

**WEEKLY REPORT FOR WEEK 33
(MARCH 18, 2019 – MARCH 22, 2019)**

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Acronyms and Abbreviations

MFC	Mass Flow Controller
ML	Mobile Laboratory
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
R&D	Research and Development
SME	Subject Matter Expert
VOC	Volatile Organic Compound

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1.0 INTRODUCTION

During the week of March 18, 2019, through March 22, 2019, TerraGraphics personnel completed testing activities and Mobile Laboratory (ML) maintenance tasks. The following sections provide additional details for daily activities performed during Week 33. The data team processed data from the previous week's testing activities, and the reporting team continued working towards completion of weekly reports for Weeks 30 through 32.

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2.0 MARCH 18, 2019 – MOBILE LABORATORY TESTING

2.1 Summary

On March 18, 2019, the ML personnel arrived at the TerraGraphics warehouse in Pasco, WA at 10:26 after attending a status meeting at the TerraGraphics Ainsworth Office. At 10:45, operators began testing the flow rate of two mass flow controllers (MFCs) installed in the sorbent calibration box (cz-mhe-03). The ML Operators connected diagnostic mock Carbotraps^{®1} to the sampling system and initiated sampling. Both MFCs reached the expected flow rates through the sorbent samples and were deemed acceptable by the Subject Matter Expert (SME). At 10:59, a span was initiated using the volatile organic compound (VOC) gas standard.

The primary test for the day was to evaluate the newly designed sample dilution system. When the ML is deployed to develop source fingerprints, it often requires sampling directly at the source. This can result in extremely high concentrations that saturate the signal. Once the signal is beyond the saturation point, it is no longer a linear relationship and will lead to underestimation of the actual concentration. To remedy this, a method was developed to dilute the sample with a known amount of dilution air to reduce the chance of saturation. This is done using a pump that pushes air ambient through a charcoal filter with the flow controlled by a 5000 sccm MFC. After quantifying the summation of instrument flows [Proton Transfer Reaction – Mass Spectrometer (PTR-MS), LI-COR^{®2}, Picarro] at ~1800 sccm, the dilution flow can be set to reduce the source concentrations to a desired level.

Figure 2-1 shows a sample dilution test using toluene. From 10:59 until 11:29, the zero/span for the PTR-MS was performed. After this time, the PTR-MS began sampling the garage air from the ML mast inlet. There is typically toluene present within the garage at reasonably stable levels. In this instance, there was approximately 5 ppbv of toluene observed between 11:29 and 11:55. For the purpose of this test, the objective was to introduce a dilution flow and watch the toluene reduce to the expected level. The ML Operators tested varying levels of dilution and compared them to expected calculations for the remainder of the day. In addition, the dilution flow was set above the summed instrument flow so they were only sampling the charcoal filtered dilution air. This was performed to quantify any contaminants present in the charcoal filter air that could skew the expected result. This initial test showed that the observed toluene signal compared well with the expected calculation based on the flows. This test will be further explained in the corresponding monthly report. A new testing file was initiated on the PTR-MS for overnight collection at 14:08. Operators departed the TerraGraphics warehouse at 14:25 to deliver ML data to the Ainsworth Office.

¹ Carbotrap is a registered trademark of Sigma-Aldrich Co., LLC, St. Louis, Nebraska.

² LI-COR is a registered trademark of LI-COR, Inc., Lincoln, Nebraska.

