Assessment of Pneumatic Controller Emission Measurements Using a High Volume Sampler at Oil and Natural Gas Production Pads in Utah

3/17/2016

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Oil and Natural Gas Production

Oil and Natural Gas Basins

- Thousands of wells per basin

Potential Environmental Impacts

- Air
  - VOCs -> photochemical smog
  - HAPs
  - Green House Gases
- Water
  - Surface Water
  - Ground water
- Land Use
  - Wildlife

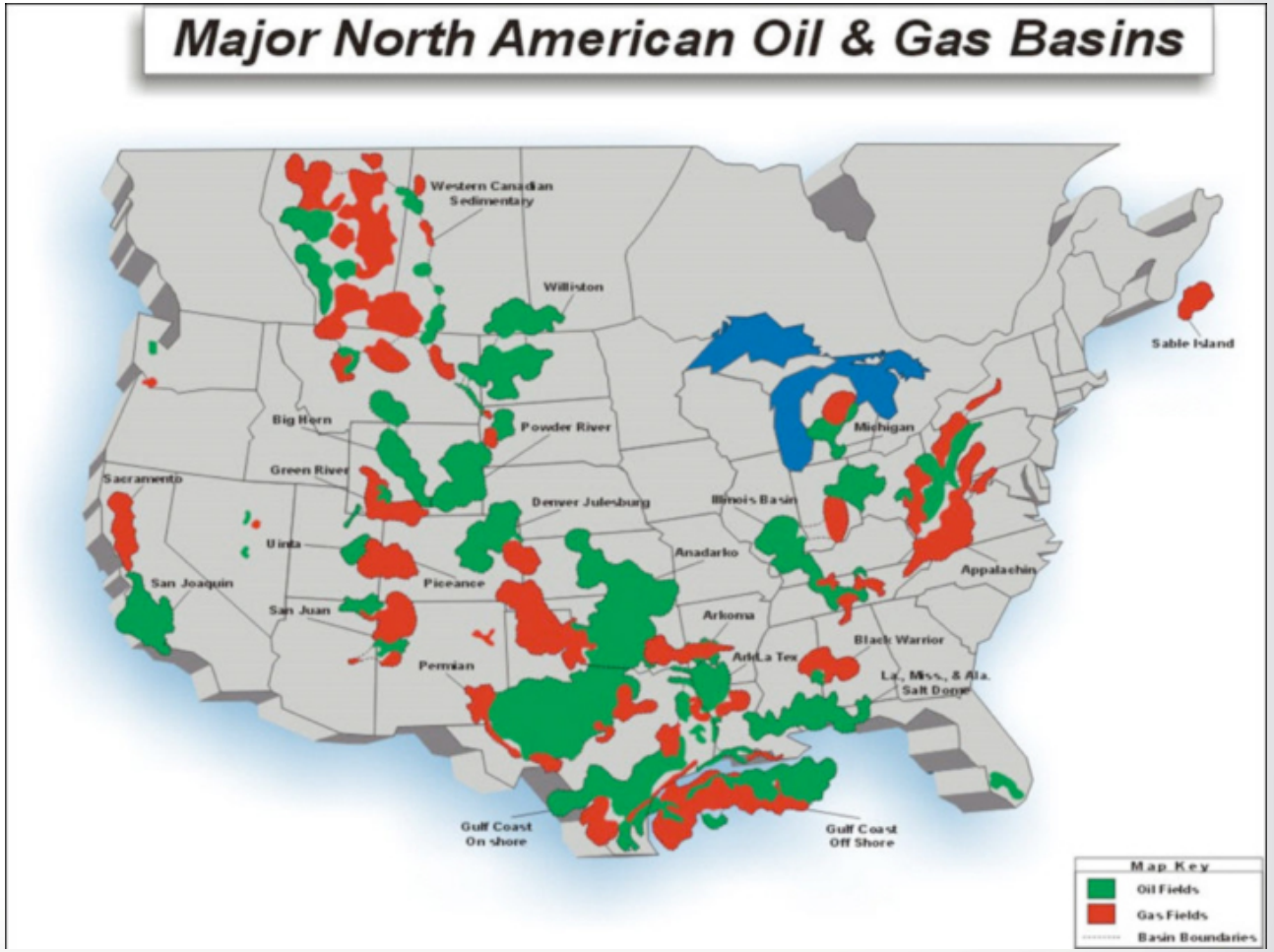


Image Credit: GeologyCafe.com

Pneumatic Controllers (PCs)

