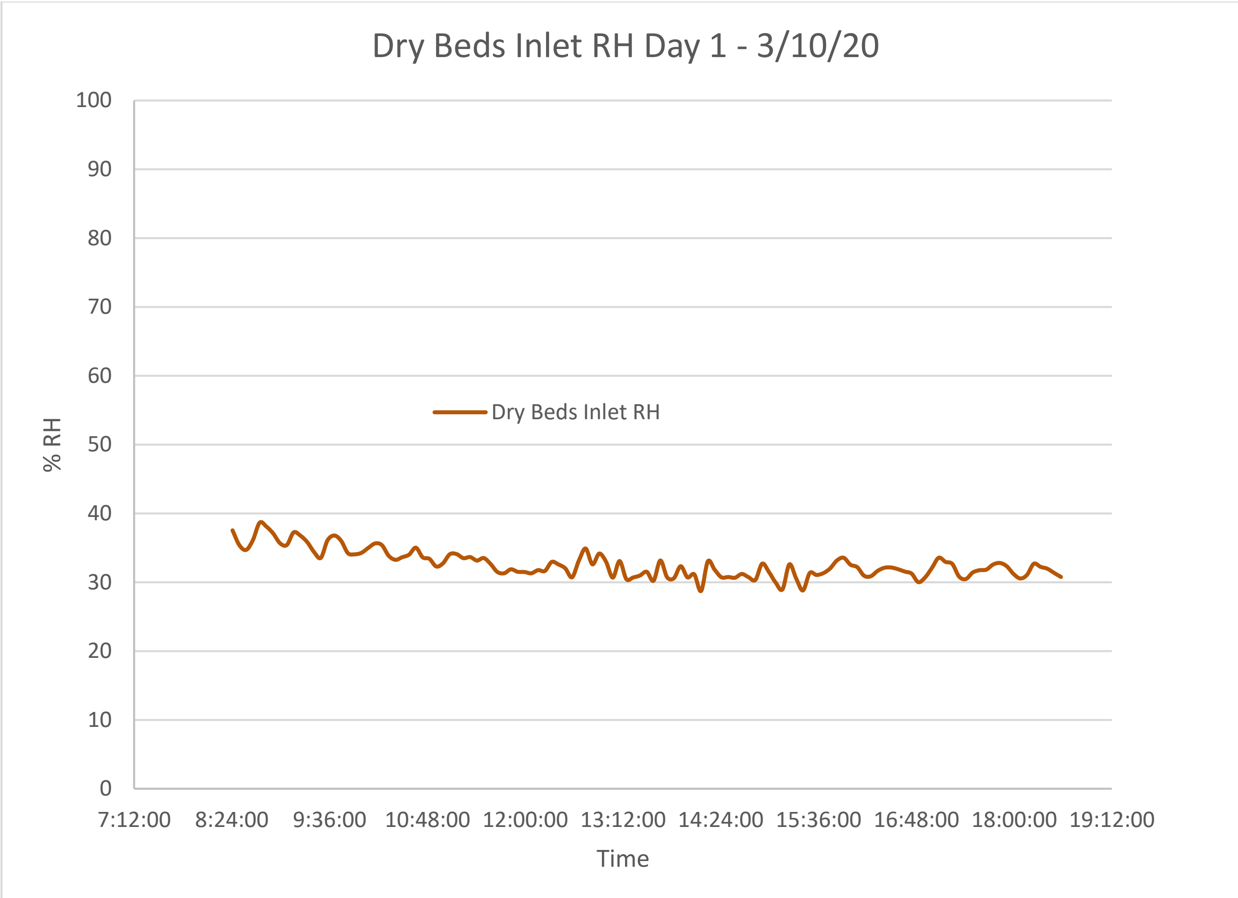

Packed Towers 1, 2, and 3 Scrubbant Flowrates Day 1 - 3/10/20
PB1 Pump 2
PB2 Pump 4
PB3 Recirculation Pump
PB3 Recirculation Pump 3HR Rolling Avg
PB3 Spray Pump
PB3 Spray Pump 3HR Rolling Avg
GPM
800.0
750.0
700.0
650.0
600.0
550.0
500.0
7:12:00
8:24:00
9:36:00
10:48:00
12:00:00
13:12:00
14:24:00
15:36:00
16:48:00
18:00:00
19:12:00
Time


Packed Towers 1, 2, & 3 pH Day 1 - 3/10/20
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
PH
7:12:00
9:36:00
12:00:00
14:24:00
16:48:00
19:12:00
Time
PB 1-2 PH
PB3 PH
PB3 PH (3HR Average)

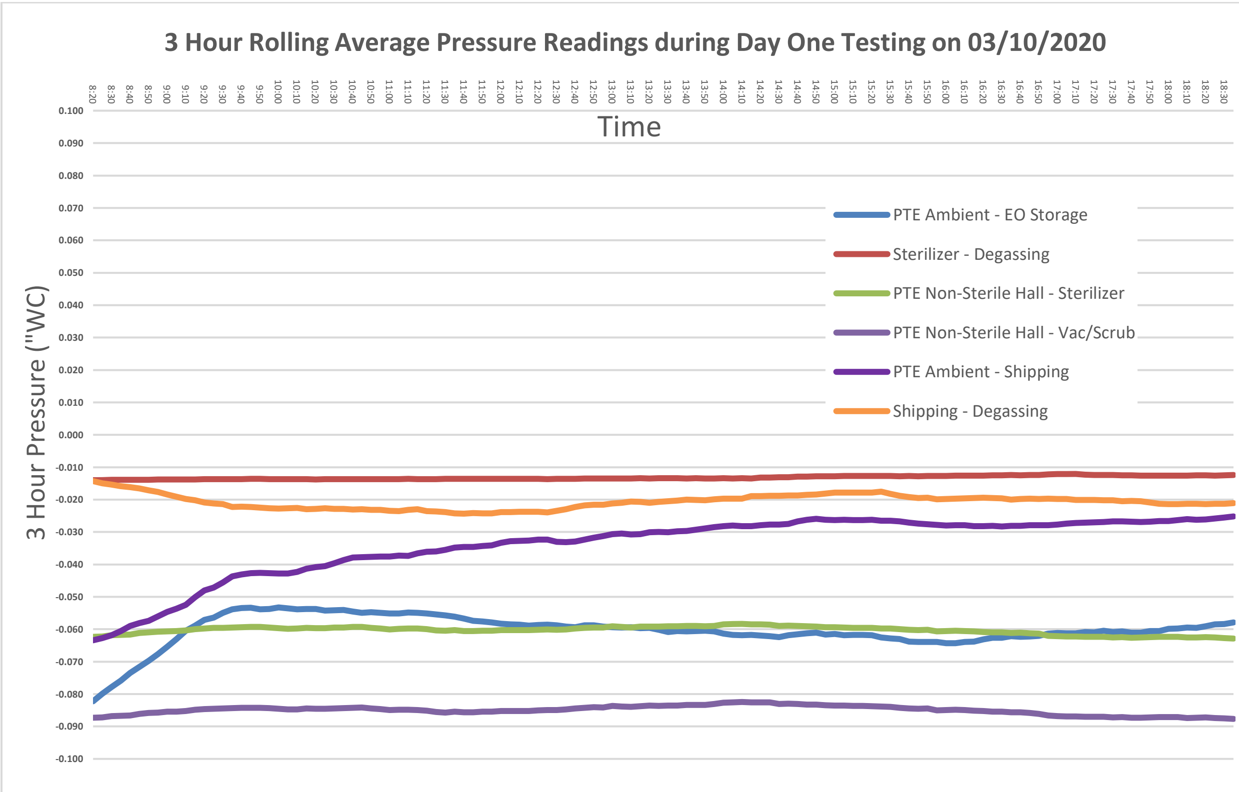

Packed Tower and Dry Bed Inlet Temperatures Day 1 - 3/10/20
160
140
120
100
80
60
40
20
0
Deg F
7:12:00
9:36:00
12:00:00
14:24:00
16:48:00
19:12:00
Time
PB1 Inlet Temperature
PB2 Inlet Temperature
Dry Bed Inlet Temperature
PB3 Inlet Temperature

