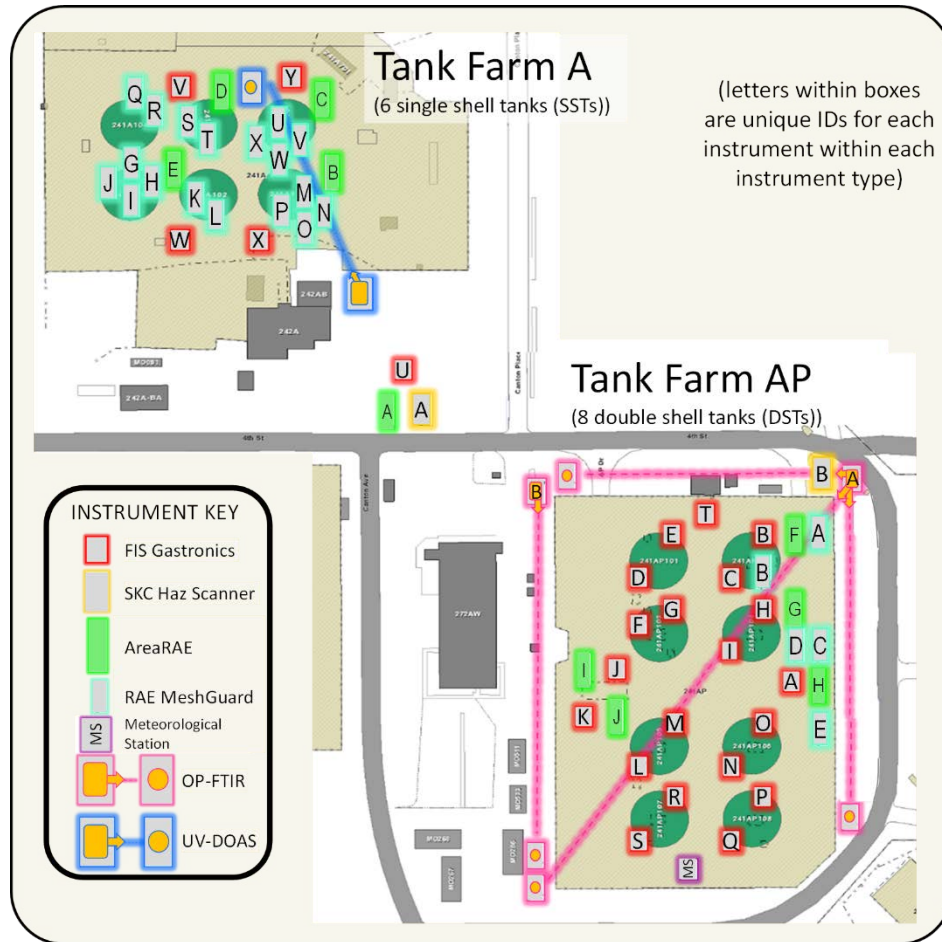


OP-FTIR Weekly Summary

11/16/16 6:00 – 11/23/16 6:00



The following information is for the time period from November 16th at 6:00 a.m. through November 23rd at 6:00 a.m. This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week for the open path Fourier transform infrared spectrometer (OP-FTIR). Pilot-scale testing is focused on evaluating component integration and functionality. Data shown may include results from calibration and bump tests performed verify instruments function; these tests result in data spikes.

- Abbreviations:
- CH₄ = methane
 - IR = infrared
 - NH₃ = ammonia
 - NO = nitric oxide
 - N₂O = nitrous oxide
 - NO₂ = nitrogen dioxide
 - OEL = occupational exposure limit
 - OP-FTIR = Open Path Fourier Transform Infrared Spectrometer
 - R² = R-squared
 - VMDS = Vapor Monitoring and Detection System

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Weekly Summary:

The OP-FTIR spectrometer provides real-time multi-gas measurement (qualitative and quantitative) of gases¹. Even though the instrument is very accurate regarding the quantification of compounds, reported results cannot be directly calculated into a concentration for a specific location, this is due to its sample size – an open path between two points. The sample path is defined by the location of the emitter and the reflector which may be 10s to 100s of meters apart. Therefore data from these instrument types will not be directly compared to Occupational Exposure Limits (OELs) and Action Levels, but used to determine concentrations of compounds along the path of the instrument's beam.

