Benefits of Using Sensor Technology in Conjunction with Traditional Sampling

MONTROSE ENVIRONMENTAL

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CO Reg 7 Continuous Monitoring

Objectives

- SB-181 allows local government to regulate the surface impacts of oil and gas operations in a reasonable manner to address air emissions and air quality to protect and *minimize adverse impacts to public health, safety, and welfare*

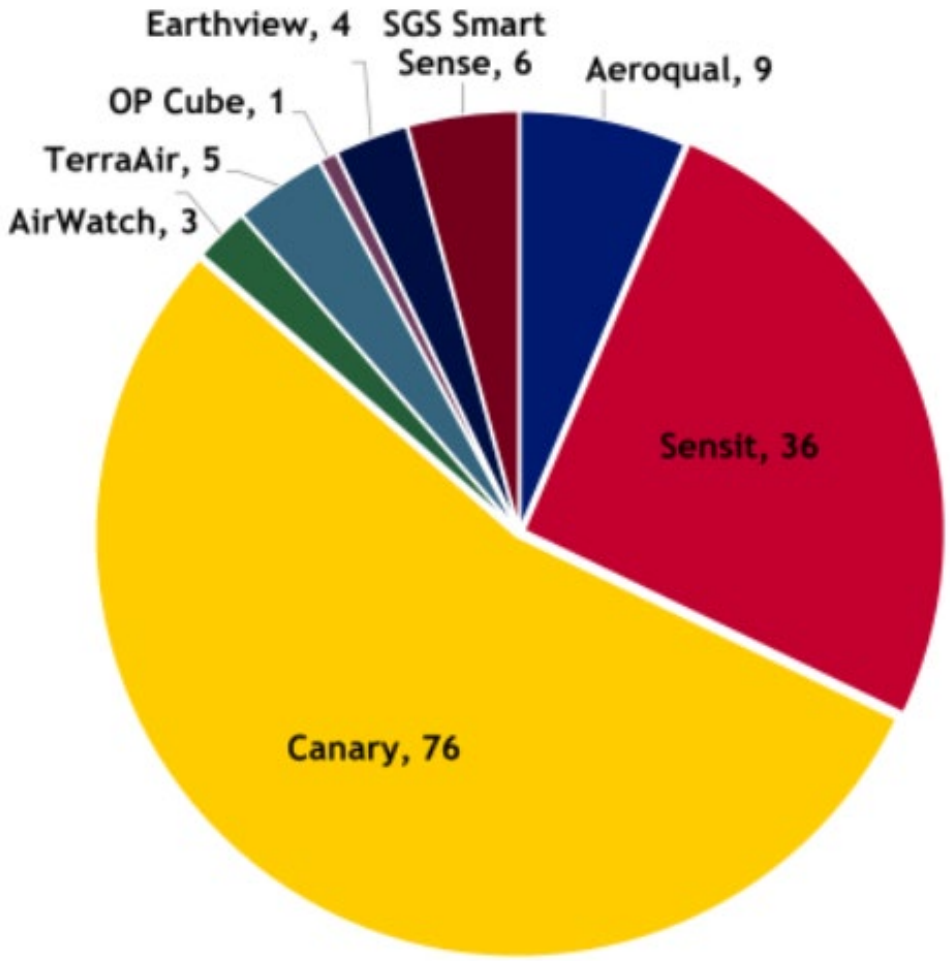
Requirements

- Monitoring Plan – 60 days prior to drilling
- Monitoring for Methane, tVOC, BTEX, or Benzene
- Continuous monitors with ability for monitor data to trigger notifications
- Justified action levels that may require notification to CDPHE
- Monthly reporting

Technology Deployed Across Colorado

Regulation 7 - sensors

- Meteorological sensors
- Photoionization detectors
  - Canary S
  - Sensit SPOD
  - Aeroqual AQS1
  - Earthview AlphaSense
  - SGA Smart Sense
  - Praxis/OP Cube
- Metal oxide Sensors
  - Airwatch
  - Terra AirGuardian

