Introduction to Optical Gas Imaging

PIOGA Air Quality Compliance Training
October 12, 2017
What is Infrared Spectroscopy and how is it used for OGI?
Frederick William Herschel (1738 – 1822)

- German-born British Composer, Mathematician and Astronomer
- Built several telescopes in his backyard
- Discovered the planet Uranus in 1781
- Defined IR spectroscopy as the “measurement of light absorption in the infrared”
Herschel Experiment (March 1800)

- IR radiation can be felt, but not seen by the human eye.
- The absorption of IR radiation transfers energy and heats the surface (blackened thermometer).
FLIR GF320: 3.2 – 3.4 μm

Infrared Region

- Near IR: 0.7–1.4 μm
- Short Wavelength IR: 1.4–3.0 μm
- Mid Wavelength IR: 3.0–8.0 μm
- Far Wavelength IR: 8.0 μm–1.0 mm

Group Frequency Region

Fingerprint Region

- Gamma: 1 x 10^{-14}
- X-Rays: 1 x 10^{-12}
- Ultraviolet: 1 x 10^{-8}
- Radar: 1 x 10^{-4}
- FM: 1 x 10^{-2}
- TV: 1 x 10^{1}
- Shortwave: 1 x 10^{4}
- AM: 1 x 10^{5}
Methane at 5C (1ppm-m)
Ethane at 5C (1ppm-m)
Propane at 5C (1ppm-m)
Butane at 5C (1ppm-m)
Are there any compounds that do not absorb in the IR?

• Homonuclear molecules
Infrared Detectors
FLIR GasFindIR GF320

• Needs to be cryo-cooled using on board Stirling cooler
• Excellent performance in the 1 to 5.5 µm wavelength region
• Susceptible to IR overdrive damage
How do I determine whether my target gas can be seen with the FLIR GF320?
FLIR to the rescue.

Gases Detected and Minimum Detected leak rate (MDLR)

Independent laboratory (third party) testing confirms that the GasFindIR cameras can see the following gases at the minimum detected leak rate (MDLR):

- 1-Pentene - 5.6g/hr
- Benzene - 3.5g/hr
- Butane - 0.4g/hr
- Ethane - 0.6g/hr
- Ethanol - 0.7g/hr
- Ethylbenzene - 1.5g/hr
- Ethylene - 4.4g/hr
- Heptane - 1.8g/hr
- Hexane - 1.7g/hr
- Isoprene - 8.1g/hr
- MEK - 3.5g/hr
- Methane - 0.8g/hr
- Methanol - 3.8g/hr
- MIBK - 2.1g/hr
- Octane - 1.2g/hr
- Pentane - 3.0g/hr
- Propane - 0.4g/hr
- Propylene - 2.9g/hr
- Toluene - 3.8g/hr
- Xylene - 1.9g/hr
What if my target gas is not on the list?
NIST Chemistry WebBook

NIST Standard Reference Database Number 69

View: Search Options, Models and Tools, Special Data Collections, Documentation, Changes, Notes

Credits

NIST reserves the right to charge for access to this database in the future.

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Propene

INFRARED SPECTRUM

FLIR GF320:
3.2 – 3.4 \( \mu \text{m} \)
3120 – 2940 \( \text{cm}^{-1} \)

NIST Chemistry WebBook (http://webbook.nist.gov/chemistry)
General Warnings

• Do not point the camera at any object that has surface or reflected temperature in excess of 662 °F (350 °C)

• Do not point the camera at the sun
Conclusion

• Knowledge of basic thermographic principles can be a valuable advantage in OGI

• Use the NIST website as a reference for detectability
Additional Resources

- NIST: webbook.nist.gov/chemistry
- ITC: www.infraredtraining.com
- FLIR: www.flir.com/ogi/