Leak Detection
by FLIR Optical Gas Imaging

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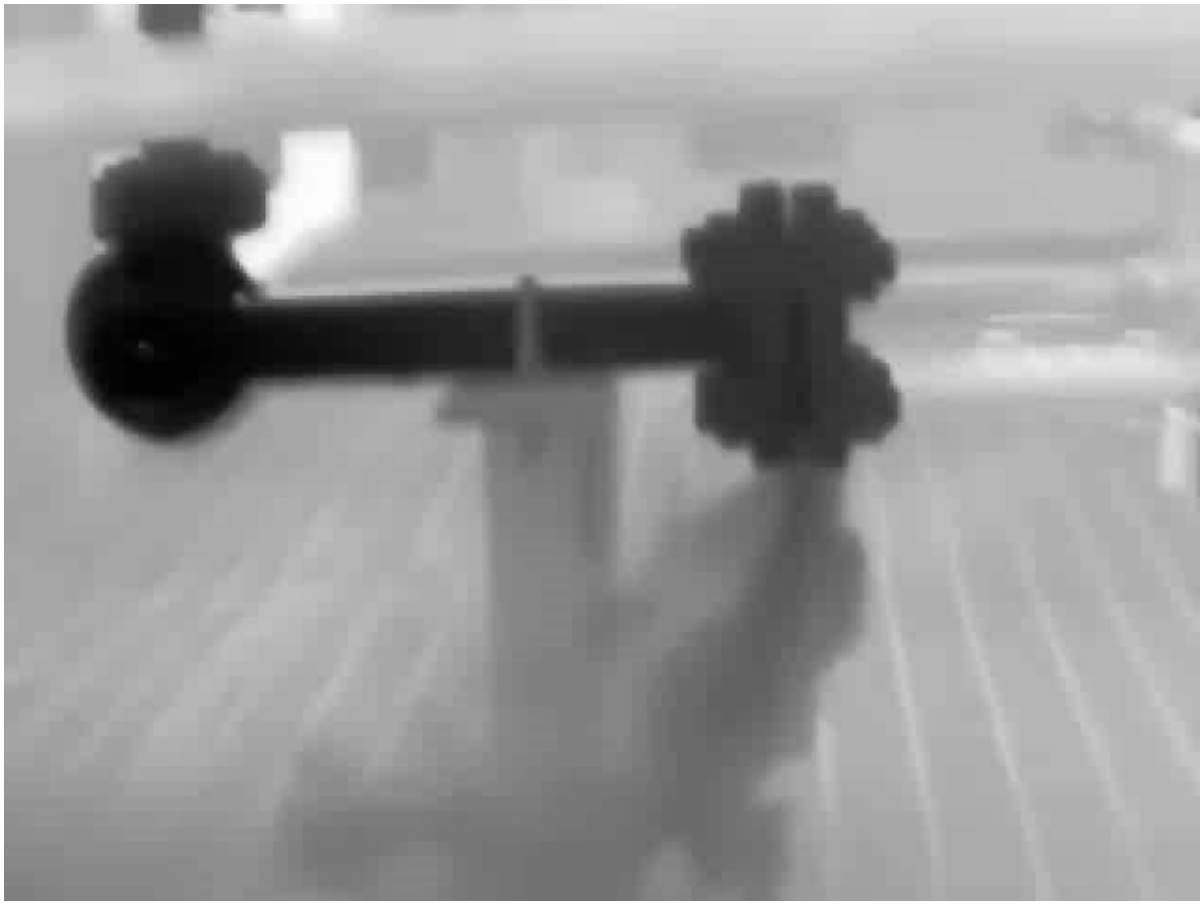
What is Optical Gas Imaging (OGI)?



