



NISTM

**6th Annual Aboveground Storage Tank Conference & Trade Show
Houston, Texas | September 19, 2013**

**“Pictures” the Emissions of Storage Tanks
with the Use of Infrared Cameras**

The Sniffers nv, Belgium

Agenda

- **Intro TS**
- **Possible techniques**
- **Examples and Case studies**
- **Lessons learned**
- **Q&A**

Short review of The Sniffers

- 1. The Sniffers is a service company which has 2 main focus area's:**
 - 1. Emission - and energy loss reduction management**
 - 2. Pipeline inspection and – management services**
- 2. Founded in 1991**
- 3. Real take off was in 2002 with 4 persons**
- 4. Today we operate with between 110 and 140 employees, mainly field operators**
- 5. Our focus market are Europe and Middle-East**
- 6. Looking now to expand to Asia/(Latin-)America and EEU**
- 7. Today we have project references in more than 20 countries**
- 8. ISO 9001 and VCA** certified since 2003**
- 9. In January we finalized our first Acquisition: Leak Consultancy, Dutch company**
- 10. Today our shareholder structure is:**
 - 1. 80% the Carlyle Group (US)**
 - 2. 20% private**

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Possible Techniques

- 1. On storage tanks, we can executed the following inspection services:**
 - 1. Infrared screening and concentration determination**
 - 1. Screening of the tanks with a portable infrared gas imaging camera**
 - 2. All (bigger) emission sources are visualized by this camera**
 - 3. All emission sources are reported and transferred to a maintenance report**
 - 2. Thermographic Screening**
 - 1. Screening of the tanks with a portable infrared thermo camera**
 - 2. With this camera, we can image hot spots, corrosion failures,**

Infrared screening

1. IR screening with infrared camera GF320 from FLIR and/or EyeCGAS from Opgal is an effective way to find the significant leakers on a cost-efficient way
2. Concentration determination of all found leaks: The concentrations of all found leaks can be measured with a FID TVA1000B to quantify these leaks or with the High flow sampler technique.
3. The measured ppm values are converted to emission loss (kg/year) and these calculations are based on the EPA Correlation method 21 SOCMF factors or quantification through the HFS sampling method

EyeCGas



FLIR GF320

Infrared camera for gas leak detection and electrical inspections

The new FLIR GF320 is a revolutionary infrared camera capable of finding Methane emissions or other Volatile Organic Compounds (VOC). It is unbeatable for detecting even the smallest gas leaks.

- Real-time visualization of even very small gas leaks thanks to the Excellent High Sensitivity Mode (<math><25\text{mK}</math>)
- High performance LCD & Tilttable high resolution viewfinder delivers bright and vivid image in poor lighting environment or under



Thermography

1. Inspection done by level 2 Certified operator (highest level for thermograph inspections)
2. A thermographic study can be performed to investigate the state of the insulation
3. Temperature deviations between different connecting parts may indicate insulation defects.
4. A thermographic camera detects radiation in the infrared range of the electromagnetic spectrum.

FLIR T620 & T640

High performance thermal imaging with on-board 5MP visual camera, interchangeable lens options with autofocus, and large 4.3" touchscreen LCD

These thermal cameras combine excellent ergonomics with superior image quality, providing the ultimate image clarity and accuracy plus extensive communication possibilities:

Highest IR Resolution in Its Class - Crisp thermal images with 307,200 pixels (640 x 480) for the best detection, pictures, and temperature measurements from long range



Thermography

5. The radiation intensity has been measured with a thermal camera. The radiation intensity depends mainly on the radiant power, emissivity of the screened object and the temperature. The amount of radiation emitted by an object increases with temperature.
6. Temperatures of objects can be measured from a distance, these parameters have to be corrected. The temperatures mentioned in this report have been corrected.
7. Deriving temperatures from the color scale is only possible for an indication of temperature.

FLIR T620 & T640

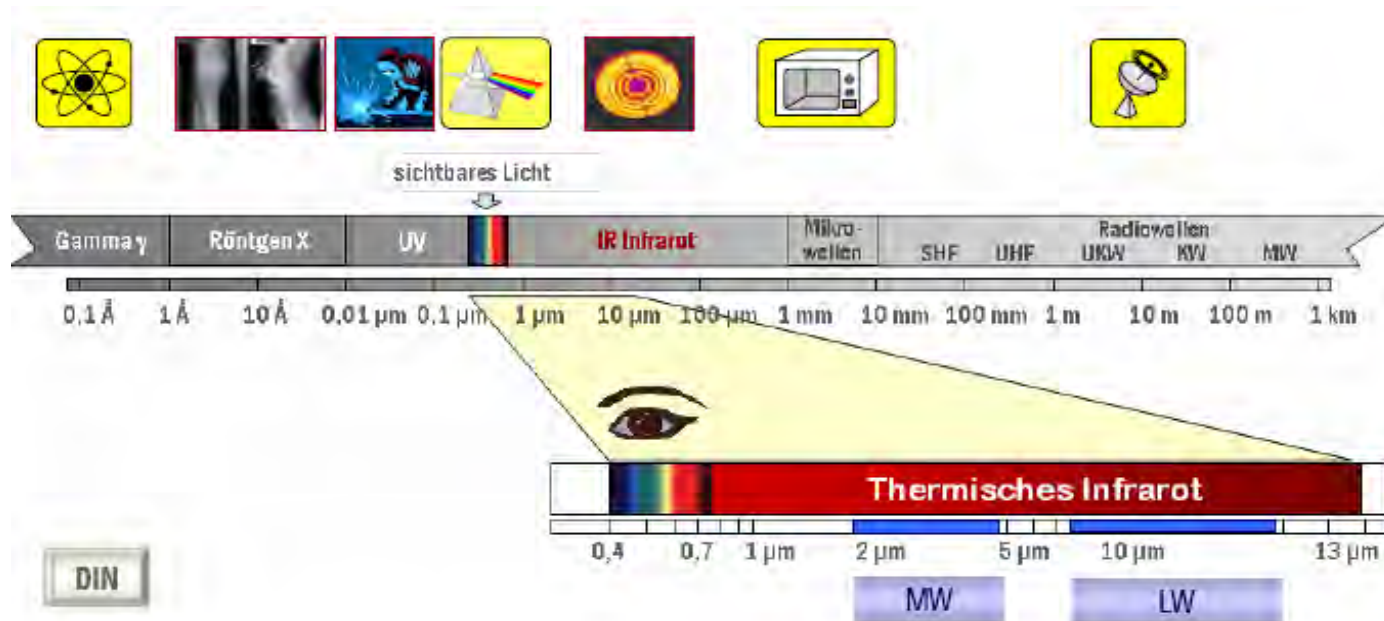
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Thermography

