Methane to Markets

Methane Savings from Natural Gas Dehydrators

Gazprom – EPA Technical Seminar on Methane Emission Mitigation

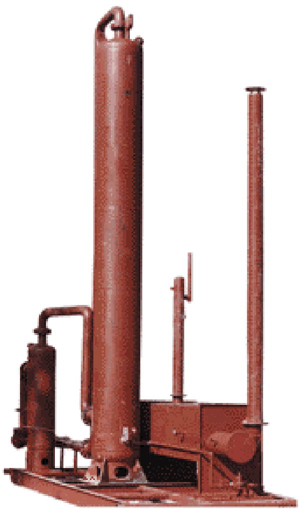
28 – 30 October, 2008

Methane Savings from Natural Gas Dehydrators: Agenda

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

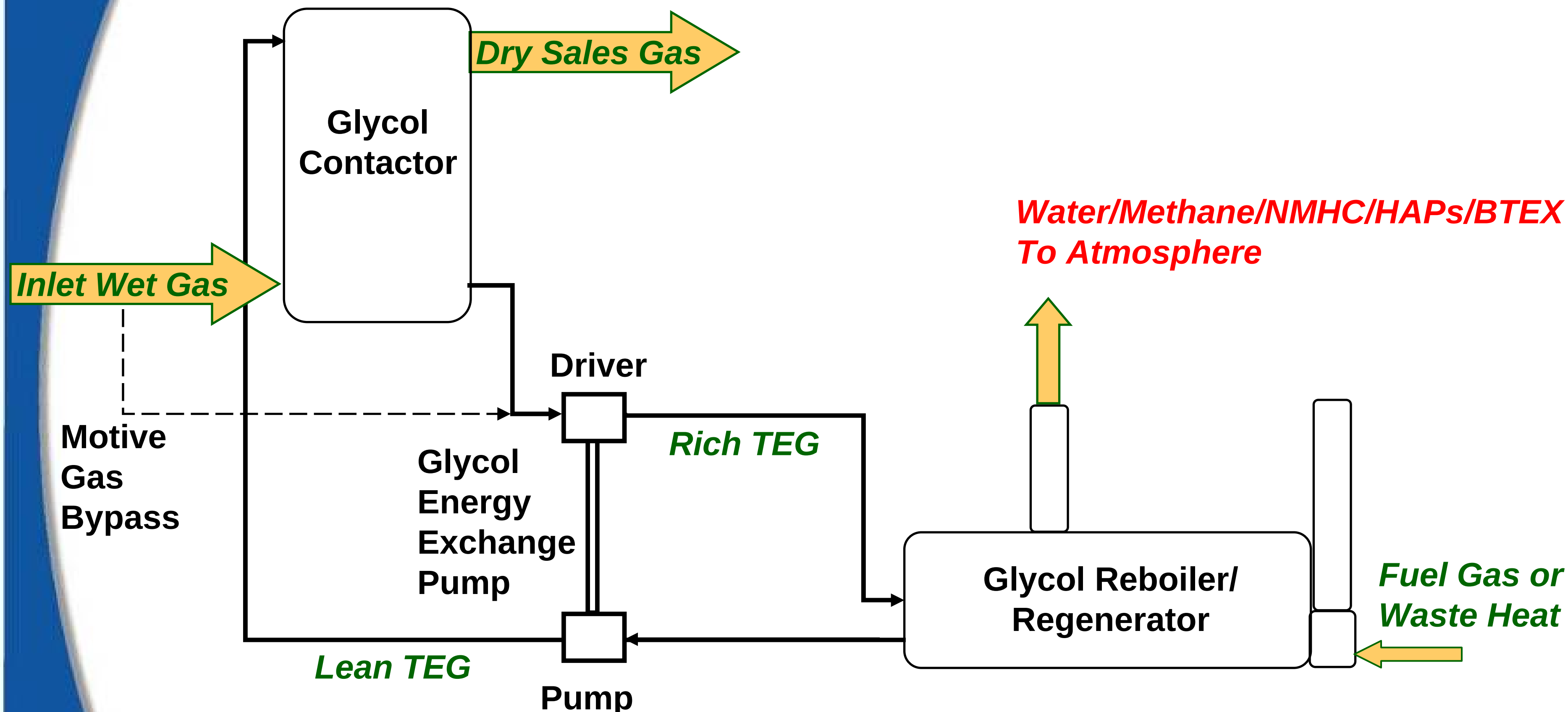
Dehydrators: Methane Losses

- Produced gas is saturated with water, which must be removed for long distance gas pipelines
- Glycol dehydrators are the most common equipment used to remove water from gas
  - Most use triethylene glycol (TEG)
- Glycol dehydrators emit methane
  - Methane, Non-Methane Hydrocarbons (NMHC), Hazardous Air Pollutants (HAPs), Benzene, Toluene, Ethylbenzene, Xylene (BTEX) from reboiler vent
  - Methane from pneumatic controllers and glycol circulation pumps



