Gas Processing Technology Experience: Priorities

Seminar with Russian Independent Oil and Gas Producers on Methane Mitigation Technologies and Strategies

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NaturalGas
EPA POLLUTION PREVENTER

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

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2008 Processing Sector Methane Emissions (34 Bcf)

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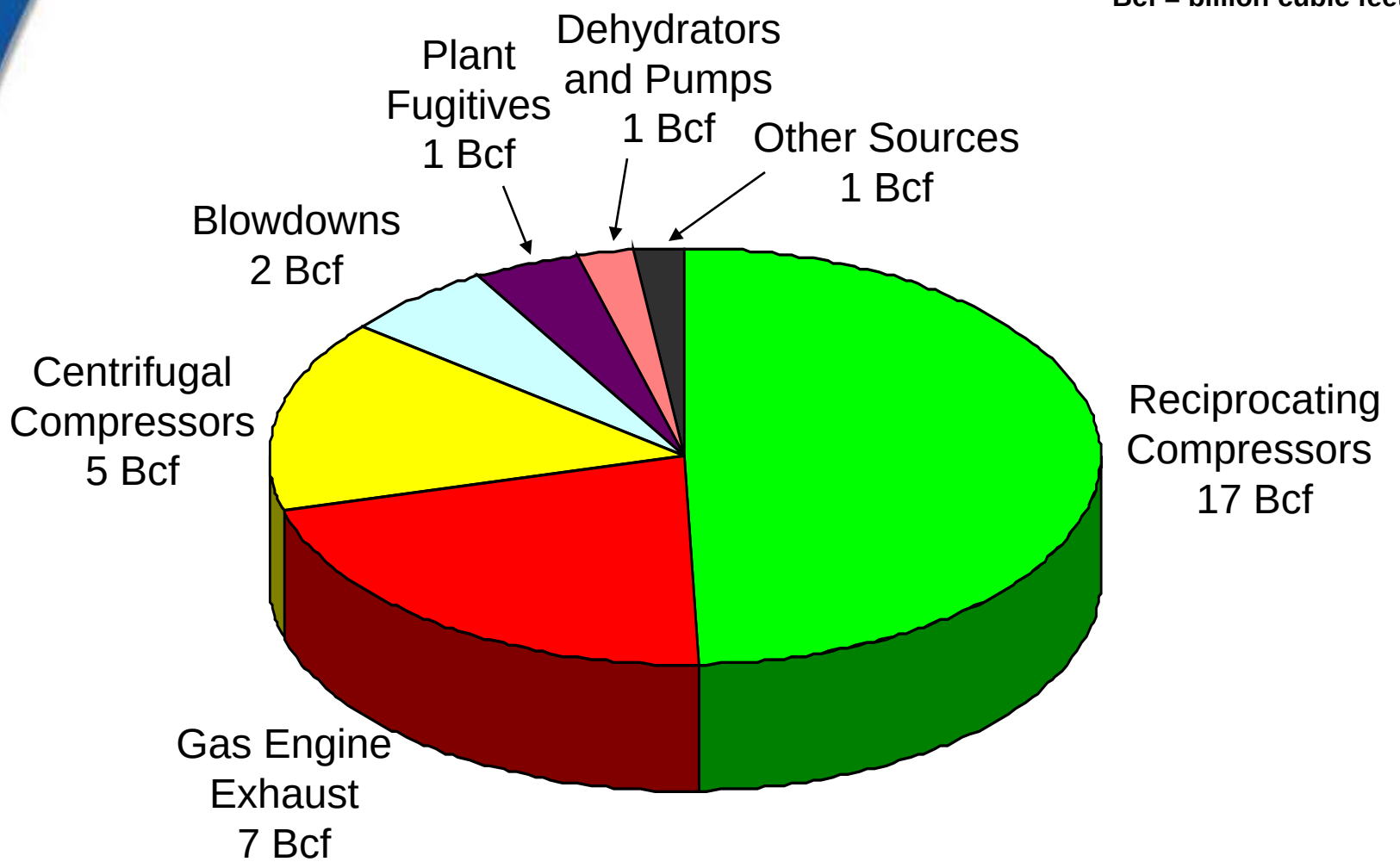
Bcf = billion cubic feet



EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2008.* April, 2010. Available on the web at: epa.gov/climatechange/emissions/usinventoryreport.html.

