Options for Reducing Methane Emissions from Pneumatic Devices

Lessons Learned from the Natural Gas STAR Program

Producers Technology Transfer Workshop

Newfield Exploration Company,
Anadarko Petroleum Corporation,
Utah Petroleum Association,
Interstate Oil & Gas Compact Commission,
Independent Petroleum Association of Mountain States

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epa.gov/gasstar

Pneumatic Devices: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions
What is the Problem?

- Pneumatic devices are collectively a major source of methane emissions from the natural gas industry.
- Natural gas powered pneumatic devices used throughout the oil and natural gas industry.

<table>
<thead>
<tr>
<th></th>
<th>Natural Gas Systems</th>
<th>Petroleum Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production and Gathering¹</td>
<td>411,000</td>
<td>379,436</td>
</tr>
<tr>
<td>Processing¹</td>
<td>11,000</td>
<td>-</td>
</tr>
<tr>
<td>Transmission and Storage¹</td>
<td>85,000</td>
<td>-</td>
</tr>
</tbody>
</table>

¹ - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2008
Methane Emissions

- As part of normal operations, pneumatic devices release natural gas to atmosphere

- High-bleed devices bleed in excess of 6 scf/hour
  - Equates to >50 Mcf/year
  - Typical high-bleed pneumatic devices bleed an average of 140 Mcf/year

- Actual bleed rate is largely dependent on device’s design

Location of Pneumatic Devices at Production Sites

- SOV = Shut-off valve (Unit isolation)
- LC = Level control (Separator, contactor, flash tank separator, TEG regenerator)
- TC = Temperature control (Regenerator fuel gas)
- FC = Flow control (TEG circulation, compressor bypass)
- PC = Pressure control (FTS pressure, compressor suction/discharge)
How Can Methane Emissions be Recovered?

- Option 1: Replace high-bleed devices with low-bleed devices

- Option 2: Retrofit controller with bleed reduction kits
  - Field experience shows that up to 80% of all high-bleed devices can be replaced or retrofitted with low-bleed equipment

- Option 3: Maintenance aimed at reducing losses
Option 1: Replace High-Bleed Devices

- Most applicable to
  - Controllers: liquid-level and pressure
  - Positioners and transducers

- Suggested action: evaluate replacements
  - Replace at end of device’s economic life
  - Early replacement

Option 1: Cost to Replace High-Bleed Devices

- Costs vary with size:
  - Typical costs range from $700 to $3,000 per device

- Incremental costs of low-bleed devices are modest ($150 to $250)

- Gas savings often pay for replacement costs in short periods of time (2 to 8 months)
Option 2: Retrofit with Bleed Reduction Kits

- Applicable to most high-bleed controllers
- Suggested action: evaluate cost-effectiveness as alternative to early replacement
- Retrofit kit costs ~ $675
- Payback time ~ 9 months

Option 3: Maintenance to Reduce Losses

- Applies to all pneumatic devices
- Suggested action: add to routine maintenance procedures
  - Field survey of controllers
  - Where process allows, tune controllers to minimize bleed
Option 3: Maintenance to Reduce Losses (cont’d)

- Suggested action (cont’d):
  - Re-evaluate the need for pneumatic positioners
  - Repair/replace airset regulators
  - Reduce regulated gas supply pressure to minimum
  - Routine maintenance should include repairing/replacing leaking components

- Costs are low

Source: www.bpe950.com

Five Steps for Reducing Methane Emissions from Pneumatic Devices

- Locate and INVENTORY high-bleed devices
- ESTABLISH the technical feasibility and costs of alternatives
- ESTIMATE the savings
- EVALUATE economics of alternatives
- DEVELOP an implementation plan
Suggested Analysis for Replacement

- Replacing high-bleed controllers at end of their economic life
  - End of economic life when major overhaul cost avoided
  - Determine incremental cost of low-bleed device over high-bleed equivalent
  - Determine gas saved with low-bleed device using manufacturer specifications
  - Compare savings and cost
- Early replacement of high-bleed controllers
  - Compare gas savings of low-bleed device with full cost of replacement

Economics of Replacement

<table>
<thead>
<tr>
<th></th>
<th>Replace at End of Life</th>
<th>Early Replacement</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level Control</td>
</tr>
<tr>
<td>Cost ($)</td>
<td>210 – 340 $^2$</td>
<td>513</td>
</tr>
<tr>
<td>Annual Gas Saving (Mcf)</td>
<td>50 - 200</td>
<td>166</td>
</tr>
<tr>
<td>Annual Value of Gas Saved ($) $^3$</td>
<td>350 - 1400</td>
<td>1165</td>
</tr>
<tr>
<td>Paybacks (months)</td>
<td>3 - 8</td>
<td>6</td>
</tr>
<tr>
<td>IRR (%) $^4$</td>
<td>138 - 933</td>
<td>226</td>
</tr>
</tbody>
</table>

