FUGITIVE EMISSIONS SUMMIT AMERICAS

2022

Emission Factors: The Methodology Behind Emission Inventory Calculations

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Emission Factor Correlation Equations:

- Methodology
- History
- Current State of Affairs
- Applications for Industry

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Methodology

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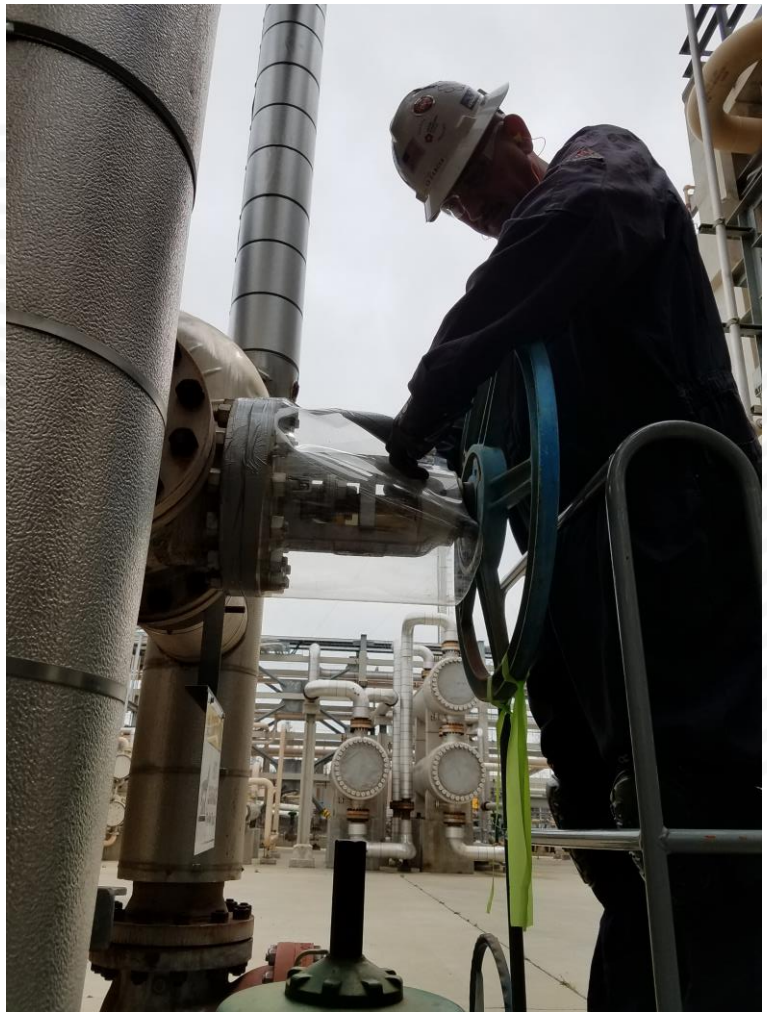
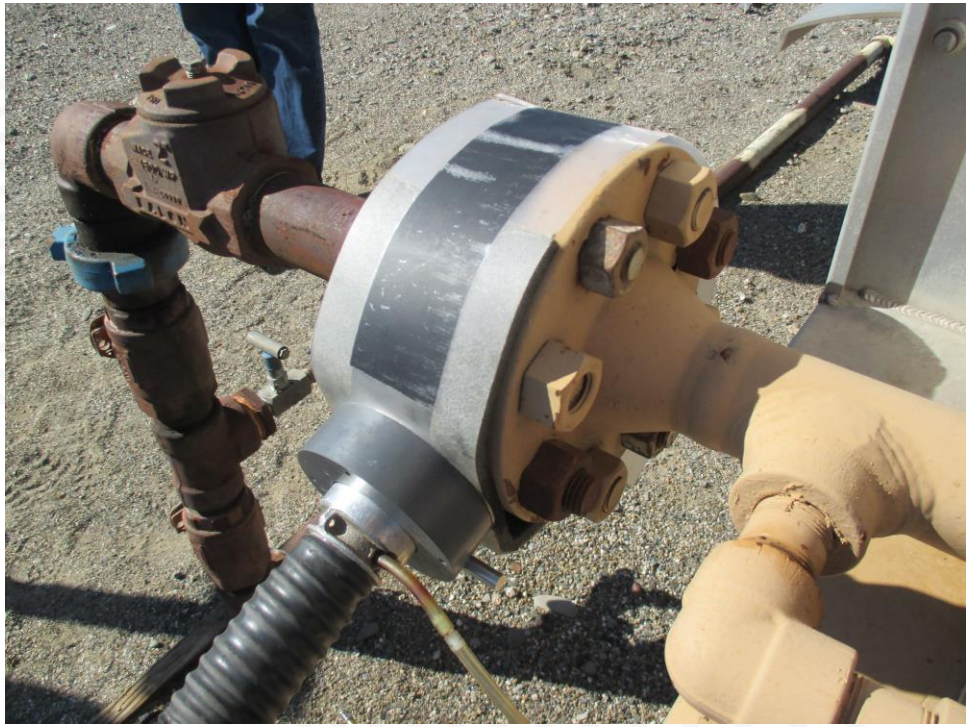


