BioCycle Beta Test
Plum Island Wastewater Treatment Plant
Executive Summary

Introduction

Evaluation of the BioCycle control system in the Plum Island Wastewater Treatment Plant began this spring to assess the power savings and continued performance of the process when periods of mixing with BioMix large bubble aeration were interspersed with the ordinary aeration in use at the plant. The plant allows continued operation of most basins in the complete-mixed activated sludge process of the original design while several basins operate with the BioCycle system.

The Plum Island Plant is a 36 million gallon per day (MGD) facility which provides primary and secondary treatment prior to disinfection and then return of the treated water to Charleston Harbor. After preliminary screening the flows are divided between two trains which unite only after the secondary clarifiers. The secondary treatment process is composed of nine complete-mix tanks, six on the A-side (Basins 1 through 6) and three on the B-side (Basins 7 through 9). The tanks are nearly square (72' x 74') with fine bubble diffusers supplying air to the mixed liquor. Each side receives a mixture of primary clarifier effluent and return activated sludge from its respective feed channel.

The mixed liquors from each side's treatment basins mix as they pass to their secondary clarifiers in channels and pipes. The secondary effluents are sampled and then combine as they reach the chlorination tank.

Current operation of the facility utilizes six of the nine aeration tanks. The flows are split by passive weirs to provide two-thirds of the flow to the A-side of the plant where four basins are in use. The remaining one-third of the flow is treated in two basins on the B-side of the plant. These two basins, B-8 and B-9, were outfitted with BioMix equipment, valves and probes connected to the BioCycle controls.

All of the equipment was installed by the end of March. Tank 8 went into Biocycle Operation on Tuesday, April 19th at approximately 12 noon. Tank 9 went into Biocycle Operation on Tuesday, April 26th at approximately 4 pm. The official start of the 30 day test was on May 1st.

Air flow

Of particular interest for this investigation is the air flow to the plant. This flow is being used to calculate energy reduction in the biological process. Since the blowers are not designated to the two process trains, but feed a common header, the final use of the air is the available location to separate the needs for the two trains, A and B. There are airflow meters at several locations in the treatment process tanks to measure air to the aeration basins as well as mixing air to the influent and effluent aeration basin channels.

In order to calculate the air flow reduction while Biocycle was in use a baseline air study was conducted from March 1st through March 15th. These dates were used because this was the closest time to the 30 day trial period before Enviromix made any modifications to the aeration system for the installation of Biocycle.

Baseline Airflow

	A-side, Average Daily Air Volume	B-side, Average Daily Air Volume	Total Process Average Daily Air Volume	B-side Average Daily Air Volume as % of A-side Average Daily Air Volume
March 1 through March 15 (ft^3/d)	13,906,007	3,454,395	17,360,402	24.8%
March 1 through March 15 (m^3/d)	393,774	97,818	491592	

As shown in the table above, the B-side aeration air is approximately 24.8% of that of the A-side aeration air.

Aeration Requirements

The air into the Process Tanks provides a measure of how effective the BioCycle system is at reducing the power requirements for operation. Since the BioCycle is only operating on the B-side of the plant, the intention was to compare the A-side airflow per basin to the B-side airflow per basin. Airflow for each side of the plant was calculated with the measured rates multiplied by the time interval between measures (5 minutes) and then summed for that day. The theoretical B-side airflow was then calculated by multiplying the A-side airflow by 24.8% determined above. This was then used to calculate the reduction in B-side airflow.

Airflow Reduction

	A-side, Average Daily Air Volume	B-side, Average Daily Air Volume	Total Process Average Daily Air Volume	Theoretical B-side Average Daily Air Volume without Biocycle (A-side x 0.248)	B-side % Reduction
May 1 through May 30 (ft3/d)	20,319,152	2,522,284	22,841,436	5,039,150	49.9
May 1 through May 30 (m3/d)	575,374	71,423	646,797	142,693	

The numbers above show that there was a 49.9% reduction in the aeration requirements for the B-side of the plant with BioCycle operating versus what the aeration requirements would have been for the B-side of the plant without Biocycle operating.

Effluent Quality

Critical to the success of any new operation or equipment at Plum Island is continuing to produce effluent of sufficient quality for discharge. The discharge requirements for the facility are provided in the table with the effluent quality for the Phase 3 period with both B-tanks operating with BioCycle controls and BioMix equipment.

