Methane Mondays

OGMP 2.0 compliant emission measurements

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Cindy Verhoeven – Regional Business Manager
Realizing your Environmental, and Sustainability Ambitions and safe Pipeline Operations

The Sniffers Environmental & Integrity Service Provider

Emission Management
Pipeline Integrity

35 Countries
Worldwide experience

9,000
Emission Reduction Projects

Innovative Technologies,
Equipment and Applications

Certified & accredited
ISO 9001 - 14001 / ISO 17025
612-TEST Belac  389-TEST Israc
Emission Reduction

Broad range of Services

- LDAR Fugitive Emission Management HFS / PID / FID
- Hybrid LDAR Fugitive Emission Management OGI Camera
- Methane Accounting Program / OGMP 2.0 compliance
- Storage Tank, LNG Emission Management
- Emission Management Software SFEMP
- IoT, Ai, Remote Sensing, Drones & Satellites Innovation

- Training Competence Development
- Environmental Program Development
- Benchmarking Emission Performance

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Level Scenario

**Level 1**
- Venture / Asset Reporting
  - Single, consolidated emission factors
  - Only applicable where company has limited information sharing

**Level 2**
- Emission Category
  - Report emissions based on methane emissions categories
  - Estimates based on emission factors

**Level 3**
- Emission Source Level
  - Emissions allocated to individual source types
  - Estimates based on generic emission factors
  - Source based inventory

**Level 4**
- Emission Source Level
  - Emissions allocated to individual source types
  - Estimates based on specific EFs and direct measurements

**Level 5**
- Site Level
  - Emissions allocated to individual source types
  - Reporting based on site-level measurements to reconcile source and site level emissions estimates

**GOLD Standard**
Plan in place to report at level 4/5 within 3 years (5 for JV's)

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Reporting against OGMP2.0

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What do companies want?
• Understand current emission picture
• Compliance
• Targets: Able to monitor improvements
• Data intelligence
• Reassurance: validation, prognoses...

Data needs to be:
• Complete
• Reliable
• Traceable
• Actionable
• Comparable

How?
Inventorizing
measuring
Structuring programs: LDAR

How not:
estimating
modelling
Random projects

OGMP 2.0 Moving from L1 to L5
Detailed and reliable emission data allows stepwise improvements
How to ensure success and drive emission reduction results?

1. **LDAR protocol**, standards / regulation (EPA M21, EN15446, OGMP 2.0, NTA8399)
2. **LDAR scope cycle**: Define annual measurement scope
3. **Inventory** of sources + VOC streams: Detailed, high quality and always up to date
4. Combine **carefully chosen measurement techniques**: FID / (Q)OGI / HFS / flowmeter / VPAC / drone / VSIR / fixed sensor …
5. **people**: Dedicated, skilled, experienced
6. Emission management **software** (forget about Excel)
7. **Optimize**: automation, innovation, software integration
8. **Discipline**: stick with the program cycle

1 = Identify    2 = quantify    3 = Improve

**LDAR cycle:**

1. **Program preparation** (software, scope, P&I’s)
2. **Source inventory** (High quality database)
3. **Onsite measurements** (ppm or Kg/year)
4. **Data analysis** (Validation, processing, calculation)
5. **Emission reporting** (intell for all stakeholders)
6. **Follow up advice** (Improvements, Repairs)

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1. Identify: Detailed & high quality inventory

2. Quantify: Fit for purpose measurements

3. Improve: Emission reporting and benchmarking, Software
**High quality Sources based measurements for fugitive emissions:**

**Most common techniques**

- **Bagging / HFS:**
  - Measurements: 25-50 sources / day
  - Direct loss measurement (Kg/yr)
  - Most accurate field measurement
  - Development of new emission correlation factors (e.g. CH4)

- **Sniffing (FID, PID, CH4 laser):**
  - Measurements: 800-2000 sources / day
  - Concentration measurement, converted into loss using correlation tables (EN15446, EPA M21 PI/SOCMI)

- **OGI (infrared camera):**
  - Screening: 2000-5000 sources / day
  - Only qualitative, converted into loss using Leak-no-leak factors, or combined with HFS / QOGI tablet / sniffing for quantification
**Mass Emission Calculations**

**PID-FID**
- EPA Method 21 Petroleum Industry factors

<table>
<thead>
<tr>
<th>Equipment Type (all services)</th>
<th>Default Zero Emission Rate (kg/hr/source)</th>
<th>Pegged Emission Rates (kg/hr/source)</th>
<th>Correlation Equation&lt;sup&gt;5&lt;/sup&gt; (kg/hr/source)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10,000 ppmv</td>
<td>100,000 ppmv</td>
<td>Mar</td>
</tr>
</tbody>
</table>

**Leak Rates for Petroleum Industry (Refinery, Marketing Terminals and Oil and Gas Production)**
- **Valve**: 7.8E-06, 0.064, 0.14, 2.29E-06xSV<sup>0.748</sup>
- **Pump**: 2.4E-05, 0.074, 0.16, 5.03E-05xSV<sup>0.610</sup>
- **Other**: 4.0E-06, 0.073, 0.11, 1.36E-05xSV<sup>0.583</sup>
- **Connector**: 7.5E-06, 0.028, 0.030, 1.53E-06xSV<sup>0.735</sup>
- **Flange**: 3.1E-07, 0.085, 0.084, 4.61E-06xSV<sup>0.703</sup>
- **Open-ended line**: 2.0E-06, 0.030, 0.079, 2.20E-06xSV<sup>0.704</sup>