Gas Imaging Cameras from FLIR

Gas Detection of >20 VOC gases
i.e. Methane, Propane, Butane
Radiometric, Accuracy ±1 °C
Temp range -40 °C to +350 °C

FLIR GF320

FLIR GF306

FLIR GF346

Gas Imaging Cameras from FLIR

Gas detection of SF_6 & Ammonia
Radiometric, Accuracy ±1 °C
Temp range -40 °C to +500 °C

FLIR GF320

FLIR GF306

FLIR GF346

Gas Imaging Cameras from FLIR

Gas detection of Carbon monoxide
Radiometric, Accuracy ±1 °C
Temp range -20 °C to +200 °C

FLIR GF320

FLIR GF306

FLIR GF346

User Problems to be Solved

Finding Gas Leaks

- Environmental Compliance
- Safety
- Loss of revenue/product

Environmental Compliance

- State of Delaware uses Optical Gas Imaging on the ocean!

Looking for Air Emissions Using New Infrared Imaging

The camera has innumerable applications that range from "looking" for VOC emissions from routine everyday activities such as refueling at gas stations to complex facilities such as the Delaware City petroleum refinery.

DNREC's Air Quality Management Section has begun monitoring fugitive volatile organic compounds (VOCs) emissions using a new **Gas FindIR camera.** This state-of-the-art infrared video camera uses energy, instead of visible light, to "see" VOCs. The camera has innumerable applications that range from "looking" for VOC emissions from routine everyday activities such as refueling at gas stations to complex facilities such as the Delaware City petroleum refinery.

In April 2006, DNREC staff observed a ship off-loading crude oil, a process called "lightering," from a tanker at the Big Stone Anchorage in the Delaware Bay, eight nautical miles north of Lewes. When crude oil is pumped into an empty vessel, VOC vapors are displaced and pushed out through the stacks called "mast risers" into the atmosphere. As soon as pumping began, the camera revealed the VOC vapors as black "smoke" (see photos below). The prevailing winds blew those emissions, invisible to the naked eye, west towards Delaware.

Recently, DNREC successfully negotiated an agreement and air pollution control permit with Maritrans Corporation. Maritrans has committed to a process of vapor recovery to prevent these VOC emissions and has invested more than a half billion dollars to replace their fleet of ships with state-of-the-art vessels containing built-in vapor recovery equipment and other safety features.

FLIR Systems' Gas FindIR camera.

Manufactured by FLIR Systems, the Gas FindIR camera has been used on compliance inspections at several companies to help determine if VOCs leak from their equipment and whether the facility meets its regulatory obligations for leak detection and repair requirements. The new GAS FindIR-camera offers DNREC the ability to implement cutting-edge technologies in its aggressive efforts to achieve healthier air quality for Delawareans, and provide a level playing field for those companies that make investments in controlling emissions.

—Article by Bruce Steltzer/Jim Werner (DAWM)

Crude oil tankers performing lightering operations.

VOC emissions visible during lightering operations.

Safety

- The number one (#1) reason that ExxonMobil purchased GF Series was for safety!
- GF Series allows to scan a large area and check for potential gas leaks before entering.
- Personnel can work at safer distance from potential leaks.
- Climbing to reach for probing can in many cases be avoided.
  - New US regulation sates that OGI must be used for over 2m elevation!

Loss of Revenue

- Leaking Relief Valve: ~ $50,000 per year!

Gas Detection with IR Cameras

User Benefits

- Visualize and trace gas leaks
- Reduced inspection time
- Improve worker safety
- Efficiently reduce revenue losses

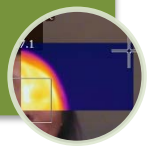
FLIR GF320

Image quality

- 320x240
- <25 mK
- 60 Hz
- -40 °C to +350 °C
- 1°C/1%

Modes

- **Gas Imaging**
- Thermal
- High Sensitivity Mode
- Visual (3.2 Mpixel)
- Simultaneous storage
- Periodic storage



Gases

- Methane (Nat. gas)
- Propane, Butane (LPG)
- C5-C8
- Ethylene & Propylene
- Methanol & Ethanol
- >20 gases in total

