



G L O B A L F O R U M

On Flaring and Venting Reduction
and Natural Gas Utilisation

Tank Inspection at Shell Refinery Gothenburg, Sweden

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Objective

- Quantify and verify VOC emissions for storage tanks
 - Quantitative with Fluxsense TCT method
 - Pin pointing leaks with Optical Gas Imaging (FLIR GasFindIR)
- Compare above results with current API algorithms for estimation of tank emissions
- Concawe has evaluated different methods for detecting and measuring leaks, among them GasFindIR. This presentation is based on the tank inspection described in their report No. 6/08 "Optical methods for remote measurement of diffuse VOCs: their role in the quantification of annual refinery emissions".

Topics

- Fluxsense Time Correlation Tracer (TCT) method
- Optical Gas Imaging (OGI) with FLIR GasFindIR
- Result from tank inspection Shell Gothenburg
- Other equipment leaks at Shell Gothenburg

Combined Measurements at Shell Refinery

Shell refinery in Gothenburg, Summer of 2007

To quantify emissions:

Company: FLUXSENSE

www.fluxsense.se

Methods: SOF and TCT



Fluxsense personnel driving with their test equipment along the plants in Houston ship channel

To identify and locate the leakages:

Company: FLIR SYSTEMS

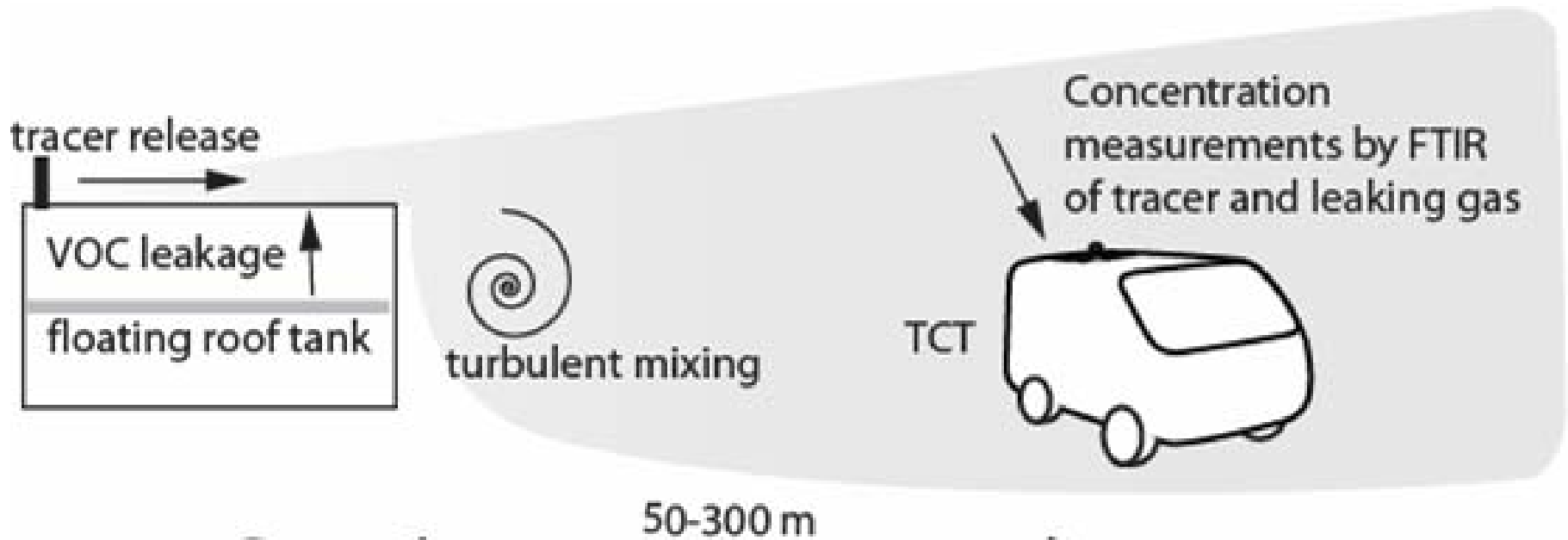
www.flirthermography.com

Method: Special Infrared camera
model called "GasFindIR"

