Iowa Onsite Waste Water Association (IOWWA)

Operation and Maintenance of Onsite Wastewater Systems

Data Summary

June 2012

Introduction

Using a site developed in conjunction with "Habitat for Humanity" where numerous different onsite wastewater systems have been installed, a maintenance program has been developed in conjunction with the various equipment manufacturers by the Iowa Onsite Waste Water Association (IOWWA). This program includes maintenance and effluent sampling beyond the every 6 months that is legally required by the Iowa State Department of Natural Resources. The additional data collection also exceeds the recommendations or requirements by the various manufacturers as manufacturers seldom recommend field sampling. IOWWA sampled the effluent monthly for a year to show seasonal performance fluctuations and variations between homes, but no influent samples were taken before the units so impacts of inflow characteristics to the units is unknown. IOWWA cautions readers of this report that one year of monthly data is insufficient to make any performance evaluations especially as each home had unique flow and wastewater characteristics.

This project collected additional effluent sampling beyond regulatory required minimums of several different onsite wastewater treatment products documents how they are performing, under field conditions. The systems sampled included:

Five homes served by one Biomicrobics FAST system followed by an American Manufacturing drip irrigation field.
One home with a Hoot aerobic system followed by a Netafim drip irrigation field.
One home with an Orenco Advantex to open discharge.
One home with a Clarus Fusion to open discharge.
One home with a Premier Tech Ecoflow to open discharge.
One home with a Premier Tech Ecoflex to open discharge.
One home with a Quanics BioCOIR to open discharge.

Table 1 below documents how long each of the systems has been in operation. During this period of operation the systems have been maintained according to the manufactures requirements.

Methods

The samples were obtained as grab samples either from the unit itself, a pump tank or a sampling port after the unit as show in Table 1 below:

Table 1. Sampling Location and Time in Operation.

System	Sampling Location	Time in Operation at Beginning of Sampling (years)
Biomicrobics FAST	Pump Tank	4.4
Hoot	Pump Tank/Sampling Port	1.2
Orenco Advantex	Unit/Sampling Port	4.4
Clarus Fusion	Sampling Port	2.0
Premier Tech Ecoflow	Sampling Port	4.4
Premier Tech Ecoflex	Sampling Port	4.2
Quanics BioCOIR	Sampling Port	4.2

Inflow volume to the systems was determined by accessing monthly water meter readings through each of the home's rural water system. Influent wastewater samples to the systems were not collected due to minimize laboratory costs. Therefore organic loading to the systems cannot be determined. Effluent sample points were identified prior to commencement of the sampling regime. Training on proper sample collection was provided by each of the equipment manufacturers. The effluent samples taken by Bob McKinney with River to River Onsites were grab samples meaning they only represent a unit's performance at one point in time. The samples were maintained at 4°C until they were delivered to the lab. Maximum holding times were not exceeded for any of the samples. Chain of custody forms were completed and provided to Keystone Labs out of Newton, IA.

The samples were primarily collected on a Tuesday (3 events) or Wednesday (8 events) with one on a Friday. The samples were collected between the hours of 8:00 AM and 7:00 PM. All systems were sampled at each event. The sampling days and times were not randomized, but instead based upon availability of the lab and sampling personal.
Effluent samples were analyzed for carbonaceous biochemical oxygen demand ($CBOD_5$) using EPA Method SM 5210B and total suspended solids (TSS) using EPA Method 160.2. These methods have a detection limit of 2 mg/l although the lab reported CBOD minimum values at <

8 mg/l. In addition, field measurements of dissolved oxygen (DO) and effluent temperature in degrees Fahrenheit were determined for each sample. The daily air temperature and the mean 30 day temperature were obtained from www.wunderground.com/.

Data Summary

The data for each technology was evaluated on the month, temperature and usage. The average and median values for temperature, BOD, TSS, usage, and DO were determined. When the lab reported TSS values less than 2 mg/l the value of 2 was used to determine the values and with BOD a value of 8 mg/l was used when the value was reported as < 8 mg/l. Highlighted results for each system are provided below, but the actual data and corresponding graphs are included in Appendix A.

In the fall of 2010, the treatment tanks were pumped as needed and required by the manufactures. The systems were maintained either every 6 months or annually depending on the manufactures requirements. Homeowners were all provided educational materials highlighting proper usage and tips.

Advantex

During the year of sample collection, the unit met its performance goals a majority of the time with only two sampling events exceeding a BOD and/or TSS sample over 25 mg/l. The design flow for this system was 450 gpd, but the usage for this system has been low averaging 89 gpd. There was little trend in the data with performance based on usage, but a strong positive trend was evident both over time and with increasing temperature.

BioCOIR

The unit met its performance goals a vast majority of the time with only one BOD sample over 25 mg/l. The design flow for this system was 450 gpd, but the usage was low averaging 116 gpd. There was not a performance trend based on usage or time, but a positive trend was evident with increasing temperature.

Ecoflex

This unit rarely met its performance goals over the study time period with 10 of the 12 samples exceeding BOD and/or TSS samples over 25 mg/l. The design flow for this system was 450 gpd, while the actual usage for this system averaged 177 gpd with one month averaging 633 gpd due to a leaking toilet. If this one month is removed from the average flow determination the hydraulic loading averages 136 gpd. The last few months of sampling the unit's performance improved to the point where it reached the BOD / TSS targets of 25 mg/l. This unit was a prototype and the sprayer arms had to be replaced 5-6 months into the testing. The control panel was installed in the home and the service provider was not able to adjust the setting on the control panel until 6 months into the study.

Ecoflow

The unit performed moderately well over the study period with 4 samples of BOD and/or TSS over 25 mg/l. The system and sampling data may be influenced by high medicine usage by individuals in the home. The design flow for this system was 450 gpd, while the actual usage averaged 186 gpd. There was not a performance trend based on usage or time, but a positive trend was evident with increasing temperature.

FAST

This unit often did not meet its performance goals over the study time period with 8 of the 12 samples exceeding BOD and/or TSS samples over 25 mg/l. The treatment was compromised by a high water condition; therefore these samples are not an accurate representation of how the system can perform. The high water alarm was activated soon after installation so it is likely the condition existed for much of the 4.4 years the system has been in operation and certainly for some time prior to this sampling program starting. It was assumed the alarm was a panel issue so the high water alarm wiring was disconnected without further investigation. The high water condition was noted in May of 2011 when a new panel was installed and the alarm again sounded. Subsequent investigation found the outlet pipe had settled causing the high water condition in the FAST unit. This was repaired on September of 2011; therefore the data from is not an accurate reflection of the unit's performance.

In addition, the initial design flow for this system was 1350 gpd which increased to 2250 with the addition of two homes. The actual usage for this system averaged 624 gpd with 5 homes hooked with to the system with a peak monthly flow of 1033. With numerous monthly averages above 700 gpd, this unit is likely being overloaded particularly during high use days such as weekends as the monthly data collection averages out the daily peaks. The drip system which receives the effluent from the system has experienced problems due to electrical issues and the compromised treatment caused by the high water and possible overloading. The two systems which were added will be removed and the system will return to treating the wastewater from just three homes.

Fusion

The unit performed moderately well over the study period with 5 samples of BOD and/or TSS over 25 mg/l. The design flow for this system was 450 gpd, while the actual usage averaged 211 gpd and one month of flow averaging at 323 gpd. This unit is likely being overloaded particularly during high use days such as weekends as the monthly data collection averages out the daily peaks. During inspections a considerable amount of white foam has been present in the Fusion unit, indicating detergent or soap of some type. This could have influenced treatment quality especially if there was chlorine present. There was a positive performance trend based on time and a weaker trend, still evident based on usage and increasing temperature.

