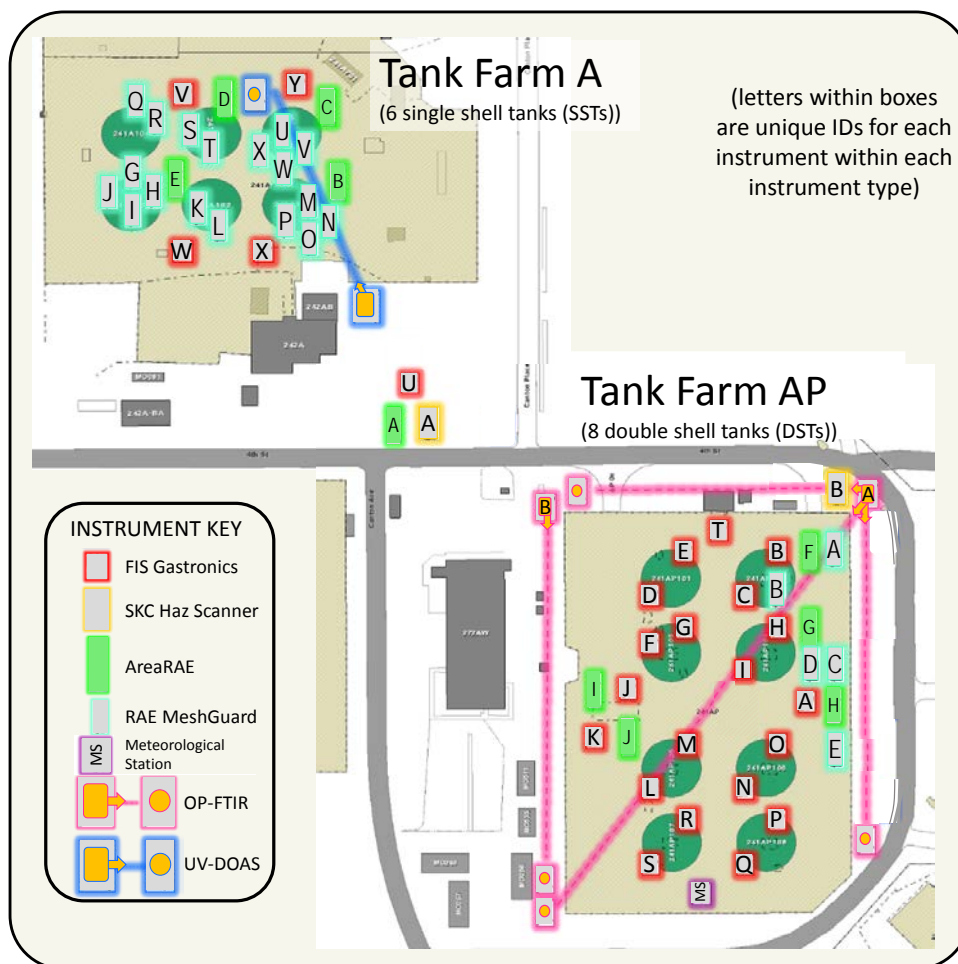


OP-FTIR Weekly Summary

9/14/16 6:00 – 9/21/16 6:00



The following information is for the time period from September 14th at 6:00am through September 21st at 6:00am. This summary contains Vapor Monitoring and Detection System (VMDS) Phase 1 pilot-scale data collected over one week for the open path Fourier transform infrared spectrometer (OP-FTIR). Phase 1 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:
- NH₃ = ammonia
 - CO = carbon monoxide
 - CO₂ = carbon dioxide
 - LEL = lower explosive limit
 - ND = not detected
 - NO = nitric oxide
 - N₂O = nitrous oxide
 - NO₂ = nitrogen dioxide
 - OP-FTIR = open path Fourier transform infrared spectrometer
 - PM 2.5 / PM 10 = particle monitors for >2.5µm and >10µm particles respectively
 - H₂S = hydrogen sulfide
 - SO₂ = sulfur dioxide
 - VOC = volatile organic carbons, which include both volatile and semi-volatile compounds.

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Weekly Summary Analysis: 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 discussion for these instrument types will not be with regards to Operational Exposure Limits (OELs) and Action Levels.

While sampling during the week in review, ammonia (NH₃) was not detected, but there were varying readings for nitrous oxide (N₂O), methane (CH₄), and butadiene (C₄H₆). These compounds 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, and it also indicates that there have been minimal fugitive emissions across the fence line path in AP-Tank Farm. Specific instrument information is reported below.

Data reporting is based off R-squared (R²) values calculated by the model, the model in this case consists of the data gathered and reported by the instrument versus specific predetermined IR traces for each compound in the instruments library. R-squared is the “percent of variance explained” by the model, or an estimate of how the two traces match each other. That is, R-squared is the fraction by which the variance of the errors is less than the variance of the dependent variable. R-squared values range from 0 to 1 with higher values indicating a better fit. R-squared 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-squared value of greater than 0.5.

September 7th – 14th 2016 Instrument Notes:

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

Chemical (ALL PM)	506A: OP-FTIR Multipath ^a	506B: OP-FTIR Single ^a
Nitrous Oxide*	Range: ND – 0.485 ppm	Range: 0.359 – 0.398 ppm
Ammonia*	ND	ND
Methane	Range: ND – 2.7 ppm ^a	Range: 1.5 – 1.9 ppm
1-3-Butadiene*	Range: ND – 0.238 ppm ^b	ND
1-Butanol*	ND	ND
2-Hexanone*	ND	ND
3-Buten-2-one*	ND	ND
Acetaldehyde*	ND	ND
Acetonitrile*	ND	ND
Benzene*	ND	ND

¹ OP-FTIR Fact Sheet: <http://hanfordvapors.com/wp-content/uploads/2016/09/OP-FTIR-Fact-Sheet.pdf>

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Chemical (ALL PM)	506A: OP-FTIR Multipath ^a	506B: OP-FTIR Single ^a
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
N-Nitrosodiethylamine*	ND	ND
N-Nitrosodimethylamine*	ND	ND
N-Nitrosomorpholine*	ND	ND
Propanenitrile*	ND	ND
Pyridine*	ND	ND
Tributyle Phosphate*	ND	ND

*Chemical is on COPC list

a) Chemicals concentrations are only reported for those that meet both of the following criteria:

- Detected (i.e., value reported is not 0)
- R² value is >0.5

Notes:

b) Additional analysis needed for confirmation of chemical identification; most of the time the R² value for 1-3-Butadiene was below 0.5, but the peak values did occur at the same time R² values were >0.5.

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

Table 2) OP-FTIR instrument downtime.

Instrument	Comments
506A	The instrument was reporting 83% of the time.
506B	The instrument was reporting 72% of the time.

Notes: a) % down is based on hourly interval data as exported from OSI PI²

² OSI PI is a data visualization software package from [OSIsoft](#).