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Improvement in SBR MLSS Settleability

Undesired settleability of mixed liquor suspended solids (MLSS) is a common operational problem at activated sludge processes, including sequencing batch reactors (SBR). There are several operational conditions that are responsible for undesired settleability including excessive growth of filamentous organisms, nutrient deficiency, and excessive production and accumulation of polysaccharides. Undesired settleability can result in increased operational costs and discharge permit violations. Corrective measures are usually expensive and consist of the addition of a cationic polymer or metal salt such as ferric chloride ($FeCl_3$) that acts as a coagulant.

Undesired settleability of MLSS has been a long-term problem for the Waymart Area Authority (WAA). The WAA is located in northeast Pennsylvania. The WAA treats mostly domestic wastewater from Waymart Borough and Cannon Township. The wastewater includes the discharges from a state correctional facility and a federal correctional facility. The WAA receives approximately 0.7 MGD of wastewater. Aerobic treatment of wastewater occurs in three SBRs. Each SBR has a capacity of 300,000 gallons. Although undesired settleability of solids has occurred in all SBRs, it is most problematic in No. 3 SBR.

In an effort to improve settleability and increase hydraulic loading to the treatment plant WAA added micronutrients to its influent and added Arkea® to its SBRs starting the last week in October 2014. Arkea® is a proprietary blend of microbial cultures. Micronutrients were added to increase the microbial activity of indigenous and augmented microbes. Arkea® was added to increase the population of desirable bacteria and archaea (ArchaeaSolutions, Inc., Tyrone, Georgia). Micronutrients

were added at a rate of 1 mg/L, while Arkea® was added at a rate of 8 lbs. per month (approximately 0.25 lbs. per day).

Although micronutrient and Arkea® additions continue at WAA, appropriate operation data are presented to compare settleability over the six-month time period November 1, 2014 to April 30, 2015 with appropriate six-month time periods: November 1, 2013 to April 30, 2014; November 1, 2012 to April 30, 2011; November 1, 2011 to April 30, 2012.

Influent data (Table 1) and effluent data (Table 2) for the four time periods reveal no significant difference in any listed influent parameter. An increase in total suspended solids (TSS) during the November 1, 2014 to April 30, 2015 time period did occur, but the increase is acceptable since much below the discharge permit value for TSS.

Table 1

Influent Operational Parameters

Time Period	BOD* mg/L	NH_3-N* mg/L	TP* mg/L	Flow MGD
2011 – 2012	200	16	4	0.7
2012 - 2013	230	15	5	0.7
2013 – 2014	150	14	5	0.7
2014 – 2015	**240**	**14**	**4**	**0.7**

*BOD = biochemical oxygen demand; TSS = total suspended solids; NH_3-N = ammonia-nitrogen; TP = total phosphorus;

Table 2

Effluent Operational Parameters

Time Period	cBOD* mg/L	TSS mg/L	NH_3-N mg/L	TP mg/L	Flow MGD
2011 – 2012	3	3	1	1	0.7
2012 – 2013	2	3	1	1	0.7
2013 – 2014	2	6	1	1	0.7
2014 – 2015	**4**	**12**	**1**	**1**	**0.7**

*cBOD = carbonaceous, biochemical oxygen demand

Operational data (monthly averages) for all SBRs related to solids settleability are presented in Tables 3, 4, and 5 for MLSS (mg/L); Tables 6, 7, and 8 for settled solids for the 30-minute settleability; and Tables 9, 10, and 11 for sludge volume index (SVI). The average values for the first three, six-month time periods are also provided in each table. The tables indicate improvement in settleability with micronutrient and Arkea®, especially in SBR No. 3.

