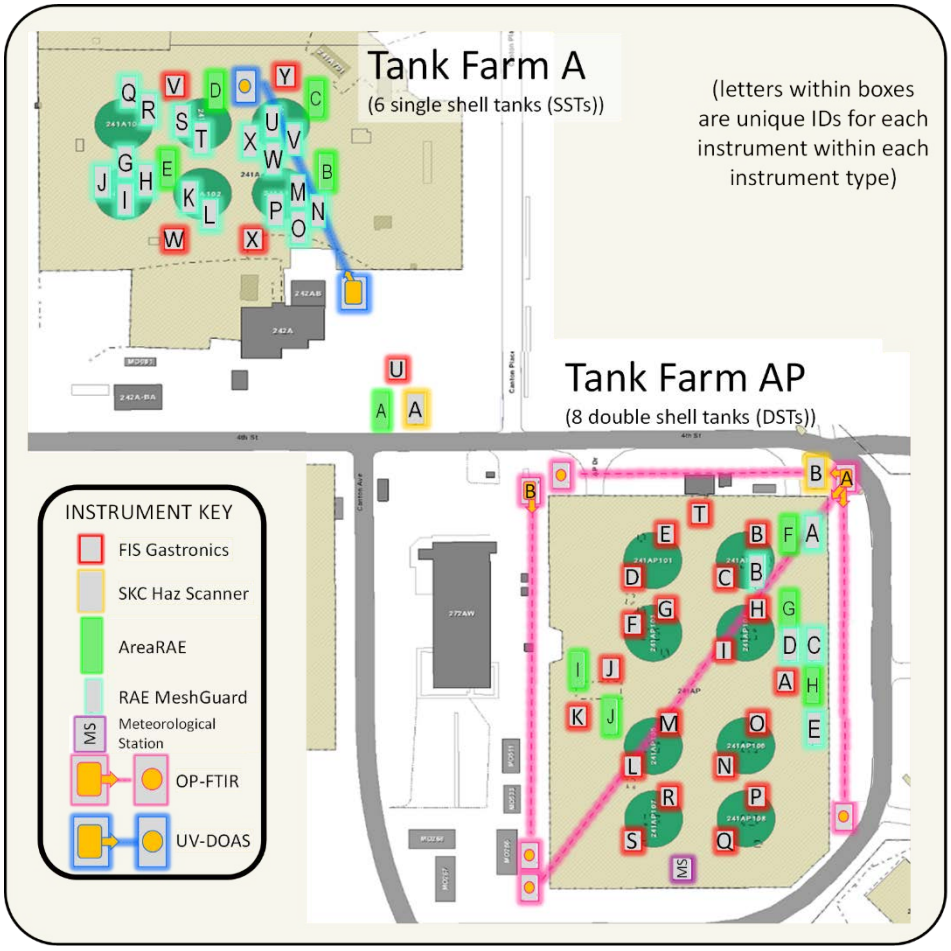
UV-DOAS Weekly Summary

10/5/16 6:00 – 10/12/16 6:00



The following information is for the time period from October 5th at 6:00am through October 12th at 6:00am. This summary contains Vapor Monitoring and Detection System (VMDS) Phase 1 pilot-scale data collected over one week for the ultraviolet differential optical absorption spectrometer (UV-DOAS). Phase 1 testing is focused on evaluating component integration and functionality. Data shown may include results from calibration and bump tests performed to verify sensors function. These tests result in data spikes.

Abbreviations:

NH_3 = ammonia
CO = carbon monoxide
CO_2 = carbon dioxide
LEL = lower explosive limit
ND = not detected
NO = nitric oxide
N_2O = nitrous oxide
NO_2 = nitrogen dioxide
UV-DOAS = ultraviolet differential optical absorption spectrometer
VOC = volatile organic compounds, which include both volatile and semi-volatile compounds.

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Weekly Summary Analysis: The UV-DOAS spectrometer provides real-time multi-gas measurement (qualification and quantification) of gases[1]. While sampling during the period under review, ammonia (NH_3), nitric oxide (NO), oxygen (O_2), ozone (O_3), and p-xylene were detected by the sensor. All but p-xylene are typically found in detectable quantities in air[2]. Additional analysis is needed for confirmation of p-xylene. No events of particular interest were noted.