**Optical Gas Imaging - OGI**
- Leak/No Leak Factors

<table>
<thead>
<tr>
<th>Component type</th>
<th>Emission factor type</th>
<th>Emission factor (g/h/component for specified leak definition (g/h))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td><strong>Valves</strong></td>
<td>No-leak</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>Leak</td>
<td>55</td>
</tr>
<tr>
<td><strong>Pumps, compressors</strong></td>
<td>No-leak</td>
<td>0.096</td>
</tr>
<tr>
<td></td>
<td>Leak</td>
<td>140</td>
</tr>
<tr>
<td><strong>Hinges</strong></td>
<td>No-leak</td>
<td>0.0028</td>
</tr>
<tr>
<td></td>
<td>Leak</td>
<td>29</td>
</tr>
<tr>
<td><strong>Other components</strong></td>
<td>No-leak</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>Leak</td>
<td>55</td>
</tr>
</tbody>
</table>

- Development of new specific emission factors and CH4 correlation factors
High Flow Sampling or Bagging
Our custom made HFS in detail

1. Heavy-duty trolley
2. 1½” tubing, 2 auto-quick connectors
3. 3D-printed Intake
4. 3D-printed Exhaust + FID/PID connection for concentration (ppm)
5. Air fan, constant flow ± 205lpm, Explosion protected zone 1
6. Anti-static Capture bag, 80cm x 80cm with a 3D-printed connector
7. Methane Gas Detector 0.1ppm → 100VOL% 
8. In-line flow meter, daily check-up the flow of the air fan.
Hybrid emission calculation
Leak Quantification by QOGI

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Flaring or Venting
Loss of VOC’s, CH₄
Internally passing equipment
High losses

Examples:
pressure relief valves, safety valves, bypass valves, automatic regulated valves, check valves ...
### Results from Gas Plant Survey

<table>
<thead>
<tr>
<th>Equipment</th>
<th># Sources</th>
<th># Leaks</th>
<th>% leaks</th>
<th>Loss (Kg/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Valve</td>
<td>41</td>
<td>3</td>
<td>7,3</td>
<td>1.854.074</td>
</tr>
<tr>
<td>Hand Valve</td>
<td>108</td>
<td>3</td>
<td>2,8</td>
<td>39.852</td>
</tr>
<tr>
<td>Pressure Safety Valve</td>
<td>78</td>
<td>1</td>
<td>1,3</td>
<td>221</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0</td>
<td>0,0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>228</strong></td>
<td><strong>7</strong></td>
<td><strong>3,1</strong></td>
<td><strong>1.894.147</strong></td>
</tr>
</tbody>
</table>

Repairing only 3 control valves saves +1.800.000 kg/year of product
SMART scoping: Optimized effectiveness, lower cost

For building reliable emission data, it is not necessary to measure everything all the time!

- Combined Sniffing and OGI scope + HFS
- Detect all leaks above repair threshold
- Add Sniffing scope to keep level of detail
- Attention for equipments that have a high risk of leaking: e.g. pump seals, compressor seals
- Hazardous products (HAP’s) are covered
- Bottom Up approach → Actionable, data driven program

High quality program, focused on leaks with highest probability and consequence (RBI), and with limited investments

G1 = Group 1 equipments (high risk potential)
NA = Non-Accessible sources
HAP’s = Hazardous Products (e.g. benzene)
• **Maintenance:** Leak traceability and repair information, SAP integration, Inventory updates, bad actors.

• **HSE:** Leak follow up information and emission values, high focus on HAPS and risks, Emissions per medium, regulatory compliance.

• **Management:** Success rate of LDAR program, benchmarking

• **Board:** Corporate social responsibility, positioning of the company

• **Authorities:** Compliance audits, legislation, audit trails

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**Reports:** different results for different stakeholder
SFEMP Mobile: auditable processing of field data
LDAR Results -75% emission reduction

Emissions per Source kg/year

- Initial Emission
- 3,9
- Emissions Today
- 0,9
- 76%

Methane Reduction after Repair Tons/year

- Total 1,400 Ton Methane Savings

The Sniffers Study: 64 Companies - 2Mio Sources – Evolution over 6 years Fugitive

The Sniffers Study: 7 Gas Processing Plants -70% in one year Methane
Why mix measurement technologies?
EXAMPLE: OGI versus SNIFFING

Overview per leak class

<table>
<thead>
<tr>
<th>Class</th>
<th>Number measured</th>
<th>Leaks&gt;9ppm</th>
<th>Number leaks&gt;RD</th>
<th>Leaks IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZERO</td>
<td>10340</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Below 1000</td>
<td>358</td>
<td>358</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>1000+</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>0</td>
</tr>
<tr>
<td>10,000+</td>
<td>113</td>
<td>113</td>
<td>113</td>
<td>12</td>
</tr>
<tr>
<td>50,000+</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>100,000+</td>
<td>167</td>
<td>167</td>
<td>167</td>
<td>119</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11209</td>
<td>869</td>
<td>511</td>
<td>135</td>
</tr>
</tbody>
</table>

- Only 135 out of 869 leaks detected with OGI camera = 15,5%
- Also big leaks are missed with OGI camera
- With current OGI technology, leaks < 10,000 ppm remain undetected. CH4, as the smaller molecule is more difficult to detect by the camera.
- CH4: Relatively large amount of small leaks, responsible for a substantial part of the total emissions
- With OGI a secondary measurement is needed for accurate quantification
- Main advantage of OGI vs Sniffing: non-accessibles can be screened from a distance

LDAR study:
FID (sniffing) measurements compared to OGI camera