Hoot

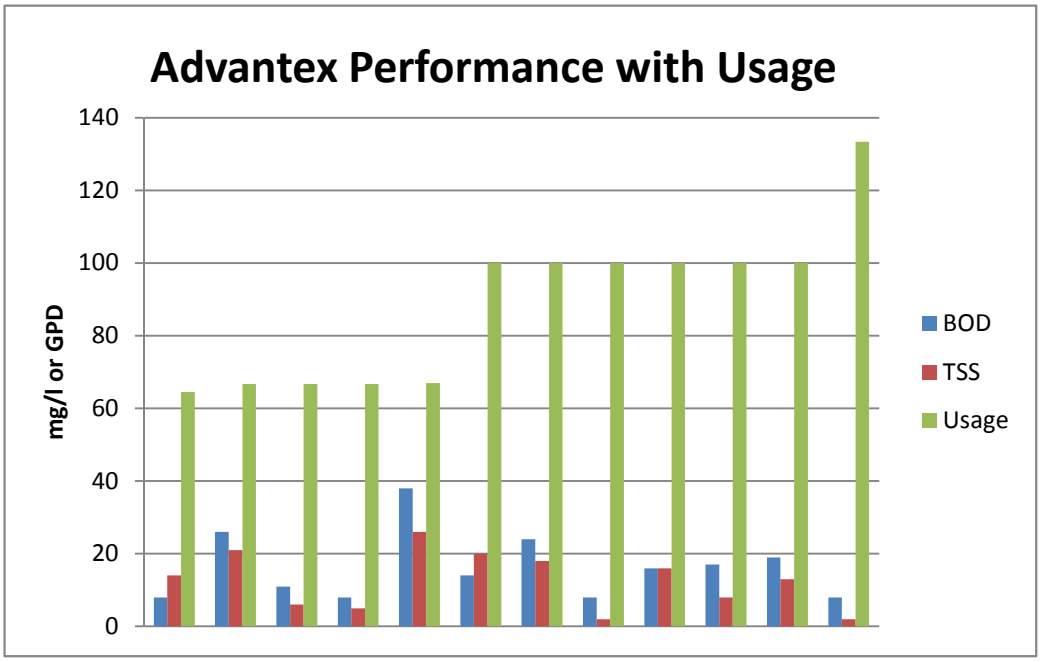
The unit performed well over the study period with no samples over 25 mg/l for BOD or TSS. The design flow for this system is 450 gpd, while the actual usage has been low averaging 106 gpd. There was little correlation with performance based on usage, but a strong positive trend was evident both over time and with increasing temperature.

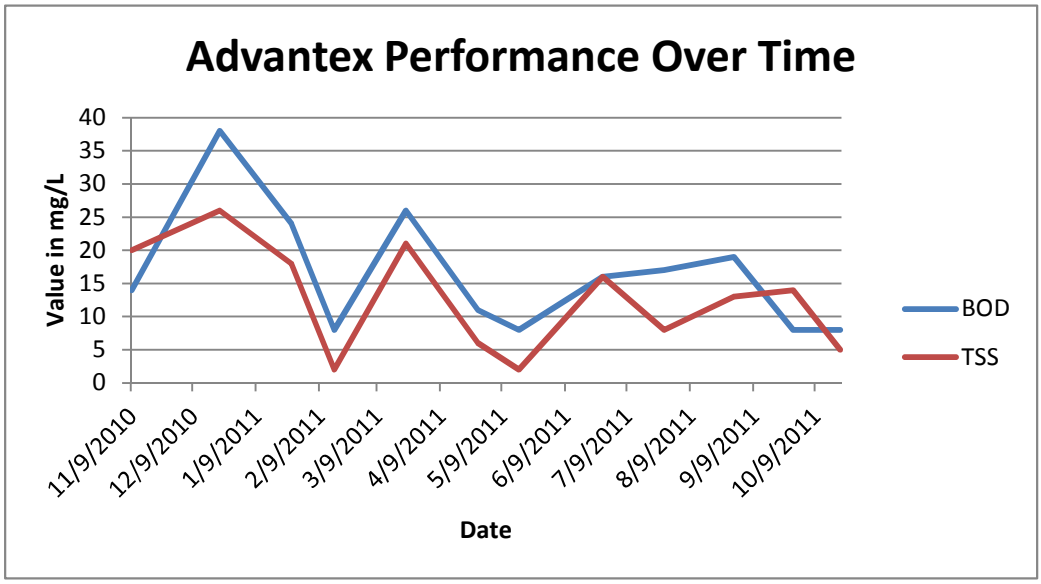
Summary

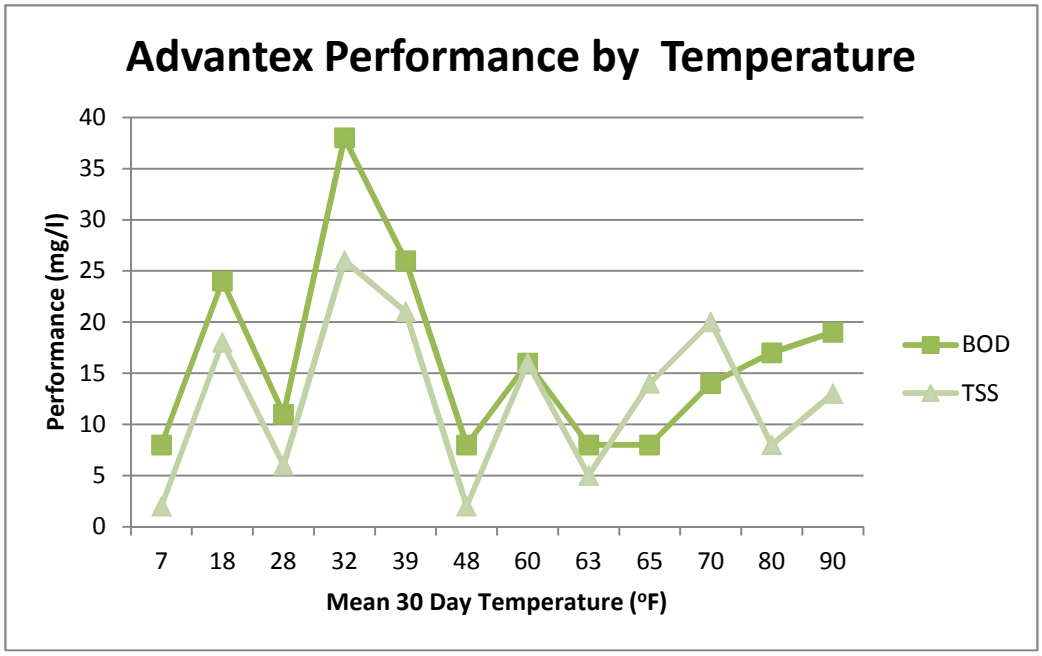
Over one year IOWWA sampled 7 systems at the Habitat for Humanity site. In general the units are performing well, but some systems are receiving higher flows and consequently are not performing as well as those with flows significantly below their design flow. Some of the units showed their performance trended as a function temperature or length time. Due to the limitations of the sample set, including sampling day of the week and time, and inherent weakness of the grab sample technique without influent sampling no assumptions should be made about future performance of these units at the site or other locations across Iowa or the US. It would advantageous to continue monthly sampling for 2-3 more years so a larger sample set could be evaluated including microbial parameters.

Advantex Data Summary

System	Date	Outside Temp (°F)	Mean 30 Day Temp (°F)	BOD (mg/L)	TSS (mg/L)	Usage (GPD)	Sample Temp (°F)	DO (mg/L)
Advantex	11/9/2010	69	70	14	20	100		
Advantex	12/22/2010	32	32	38	26	67		
Advantex	1/26/2011	19	18	24	18	100	47	6.7
Advantex	2/16/2011	35	7	8	2	133	47	8.2
Advantex	3/23/2011	52	39	26	21	67	48	6.8
Advantex	4/27/2011	43	28	11	6	67	51	7.3
Advantex	5/17/2011	67	48	8	2	100	61	6.4
Advantex	6/27/2011	80	60	16	16	100	68	5.6
Advantex	7/27/2011	90	80	17	8	100	76	5.0
Advantex	8/30/2011	69	90	19	13	100	70	6.6
Advantex	9/28/2011	61	65	8	14	65	64	7.3
Advantex	10/21/2011	60	63	8	5	67	63	8.5
	Average	56	50	16	13	89	60	6.8
	Median	60	50	16	13	100	61	6.8

