Today’s Webinar Outline

• Challenges with Typical LFG Wellheads and Well Caps
• Well Caps
  o Traditional Gas Well completions
  o QED’s Stabilizer Well Caps
• Flow Measurement
  o Traditional Flow Measurement
  o QED’s Flow Measurement Offering
• Flow Control
  o Traditional Flow Control
  o The Precision Fine Tune Control Valve™
• QED’s LFG Wellheads
Reasons for Measuring and Controlling Landfill Gas

- Maximize LFG energy content (flow rate and methane concentration) when gas is utilized
- Avoid NSPS violations for PTO exceedence
- Compliance of LFG surface emissions
- Avoid odor complaints from neighbors
- Reduce time and labor for wellfield management
- Reduce and simplify wellfield maintenance and repairs
Traditional LFG Wellheads

- PVC gate valve for flow control is most common
- A Union orifice plate, Pitot tube or venturi used for flow measurement (calculated from differential pressure)
- Flexible couplings are used to connect the well riser and well head
Problems with Traditional Wellheads

- Flexible rubber couplings (e.g., Fernco® couplings) have very little structural strength to support well head and flex hose weight, become brittle, collapse under vacuum, and can be difficult to seal, all resulting in air leaks.
- Pitot tubes, orifice plates and venturi used for flow measurement have limitations with accuracy or are difficult to use, resulting in measurement errors.
- Gate valves were designed for controlling liquids, not for regulating gas flow – small adjustments in valve opening can result in large changes in applied vacuum and resultant flow.
The Problem with Traditional Well Caps
Leaking Flexible Coupling
Introducing

The First Engineered Solutions for LFG Measurement & Control
QED Stabilizer™ Well Caps

• First engineered LFG Well Cap that aligns and stabilizes the LFG wellhead minimizing air leaks and gas release.

• Features a unique support ring molded directly into the Well Cap (patent pending) that aligns and stabilizes the wellhead.

• Takes pressure off the flexible coupling and the flex hose.
QED Stabilizer™ Well Caps

• Easy access for liquid level measurements – faster, safer, no need to shut down the vacuum system.

• Caps are molded in a highly visible, bright yellow helping identify and protect the entire well from damage.

• Durable, heavy-walled, polyethylene construction makes it ideal for any climate.
QED Stabilizer\textsuperscript{sm} Well Caps

- Designed to work with 6” and 8” diameter wells with 2” or 3” wellheads
- All models provide ports to accommodate a down well pump.
- Pump fitting kits allow conversion of gas recovery caps to dual extraction
Traditional Flow Measurement
Common Flow Measurement Methods for Landfill Gas Wellheads

- Pitot Tube
- Orifice Plate
- Venturi

New Flow Measurement Method

- Portable Thermal Mass Flow Meter
Pitot Tube

Bernoulli's Equation:
\[ p + \frac{1}{2} \rho V^2 = p_1 \]

Solve for Velocity:
\[ V = \sqrt{\frac{2(p_1 - p_2)}{\rho}} \]

Diagram of Pitot Tube components:
- Static Pressure Port
- Impact Pressure Port
- Thermometer Port
- Flow Control Valve
- Sample Port
- Measurement Tube
- Adapter
- Well Casing
- Flex Hose
- Lateral Piping

Photo of a 3/16" Pitot Tube with a coin for scale.
Orifice Plate

- Orifice plate
- Flow direction
- Annular slot
- Inlet pipe
- Carrier ring
- Pressure difference $\Delta p$

Diagram of orifice plate with flow direction and pressure difference.
Venturi
Common Flow Measurement Methods

**Pitot Tube**

**Advantages** – widely used, variety of sizes and configurations, for vertical or horizontal applications

**Disadvantages** – tube can plug from moisture or mineralization and give false readings, design has poor resolution for flows under 25 SCFM

**Orifice Plate**

**Advantages** – proven technology with accurate results, ability to change plate sizes to match desired pressure differential

**Disadvantages** – changing plates in most designs is cumbersome; don’t know if a plate is in place, or what size; commonly only for vertical applications

**Venturi**

**Advantages** – can be used for vertical or horizontal applications, promoted as one-size-fits-most applications

**Disadvantages** – significant pressure drop (>12”) for flows > 100 SCFM; insufficient pressure drop for reliable measurement at flows under 20 SCFM
Introducing

The First Engineered Solutions for LFG Measurement & Control
Quick-Change™ Orifice Plate

• Easy as 1-2-3 to change to the most appropriate size plate for the given conditions.

• Change to the correct plate in seconds, no time wasted shutting down the control valve or rebalancing the wellfield.

• Accessible plate housing for easy plate change and size confirmation.