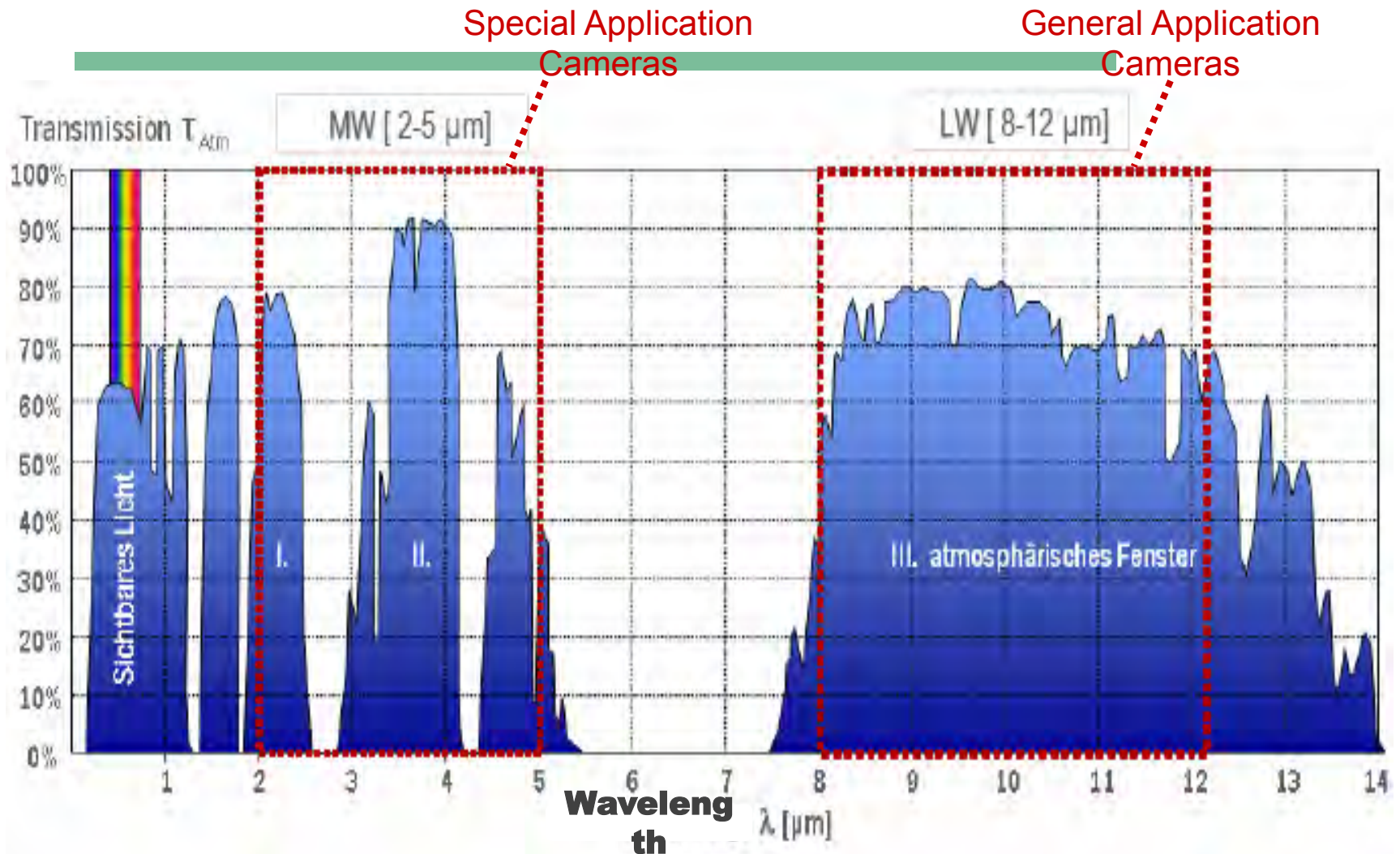


- visible light: $0,4 \mu\text{m} < \lambda < 0,7 \mu\text{m}$
- infrared radiation: $0,7 \mu\text{m} < \lambda < 1000 \mu\text{m}$
- ➔ thermal infrared: $0,7 \mu\text{m} < \lambda < 14 \mu\text{m}$

IR-Cameras detects radiation in two bands

- MW - Mid Wave: 2 - 5 μm [prev.: SW shortwave]
- LW - Long Wave: 8 - 12 μm

Thermography



Imaging applications in 5 - 8 μm range are not possible due atmospheric absorption (H_2O and CO_2)

Possible extra Deliverables



Repair number	<input type="text"/>	Leak Equipment Code	06
LDAR project	<input type="text"/>	Source Code	2A

