Integration of Gas Chromatographs into the FHWA/Environmental Protection Agency Near Road MSAT Study in Las Vegas, NV

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Background – Identification of Research Problem

- **FHWA Protocol specified the use of EPA methods TO-15 and TO-14 sampling methods for the measurement of MSAT's.**
  - **The cost of labor, analysis and shipping limit the number of samples collected. The protocol specified one sample day for every twelve days of operation; four sites with QC require 1200 plus samples.**
- **Gas chromatography with PID detector**
  - **After the cost of initial purchase, the GC must be reliable, provide self contained operation, and continuous data in a usable format. This presentation is reporting on the field evaluation of a GC**

Field Monitoring Location

- **Sierra Club sued FHWA**
  - **NEPA process, no established criteria to include MSATs**
  - **FHWA has developed a tiered approach**
- **Unobstructed view of 400 meters**

Field GC Description

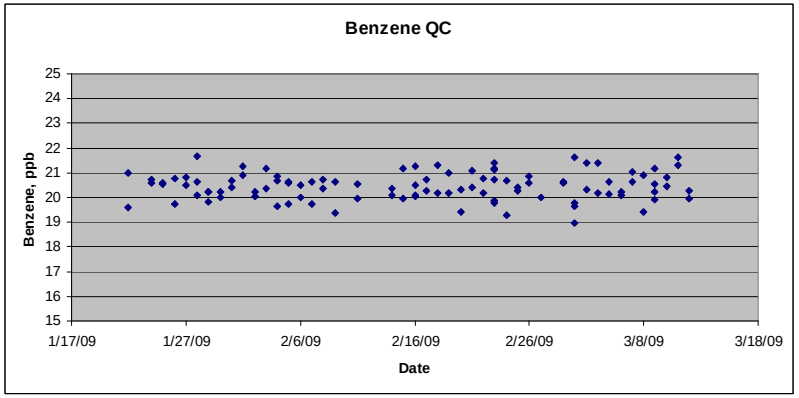
BTEX SYSTEM	
Column Type	Metallic, L=30m, id=0.28mm
Actuator Valve	6 port, pneumatic
Detector type	Photo Ionization Detector (PID), 10.6eV Lamp
Carrier gas	Nitrogen
Trap type	Carbotrap
Thermo-Desorption Temperature	380°C
Cycle time	15 to 30 minutes
Detection Range	0.3 to 320 µg/m^3
Detection Limit	10 ppt
Relative standard deviation on concentration	<3%
Relative standard deviation on retention time	<0.3%
Calibration	Benzene Permeation Tube, Fully automatic, self adjustable
Optimized	Flows, normalized lamp response, network capable and ASCII output files for both calibration and measurement data.