There are two approaches to mass emissions capture: true bagging and hi flow sampling.

True bagging is useful for a wide array of constituents or for mixed streams.

Hi flow sampling is specific to natural gas and can not be used for streams containing other constituents.



Methodology

True bagging involves capture of emissions into a sample bomb and sent for lab analysis.

- Useful for determining mass emissions on any constituent or combination of constituents.
- The positive pressure method presents risk of “pushing” emissions out through any gaps.
- The vacuum method is more accurate at capturing a true account of mass.

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Methodology

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Hi flow sampling is a live sampling method specifically engineered toward natural gas streams.

- Bacharach Hi Flow Sampler was the only option for years, but it is no longer produced or sold.
- Recently, a university and another 3rd-party vendor have developed newer models.
- Alternative methods are needed for low concentration (< 10,000 ppm) emission points.

History

US EPA commissioned a study, took place in 1976/77 involving 14 refineries

- Conducted using traditional bagging, as refining constituents preclude the use of Hi Flow
- These initial studies resulted in the AP-42 correlation equations for refining sector in the Protocol for Equipment Leak Emission Estimates (See Table 2-2)

TABLE 2-2. REFINERY AVERAGE EMISSION FACTORS[a]

Equipment type	Service	Emission factor (kg/hr/source)[b]
Valves	Gas	0.0268
	Light liquid	0.0109
	Heavy liquid	0.00023
Pump seals[c]	Light liquid	0.114
	Heavy liquid	0.021
Compressor seals	Gas	0.636
Pressure relief valves	Gas	0.16
Connectors	All	0.00025
Open-ended lines	All	0.0023
Sampling connections	All	0.0150

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History

Based on the success of the refinery studies, additional studies were conducted in the early 1980s to determine correlation equations for the chemical industry.
These results were also added to the AP-42 Protocol under the SOCMI sector.
(Table 2-1)

TABLE 2-1. SOCMI AVERAGE EMISSION FACTORS

Equipment type	Service	Emission factor[a] (kg/hr/source)
Valves	Gas	0.00597
	Light liquid	0.00403
	Heavy liquid	0.00023
Pump seals[b]	Light liquid	0.0199
	Heavy liquid	0.00862
Compressor seals	Gas	0.228
Pressure relief valves	Gas	0.104
Connectors	All	0.00183
Open-ended lines	All	0.0017
Sampling connections	All	0.0150

History

Multiple other studies conducted to determine correlations for various industries. Some were adopted into the Protocol, others were discarded as the results were not definitive.

In the early 1990s, a study on barges on the Mississippi River were inconclusive and were not added to the Protocol.

