Methane Emission Measurement Techniques

Methane To Markets Partnership Expo

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Why Quantify Emission Rates?

- Justification for repair/control costs.
- Prioritization and optimization of efforts?
- Objective performance monitoring.
- Potential to generate marketable GHG credits.

Key Measurement Parameters:

- Temperature
- Pressure
- CH_4 Concentration
- Volumetric Flow

Performance Requirements:

- Practical and safe to use in the field.
- Reasonable cost.
- Readily available.
- Sufficient accuracy for economic evaluations (e.g., ±25% or better).

Basic Options:

- Measurements at the source.
- Remote measurement techniques.
- Engineering Calculations.

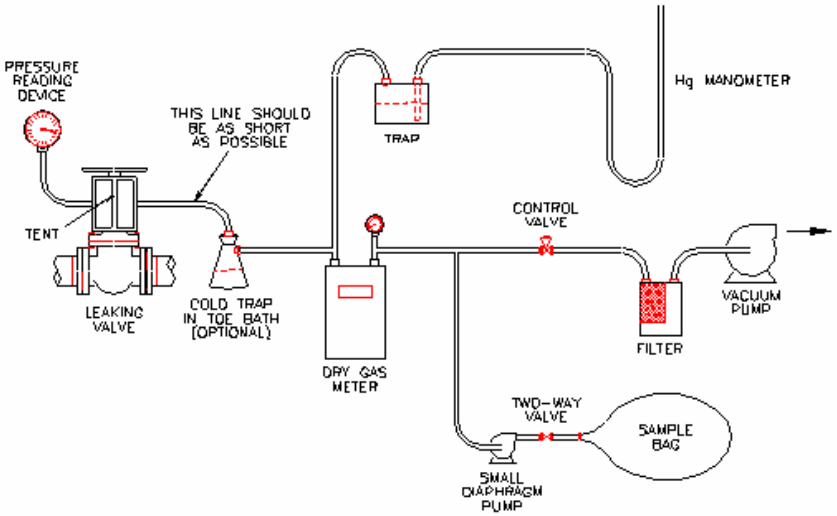
Measurements at the Source

- Typical Applications:
  - Equipment leaks, venting and flaring.
- Basic constraints:
  - Requires easy or supplied access to source.
- Potential Issues:
  - Safety concerns (H_2S or relief events).
  - Backpressure limitations.
  - High or cold temperature surfaces.
  - Fouling (e.g., condensing vapor or lube oil mist).

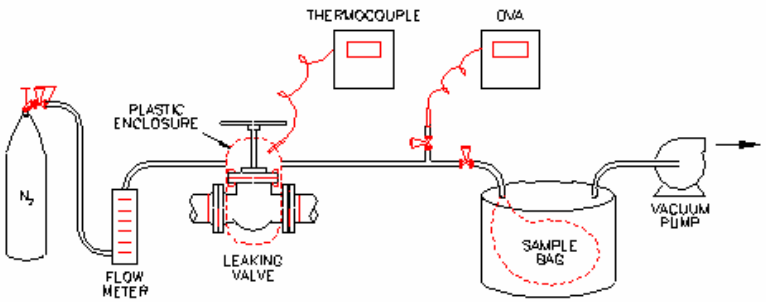
Measurements at the Source:

- Methods:
  - Bagging
    - Time consuming and costly to apply.
    - Applicable for small to moderate leak rates.
  - Hi-Flow Sampler
    - Convenient approach for smaller to medium sized leaks (e.g., 8 to 10 scfm or $25,200 to $31,500/y at $6/mscf).
  - End-of-Pipe Capture & Measurement Techniques
    - Calibrated Bag
    - Full-flow flow meters.
    - Velocity Traverses
  - Inline Measurements
    - Velocity Traverses
    - Tracer Techniques