Source: www.prideofthehill.com

Basic Glycol Dehydrator System Process Diagram



Natural Gas Dehydrators: Options for Methane Recovery

- Optimize glycol circulation rates
- Install flash tank separator
- Install electric pump

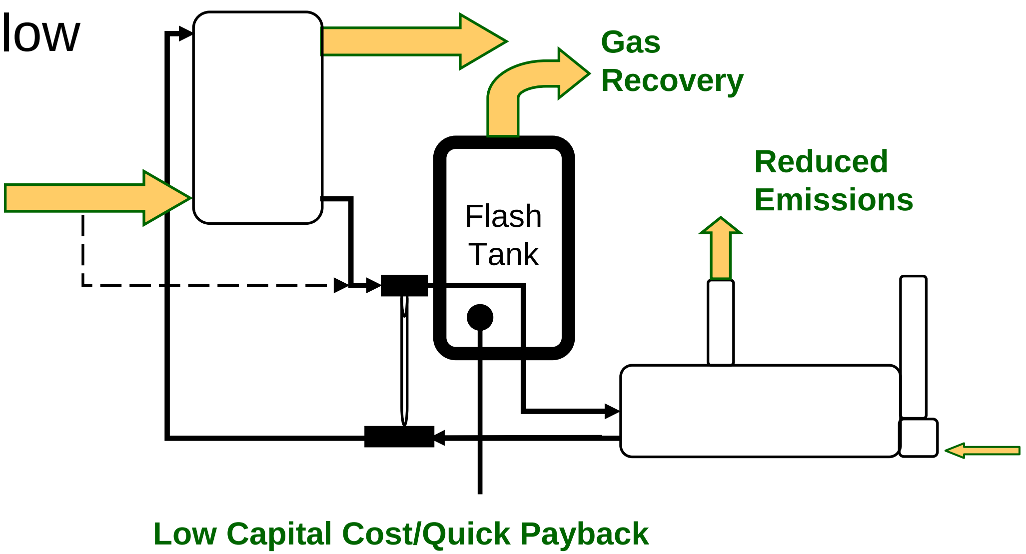
Glycol Dehydrator Unit
Source: GasTech

Optimizing Glycol Circulation Rate

- Gas pressure and flow at gathering/booster stations vary 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 glycol circulation rate
  - Reduction in the glycol circulation rate reduces methane emissions
  - Lessons Learned study: optimize circulation rates

Flash Tank Recovers Methane

- Methane and NMHC entrained with the rich TEG is vented to the atmosphere from the TEG regenerator
- Installation of flash tank separators enables gas and liquid separation at either the fuel gas system pressure or a compressor suction pressure
- Recovers about 90 percent of methane emissions and 10 to 90 percent of NMHC
- Must have an outlet for low pressure gas
  - Fuel
  - Compressor suction
  - Vapor recovery unit (VRU)



Flash Tank Costs

- Lessons Learned study[1] provides guidelines for scoping costs, savings and economics
- Capital and installation costs:
  - Capital costs range from $3,300 to $6,700 per flash tank
  - Installation costs range from $1,600 to $3,000 per flash tank
- Negligible operational and maintenance costs

[1]Source: EPA Natural Gas STAR Lessons Learned Document “Optimize Glycol Circulation and Install of Flash Tank Separators in Dehydrators”

