Natural Gas Dehydration
Lessons Learned from the Natural Gas STAR Program
Producers Technology Transfer Workshop

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Utah Petroleum Association,
Interstate Oil & Gas Compact Commission,
Independent Petroleum Association of Mountain States

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Natural Gas Dehydration: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion
Methane Losses from Dehydrators

- Dehydrators and pumps account for:
  - 12 Billion cubic feet (Bcf) of methane emissions in the production, gathering, and boosting sectors
  - Well Venting and Flaring: 7 Bcf
  - Storage Tank Venting: 5 Bcf
  - Other Sources: 7 Bcf
  - Meters and Pipeline Leaks: 8 Bcf
  - Compressor Fugitives, Venting, and Engine Exhaust: 12 Bcf
  - Offshore Operations: 29 Bcf
  - Pneumatic Devices: 43 Bcf


Natural Gas STAR reductions from gathering and boosting operations have been moved to the production sector.

What is the Problem?

- Produced gas is saturated with water, which must be removed for gas transmission
- Glycol dehydrators are the most common equipment to remove water from gas
  - 41,000 dehydration units in natural gas production, gathering, and boosting
  - Most use triethylene glycol (TEG)
- Glycol dehydrators create emissions
  - Methane, Volatile Organic Compounds (VOCs), Hazardous Air Pollutants (HAPs) from reboiler vent
  - Methane from pneumatic pump and valves

Source: www.prideofthehill.com
Basic Glycol Dehydrator System Process Diagram

Methane Recovery

- Optimize glycol circulation rates
- Flash tank separator (FTS) installation
- Electric pump installation
- Re-route glycol skimmer gas
- Other opportunities
Optimizing Glycol Circulation Rate

- Gas pressure and flow at wellhead dehydrators generally declines over time
  - Glycol circulation rates are often set at a maximum circulation rate
- Glycol overcirculation results in more methane emissions without significant reduction in gas moisture content
  - Partners found circulation rates two to three times higher than necessary
  - Methane emissions are directly proportional to circulation
- Lessons Learned study: optimize circulation rates

Installing Flash Tank Separator (FTS)

- Methane that flashes from rich glycol in an energy-exchange pump can be captured using an FTS
- Many small units are not using an FTS

![Bar Chart](chart.png)

- MMcf/day processed (MMcf = Million cubic feet)
- Source: API

Glycol MACT applies to all large and ~half medium sized dehydrators.
Methane Recovery

- Recovers about 90% of methane emissions
- Reduces VOCs by 10 to 40%
- Must have an outlet for low pressure gas
  - Fuel
  - Compressor suction
  - Vapor recovery unit

Flash Tank Costs

- Lessons Learned study provides guidelines for scoping costs, savings and economics
- Capital and installation costs:
  - Capital costs range from ~$3,375 to $6,750 per flash tank
  - Installation costs range from ~$1,650 to $3,050 per flash tank
- Negligible operating and maintenance (O&M) costs
Installing Electric Pump

- Gas-assist pumps require additional wet production gas for mechanical advantage
  - Removes gas from the production stream
  - Largest contributor to emissions
- Gas-assist pumps often contaminate lean glycol with rich glycol
- Electric pump installation eliminates motive gas and lean glycol contamination
  - Economic alternative to flash tank separator
  - Requires electrical power
Overall Benefits

- Financial return on investment through gas savings
- Increased operational efficiency
- Reduced O&M costs
- Reduced compliance costs (HAPs, BTEX\(^1\))
- Limitation: must have electric power source

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1 – Benzene, toluene, ethylbenzene, xylene

Is Recovery Profitable?

Three Options for Minimizing Glycol Dehydrator Emissions

<table>
<thead>
<tr>
<th>Option</th>
<th>Capital Costs</th>
<th>Annual O&amp;M Costs</th>
<th>Emissions Savings</th>
<th>Payback Period(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimize Circulation Rate</td>
<td>Negligible</td>
<td>Negligible</td>
<td>394 to 39,420 Mcf/yr</td>
<td>Immediate</td>
</tr>
<tr>
<td>Install Flash Tank</td>
<td>$6,500 to $18,800</td>
<td>Negligible</td>
<td>1,191 to 10,717 Mcf/yr</td>
<td>4 to 11 months</td>
</tr>
<tr>
<td>Install Electric Pump</td>
<td>$1,400 to $13,000</td>
<td>$165 to $6,500</td>
<td>360 to 36,000 Mcf/yr</td>
<td>&lt; 1 month to several years</td>
</tr>
</tbody>
</table>

1 – Gas price of $7/Mcf

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Re-route Glycol Skimmer Gas

- Non-condensable skimmer gas from the condensate separators in glycol dehydrators can be re-routed to
  - Reboiler for fuel use
  - Low pressure fuel systems for fuel use
- The reboiler must operate at a higher pressure than the destination fire tubes for skimmer gas combustion
- Potential methane savings: 7,600 Mcf/year

Skimmer Gas Re-routing Costs

- Capital and installation costs:
  - Capital costs are below $1,000
  - Operating and maintenance costs range from $100 to $1,000
  - Payback in less than a year
- Negligible Installation costs
Partner Experience

- EnCana, in the Denver-Julesburg Basin, is trying the JATCO BTEX condensers and venturi ejector
- Closed loop technology used to route dehydrator vapors back to the suction of the facility
- All vapors post condenser are routed to the inlet via a venturi ejector
- Must have high pressure motive gas
  - Motive gas can be from a compressor or dry gas from the dehydrator
- Must have a low pressures destination
  - Compressor suction or fuel gas
JATCO - Operation

- Shell and tube exchanger and venturi ejector
  - Rich glycol comes in from the dehy skid to the tube side of the condenser
  - Methane, VOC and BTEX gases off of the still vent come into shell side of the condenser
  - Glycol and gases exchange heat dropping out any entrained liquids in the gases
  - Glycol exits the Jatco back to the dehy skid
  - Liquids accumulate in a small pressure tank, and dump to inlet when full
  - Gases are sent back to suction of compressor station via the venturi ejector

JATCO - Summary

- Average unit cost ~ $12,000
- Average piping cost ~ $1,300
- Average installation ~ $6,500
- Total Cost ~ $19,800
- JATCO systems with venturi ejector create a closed loop system for glycol dehydrators
- Reduces methane, VOC, and BTEX emissions
- Great technology to reduce emissions and eliminate the need for combustion or incineration of vapors
Other Partner Reported Opportunities

- Pipe glycol dehydrator to vapor recovery unit (VRU)
- Replace glycol dehydration units with methanol injection
- Flare regenerator off-gas (no economics)
- Replace glycol dehydrator with desiccant dehydrator (see Lessons Learned study)
- With a vent condenser,
  - Route skimmer gas to firebox
  - Route skimmer gas to tank with VRU
- Instrument air for controllers and glycol pump

Lessons Learned

- Optimizing glycol circulation rates increase gas savings, reduce emissions
  - Negligible cost and effort
- FTS reduces methane emissions by about 90 percent
  - Require a low pressure gas outlet
- Electric pumps reduce O&M costs, reduce emissions, increase efficiency
  - Require electrical power source
- Re-routing glycol skimmer gas to fuel gas or reboiler reduces emissions and increases efficiency
- Additional methane emissions reduction technologies and practices available on the Natural Gas STAR website
Discussion

- Industry experience applying these technologies and practices
- Limitations on application of these technologies and practices
- Actual costs and benefits