Development and Evaluation of a Novel Continuous and Concurrent Sampling System for Sub-ppb Level Detection of Volatile Organic Compounds in an Industrialized Area in Los Angeles


*South Coast Air Quality Management District
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Objectives:

- Overview of Rule 1180 community network
- Detection and Characterization of VOC plume
- Development and demonstration of the Concurrent Sampling System (CSS)
Rule 1180 monitoring at a glance

- 7 major refineries
- Community monitoring stations - 10 permanent sites
- Real-time monitoring for all Rule 1180 required compounds
- Dedicated public data portal and notification system

https://xappprod.aqmd.gov/Rule1180CommunityAirMonitoring/
Automated Gas Chromatography

- Continuous hourly averaged concentration
  - 40 minutes sampling followed by 20 minutes analysis
- Sub-ppb range detection capability on community level trace VOCs monitoring
UV-DOAS Spectroscopy

- Continuous high frequency time resolution measurement
- Minimal instrument maintenance
- Fast detection of short-lived VOC plumes
Detection and characterization of VOC plumes in the community

Styrene at the Inner Port Community site

Plume with DOAS Maximum Styrene Value

High VOC concentration but short-lived plumes

Longest DOAS Plume

Long duration plumes
Distribution of VOC plumes duration

Majority of the plumes last less than 15 minutes
Short-lived VOC plumes detection
High Styrene Events

- Majority of the plumes Auto-GC detected ~66% of the plume, the point along and near the slope line 2/3
- Few plume events, along the slope line 0, are completely undetected by Auto-GC
Low concentration long-term VOC detection

- 66% of the time hourly Benzene was above Auto-GC detection level but less than UV-DOAS detection level
- 3% of those hourly Benzene values were above Chronic REL.
Concurrent Sampling System Development, Demonstration and Testing

Development of the CSS unit
~ 6 months

Testing at the South Coast AQMD Lab And Troubleshooting
~ 4 months

Deployed at the Rule 1180 Community Monitoring Site for Co-location and Comparison
55 minutes sampling time (hourly data cycle)
15 minutes sampling time (20-min data cycle)

55 minutes sampling time (hourly data cycle)
15 minutes sampling time (20-min data cycle)
Concurrent Sampling System – 55-minute sampling

55-minute sampling begun on March 19, 2022.
Benzene

55-minute Sampling Cycle - Benzene

R² = 0.84

Y = 0.8X + 0.26
55-minute Sampling Cycle - Toluene

Toluene Concentration (ppb)

CSS
Co-locating Unit

R2 = 0.96
Y = 0.92X + 0.09

April 2022
Concurrent Sampling System – 20-minute sampling

20-minute sampling begun on April 22, 2022.
20-minute Sampling Cycle

Benzene Concentration (ppb)

-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0

CSS_20 Min
Co-locating Unit
DOAS_20min
DOAS_1min

22 Apr 2022
20-minute Sampling Cycle
Summary

• Successful development and demonstration of the Concurrent Sampling System (CSS)

• CSS operates in two sampling modes:
  • 55-minute sampling mode:
    ✓ >90 % of air is being collected and analyzed
    ✓ 1 sample point every hour
  • 20-minute sampling mode:
    ✓ 3 sample points per hour
    ✓ Sub-ppb detection level

• Initial co-location with traditional 40-minute Auto-GC and UV-DOAS showed good agreement

• 20-minute sampling can be also useful for deployment on mobile platform