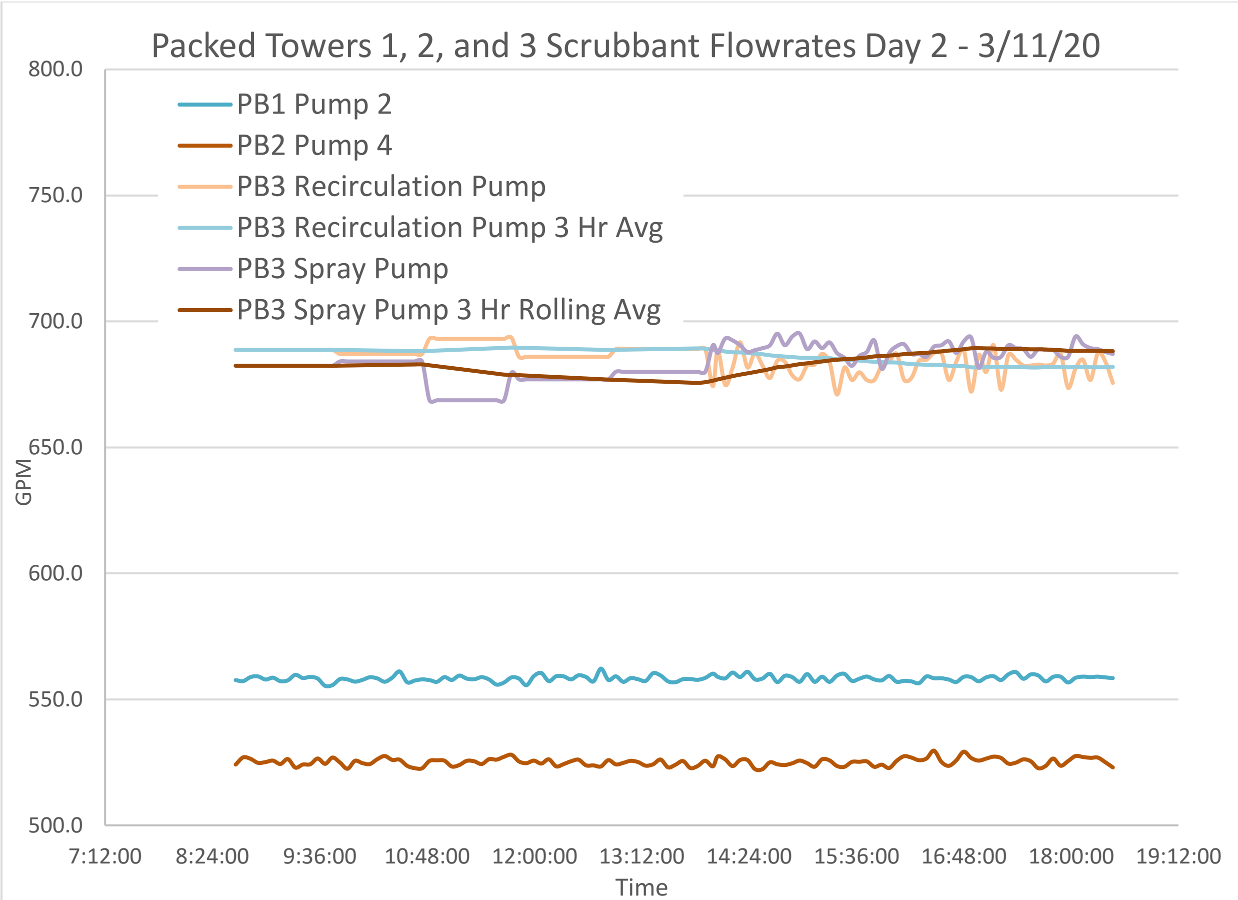

3 Concentration Readings 3 Hour Rolling Average Day 1 - 3/10/20
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
EO Concentration (ppb)
Stack EO Concentration 3HR Avg
7:12
8:24
9:36
10:48
12:00
13:12
14:24
15:36
16:48
18:00
19:12
Time (3/10/20)


Catalytic Oxidizer Temperatures Day 1 - 3/10/20
420
400
380
360
340
320
300
Deg F
7:12:00
8:24:00
9:36:00
10:48:00
12:00:00
13:12:00
14:24:00
15:36:00
16:48:00
18:00:00
19:12:00
Time
Catalyst Inlet Temperature
Catalyst Outlet Temperature
Catalyst Inlet Temperature (3HR Avg)
Catalyst Outlet Temperature (3HR Avg)