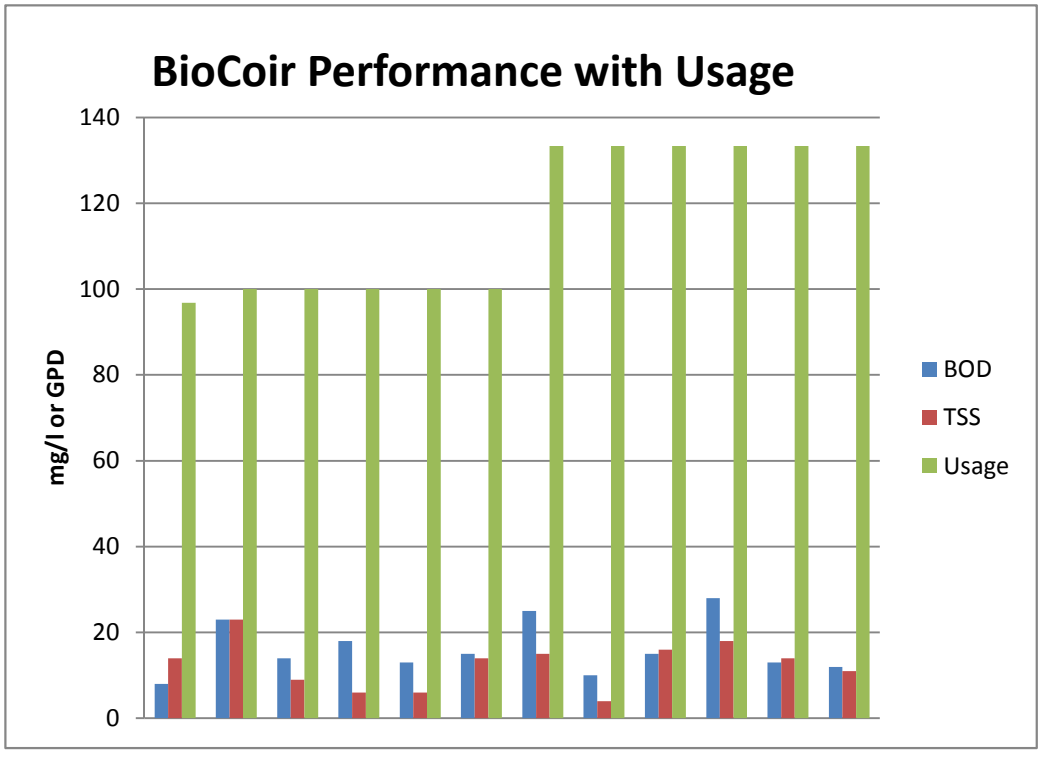


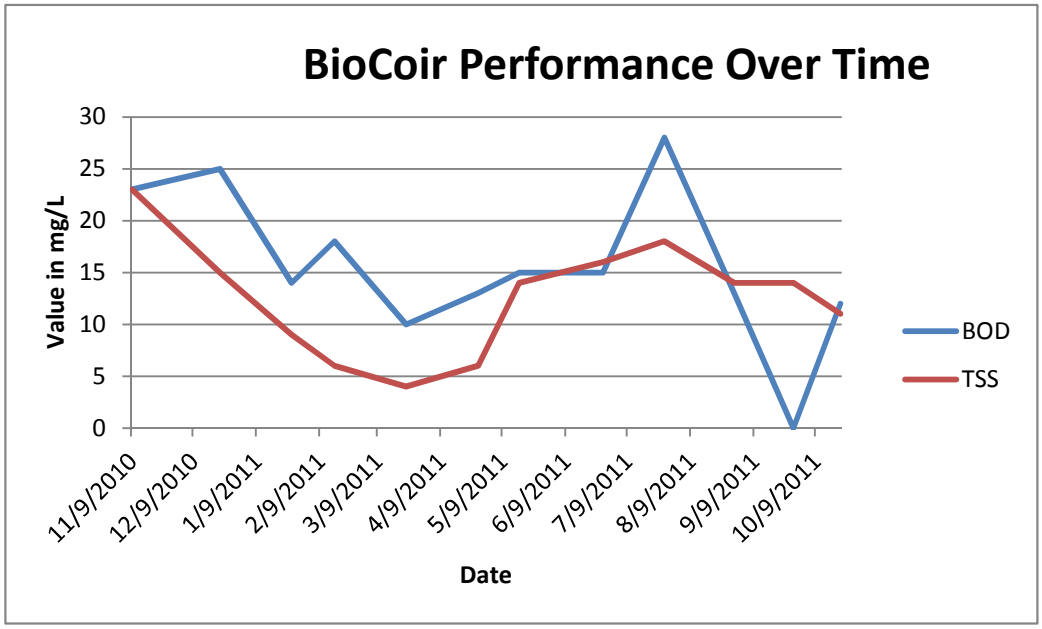

Advantex Performance Over Time
Value in mg/L
40
35
30
25
20
15
10
5
0
11/9/2010
12/9/2010
1/9/2011
2/9/2011
3/9/2011
4/9/2011
5/9/2011
6/9/2011
7/9/2011
8/9/2011
9/9/2011
10/9/2011
Date
BOD
TSS

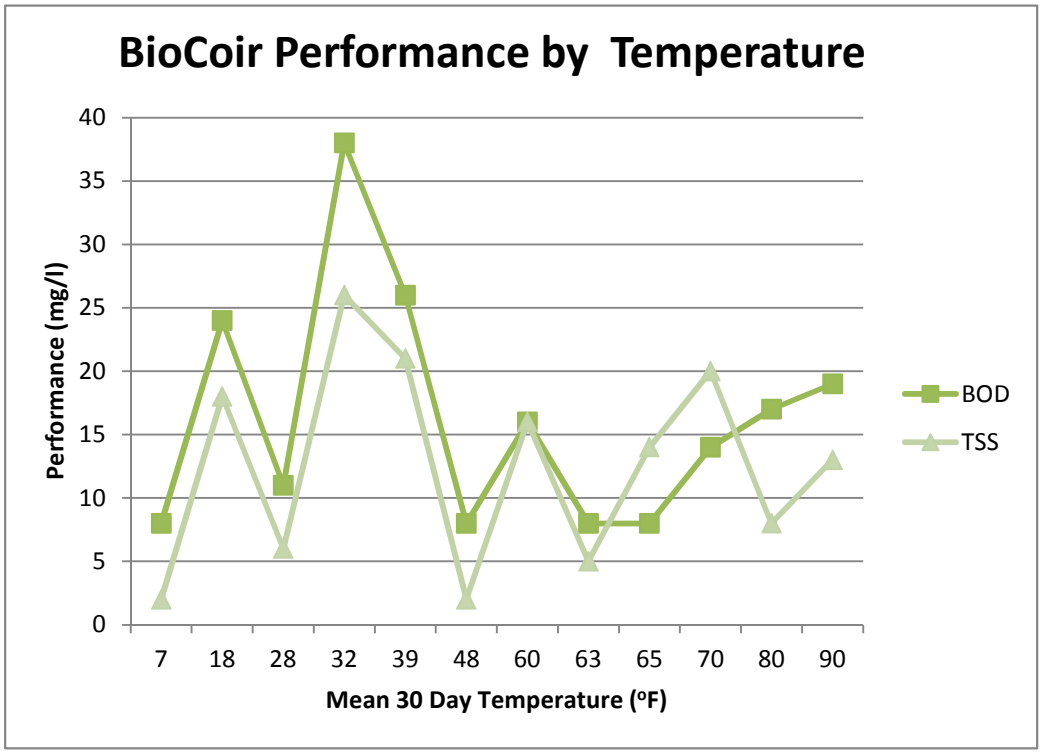

Advantex Performance by Temperature
Performance (mg/l)
40
35
30
25
20
15
10
5
0
7
18
28
32
39
48
60
63
65
70
80
90
Mean 30 Day Temperature (°F)
BOD
TSS

BioCoir Data Summary

System	Date	Outside Temp (°F)	Mean 30 Day Temp (°F)	BOD (mg/L)	TSS (mg/L)	Usage (GPD)	Sample Temp (°F)	DO (mg/L)
BioCoir	11/9/2010	69	70	23	23	100		
BioCoir	12/22/2010	32	32	25	15	133		
BioCoir	1/26/2011	19	18	14	9	100	43	4.3
BioCoir	2/16/2011	35	7	18	6	100	47	7.1
BioCoir	3/23/2011	52	39	10	4	133	45	6.9
BioCoir	4/27/2011	43	28	13	6	100	48	5.7
BioCoir	5/17/2011	67	48	15	14	100	56	2.7
BioCoir	6/27/2011	80	60	15	16	133	65	2.4
BioCoir	7/27/2011	90	80	28	18	133	72	3.3
BioCoir	8/30/2011	69	90	13	14	133	66	3.8
BioCoir	9/28/2011	61	65	<8	14	97	62	6.0
BioCoir	10/21/2011	60	63	12	11	133	61	6.5
	Average	56	50	17	13	116	56	4.9
	Median	60	50	15	14	116	56	4.9