REPAIR ORDER

Site: SNIFFERS	System: 101A36	<input checked="" type="checkbox"/> Very big
Unit: MOL	EquipmentId: 0101KEV03	<input type="checkbox"/> Blind req.
Section: None	Level: 1	<input type="checkbox"/> Remark
Drawing: WANT-006-P-203	Routing nr:	<input type="checkbox"/> Insulated
Stream: Aceton-G	Access: Accessable	<input type="checkbox"/> Corrosion
Service: Gas / vapour	Manufacturer:	
Stream composition: Aceton (dimethylketon, propanon-2)	Line/Spec:	
Toxicity class: Organic gasses or vapours O3	Production Hrs: 6,760	
Equipment name: Relief Valve	Source name: Relief Valve (outlet), Outlet	
Equipment type:	Source location:	
Equipment Location: Above North-East side 101-A-36, n=0,25m	Size: 20 IN	
Detect equipm: HVM 630 FID, THIS	RF 500: 2,60	Leak Def.: 9
Calibration medium: Methane (sardgas)	RF 10000: 1,40	Tag Def.: 10,000
Calculation method: Correlation Socmi	Status:	Repair Def.: 10,000

Historical measurement data

Date	PPM	Loss kg/yr	Operator	Source information	Repair Action
21/02/2005	100,001	4,717,87	TM		
18/03/2005	100,001	4,717,87	TM		
12/05/2003	92	6,91	RN		

MAINTENANCE INFORMATION

Repair period:	Repair code:
Repair action:	Gasket/Sealing:
Repair date:	Repair executor:
Repair cost: 0,00	Monitor frequency: 0 (in days)
Repair memo:	Pre-information days: 0
Replace packing	




Agenda

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Infrared screening

3.2.3.2 Scheme : Tank FB-753

3.2.3.1 Specifications : Tank FB-753

Date	29/03/2013
Time	09h00u – 09h30
Product in tank	Ethylene (liquid)
Temperature of the tank	-100°C
Wind speed	3 m/s
Wind direction	North East
Cloudiness	Low
Ambient Temperature	3°C