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 because the sample encompasses 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 Occupational Exposure Limits (OELs) and Action Levels.

Each analyte has a specific predetermined UV 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 UV-DOAS 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 0.5.

October 5th – October 12th 2016 Instrument Notes:

Table 1. Chemical Species Detected on UV-DOAS at A Tank Farm.

Chemical	508A: UV-DOAS	Chemical	508A: UV-DOAS
Ammonia*	ND – 0.026 ppm (average 0.001 ppm)	Mercury*	ND
Nitric Oxide	ND – 0.038 ppm (average 0.000 ppm)	Methyl Nitrite*	ND
Oxygen	Average 20.6 %	Pyridine*	ND
Ozone	ND – 0.098 ppm (average 0.024 ppm)	1-2-4 Trimethylbenzene	ND

[1] UV-DOAS Quick Sheet: http://hanfordvapors.com/wp-content/uploads/2016/10/UV-DOAS-Fact-Sheet.pdf

[2] Air Composition from "The Engineering ToolBox": http://www.engineeringtoolbox.com/air-composition-d_212.html

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Table 1. Chemical Species Detected on UV-DOAS at A Tank Farm.

Chemical	508A: UV-DOAS	Chemical	508A: UV-DOAS
1-3 Butadiene*	ND	1-3-5 Trimethylbenzene	ND
2-Methyl-2-butenal*	ND	Ethylbenzene	ND
2-Methylfuran*	ND	m-Xylene	ND
Acetaldehyde*	ND	Nitrogen Dioxide	ND
Benzene*	ND	o-Xylene	ND
Butanal*	ND	p-Xylene	ND – 0.009 ppm (average 0.001 ppm)
Ethylamine*	ND	Styrene	ND
Formaldehyde*	ND	Sulfur Dioxide	ND
Furan*	ND	Toluene	ND

Notes: *Chemical is on COPC list

ND – Not detected by instrument (either 0 was reported or the R^2 value was <0.5)

Figure 1. Additional Analysis is Needed for Confirmation of p-Xylene.

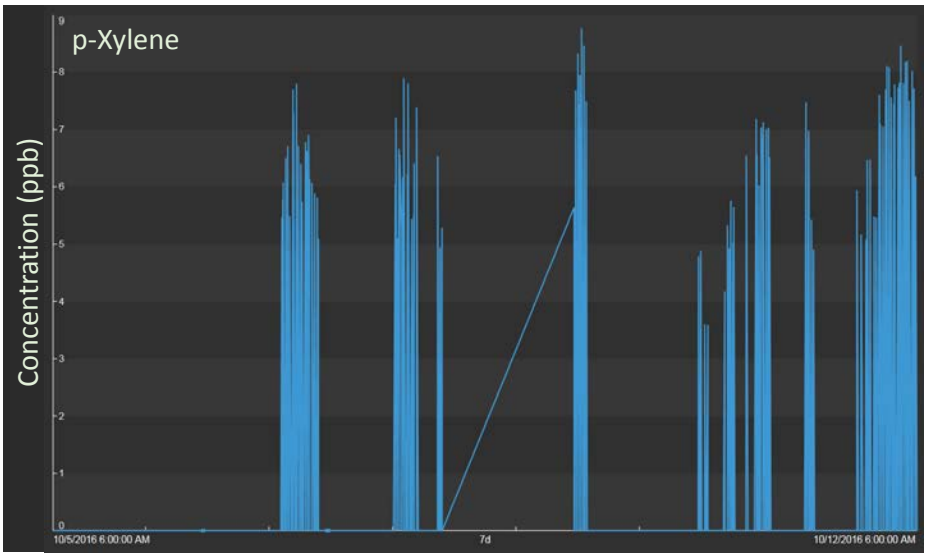

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Table 2. UV-DOAS Instrument Time Reporting[a].

Instrument	Comments
508A	The instrument was reporting 100% of the time.

Notes: % down is based on review of hourly interval data as exported from OSI PI[3].

[3] OSI PI is a data visualization software package from OSIsoft.