Advances in Leak Detection Technology

Bruce Steltzer
Delaware DNREC - Air Quality Management
February 7, 2006
Gas FindIR Camera

- Manufactured by FLIR Systems
- Technology uses infrared energy to "see" gas vapors
- The gas vapors appear as smoke
- Thermal imaging camera
FLIR Gas FindIR

- Capable of scanning large areas faster than flame ionization detectors (FID) and photo ionization detectors (PID)
- Shows gas leaks in real time
- Record to video
What the Gas FindIR sees

- Hydrocarbons: -anes, -enes, & -ynes

For example:
- Benzene
- Butane
- Methane
- Heptane
- Propylene
What it doesn’t see

- Carbon dioxide
- Hydrogen sulfide
- Nitrogen dioxide
- Sulfur dioxide
- Carbon Monoxide
- Ammonia
Gas FindIR Camera

- The camera lens transmits IR energy with wavelengths of 3.3 – 3.4 micrometers.
- Transmission – To cause energy, light, etc., to pass through space or a medium.
The Electromagnetic Spectrum

Wavelength in micrometers

Gamma | X-Ray | UV | IR | Microwave | Radio

$10^{-5}$ | $10^{-2}$ | 3 | $10^2$ | $10^4$ | $10^6$
Butane Absorption Characteristics

Transmittance

Wavelength in micrometers

- Butane
- Gas FindIR Transmittance
Radiant Energy & the Gas Cloud

Back Ground Energy

Energy Absorbed

Transmitted
Similar to another test method?

- RM 9 of 40 CFR Part 60 for Opacity
- We determine the opacity of the smoke by determining how much light is transmitted through it.
To “see” a gas cloud

- Cloud must absorb radiant energy at wavelength of the Gas FindIR
- Cloud must have a radiant contrast (temperature) compared to the background or surroundings
- Gas cloud motion is key
Visible Light
Infrared Energy
Thermal image in color
Refinery Tank Inspection

- Object: to view tanks storing variety of materials
- Crude oil
- Crude residuals
- Finished Gasoline
Properties

- Crude Oil
  API – 31.8, RVP – N/A @ 63 deg F

- Crude Residuals
  API – 14.0, RVP – N/A @ 131 deg F

- Gasoline
  API – 52.4, RVP – 10.9 @ 40 deg F
Thermal Image of Tanks
Tank Seal
Tank Roof
Observed truck transferring gasoline into a 12,000 gallon AGST

Vapor recovery line coupling was not secured tightly

Gas vapors observed with the camera

Informed truck operator of gas leak

Operator secured the coupling

No vapors noticed during rest of unloading
12,000 gal gas storage tank
Gasoline
And
Vapor Line
Hookups
Gas & Vapor Lines
Vapor Line Hookup
Vapor Line Hookup to Truck
Landfill Gas Wellhead
FID detected 2300 ppm CH$_4$
Company FAQs

- How much does that thing cost?
- Holy cow!! Or other similar expression
- What if you see a leak?
- Will it be considered as credible evidence?
Credible Evidence

- Clean Air Act section 113(a) authorizes EPA to bring an administrative, civil, or criminal enforcement action “on the basis of any information available to the Administrator.”

Credible Evidence

- The most common form of evidence is that gathered by the reference test methods of 40 CFR Part 60 and 63 as required by the NSPS and NESHAP regulations.
- Testing may be required under State’s regulations.
Credible Evidence

The language of Section 113(a), together with the fact that the Act nowhere prohibits the use of information other than reference test results to prove violations, indicates the Act does not limit the use of any information to prove a violation.

Delaware Water &
Air Resources Act

- 7 Del. C. 60 section 6024 – Right of Entry:

  The Secretary, or duly authorized designee, in regulating water pollution, air pollution, solid waste disposal or any other matter over which he has jurisdiction...
Delaware Water & Air Resources Act

- Right of Entry statute (paraphrased):

  DNREC staff may enter, at reasonable times, private or public property to determine compliance with a statute or regulation after giving verbal notice and presenting official ID.
Right to Inspection

Regulation No. 17, Section 2.3 –

The Department may conduct tests of emissions from or fuel used by any air contaminant source.
Right to Inspection

Regulation No. 30, Section 6(c)(2) –

…The permittee shall allow authorized officials of the Department to perform the following…
Right to Inspection

- Inspect at reasonable times and using reasonable safety practices any facilities, equipment, practices, or operations regulated or required under the permit.

- As authorized under the CAA, sample or monitor at reasonable times substances or parameters for the purpose of assuring compliance with the permit or applicable requirements.
How DNREC uses this

- Currently experimenting with the camera at different industries and in different environments
- Camera’s role in inspections and enforcement will evolve over time
How DNREC may use this

- Use to determine compliance with equipment and operational standards (leak / no leak standard, tank seals)
- Use in conjunction with FID/PID for quantitative data for emission standards (leaks with concentration limit)
- Community & business outreach
Reference

- FLIR Gas FindIR course manual
- www.flirthermography.com/smartLDAR