Current State of Affairs

Several companies in the natural gas storage and transportation sector have challenged a state EPA ruling that Refinery Sector factors should be used in their annual emissions inventories.

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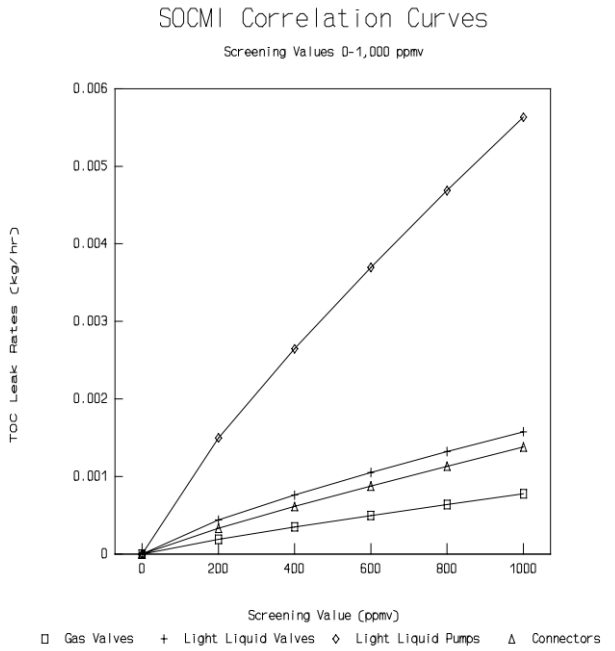
Current State of Affairs

The state agreed to conduct a study to determine the accuracy of using refining factors as applied to an industry dealing with lighter constituents.

To ensure a good sample size, studies typically target a minimum of 5 data points for each category. In some categories, this can be very difficult to achieve.

Component Type	< 100	100-1,000	1,000-10,000	10,000-100,000	> 100,000
Connector					
Flange					
OEL					
Other					
Valve					



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Applications for Industry

The study is ongoing, time will tell what the results are. However; there is precedent for industry to challenge the accuracy of the factors. If successful, this study could result in significant reductions in reported emissions to atmosphere for the natural gas storage and transportation industries in that state.

Applications for Industry

Additional areas for industry to question their methodology:

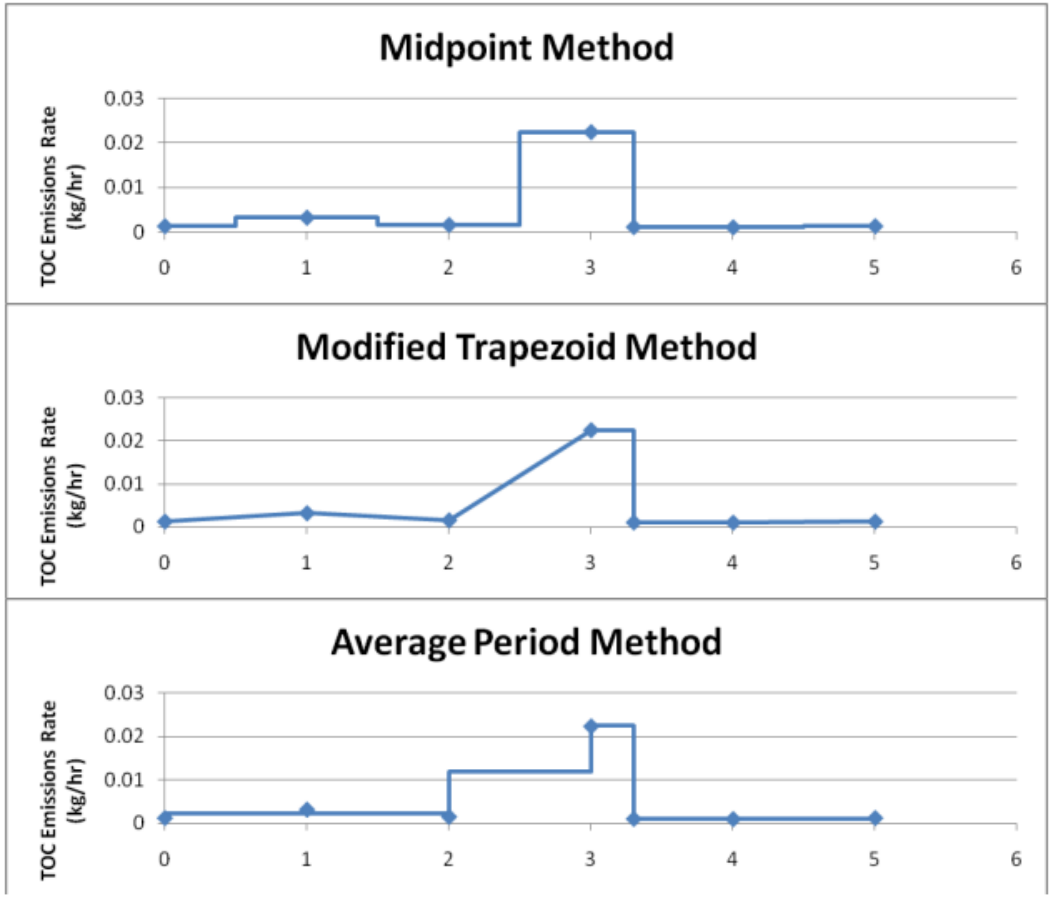
- In one 3rd-party audit, it was found that some components at a refinery had incorrect factors applied to some components in their database. This site used the database EI function for their annual EI calculation, so this error resulted in a misrepresentation of true emissions emitted to atmosphere.