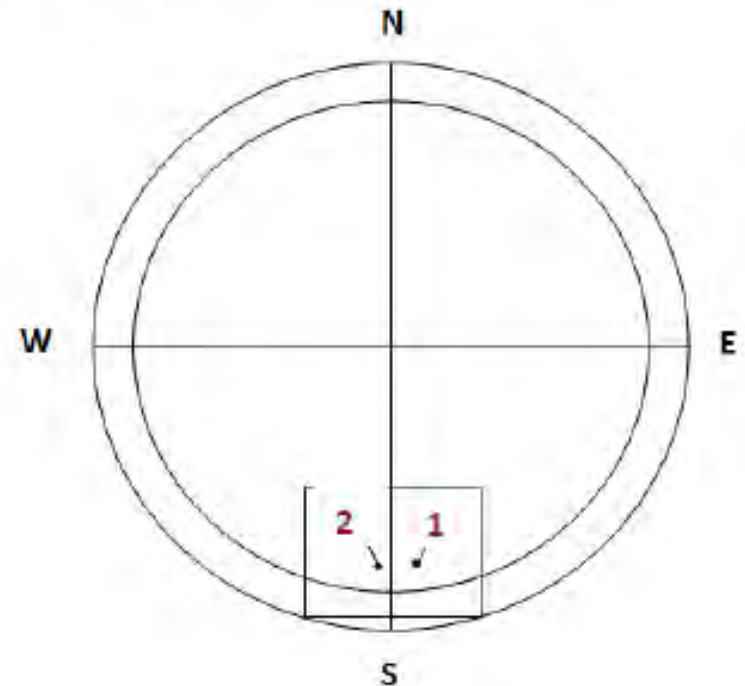


Figure 3-3: Scheme tank FB-753

*. 2 emission locations were found at on the roof, at the breather valves

Infrared screening

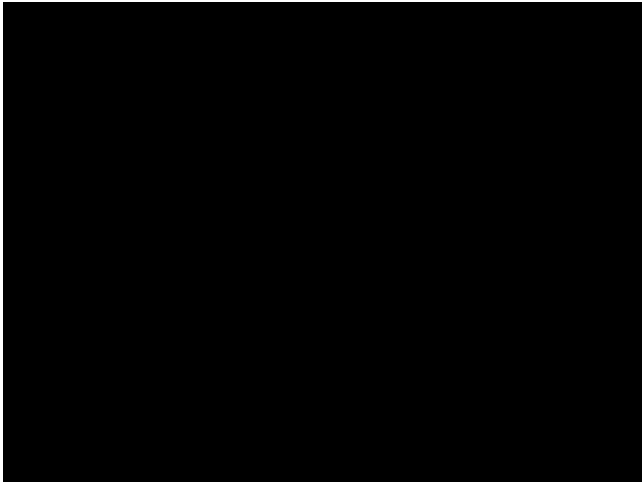


1. Visual inspection



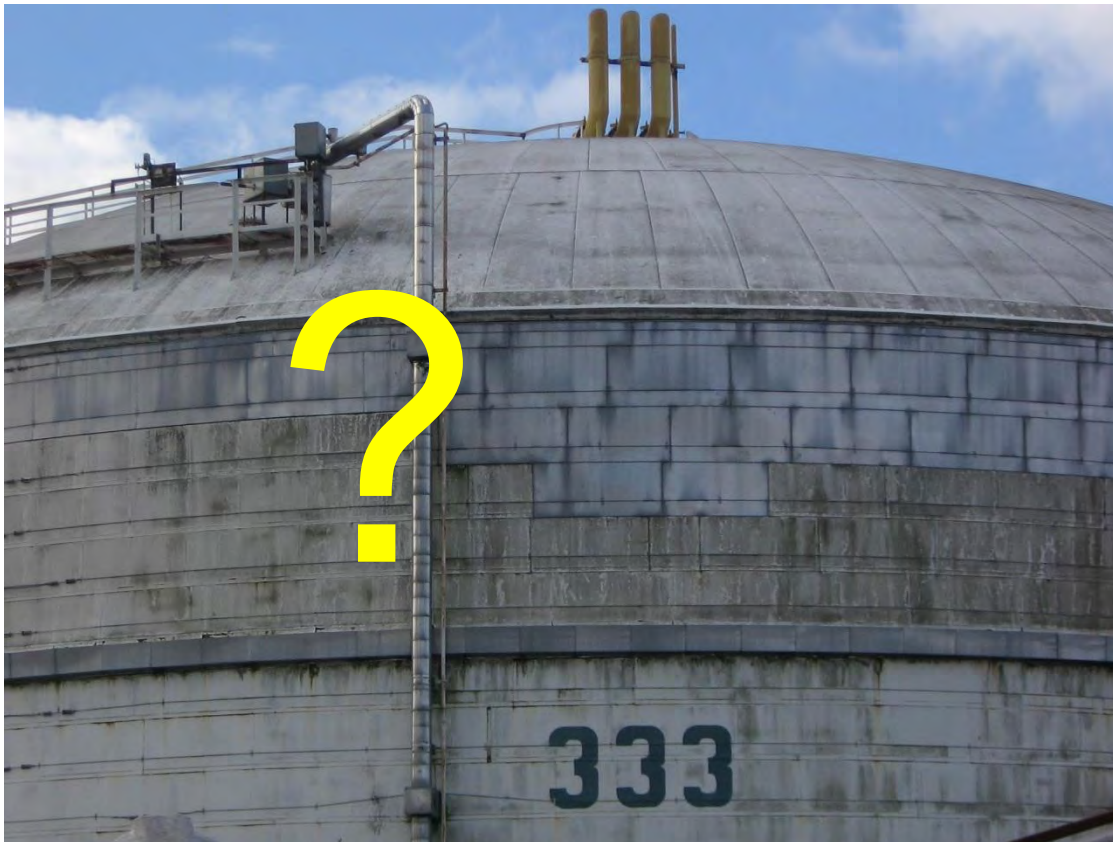
2. IR inspection

3. High resolution
mode inspection



Some examples

Propane Tank (propane)



Leak invisible with the naked eye!!

Some examples

1. Propane Tank (propane)



But with an
infrared leak
camera ...

Lessons learned: ex other movies



Thermography

Weather Conditions on 29/3/2013:

Temperature (outside)	4,5 °C
Wind	light breeze from north-eastern direction
Wind speed	2,3 m/s
Cloudiness	low - medium
Relative humidity	25%

Used devices:

- **Infrared camera**

Equipment	Flir Systems
Type	T-640 , serial number 55901349
Lens	23° and 45°
Resolution	640 x 480
Range	depending on the situation
Calibration	55901349/2013

- **Temperature measurement:** The ambient temperature during the measurements is recorded by a data logger and processed in the evolution of the images.

Equipment	ATAL
Type	ATV-11
Calibration Certificate	867375k63767

- **Anemometer:** The wind speed is determined at various locations by an anemometer

Device	Extech
Type	AN100 AAS
Calibration Certificate	AF Company

Thermography

2.2.2 Screening Positions

Each tank has been screened from different positions.

2.2.2.1 Tank FB-753

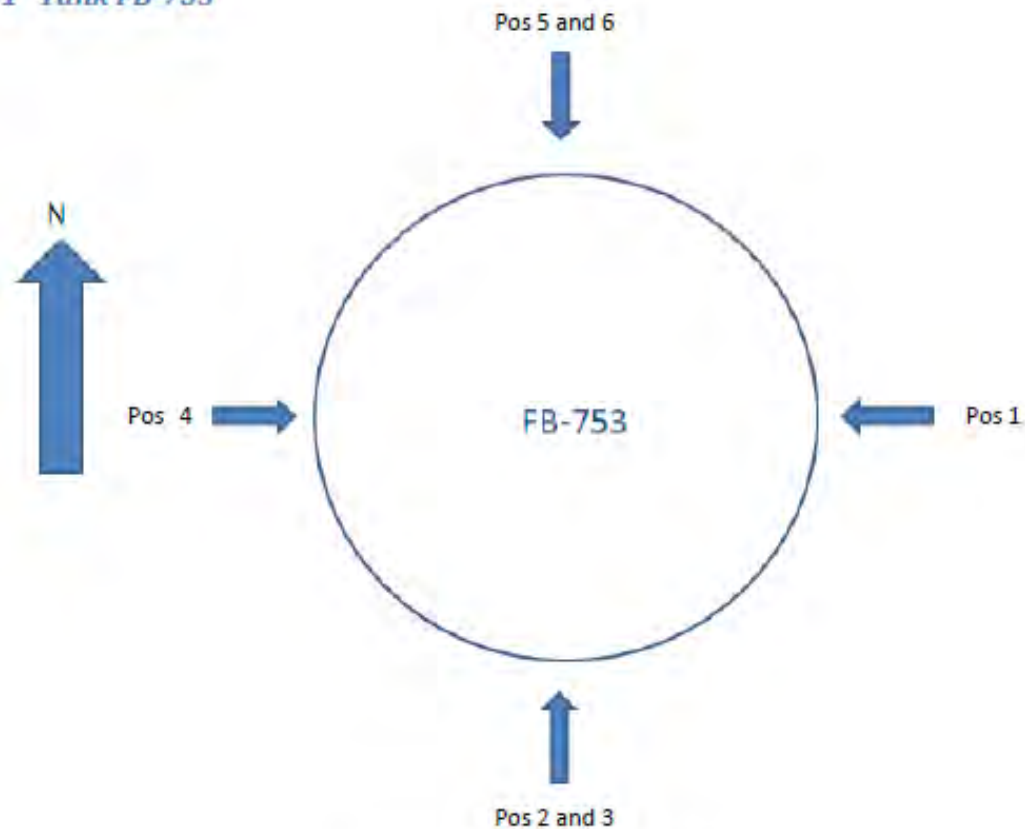


Figure 2-1: Screening positions Tank FB-753

Thermography

Thermographic Screening

THE SNIFFERS

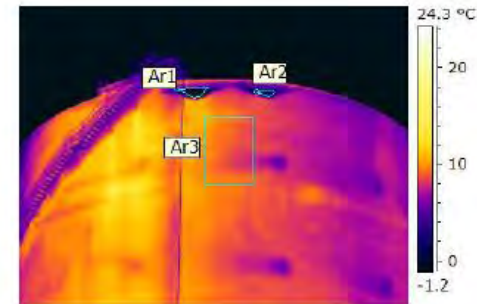
Identification

Location:	
Equipment:	Tank
Type:	FB-753
Product:	Ethylene
Position:	Pos 3
Deviation	(1)
Recommendation	Follow up – Plan a new inspection