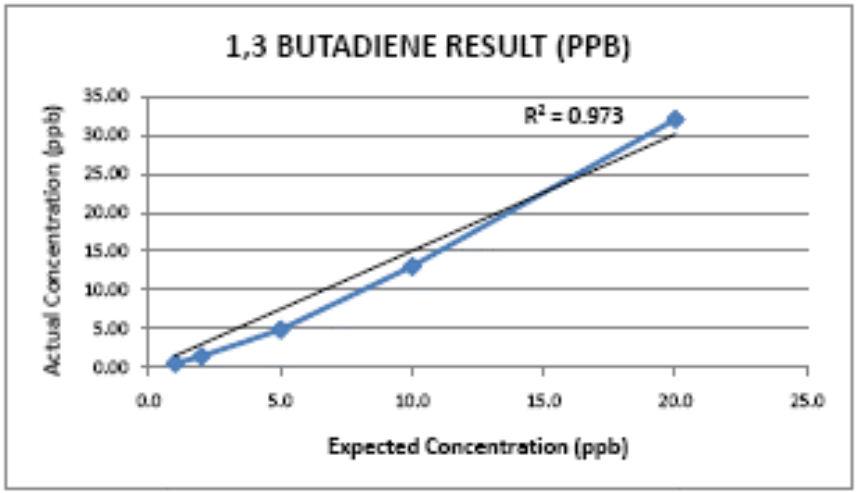
GC Evaluation Procedure

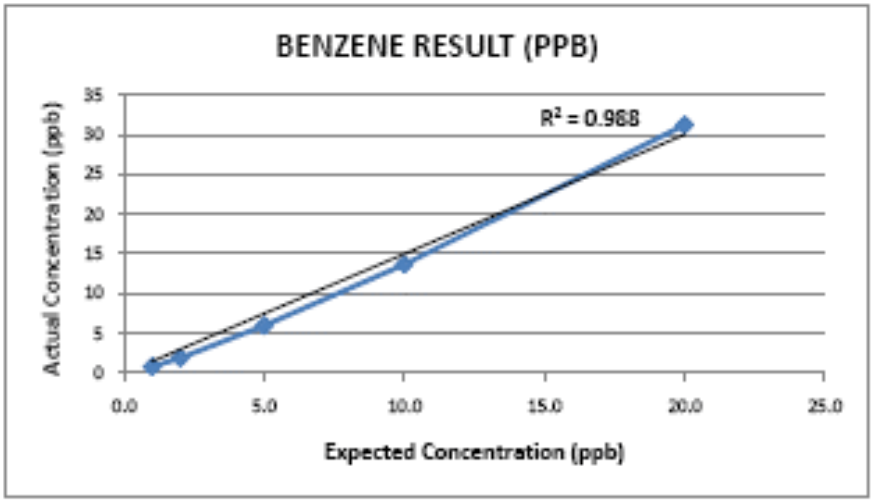
- **Comparison to the TO-15 criteria**
  - **Method detection limit of ≤ 0.5 ppb, replicate precision within 25 percent, accuracy within 30 percent**
- **Comparison to the canister results**
  - **Method detection limit of ≤ 0.5 ppb, replicate precision within 25 percent, accuracy within 30 percent**
- **Operate one GC in the field while canister samples are collected**
  - **Decide if the purchase of three additional GCs is justified**

Calibration and QC Control

Conc., ppb, 1/23/09	n, points	Butadiene Avg/Std	Benzene Avg/Std
1	7	0.53/0.12	0.81/0.18
2	13	1.42/0.12	1.93/0.09
5	4	4.87/0.39	6.0/0.47
10	8	13.03/0.74	13.68/0.53
20	8	32.01/2.47	31.19/1.61