Applications for Industry

Additional areas for industry to question their methodology:

- Midpoint vs. modified trapezoid vs. average period extrapolation. The use of one method vs. another may remove a portion of the reported emissions depending on the circumstances.

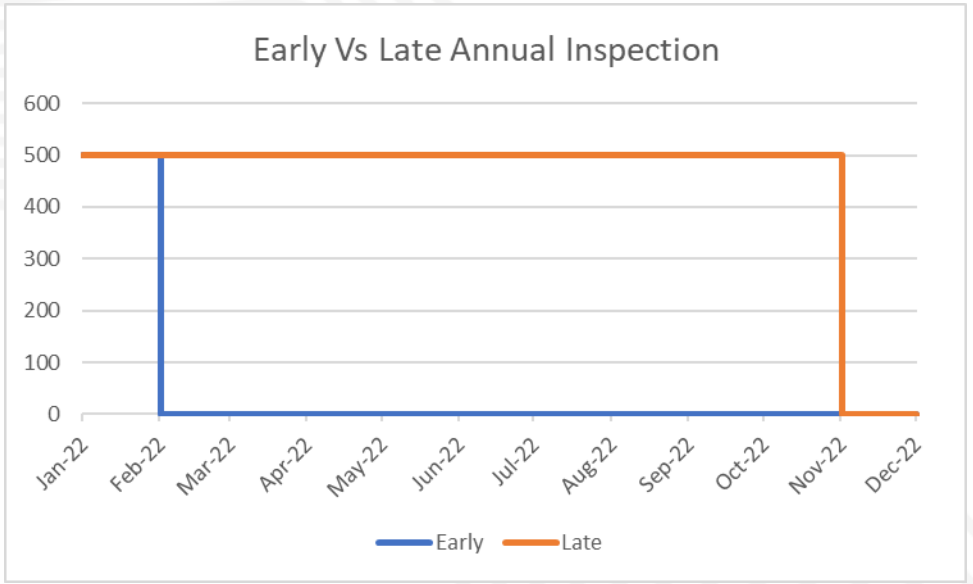
- Particularly of interest for annual components.



Applications for Industry

Additional areas for industry to question their methodology:

- Front loading of DTMs: amount of emissions reported assumes the leak began on Jan 1 of the year, no inspection until November assumes it was leaking for 11 months



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Thank you for attending!

Any Questions?

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