Thermogram

Object Distance:	15.0 m
Atmospheric Temperature:	4.5 °C
Emissivity:	0.90
Reflected Temperature:	-5.2 °C
Ar1 Average Temperature:	-1.1°C
Ar2 Average Temperature:	-0.4 °C
Ar3 Average Temperature:	9.0 °C



Analysis & Recommended action

- The average temperature of Ar1 en Ar2 is 10.0°C lower than the connected wall (Ar3). Ice is formed on the wall of the tank. Deviation

Thermography

Thermographic Screening

THE SNIFFERS

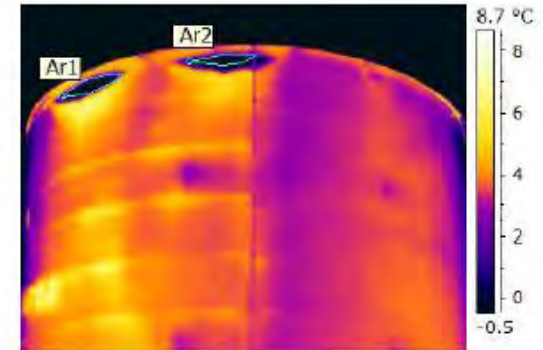
Thermogram

Identification

Location:	I
Equipment:	Tank
Type:	FB-752
Product:	Ethylene
Position:	Pos 8
Deviation	(1)
Recommendation	Follow up – Plan a new inspection



Object Distance:	15.0 m
Atmospheric Temperature:	4.5 °C
Emissivity:	0.90
Reflected Temperature:	-7.4 °C
Sp1 Average Temperature:	-0.9 °C
Sp2 Average Temperature:	-2.1 °C

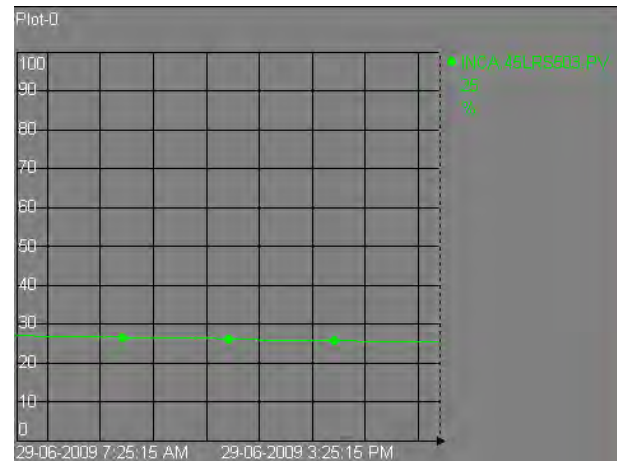
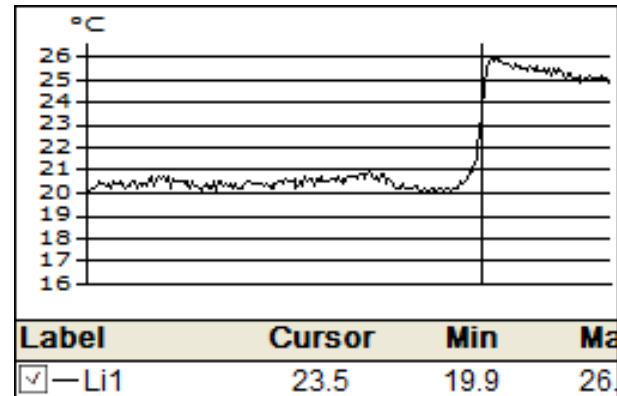
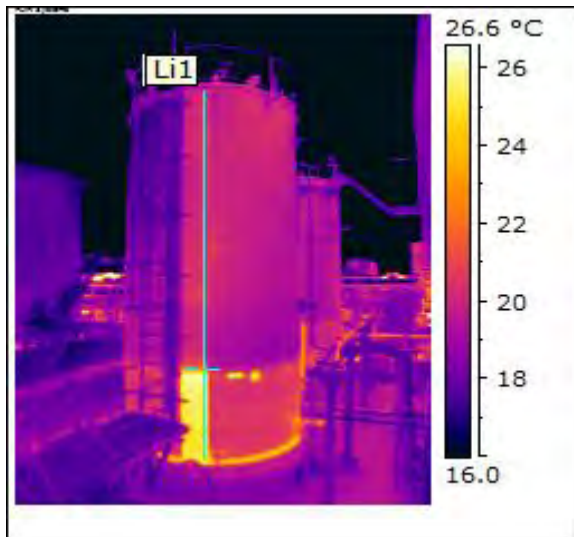


Analysis & Recommended action

- The average temperature of Ar1 is ca. -0.9°C and the average temperature of Ar2 is ca. -2.1°C . It is recommended to follow up these locations and to plan a new inspection. Deviation