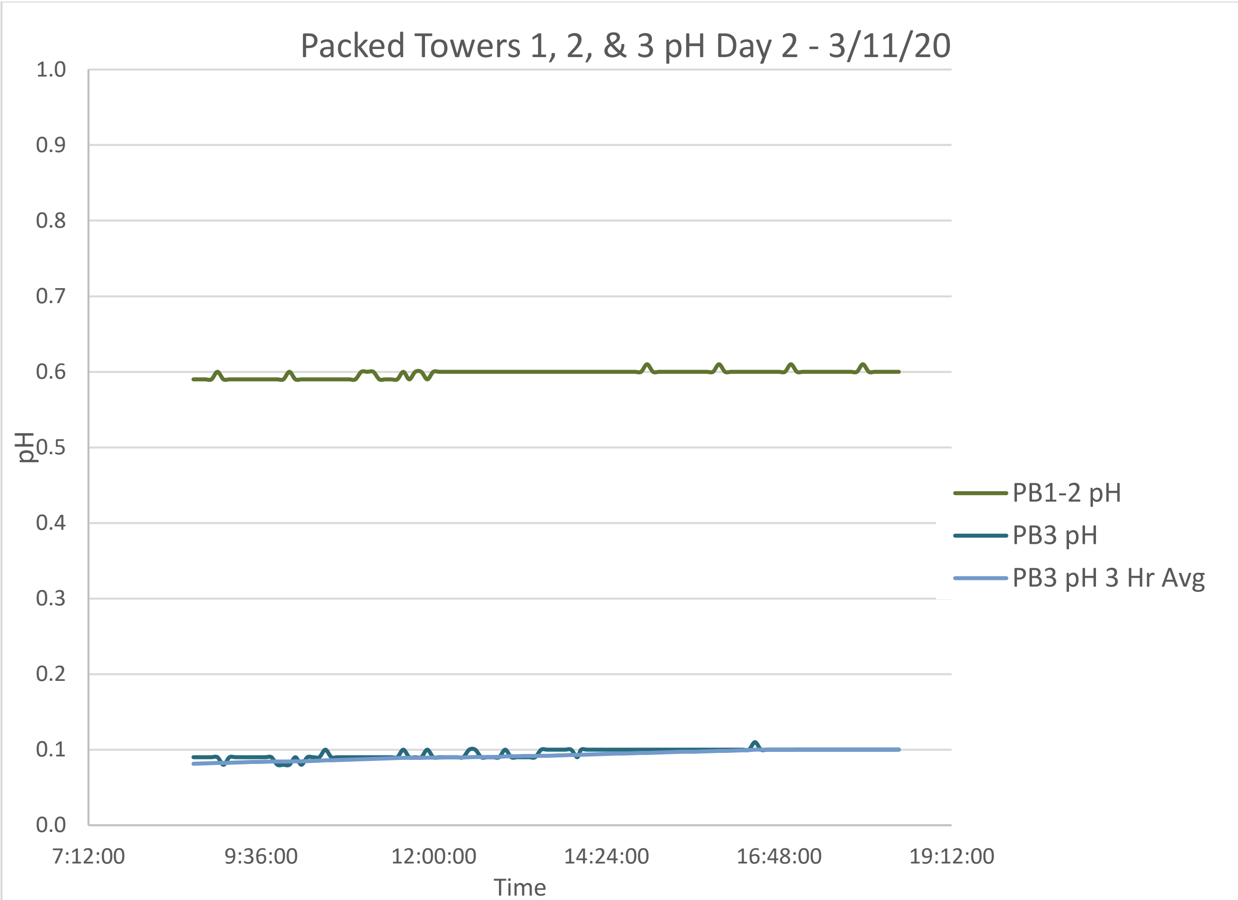


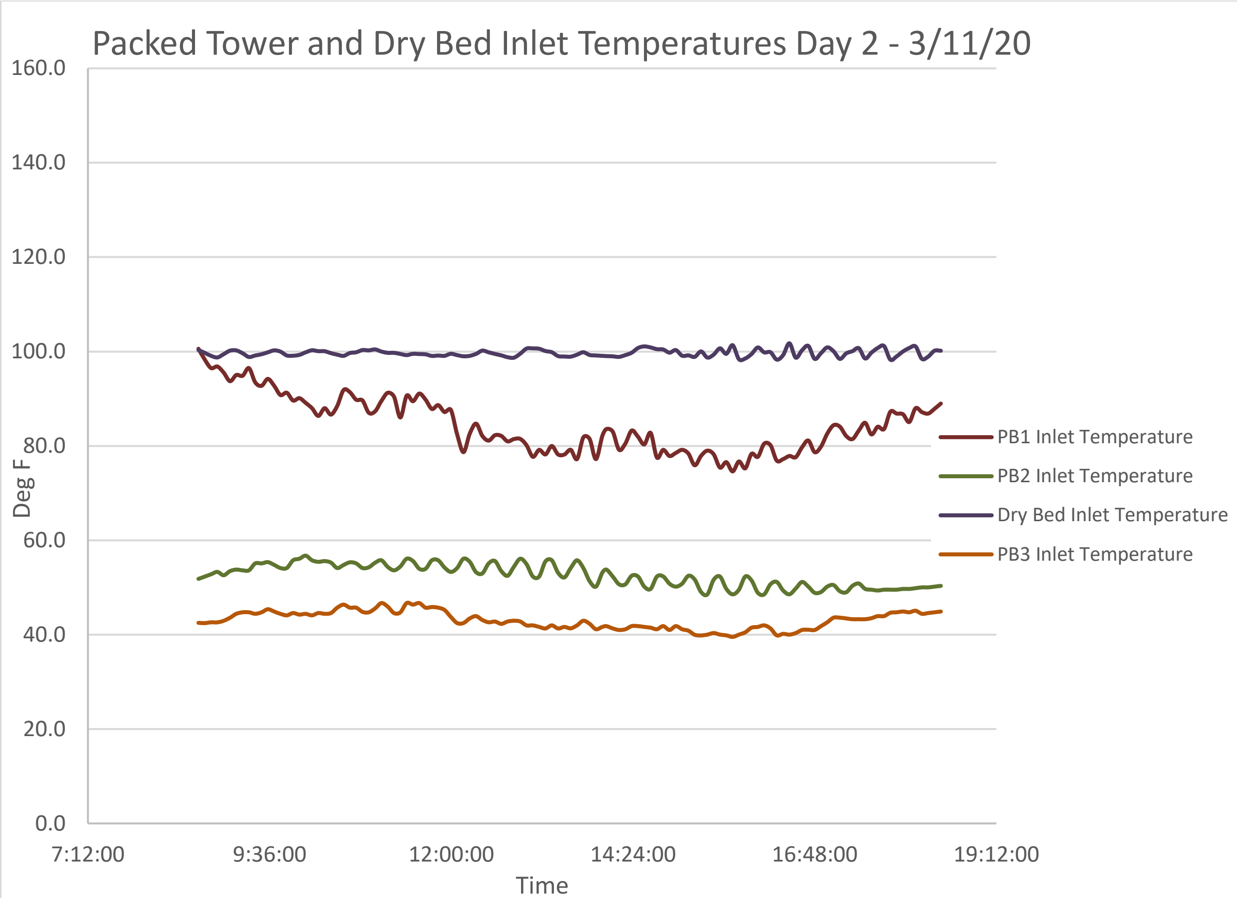
Dry Bed #	Damper Position		Dry Bed #	Damper Position
1	Open		13	Open
2	Open		14	Open
3	Open		15	Open
4	Open		16	Open
5	Open		17	Open
6	Open		18	Open
7	Open		19	Open
8	Open		20	Open
9	Open		21	Open
10	Open		22	Open
11	Open		23	Open
12	Open		24	Open


3 Hour Rolling Average Pressure Readings during Day One Testing on 03/10/2020
Time
3 Hour Pressure ("WC)
PTE Ambient - EO Storage
Sterilizer - Degassing
PTE Non-Sterile Hall - Sterilizer
PTE Non-Sterile Hall - Vac/Scrub
PTE Ambient - Shipping
Shipping - Degassing