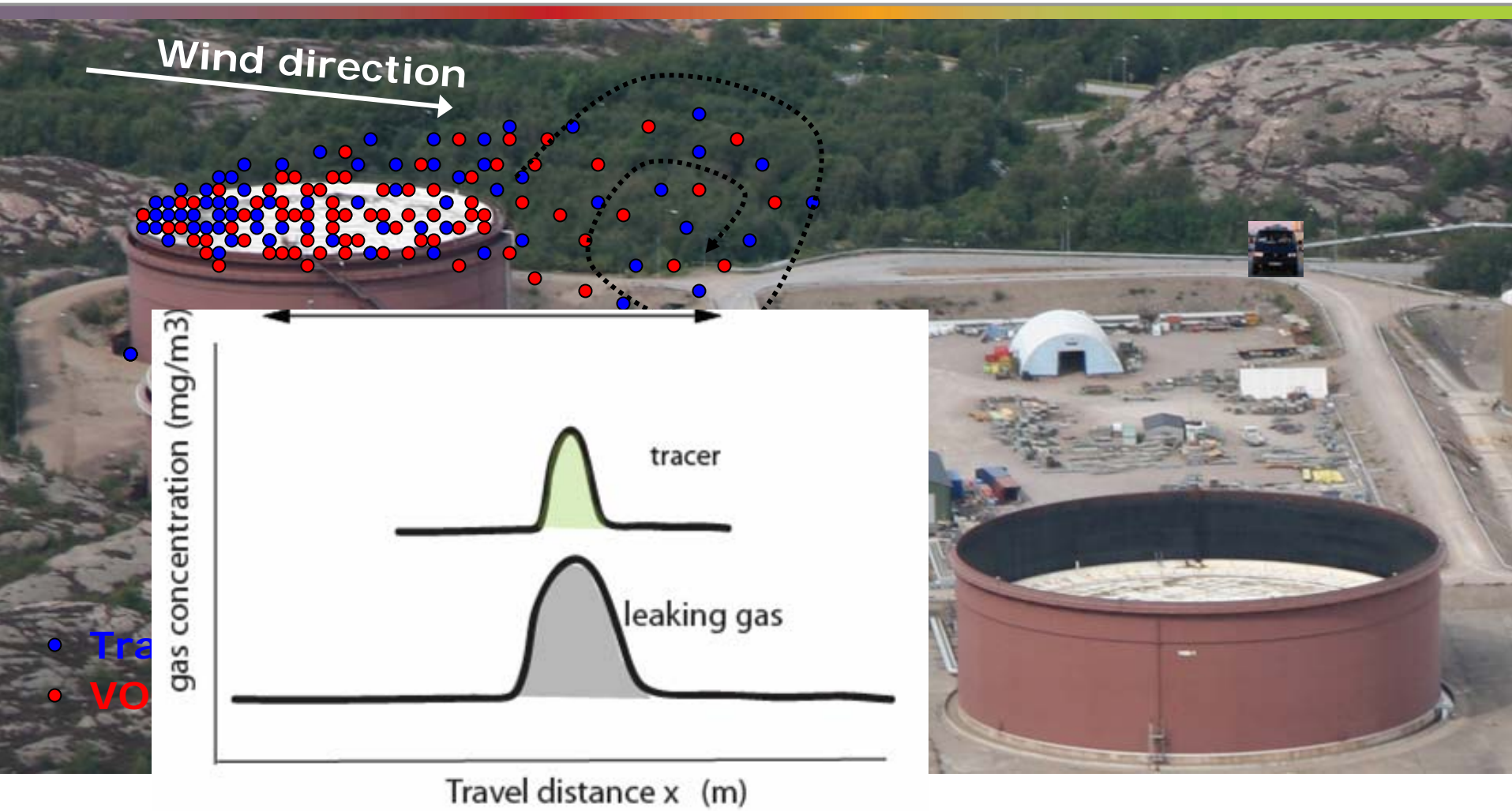
Inspection with the GasFindIR camera, a handheld IR camera for gas detection



Time correlation tracer (TCT) method



Tracer methodology – crude oil tank



The tracer provides the gas dispersion – the VOC/N₂O concentration ratio, integrated across the plume is measured., yields the emission in kg/h

GasFindIR – Optical Gas Imaging



- Infrared camera for real time gas leak detection
- Narrow-band passive infrared technology
- Simple to use and easily portable



GasFindIR - Tested Gases

| Compound | Compound |
|-----------|---------------------------|
| 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 |

GasFindIR – Optical Gas Imaging

- Real-time visualization and documentation of gas leaks
- Trace leaks to its source
- Reduced inspection time
- Perform safer inspections
- Inspection without interruption of process
- Verification of repairs

Seeing is Believing!

Shell Tank Inspection Video



Results from Tank Inspection

| Service | Type | Emission TCT ton/year | Emission API ton/year | # Leaks (FLIR) |
|--------------------|---------------------|----------------------------------|----------------------------------|---------------------------|
| Crude oil slops | EFRT double seal | 4 | 3 | 1 |
| Crude oil | EFRT double seal | 35 | 4 | 4 |
| Crude oil | EFRT double seal | 120 | 4 | 22 |
| Reformate | IFRT double seal | <1 | 0.2 | 0 |
| Heavy fuel oil | External roof | <1 | 1 | 0 |

Results from a study where the emissions from tanks have been measured with TCT (one of Fluxsenses two methods), calculated with the API model and leak search has been conducted with an infrared camera (FLIR GasFindIR).

Tank Inspection Conclusions

- Tests show a fair correlation between #leaks detected with FLIR and quantification with SOF-TCT for tanks
- When API's estimates are compared with the quantitative methods it showed that the the real emissions were at least 5-10 times higher compared with the estimate.
- The FLIR provides the locations of the leaks but not quantitative estimates of the leakage rate. The latter may be necessary for calculating whether it is worth to invest in repairs. The combination of the two techniques is hence very attractive.

Productions site - Shell



Equipment leaks production site

**Leak Detection
using FLIR GasFindIR**

**Shell, Göteborg, Sweden
2007**

Conclusions Concaawe Report

- Conclusions (page 38 in the report)
"... Recently developed optical gas imaging (OGI) techniques permit remote leak detection with hand held, relatively simple to use cameras. All components can be scanned and surveys can be completed at a much faster rate. An OGI leak detection survey can identify the "significant emitters" permitting focused equipment maintenance and subsequent emission reductions. The use of OGI cameras has been demonstrated to be a viable alternative to sniffing with conventional detectors..."

More Information

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