Directed Inspection and Maintenance & High Bleed Pneumatic Device Conversion

EPA Gas STAR Production Technology Transfer Workshop. State College, PA. November 18, 2009

Milton W. Heath III
Heath Consultants Incorporated

Agenda

1. Industry Research Findings
2. DI&M with Advanced Leak Detection and Measurement Technologies
3. Chesapeake Energy Experience/Gas STAR Partner Savings
4. Leak Measurement Examples
5. Rod Packing Leak Rates

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
What is the Problem?

• Gas leaks are invisible, unregulated and go unnoticed
• STAR Partners find that valves, connectors, compressor seals and open-ended lines (OELs) are major sources
  - 27 Bcf methane emitted per year by reciprocating compressor seals and OELs
  - Open ended lines contribute half these emissions
• Facility fugitive methane emissions depend on operating practices, equipment age and maintenance

Industry Research on Leakage From Compressor Stations

• Indicates gas losses at compressor stations average 35,000 Mcf/station/year
• Equivalent to a loss of $140,000/year at $4/Mcf.
• Cost of Service + Repairs = $50,000
• Payback Period = 4.0 months
• Profits Increase with Time
Approach to Reducing Leakage

• Institute a measurement program that accurately measures all leaks
• Station personnel then have the information necessary to weigh the cost of the leak repair versus the value of the lost gas for each leak.

Partial List of Potential Leak Sources

• Compressor Unit Valves
• Relief Valves
• Unit Blowdowns
• Compressor Packing
• Meter Tubes
• Valve Stems
• High Bleed Pneumatics
• Fuel Valves
• Various Piping & Vessel Flanges
• Online Gas Analyzers
• Centrif. Comp. Seals
• Pipeline Damage
• Winterization Pumps
• Chemical Pumps
Top 4 Typical Fugitive Sources

- Reciprocating Compressor Packing
- Blow Down Valves
- Unit Valves
- Scrubber Dump Valves

“Find The Needle In The Haystack”
Implementing DI&M Program
The Process

- CONDUCT baseline survey
- SCREEN and MEASURE leaks
- FIX on the spot leaks
- Estimate repair cost, FIX to Payback criteria
- PLAN for future DI&M
- Record savings/REPORT to Gas STAR

Leak Survey Methods

Leak Detection Tools

- Remote Methane Leak Detector (RMLD)
- Soap solution
- Flame Ionization
- Heath Detecto-Pak Infrared
- Catalytic oxidation/thermal conductivity
- Gas Imaging Camera
- Ultrasonic
- Visual

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
Environmental Stewardship, Emission Reductions, Improved Safety and Profitability

Pump Driven CGI

Ultrasonic

Milton W. Heath III, Heath Consultants Inc. 713-844-1304 milt.heath3@heathus.com
Measuring Fugitive Methane Emissions

Commercially Available Measurement Tools
- Hi Flow Samplers
- Vent-Bag
- Hot Wire Anemometer
- Rotameter

Measurement / Quantification of Hydrocarbon Emissions

- For leaks up to 10 cfm – Hi Flow Sampler
  10.5 cfm @ $5/Mcf = $27,594
  Hi Flow Sampler Cost = $17,640

- For leaks 10 – 240 cfm – Vent-Bag Method
  50 cfm @ $5/Mcf = $131,400
  100 cfm @ $5/Mcf = $262,800
  Calibrated Vent Bag Cost = $75

- For leaks >180 cfm – Anemometer
  - Used only on vertical open ended line
  - Much more subjective, requires experience.
Hi Flow Sampler
Applications

Advantages:
- Total Leak Capture
- Measures Leak Rate Directly
- Can Measure 30 components per hour
- Repair Decision Based on Leak Rate & Repair Costs

Hi Flow Sampler
Technology

- Captures Entire Leak
  - Measures Flow Rate (F) and Concentration (sample)
  - Subtracts the background (back) Concentration
  - Leak Rate = F x (sample – back)

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
Environmental Stewardship, Emission Reductions, Improved Safety and Profitability