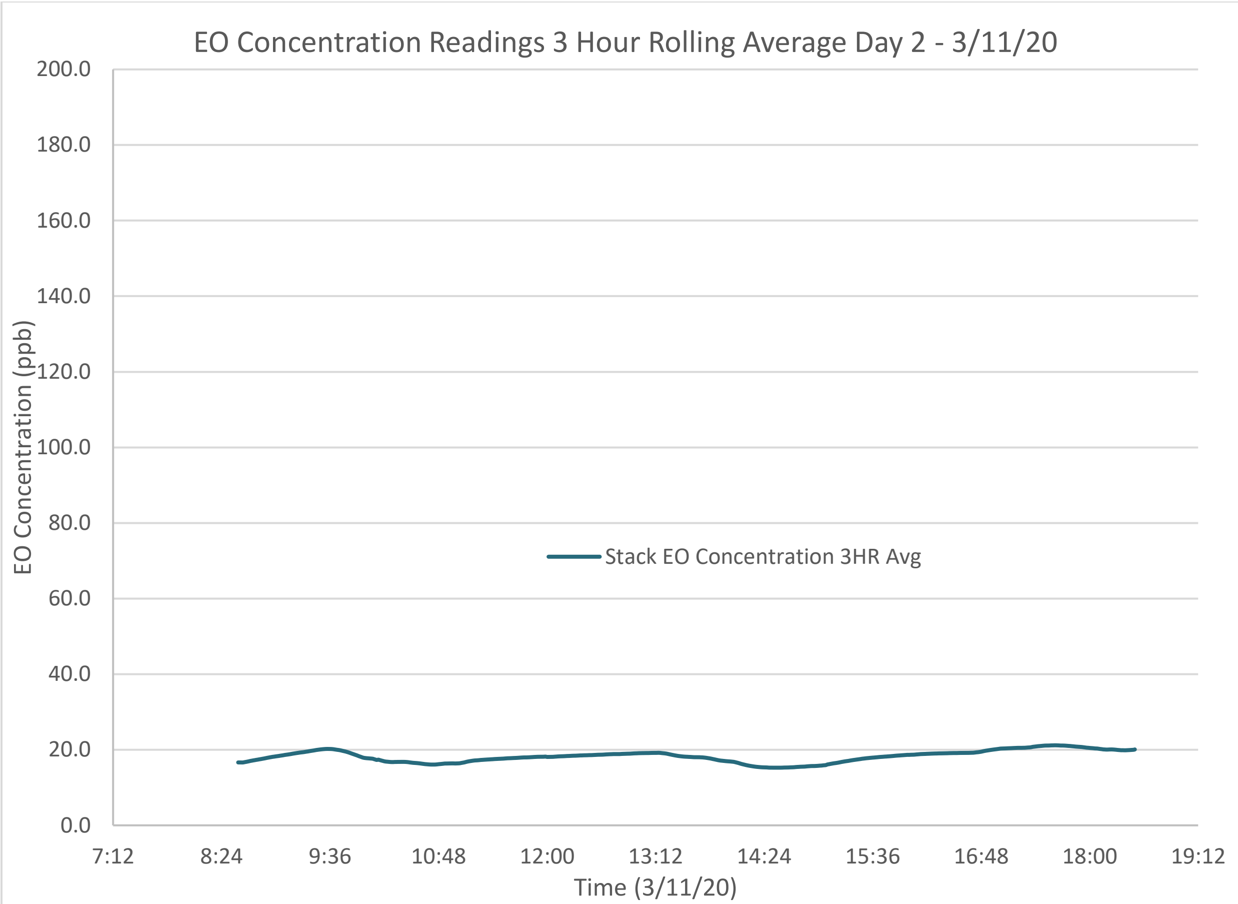


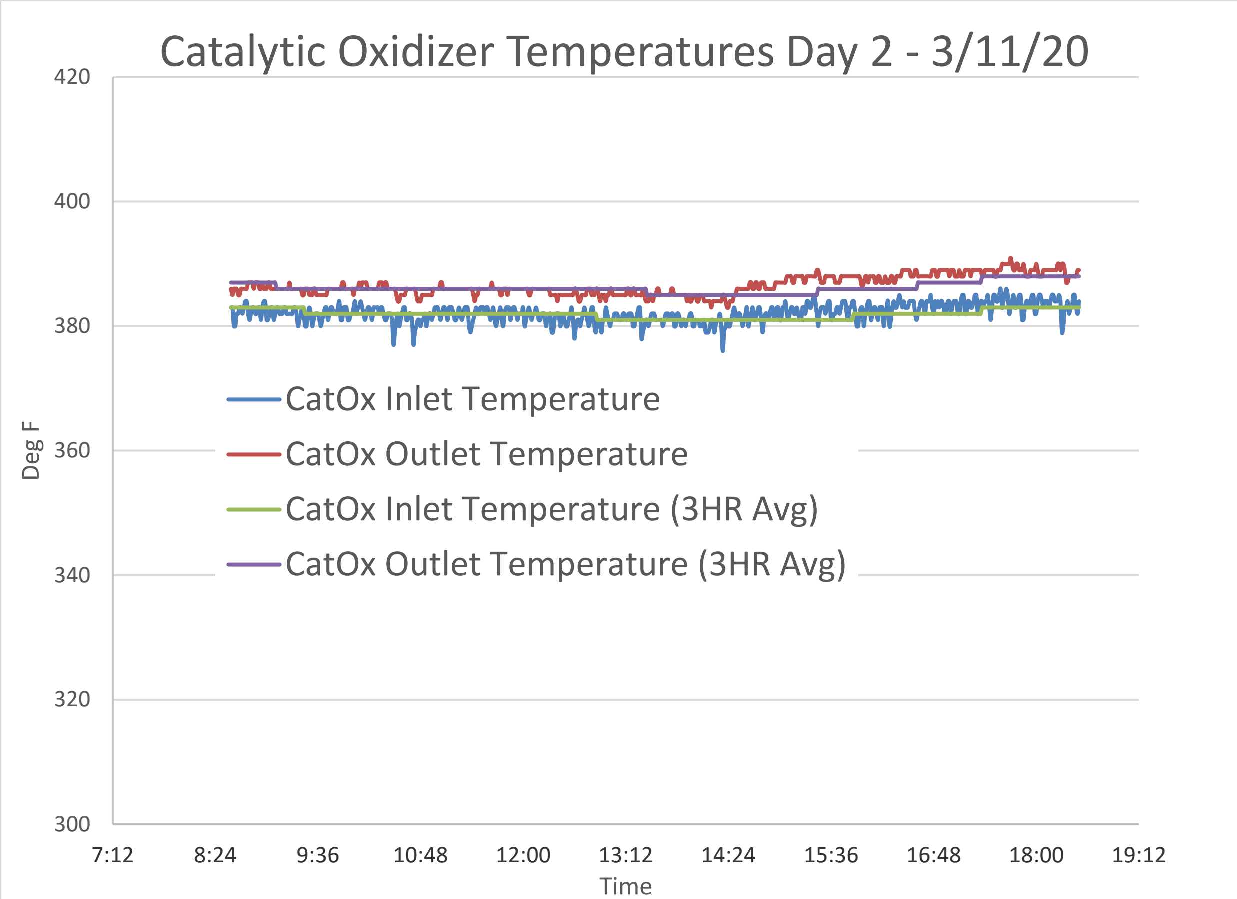
Packed Towers 1, 2, and 3 Scrubbant Flowrates Day 2 - 3/11/20
800.0
750.0
700.0
650.0
600.0
550.0
500.0
GPM
PB1 Pump 2
PB2 Pump 4
PB3 Recirculation Pump
PB3 Recirculation Pump 3 Hr Avg
PB3 Spray Pump
PB3 Spray Pump 3 Hr Rolling Avg
7:12:00
8:24:00
9:36:00
10:48:00
12:00:00
13:12:00
14:24:00
15:36:00
16:48:00
18:00:00
19:12:00
Time

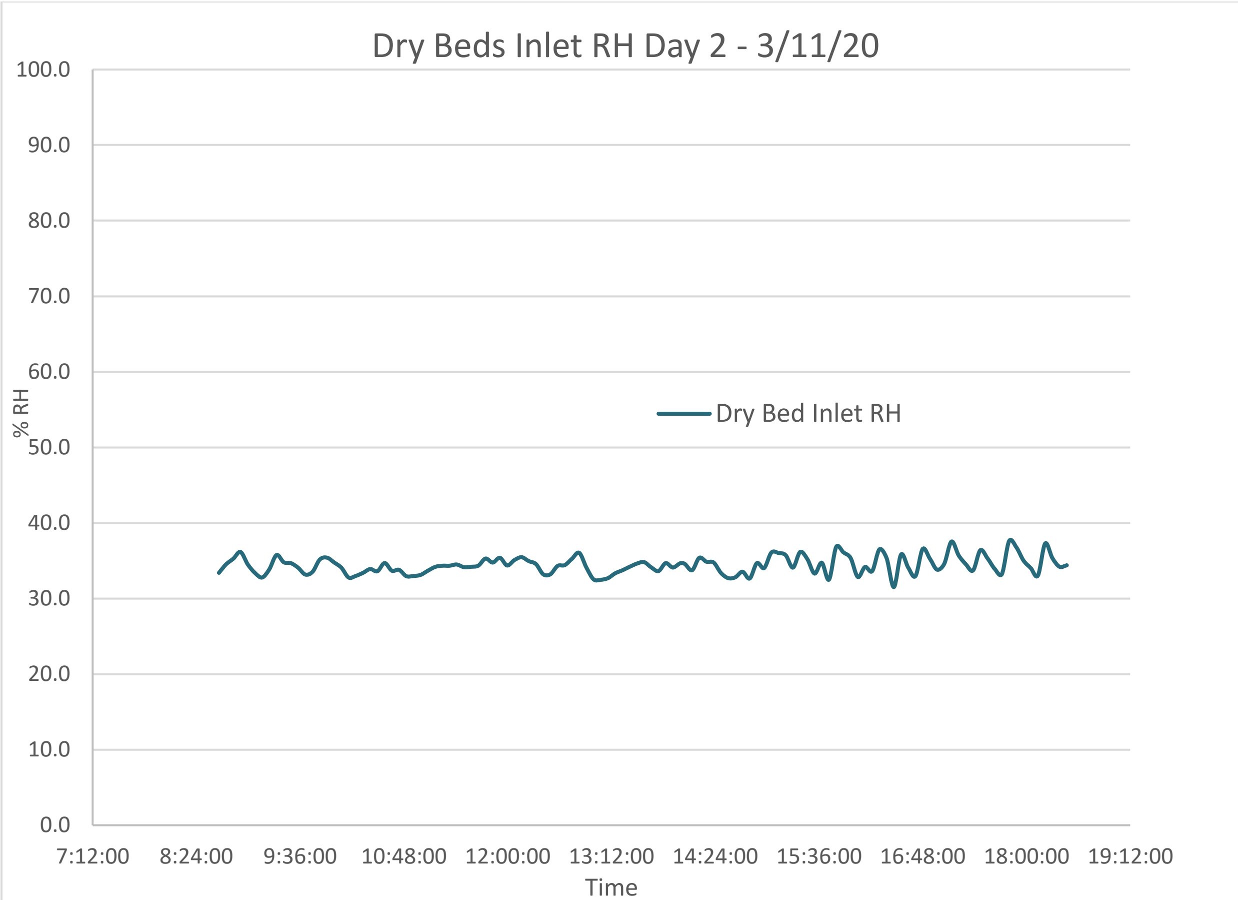

Packed Towers 1, 2, & 3 pH Day 2 - 3/11/20
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
pH
7:12:00
9:36:00
12:00:00
14:24:00
16:48:00
19:12:00
Time
PB1-2 pH
PB3 pH
PB3 pH 3 Hr Avg