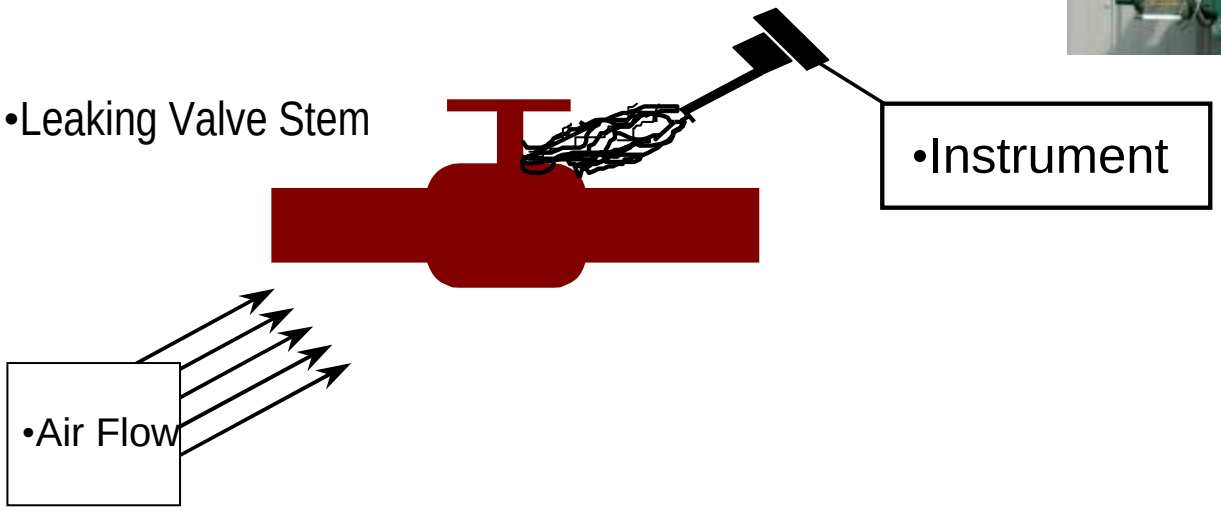
VACUUM METHOD



BLOW-THROUGH METHOD



HiFlow Sampler



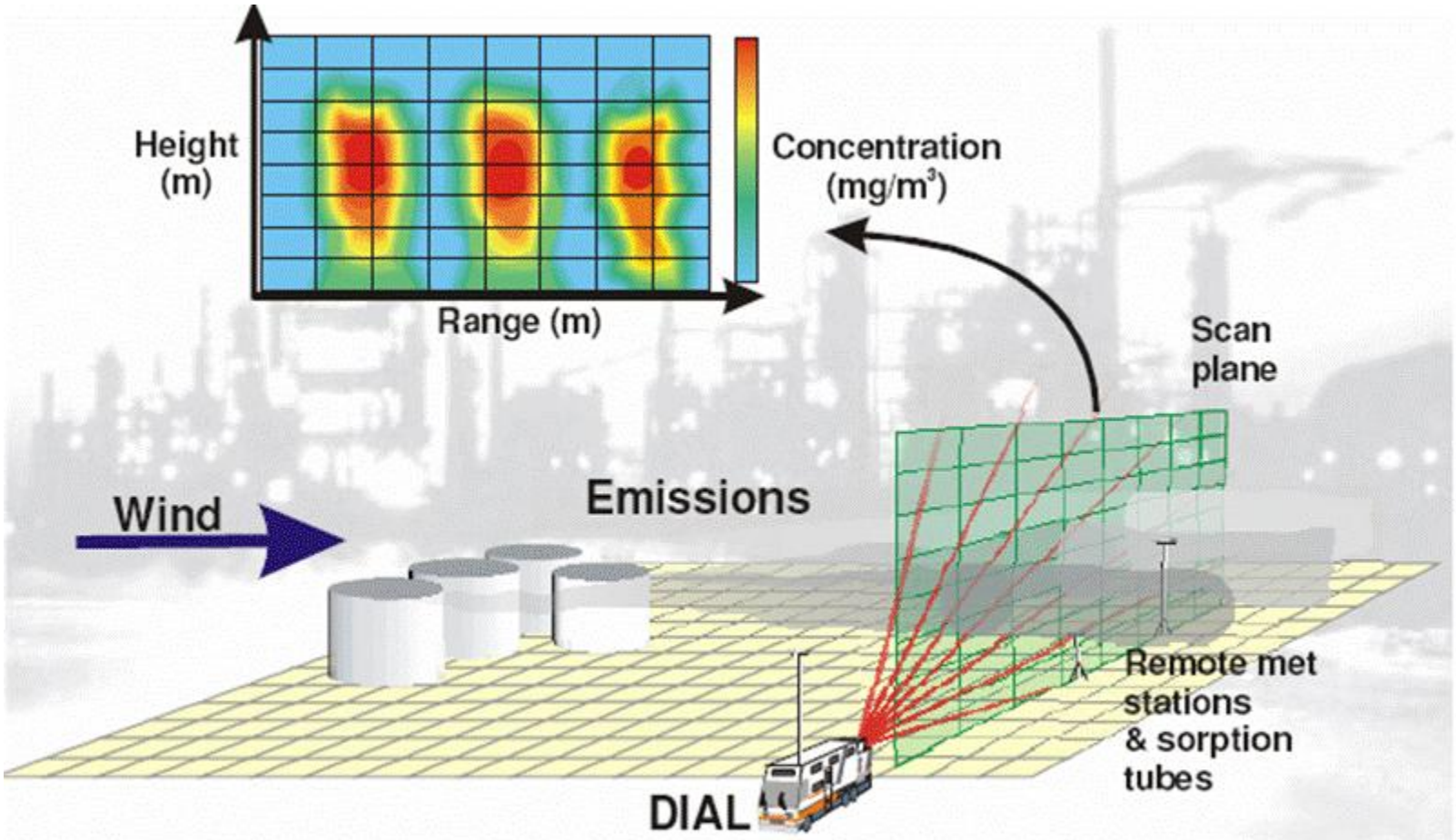
Remote Measurements:

- Typical Applications:
  - Area and volume sources.
  - Inaccessible or unsafe to access sources.
- Basic Constraints:
  - Generally more costly and complicated to use.
- Potential Issues:
  - Weather dependent.
  - Susceptible to interferences.
  - Require suitable downwind access.
  - Potentially reduced resolution and accuracy.