Table 3

SBR No. 1, MLSS (mg/L)

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	2900	3400	3700	3300	2800	3200
2012 – 2013	2000	1900	2400	3000	3000	2800
2013 – 2014	2200	3200	2900	3400	2600	2000
Average 2011 – 2014	2400	2800	3000	3200	2800	2700
2014 - 2015	**2600**	**2800**	**3100**	**3100**	**3300**	**2800**

Table 4

SBR No. 2, MLSS (mg/L)

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	2500	3200	3100	2700	2500	2200
2012 – 2013	1600	1700	2300	3000	2400	2200
2013 – 2014	3400	3500	3400	3300	2900	2600
Average 2011 – 2014	2500	2800	2900	3000	2600	2300
2014 - 2015	**2500**	**1900**	**3000**	**3600**	**3100**	**3200**

Table 5

SBR No. 3, MLSS (mg/L)

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	2500	2900	1800	2100	2300	2300
2012 – 2013	1700	1800	2000	2400	2400	2200
2013 – 2014	2000	2300	2200	1900	2400	2100
Average 2011 – 2014	2100	2300	2000	2100	2400	2200
2014 - 2015	**2300**	**2200**	**2300**	**1900**	**2400**	**3100**

Table 6

SBR No. 1, 30-minute Settleability

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	310	450	540	350	260	280
2012 – 2013	340	270	380	290	280	270
2013 – 2014	180	260	390	310	220	170
Average 2011 – 2014	280	330	440	320	250	240
2014 - 2015	**210**	**200**	**250**	**270**	**310**	**260**

Table 7

SBR No. 2, 30-minute Settleability

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	280	490	460	410	410	250
2012 – 2013	420	400	570	360	290	240
2013 – 2014	240	290	310	270	210	190
Average 2011 – 2014	310	390	450	350	300	230
2014 - 2015	**300**	**180**	**280**	**360**	**280**	**240**

Table 8

SBR No. 3, 30-minute Settleability

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	390	530	560	380	450	460
2012 – 2013	650	720	750	570	450	430
2013 – 2014	770	740	510	460	550	520
Average 2011 – 2014	600	660	610	470	480	470
2014 - 2015	**370**	**310**	**410**	**240**	**320**	**400**

Table 9

SBR No. 1, SVI

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	140	170	180	140	120	100
2012 – 2013	160	140	160	120	100	100
2013 – 2014	80	80	140	90	80	80
Average 2011 – 2014	130	130	160	120	100	90
2014 - 2015	**80**	**70**	**80**	**90**	**90**	**90**

Table 10

SBR No. 2, 30 SVI

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	150	200	180	150	160	110
2012 – 2013	220	230	250	120	110	110
2013 – 2014	70	80	90	80	70	80
Average 2011 – 2014	150	170	170	120	110	100
2014 - 2015	**120**	**90**	**90**	**100**	**90**	**80**

Table 11

SBR No. 3, SVI

Period	Month					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
2011 – 2012	200	240	220	180	180	200
2012 – 2013	380	390	370	230	200	190
2013 – 2014	400	320	230	230	230	190
Average 2011 – 2014	330	320	270	210	200	190
2014 - 2015	**160**	**140**	**180**	**130**	**130**	**120**

The improvements in MLSS, 30-minute settleability testing, and SVI were obtained for all three SBRs; however, the improvements in SBR No. 3 are most dramatic. Figure 1 shows that for the four periods of study for MLSS, SBR No. 3 held the most MLSS during the 2014 – 2015 period when Arkea® and humate were added. Figure No. 2 shows that for the four periods of study for 30-minute settleability testing, SBR No. 3 produced the smallest volume of settle solids (MLSS) during the 2014 – 2015 period when Arkea® and humate were added. Figure No. 3 shows that for the four periods of study for SVI, SBR No. 3 produced the lowest SVI values during the 2014 – 2015 period when Arkea® and humate were added. Arkea® and humate continue to be added to the Waymart Area Authority SBRs with acceptable values for MLSS, 30-minute settling of solids (MLSS), and SVI values.