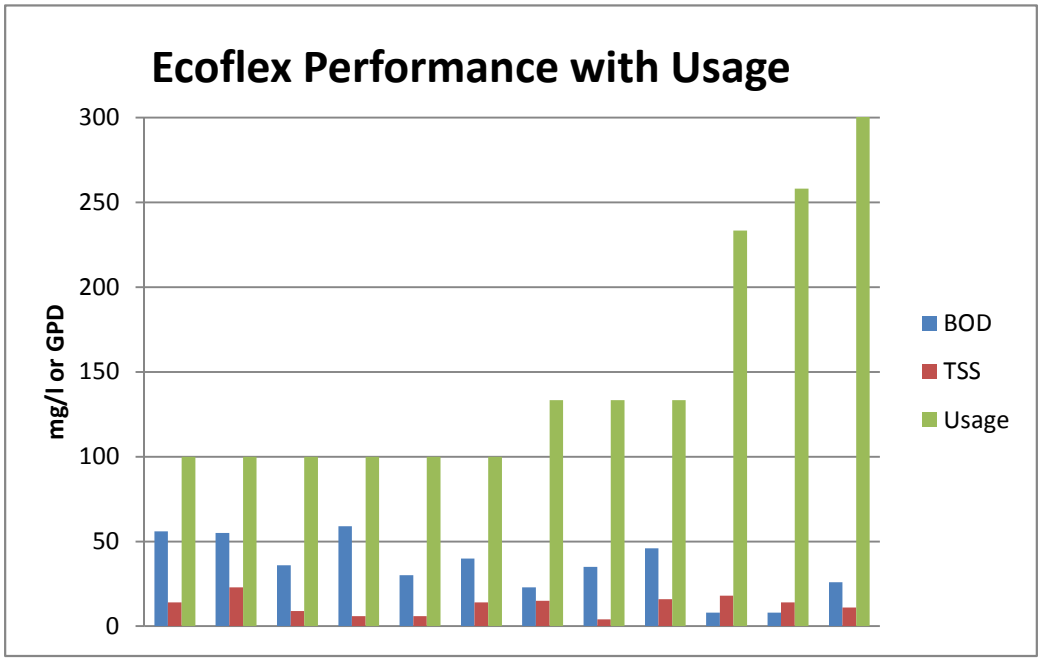


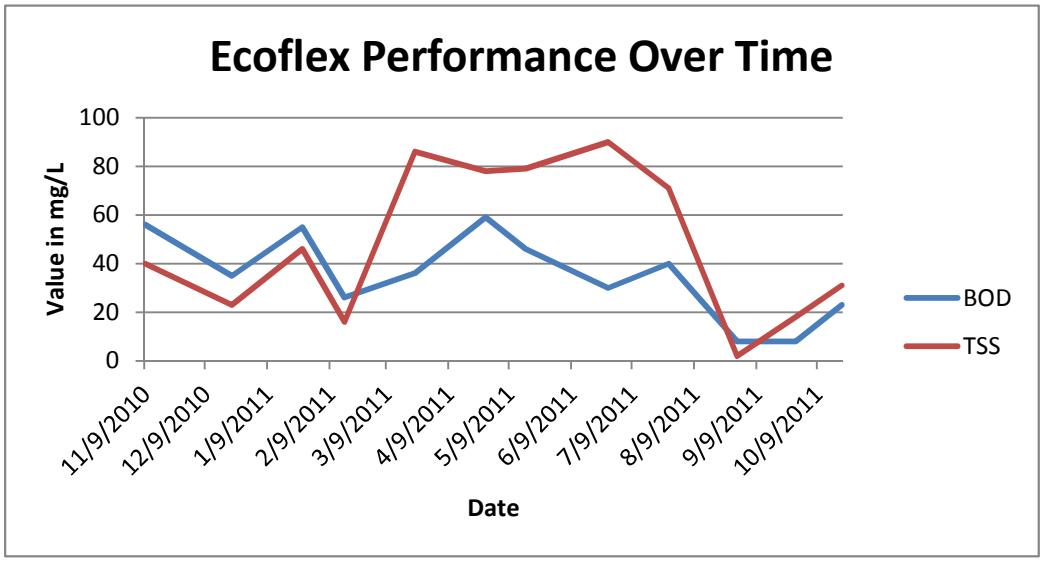

BioCoir Performance Over Time
Value in mg/L
30
25
20
15
10
5
0
11/9/2010
12/9/2010
1/9/2011
2/9/2011
3/9/2011
4/9/2011
5/9/2011
6/9/2011
7/9/2011
8/9/2011
9/9/2011
10/9/2011
Date
BOD
TSS

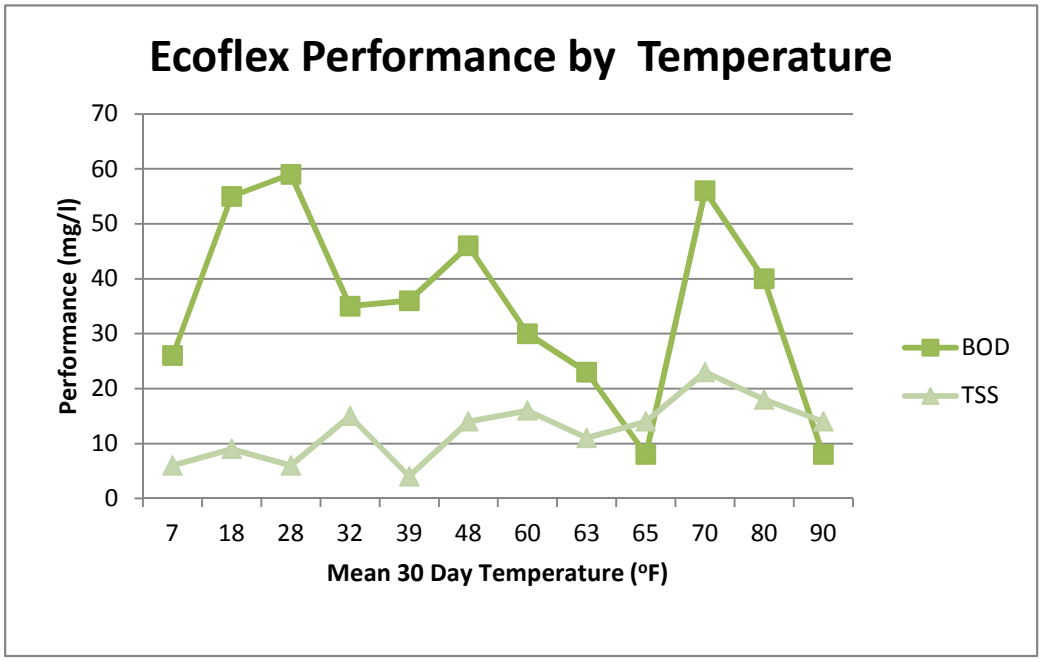

BioCoir Performance by Temperature
Performance (mg/l)
40
35
30
25
20
15
10
5
0
7
18
28
32
39
48
60
63
65
70
80
90
Mean 30 Day Temperature (°F)
BOD
TSS

Ecoflex Data Summary

System	Date	Outside Temp (°F)	Mean 30 Day Temp (°F)	BOD (mg/L)	TSS (mg/L)	Usage (GPD)	Sample Temp (°F)	DO (mg/L)
Ecoflex	11/9/2010	69	70	56	40	100		
Ecoflex	12/22/2010	32	32	35	23	133		
Ecoflex	1/26/2011	19	18	55	46	100	45	7.3
Ecoflex	2/16/2011	35	7	26	16	633	45	8.2
Ecoflex	3/23/2011	52	39	36	86	100	48	7.4
Ecoflex	4/27/2011	43	28	59	78	100	53	5.1
Ecoflex	5/17/2011	67	48	46	79	133	58	5.2
Ecoflex	6/27/2011	80	60	30	90	100	68	6.4
Ecoflex	7/27/2011	90	80	40	71	100	78	5.2
Ecoflex	8/30/2011	69	90	8	2	233	72	7.7
Ecoflex	9/28/2011	61	65	8	18	258	67	7.9
Ecoflex	10/21/2011	60	63	23	31	133	62	8.1
	Average	56	50	35	48	177	60	6.9
	Median	60	50	35	46	133	60	7.3