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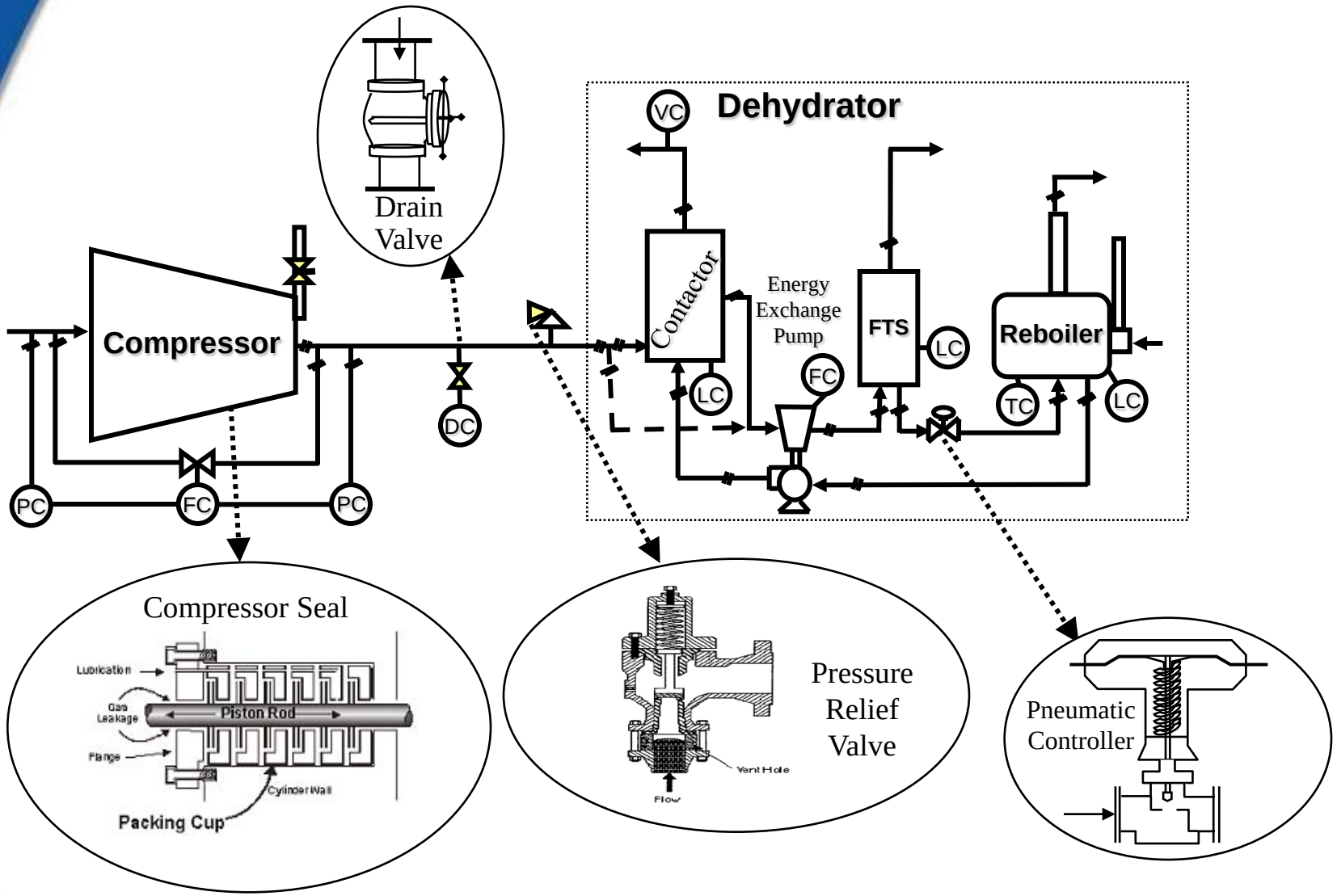
Emission Sources in Processing Plants