Remote Measurements:

- Methods:
  - Tracer techniques:
    - Pollutant-to-tracer ratio technique.
  - Remote plume sensing methods.
    - US EPA (2006): ORS Protocol (www.epa.gov/ttn/emc/prelim/otm10.pdf).
    - DIAL (ftp://public:access@ts.clearstone.ca).
    - Back-calculation using atmospheric dispersion models and upwind/downwind monitoring data.
    - AIRDAR.

Storage Tanks – Remote Emissions Measurement



Engineering Calculations

- Typical Applications:
  - Process Venting
- Basic Constraints:
  - Requires detailed and accurate process data.
- Potential Issues:
  - Requires expert knowledge.
- Methods:
  - Mass balance and energy balance techniques.
  - Process simulators.

Compressor Seal Vents:

- Causes of Emissions:
  - Seal wear.
- Typical Measurement Problems:
  - Potentially multiple leakage points:
    - Centrifugal:
      - Lube oil degassing reservoir.
      - Seal Vent.
    - Reciprocating compressors:
      - Distance piece and packing case vents.
      - Lube oil drain tank vent.
      - Crank case vent.

  - Potentially large flows.
  - Minimal tolerance to any back-pressure.
  - Fouling due to lube oil mist.

Compressor Seal Vents:

- Typical Measurement Problems:
  - Oily roof-tops and limited roof-top access.
  - Lack of ports on vent lines.
  - Possibly weather caps on vent outlets.
- Measurement Approaches.
  - Vane anemometers.
  - Diaphragm meters or calibrated bags where some backpressure can be tolerated.
  - Hi-Flow Sampler
  - Quantitative remote sensing methods.
  - Permanent Solutions:
    - Flow switches.
    - Rotameters.

Blowdown and Vent/Flare Systems:

- Causes of Emissions (During Passive Periods):
  - Purge gas.
  - Leakage past the seats of blowdown/relief valves (5 to 10% leak and 1 to 2% of these contribute over 75% of the emissions).
  - Blowdown or drain valves not fully closed.
  - Compressor seals.
- Typical Measurement Problems:
  - Potentially large flows.
  - Difficulty accessing end of pipe.
  - Limited or no suitable ports for insertion of velocity probes.

Blowdown and Vent/Flare Systems:

- Typical Measurement Problems:
  - Low flow velocities.
  - Potentially wet or fouling environment inside pipe.
  - Safety concerns (relief episodes).

- Measurement Approaches.
  - Micro-tip vane and thermal dispersion anemometers.
  - In-line tracer tests.
  - Ultrasonic sensors (portable & online).
  - Remote sensing methods.
  - Permanent Solutions:
    - Ultrasonic transit-time flow meters.
    - Flow switches.

Storage Tanks:

- Causes of Emissions:
  - Working and breathing losses.
  - Flashing losses.
  - Unaccounted for contributions:
    - Unintentional Gas carry-through.
      - Leaking drain and dump valves.
      - Malfunctioning level controllers.
      - Inefficient upstream gas/liquid separation.
      - Piping changes resulting in storage of unstablized product.
      - Non-routine storage of unstabilized product in atmospheric tanks.
    - Malfunctioning vapor recovery systems:
      - Faulty blanket gas regulators or pressure controllers.
      - Fouled vapor collection lines.
      - Leaking roof fittings and seals.

Storage Tanks:

- Typical Measurement Problems:
  - Multiple roof openings.
  - Edge-of-roof access only.
  - Dependence on pump in/out activity and meteorological conditions.
  - Fall protection and potentially confined space training required.
  - Interpretation and extrapolation of results.
- Measurement Approaches:
  - Velocity profiles across openings.
    - Vane anemometers.
  - Tracer techniques.
  - DIAL

- Engineering Calculations
  - API E & P TANKS Model (Flashing, working and breathing losses).

Best options by source:

Source	Hi-Flow	End-of-Pipe Flow Meters	Velocity Probes	Tracer Methods	Quantitative Remote Sensing	Flow/Leak Sensors
Connectors	X					
Valves	X					
PRVs	X	X				
OELs	X	X	X			
Blowdown Systems		X	X	X		X
Compressor Seals	X	X	X			X
Flare Systems			X	X	X	X
Tanks		X	X	X	X	X
Non-point Sources				X	X	

Conclusions on Leak Measurement:

- A selection of measurement technologies is usually required.
- Instrumented solutions are the best choice for large potential emitters:
  - Compressor seals.
  - Flare and vent systems.
  - Metering of gas blanketing systems.