

API Field Measurement Study: Equipment Leak Detection and Quantification

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Basics of Equipment Leaks in Upstream

- Equipment leaks are unintended emissions of process gas from equipment components like valves and flanges.
- Typical composition is primarily methane and other light alkanes.
- Identification of equipment leaks can include:
 - Optical Gas Imaging (OGI)
 - Method 21 with Flame Ionization Detectors (FID)
 - Audial, visual, olfactory (AVO) observations
- Emissions in the US Greenhouse Gas Reporting Program (GHGRP) are estimated by:
 - Default component counts from operator-provided major equipment count and average or “population” component-based emission factors [most common approach]
 - ‘Leakers’ emission factors based on leaks detected or “screened” using OGI or Method 21 [recent method addition]

Study Design

- 67 volunteer sites in 4 basins in the Western United States
 - Production
 - Gathering and Boosting
 - Top 4 basins for reported emissions from equipment leaks in 2017
- Screened 84,000+ components with OGI and Method 21
- Used high volume sampler for quantification of leaks
 - Any leak detected with OGI
 - Any reading ≥ 500 ppm on the FID

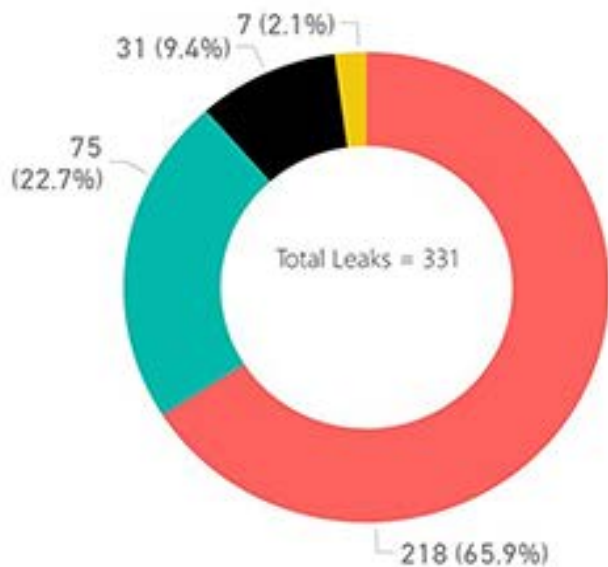


Finding 1: OGI equally effective in detecting emissions as Method 21 (≥ 500 ppm) for the 67 sites in the study

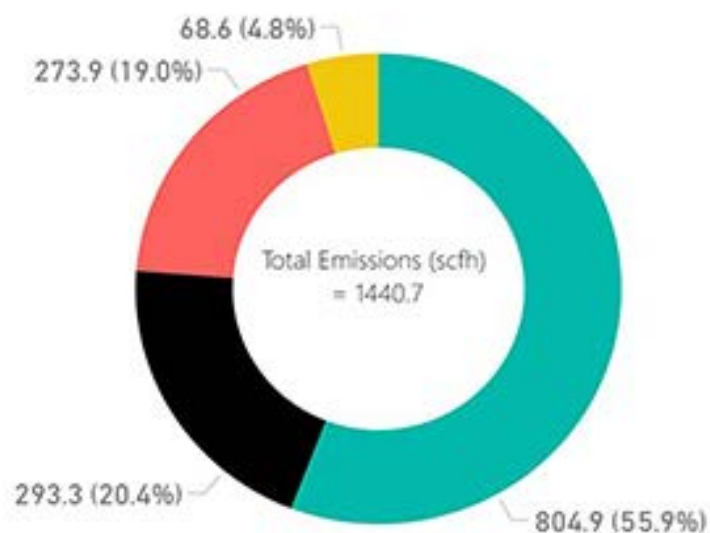
➤ OGI found less leaks than Method 21 (33% vs. 90%)

➤ OGI (80%) and Method 21 (79%) identified similar overall emissions

Count of Leaks Detected in Study
Leak Detection Method ● FID Only ● OGI and FID ● OGI Only ● OGI Only - No FID Survey