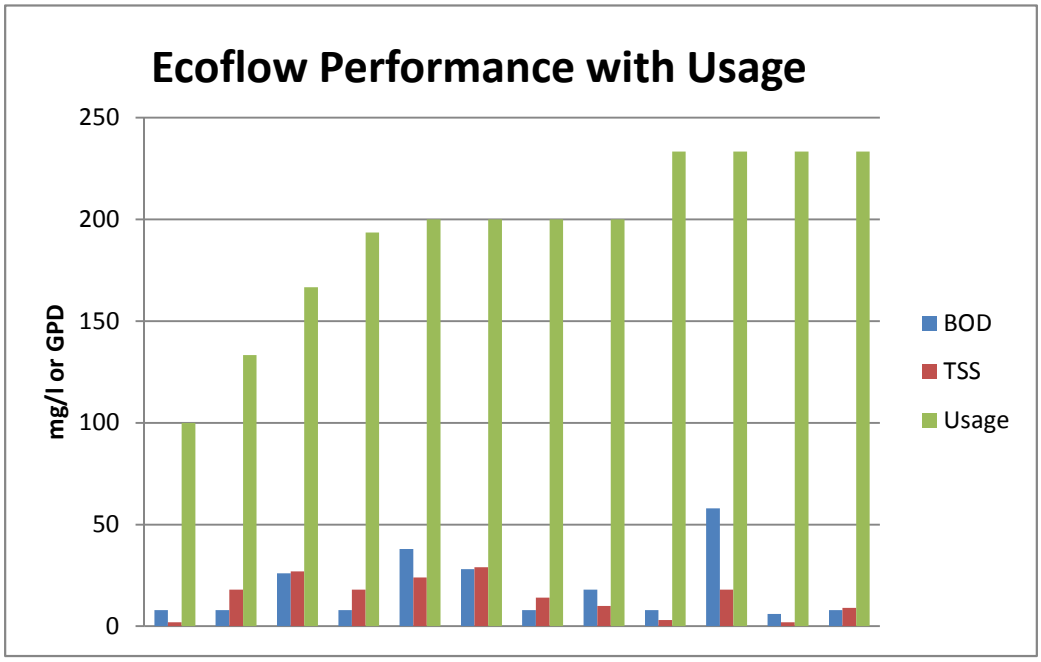


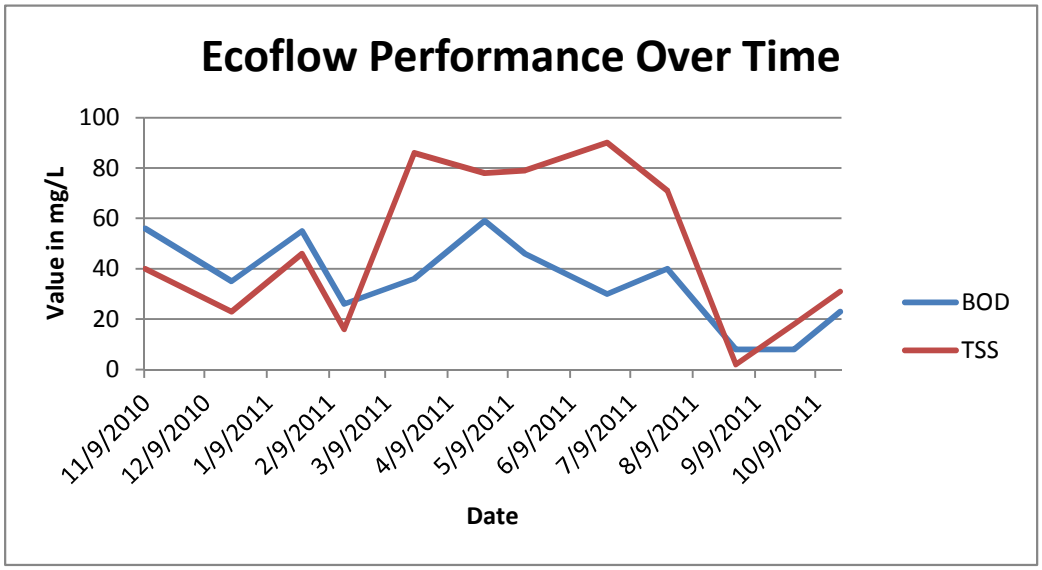

Ecoflex Performance Over Time
Value in mg/L
100
80
60
40
20
0
11/9/2010
12/9/2010
1/9/2011
2/9/2011
3/9/2011
4/9/2011
5/9/2011
6/9/2011
7/9/2011
8/9/2011
9/9/2011
10/9/2011
Date
BOD
TSS

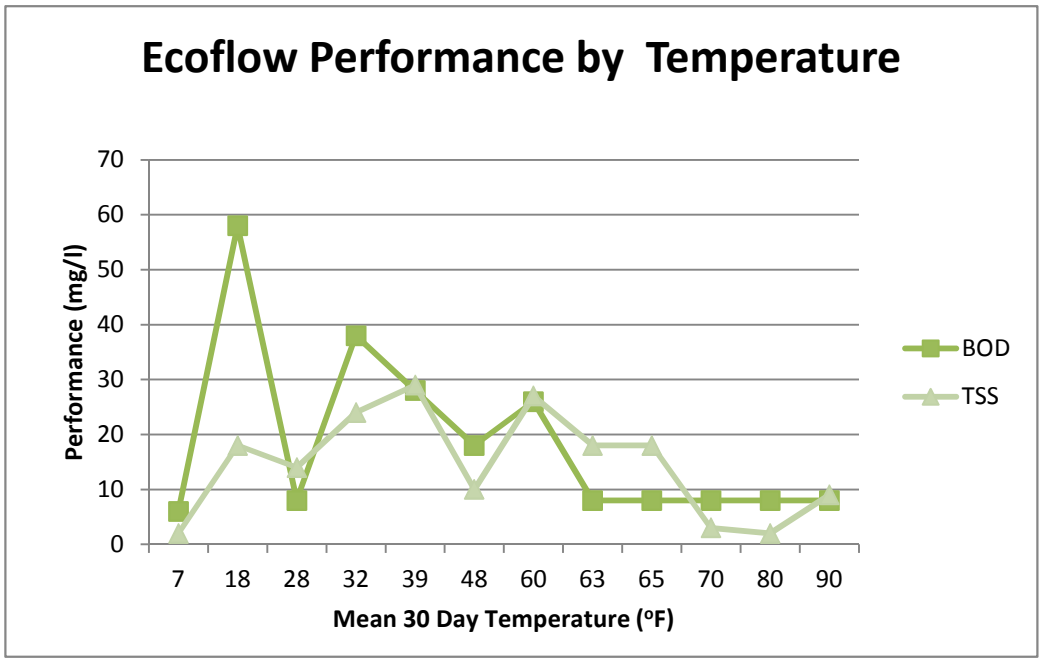

Ecoflex Performance by Temperature
Performance (mg/l)
70
60
50
40
30
20
10
0
7
18
28
32
39
48
60
63
65
70
80
90
Mean 30 Day Temperature (ºF)
BOD
TSS

Ecoflow Data Summary

System	Date	Outside Temp (°F)	Mean 30 Day Temp (°F)	BOD (mg/L)	TSS (mg/L)	Usage (GPD)	Sample Temp (°F)	DO (mg/L)
Ecoflow	11/9/2010	69	70	8	3	233		
Ecoflow	12/22/2010	32	32	38	24	200		
Ecoflow	1/26/2011	19	18	58	18	233	44	4.5
Ecoflow	2/16/2011	35	7	6	2	233	47	4.2
Ecoflow	3/23/2011	52	39	28	29	200	49	4.6
Ecoflow	4/27/2011	43	28	8	14	200	51	6.7
Ecoflow	5/17/2011	67	48	18	10	200	60	5.9
Ecoflow	6/27/2011	80	60	26	27	167	71	3.2
Ecoflow	7/27/2011	90	80	8	2	0	82	3.9
Ecoflow	8/30/2011	69	90	8	9	233	73	5.4
Ecoflow	9/28/2011	61	65	8	18	194	63	8.7
Ecoflow	10/21/2011	60	63	8	18	133	63	8.7
	Average	56	50	19	15	186	60	5.6
	Median	60	50	8	15	200	60	5.4

