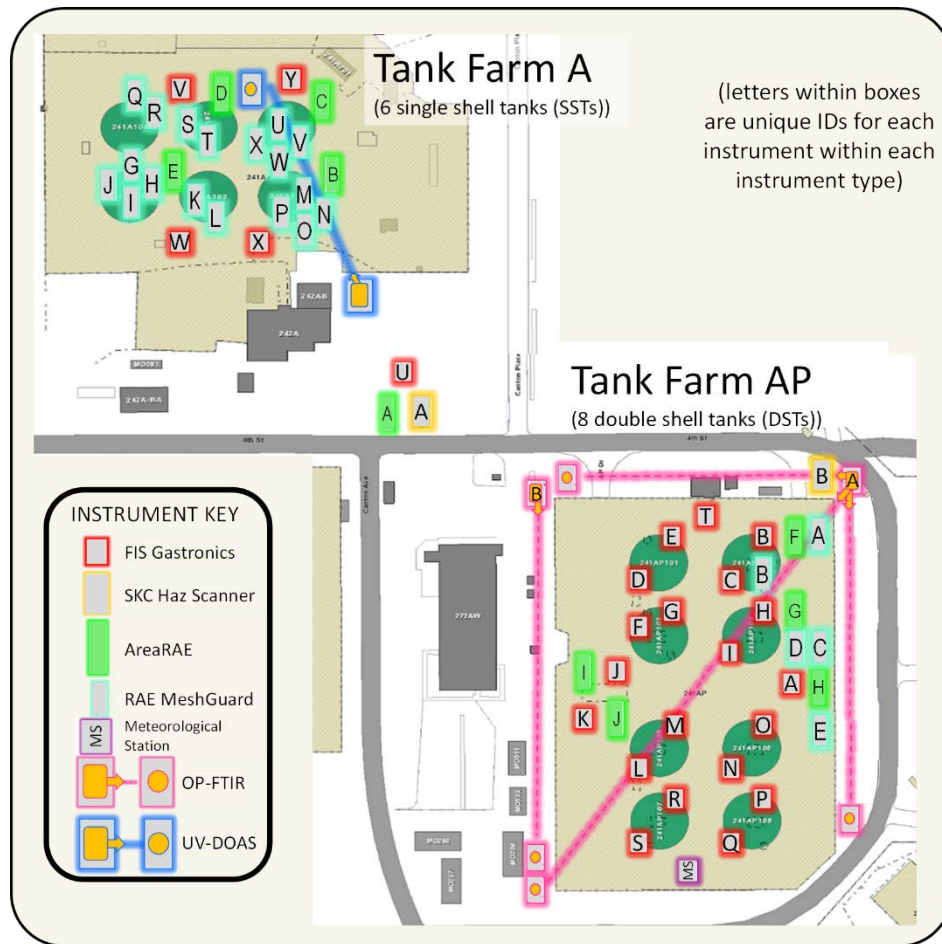


OP-FTIR Weekly Summary

12/14/16 6:00 – 12/21/16 6:00



The following information is for the time period from December 14th at 6:00am through December 21st at 6:00am. 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
 - 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 tens to hundreds 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. Typically the threshold used for reporting is an R^2 value of greater than or equal to 0.5; some compounds may have different reporting thresholds based on optimization of the analysis method using AP and A Tank Farm data.

During the week in review, instrument 506A detected nitrous oxide (N_2O) and methane (CH_4). These chemicals are typically found in the atmosphere, and the recurring pattern of simultaneous N_2O and CH_4 spikes on this instrument was noted again this week.

Instrument 506B detected N_2O , CH_4 , methyl nitrite, ammonia (NH_3), and 1-butanol. Concentrations of N_2O and CH_4 are consistent with values reported by instrument 506A for the week. There was a period where concentrations of N_2O and CH_4 were reported lower than typical, and during that time methyl nitrite was reported (its R^2 value was ≥ 0.50). The identification of methyl nitrite is suspect and requires additional investigation due to when it was observed relative to reporting of N_2O and CH_4 . One instance (reported at 1 ppm) of 1-butanol was observed on Saturday, 12/17. The Conference of Governmental Industrial Hygienists (ACGIH) TLV value for 1-butanol² is 20 ppm. Ammonia was also at low concentrations (max 0.016 ppm).

Most compounds 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. Specific instrument information is reported below.

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

² ACGIH information regarding 1-butanol:

https://www.osha.gov/dts/chemicalsampling/data/CH_222900.html

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December 14th – December 21st 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 – 0.52 ppm	0.10 - 0.45 ppm
Ammonia*	ND	ND – 0.016
Methane	ND - 2.42 ppm	0.60 – 1.74 ppm
1-3-Butadiene*	ND	ND
1-Butanol*	ND	ND – 1.00
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 – 0.93 ppm
N-Nitrosodiethylamine*	ND	ND
N-Nitrosodimethylamine*	ND	ND
N-Nitrosomorpholine*	ND	ND
Propanenitrile*	ND	ND
Pyridine*	ND	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)