Each analyte has a specific predetermined infrared (IR) trace which represents the model for that chemical. The detection and reporting of that chemical is based on evaluation of the R-squared (R^2) values (coefficient of determination) calculated by comparing the detection trace to the model trace for that chemical. R^2 is a statistical value representing the "percent of variance explained" by evaluating the detected trace with the model trace, or an estimate of how well the two traces match. R^2 values range from 0 to 1 with higher values indicating a better fit. R^2 values for OP-FTIR data are dependent on sample concentration, chemical compounds [chemicals present can interfere/overlap with each other at key locations; typically those having the same functional groups (e.g., methane or ketone groups)], and many other factors. Results presented here are for compounds having an R^2 value of greater than or equal to 0.5.

During the week in review, instrument 506A detected nitrous oxide (N_2O), methane (CH_4), 1-butanol, and pyridine. A recurring pattern of simultaneous N_2O and CH_4 spikes was noted again this week. The R^2 values for 1-butanol and pyridine are typically below the reporting threshold of 0.5, but in few instances the R^2 value was 0.5 or above and the detected peak concentrations were 3.0 ppm for 1-butanol (20 ppm OEL) and 7.8 ppm for pyridine (1 ppm OEL). Identification of 1-butanol and pyridine occurred during periods where CH_4 and N_2O concentrations were atypical due to fog in the area. Additional analysis is needed for confirmation of 1-butanol and pyridine during these time periods.

Instrument 506B detected N_2O , and CH_4 , 1-butanol, and methyl nitrite. The R^2 values for 1-butanol and methyl nitrite are typically below the reporting threshold of 0.5, but in a few instances the R^2 value was 0.5 or above and the detected peak concentrations were 2.0 ppm for 1-butanol (20 ppm OEL) and 0.19 ppm for methyl nitrite (0.1 ppm OEL). Identification of 1-butanol and methyl nitrite occurred during periods where CH_4 and N_2O concentrations were atypical due to fog in the area. Additional analysis is needed for confirmation of 1-butanol and methyl nitrite during these time periods.

¹ OP-FTIR Fact Sheet: <http://hanfordvapors.com/wp-content/uploads/2016/10/OP-FTIR-fact-sheet.pdf>

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The N₂O, and CH₄ detected by both instruments are typically present in air at detectable levels. This information indicates that the OP-FTIR units are effectively measuring composition of the gas components within its path, when fog is not present in the area. Specific instrument information is reported below.

November 16th – November 23rd 2016 Instrument Notes:

Table 1. Chemical Species Detected on Open Path FTIRs at AP Tank Farm.

Chemical	506A: OP-FTIR Multipath	506B: OP-FTIR Single
Nitrous Oxide*	ND – 0.48 ppm	ND – 0.42 ppm
Ammonia*	ND	ND
Methane	ND - 2.4 ppm	ND – 1.8 ppm
1-3-Butadiene*	ND	ND
1-Butanol*	ND – 3.0 ppm	ND – 2.0 ppm
2-Hexanone*	ND	ND
3-Buten-2-one*	ND	ND
Acetaldehyde*	ND	ND
Acetonitrile*	ND	ND
Benzene*	ND	ND
Butanal*	ND	ND
Butyl Nitrite*	ND	ND
Ethylamine*	ND	ND
Formaldehyde*	ND	ND
Furan*	ND	ND
Methanol*	ND	ND
Methyl Isocyanate*	ND	ND
Methyl Nitrite*	ND	ND – 0.19 ppm
N-Nitrosodiethylamine*	ND	ND
N-Nitrosodimethylamine*	ND	ND
N-Nitrosomorpholine*	ND	ND
Propanenitrile*	ND	ND
Pyridine*	ND – 7.8 ppm	ND
Tributyle Phosphate*	ND	ND

Notes: *Chemical is on COPC list

ND – Not detected by instrument (i.e., either value reported was 0 or R2 value is <0.5)

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Figure 1. OP-FTIR A (506A) Review.
(Note that concentration units are ppb)