2008 Chesapeake Energy
Reductions by BMP

<table>
<thead>
<tr>
<th>Methane Reduction Activity</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline Leak Repair</td>
<td>1.3%</td>
</tr>
<tr>
<td>Low Bleed pneumatic Level Controllers</td>
<td>0.5%</td>
</tr>
<tr>
<td>Recover Delay Flash Gas</td>
<td>5.4%</td>
</tr>
<tr>
<td>Pressure LTH</td>
<td>9.2%</td>
</tr>
<tr>
<td>Re-Bleed Chem Pump</td>
<td>1.5%</td>
</tr>
<tr>
<td>Optimize Giant Site Gas</td>
<td>1.1%</td>
</tr>
<tr>
<td>Replace Prod Unit w/Mech Dump Sep</td>
<td>1.2%</td>
</tr>
<tr>
<td>Workover - Green No Completion</td>
<td>0.9%</td>
</tr>
<tr>
<td>VRU</td>
<td>0.7%</td>
</tr>
<tr>
<td>De-Water/Unload with Foaming Agents</td>
<td>0.5%</td>
</tr>
<tr>
<td>Pressures/Hydrant SLAB</td>
<td>0.3%</td>
</tr>
<tr>
<td>Integral Nitrogen Pump</td>
<td>0.4%</td>
</tr>
<tr>
<td>Vent Sis - Integral Mech Monge</td>
<td>0.1%</td>
</tr>
<tr>
<td>De-Water/Unload with Cap String</td>
<td>0.1%</td>
</tr>
<tr>
<td>Snubbing Operations</td>
<td>0.1%</td>
</tr>
<tr>
<td>Replace Gas Driver w/Pop Motor - Compressors</td>
<td>0.1%</td>
</tr>
<tr>
<td>PSU Camera Leak Repair</td>
<td>0.1%</td>
</tr>
<tr>
<td>Release/Eject Prod Unit or Sep</td>
<td>0.1%</td>
</tr>
<tr>
<td>Low Bleed Pressure Control</td>
<td>0.1%</td>
</tr>
<tr>
<td>Recover Delay Pipe Injection</td>
<td>0.1%</td>
</tr>
<tr>
<td>Replace Gas Driver w/End Motor - Pumping Units</td>
<td>0.9%</td>
</tr>
<tr>
<td>Slow Down to Sales</td>
<td>0.04%</td>
</tr>
<tr>
<td>No-Vent Gathering System Fills</td>
<td>0.03%</td>
</tr>
<tr>
<td>Engine Starter Change</td>
<td>0.02%</td>
</tr>
<tr>
<td>Snubbing Hot Tap</td>
<td>0.01%</td>
</tr>
<tr>
<td>De-Water/Unload with CVR String</td>
<td>0.004%</td>
</tr>
<tr>
<td>De-Water/Unload with Pumping Unit</td>
<td>0.004%</td>
</tr>
<tr>
<td>De-Water/Unload with Compression</td>
<td>0.001%</td>
</tr>
<tr>
<td>De-Water/Unload with Gas Lift</td>
<td>0.001%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
Low Bleed Pneumatic Level Controllers

Environmental Stewardship, Emission Reductions, Improved Safety and Profitability

Typical Hi-Bleed Cycle
Pneumatic Level Control

Dump Valve Closed

1. Control is in static condition, between dump cycles. Dump valve is CLOSED. Supply gas is bleeding to atmosphere.

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
Typical Hi-Bleed Cycle
Pneumatic Level Control

**Dump Valve Opens**

1. Level increases, causing control to divert supply gas to Dump Valve. Valve opens, lowering level in vessel. Differential between supply pressure and valve pressure requirement continues to bleed to atmosphere.

2. Differential Bleed to Atmosphere

**SUPPLY GAS**

3. Dump Valve Vents

4. After valve dumps, liquid level in tank drops. The control senses the drop and stops supply pressure to valve. Valve spring forces the valve shut, and evacuates the diaphragm housing, venting used gas to atmosphere.

5. Evacuated Vent Gas to Atmosphere

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
Mizer Technology

No-Bleed Pilot Valve For FMC Invalco Controllers

THE 10 MINUTE SOLUTION:
Install Mizer's Patented NZ17™ Pilot Valve in your controller and save tens of thousands per year.
Plus, improve the air quality for generations to come.