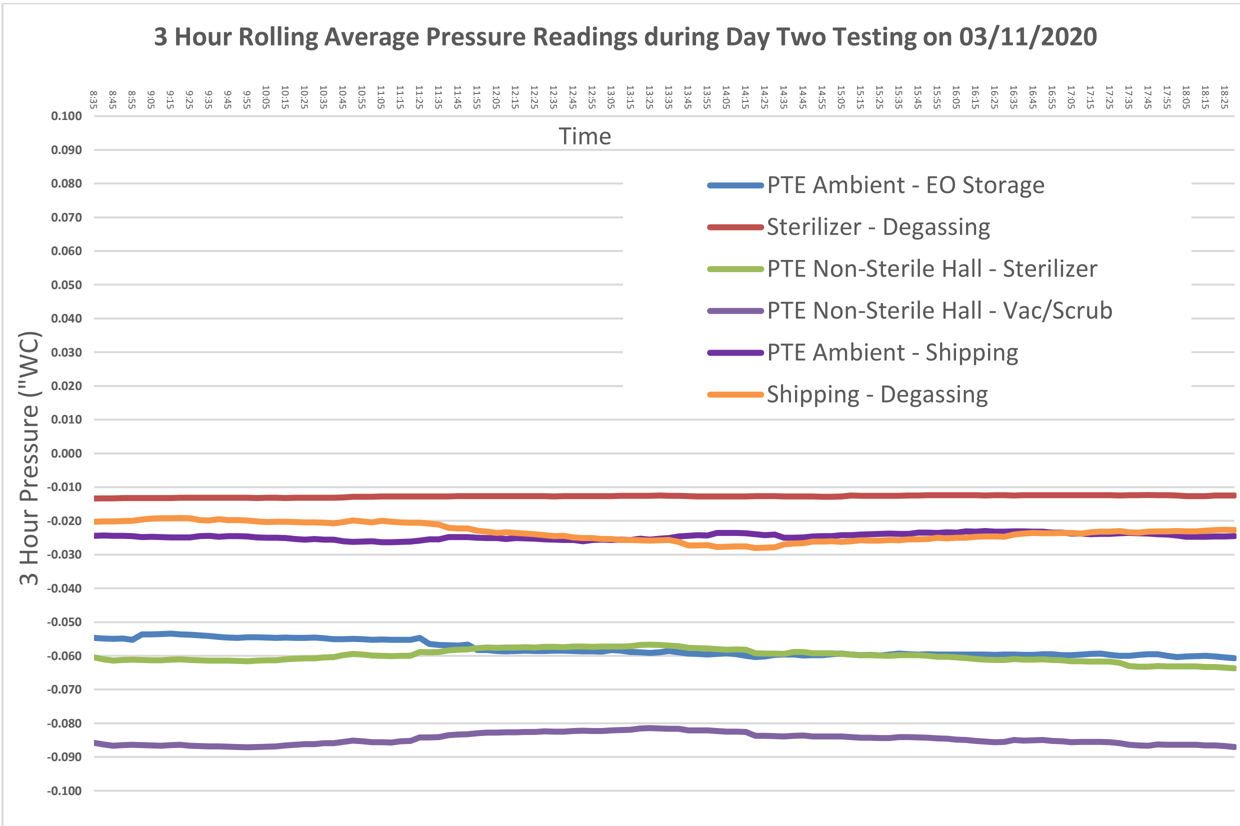
Packed Tower and Dry Bed Inlet Temperatures Day 2 - 3/11/20
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Deg F
7:12:00
9:36:00
12:00:00
14:24:00
16:48:00
19:12:00
Time
PB1 Inlet Temperature
PB2 Inlet Temperature
Dry Bed Inlet Temperature
PB3 Inlet Temperature

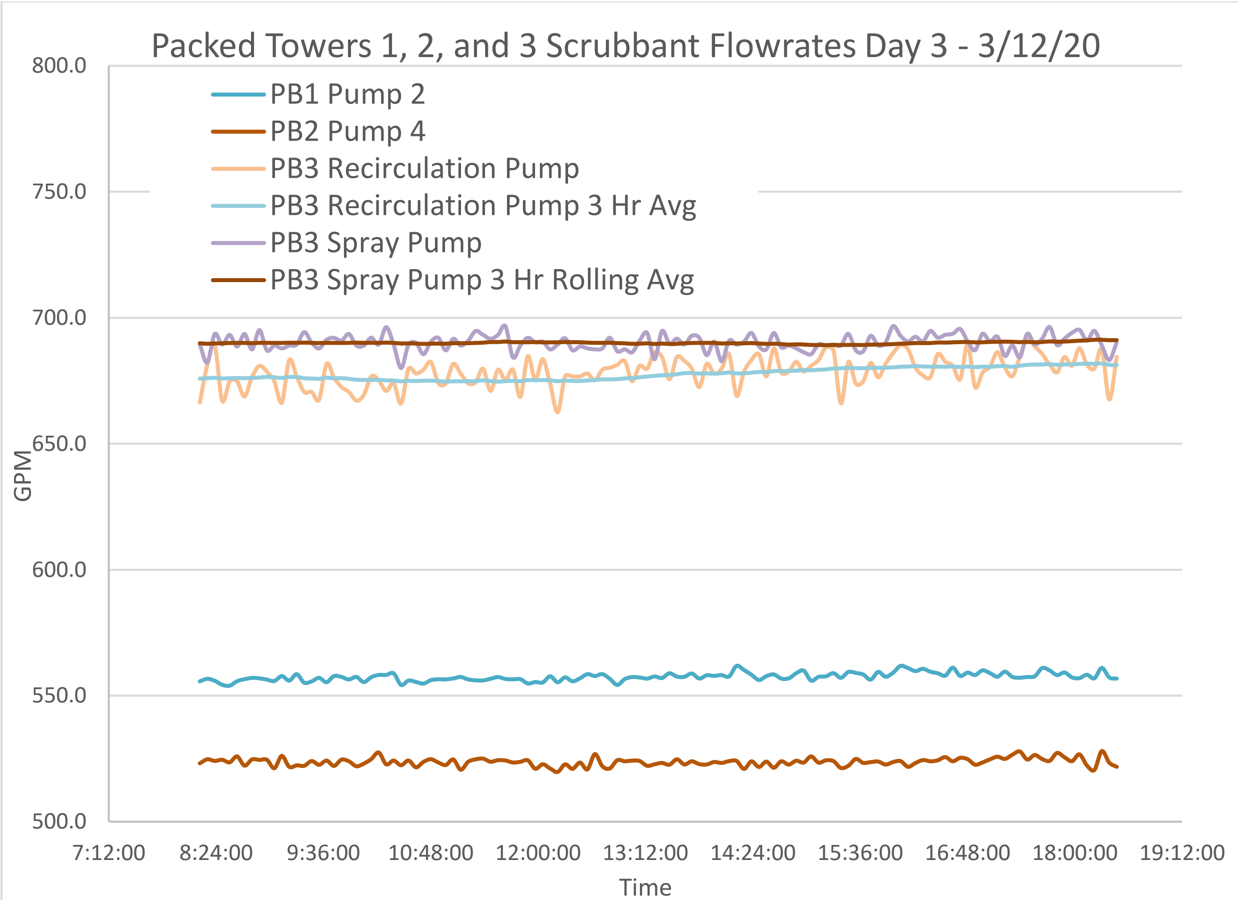

EO Concentration Readings 3 Hour Rolling Average Day 2 - 3/11/20
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
EO Concentration (ppb)
Stack EO Concentration 3HR Avg
7:12
8:24
9:36
10:48
12:00
13:12
14:24
15:36
16:48
18:00
19:12
Time (3/11/20)