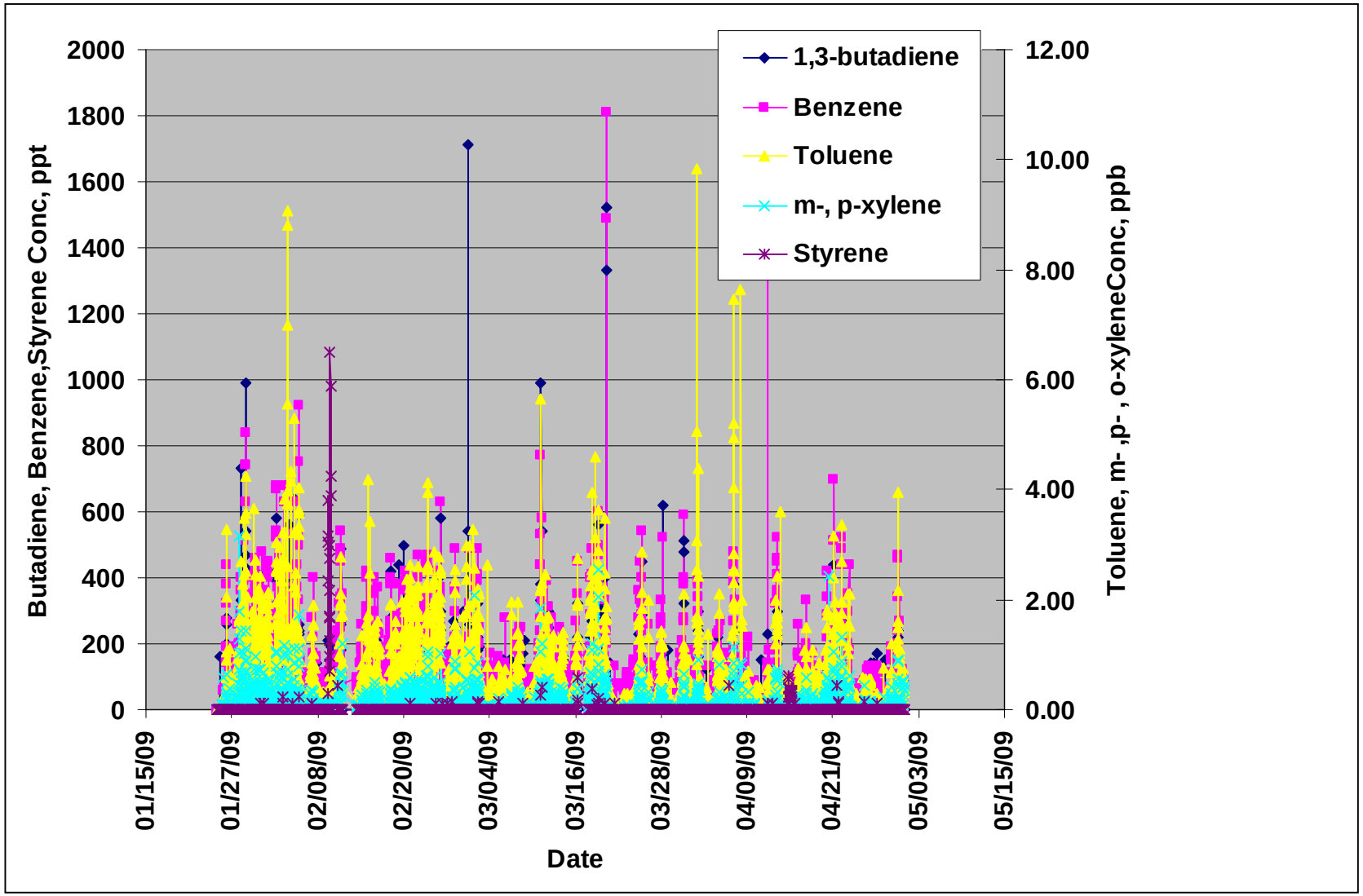




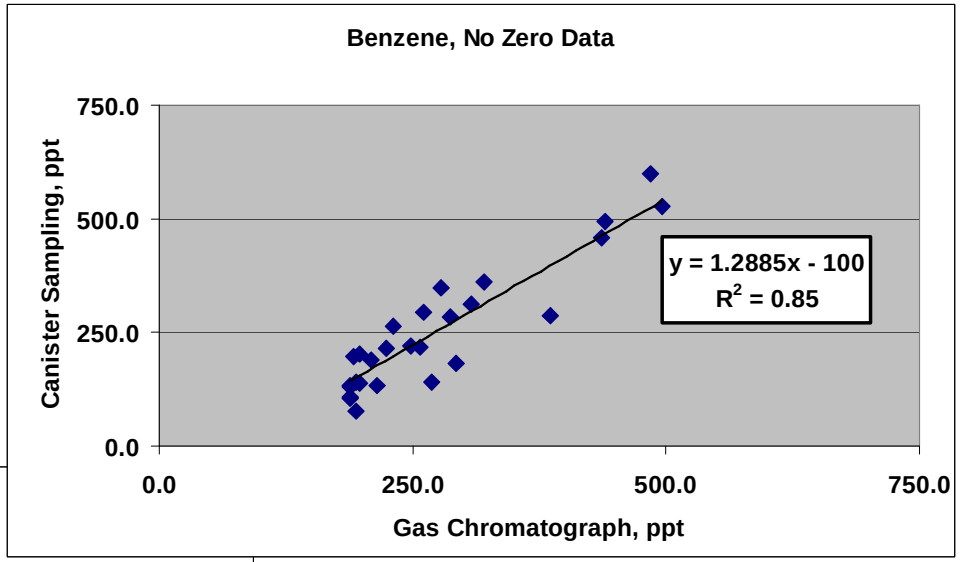
GC Comparison to TO-15 Method

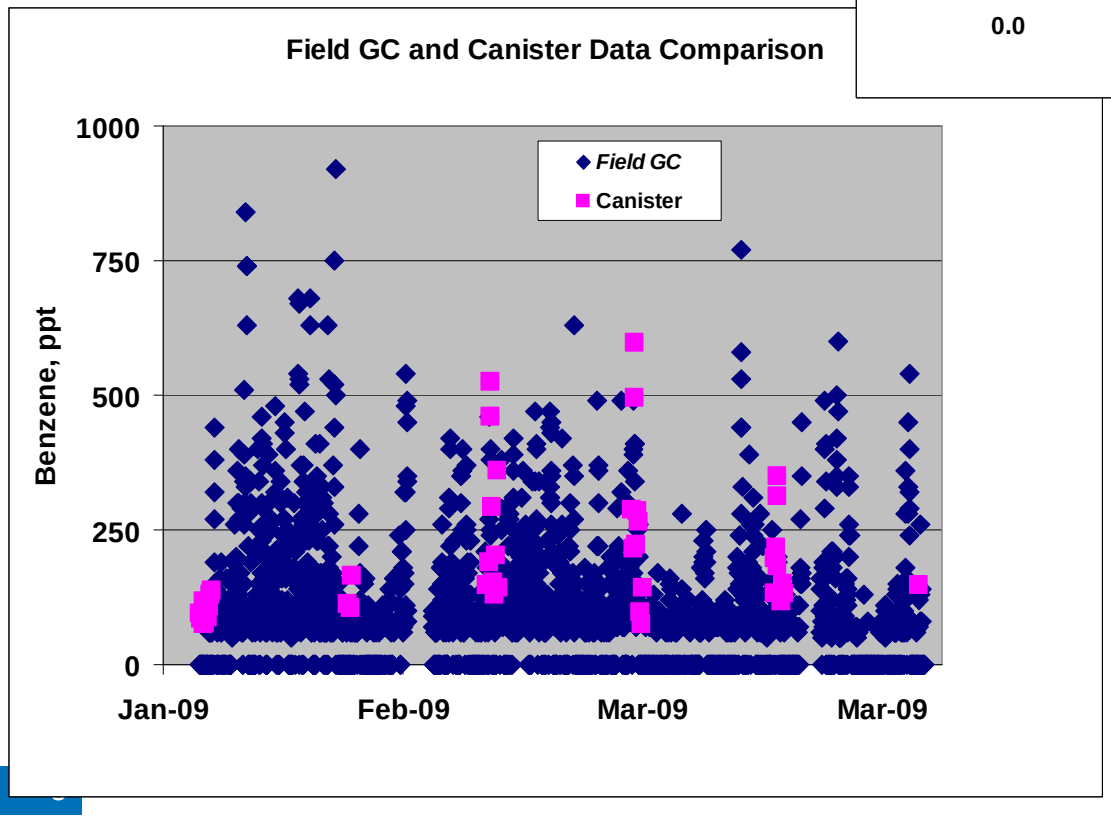
- Method detection limit for 1,3-butadiene and benzene ranged from 0.28 to 0.57 ppb, calculated for 1 and 2 ppb. Method specifies 0.5 ppb.