- PC Emissions
  - 3rd largest VOC contributor (after tanks and glycol dehydrators – WRAP III)
  - 1st largest methane contributor (GHGRP-W Onshore Production)
    - Up to 37.8% CH_4 Emissions from ONG production
- PC Types
  - Basic types: Continuous vs Intermittent
  - Low Bleed vs High Bleed
- PC Emission Rate Measurement Tools
  - High Volume Sampler (HVS)
    - Bacharach Hi Flow Sampler
  - QOGI

Research Question

Can we develop an augmented protocol to leverage currently available technology for direct measurements of PC emission rates?

Methodology

- HVS Operation
  - Adjustable blower with HC sensor
  - Sensor modes:
    - thermal conductivity (>5%)
    - catalytic oxidation (<5%)
- HVS Strengths
  - Quantifies continuous bleed emissions streams
    - Verifies regulatory compliance
    - Emission inventory
- HVS Weaknesses
  - Sensor malfunction
  - Complex emission streams
  - Limited to continuous bleed PCs

Image courtesy of Heath Consultants
http://207.91.155.2/emissions_products.htm

Methodology

- Augmenting Standard HVS Protocol
  - Flame Ionization Detector (FID) measurements
    - HVS Sensor data quality indicator (DQI)
    - Taken at exhaust of HVS
    - Verifies HVS sensor concentrations
  - Photo Ionization Detector (PID) measurements
    - Taken at exhaust of HVS
    - Provides information on stream composition
  - Canister measurements
    - Taken at exhaust of HVS
    - Provides full speciation profiles of emissions