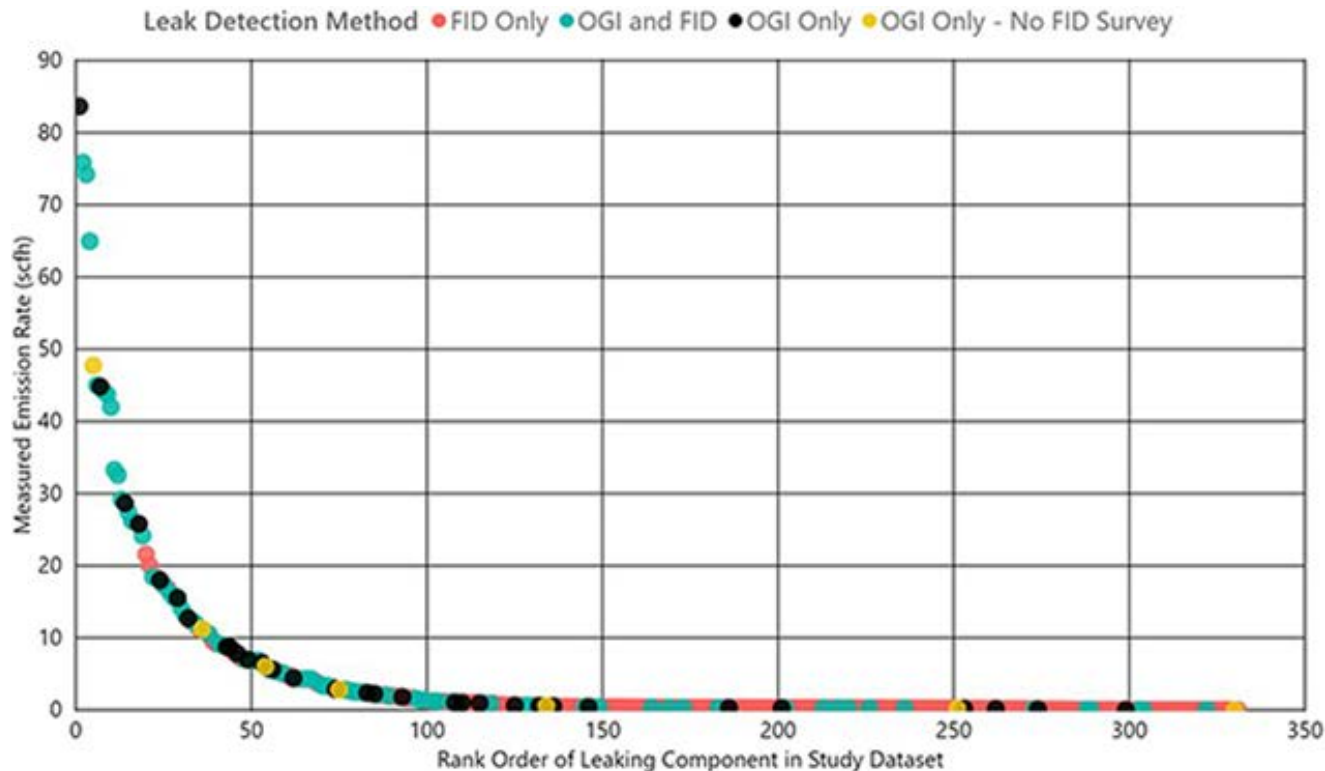


Emissions Measured (scfh) in Study
Leak Detection Method ● OGI and FID ● OGI Only ● FID Only ● OGI Only - No FID Survey