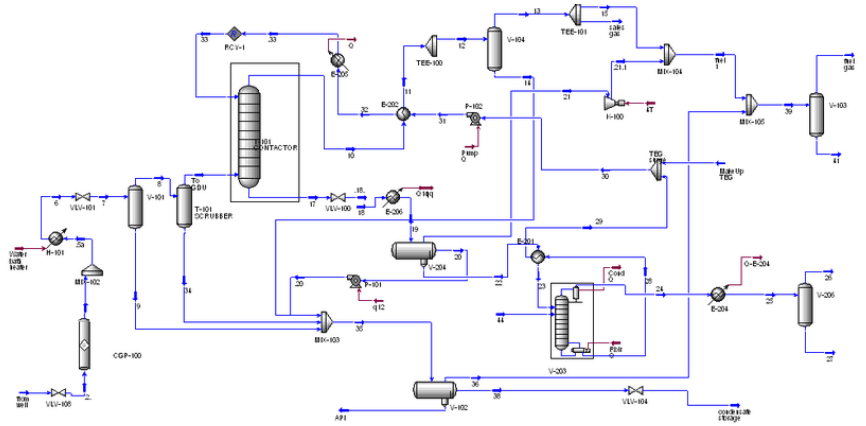


Source: AQCC meeting – Colorado oil and gas monitoring program briefing

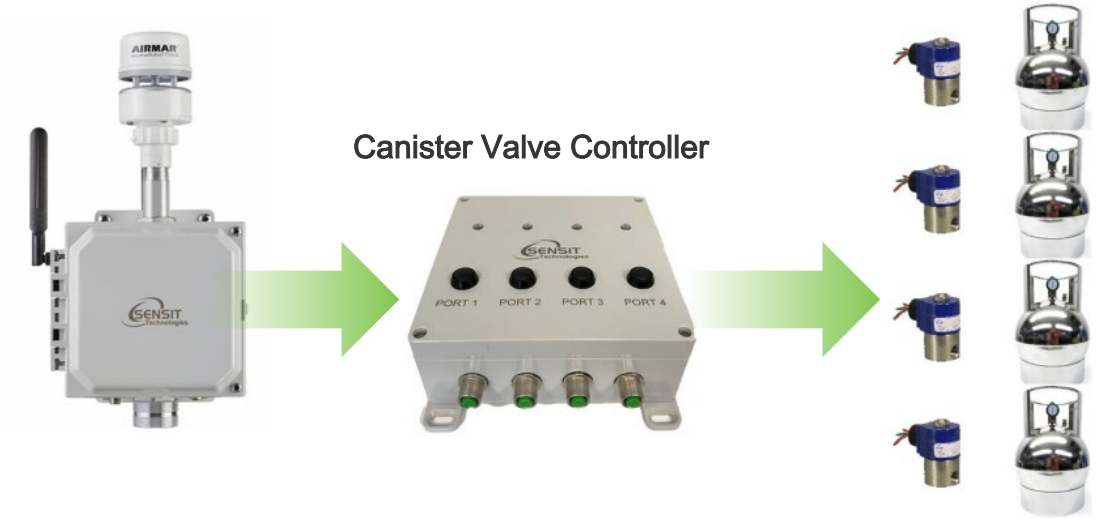
Current Ways tVOC is Used as a Benzene Surrogate

Using Benzene (ppb)-to-tVOC (ppm) (BTT) ratios derived via:

- Historical benzene tube or summa canister and tVOC monitor collocation
- Modeling to determine estimated ratio from worst case scenario source (thief hatch)



Accurate Ratio Determine Solution



Hardware

- Photoionization Detector (PID) with Auto-Trigger Summa Canister
- Meteorological Station