1 - All data based on partners’ experiences. See Lessons Learned for more information
2 - Range of incremental costs of low-bleed over high bleed equipment
3 - Gas price is assumed to be $7/Mcf
4 - Internal Rate of return IRR calculated over 5 years
Suggested Analysis for Retrofit

- Retrofit of low-bleed kit
  - Compare savings of low-bleed device with cost of conversion kit
  - Retrofitting reduces emissions by average of 90%

<table>
<thead>
<tr>
<th></th>
<th>Level Controllers</th>
<th>Pressure Controllers</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mizer</td>
<td>Large to small orifice</td>
</tr>
<tr>
<td>Implementation Costs ($)</td>
<td>675</td>
<td>41</td>
</tr>
<tr>
<td>Bleed rate reduction (Mcf/device/year)</td>
<td>219</td>
<td>184</td>
</tr>
<tr>
<td>Value of gas saved ($/year)</td>
<td>1533</td>
<td>1288</td>
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<tr>
<td>Payback (months)</td>
<td>6</td>
<td>&lt;1</td>
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<tr>
<td>IRR (%)</td>
<td>226</td>
<td>&gt;3100</td>
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</tbody>
</table>

1 - All data based on partners’ experiences. See Lessons Learned for more information
2 - Gas price is assumed to be $7/Mcf
3 - Internal Rate of return (IRR) calculated over 5 years

Suggested Analysis for Maintenance

- For maintenance aimed at reducing gas losses
  - Measure gas loss before and after procedure
  - Compare savings with labor (and parts) required for activity

<table>
<thead>
<tr>
<th></th>
<th>Reduce Supply Pressure</th>
<th>Repair &amp; Retune</th>
<th>Change Settings</th>
<th>Remove Valve Positioners</th>
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<tbody>
<tr>
<td>Implementation Cost ($)</td>
<td>207</td>
<td>31</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Gas Savings (Mcf/year)</td>
<td>175</td>
<td>44</td>
<td>88</td>
<td>158</td>
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<tr>
<td>Value of gas saved ($/year)</td>
<td>1225</td>
<td>308</td>
<td>616</td>
<td>1106</td>
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<tr>
<td>Payback (months)</td>
<td>3</td>
<td>2</td>
<td>immediate</td>
<td>Immediate</td>
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<tr>
<td>IRR (%)</td>
<td>&gt;500%</td>
<td>&gt;900</td>
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</table>

1 - All data based on partners’ experiences. See Lessons Learned for more information
2 - Gas price is assumed to be $7/Mcf
3 – Internal rate of return (IRR) calculated over 5 years
Industry Experience – Chesapeake Energy

- Level controllers retrofitted with Mizer components
- Hi-flow sampler used to measure emissions reduction from retrofits

### Industry Experience – Chesapeake Energy

<table>
<thead>
<tr>
<th>District</th>
<th>Retrofits Done Thru 31-Mar-09</th>
<th>Total Capital ($)</th>
<th>Daily Reduction (MCF)</th>
<th>Annual Reduction (MMCF)</th>
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<tbody>
<tr>
<td>Anadarko</td>
<td>1264</td>
<td>685,088</td>
<td>885</td>
<td>324</td>
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<tr>
<td>Arkansas</td>
<td>100</td>
<td>54,200</td>
<td>70</td>
<td>26</td>
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<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>201,264</td>
<td>260</td>
<td>99</td>
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<tr>
<td>W. Mid Continent</td>
<td>47</td>
<td>25,474</td>
<td>33</td>
<td>13</td>
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<tr>
<td>Gulf Coast</td>
<td>161</td>
<td>87,262</td>
<td>113</td>
<td>41</td>
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<td>Louisiana</td>
<td>117</td>
<td>9,214</td>
<td>12</td>
<td>4</td>
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<td>N. Permian</td>
<td>117</td>
<td>20,406</td>
<td>65</td>
<td>24</td>
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<tr>
<td>S. Permian</td>
<td>149</td>
<td>80,578</td>
<td>104</td>
<td>22</td>
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<tr>
<td>Total</td>
<td>2,670</td>
<td>1,447,140</td>
<td>1869</td>
<td>651</td>
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</table>

Average Installation Cost = $542

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

- Most high-bleed pneumatics can be replaced with lower bleed models
- Replacement options save the most gas and are often economic
- Retrofit kits are available and can be highly cost-effective
- Maintenance is low-cost and reduces gas loss

Discussion Questions

- To what extent are these opportunities being implemented?
- How could these opportunities be improved upon or altered for use in your operation?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing these practices?