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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”

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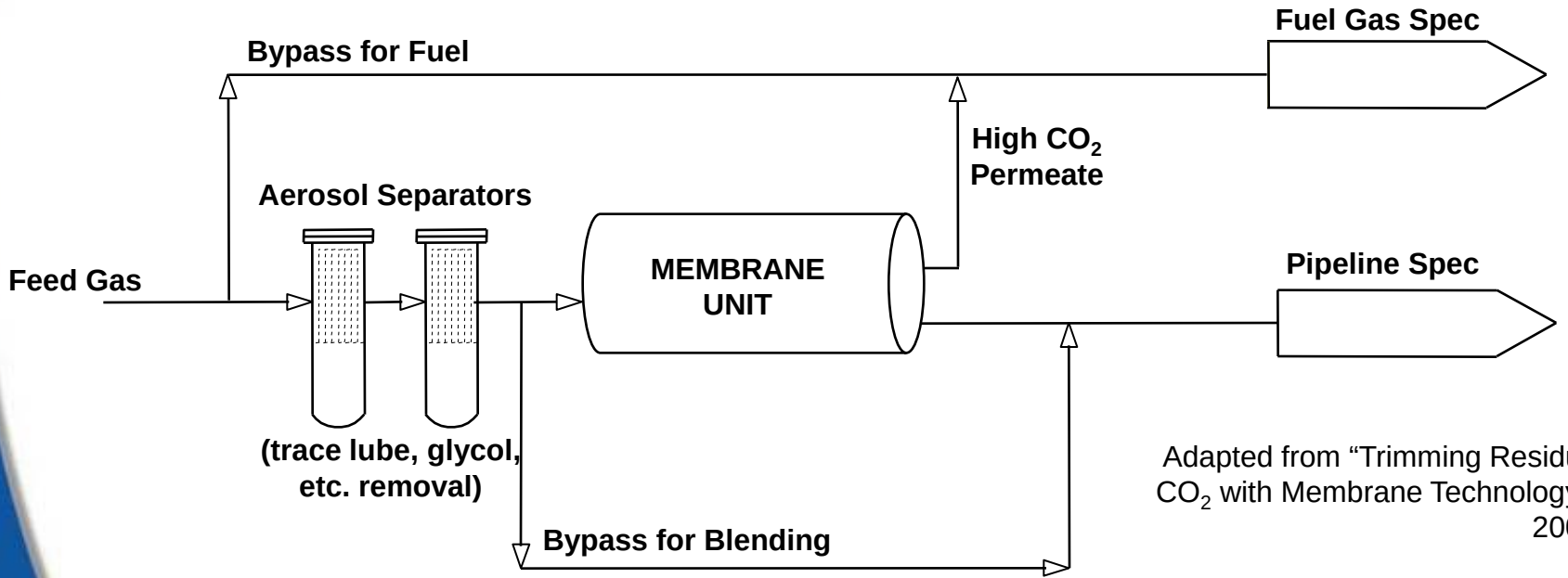
Leak Detection, Quantification, and Repair by Leak Imaging

- Majority of fugitive methane emissions are from a 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 CO_2 from feed gas
- High CO_2 permeate (effluent or waste stream) exiting the membrane is vented or blended into fuel gas
- Low CO_2 product exiting the membrane exceeds pipeline spec and is blended with feed gas