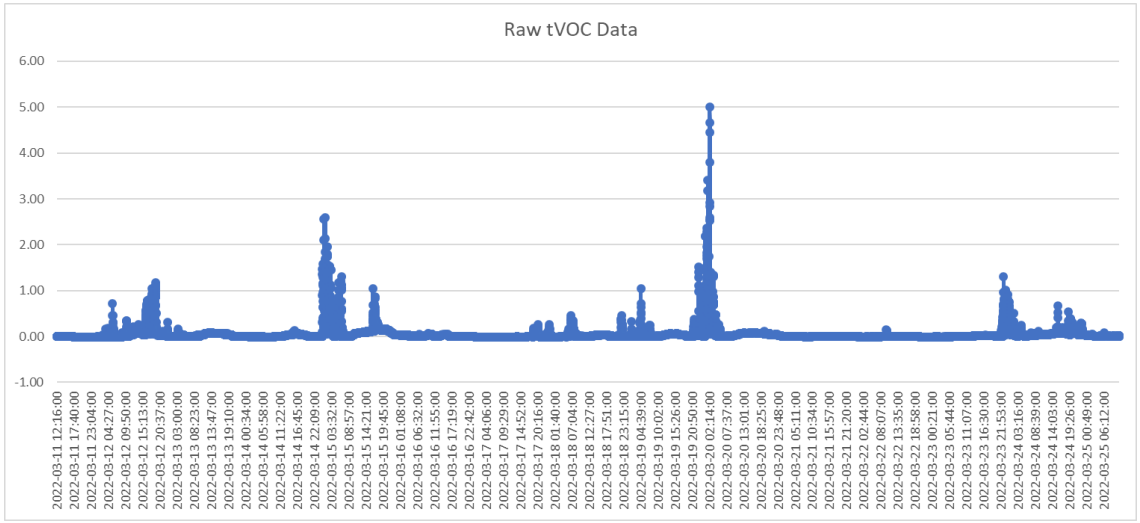
Software

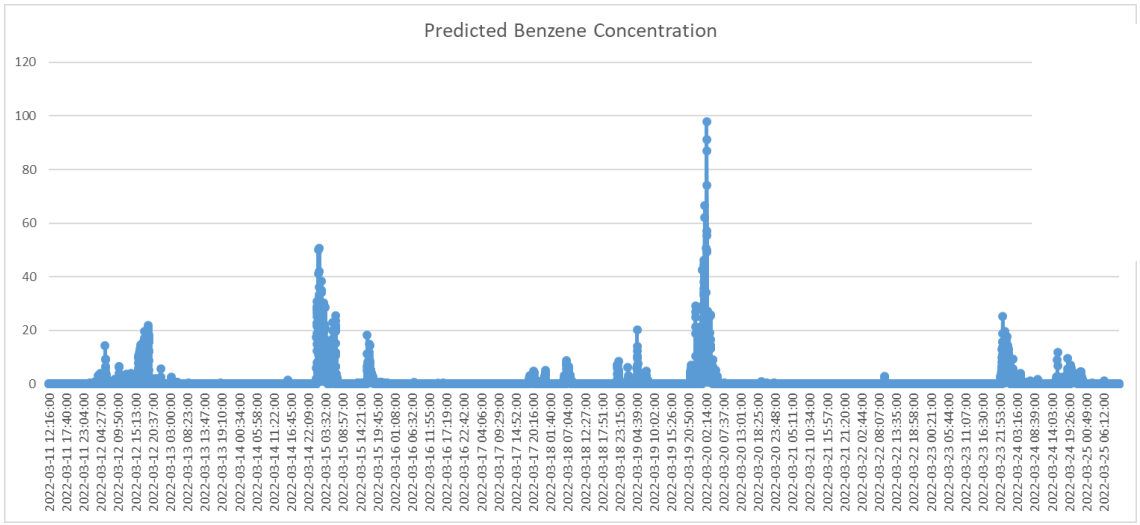
- Concentration Alerts
- QA/QC Alerts (Sample Integrity)
- Triangulation and Source Identification
- Remote Triggering of Summas

