



# EVALUATION OF VISCOTAQ<sup>®</sup> PIPELINE WRAP PERFORMANCE RELATED TO CRUDE OIL EXPOSURE

Progress Summary

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December 2015

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## PROGRESS SUMMARY: DECEMBER 2015

The Energy & Environmental Research Center's (EERC's) last progress summary report included activities through mid-November (Week 21). This report includes the results of one additional sampling event that occurred on November 30, 2015 (Week 25). According to the proposed scope of work, this sampling event concluded the 6-month exposure experiment. Since prior sample results have shown no definitive evidence of crude oil leaking into the pipes, additional quantitative tests above and beyond the routine total organic carbon (TOC) analysis were performed on this sample set to help detect possible crude oil components. The additional tests included:

- Semivolatile petroleum hydrocarbons by U.S. Environmental Protection Agency (EPA) Method 8015B, using a solvent extraction followed by gas chromatography–flame ionization detection (GC–FID). This method detects diesel range organics or other hydrocarbons eluting between C10 and C28.
- Volatile petroleum hydrocarbons by EPA Method 8015B, using purge and trap followed by GC–FID. This method detects gasoline range organics or other hydrocarbons eluting between C5 and C10.
- Volatile organic compounds by EPA Method 8260B, using purge and trap followed by gas chromatography–mass spectrometry (GC–MS). This method detects benzene, toluene, ethylbenzene, and total xylenes (BTEX).

These tests were the same as those performed on the sample set collected on July 7, 2015, (Week 4) with the exception of the BTEX analysis, which was added because the method is specific for the more soluble hydrocarbon components typically present in crude oil, and it has a lower detection limit.

TOC results from the samples collected in Week 25 have been added to the results that were reported previously (see Table 1). As with previous reports, the averages were calculated for all weeks and also for the weeks after the flushing procedure was implemented. The data show only slight differences in TOC levels from those previously reported but seem to follow the same trend as before (Figure 1). With the exception of Pipe No. 4, the TOC levels are actually lower than any of the previously reported results.

The results of the additional testing using EPA Method 8015B are presented in Table 2. The data show that the semivolatile petroleum hydrocarbons were below or near the method reporting limit of 0.30 mg/L, ranging from nondetectable (ND) to 0.77 mg/L. The results of the volatile petroleum hydrocarbon using Method 8015B were above the method reporting limit of 0.02 mg/L, ranging from 0.386 to 0.606 mg/L. These results were similar to those from the sample set collected on July 7, 2015, and are likely due to the organic chemicals used to assemble the PVC tubing, including tetrahydrofuran, acetone, butanone, and cyclohexane.

**Table 1. TOC Results, mg/L**

	Pipe No. 1	Pipe No. 2	Pipe No. 3	Pipe No. 4	Pipe No. 5	Pipe No. 6
Baseline	<1	<1	<1	<1	<1	<1
Week 1	7.0	7.4	7.5	7.5	9.5	9.0
Week 2	11.9	12.3	11.9	12.1	15.6	14.3
Week 3	2.9	4.3	2.3	2.7	4.7	3.1
Week 4	2.9	2.9	2.4	2.6	4.4	3.3
Week 6	4.2	4.4	3.9	4.7	5.8	4.8
Week 8	2.5	3.2	3.6	3.2	5.1	4.5
Week 10	1.9	2.8	2.1	2.5	3.4	2.9
Week 12	1.6	2.3	1.4	2.0	2.7	2.1
Week 15	2.2	2.2	1.7	2.1	2.9	2.7
Week 18	1.9	2.2	1.6	2.0	3.2	2.3
Week 21	2.1	2.0	1.3	1.2	2.8	1.2
Week 25	1.5	1.5	<1	1.2	2.0	1.7
Weeks 1–25 Average	3.5	4.0	3.4	3.7	5.2	4.4
Weeks 3–25 Average	2.4	2.8	2.1	2.4	3.7	3.0