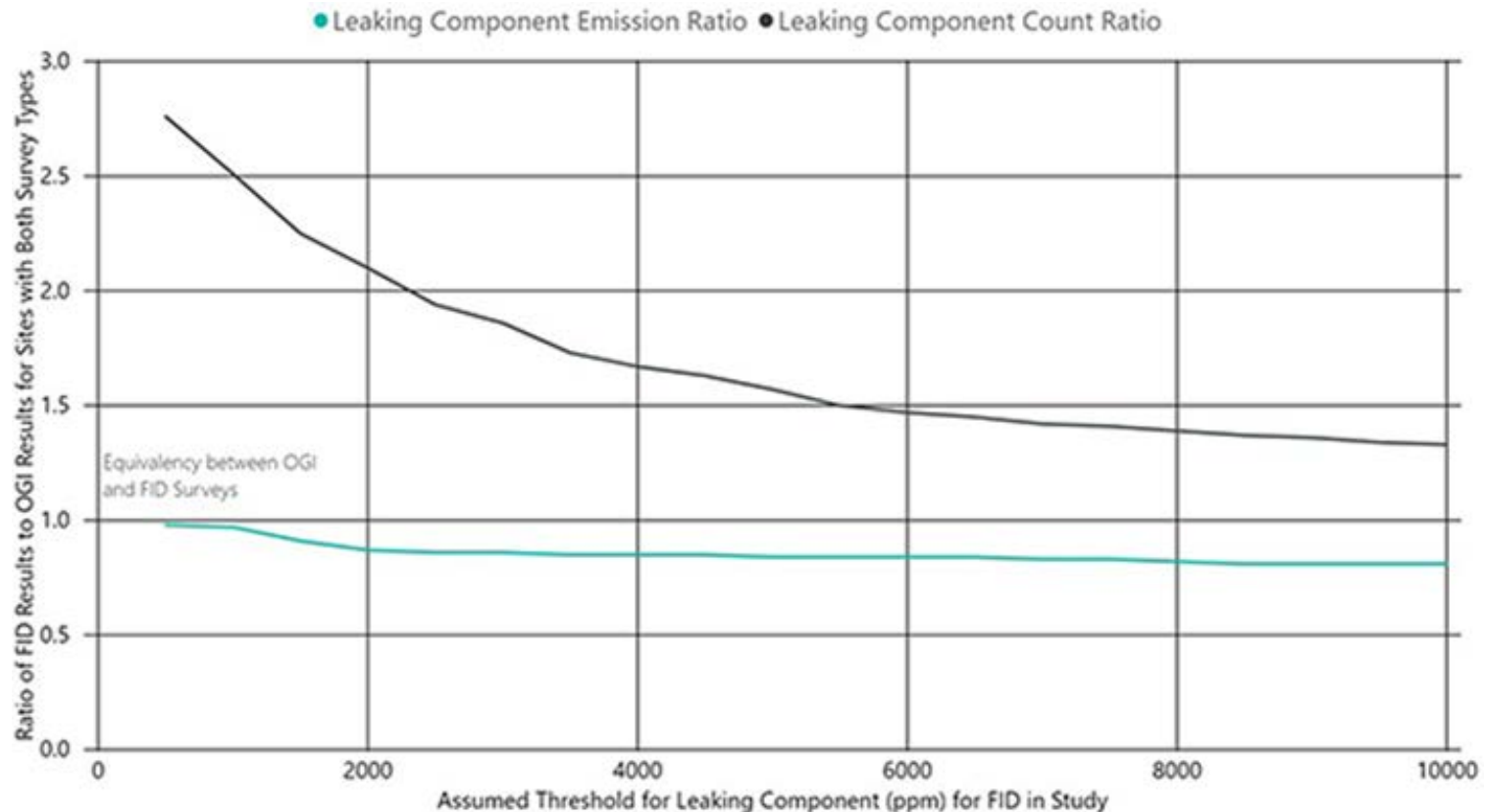
Finding 2: OGI emission equivalence was driven by unique identification of several of the largest emissions

- 4 components in the top 5% of leak rates in the study were only identified with OGI
- 67% of leaks identified in the study had emission rates less than 1 scfh, and 83% of those were identified only with Method 21



Finding 3: There is no threshold with direct equivalency between OGI and Method 21

- With Method 21 thresholds of 500-10,000 ppm, Method 21 would have always identified more leaks and lower emissions than OGI



Finding 4: The overall frequency of leaking components was less than studies from the early 1990's

- 0.39% of components identified as leaking with OGI and/or Method 21 surveys (0.49% in gas service, 0.11% in oil service)
- Identified leaks in oil and gas service have similar characteristics.
- Prior field study (API 1995) that forms the basis of current EPA emission factors only used Method 21. Direct comparison is in the table below.

Reference	Source Description	Component Count in Population	Leaking Component Count		Leaking Component Frequency in Population	
			>500 ppm	>10,000 ppm	>500 ppm	>10,000 ppm
API 1995	Onshore Gas Production	40,178	1,138	648	2.83%	1.61%
API 1995	Onshore Oil Production	62,408	673	419	1.08%	0.67%
API 1995	Onshore Oil and Gas Production	102,586	1,811	1,067	1.77%	1.04%
This Study	Onshore Gas Production	46,140	173	82	0.37%	0.18%
This Study	Onshore Oil Production	36,134	117	56	0.32%	0.15%
This Study	Onshore Oil and Gas Production	82,274	290	138	0.35%	0.17%

Finding 5: Equipment leak emissions at these sites were less overall than Subpart W average factors would indicate



- 54 of 65 sites with component counts had less emissions than estimated from major equipment count
- Aggregate emissions from all 65 sites with component counts were 22%-36% lower than current emission estimates from major equipment counts
- Leaker emission factors are slightly larger than current EPA leaker factors

Finding 6: New information on high volume sampler measurement

- First field study to include a backup hydrocarbon detector in the high volume sampler exhaust as a check for transition between two measurement modes.
- Transition errors would have occurred in 6 measurements (2.1% of those in study), and all were with lower methane content gas (<90%)
- Could have increased component level quantification by 10.3 scf/hr/instance and overall study emissions by ~4%

More Information

Pacsi, A.P., Ferrara, T., Schwan, K., Tupper, P., Lev-On, M., Smith, R. and Ritter, K., 2019. Equipment leak detection and quantification at 67 oil and gas sites in the Western United States. Elem Sci Anth, 7(1), p.29. DOI: <http://doi.org/10.1525/elementa.368>