Ratio Determination

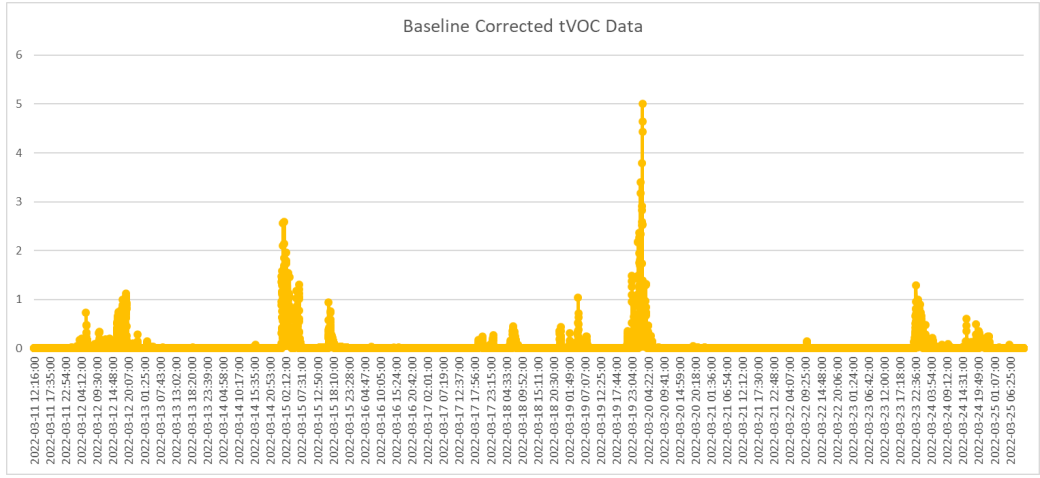
Site Phase	10-sec Benzene Concentration (ppb)	10-sec tVOC Concentration (ppm)	Ratio
Phase A	43.6	4.95	8.8
Phase A	27.9	1.24	22.5*
Phase A	15.0	1.49	10.1
Phase A	1-Hour Sample Interpolation		8.1
Phase A	1-Hour Sample Interpolation		9.5
Phase A	9.74	0.70	13.9
Phase B	13.2	1.42	9.3*
Phase B	24.4	0.92	26.6
Phase B	17.1	0.89	19.2
Phase B	71.98	1.29	55.6*
Phase B	39.8	1.4	28.42

Applying Ratio





Baseline Correction



Ratio Applied

Results of Simultaneous Samples So Far

Site Phase	Benzene (ppb)-to-tVOC (ppm) Ratio	1-hour Benzene Summa Results (ppb)	1-hour Benzene Predicted Results (ppb)	Error (%)
Phase B	55.6	14.7	17.4	18.5
Phase B	26.63	11.0	11.6	5.9
Phase B	19.2	4.56	4.54	0.3
Phase B	9.3	7.84	6.15	22.0

Results of Previously Collected Samples

Site Phase	Benzene (ppb)-to-tVOC (ppm) Ratio Applied	14-Day Benzene Tube Results (ppb)	14-Day Benzene Predicted Results (ppb)	Error (%)
Phase A	9.12	0.312	0.240	23.0
Phase A	9.12	0.268	0.237	11.5
Phase A	9.12	0.247	0.236	4.5
Phase A	9.12	0.426	0.346	18.7
Phase A	9.12	0.326	0.325	0.4
Phase A	9.12	0.310	0.306	1.4
Phase A	9.12	0.357	0.325	9.1
Phase A	9.12	0.318	0.366	14.9
Phase A	9.12	0.320	0.317	0.9
Phase A	9.12	0.275	0.275	0.0
Phase A	9.12	0.315	0.242	23.3
Phase A	9.12	0.311	0.237	24.0
Phase B	27.8	1.81	1.49	18.0

Conclusions

- If using low cost tVOC solution, the data must have a baseline correction to account drift
- Must have confidence on the source to be able to apply correct ratio
- An average 11.6% error provides a great screening tool, not a replacement for direct measurements
- Useful tool to drive more proactive response rather than current methods that are reactive

Next Steps

- More data needs to be collected to gain confidence in ratio
- Determine if the ratio would be specific to each operator, phase of site operation, and/or geologic region

Thank you!

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