Natural Gas Dehydration

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

Natural Gas Dehydration: Agenda

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

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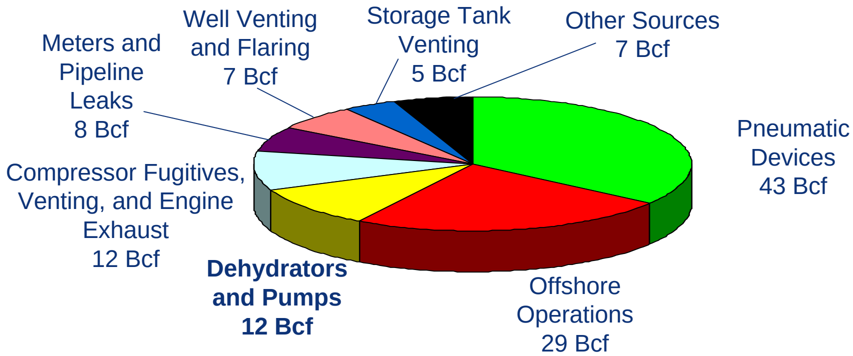
Methane Losses from Dehydrators

- Dehydrators and pumps account for:
  - 12 Billion cubic feet (Bcf) of methane emissions in the production, gathering, and boosting sectors



EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2007.* April, 2009. Available on the web at: epa.gov/climatechange/emissions/usinventoryreport.html
Natural Gas STAR reductions from gathering and boosting operations have been moved to the production sector.

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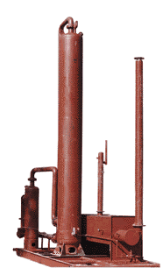
What is the Problem?

- 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

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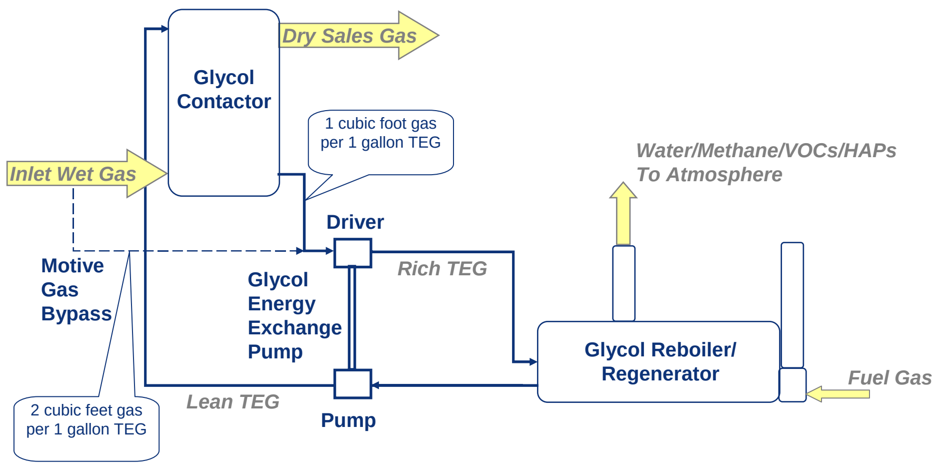
Basic Glycol Dehydrator System Process Diagram



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Methane Recovery

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

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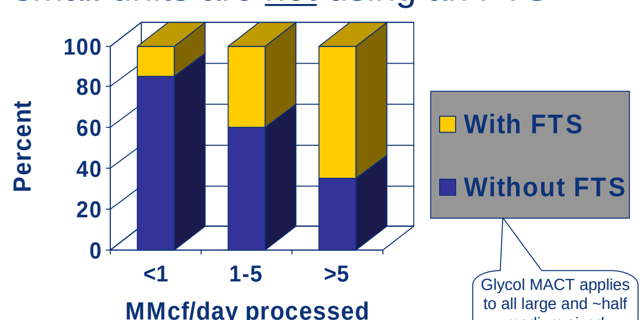
Optimizing Glycol Circulation Rate

- 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)

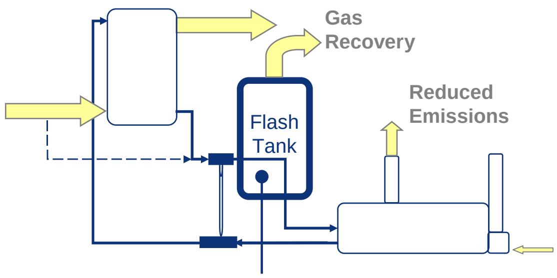
- Methane that flashes from rich glycol in an energy-exchange pump can be captured using an FTS
- Many small units are not using an FTS



