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- The audio recording for this webinar starts at slide #21.
Leak Detection: Creating a Program that Works

June 7, 2012
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If you’d like to remain anonymous, send your question by CHAT to Keilly Witman instead of to all participants

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Today’s speakers........
Ted Gartland is the owner of E. Gartland Associates, a refrigeration and environmental consulting firm. Ted is an adviser on the Climate Action Reserve ODS destruction working group, which recently standardized a methodology around carbon offset credits for refrigerant destruction. Ted was formerly the Director of Refrigerants and Carbon Management at Verisae. Previously, he spent fourteen years with Honeywell Genetron Refrigerants where he worked in the commercialization of R-507, R-404A, R-410A and many HFC based refrigerants.
Matt Thiel – Bacharach

Matt Thiel
Business Unit Manager – Gas Detection
Bacharach
Office: 724-334-5066
Email: MattT@MyBacharach.com

Matt Thiel is the Business Unit Manager for Bacharach’s gas detection products. He has fifteen years of gas/leak detection experience, with the last two years focusing primarily on refrigerant leak detection technologies and applications.
Jim Mowery has worked at Bacharach for twelve years, the last three in the refrigerant monitor division as a sales and training product specialist. He is licensed to handle all types of refrigerant gasses and is experienced in both sales and service of heating and air conditioning instruments. Jim currently holds a patent on a heating control system for heat pumps. He is currently focusing on sales and training for fixed monitoring systems. Jim holds a degree in business management and has additional education credits from James Madison University and the American Management Association.
Leak Detection
Creating a Program that Works
Agenda

• Why Monitor?
• Sensing Technologies
• Continuous vs. Manual
• Selecting the Right Product
• Cost of Leaks
What are the benefits of a Refrigerant Monitor?

- Reduce energy consumption – SAVE $$$
- Reduce emissions of ozone depleting agents – Be GREEN
- Reduce the amount of refrigerant being used – SAVE $$$
- Being code compliant
  - ASHRAE 15, ASHRAE 147, California Sub article 5.1
- To protect people (refrigerants are oxygen displacing agents)
- To protect products & equipment
  - Food products (meat, produce, dairy)
  - Chillers, RAC units, and walk-in boxes
Industry Trends

• California Sub article 5.1/ F-Gas
  – Mandatory monitoring / leak checking
• Refrigerant Management Programs
  – Lower detection limits (10 ppm)
Myth or Reality?

80% of leaks occur in the engine (Rack) room

Most monitoring takes place in the engine rooms. Most technology cannot accurately detect and locate small leaks.

What if we could find the small leaks?
Many leaks occur in display sales area, freezers, coffin cases and Dairy coolers.
Sensing Technologies
Metal Oxide (MOS) Sensors

(AKA – Solid State, Heated Diode)

- Detect toxic, combustible & refrigerant gases
- Respond to many compounds, including H2O and temperature changes
- Not very accurate
- Require calibrations
- Low cost
- Long life span (5-7 years)
Metal Oxide (MOS) Sensors
Detection Principal

A fine metallic oxide film is deposited on a silicon wafer (see illustration below). The absorption of the sample at the surface of the metal oxide is followed by a catalytic oxidation and modifies the electric resistance of the oxide. This value is linked to the gas concentration.

Semi-conductor sensor
So how does Infrared detection differ?
Technical Background

- Infrared gas detection is a well-established technology that has been practiced for more than 60 years.
- It is based on the principle that any gas molecule composed of two or more dissimilar atoms will absorb infrared light in a manner unique to that specific molecule.
- The unique pattern of absorption, dictated by the molecular structure, is called an absorption spectrum, and represents a fingerprint for a specific molecule.
What does this mean?

