Gas Processing Technology Experience: Priorities

Seminar with Russian Independent Oil and Gas Producers on Methane Mitigation Technologies and Strategies
October 4, 2010, Moscow, Russia

Don Robinson, Vice President
ICF International
Agenda

- U.S. Processing Sector Methane Emissions
- Overview of Technologies and Practices
- Methane Saving Opportunities
  - Compressor seals
  - Leak detection, quantification, and repair
  - Acid gas removal
- Contact Information and Further Information
2008 Processing Sector Methane Emissions (34 Bcf)

- Reciprocating Compressors: 17 Bcf
- Centrifugal Compressors: 5 Bcf
- Gas Engine Exhaust: 7 Bcf
- Blowdowns: 2 Bcf
- Plant Fugitives: 1 Bcf
- Dehydrators and Pumps: 1 Bcf
- Other Sources: 1 Bcf

Bcf = billion cubic feet

Emission Sources in Processing Plants

Compressor

Drain Valve

Dehydrator

Contactor

Energy Exchange Pump

Reboiler

FTS

FC

LC

VC

Pneumatic Controller

Pressure Relief Valve

Compressor Seal

Lubrication

Gas Leakage

Flange

Packing Cup

Methane to Markets
Overview of Technologies and Practices

- 29 technologies and practices that apply to the processing sector
  - 17 focused on operating practices
  - 12 focused on technologies

- Relevant processing technologies and practices:

**Operating practices**
- Begin leak detection, quantification and repair at processing plants
- Eliminate unnecessary equipment and/or systems
- Rerouting glycol skimmer gas
- Pipe glycol dehydrator to vapor recovery unit
- Inspect and repair compressor station blowdown valves

**Technologies**
- Convert gas-driven pneumatic devices to instrument air
- Install flash tank separators in glycol dehydrators
- Use of composite wrap repair
- Install pressurized storage of condensate
- Use ultrasound to identify leaks
Compressor Seals

- Rod packing in reciprocating compressors leak gas by design
  - Anywhere between 0.33 to 25.5 m$^3$/hour depending on age of packing
  - Replace rod packing to minimize leaks

- Seal oil degassing, from centrifugal compressors, can vent 1.1 to 5.7 m$^3$/minute to the atmosphere
  - Use dry seals to avoid the use of seal oil

- More information on emission reductions from compressor seals can be found in the presentation “Reducing Methane Emissions from Centrifugal and Reciprocating Compressors”
Leak Detection, Quantification, and Repair by Leak Imaging

- Majority of fugitive methane emissions are from a relatively small number of leaking components
  - Valves (30%) Connectors (24%)
  - Compressors (23%)
  - Open-ended lines, crankcase vents, pressure relief devices and pump seals (23%)

- IR leak imaging
  - Real-time visual image, quicker identification, & repair of leaks
  - Screen hundreds of components an hour
  - Screen inaccessible areas simply by viewing

- Hi Flow® Sampler
  - Total leak capture & measures leak rate directly
  - Can measure 30 components per hour
  - 1.42 to 226 liters per minute (LPM) or 0.05 to 10.5 standard cubic feet per minute (scfm)

- More information can be found in the presentation “Directed Inspection and Maintenance Program”
Acid Gas Removal (AGR) 
Alternatives to Amine Absorbers

- Membrane separation of CO₂ from feed gas
- High CO₂ permeate (effluent or waste stream) exiting the membrane is vented or blended into fuel gas
- Low CO₂ product exiting the membrane exceeds pipeline spec and is blended with feed gas

Adapted from “Trimming Residue CO₂ with Membrane Technology”, 2005
**AGR- Membrane Economics: Is Recovery Profitable?**

- **Cost comparison**
  - DEA AGR cost RUB 138.0 to RUB 154.1 million capital, RUB 15.4 million operation and maintenance (O&M) per year
  - Membrane process cost RUB 46.1 to RUB 52.3 million capital, RUB 0.65 to RUB 1.51 million O&M per year

- **Optimization of permeate stream**
  - Permeate mixed with fuel gas, RUB 11,360/Mcm fuel credit
  - Only install enough membranes to take feed from >3% to <2% CO$_2$
  - Expand with additional membranes
Acid Gas Removal
Alternatives to Amine Absorbers

- Molecular Gate® adsorbs acid gas (CO₂ and H₂S) in fixed bed
- Molecular sieve application selectively adsorbs acid gas molecules of smaller diameter than methane
- Bed regenerated by depressurizing
  - 10% of feed methane lost in depressurizing
  - Route tail gas to fuel
- Applicable to lean gas sources
**AGR- Molecular Gate® Economics: Is Recovery Profitable?**

- Molecular Gate® costs are 20% less than amine process
- Fixed-bed tail gas vent can be used as supplemental fuel
  - Eliminates venting from acid gas removal
- Other Benefits
  - Allows wells with high acid gas content to produce (alternative is shut-in)
  - Can dehydrate and remove acid gas to pipeline specs in one step
  - Less operator attention
AGR - Morphysorb® Process

- Morphysorb® has a 30% to 40% operating cost advantage over DEA or Selexol™\(^1\)
  - 66% to 75% less methane absorbed than DEA or Selexol™
  - 33% less total hydrocarbons (THC) absorbed\(^1\)
  - Lower solvent circulation volumes

- Morphysorb® can process streams with high (>10%) acid gas composition
- At least 25% capital cost advantage from smaller contactor and recycles\(^1\)
- Flashing of Morphysorb recycling recovers about 80% of methane that is absorbed\(^2\)

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1 – GTI
2 – Oil and Gas Journal, July 12, 2004, p 57, Fig. 7
### Comparison of AGR Alternatives

<table>
<thead>
<tr>
<th></th>
<th>Amine (or Selexol™) Process</th>
<th>Morphysorb® Process</th>
<th>Kvaerner Membrane</th>
<th>Molecular Gate® CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Absorbent or Adsorbent</strong></td>
<td>Water &amp; amine (Selexol™)</td>
<td>Morpholine derivatives</td>
<td>Cellulose acetate</td>
<td>Titanium silicate</td>
</tr>
<tr>
<td><strong>Methane Savings Compared to Amine Process</strong></td>
<td>--</td>
<td>66 to 75% less methane absorption</td>
<td>Methane in permeate gas combusted for fuel</td>
<td>Methane in tail gas combusted for fuel</td>
</tr>
<tr>
<td><strong>Regeneration</strong></td>
<td>Reduce pressure &amp; heat</td>
<td>Reduce pressure</td>
<td>Replace membrane about 5 years</td>
<td>Reduce pressure to vacuum</td>
</tr>
<tr>
<td><strong>Primary Operating Costs</strong></td>
<td>Amine (Selexol™) &amp; steam</td>
<td>Electricity</td>
<td>Nil</td>
<td>Electricity</td>
</tr>
<tr>
<td><strong>Capital Cost</strong></td>
<td>100%</td>
<td>75%</td>
<td>35%</td>
<td>&lt;100%</td>
</tr>
<tr>
<td><strong>Operating Cost</strong></td>
<td>100%</td>
<td>60% to 70%</td>
<td>&lt;10%</td>
<td>80%</td>
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Contact Information and Further Information

- More detail is available on these practices and over 80 others online at: epa.gov/gasstar/tools/recommended.html
- For further assistance, direct questions to:

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