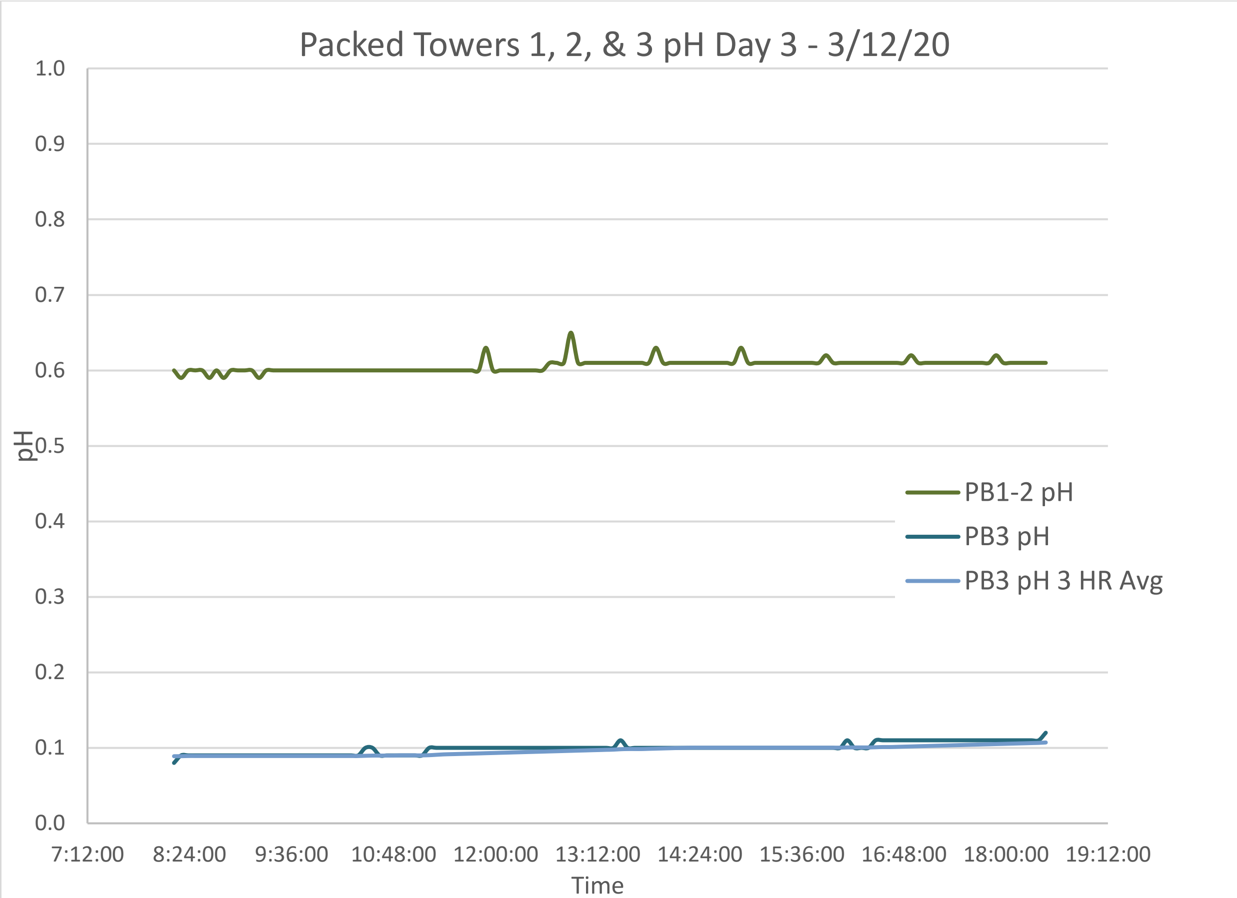

Catalytic Oxidizer Temperatures Day 2 - 3/11/20
420
400
380
360
340
320
300
Deg F
7:12
8:24
9:36
10:48
12:00
13:12
14:24
15:36
16:48
18:00
19:12
Time
CatOx Inlet Temperature
CatOx Outlet Temperature
CatOx Inlet Temperature (3HR Avg)
CatOx Outlet Temperature (3HR Avg)