Path Length Determines Minimal Detectable Limit
- ~7 inches = 25 ppm
- ~10 inches = 1 ppm
Infrared Gas Sensing

**Advantages**
- Able to Self-test / calibrate
- Fast Response Times
- Very selective, few cross interfering gases
- 1 ppm sensitivity
- Low level accuracy

**Disadvantages**
- Sensitive to H2O
- Maintenance required for dust and water
## Leak Detection Excuse Selection Chart

<table>
<thead>
<tr>
<th>Continuous monitors don’t work</th>
<th>All leaks occur in the RAC rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t have time to manually inspect every line</td>
<td>My continuous monitor never alarms</td>
</tr>
<tr>
<td>You can’t find small leaks</td>
<td>My continuous monitor alarms but I cannot find a leak</td>
</tr>
<tr>
<td>Small leaks are not worth finding</td>
<td>Leak detection is too expensive</td>
</tr>
<tr>
<td>Putting detectors on the store floor doesn’t work</td>
<td>I’m manually checking, I don’t need a continuous monitor</td>
</tr>
<tr>
<td>You can’t find leaks in cases/reach-ins</td>
<td>I have continuous monitor, I don’t need a good hand held detector</td>
</tr>
<tr>
<td>You can’t find leaks outdoors</td>
<td></td>
</tr>
</tbody>
</table>
How do I Monitor Leaks?

- Portable leak detector
- Continuous monitor
Create a Program that Works for You!
Compliance vs. Management

- **Compliance Monitoring:**
  - Meets local regulator requirements
  - Looking for larger leaks

- **Refrigerant Management:**
  - Find leaks sooner
  - Locate smaller leaks

Semiconductor Detectors

Infrared Analyzers
Selecting the Right Continuous Monitor Product

<table>
<thead>
<tr>
<th></th>
<th>Semiconductor</th>
<th>Diffusion Infrared</th>
<th>Infrared Sampling System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Detection Limit</td>
<td>50 ppm</td>
<td>15 ppm</td>
<td>1 ppm</td>
</tr>
<tr>
<td>Cost Per Point</td>
<td>$400.00</td>
<td>$1000.00</td>
<td>$380 (16) - $1250 (4)</td>
</tr>
<tr>
<td>Installation</td>
<td>Wiring</td>
<td>Wiring</td>
<td>Tubing</td>
</tr>
</tbody>
</table>
## Selecting the Right Portable Detector / Analyzer

<table>
<thead>
<tr>
<th></th>
<th>Semiconductor</th>
<th>Infrared Detector</th>
<th>Infrared Analyzer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Detection Limit</td>
<td>50 ppm</td>
<td>25 ppm</td>
<td>1 ppm</td>
</tr>
<tr>
<td>Cost</td>
<td>$300.00</td>
<td>$500.00</td>
<td>$3000</td>
</tr>
<tr>
<td>Indications</td>
<td>Beeping</td>
<td>Beeping</td>
<td>Actual ppm readings</td>
</tr>
<tr>
<td>False responses</td>
<td>Temp/humidity</td>
<td>Change in background</td>
<td>None</td>
</tr>
</tbody>
</table>
Where do I Monitor?

- You cannot monitor everywhere
- Monitor high probability areas
  - Compressor room
  - Walk in freezers
  - Cases / aisles
- Freon and CO2 are heavier than air – tend to fall
  - Pick up locations should be close to ground for Freon
  - Pick up locations should be higher for CO2 (as it disperses)
Where do I Monitor – Compressor RAC?

- 2 pick-up points per RAC
  - **NOT** 2 per Mechanical room!
- Multiple refrigerants, have multiple pick up points!
- Can use a splitter kit

😊 Best Practice Tip: Mount A/V alarm outside mechanical room door
Checking the refrigeration racks outside the wind does not affect the analyzer.
Where do I Monitor – Coolers/Freezers?

- Can monitor inside or outside for leaks.

Best Practice Tip: Don’t mount inside cooler next to door – will get frost build-up!

Best Practice Tip: For CO2, mount pickup point at 4-6 feet
Where do I Monitor – Cases?