Interfaces &Reporting

- Video editing SW
- Quick report
- Digital video output
- USB

Easy of use

- Optimized ergonomics
- Multi-angle handle
- Bright 4.3” LCD
- Tiltable high resolution viewfinder

Other

- Laserpointer
- LED lights
- Full range of optics
- Zoom
- GPS

Exportability of GF-series

- The FLIR Systems AB manufactured GF- camera is not controlled by the US Government
- The GF camera is considered as a dual use item and requires an export authorization to all destinations outside EU.
- FLIR Systems AB has a global permit issues by the Swedish authorities which allows FLIR Systems to export to some countries as long as it is for civil end use such as pre-maintenance etc.
- Indonesia, Malaysia, Thailand, Philippines, Singapore, Vietnam, Brunei and Taiwan are approved countries on the Swedish global permit for export of the GF-series.
- FLIR Systems AB do not need to obtain any further authorization from any other authorities prior delivery when an order is approved on the global permit.

FLIR GF320: Gases that can be detected

Gas	Gas
Methane	Isoprene
Ethane	1-Pentene
Propane	Benzene
Butane	Toluene
Pentane	Xylene
Hexane	Ethyl-Benzene
Heptane	Methanol
Octane	Ethanol
Ethylene	Methyl Ethyl Ketone (MEK)
Propylene	MIBK

Controlled lab tests

Gas	2005 (g/hr) by GasFindIR	2009 (g/hr) by GF320
Methane	0.8	0.4
Ethane	4.4	1.1
Propene	2.9	1.7