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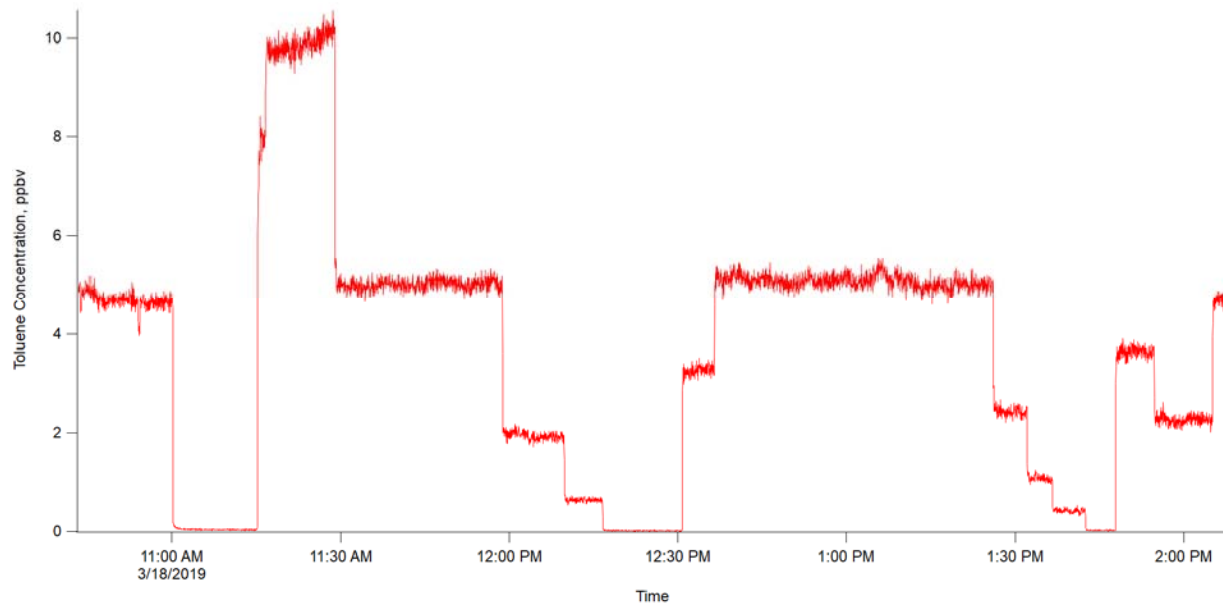


Figure 2-1. Time Series Plot of Toluene Concentration at Various Dilution Factors.

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3.0 MARCH 19, 2019 – MOBILE LABORATORY TESTING

3.1 Summary

On March 19, 2019, ML personnel arrived at the TerraGraphics warehouse at 08:09 to test the dilution system using the 35-foot heated line. The heated mast inlet was disconnected, and the 35-foot heated side-port line was connected making it the new inlet; PTR-MS data collection was stopped. At 08:20, a new PTR-MS file was started for the testing to follow. At 08:27, a zero and span check was initiated on the PTR-MS. After this check, a similar sample dilution system test to the March 18, 2019, test was performed on the 35-foot sample line. The observed toluene compared well with the expected calculations and further analysis of this data will be presented in the corresponding monthly report. Beyond testing the feasibility of the sample dilution system, this testing provided the ML Operators the opportunity to learn how the system works and be prepared to use it as needed during monitoring activities.