- Monitor inside or outside cases for leaks.
- In kick rails
- On Top of cases
- At each end
- Behind and in between two aisle cases

😊 Best Practice Tip: Try to maximize coverage area
2 PPM

PPM reading increasing on Infrared Analyzer

Bubbles not finding it

PPM reading increasing on Infrared Analyzer

Conclusion: Bad braze joint on the evaporator

17, 672 PPM
Where do I Monitor – Cases / Aisles?
Best Practice Tips

• Utilize both handheld and continuous monitors
  – Continuous gets you to the area
  – Hand held pin points the leak
• Maintain your instruments (change filters)
• Test your equipment
• Set alarm thresholds appropriately
  – A must if you are using splitter kits/spurs
• React to alarms
  – Early detection saves the environment and money too
## Costs of leaks

<table>
<thead>
<tr>
<th>Leak rate in pounds per month</th>
<th>Refrigerant type</th>
<th>Cost per pound</th>
<th>Cost of Leak per month</th>
<th>Number of months to cover continuous monitor Purchase</th>
<th>Number of months to cover Portable Analyzer Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>R22</td>
<td>$12.00</td>
<td>$600.00</td>
<td>11.0</td>
<td>6.2</td>
</tr>
<tr>
<td>100</td>
<td>R22</td>
<td>$12.00</td>
<td>$1,200.00</td>
<td>5.5</td>
<td>3.1</td>
</tr>
<tr>
<td>200</td>
<td>R22</td>
<td>$12.00</td>
<td>$2,400.00</td>
<td>2.8</td>
<td>1.5</td>
</tr>
<tr>
<td>250</td>
<td>R22</td>
<td>$12.00</td>
<td>$3,000.00</td>
<td>2.2</td>
<td>1.2</td>
</tr>
<tr>
<td>500</td>
<td>R22</td>
<td>$12.00</td>
<td>$6,000.00</td>
<td>1.1</td>
<td>0.6</td>
</tr>
<tr>
<td>50</td>
<td>R404a/R407a</td>
<td>$8.00</td>
<td>$400.00</td>
<td>16.5</td>
<td>9.3</td>
</tr>
<tr>
<td>100</td>
<td>R404a/R407a</td>
<td>$8.00</td>
<td>$800.00</td>
<td>8.3</td>
<td>4.6</td>
</tr>
<tr>
<td>200</td>
<td>R404a/R407a</td>
<td>$8.00</td>
<td>$1,600.00</td>
<td>4.1</td>
<td>2.3</td>
</tr>
<tr>
<td>250</td>
<td>R404a/R407a</td>
<td>$8.00</td>
<td>$2,000.00</td>
<td>3.3</td>
<td>1.9</td>
</tr>
<tr>
<td>500</td>
<td>R404a/R407a</td>
<td>$8.00</td>
<td>$4,000.00</td>
<td>1.7</td>
<td>0.9</td>
</tr>
</tbody>
</table>

- **Infrared Continuous Monitor**: $6,600
- **Portable Infrared Analyzer**: $3,700
## Real World Case Study

### Leak savings calculator

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Leak rate in pounds per month</th>
<th>Refrigerant type</th>
<th>Cost per pound</th>
<th>Cost of Leak per month</th>
<th>Number of months to cover continuous monitor Purchase</th>
<th>Number of months to cover Portable Analyzer Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location 1</td>
<td>695</td>
<td>R22</td>
<td>$12.00</td>
<td>$8,340.00</td>
<td>0.8</td>
<td>0.4</td>
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<tr>
<td>Location 2</td>
<td>48</td>
<td>R404a</td>
<td>$8.00</td>
<td>$384.00</td>
<td>17.2</td>
<td>9.6</td>
</tr>
<tr>
<td>Location 3</td>
<td>100</td>
<td>R404a</td>
<td>$8.00</td>
<td>$800.00</td>
<td>8.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Location 4</td>
<td>200</td>
<td>R407a</td>
<td>$8.00</td>
<td>$1,600.00</td>
<td>4.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Location 5</td>
<td>400</td>
<td>R22</td>
<td>$12.00</td>
<td>$4,800.00</td>
<td>1.4</td>
<td>0.8</td>
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<tr>
<td>Location 6</td>
<td>150</td>
<td>R404a</td>
<td>$8.00</td>
<td>$1,200.00</td>
<td>5.5</td>
<td>3.1</td>
</tr>
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- **Infrared Continuous Monitor**: $6,600
- **Portable Infrared Analyzer**: $3,700
Thank you