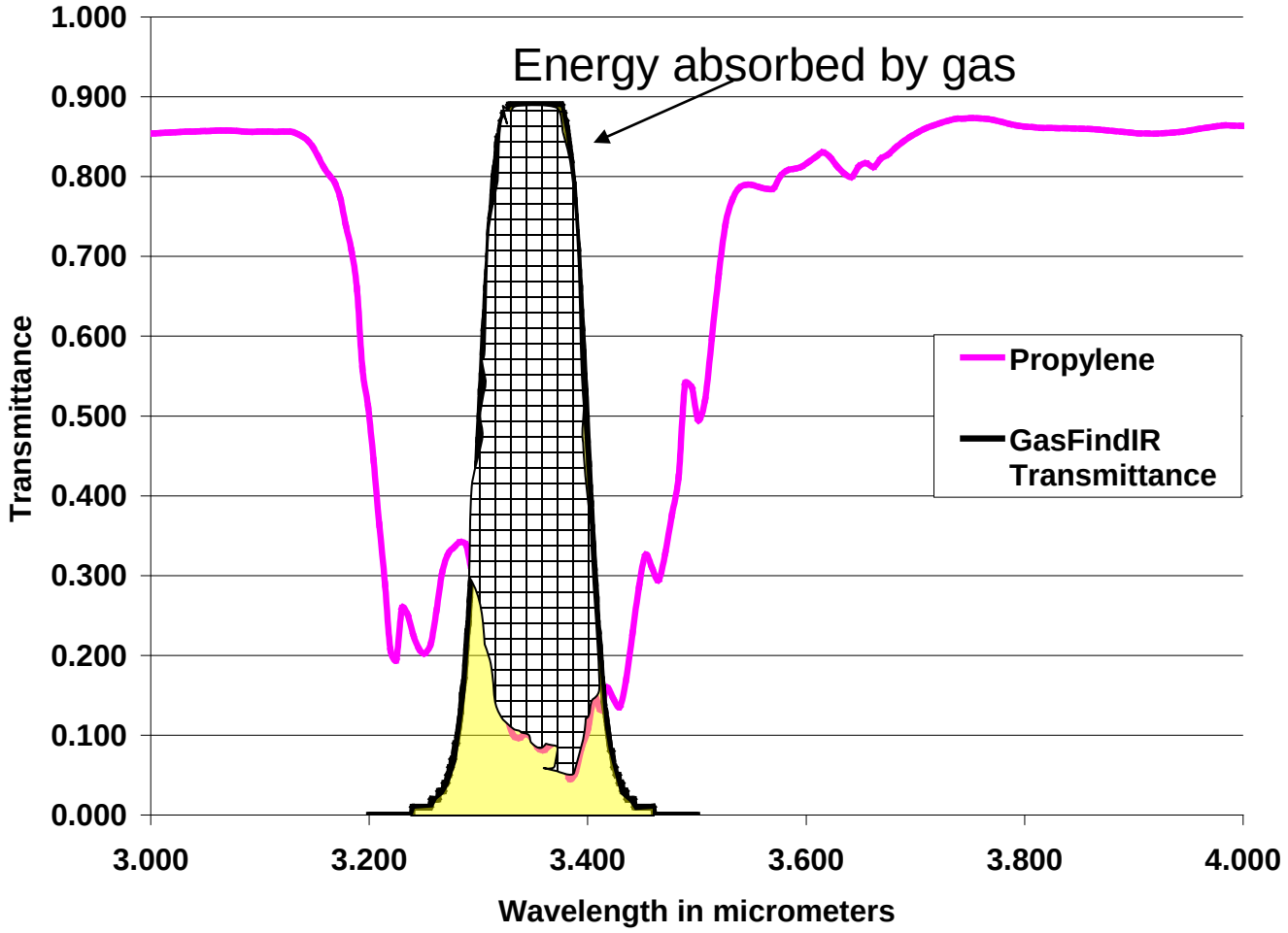
Change colour palettes

How Can We See Gas?

How can we see gas?

- Gas movement
- Temperature difference between gas and background is essential
- Spectral filter ~3.3 µm
- Very sensitive cooled detector technology. Using InSb detector produced by FLIR
- Detector operated at ~70 K
- Gas filter (spectral filter) must be cooled for best performance

Spectral filter corresponding with IR radiation absorbed by gas



Applications & Users

Applications

- Refining Industry
  - Light hydrocarbons & Aromatics
- Natural Gas Industry
  - Methane
- Waste treatment/Biogas production
  - Methane
- Petrochemical Industry
  - Ethylene & Propylene

Outdoor – LPG Compressor

Industry: Petro Refinery

Application:

Verify flange seals do not leak.

Inside story:

I was approximately 8-10 Meters away from the compressor. If you look at the flange on the left, it is clear there is a leak, which has been “tagged” by the TVA technician. If you watch the video I was also able to find a leak coming from the right flange. The technician missed this one and did not believe me. After watching the video he put his TVA at the leak and it “flamed out.” Meaning it was over the maximum.

Natural Gas Compressor Stations

Measurement Technology

Hi Flow® Sampler

- volumetric leak measurement
- vacuum flow rate detection uses dual-element hydrocarbon (methane) detector
- measures hydrocarbon concentrations in the captured air stream and determines the leak flow rate (+/- 10%)

Benefits :

- offers a much higher accuracy of measurement (compared to conventional methods)
- allows an objective cost-benefit analysis of each repair opportunity

Outdoor – Storage Tanks

Industry: Storage & Transport

- Applications:
  - See Gas Leaks
  - Check tank levels for product
  - Confirm sludge levels

Inside story: This is one of the first demos we did. The customer was very excited because they had no idea that the camera was able to show them how bad they were venting. Very impressed with the ability to see the tank levels.

Users














- Major Multinational Petrochemical companies have bought into FLIR's OGI technology
- Technology now accepted as a legitimate and practical way to find leaks
- Major Power & Utilities worldwide are starting to use GF306 for SF6 detection

Let’s Fix the Leak!

Industry: Petro Refinery

Application:

- Fixing leaking isolation valve

Inside story:

This leakage was found during a quick scan of the plant area. As you can see this is a relatively small leak but the TVA indicated 150.000 ppm. This leak was an easy fix and the repair could be verified with the OGI camera from FLIR.

Seeing is Believing!

Demonstration outside

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Thank you!