Environmental Stewardship, Emission Reductions, Improved Safety and Profitability

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com

Level Controller Retrofits

Invalco 415, 215, 402
Retrofit w/ Mizer valve, block & gauges

WellMark Flexivel
This is the "old style" WellMark
Replace/Retrofit with the entire Cemco head

Fisher 2500, 2506
Retrofit w/ Mizer, bracket, tubing & relay plug

Cemco/WellMark 6900
Retrofit w/ Mizer Valve

Environmental Stewardship, Emission Reductions, Improved Safety and Profitability
**Mizer Retrofits 2008 - 2009**

<table>
<thead>
<tr>
<th>District</th>
<th>Done Thru March 31, 2009</th>
<th>Total Capital</th>
<th>Daily Reduction (MCF)</th>
<th>Annual Reduction (MMCF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anadarko</td>
<td>1,264</td>
<td>685,088</td>
<td>885</td>
<td>324</td>
</tr>
<tr>
<td>Arkansas</td>
<td>100</td>
<td>54,200</td>
<td>70</td>
<td>26</td>
</tr>
<tr>
<td>Arkoma</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N. Mid Continent</td>
<td>467</td>
<td>253,114</td>
<td>327</td>
<td>98</td>
</tr>
<tr>
<td>Southern Oklahoma</td>
<td>372</td>
<td>201,624</td>
<td>260</td>
<td>99</td>
</tr>
<tr>
<td>W. Mid Continent</td>
<td>47</td>
<td>25,474</td>
<td>33</td>
<td>13</td>
</tr>
<tr>
<td>Barnett</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gulf Coast</td>
<td>161</td>
<td>87,262</td>
<td>113</td>
<td>41</td>
</tr>
<tr>
<td>Louisiana</td>
<td>17</td>
<td>9,214</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>N. Permian</td>
<td>93</td>
<td>50,406</td>
<td>65</td>
<td>24</td>
</tr>
<tr>
<td>S. Permian</td>
<td>149</td>
<td>80,758</td>
<td>104</td>
<td>22</td>
</tr>
<tr>
<td>E. Texas</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,670</strong></td>
<td><strong>$1,447,140</strong></td>
<td><strong>1,869</strong></td>
<td><strong>651</strong></td>
</tr>
</tbody>
</table>

Average Installation Cost = $542

Using $3.50/MCF, the simple payback is 7 months.

Environmental Stewardship, Emission Reductions, Improved Safety and Profitability

---

**Wilden winterization pump bleed measurement using vinyl containment bag and Hi Flow Sampler**

---

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
Condensate Tank Leakage Identified Loses/Savings

Estimated Annual Loss with 3 CFM Anti-Static Measurement Bag
13,515 Mcf/yr
Or
$54,060 @ $4/Mcf

Calibrated 3 Cubic Foot Measurement Bag

Environmental Stewardship, Emission Reductions, Improved Safety and Profitability

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
How Much Was That Leak?

Leaking Valve Actuator. Leak measured at 6.74 scfm or $14,170/yr. Estimated to have been leaking at current leak rate for last three years or more. Successfully repaired next day and reduced to zero emissions.

$$$$$$

Entire Survey Paid
For in recovered gas, Including investment of new Hi Flow Sampler

$$$$$$

How Much Was That Leak?

Leaking Actuator on Methanol Injector Pump. Leak Rate at 3.5 cfm or $7,358/yr. Estimated repair <$500.

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
About Rod Packing Leakage

• Under best conditions leak rate can be expected at a minimum of 11.5 scfh
• Leakage can be reduced through proper monitoring and a cost effective schedule for replacing packing rings & piston rods.
• Step one is to monitor and record baseline packing leakage and piston rod wear.
• Establish a replacement threshold

Rod Packing Leak Rates at Oklahoma Compressor Station

1 Year Payback Threshold at 55 scfh
Equivalent to $1,927/yr

Milton W. Heath III, Heath Consultants
Inc. 713-844-1304
milt.heath3@heathus.com
Questions?

Milton W. Heath III
9030 Monroe Road
Houston, Texas 77061
713-844-1304
Milt.heath3@heathus.com