U.S. Environmental Protection Agency
Natural Gas STAR Program

Vapor Recovery

Presented by
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Beliefs in O&G Industry

★ Vent gas methane quantities are low
★ Vent gas dollar value is low
★ Too hard to measure vent gas flow rates
★ Too hard to recover vent gas
New Facts

★ Millions of BTUs per day are vented to the atmosphere
★ Millions of dollars per day are lost
★ Measurement of vent flow rates is easy
★ Recovery of vent gases is easy
Past Vent Gas Determination Methods

- Vasquez-Beggs
- Computer simulations
- Pressurized oil sample to determine gas-to-oil ratio
- Direct measurement with orifice plate meter
- Educated Guess
New Facts

★ Vent Gas Volume are Large and Have Value
★ Actual Measurement
  ▪ 150,000 SCFD (150 MSCFD)
  ▪ 1850 BTU/SCF
  ▪ $5.00/MMBTU
  ▪ Yields: $506,438/year lost profit
## Estimated Potential from O&G Facilities

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Est. Gas Volume per Facility</td>
<td>100,000 SCF/day</td>
</tr>
<tr>
<td>Number of Facilities</td>
<td>1,500</td>
</tr>
<tr>
<td>Vent Gas CH4 Content</td>
<td>65 Volume %</td>
</tr>
<tr>
<td>Volume of CH4 Per Facility</td>
<td>23,725,000 SCF/yr</td>
</tr>
<tr>
<td>Total Volume CH4 All Facilities</td>
<td>35,587,500,000 SCF/Yr</td>
</tr>
<tr>
<td>Annual Vent Gas Value per facility</td>
<td>$273,750</td>
</tr>
<tr>
<td>Annual Vent Gas Value per facilities</td>
<td>$410,625,000</td>
</tr>
<tr>
<td>Gas price = $5.00/MMBTU and BTU value of 1,500 BTU/scf</td>
<td></td>
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</tbody>
</table>
### Estimated Potential from O&G Facilities

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of CH4 per Facility</td>
<td>501</td>
<td>tons/yr</td>
</tr>
<tr>
<td>CO2 equivalent per Facility</td>
<td>10,517</td>
<td>tons/yr</td>
</tr>
<tr>
<td>Total CO2 eq. all Facilities</td>
<td>15,774,934</td>
<td>tons/yr</td>
</tr>
</tbody>
</table>
Gas STAR Estimated Annual Methane by Sectors

- **Production** = 89 bcf
- **Transmission and Storage** = 96 bcf
- **Distribution** = 77 bcf
- **Processing** = 36 bcf
Production Sector Opportunities

- Storage tanks
- Separators and heater treaters
- Glycol dehydration units flash tanks and still column vents
- Low pressure vent systems
New Fact

★ Vent gases can be measured easily using ultrasonic methods
★ Measurement is critical to sizing vapor recovery unit properly to get total volume and variations in flow
Gas Measurement Types

- Ultrasonic transit-time meters
- Differential Pressure - orifice plate, pitot tube, annubars, venturi
- Turbine meters
- Thermal mass flow meters
- Vortex flow meters
- Acoustic meters for through-valve leaks
Ultrasonic Measurement

- Meter sends signals from transducers through pipe - velocity of signal increases with flow and decreases against flow. Differential time proportionable to velocity of gas in pipe.
- Known pipe diameter to calculate flow rate
- Independent of gas composition
- Speed of sound through air calibration check
New Fact

Vent gases can be recovered using the Jet Pump (EVRU™) or mechanical vapor recovery unit (VRU)
Mechanical VRU Compressors

- Reciprocating Compressors
- Centrifugal Compressors
- Screw Compressors
  - Wet
  - Dry
- Rotary Vane
Non-Mechanical Compressors

★ Jet Pump (Ejector Vapor Recovery Unit - EVRU™)
★ see: http://www.epa.gov/etv/verifications/vcenter3-10.html
Summary

- Vent gases volumes can be large
- Recovery reduces VOC and GHG emissions
- Vent gases have value
- Vent gases can be measured accurately with ultrasonic methods
- Vent gases can be recovered