- Average method detection limit of 0.4 ppb.
- Precision results are within 6 percent, calculated for 20 ppb. Method specifies 25 percent.
- Accuracy better than 30 percent. Method specifies 30 percent.

GC Measurement Data



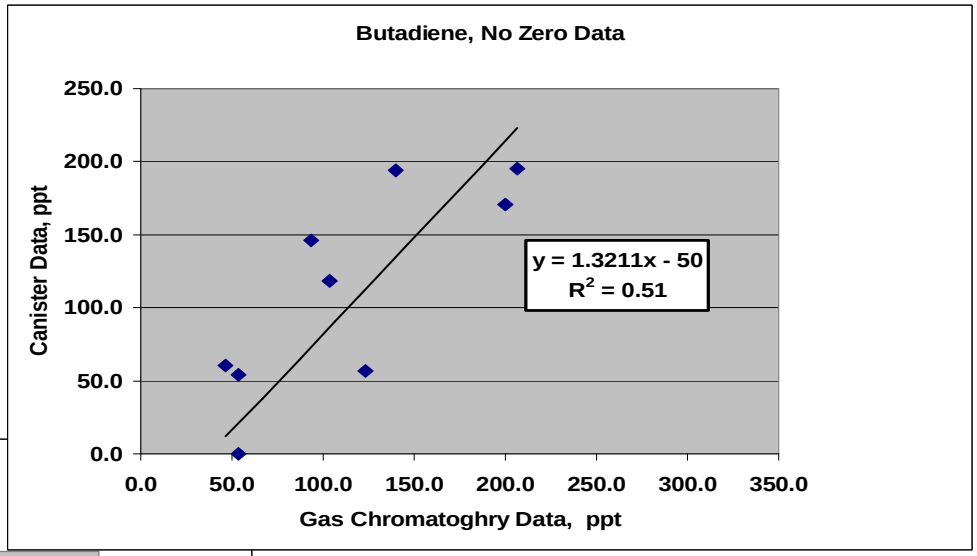
GC Comparison to Canister Results - Benzene