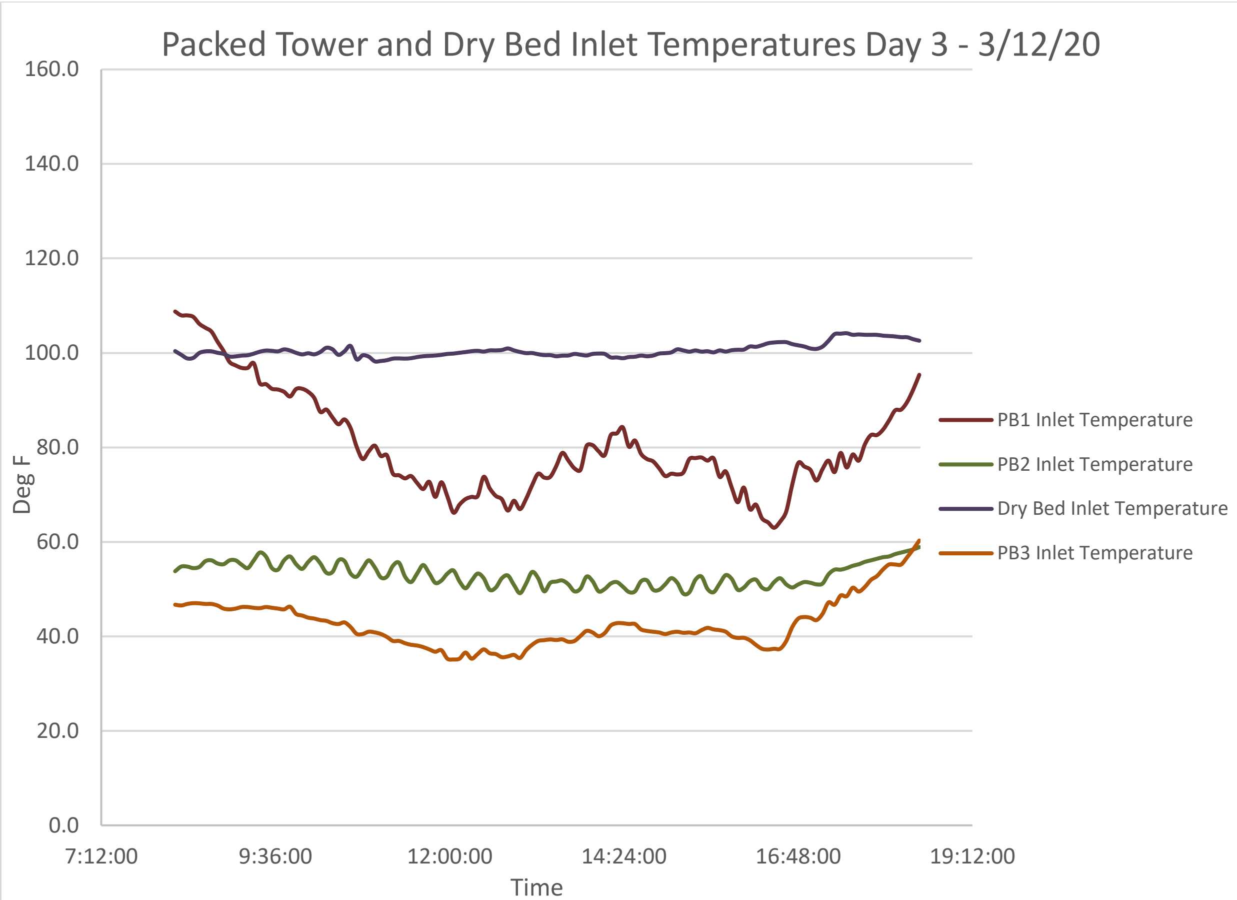


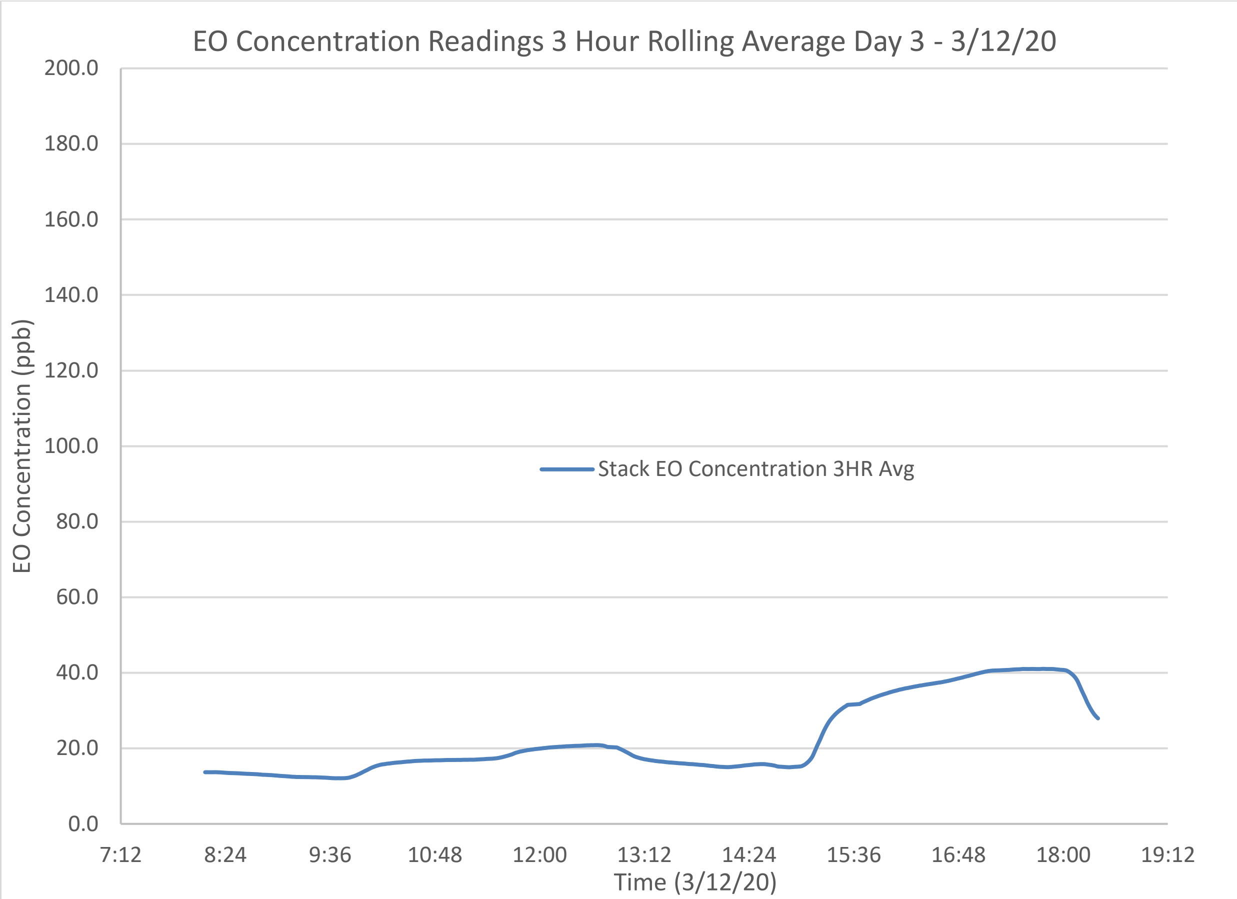
Dry Bed #	Damper Position		Dry Bed #	Damper Position
1	Open		13	Open
2	Open		14	Open
3	Open		15	Open
4	Open		16	Open
5	Open		17	Open
6	Open		18	Open
7	Open		19	Open
8	Open		20	Open
9	Open		21	Open
10	Open		22	Open
11	Open		23	Open
12	Open		24	Open

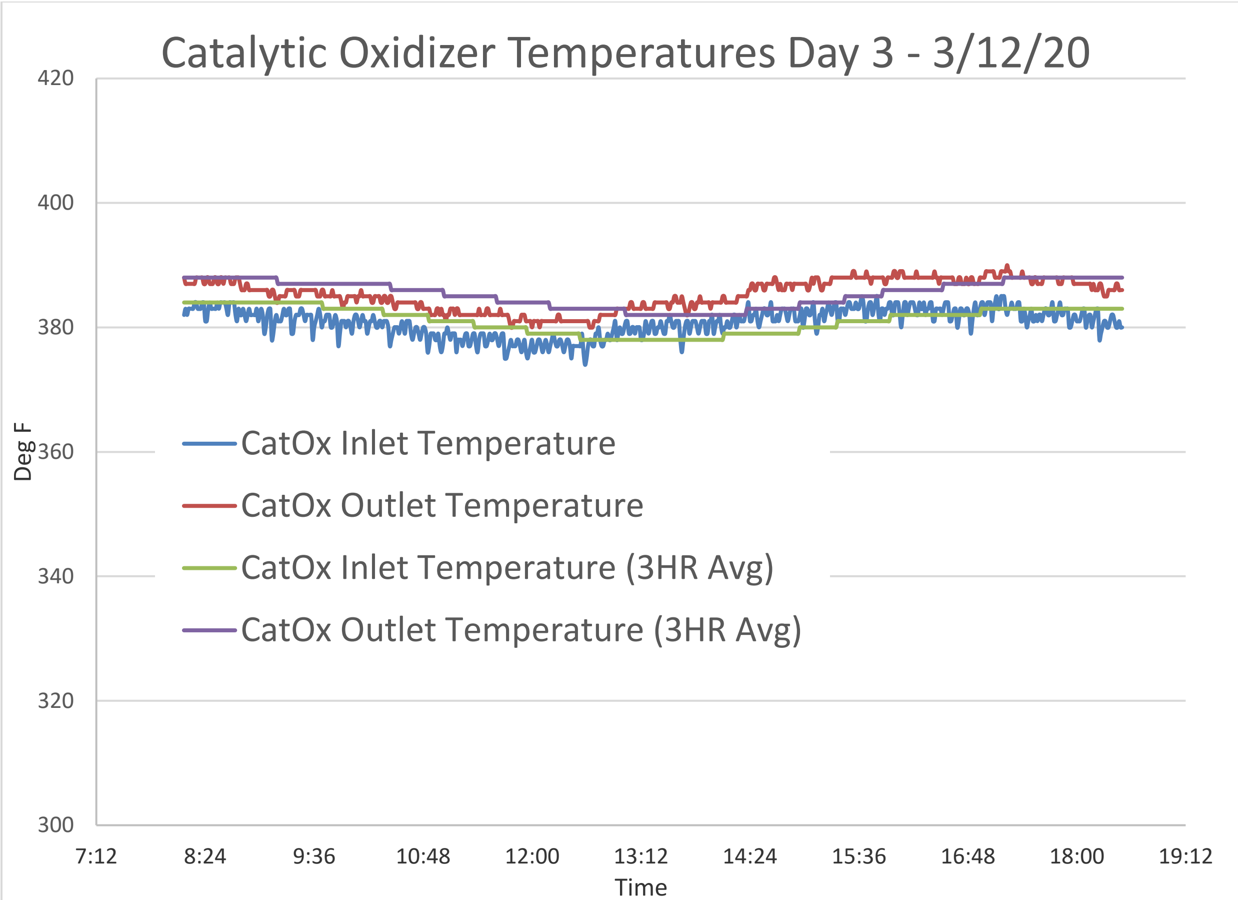

3 Hour Rolling Average Pressure Readings during Day Two Testing on 03/11/2020
Time
3 Hour Pressure ("WC)
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
-0.010
-0.020
-0.030
-0.040
-0.050
-0.060
-0.070
-0.080
-0.090
-0.100
PTE Ambient - EO Storage
Sterilizer - Degassing
PTE Non-Sterile Hall - Sterilizer
PTE Non-Sterile Hall - Vac/Scrub
PTE Ambient - Shipping
Shipping - Degassing

