



Refinery Fenceline Monitoring

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Related Experience



- Founded in 1991 for DAAMS (Depot Area Air Monitoring)
- Chosen tube for API/AFPM Pilot Study at 12 Refineries (790 Tubes)
- 2.5 Million Sample Tubes Manufactured (Houston TX)
- Over 2,200 Fenceline Tubes in the field
- Over 850 Tube Shelters in the field
- Currently facilitating numerous 325 Fenceline Programs

General Information



- Fenceline monitoring must begin on or before January 30th 2018
- ~150 Refineries in the USA
- Continuous 14 Day samples taken for Benzene
- Samples to be analyzed by TD-GC/MS
- Action level of $9\mu\text{g}/\text{m}^3$
- Data Reported Quarterly to EPA
- Data to be made available to the public

Companion Methods

EPA 325 A&B



Method 325A

- Equipment (Tubes, Tube Shelters & Sampling Kits)
- Deploying & Harvesting Samples

Method 325B

- Laboratory Analysis - Thermal Desorption (TD) Gas Chromatography/Mass Spectrometry (GC/MS)
- Reporting Requirements
- Based off of TO-17

Method List & Reporting Limits

- The required reporting limit (RL) for benzene is 5 nanograms (ng). The RL represents a baseline above which results exceed laboratory-determined limits of precision and accuracy.

Compound	Detection Limit (ng)	Reporting Limit (ng)	14-day period		Action Level (µg/m ³)
			Detection Limit (µg/m ³)	Reporting Limit (µg/m ³)	
Benzene	1.5	5.0	0.11	0.37	9.0

Additional Compounds

Table of Diffusive Sampling Rates for Carpack X Deactivated SS TD Tube

Compound Name	CAS#	75% RH Eff. Sampling rate a/cm ³ min ⁻¹	75% RH Eff. Uptake rate/ng ppmv-1 min ⁻¹	Martin et al .ref. 3 [ref 9-11]	35% RH rate = 75% RH Rate Times
1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 14)	76-14-2	0.44 ± 0.08	3.12 ± 0.60		1.06
1,3-Butadiene	106-99-0	0.61 ± 0.11	1.36 ± 0.24	1.24 ± 0.16	0.88
Trichlorofluoromethane (CFC 11; Freon-11; R-11)	75-69-4	0.51 ± 0.07	2.87 ± 0.39		0.98
1,1-Dichloroethene (1,1-DCE)	75-35-4	0.57 ± 0.14	2.27 ± 0.54		0.91
3-Chloropropene	107-05-1	0.51 ± 0.30	1.61 ± 0.96		0.83
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC 113; Freon-113)	76-13-1	0.46 ± 0.05	3.58 ± 0.42		0.98
1,1-Dichloroethane	75-34-3	0.57 ± 0.10	2.34 ± 0.42		1.12
cis-1,2-Dichloroethene (1,2-DCE)	156-59-2	0.58 ± 0.08	2.31 ± 0.30		0.96
1,2-Dichloroethane (DCE)	107-06-2	0.57 ± 0.08	2.34 ± 0.33		0.97
1,1,1-Trichloroethane	71-55-6	0.51 ± 0.10	2.80 ± 0.54		1.11
Benzene	71-43-2	0.67 ± 0.11	2.15 ± 0.36	1.99 ± 0.48	1.12
Carbon Tetrachloride (CCl ₄)	56-23-5	0.51 ± 0.06	3.24 ± 0.36		1.17
1,2-Dichloropropane	78-87-5	0.52 ± 0.10	2.41 ± 0.45		0.91
Trichloroethene (TCE)	79-01-6	0.50 ± 0.05	2.74 ± 0.30		1.07
1,1,2-Trichloroethane (1,1,2-TCA)	79-00-5	0.49 ± 0.13	2.69 ± 0.72		0.91
Toluene	108-88-3	0.52 ± 0.14	1.98 ± 0.51	2.23 ± 0.52	1.01
Tetrachloroethene (PERC)	127-18-7	0.48 ± 0.05	3.27 ± 0.36		1.01
Chlorobenzene (MCB)	108-90-7	0.51 ± 0.06	2.35 ± 0.30		0.99
Ethylbenzene	100-41-4	0.46 ± 0.07	2.03 ± 0.30		0.99
m,p-Xylene	m-108-38-3; p-106-42-3	0.46 ± 0.09	2.00 ± 0.39		0.99
Styrene	100-42-5	0.50 ± 0.14	2.12 ± 0.57		0.96
o-Xylene	95-47-6	0.46 ± 0.12	2.01 ± 0.54	1.79 ± 0.41	0.99
4-Ethyltoluene	622-96-8	0.41 ± 0.11	2.03 ± 0.57		0.93
1,3,5-Trimethylbenzene	108-67-8	0.41 ± 0.10	1.72 ± 0.42		0.96
m-Dichlorobenzene (mDCB)	541-73-1	0.44 ± 0.07	2.68 ± 0.45		0.97
p-Dichlorobenzene (pDCB)	106-46-7	0.45 ± 0.05	2.71 ± 0.30		0.97
o-Dichlorobenzene (oDCB)	95-50-1	0.45 ± 0.06	2.72 ± 0.36		0.98

