WASTEWATER TECHNOLOGY

NSF/ANSI Standard 40 - *Residential Wastewater Treatment Systems*

Final Report:

Canadian Wastewater Solutions Ltd.
CWS-MBBR-500
17/07/055/0030

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EXECUTIVE SUMMARY

Testing of the Canadian Wastewater Solutions Ltd. CWS-MBBR-500 was conducted under the provisions of NSF/ANSI Standard 40 for Residential Wastewater Treatment Systems (April 2013 revision). NSF/ANSI Standard 40 was developed by the NSF Joint Committee on Wastewater Technology.

The performance evaluation was conducted at the NSF Wastewater Testing Facility located in Waco, Texas, using wastewater diverted from the City of Waco municipal wastewater collection system, which serves predominantly residential development. The evaluation consisted of sixteen weeks of dosing at design flow, seven and one half weeks of stress testing and an additional two and one half weeks of dosing at design flow. Dosing was initiated on March 4, 2018 and the test was officially started on March 5, 2018. Sampling started in the winter and continued through the spring and summer, covering a range of operating temperatures.

Over the course of the evaluation, the average effluent $CBOD_5$ was 5 mg/L, ranging between <1 and 12 mg/L, and the average effluent total suspended solids was 8 mg/L, ranging between 3 mg/L and 22 mg/L.

The CWS-MBBR-500 produced an effluent that successfully met the performance requirements established by NSF/ANSI Standard 40 for Class I effluent:

> The maximum 7-day arithmetic mean was 9 mg/L for $CBOD_5$ and 14 mg/L for total suspended solids, both below the allowed maximums of 40 and 45 mg/L, respectively. The maximum 30-day arithmetic mean was 7 mg/L for $CBOD_5$ and 10 mg/L for total suspended solids, both below the allowed maximums of 25 mg/L and 30 mg/L, respectively.

The effluent pH during the evaluation ranged between 7.1 and 7.6, within the required range of 6.0 to 9.0. The CWS-MBBR-500 met the requirements for noise levels (less than 60 dbA at a distance of 20 feet), color, threshold odor, oily film and foam.

CERTIFICATION

NSF International has determined by performance evaluation under the provisions of NSF/ANSI Standard 40 (revised April 2013) that the Canadian Wastewater Solutions Ltd. CWS-MBBR-500 has fulfilled the requirements of NSF/ANSI Standard 40. The CWS-MBBR-500 has therefore been authorized to bear the NSF Mark so long as Canadian Wastewater Solutions continues to meet the requirements of Standard 40 and NSF General and Program Specific Policies.

General performance evaluation and stress tests were performed at the NSF Wastewater Technology Site located in Waco, Texas. The raw wastewater used in the test was residential wastewater. The characteristics of the wastewater during the test are included in the tabulated data of this report.

The observations and analyses included in this report are certified to be correct and true copies of the data secured during the performance tests conducted by NSF on the wastewater treatment system described herein. The manufacturer has agreed to present the data in this certification in its entirety whenever it is used in advertising, prospectuses, bids or similar uses.

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TABLE I. SUMMARY OF ANALYTICAL RESULTS

	Average	Std. Dev.	Minimum	Maximum	Median	Interquartile Range
Biochemical Oxygen Demand (mg/L)						
Influent (BOD_5)	210	50	130	360	210	180 - 240
Effluent ($CBOD_5$)	5	2	<1	12	5	3- 6
Total Suspended Solids (mg/L)						
Influent	200	60	110	420	200	160 - 240
Effluent	8	4	3	22	7	5 -10
pH						
Influent	-	-	6.8	7.5	7.1	7.0 – 7.2
Effluent	-	-	7.1	7.6	7.4	7.3 – 7.4
Temperature (°C)						
Influent	28	4	22	32	29	24 – 31
Effluent	27	4	20	32	29	23 - 31
Dissolved Oxygen (mg/L)						
Effluent	1.2	0.7	0.2	3.7	0.9	0.7 –1.5

Notes: The median is the point where half of the values are greater and half are less.
The interquartile range is the range of values about the median between the upper and lower 25 percent of all values.