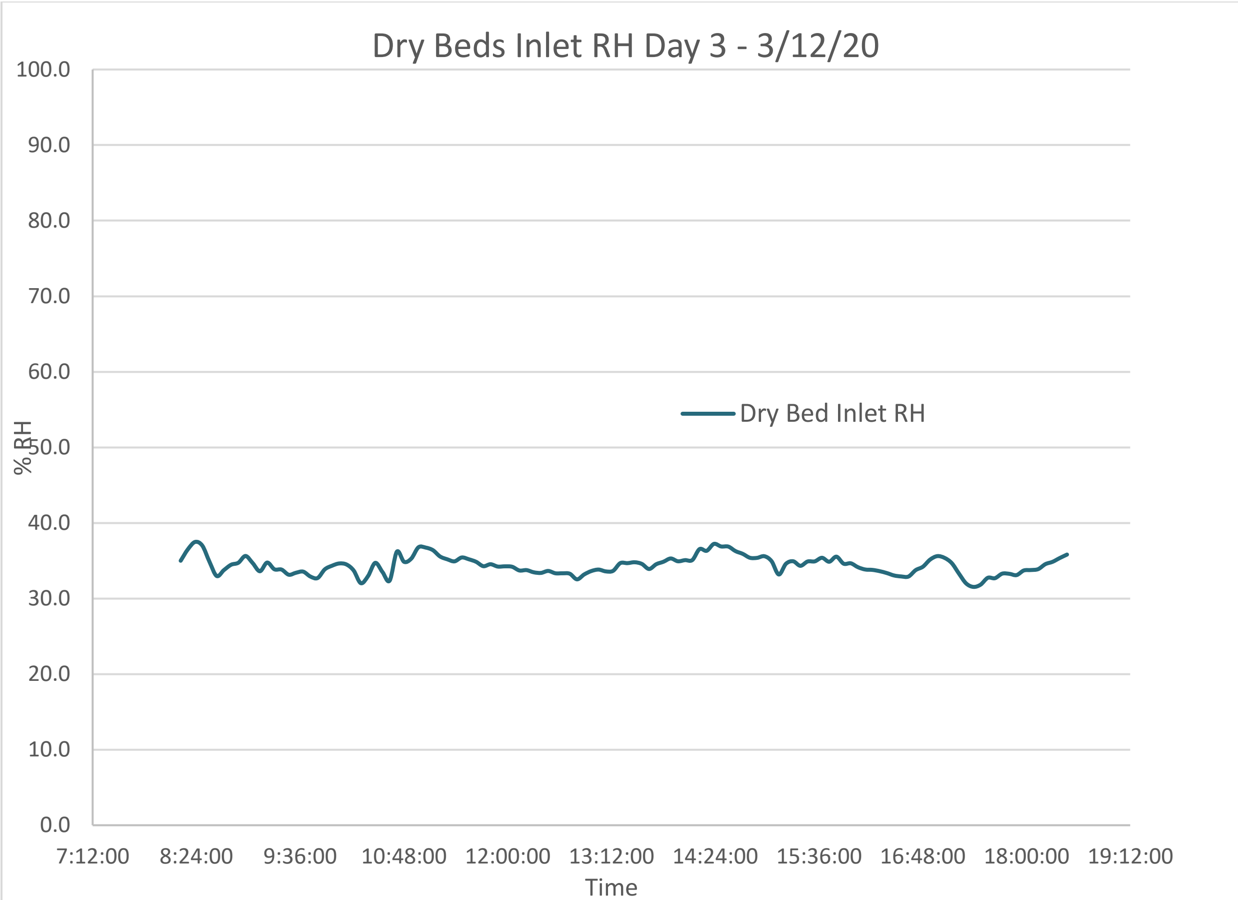

Packed Towers 1, 2, and 3 Scrubbant Flowrates Day 3 - 3/12/20
PB1 Pump 2
PB2 Pump 4
PB3 Recirculation Pump
PB3 Recirculation Pump 3 Hr Avg
PB3 Spray Pump
PB3 Spray Pump 3 Hr Rolling Avg
800.0
750.0
700.0
650.0
600.0
550.0
500.0
GPM
7:12:00
8:24:00
9:36:00
10:48:00
12:00:00
13:12:00
14:24:00
15:36:00
16:48:00
18:00:00
19:12:00
Time


Packed Towers 1, 2, & 3 pH Day 3 - 3/12/20
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
pH
PB1-2 pH
PB3 pH
PB3 pH 3 HR Avg
7:12:00
8:24:00
9:36:00
10:48:00
12:00:00
13:12:00
14:24:00
15:36:00
16:48:00
18:00:00
19:12:00
Time

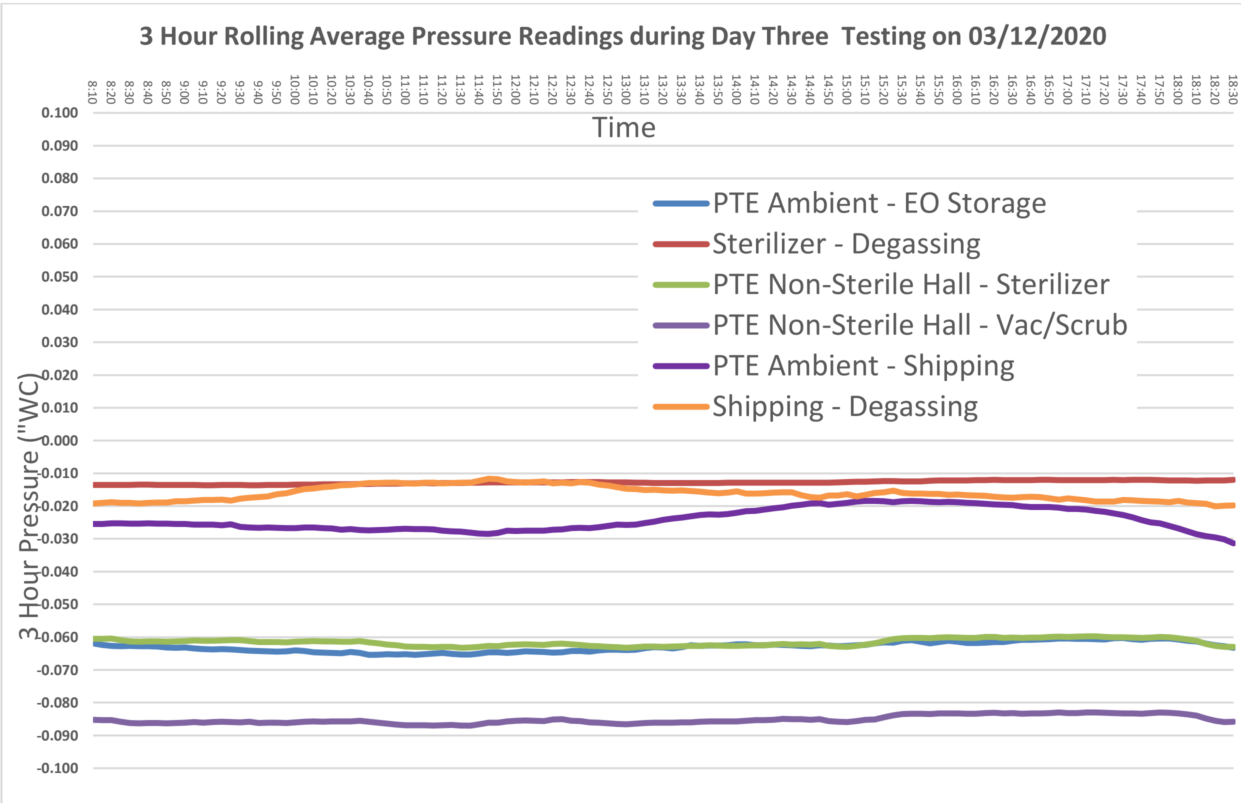

Packed Tower and Dry Bed Inlet Temperatures Day 3 - 3/12/20
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Deg F
7:12:00
9:36:00
12:00:00
14:24:00
16:48:00
19:12:00
Time
PB1 Inlet Temperature
PB2 Inlet Temperature
Dry Bed Inlet Temperature
PB3 Inlet Temperature


EO Concentration Readings 3 Hour Rolling Average Day 3 - 3/12/20
EO Concentration (ppb)
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Stack EO Concentration 3HR Avg
7:12
8:24
9:36
10:48
12:00
13:12
14:24
15:36
16:48
18:00
19:12
Time (3/12/20)


Catalytic Oxidizer Temperatures Day 3 - 3/12/20
420
400
380
360
340
320
300
Deg F
CatOx Inlet Temperature
CatOx Outlet Temperature
CatOx Inlet Temperature (3HR Avg)
CatOx Outlet Temperature (3HR Avg)
7:12
8:24
9:36
10:48
12:00
13:12
14:24
15:36
16:48
18:00
19:12
Time



Dry Bed #	Damper Position		Dry Bed #	Damper Position
1	Open		13	Open
2	Open		14	Open
3	Open		15	Open
4	Open		16	Open
5	Open		17	Open
6	Open		18	Open
7	Open		19	Open
8	Open		20	Open
9	Open		21	Open
10	Open		22	Open
11	Open		23	Open
12	Open		24	Open


3 Hour Rolling Average Pressure Readings during Day Three Testing on 03/12/2020
Time
3 Hour Pressure ("WC)
PTE Ambient - EO Storage
Sterilizer - Degassing
PTE Non-Sterile Hall - Sterilizer
PTE Non-Sterile Hall - Vac/Scrub
PTE Ambient - Shipping
Shipping - Degassing