

Permit Compliance with the Reduction in Number of On-line SBRs

The Central Wayne Regional Authority (CWRA) is located in northeast Pennsylvania. The CWRA Wastewater Treatment Plant (WWTP) treats mostly domestic wastewater from Cherry Ridge Township, Honesdale Borough, and Texas Township. The plant is designed to handle 2.2 million gallons per day (MGD) of wastewater and receives an average dry weather flow of 1.1 MGD. Aerobic treatment of wastewater occurs in three sequencing batch reactors (SBRs). Each SBR has a capacity of 0.8 million gallons. There are four cycles per day per SBR when all SBRs are on-line. Average daily influent values for cBOD and TSS in 2014 for CWRA are listed in Table 1.

Table 1

Average Daily Influent Values for cBOD and TSS in 2014

Month	Parameter	
	cBOD (mg/L)	TSS (mg/L)
March	136	134
April	75	69
May	129	152
June	146	170
July	149	167
August	169	214

With the use of bioaugmentation and micronutrient addition to the one of the SBRs in 2014, compliance to discharge standards from the Pennsylvania Department of Environmental Resources was achieved after the reduction in number of SBRs from three SBRs on-line to one SBR on-line. When three SBRs are on-line, influent to the SBR is single fill, while when one SBR is on-line, influent feed is continuous.

To compensate for loss of solids (MLSS) under aeration with two SBRs off-line, Arkea[®] was used for bioaugmentation and micronutrients were added. Arkea[®] is a proprietary blend of microbial cultures. Arkea[®] was added to increase the population of desirable microbes, while micronutrients were added to increase the microbial activity of indigenous and augmented microbes (ArchaeaSolutions, Inc., Tyrone, Georgia). Arkea[®] and micronutrients were both added to the influent. Arkea[®] addition was started on June 11 at the rate of 8 lbs. per month (approximately 0.25 lbs. per day). Micronutrient addition was started on June 19 at the rate of 1 mg/L per day.

Treatment efficiency of the WWTP before and after bioaugmentation and micronutrient addition is revealed in a comparison of the approximate 3-month time period (March, April, and May) before bioaugmentation and micronutrient addition to the approximate 3-month time period (June, July, and August) when the additions occurred. Treatment over the 3-month time period, June – August, was performed with a 68% reduction in mixed liquor suspended solids (MLSS) under aeration (Table 2).

Table 2

March – August 2014
Daily Average MLSS (mg/L) and Pounds MLSS under Aeration

Month	Arkea [®] Micronutrients	SBR		
		#1	#2	#3
March	Not added	4200 MLSS	4500 MLSS	4500 MLSS
		28,000 lbs.	30,000 lbs.	30,000 lbs.
April	Not added	4500 MLSS	3600 MLSS	4000 MLSS
		30,000 lbs.	24,000 lbs.	27,000 lbs.
May	Not added	4200 MLSS	3600 MLSS	3800 MLSS
		28,000 lbs.	24,000 lbs.	25,000 lbs.
June	Added	4200 MLSS	Off-line	Off-line
		28,000 lbs.	Off-line	Off-line
July	Added	3,000 MLSS	Off-line	Off-line
		28,000 lbs.	Off-line	Off-line
August	Added	3,100 MLSS	Off-line	Off-line
		21,000 lbs.	Off-line	Off-line

Table 2 shows a daily average total pounds of solids under aeration of 82,000 lbs. for March – May, and a daily average total pounds of solids under aeration of 26,000 lbs. for June – August. The pounds of solids under aeration after Arkea[®] and micronutrient addition represent a 68% reduction in solids. Selected operational parameters for monitoring the daily performance of each SBR are listed in Tables 3, 4, and 5. The reported values represent the consistent and compatible treatment of each SBR.

Table 3

Daily Operational Parameters for Monitoring the Performance of SBR #1
(values obtained after react phase)

Month 2014	Monitoring Parameter				
	Alkalinity (mg/L)	pH	NH ₃ -N (mg/L)	Temperature* (°C)	Settleability (mL)
March	97	6.5	0.9	8	240
April	87	6.6	1.0	10	310
May	93	6.6	1.0	13	260
June	100	6.6	0.6	16	240
July	100	6.8	< 0.2	19	140
August	120	6.8	1.5	19	200

* The influence of temperature upon wastewater treatment was not evaluated.