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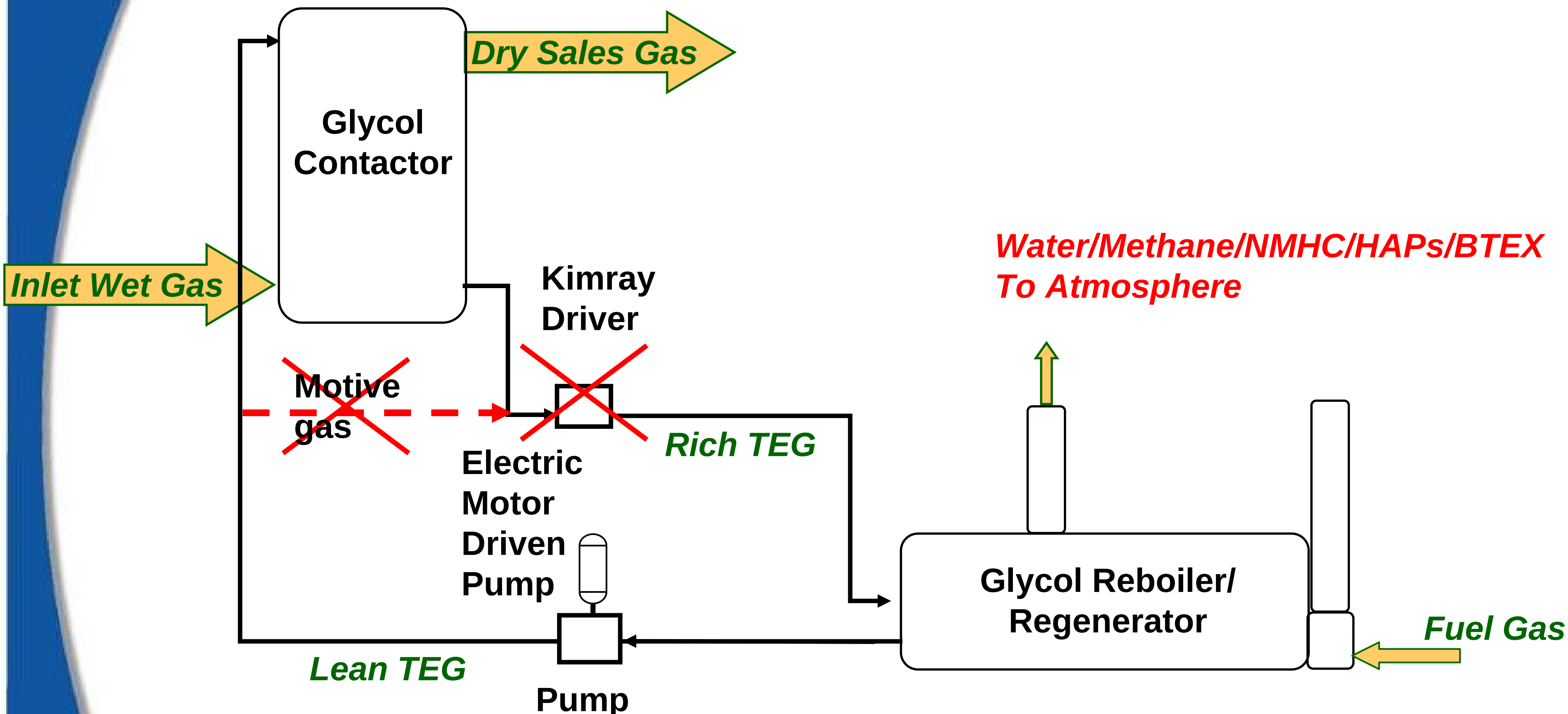
Electric Pump Eliminates Motive Gas



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Overall Benefits: Reducing Dehydrator Emissions

NaturalGas EPA POLLUTION PREVENTER

- Financial return on investment through gas savings
- Increased operational efficiency
- Reduced Operational and Maintenance costs (fuel gas, glycol make-up)
- Reduced air pollutant emissions (NMHC, HAPs, BTEX)

Is Recovery Profitable?

Economic Analysis of Dehydrator Options Based on Natural Gas STAR Partner Experiences

Option	Cost of Implementation	Emissions Savings ($/year)	Payback Period[1]
Optimize Circulation Rate	Negligible	$2,800 to $276,000	Immediate
Install Flash Tank	$6,500 to $18,800	$8,000 to $75,000	4 to 11 months
Install Electric Pump	$2,700 to $15,100	$2,520 to $252,000	< 1 month to several years

[1] Based on US costs and gas prices; gas price of $250/Mcm

Source: EPA Natural Gas STAR Lessons Learned Document “Optimize Glycol Circulation and Install of Flash Tank Separators in Dehydrators” and “Replacing Gas-Assisted Glycol Pumps with Electric Pumps”