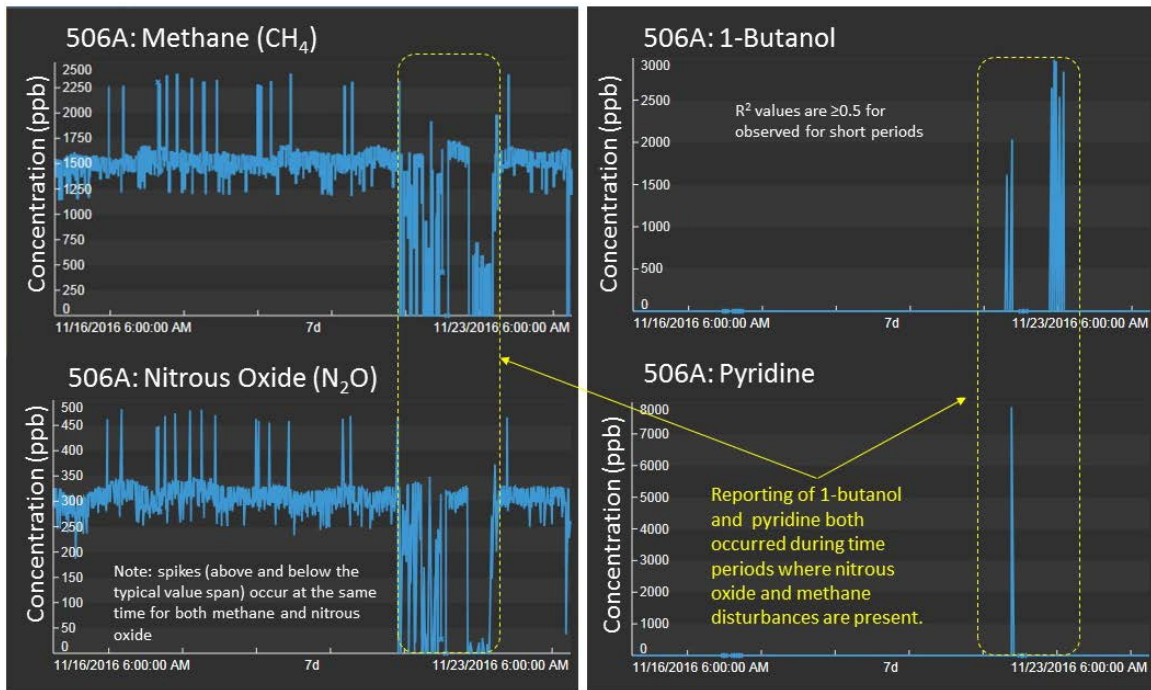
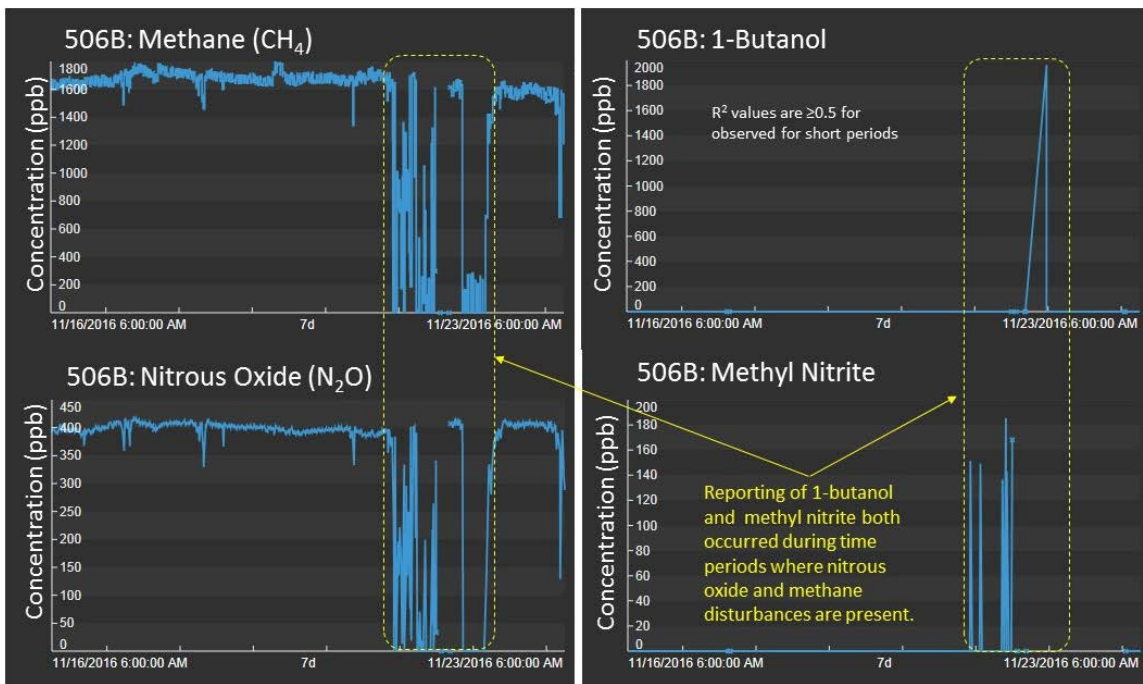


Figure 2. OP-FTIR B (506B) Review.
(Note that concentration units are ppb)



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Table 2. OP-FTIR Instrument Time Reporting^a.

Instrument	Comments
506A	The instrument was reported 100% of the time.
506B	The instrument was reporting 100% of the time.

Notes: a) % down is based on review of graph data from OSI PI²

² OSI PI is a data visualization software package from [OSIsoft](http://www.osisoft.com).