• Saves valuable field time and helps reduce labor costs.
Quick-Change™ Orifice Plate Wellhead
Precision Flow Meter™

• Precision Flow Meter is an extremely accurate portable thermal mass flow meter.
• Insertion-style Meter reads directly in SCFM, not a calculated value.
• Measures and logs gas flows through existing ports in headers 1” and larger.
• Patented self-calibration check.
Traditional Flow Control
Traditional Gate Valve

Advantages
• Lower initial cost
• Widely available

Disadvantages
• PVC valve stem can break
• Plastic threads can strip easily
• Handle can break
• Non-rising stem – blind to valve position
• Seals fail, dirt gets in threads and track
• Impacted by temperature – extreme cold and heat make valve difficult or impossible to adjust
• Full flow in less than 3 turns
Traditional Gate Valve
Introducing

Precision Fine Tune Control Valve™
Precision Fine Tune Control Valve™

- Patented flow-tuned valve design provides precise, linear control of flow from fully closed to maximum flow.

- Rising stem design and highly visible metered scale allows easy observation of valve position setting, making it easy to quickly return to the exact setting if the valve must be closed.

- Rugged stainless steel valve stem and handle makes it durable in harsh outdoor environments.
QED Precision Control Valve vs. PVC Gate Valve

- PVC gate valve offers very little control, with maximum flow achieved at just four turns.
- QED Precision Valve has highest resolution at lower flows (under 25 SCFM), with nearly linear flow control across entire range of valve opening.
Case Study

Southern Texas Landfill

3 Precision Fine Tune Control Valves

12 month period
Case Study
South Texas Landfill
Case Study
South Texas Landfill

WELL 78

- Wellhead installed 6/2011

- CH₄ %
- CO₂ %
- Flow (SCFM)
- Balance Gases
- O₂ %

7/2011 7/2012
Case Study
South Texas Landfill
# Landfill Gas Calculator

<table>
<thead>
<tr>
<th>Starting Value</th>
<th>Ending Value</th>
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<tbody>
<tr>
<td><strong>DATA INPUT</strong></td>
<td></td>
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<tr>
<td>Landfill Gas Flow (SCFM)</td>
<td>34</td>
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<tr>
<td>Methane Content (percent)</td>
<td>51</td>
</tr>
<tr>
<td><strong>Methane Collected (SCF)</strong></td>
<td>9,113,904</td>
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<tr>
<td>Annual Total</td>
<td>$18,227.8</td>
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</table>

## Current Methane Value
(U.S. Dollars/MMBtu)  
$2.00

## Current Annual Value of 1 SCFM
(U.S. dollars per 1,000 cubic feet)  
$525.6

## Additional SCFM
4

## Additional Methane
1,671,408

## Value of Additional Methane
$3,342.81

[Check Henry Hub natural gas spot price for Methane Value.](https://www.qedenv.com/landfillgas2)  
[See Total Cost of Pump Ownership](https://www.qedenv.com/landfillgas2)
QED’s Wellheads
QED’s Wellhead Offering

Quick-Change™ Orifice Plate Wellhead

Flow Meter™ Wellhead

Traditional Orifice Plate Wellhead
Quick-Change™ Orifice Plate Wellhead

- Revolutionary, patent pending orifice plate technology for the direct measurement of landfill gas.

- Combines easy plate exchanges for accurate flow measurements with precise flow control over a broad flow range.

- High reflective tape & bright yellow cap increase the visibility of the Wellhead.

**Specifications:**

<table>
<thead>
<tr>
<th>Model</th>
<th>Optimal Flow Range</th>
<th>Wellhead Materials</th>
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<tbody>
<tr>
<td>ORP215</td>
<td>0-125 scfm (0-212 m³/h)</td>
<td>PVC, Stainless Steel, Viton®</td>
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<tr>
<td>ORP315</td>
<td>30-300 scfm (50-500 m³/h)</td>
<td>Stainless Steel, Viton®</td>
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Fitting Options: Brass barbs, quick connects
Flow Meter™ Wellhead

- For those looking for cutting-edge flow measurement technology and precise flow control.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>2” (50 mm)</th>
<th>3” (76 mm)</th>
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</thead>
<tbody>
<tr>
<td>Model:</td>
<td>FMW200</td>
<td>FMW300</td>
</tr>
<tr>
<td>Optimal Flow Range:</td>
<td>0-125 scfm (0-212 m³/h)</td>
<td>30-300 scfm (50-500 m³/h)</td>
</tr>
<tr>
<td>Materials:</td>
<td>304 Stainless Steel, PVC, Viton®</td>
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</table>
Traditional Orifice Plate Wellhead

• For those looking for sensitive flow adjustment capability and a lower cost assembly.
Wellhead System Drawings

Quick-Change™ Orifice Plate Wellhead
Free Wellhead Trial Offer

Try a QED Wellhead for 60 days at no charge.

At the end of the Trial Offer you may purchase the unit or return it to QED.
Questions?

Brad Peake
QED Environmental Systems, Inc.
Ann Arbor, MI and San Leandro, CA
www.qedenv.com

E-mail: info@qedenv.com
Toll-free: 800-624-2026
Direct: 734-995-2547