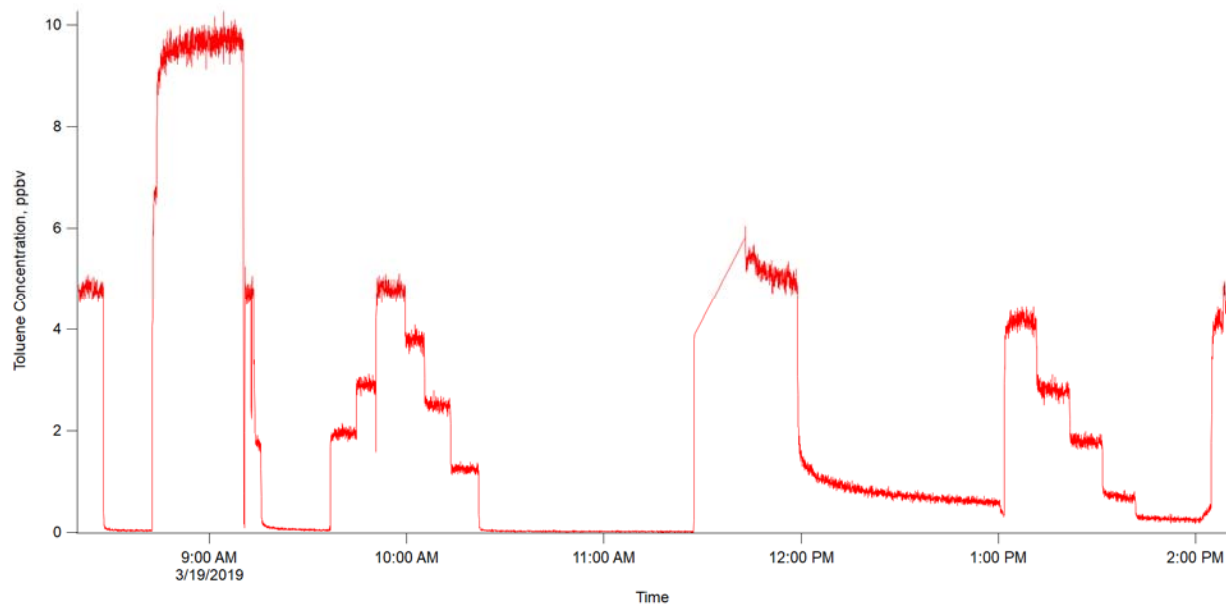


Figure 3-1. Time Series Plot of Toluene Concentration at Various Dilution Factors.

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4.0 MARCH 20, 2019 – MOBILE LABORATORY TESTING

4.1 Summary

On March 20, 2019, ML operators arrived at the TerraGraphics warehouse and prepared to depart for Les Schwab³. At 09:00, Operators arrived at Les Schwab and all tires on the truck were verified to be at 80 psi. At 10:00, the Operators washed the dirt and grime accumulated over the winter from the exterior of the ML. The operators arrived back at the TerraGraphics warehouse at 10:26. The ML personnel began tests on the first 50-foot section of the 208-foot heated line at 12:00 by initiating a zero and span check on the PTR-MS. After the spans were complete, the PTR-MS was set to sample zero-air until Operators switched to sampling from the Research and Development (R&D) gas standard. The zero-air exhaust was connected to the inlet of the hose at 13:00 and another zero and span check was started on the PTR-MS. The inlet was moved to the first section of the 208-foot line, and at 13:23 the-zero air was switched to flow out the zero-air exhaust. At 14:23, the heated line was turned on to 60°C until the PTR-MS zero was stable at 15:06, when Operators stopped PTR-MS data collection. The purpose of this testing is to characterize the new sample line. It is important to understand the effects of heating, conditioning time, and residence time within a sample line to help interpretation of data collected outside of the controlled laboratory setting. The sample line characterization will be further explained in the corresponding monthly report.

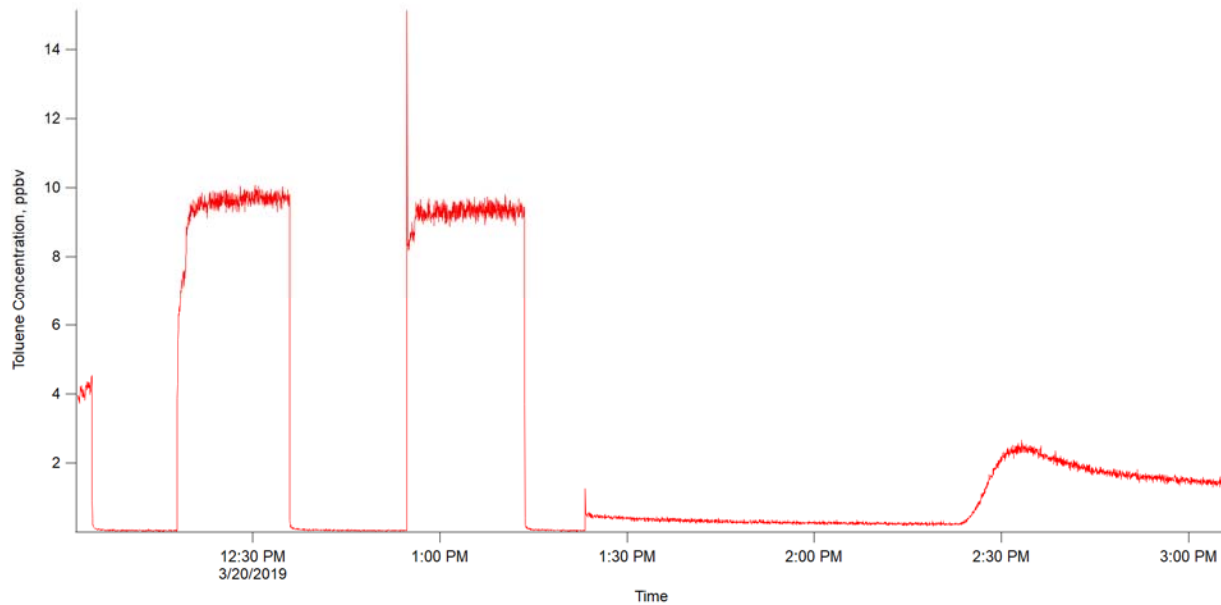


Figure 4-1. Toluene Time Series Plot, Sampling from 52-Foot Line.

