Acid Gas Removal Options for Minimizing Methane Emissions

Lessons Learned from Natural Gas STAR

Processors Technology Transfer Workshop

Pioneer Natural Resources, Inc., Gas Processors Association and EPA’s Natural Gas STAR Program

September 23, 2004
Acid Gas Removal: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions
Methane Losses from Acid Gas Removal

- There are 291 acid gas removal (AGR) units in gas processing plants¹
  - Emit 644 MMcf annually¹
  - 6 Mcf/day emitted by average AGR unit¹
  - Most AGR units use diethanol amine (DEA) process or Selexol™ process

¹Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2002
What is the Problem?

- 1/3 of U.S. gas reserves contain CO$_2$ and/or N$_2$\(^1\)
- Wellhead natural gas may contain acid gases
  - H$_2$S, CO$_2$, corrosive to gathering/boosting, transmission lines and distribution equipment
  - Off-spec pipeline quality gas
- Acid gas removal processes typically use DEA to absorb acid gas
- DEA regeneration strips acid gas (and absorbed methane)
  - CO$_2$ (with methane) is typically vented to the atmosphere
  - H$_2$S is typically flared or sent to sulfur recovery

Typical Amine Process

Sweet Gas

Sour Gas

Contractor (Absorber)

Lean Amine

Rich Amine

Flash Tank

Exchanger

Filter

Booster Pump

Reboiler

Reflux Pump

Condenser

Stripper (DEA)

CO₂ to atmosphere

H₂S to sulfur plant or flare

Heating Medium

Reducing Emissions, Increasing Efficiency, Maximizing Profits
Methane Recovery - New Acid Gas Removal Technologies

- GTI & Uhde Morphysorb® Process
- Engelhard Molecular Gate® Process
- Primary driver is process economics, not methane emissions savings
- Reduce methane venting by 50 to 100%
Morphysorb® Process

Crude Gas → Absorber → Flash 1 → Flash 2 → Flash 3 → Flash 4 → Compression → Clean Gas

Acid Gas → Compression → Flash 1 → Flash 2 → Flash 3 → Flash 4 → Pump → Crude Gas
Morphysorb® Process

- Morphysorb® absorbs acid gas but also absorbs some methane
  - Methane absorbed is 66% to 75% lower than competing solvents
- Flash vessels 1 & 2 recycled to absorber inlet to minimize methane losses
- Flash vessels 3 & 4 at lower pressure to remove acid gas and regenerate Morphysorb®

¹Oil and Gas Journal, July 12, 2004, p57
Is Recovery Profitable?

- Morphysorb® can process streams with high (>10%) acid gas composition
- 30% to 40% Morphysorb® operating cost advantage over DEA or Selexol™
  - 66% to 75% less methane absorbed than DEA or Selexol™
  - About 33% less THC absorbed
  - Lower solvent circulation volumes
- At least 25% capital cost advantage from smaller contactor and recycles
- Flash recycles 1 & 2 recover ~80% of methane that is absorbed

1 Oil and Gas Journal, July 12, 2004, p57, Fig. 7
2 GTI
Industry Experience - Duke Energy

- Kwoen plant does not produce pipeline-spec gas
  - Separates acid gas and reinjects it in reservoir
  - Frees gathering and processing capacity further downstream
- Morpysorb® used in process unit designed for other solvent
- Morpysorb® chosen for acid gas selectivity over methane
  - Less recycle volumes; reduced compressor horsepower
Methane Recovery - Molecular Gate®
CO₂ Removal

- Adsorbs acid gas contaminants in fixed bed
- Molecular sieve application selectively adsorbs acid
gas molecules of smaller diameter than methane
- Bed regenerated by depressuring
  - 5% to 10% of feed methane lost in “tail gas” depressuring
  - Route tail gas to fuel

CH₄

CO₂

C₃+ adsorbed
on binder
Molecular Gate® Applicability

- Lean gas
  - Gas wells
  - Coal bed methane
- Associated gas
  - Tidelands Oil Production Co.
    - 1 MMcf/d
    - 18% to 40% CO$_2$
    - Water saturated
  - Design options for C$_4+$ in tail gas stream
    - Heavy hydrocarbon recovery before Molecular Gate®
    - Recover heavies from tail gas in absorber bed
    - Use as fuel for process equipment

Source: http://www.engelhard.com
Industry Experience - Tidelands Molecular Gate® Unit

- First commercial unit started on May 2002
- Process up to 10 MMcf/d
- Separate recycle compressor is required
- No glycol system is required
- Heavy HC removed with CO₂
- Tail gas used for fuel is a key optimization: No process venting
- 18% to 40% CO₂ removed to pipeline specifications (2%)

Is Recovery Profitable?

- Molecular Gate® costs are 20% less than amine process
  - 9 to 35 ¢ / Mcf product depending on scale
- 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
### Comparison of AGR Alternatives

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1. [http://www.gastechnology.org](http://www.gastechnology.org)
2. [http://www.engelhard.com](http://www.engelhard.com)
Discussion Questions

- Have you studied either of these technologies?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing either of these technologies?