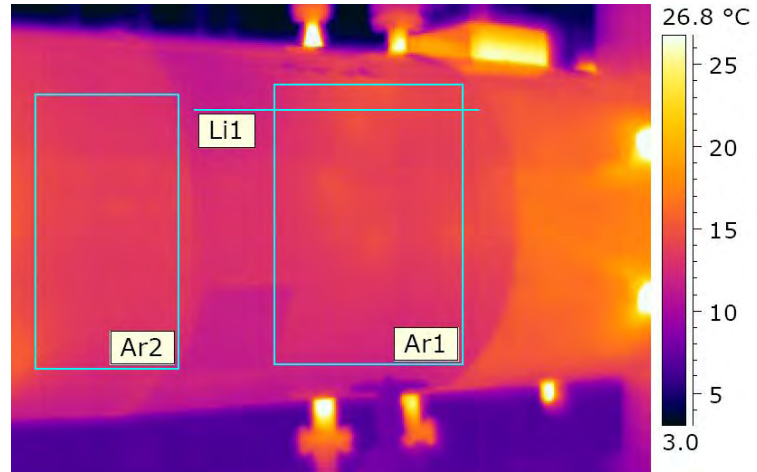
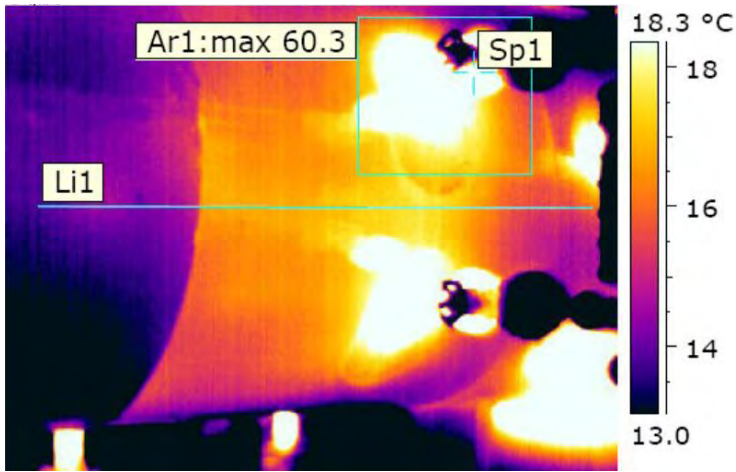
Other Case study ex.

- TANK LEVEL MEASUREMENT



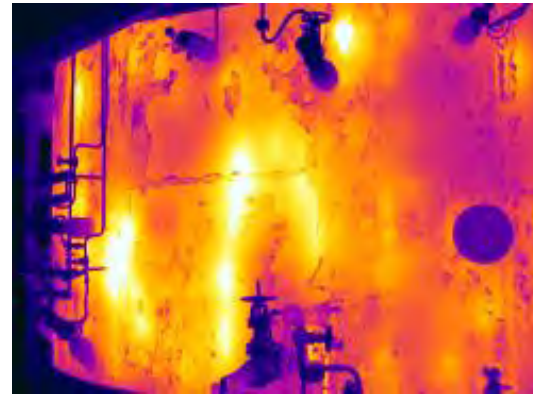
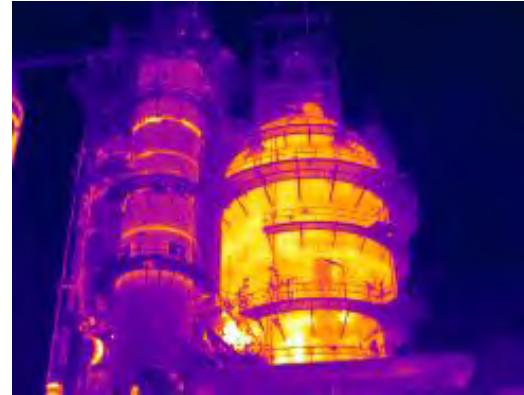
Other Case study ex.

- example Corrosion under insulation



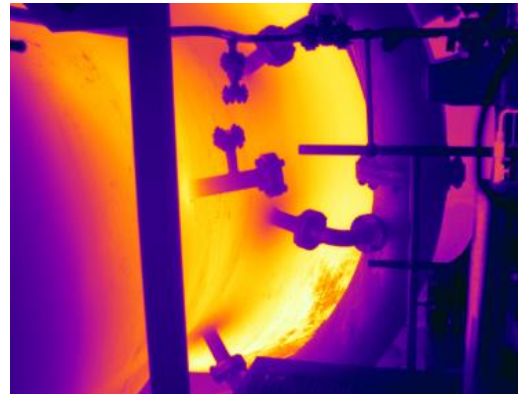
Other Case study ex.