³ Les Schwab is a registered trademark of Les Schwab Warehouse Center, Inc., Bend, Oregon.

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5.0 MARCH 21, 2019 – MOBILE LABORATORY TESTING

5.1 Summary

The ML personnel arrived at the TerraGraphics warehouse at 08:25 on March 21, 2019. Operators began switching the inlet to the mast. At 08:54, the ML was taken to Les Schwab to have the winter tires removed. The ML returned to the TerraGraphics warehouse at 11:43 and Operators began testing the 208-ft heated line. A zero and span check was initiated on the PTR-MS using the VOC gas standard. The inlet was moved to the first section of the 208-foot line and the PTR-MS was set to sample at 40 sccm. At 12:05, a new testing PTR-MS file was created, and another PTR-MS zero and span check was initiated. The calibration line was switched to the R&D gas standard at 12:30 and another PTR-MS zero and span check was initiated. At 13:53, Operators began a multipoint calibration by sampling R&D gas standard at 80 sccm. Over the next hour, the flow of gas was decreased incrementally, 20 sccm at a time, until reaching 0 sccm of R&D gas flow. The PTR-MS file was stopped at 14:08 once the calibration was complete. This test was performed as a continuation of sample line characterization of the first section of 208-foot sample line on March 20, 2019, which will be further analyzed in the corresponding monthly report. At 14:09, the empty zero-air gas tank was replaced with a new, full tank. Operators verified that all gas tanks were secured appropriately. The ML personnel departed for the TerraGraphics Ainsworth Office at 14:30.

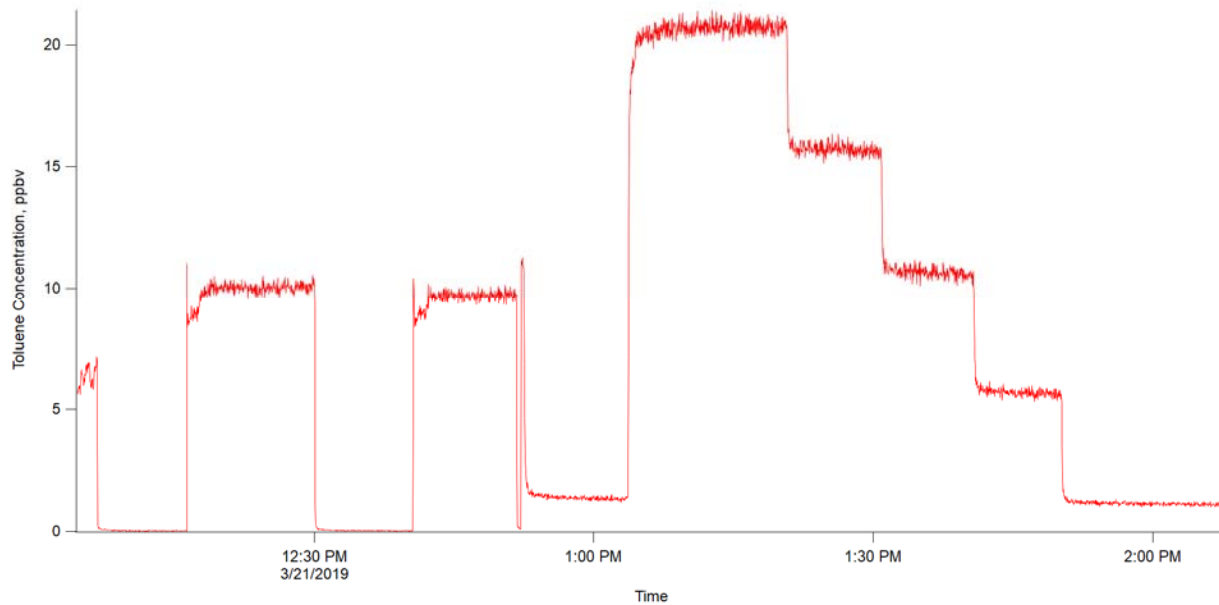


Figure 5-1. Toluene Multipoint Calibration While Sampling from 208-foot Line.