Table 4

Daily Operational Parameters for Monitoring the Performance of SBR #2
(values obtained after react phase)

Month 2014	Monitoring Parameter				
	Alkalinity (mg/L)	pH	NH ₃ -N (mg/L)	Temperature (°C)	Settleability (mL)
March	96	6.6	1.0	8	230
April	93	6.6	1.7	10	220
May	92	6.6	1.2	13	170
June*	Off-line	Off-line	Off-line	Off-line	Off-line
July	Off-line	Off-line	Off-line	Off-line	Off-line
August	Off-line	Off-line	Off-line	Off-line	Off-line

*SBR #2 taken off-line of May 21.

Table 5

Daily Operational Parameters for Monitoring the Performance of SBR #3
(values obtained after react phase)

Month 2014	Monitoring Parameter				
	Alkalinity (mg/L)	pH	NH ₃ -N (mg/L)	Temperature (°C)	Settleability (mL)
March	100	6.6	1.2	8	260
April	108	6.6	0.9	10	260
May	89	6.5	0.2	13	240
June*	100	6.6	0.3	16	220
July	Off-line	Off-line	Off-line	Off-line	Off-line

*SBR #3 taken off-line on June 9.

CWRA must satisfy several discharge requirements for the Pennsylvania Department of Environmental Protection (Table 6). In addition to cBOD and TSS requirements, CWRA must perform nitrification and denitrification in its SBRs to satisfy discharge requirements for ammonia-nitrogen and nitrite/nitrate-nitrogen. If needed, alkalinity is available on-site as magnesium hydroxide (Mg(OH)₂), but alkalinity currently is not needed to promote nitrification. CWRA must also satisfy total phosphorus and fecal coliform requirements. Phosphorus is precipitated as aluminum phosphate by adding alum (KAl(SO₄)₂•12H₂O) during the SBR react phase. Phosphorus is precipitated in the orthophosphate (H₂PO₄⁻/HPO₄²⁻) form. Disinfection to satisfy fecal coliform requirement is achieved with the use of ultraviolet (UV) radiation.

Table 6

Effluent Discharge Requirements

Parameter	Concentration (mg/L)			
	Minimum	Average Monthly	Daily Maximum	Instantaneous Maximum
pH (S.U.)	6.0	XXX	XXX	9.0
Dissolved Oxygen	7.0	XXX	XXX	XXX
cBOD ₅	XXX	15.0	23.0 Weekly Average	30.0
Total Suspended Solids	XXX	21.0	31.5 Weekly Average	42.0
Fecal Coliform (CFU/100 mL)	XXX	200 Geometric Mean	XXX	1,000
Nitrite-Nitrate as N	XXX	8.0	XXX	16.0
Total Nitrogen	XXX	Report	XXX	XXX
Total Kjeldahl Nitrogen	XXX	Report	XXX	XXX
Ammonia-Nitrogen	XXX	6.5	XXX	13.0
Total Phosphorus	XXX	1.25	XXX	2.50

Except for the occurrence of one instantaneous maximum violation for one Fecal Coliform in June, the CWRA consistently satisfied its Pennsylvania Department of Environmental Protection discharge requirements. The violation occurred during a heavy rain event resulting in a flow of 3.5 MGD to the WWTP. During late spring two SBRs were taken off-line for inspection and repairs. SBR #2 was taken off-line on May 21, and SBR #3 was taken off-line on June 9. Effluent daily averages for March – August are listed in Table 7.

Table 7

Effluent Daily Averages for Reportable Discharge Parameters

Month	Parameter				
	cBOD (mg/L)	TSS (mg/L)	NH ₃ -N (mg/L)	NO ₂ ⁻ /NO ₃ ⁻ (mg/L)	Total Phosphorus (mg/L)
March	2	7	1	2	< 1
April	3	9	2	2	< 1
May	3	5	< 1	2	< 1
June	6	18	2	1	2
July	4	3	< 1	3	1
August	5	23	2	1	1

Although plant capacity for treating wastewater was reduced by 67% with respect to the number of aerobic reactors (SBRs) and reduction in MLSS under aeration was reduced by 68%, SBR #1 alone was able to maintain successful treatment of wastewater and compliance with required discharge parameters. This ability was achieved through the addition of Arkea[®] and micronutrients and the professional operator and laboratory technician work efforts.

ArchaeaSolutions, Inc. extends its sincere appreciation to Sharon Kinzinger and Dan Guinther for their time and efforts in monitoring and reporting treatment plant performance.

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