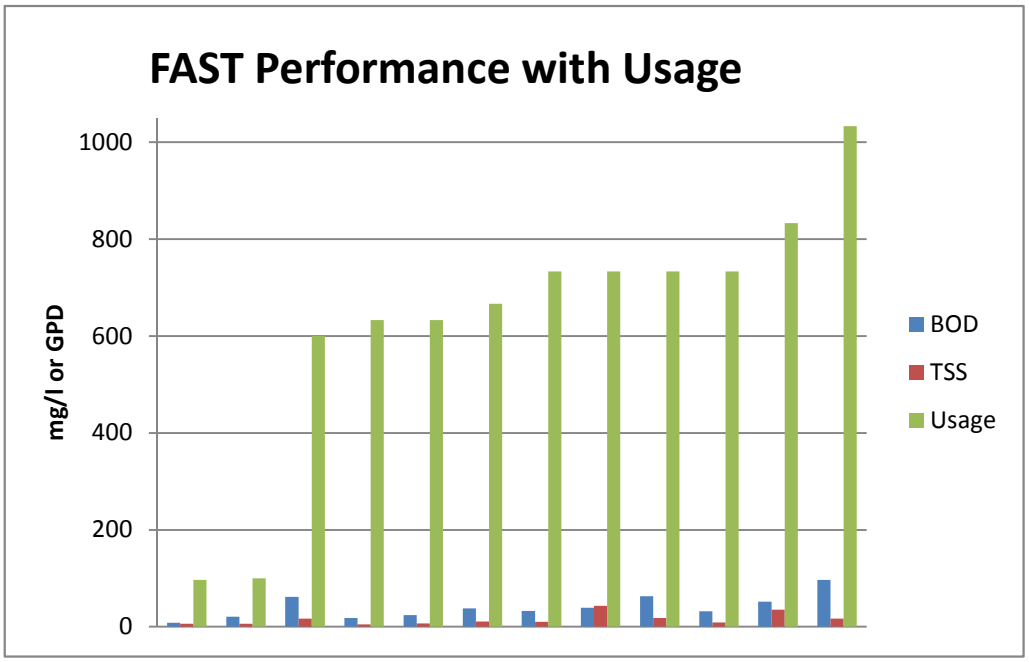


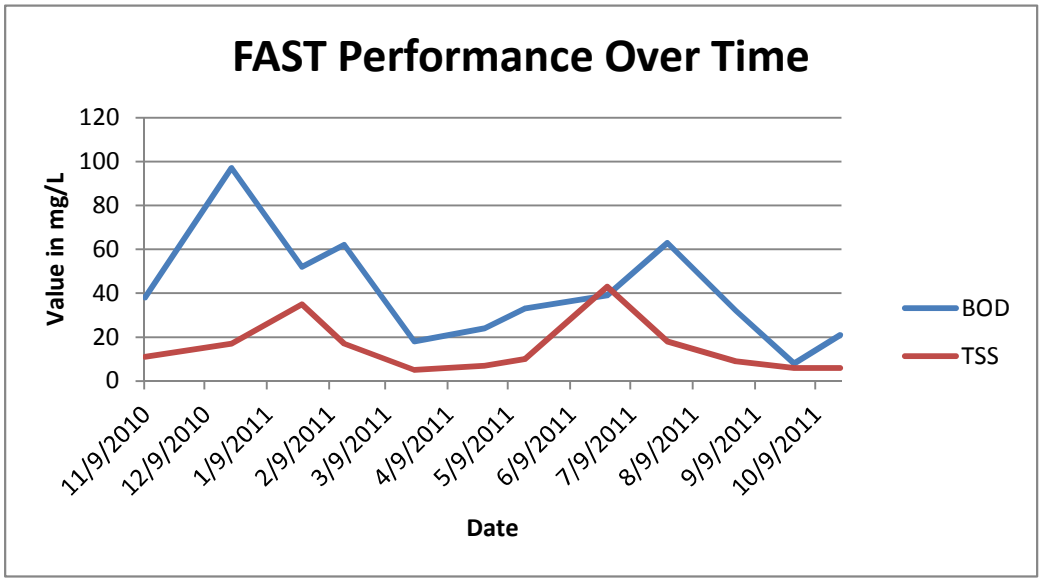

Ecoflow Performance Over Time
Value in mg/L
100
80
60
40
20
0
11/9/2010
12/9/2010
1/9/2011
2/9/2011
3/9/2011
4/9/2011
5/9/2011
6/9/2011
7/9/2011
8/9/2011
9/9/2011
10/9/2011
Date
BOD
TSS

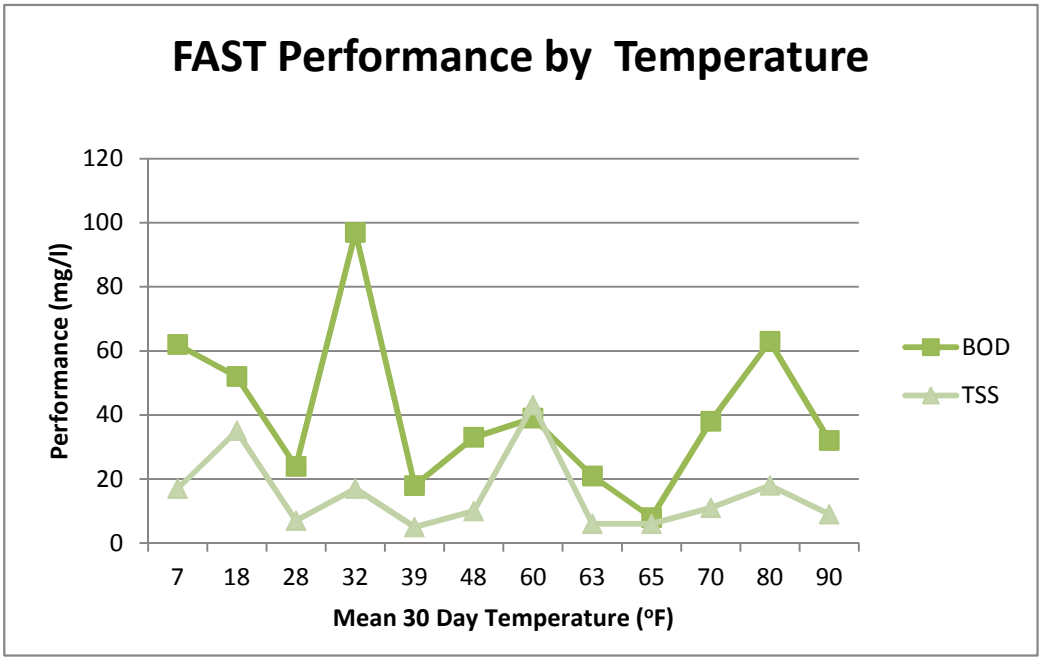

Ecoflow Performance by Temperature
Performance (mg/l)
70
60
50
40
30
20
10
0
7
18
28
32
39
48
60
63
65
70
80
90
Mean 30 Day Temperature (ºF)
BOD
TSS

FAST Data Summary

System	Date	Outside Temp (°F)	Mean 30 Day Temp (°F)	BOD (mg/L)	TSS (mg/L)	Usage (GPD)	Sample Temp (°F)	DO (mg/L)
Fast	11/9/2010	69	70	38	11	667		
Fast	12/22/2010	32	32	97	17	1033		
Fast	1/26/2011	19	18	52	35	833	41	2.4
Fast	2/16/2011	35	7	62	17	600	46	1.4
Fast	3/23/2011	52	39	18	5	633	46	4.3
Fast	4/27/2011	43	28	24	7	633	50	2.6
Fast	5/17/2011	67	48	33	10	733	60	5.7
Fast	6/27/2011	80	60	39	43	733	67	2.0
Fast	7/27/2011	90	80	63	18	733	76	1.1
Fast	8/30/2011	69	90	32	9	733	71	1.8
Fast	9/28/2011	61	65	8	6	97	67	7.7
Fast	10/21/2011	60	63	21	6	100	62	7.8
	Average	55	48	41	16	624	59	3.7
	Median	58	48	36	13	683	60	2.6