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6.0 MARCH 22, 2019 – MOBILE LABORATORY TESTING

6.1 Summary

On March 22, 2019, the ML Operators arrived at the TerraGraphics warehouse at 10:30, after attending an ML status meeting at the TerraGraphics Ainsworth Office. A new PTR-MS testing file was initiated and a zero and span check began at 10:43. The PTR-MS was set to sample VOC gas at 40 sccm for approximately 20 minutes before the R&D gas standard was connected to the calibration line. The R&D gas regulator was set to 30 psi and the PTR-MS was set to sample at 40 sccm. The flow was stopped at 11:43 so the PTR-MS could be switched to sample from the inlet. The calibration line was reconfigured to push more gas flow through the heated line. At 12:02, a multipoint calibration was started, and the flow rate was decreased incrementally over the next hour and a half. This test was performed as a continuation of sample line characterization on March 20, 2019, and March 21, 2019, but includes the additional three sections of tubing to complete the 208-foot sample line. The corresponding monthly report will show further analysis of the overall performance of the 208-foot sample line. At 15:09, data collection was stopped, and operators began preparation for upcoming ML deployment. Data were copied on an external hard drive and taken to the TerraGraphics Ainsworth Office at 15:50.

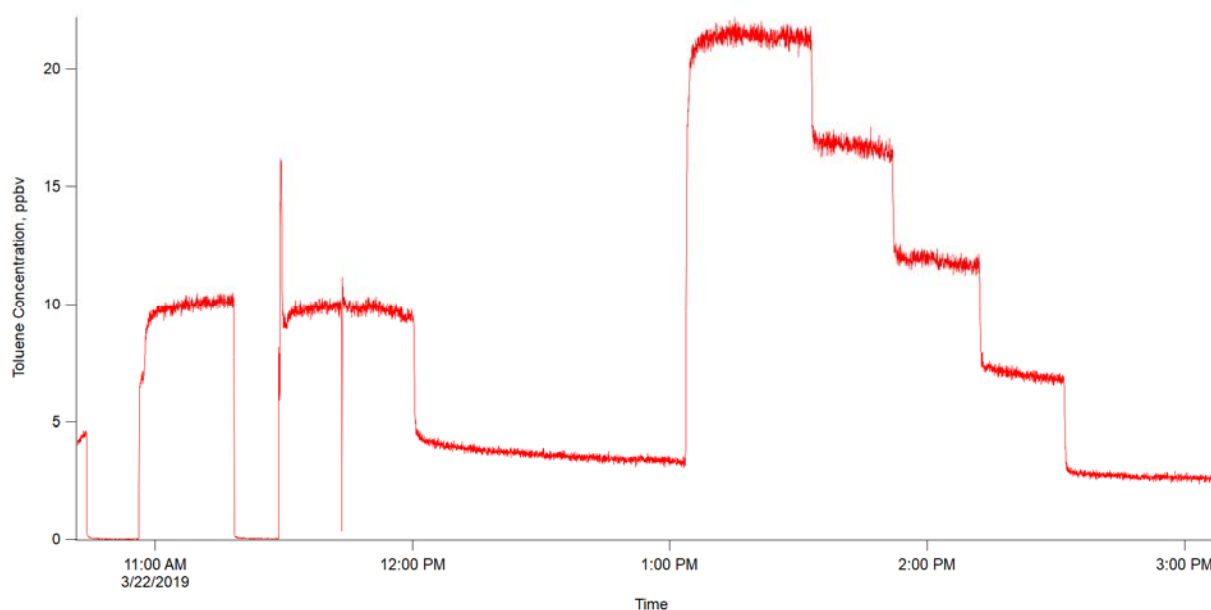


Figure 6-1. Toluene Multipoint Calibration While Sampling from 208-foot Line.

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7.0 DATA PROCESSING AND REPORTING SUMMARY

During the week of March 18, 2019, through March 22, 2019 the data processing team continued processing test data collected from the previous and current week. The reporting team made modifications and supplied content for Week 28, Week 29, Week 30, Week 31, Week 32, and Month 6 reports. Revisions were also made to the Week 24 through Week 27 reports.