^a At 22 ± 2 °C at 760 Torr. Also ± values are based on 3σ values

Equipment



Inert Coated Passive Sorbent tube with Carbopack X 40/60.
Passive Sampling Cap and Brass Compression Cap



Tube Shelter



Sampling Kit

Required Number of Sampling Locations & Siting Options



Small Refinery
<750 Acres
12 Locations
30° Placement +/- 1°



Medium Refinery
750-1500 Acres
18 Locations
20° Placement +/- 1°



Large Refinery
>1500 Acres
24 Locations
15° Placement +/- 1°

- **LINEAR PLACEMENT** - Facilities with a perimeter less than 7,315 meters require a minimum of 12 samplers evenly spaced +/- 10% of the location interval is required
- **LINEAR PLACEMENT** - Facilities with a perimeter greater than 7,315 meters require samplers to be placed 610 +/- 76 meters apart
- **Additional samplers must be deployed for emission sources within 50 meters of the property boundary**

Meteorological Data Requirements



Standard Site Monitoring Plan

- Collect Average Temperature and Barometric Pressure for the sampling period
- On-site or United States Weather Service (USWS) Met Station within 25 miles

Site Specific Monitoring Plan (Used if a non-refinery source is suspected of adding to the maximum concentration)

- Collect HOURLY averages for temperature, Barometric Pressure, wind speed and wind direction
- Collect DAILY unit vector wind direction and sigma theta
- On-site Met Station required