Criteria for evaluating the analytical results from the testing are described in Section 8.5 of NSF/ANSI Standard 40. In completing the pass/fail determination for the data, an allowance is made for effluent TSS and $CBOD_5$ during the first month of testing. The 30- and 7-day averages during this time may not equal or exceed 1.4 times the effluent limits required for the rest of the test. This provision recognizes that an immature culture of microorganisms within the system may require additional time to achieve adequate treatment efficiency. Effluent $CBOD_5$ and TSS concentrations from the CWS-MBBR-500 during the first calendar month of testing were within the normal limits and did not need to use this provision.

Section 8.5.1.1 of the Standard provides guidance addressing the impact of unusual testing conditions, including sampling, dosing, or influent characteristics, on operation of a system under test. Specific data points may be excluded from 7- and 30-day average calculations where determined to have an adverse impact on performance of the system, with rationale for the exclusion to be documented in the final report.

Sections 3.6 and 8.2.1 of the Standard define influent wastewater characteristics as they apply to testing under the Standard. Typical domestic wastewater is defined as having a 30-day average BOD_5 concentration between 100 and 300 mg/L and a 30-day average TSS concentration between 100 and 350 mg/L. The 30-day average influent remained inside this specified range for the duration of the test.

3.2 Biochemical Oxygen Demand

The five-day biochemical oxygen demand (BOD_5) and five-day carbonaceous biochemical oxygen demand ($CBOD_5$) analyses were completed using *Standard Methods for the Examination of Water and Wastewater* 22nd *edition*. The results of both analyses are shown in Figure 1.

Influent BOD_5:

Individual influent BOD_5 concentrations ranged from 130 to 360 mg/L during the evaluation, with average and median concentrations of 210 mg/L. Thirty day average concentrations ranged from 190 to 250 mg/L.

Effluent $CBOD_5$:

Effluent $CBOD_5$ concentrations ranged from <1 to 12 mg/L over the course of the evaluation, with an average and median effluent $CBOD_5$ concentrations of 5 mg/L.

The Standard requires that the effluent $CBOD_5$ not exceed 40 mg/L on a 7-day average or 25 mg/L on a 30-day average. As presented in Table II, over the course of the test the 7-day average effluent $CBOD_5$ ranged from 2 to 9 mg/L and the 30-day average ranged from 3 to 7 mg/L. The CWS-MBBR-500 met the requirements of Standard 40 for effluent $CBOD_5$.

BOD_5 Loading:

Over the course of the evaluation the influent BOD_5 loading averaged 0.88 lb/day. The CWS-MBBR-500 achieved an average reduction of 0.86 lbs/day.