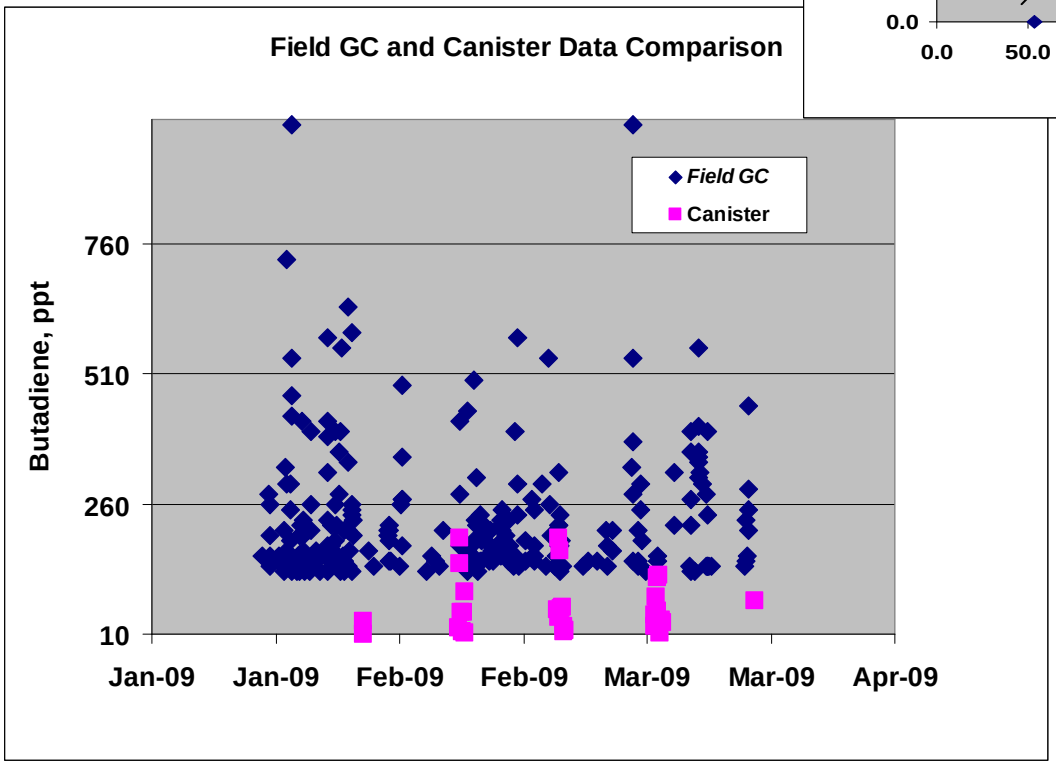


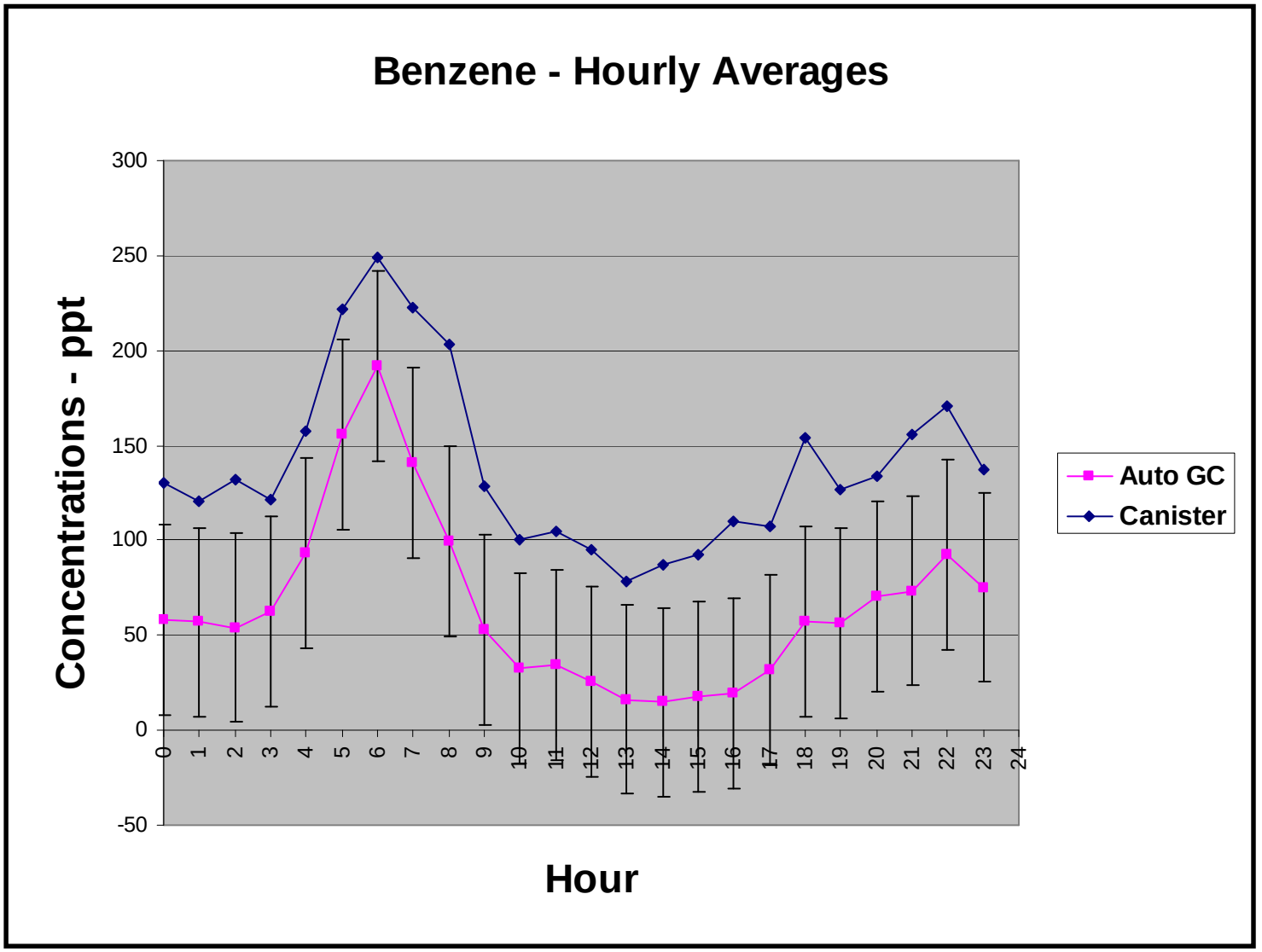


United States Environmental Protection Agency

GC Comparison to Canister results - Butadiene






Benzene - Hourly Averages
Concentrations - ppt
300
250
200
150
100
50
0
-50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour
Auto GC
Canister

Canister Results Evaluation

- Majority of the 1,3-butadiene and benzene concentrations have been less than 2 ppb
- Accuracy on average 30% for both butadiene and benzene
- Significantly more data, 43 canister samples versus 1200 benzene concentrations from the GC
- Canister method detection limit ~40 ppt and GC method detection limit ~ 100 ppt
- The GC has been operating for the past six months, unattended, data is down loaded remotely
- Three more GC's are being purchased to install in the remaining three sites

GC Evaluation Summary

- Acceptable comparison to the TO-15 method.
- Acceptable comparison to the canister results.
- Significant operational savings.
- Continuous data – 30 min cycles.
- Purchase and install GCs in the additional shelters.
- Continue canister sampling for QA/QC verification but reduce the number of samples taken.

Acknowledgements

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