Figure 1

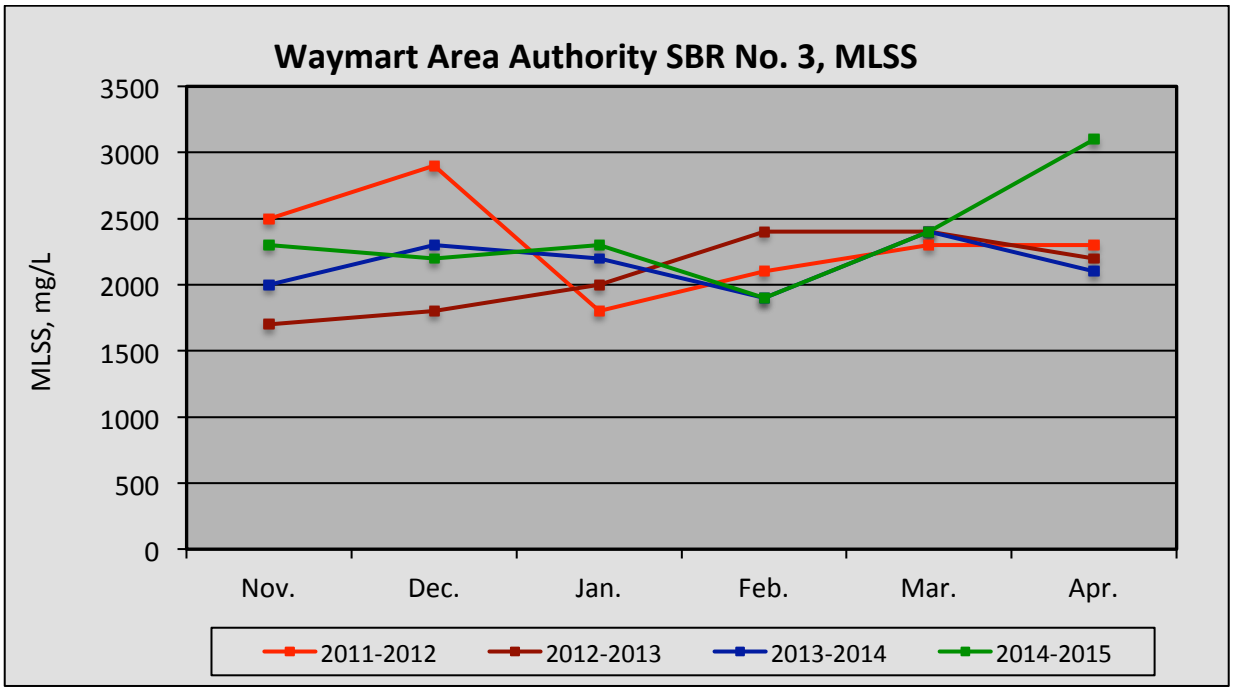


Figure 2

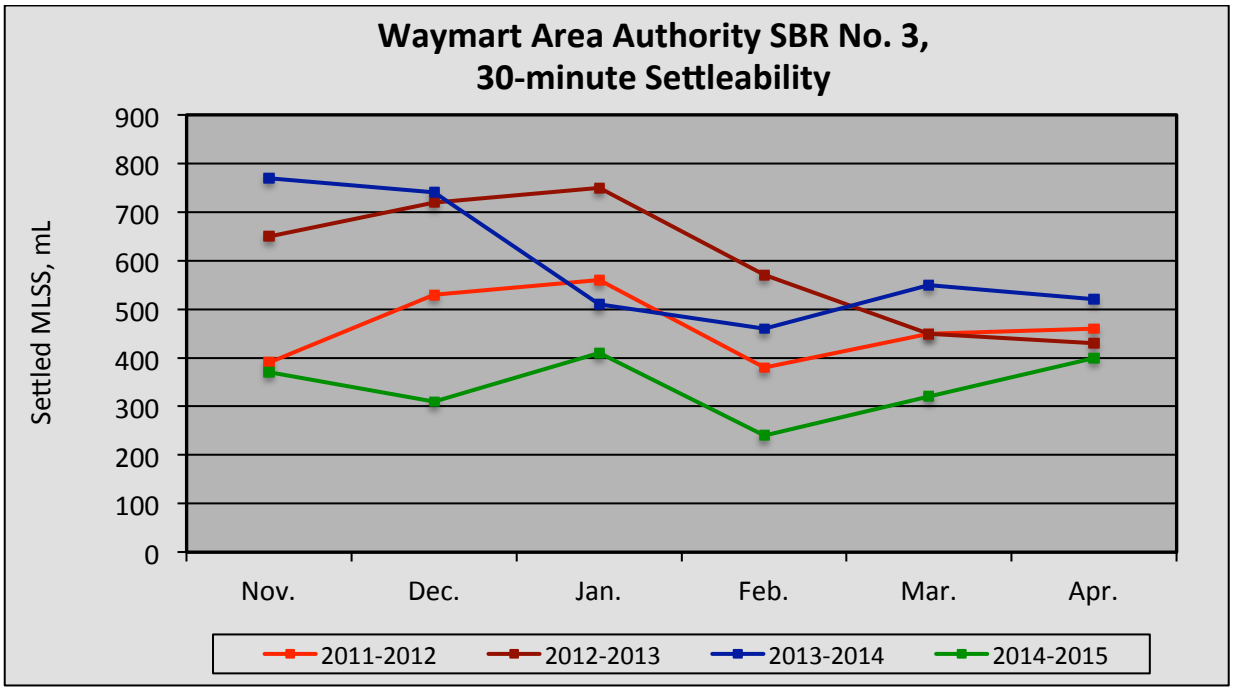
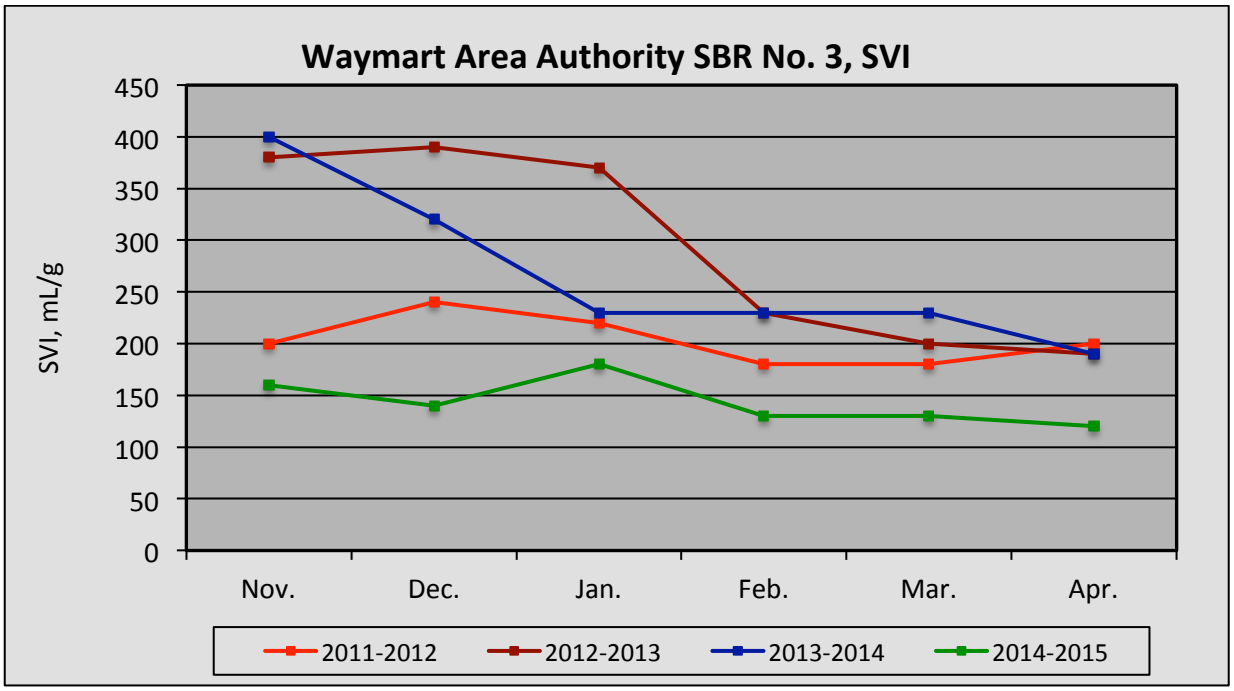


Figure 3



ArchaeaSolutions, Inc. extends its sincere appreciation to Randy Skates for his time and efforts in monitoring and reporting treatment plant performance.

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