- CONDITION MONITORING CAT CRACKERS
- INSPECTIONS EVRY MONTH



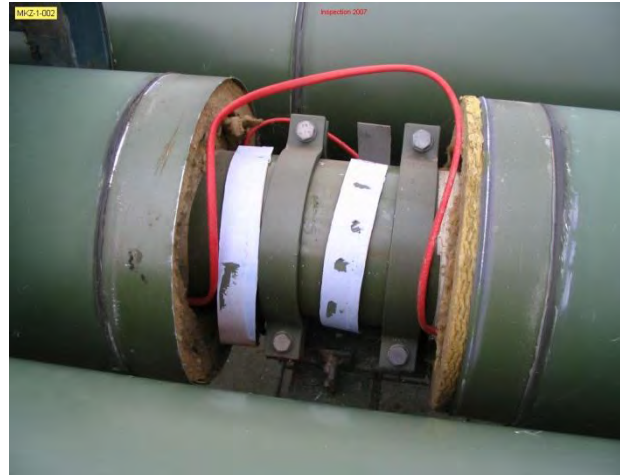
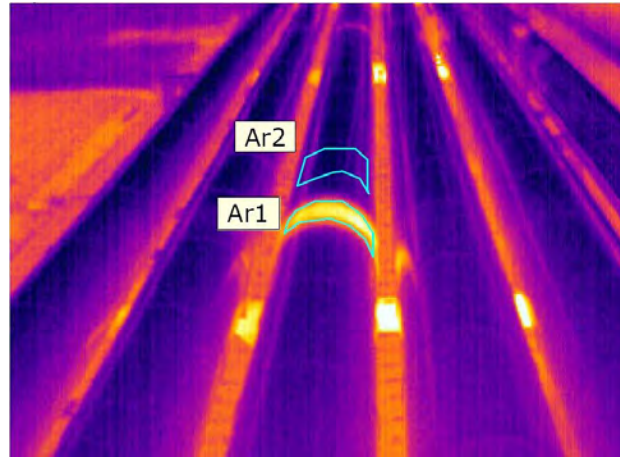
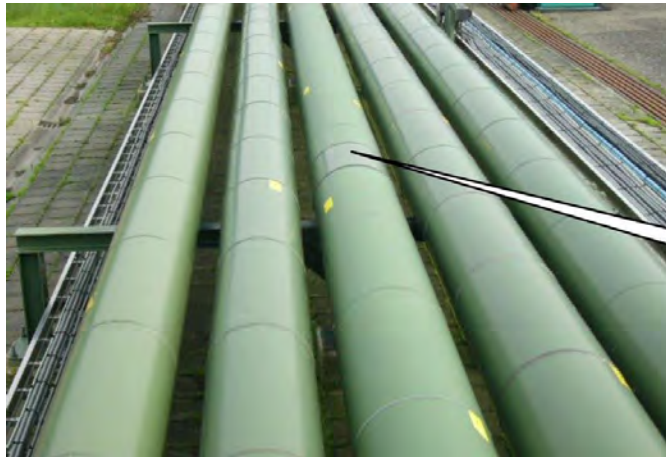
Other Case study ex.

- CONDITION MONITORING FURNACE
- INSPECTIONS EVRY MONTH



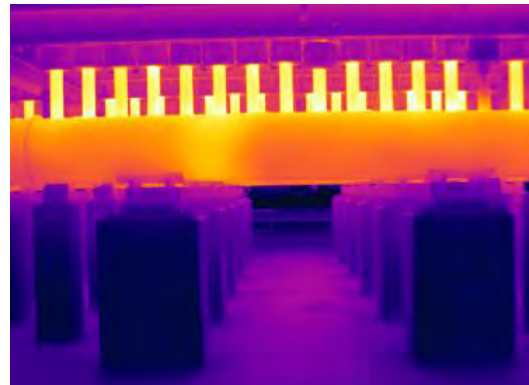
Other Case study ex.

- Example: Insulation forgotten after maintenance



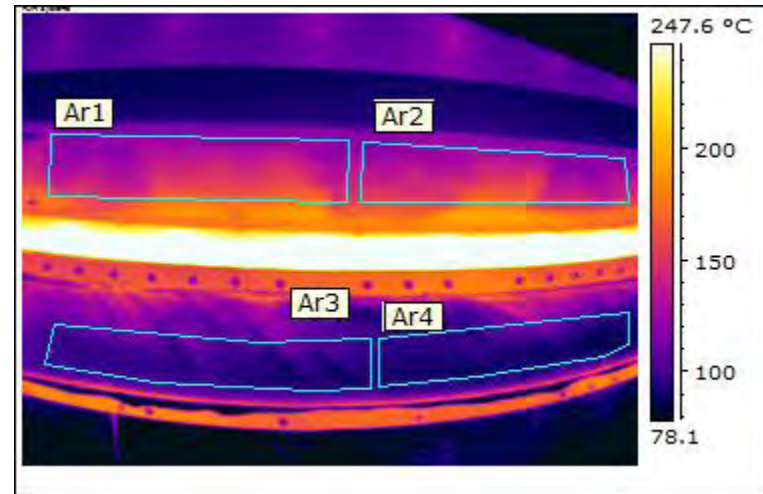
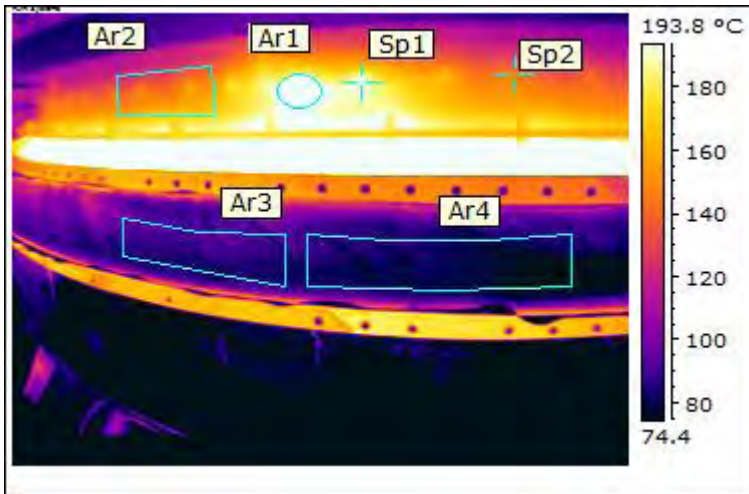
Other Case study ex.

- CONDITION MONITORING FURNACE
- INSPECTIONS EVRY MONTH



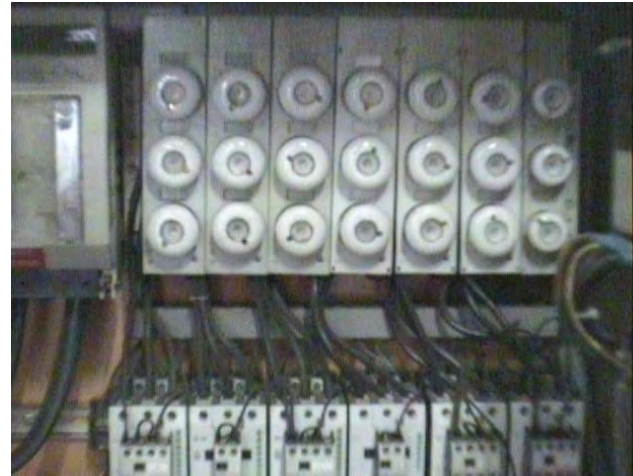
Other Case study ex.