Reporting Requirements

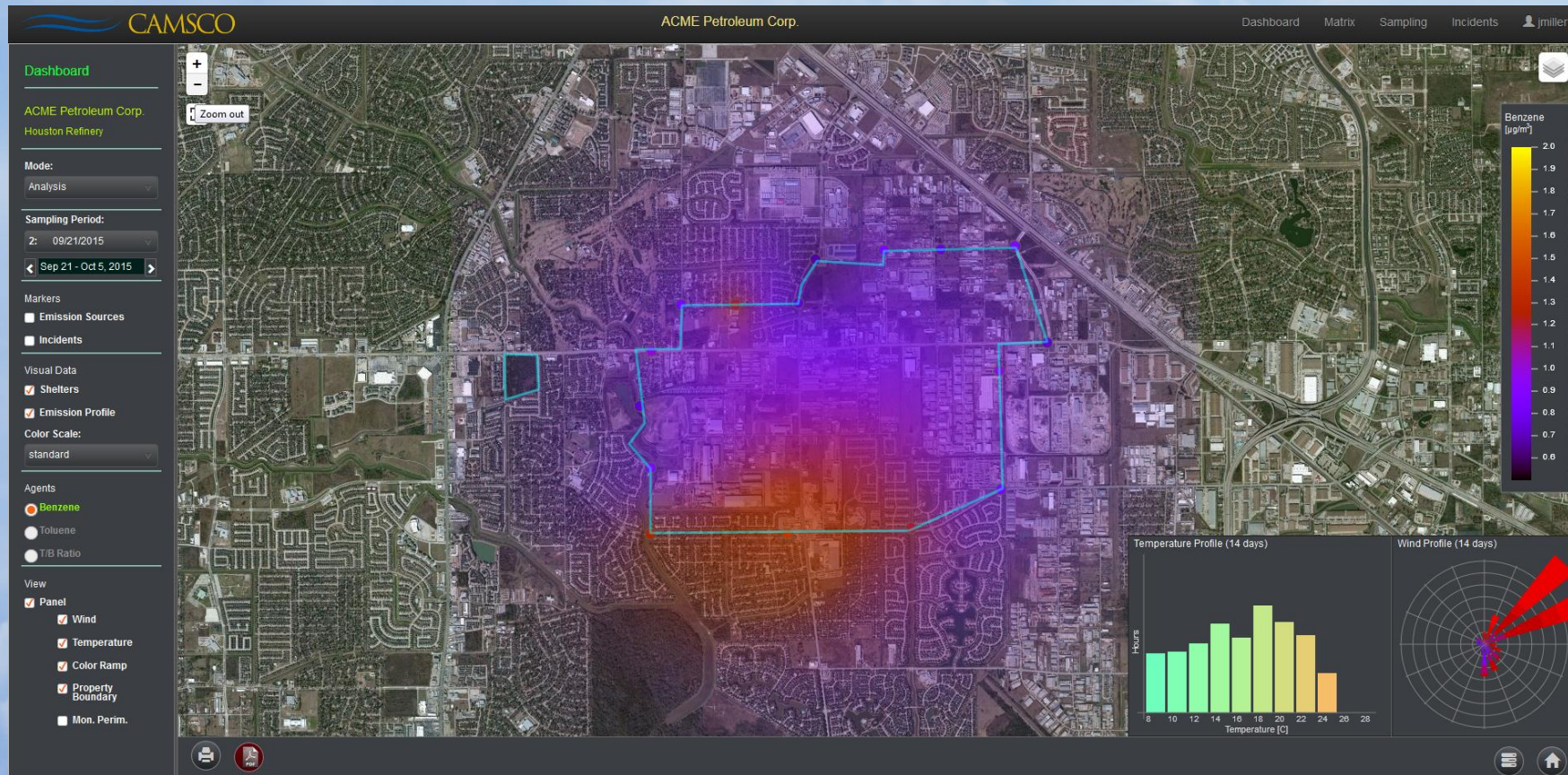


Data uploaded Quarterly via EPA Compliance and Emissions Data Reporting Interface (CEDRI) – Format TBD

The screenshot shows an Excel spreadsheet with the following data:

Passive Sampler ID	Latitude of Passive Sampler	Longitude of Passive Sampler	Passive Sampler Type	Biweekly Sampling Period 1: Start Date of Sampling Period	Biweekly Sampling Period 1: End Date of Sampling Period	Biweekly Sampling Period 1: Sample Concentration of Benzene [ug/m3]	Biweekly Sampling Period 1: Value Provided in Column P BDL	Biweekly Sampling Period 1: Outlier Removed?	Biweekly Sampling Period 1: Background Correction Used?
9123462			Primary	09/08/2015	09/22/2015	0.99			
9513547			Primary	09/08/2015	09/22/2015	1.13			
9415648			Primary	09/08/2015	09/22/2015	0.81			
9650433			Primary	09/08/2015	09/22/2015	0.59			
9598762			Primary	09/08/2015	09/22/2015	0.59			
9805649			Primary	09/08/2015	09/22/2015	0.60			
9123461			Primary	09/08/2015	09/22/2015	0.91			
9513546			Primary	09/08/2015	09/22/2015	0.00			
9415647			Primary	09/08/2015	09/22/2015	0.71			
9650432			Primary	09/08/2015	09/22/2015	0.59			
9598761			Primary	09/08/2015	09/22/2015	0.65			

Data Analysis



Annual Cost Per Refinery



Small Refinery (approximately 12 Shelter locations)
~\$55,000

Medium Refinery (approximately 18 Shelter locations)
~\$75,000

Large Refinery (approximately 24 Shelter locations)
~\$94,000



Questions?

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