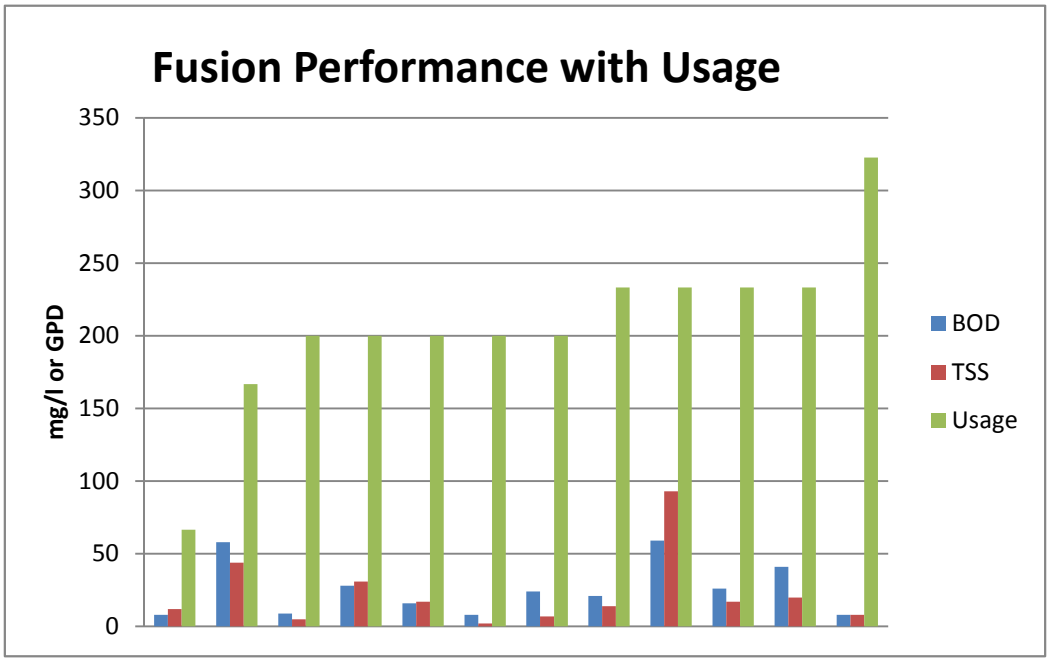


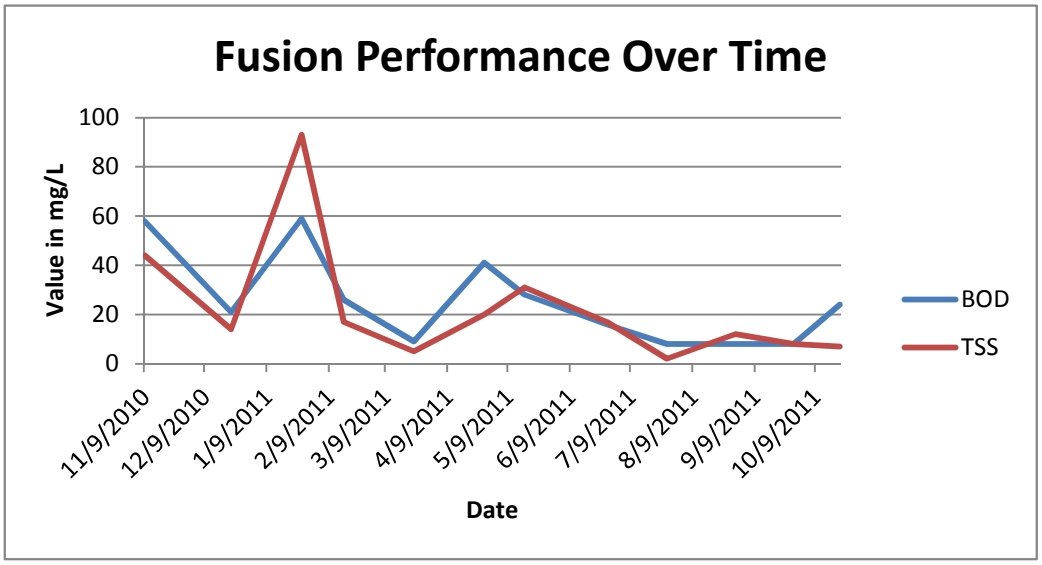

FAST Performance Over Time
Value in mg/L
120
100
80
60
40
20
0
11/9/2010
12/9/2010
1/9/2011
2/9/2011
3/9/2011
4/9/2011
5/9/2011
6/9/2011
7/9/2011
8/9/2011
9/9/2011
10/9/2011
Date
BOD
TSS

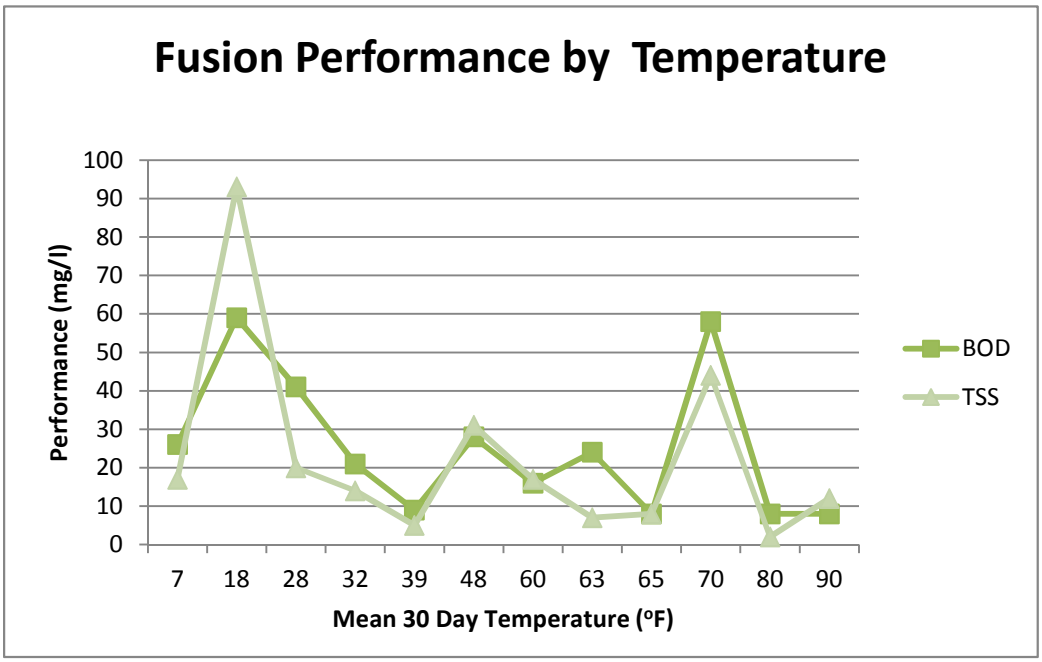

FAST Performance by Temperature
Performance (mg/l)
120
100
80
60
40
20
0
7
18
28
32
39
48
60
63
65
70
80
90
Mean 30 Day Temperature (°F)
BOD
TSS

Fusion Data Summary

System	Date	Outside Temp (°F)	Mean 30 Day Temp (°F)	BOD (mg/L)	TSS (mg/L)	Usage (GPD)	Sample Temp (°F)	DO (mg/L)
Fusion	11/9/2010	69	70	58	44	167		
Fusion	12/22/2010	32	32	21	14	233		
Fusion	1/26/2011	19	18	59	93	233	47	4.7
Fusion	2/16/2011	35	7	26	17	233	57	4.2
Fusion	3/23/2011	52	39	9	5	200	51	5.0
Fusion	4/27/2011	43	28	41	20	233		
Fusion	5/17/2011	67	48	28	31	200	67	2.3
Fusion	6/27/2011	80	60	16	17	200	74	2.9
Fusion	7/27/2011	90	80	8	2	200	80	3.3
Fusion	8/30/2011	69	90	8	12	67	75	3.7
Fusion	9/28/2011	61	65	8	8	323	64	4.2
Fusion	10/21/2011	60	63	24	7	200	69	2.7
	Average	55	48	23	21	211	65	3.7
	Median	58	48	22	16	206	66	3.7