Additional Dehydration Opportunities

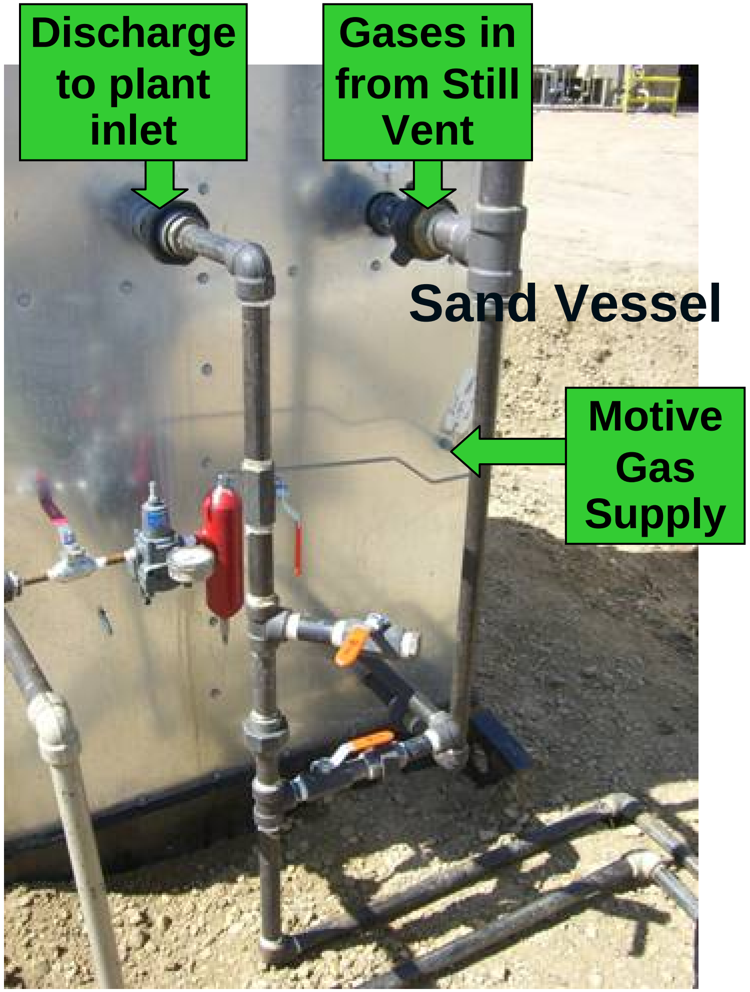
- Desiccant dehydrators
  - Use packed column of desiccant salts to remove water instead of using glycol
- Zero emission dehydrators
  - Combine several dehydration technologies (flash tanks, electric pumps, reroute skimmer gas, electric control valves) to virtually eliminate methane emissions
- JATCO venturi system
  - Use high pressure motive gas to capture still gas and reroute to facility suction to create a closed loop system

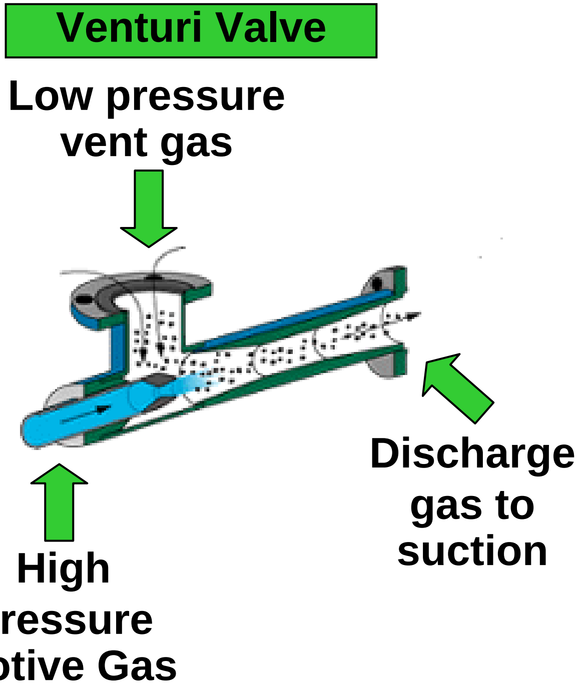
Industry Experience: EnCana Oil & Gas (USA)

- In Colorado, EnCana uses Jatco BTEX condensers and venturi valves
- Technology used to route vapors back to the suction of the facility
- All vapors post condenser are routed to the inlet via a venturi valve
- Creates a closed loop system

Source: EnCana Oil & Gas (USA) Inc.

Overview: JATCO Venturi System





EnCana Experience: JATCO Venturi Application

- Must have high pressure motive gas
- Motive gas can be from a compressor or dry gas from the dehydrator
- Must have low suction pressures, or low pressure gas stream
- EnCana's Colorado operations are applicable because they have suctions pressures of 2.7 – 3.0 atm[1]

[1] 1 atmosphere (atm) = 0 pounds per square inch gauge (psig) and 14.7 pounds per square inch atmospheric (psia)
1 atm = 1.013 bar = 101.3 kPa

EnCana Experience: Costs of Installation

- Average unit cost ~ $12,000
- Average piping cost ~ $1,300
- Average installation ~ $6,500
- Total Cost ~ $19,800
- Technology allows for large emissions savings. Quantity of methane captured is small and will vary by site.
- Eliminates the need for a BTEX combustor at the Colorado sites where the Jatco unit was installed

Methane Savings from Natural Gas Dehydrators: Discussion

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