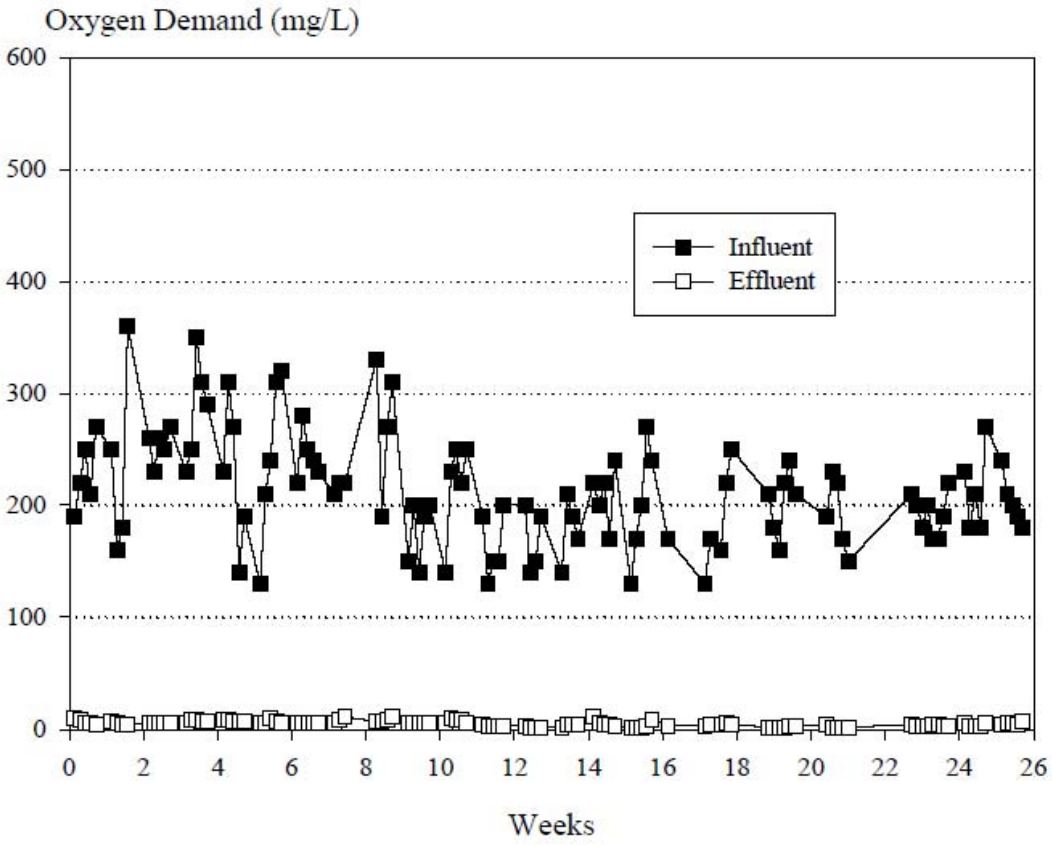

Figure 1. Biochemical Oxygen Demand

3.3 Total Suspended Solids

TSS analyses were completed using *Standard Methods for the Examination of Water and Wastewater* 22nd *edition*. The TSS results over the entire evaluation are shown in Figure 2. Data from the TSS analyses are summarized in Table I.

Influent TSS:

The influent TSS ranged from 110 to 420 mg/L during the evaluation, with an average and median concentrations of 200 mg/L. The 30-day average concentrations during the test ranged from 140 to 240 mg/L.

Effluent TSS:

The effluent TSS concentration ranged from 3 to 22 mg/L during the evaluation, with an average concentration of 8 mg/L and a median concentration of 7 mg/L.

Over the course of the evaluation, NSF/ANSI Standard 40 requires that the effluent TSS not exceed 45 mg/L on a 7-day average or 30 mg/L on a 30-day average. Table III shows the 7- and 30-day total suspended solids averages. The 7-day average effluent TSS ranged from 3 to 14 mg/L and the 30-day average ranged from 4 to 10 mg/L during the test. The CWS-MBBR-500 met the requirements of NSF/ANSI Standard 40 for effluent TSS.