- 'BEFORE' AND 'AFTER' INSPECTION OF INSULATING COMPOUND APPLICATION



Other Case study ex.

- Example electrical inspection



Agenda

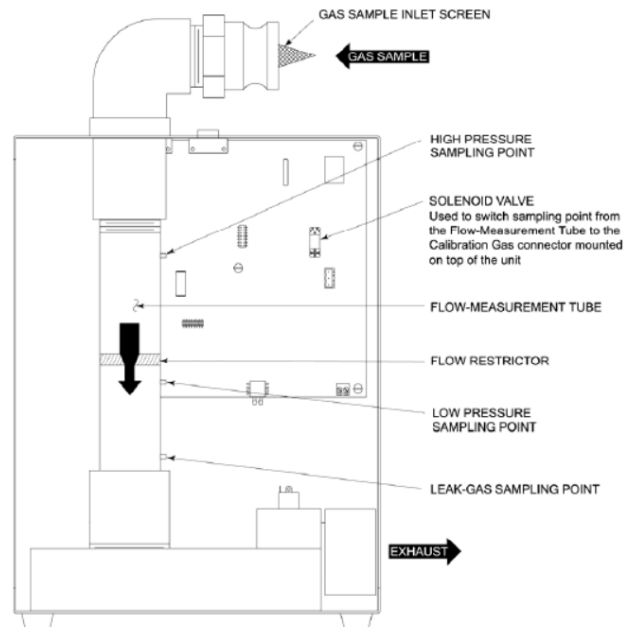
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- **Possible Techniques**
- **Examples and Case studies**
- **Lessons learned**
- **Q&A**

Lessons Learned

- 1. Infrared Imaging:**
 - 1. “fast” screening (SMART LDAR) is relative**
 - 2. Experiences and certifications are very important due to:**
 - 1. Screening during Loading and/or in normal operation**
 - 2. Wind**
 - 3. Sun**
 - 4. Level of Volume in the storage tank**
 - 3. Ideal tool for preventive maintenance and priority setting**
 - 4. Good tool for the storage tanks there we don’t need to access the roof and screen from distance**

Lessons Learned

1. **Emission detection by infrared gas imaging:**
 1. **Ideal tool to analyse efficiency of brather valves and storage tanks**
 2. **More realistic calculations can be realized with High flow sampler technology**
 1. **The high flow sampler device is a portable, intrinsically safe device which is doing measurements based on a flow rate – concentration combination and therefore is the only technique able to calculate actual emission losses coming from a leaking equipment.**



Lessons Learned: legislation on gas imaging on storage tanks

1. The Netherlands and Belgium:

1. Previous years, test are being done with Optical IR gas camera's, DIAL and SOF
2. In the Netherlands: several storage tanks camera's are since 2 years now obligate to screen the storage tanks with Infrared gas imaging camera.
3. In Belgium: government is now reviewing the different techniques for storage tank inspection on emissions together with Fedichem and Sniffers

Lessons Learned

2. Thermography:

1. Experiences and certifications are very important due to:
 1. Influences reflections
 2. Wind
 3. Sun
2. Ideal tool for preventive maintenance and priority setting
3. The more measurements, the better the historical data will support your maintenance program

Lessons learned

IMPORTANT FACTORS

- Surface emissivity
- Type of material
- Surface texture (roughness)
- Angle of measurement
- Radiation wavelength
- Background radiation
- Determined by radiant heat from objects in the environment
- Material temperature

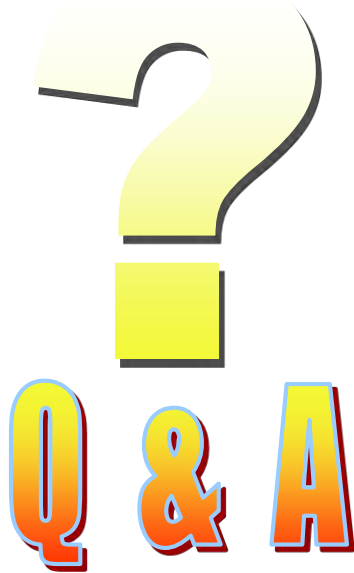
Lessons learned

KEY BENEFITS

- No-touch diagnostics
- Enables measurements on hot, moving, electrically charged, and remote objects
- Real-time, thus fast. Up to 50 frames/sec
- Results presented in two-dimensional view
- Enhanced interpretations based on comparison with surrounding surface areas
- Accurate within +/- 1 ° **C**
- Thermal sensitivity < 0.04 ° **C**

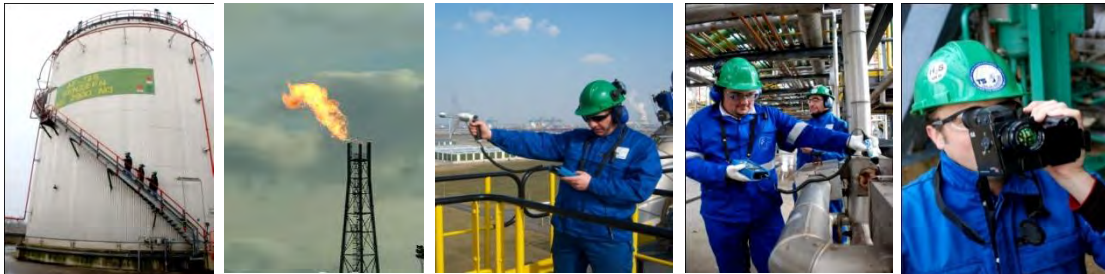
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Thank you

**Let's optimize your tank
management program together**