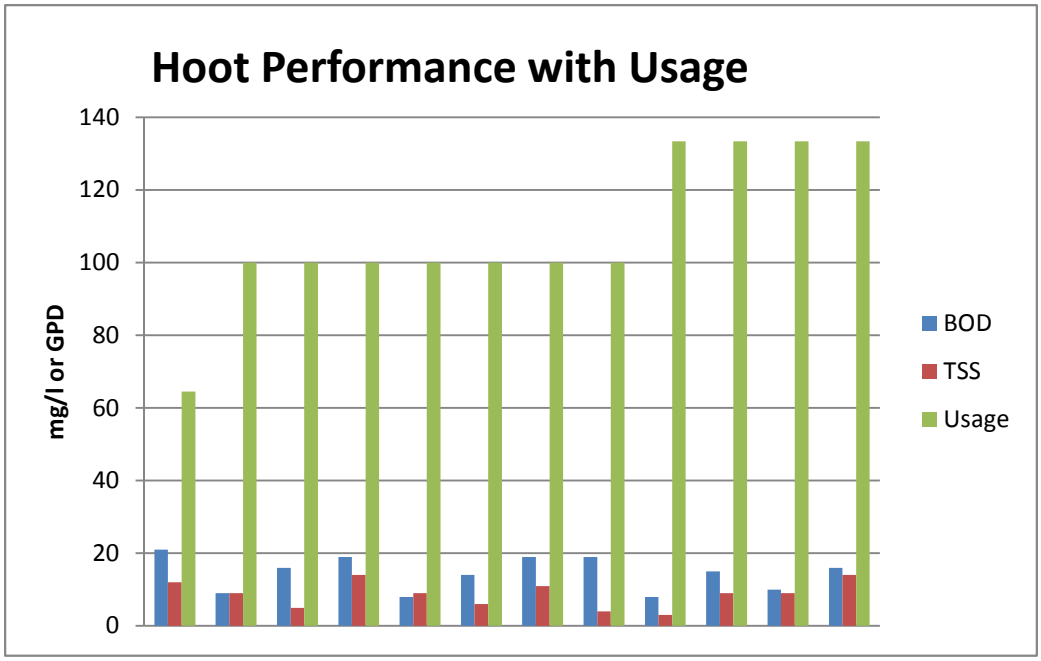


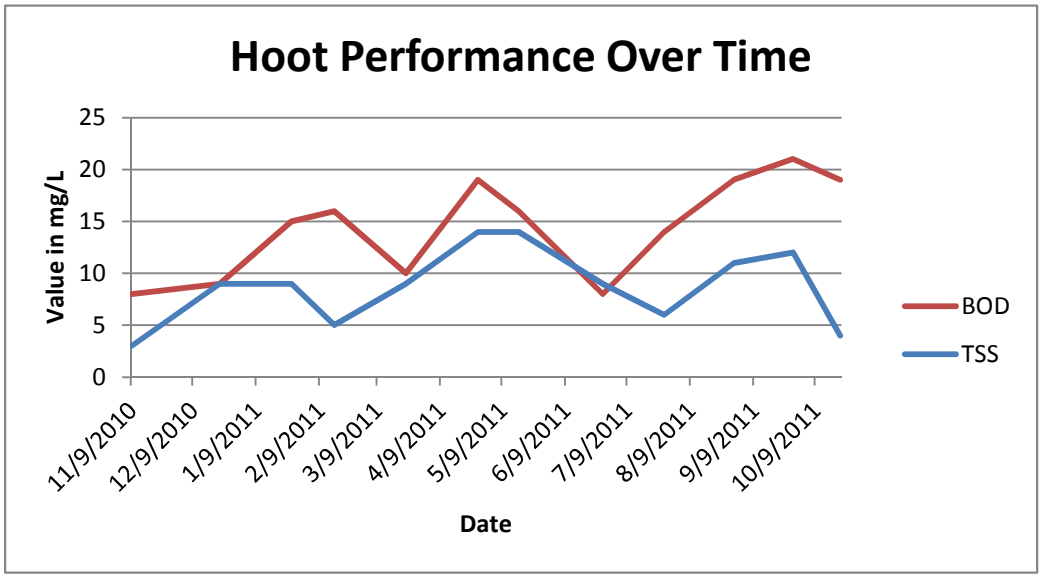

Fusion Performance Over Time
Value in mg/L
100
80
60
40
20
0
11/9/2010
12/9/2010
1/9/2011
2/9/2011
3/9/2011
4/9/2011
5/9/2011
6/9/2011
7/9/2011
8/9/2011
9/9/2011
10/9/2011
Date
BOD
TSS

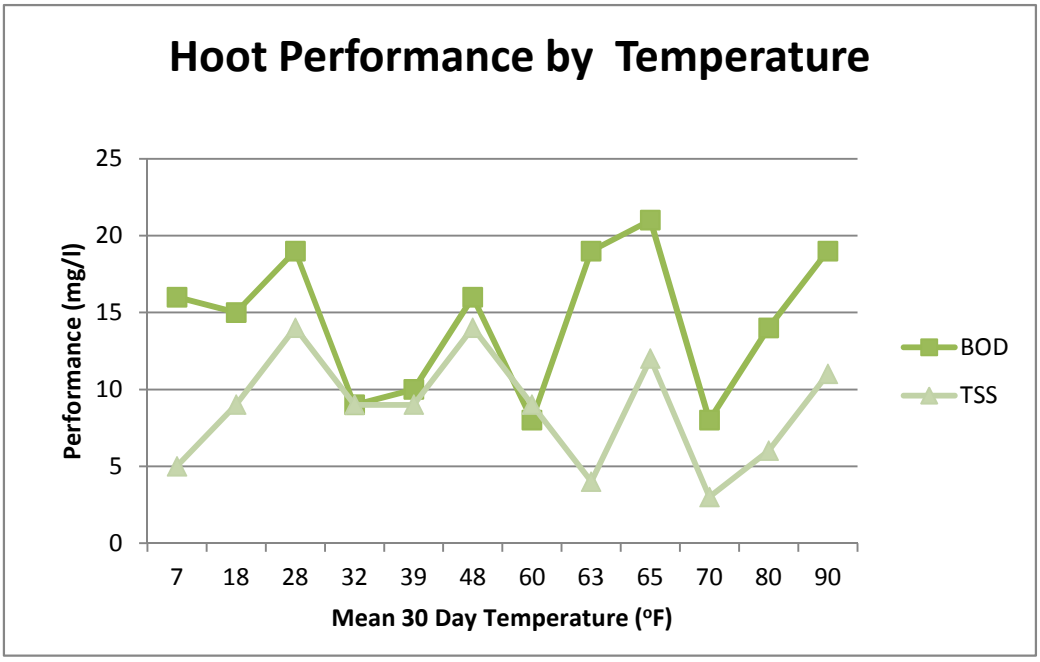

Fusion Performance by Temperature
Performance (mg/l)
100
90
80
70
60
50
40
30
20
10
0
7
18
28
32
39
48
60
63
65
70
80
90
Mean 30 Day Temperature (ºF)
BOD
TSS

Hoot Data Summary

System	Date	Outside Temp (°F)	Mean 30 Day Temp (°F)	BOD (mg/L)	TSS (mg/L)	Usage (GPD)	Sample Temp (°F)	DO (mg/L)
Hoot	11/9/2010	69	70	8	3	133		
Hoot	12/22/2010	32	32	9	9	100		
Hoot	1/26/2011	19	18	15	9	133	46	5.9
Hoot	2/16/2011	35	7	16	5	100	46	6.5
Hoot	3/23/2011	52	39	10	9	133	47	7.2
Hoot	4/27/2011	43	28	19	14	100	50	5.1
Hoot	5/17/2011	67	48	16	14	133	58	4.9
Hoot	6/27/2011	80	60	8	9	100	69	4.1
Hoot	7/27/2011	90	80	14	6	100	73	3.5
Hoot	8/30/2011	69	90	19	11	100	66	3.7
Hoot	9/28/2011	61	65	21	12	65	66	3.8
Hoot	10/21/2011	60	63	19	4	100	61	6.6
	Average	55	48	15	9	106	58	5.1
	Median	58	48	16	9	100	58	5.1




Hoot Performance Over Time
Value in mg/L
25
20
15
10
5
0
11/9/2010
12/9/2010
1/9/2011
2/9/2011
3/9/2011
4/9/2011
5/9/2011
6/9/2011
7/9/2011
8/9/2011
9/9/2011
10/9/2011
Date
BOD
TSS


Hoot Performance by Temperature
Performance (mg/l)
25
20
15
10
5
0
7
18
28
32
39
48
60
63
65
70
80
90
Mean 30 Day Temperature (ºF)
BOD
TSS