PID
Image Credit: ionscience.com

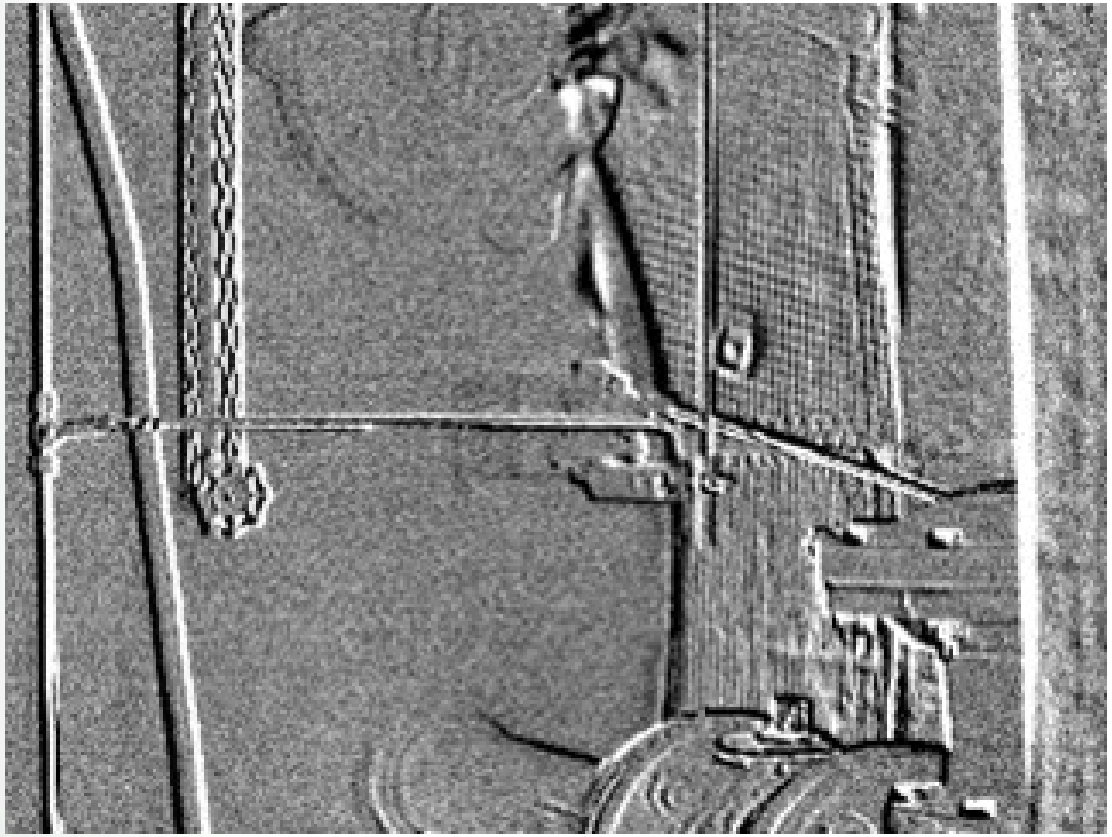
FID
Image Credit: Michael Stovern

Summa Canister
Image Credit: acclab.com

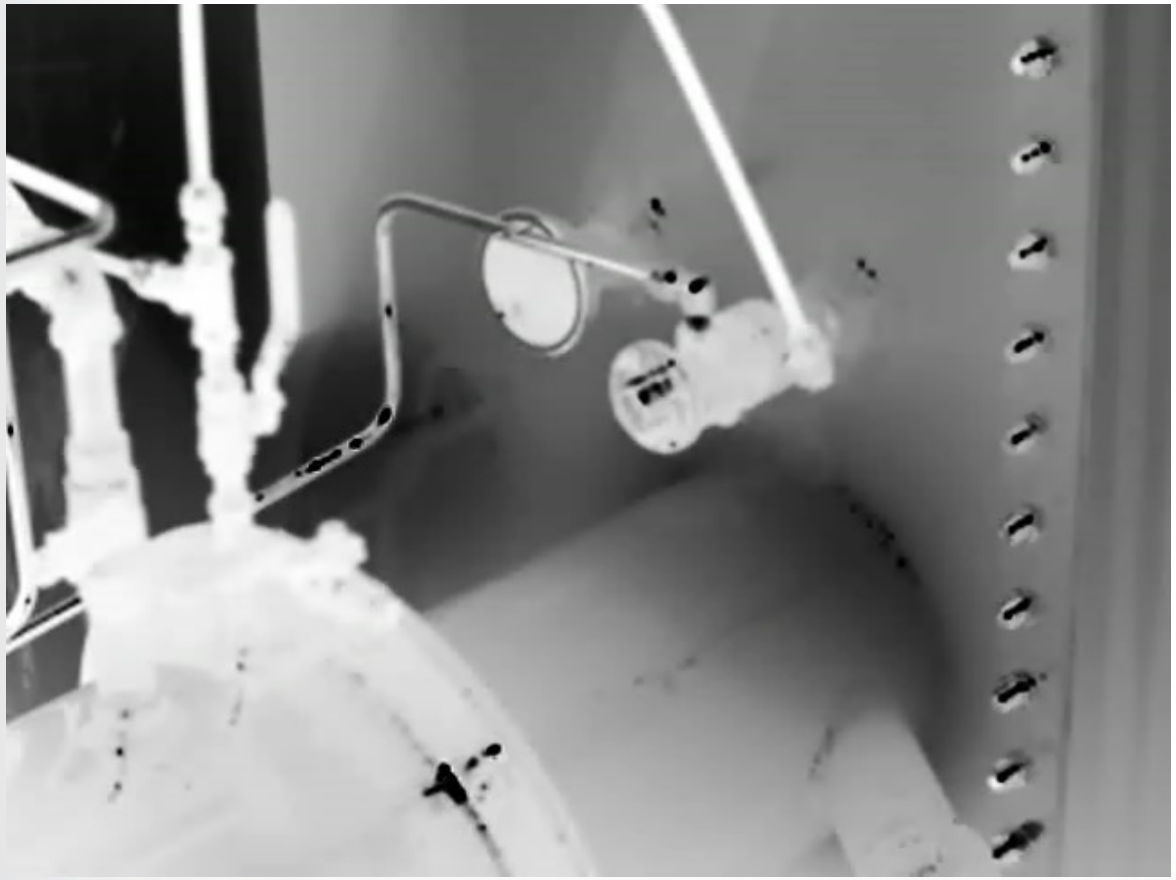
Methodology

- Sampling Location
  - Uintah Basin, Utah
  - Several operators
- Sampling Protocol
  - Safety check
  - IR site survey for leak detection
  - FID & PID pre-screen of leak
  - ‘Bagged’ the leak
  - Verified leak capture with IR camera
  - Conduct multiple HVS measurements
  - Concurrent PID, FID, Canister measurements taken at HVS exhaust

Example of Pneumatic Leak



Example of Pneumatic Leak



Leak Capture DQI Results

Device Type	Number of HVS Measurements	Average HVS Leak Rate Measured at 7 cfm Blower Rate (cfh)	Average HVS Leak Rate Measured at 6 cfm Blower Rate (cfh)	Average Leak Rate Difference (%)
TTP	7	2.64	2.60	1.52
TTP	6	0.63	0.78	23.81
TTP	13	0.58	0.59	1.82
TTP	7	0.35	0.36	2.85
SP	11	2.22	2.28	2.70
TTP	7	2.31	2.36	1.98
STP	8	1.61	1.70	5.72
TTP	2	2.28	2.10	7.90

TTP – Tank Thermostat Pneumatic
SP – Separator Pneumatic
STP – Separator Thermostat Pneumatic

HVS Sensor DQI Results

Device Type	Number of HVS Measurements	Average HVS Leak conc. (ppm)	Average FID concentration (ppm)	Canister HC concentration
TTP	7	6686	N/A	5744
TTP	6	1733	2000	1462
TTP	13	1523	1400	1379