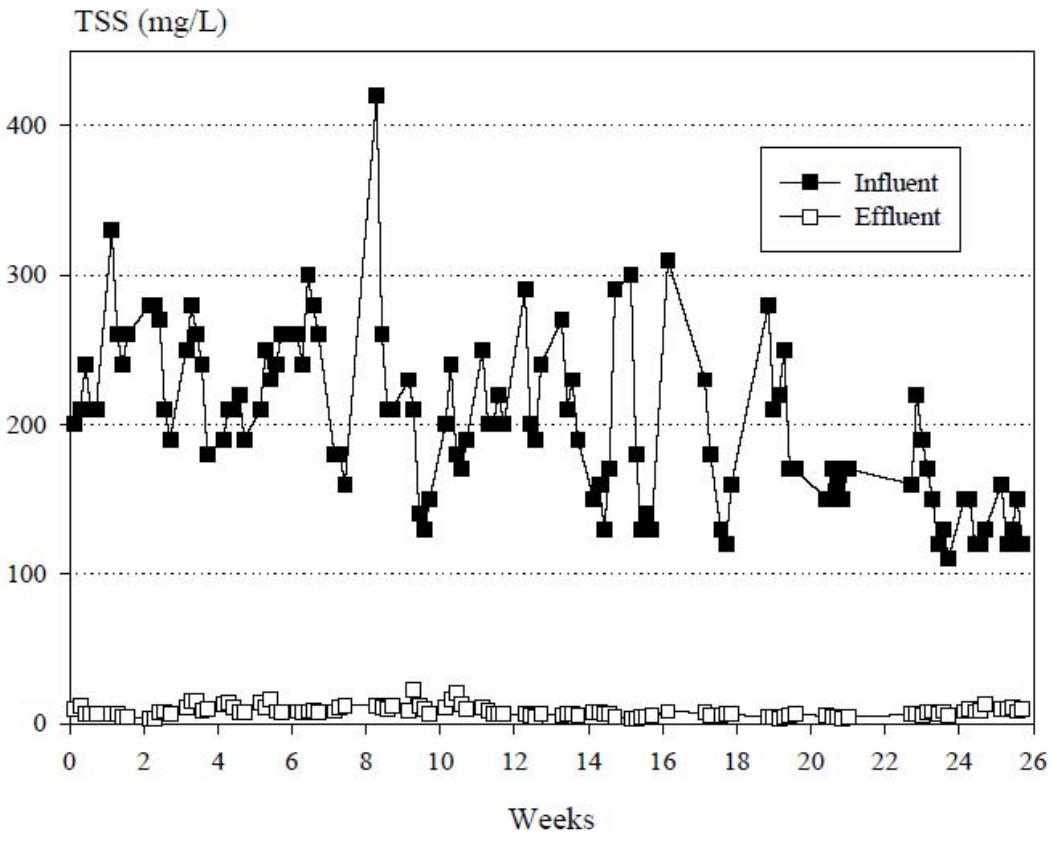

Figure 2. Total Suspended Solids

Table II. 7- and 30-day Average Effluent $CBOD_5$ and 30-day Average Influent BOD_5

Month	Week	7-day Average Effluent $CBOD_5$ (mg/L)	30-day Average Effluent $CBOD_5$ (mg/L)	30-day Average Influent BOD_5 (mg/L)
1	1	6	6	250
	2	5		
	3	5		
	4	7		
2	5	7	7	230
	6	7		
	7	5		
	8	9		
	9	8		
3	10	6	5	190
	11	8		
	12	3		
	13	2		
4	14	4	4	190
	15	5		
	16	2		
	17	5		
5	18	4	3	200
	19	4		
	20	2		
	21	3		
	22	2		
6	23	3	4	200
	24	3		
	25	4		
	26	5		

Table III. 7- and 30-day Total Suspended Solids

Month	Week	7-day Average Effluent TSS (mg/L)	30-day Average Effluent TSS (mg/L)	30-day Average Influent TSS (mg/L)
1	1	8	8	240
	2	5		
	3	5		
	4	12		
2	5	10	10	240
	6	11		
	7	8		
	8	10		
	9	11		
3	10	12	10	200
	11	14		
	12	8		
	13	5		
4	14	6	5	200
	15	6		
	16	3		
	17	6		
5	18	6	4	180
	19	5		
	20	4		
	21	5		
	22	4		
6	23	6	8	140
	24	7		
	25	10		
	26	10		

3.4 pH

Over the entire evaluation period, the influent pH ranged from 6.8 to 7.5 (median of 7.1). The effluent pH ranged from 7.1 to 7.6 during the evaluation (median of 7.4); within the 6 to 9 range required by NSF/ANSI Standard 40. The pH data for the evaluation are shown in Appendix C.

3.5 Temperature

Influent temperatures over the evaluation period ranged from 22 to 32 °C (median of 29 °C). The temperature data are shown in Appendix C.

3.6 Dissolved Oxygen

Dissolved Oxygen (DO) was measured in the effluent during the evaluation. The effluent DO ranged between 0.2 and 3.7 mg/L (median of 0.9 mg/L). All dissolved oxygen data are shown in Appendix C.

3.7 Color, Threshold Odor, Oily Film, Foam

Three samples of the effluent were analyzed for color, odor, oily film and foam as prescribed in NSF Standard 40. The effluent was acceptable according to the requirements in NSF Standard 40, with color less than 15 units, non-offensive threshold odor, no visible evidence of oily film and no foam.

3.8 Noise

A reading of the noise level at a distance of 20 feet from the plant was taken while the plant was in operation, using a hand-held decibel meter. The reading was below the 60 dbA required by ANSI/NSF Standard 40.

3.9 Alkalinity

Over the entire evaluation period, the influent alkalinity ranged from 290 to 380 (average of 340). ; within the average greater than 175 mg/L as CaCO3 required by NSF/ANSI Standard 40

4.0 REFERENCES

1. American Public Health Association (APHA), American Water Works Association (AWWA) & Water Environment Federation (WEF): *Standard Methods for the Examination of Water and Wastewater,* 21st Edition, 2005 (hereinafter referred to as *Standard Methods*.

2. ANSI/AWS D.1.1/D1.1M:2010, *Structural Welding Code – Steel* and ANSI/AWS D1.3/D1.3M:2008, *Structural Welding Code – Sheet Steel,* 5th Edition, with Errata

3. NFPA 70®: *National Electrical Code*® (NEC®), 2015

4. US EPA, *Code of Federal Regulations (CFR), Title 40: Protection of Environment, 2012*.