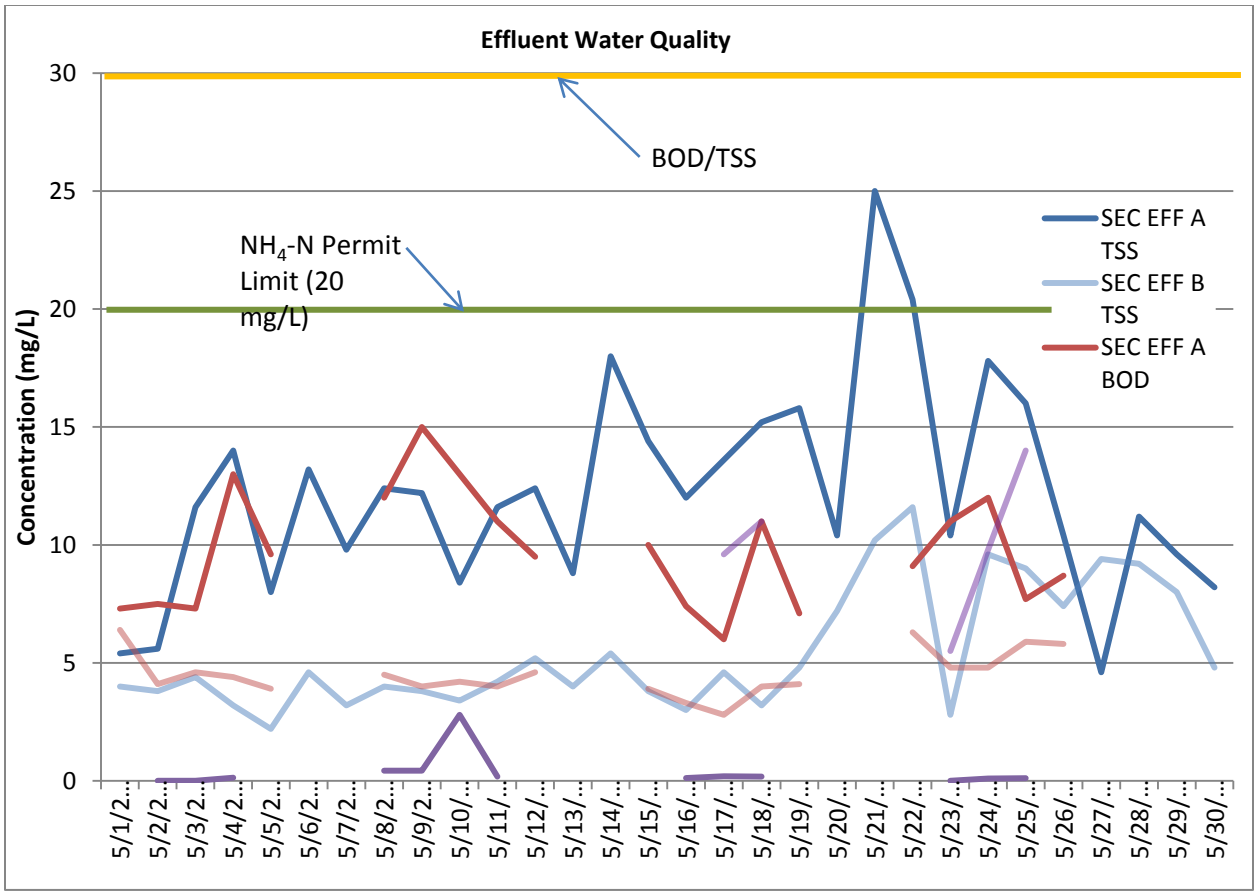
Plum Island Plant Final Effluent

Parameter	BO D5, mg/L		TSS, mg/L		NH3-N, mg/L	
	Average	Maximum Full Week	Average	Maximum Full Week	Average	Maximum Full Week
Compliance Limit, mg/L	30	45	30	45	20	30
Test Results	9.5	12.2	8.3	10	3.3	4.4

As shown in the table above, the effluent during the operation of the BioCycle continued to meet the discharge limits at the facility. In addition to the final effluent data, effluent data was compared between both the A side and B side of the plant as shown in the table and chart below.

Composite Samples

Plant Side	Plant Flow MGD	Plant Flow Tonnes/day	BOD, mg/L	TSS, mg/L	NH3, mg/L
A Side	8.54	32327	9.36	11.77	0.32
B Side	6.64	25135	4.82	5.39	10.41



Data from these periods from the B-side of the plant show BOD and TSS removal improved with BioCycle. As expected, the ammonia concentration did increase during the operation of BioCycle, however, the effluents from the B-8 and B-9 tanks were also sampled at the effluent weirs. These were grab samples which were filtered to remove the mixed liquor prior to analysis. The analyses are summarized in the two following tables. Since these tanks operate with on-off cycles of aeration, the effluent fluctuated. Due to the denitrification that occurred in the B-tanks during operation the result was an increase in the total Nitrogen removal in the B-side of the plant.

Effluent Filtered Grab Samples

	Plant Flow MGD	Plant Flow Tonnes /day	BOD, mg/L	NH3, mg/L	NOx, mg/L	TKN, mg/L	Alkalinity mg/L
B-9	6.64	25135	2.36	6.93	7.65	8.88	115
B-8	6.64	25135	2.19	6.23	5.90	8.33	120

Plum Island Process Tank Effluent Nitrogen Concentrations

	A-side Effluent (composite)	B9 Effluent (filtered grab)	B8 Effluent (filtered grab)
NH3, mg/L	0.32	6.93	6.23
NOx, mg/L	16.58	7.65	5.90
TKN, mg/L	2.16	8.88	8.33
TN, mg/L	18.9	16.5	14.4

Conclusion and Next Steps

As shown by this summary, the BioCycle system was effective and achieved the targeted results of energy reduction and maintain effluent quality. The initial goal of BioCycle was to reduce blower demand by 25%. The BioCycle system nearly doubled that target, achieving a reduction in blower demand of 49.9% while not only maintaining the effluent quality of the plant, but also decreasing total nitrogen concentrations. As EnviroMix continues to improve BioCycle, additional benefits will be realized from the system and software. Optimizing the system for dentrification could reduce sludge production volumes by up to 20%, resulting in significant savings in the processing and hauling of biosolids. Dissolved Oxygen and Blower Demand Management modules which will be added to subsequent versions of the software may also be able to provide additional energy reductions through decreased loads on the aeration blowers. We believe the solutions which have been developed to date, and those which will be developed in the future present tremendous value to potential clients and significant opportunities for both EnviroMix and Duoyuan.