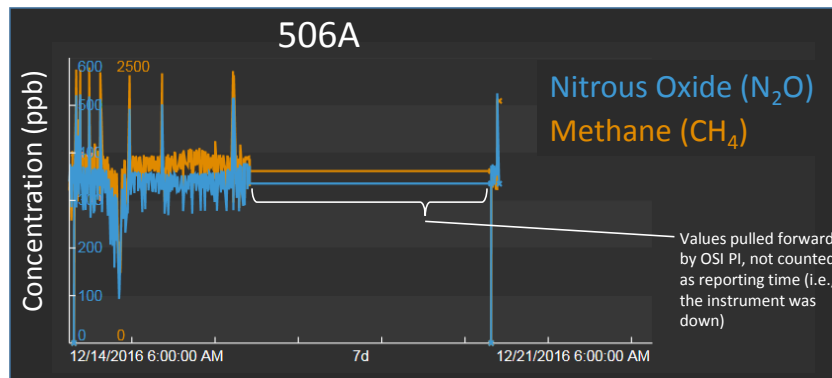
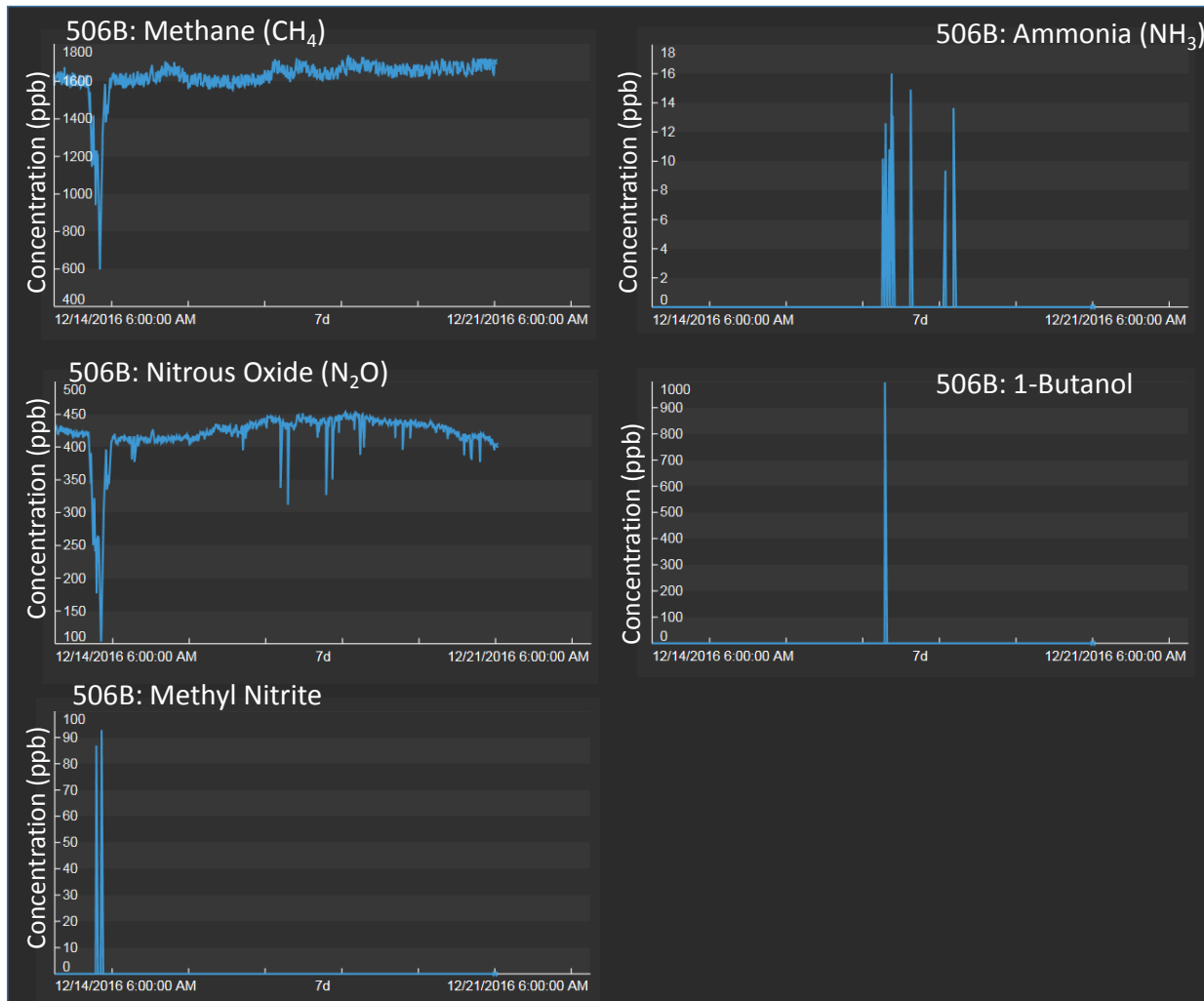


Figure 2. OP-FTIR B (506B) Review.
(Note that concentration units are ppb)



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

Instrument	Comments
506A	The instrument was reported 31% of the time.
506B	The instrument was reporting 82% of the time.

Notes: a) % down is based on data reported to OSI PI System³

³ OSI PI System is a data visualization software package from [OSIsoft](#).