MMcf = Million cubic feet
Source: API

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



Low Capital Cost/Quick Payback

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

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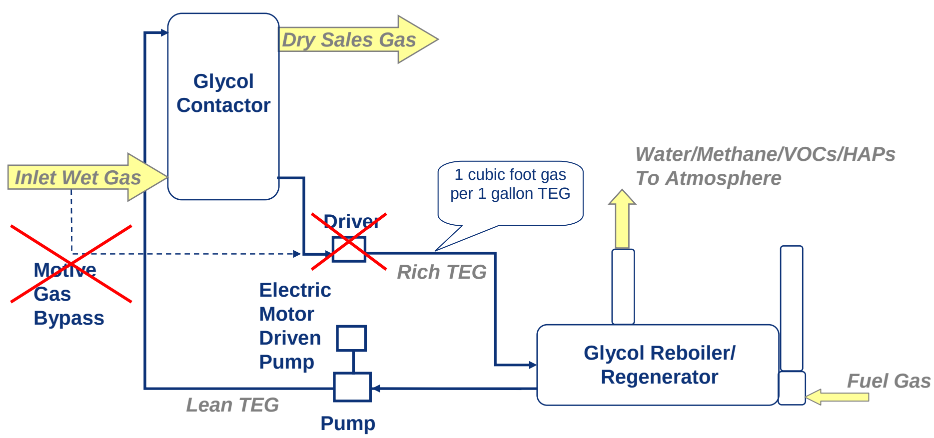
Electric Pump Eliminates Motive Gas



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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

1 – Benzene, toluene, ethylbenzene, xylene

Is Recovery Profitable?

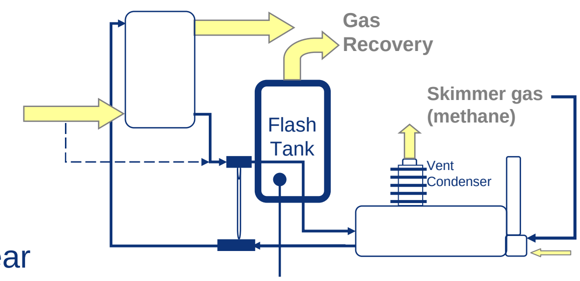
Three Options for Minimizing Glycol Dehydrator Emissions

Option	Capital Costs	Annual O&M Costs	Emissions Savings	Payback Period[1]
Optimize Circulation Rate	Negligible	Negligible	394 to 39,420 Mcf/year	Immediate
Install Flash Tank	$6,500 to $18,800	Negligible	1,191 to 10,717 Mcf/year	4 to 11 months
Install Electric Pump	$1,400 to $13,000	$165 to $6,500	360 to 36,000 Mcf/year	< 1 month to several years

1 – Gas price of $7/Mcf

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



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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

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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

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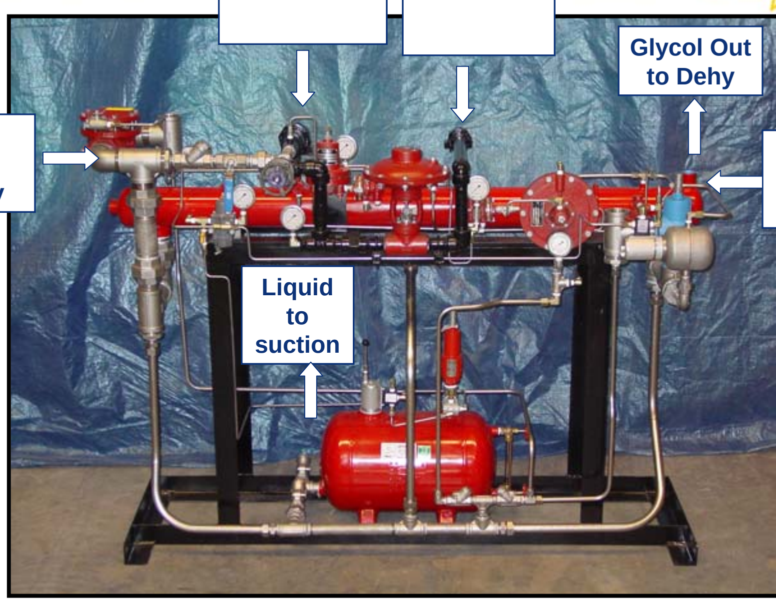

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JATCO - Operation

- 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

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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

EnCana JATCO Installations in the DJ Basin

- Reduces methane, VOC, and BTEX emissions
- Great technology to reduce emissions and eliminate the need for combustion or incineration of vapors

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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

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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

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Discussion

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

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