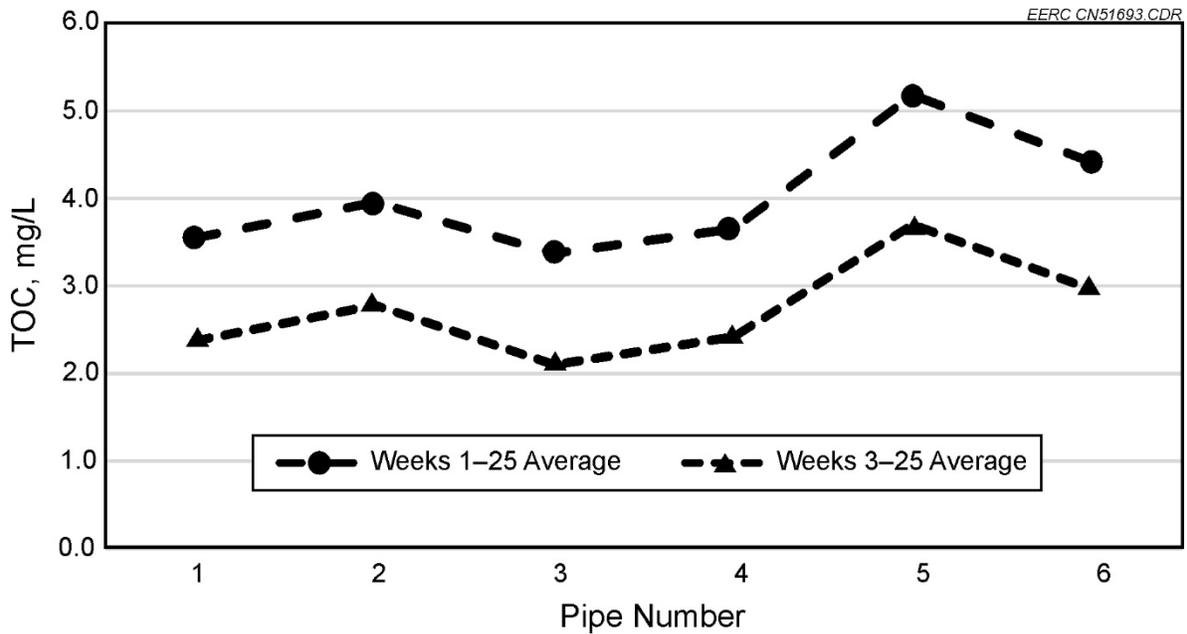


Figure 1. Comparison of TOC weekly averages.

**Table 2. Week 25 Volatile and Semivolatile Petroleum Hydrocarbon Results, mg/L**

Sample ID	Volatile Petroleum Hydrocarbons		Semivolatile Petroleum Hydrocarbons	
	Results	Reporting Limit	Results	Reporting Limit
Pipe No. 1	0.606	0.02	0.31	0.3
Pipe No. 2	0.552	0.02	0.43	0.3
Pipe No. 3	0.443	0.02	ND <sup>1</sup>	0.3
Pipe No. 4	0.386	0.02	0.34	0.3
Pipe No. 5	0.460	0.02	0.77	0.3
Pipe No. 6	0.603	0.02	0.43	0.3

<sup>1</sup> Not detected.

The BTEX results for Week 25 are presented in Table 3. The results for Pipe No. 2 show BTEX compounds in concentrations significantly above the Method 8260B reporting limit of 0.001 mg/L (1 ppb), and Pipe No. 6 shows benzene levels slightly above the reporting limit. All other pipes showed nondetect values. This may be significant since Pipes No. 2 and No. 6 are the only pipes that were not wrapped with the VISCOTAQ<sup>®</sup> sealing system. The ratios of the individual BTEX compounds found in the Pipe No. 2 water are reasonable for petroleum-derived BTEX, and their identification is likely correct since Method 8260B uses GC–MS, which is much more specific than the GC–FID used in Method 8015B. Since BTEX compounds are among the most water-soluble of crude oil components, it is possible they came from crude oil via small leaks in Pipes No. 2 and No. 6.

According to the original scope of work and proposed sampling and analysis schedule, the 6-month pipe exposure experiment has concluded. However, based on the most recent set of test results, further testing may be warranted. One recommendation would be to extend the exposure experiment for a length of time mutually agreeable to KLJ and the EERC and periodically test the pipes for BTEX only to determine if the concentrations in Pipes No. 2 or No. 6 increase or to determine if BTEX compounds appear in any other pipes.

**Table 3. Week 25 BTEX Results, mg/L**

Sample ID	Benzene	Toluene	Ethylbenzene	Total Xylenes
Pipe No. 1	ND	ND	ND	ND
Pipe No. 2	0.014	ND	0.0055	0.0023
Pipe No. 3	ND	ND	ND	ND
Pipe No. 4	ND	ND	ND	ND
Pipe No. 5	ND	ND	ND	ND
Pipe No. 6	0.0012	ND	ND	ND

The descriptions of the six test pipes are as follows:

**Pipe No. 1:** Single wrap extending to the flanges on the internal walls of the box and sealed with silicone. Internal water pressure of 45 psi.

**Pipe No. 2:** No wrap. Internal water pressure of 45 psi.

**Pipe No. 3:** Single wrap with no silicone sealant. No internal water pressure.

**Pipe No. 4:** Double wrap with no silicone sealant. Internal water pressure of 45 psi.

**Pipe No. 5:** Single wrap with no silicone sealant. Internal water pressure of 45 psi.

**Pipe No. 6:** No wrap. No internal water pressure.