TTP	7	871	1007	-
SP	11	5382	4800	4248
TTP	7	5857	4500	4986
STP	8	4038	3375	3468
TTP	2	5800	4700	4241

TTP – Tank Thermostat Pneumatic
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PID and Canister Comparison Results

Device Type	Average PID concentration (ppm)	Canister HAPs concentration (ppm)	Canister NMEVOC concentration (ppm)	Canister NMEVOC/HAPs ratio
TTP	4.30	0.58	222.8	384
TTP	1.60	0.88	143.2	163
TTP	1.55	0.43	103.3	240
TTP	1.33	-	-	-
SP	26.0	3.92	266.7	68
TTP	9.07	1.64	175.5	107
STP	30.5	4.19	254.3	61
TTP	41.5	4.04	328.0	81

HAPs = Hexane, Benzene, Ethylbenzene, Toluene, Xylene

NMEVOC = C3+

Results Summary

- Augmented HVS protocol worked well on pneumatic controller emissions
- Leak Capture DQI:
  - Met by 7 of the 8 pneumatics sampled
  - Provides indicator of both failure to capture leak and variable emission rate leaks
- HVS Sensor DQI
  - Close agreement between the FID, canister and HVS leak concentrations for PC leaks
  - FID to PID ratio could be used to identify streams with significant C3+ HC concentrations
- Acquisition of FID, PID and canister measurements at the exhaust of the HVS was found to be a useful indicator to verify that the HVS is operating properly

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Questions or Comments