Adapted from "Trimming Residue CO_2 with Membrane Technology", 2005

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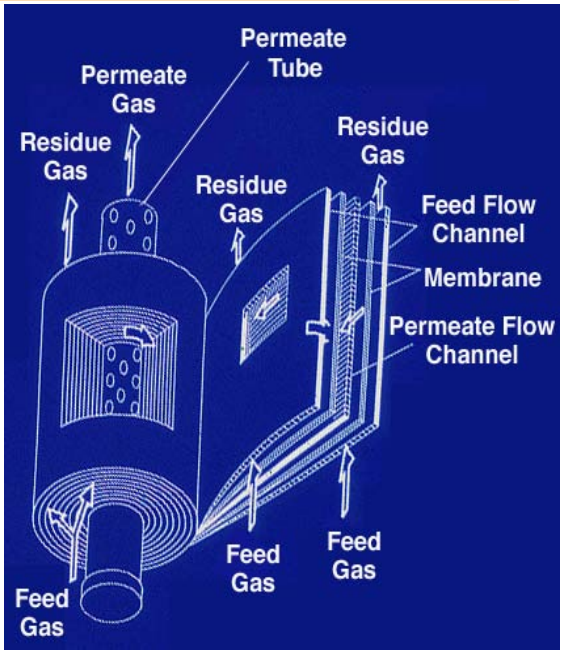
AGR- Membrane Economics: Is Recovery Profitable?

- 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

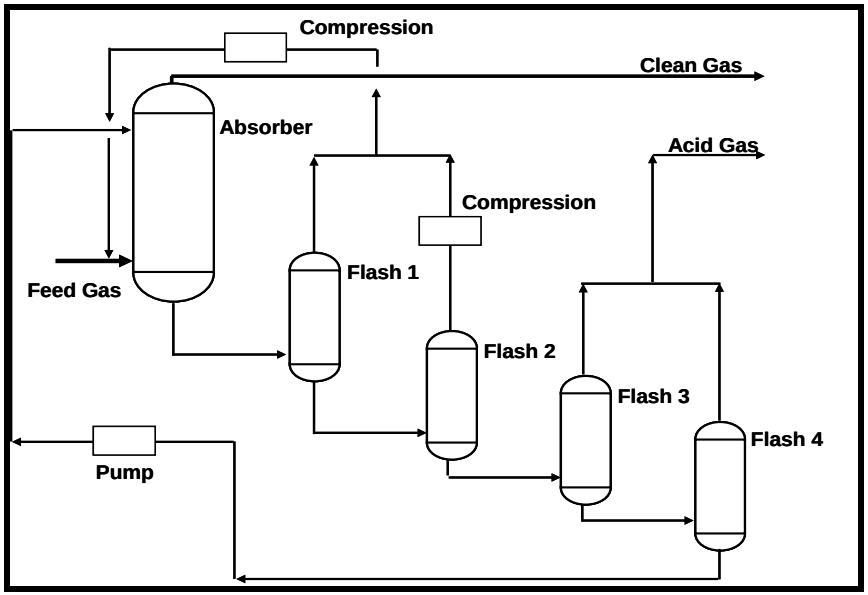
- Molecular Gate® adsorbs acid gas (CO_2 and H_2S) in fixed bed
- Molecular sieve application selectively adsorbs acid gas molecules of smaller diameter than methane
- Bed regenerated by depressuring
  - 10% of feed methane lost in depressuring
  - Route tail gas to fuel
- Applicable to lean gas sources

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]



1 – GTI
2 – Oil and Gas Journal, July 12, 2004, p 57, Fig. 7

Comparison of AGR Alternatives

	Amine (or Selexol™) Process	Morphysorb® Process	Kvaerner Membrane	Molecular Gate® CO_2
Absorbent or Adsorbent	Water & amine (Selexol™)	Morpholine derivatives	Cellulose acetate	Titanium silicate
Methane Savings Compared to Amine Process	--	66 to 75% less methane absorption	Methane in permeate gas combusted for fuel	Methane in tail gas combusted for fuel
Regeneration	Reduce pressure & heat	Reduce pressure	Replace membrane about 5 years	Reduce pressure to vacuum
Primary Operating Costs	Amine (Selexol™) & steam	Electricity	Nil	Electricity
Capital Cost	100%	75%	35%	<100%
Operating Cost	100%	60% to 70%	<10%	80%

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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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