Increasing Delayed Coker Productivity Through Reliable Flow Measurement Solutions
The Need to Improve Reliability of Furnace Feed Flow Measurements

- Thermal Cracking/Recycling to Extinction
- Recycled Coke Fines
- Wedge Meter/DP Performance
- Limited Alternative Technologies
- Heavier Crudes to Process
- Increased Refining Capacity
The Need to Optimize Control Strategies through Furnace Feed Flow Measurements

-Furnace Balance Control Strategies
  Accurately controlling feed rates:
  -Produces more uniform tube coking characteristics
Minimizing Tube Fouling Rates means:
  -Extending Spalling, Steam-Air Decoking & Pigging Frequency
  -Reducing Energy Consumption and Heat Loss
  -Reducing Furnace Tube Bend Wear
  -Increasing Production Rates
The Need to Improve Accuracy
Furnace Feed Flow Measurements

-Calculating Mass Balance:
Most Effective Calculation of Recycle Rate, requires accurately measuring:
- Fresh Feed Rate to the Fractionator
- Mixed Feed Rate to the Furnace
- Individual Furnace Pass Feed Flow Rates
Wedgemeter Accuracy?
The Need to Reduce Maintenance Cost
Furnace Feed Flow Measurements

Reducing Maintenance Costs:

Wedge Meters: Cost of Ownership

- Requires increased Man Hours to maintain feed flowmeters
- Requires Increased Man Hours in the unit Increased Risk of Personal Injury
- Purging DP Impulse Lines, Consumes Volume and Reduces Feed Throughput

\[(\text{Taps/Furnace}) \times (\text{Barrels/Day}) \times (\text{Life of the Unit}) = \text{Total Lost Production?}\]
FURNACE FEED RELIABILITY PROBLEMS
ConocoPhillips Refinery/Sweeny, TX/2001

-Delayed Coker & Vacuum Distillation
-ConocoPhillips/PDVSA Joint Venture
-Heavy Resid Processing Capacity
-Processing Heavy Venezuelan Crude
FURNACE FEED RELIABILITY PROBLEMS
ConocoPhillips Refinery/Sweeny, TX

- Reliability Problems with Vortex Technology

Alternate Technologies to Improve Reliability?
GE Sensing
Ultrasonic Transit Time Flow Measurement
Ultrasonic Transit Time Flow Measurement Technology

- Alternate Transit Time Measurements (Upstream & Down)
- Measured Delta T is Proportional to Velocity (Linear)
- High Turndown
- Zero Pressure Drop

A piezoelectric disk generates a voltage when deformed (change in shape is greatly exaggerated).
Existing Sensor Technology
Temperature Limitations

• Existing Sensors are **limited to 536°F, or less.**
  - Higher Process Temperatures will Damage the Sensor

• **OPTIONS:**
  - Design a Sensor with **Higher Temperature Rating**
  - Design a **Buffer** to protect the sensor from Process Temperatures extremes
Buffer Design

Initial Solution: **“Solid Buffer Rod”**

- Buffer Protects Sensor from Process Heat Extremes
- Weaker Signal Strengths
- Attenuating Fluids

![Diagram of Buffer Design](Image)

Buffer

-200 to 500°C

100°C

Piezoelement
Buffer Design

Initial Solution: “Solid Buffer Rod”

- Works better with Higher Frequencies (5MHz)
- Higher Temperature Liquids Require Lower Frequencies (200 KHz to 500 KHz) and a Larger Diameter Buffer
- Lines Sizes: 3” & 4”

-The Solution?
Buffer Design

Solution: “A Bundled Waveguide”

-Bundled Waveguide Technology™ (BWT)

-Large number of thin metallic conductors to efficiently transmit the ultrasonic signal (Similar to Fiber Optics)
Buffer Design

Bundle Waveguide Technology™ (BWT)

Standard Offering:

- Gas or liquid side
- Flange/Nozzle
- Inner buffer ≈ 150 mm
  Length dependent on fluid temperature
- Transducer is easily re-coupled at this point on the “air” side
- Removable xproof-design transducer
- Lap-joint flange, 1.5” 150# to 2500#
- Raised-face coupler
- Gasket
- Flange/Nozzle
Buffer Design

Bundle Waveguide Technology™ (BWT)

BWT™ improves signal shape and SNR over solid buffers
Bundled Waveguide Technology
Bundled Waveguide Technology

- **Totally Reliable Feed Flow Measurements**
- Repeatable (+/- 0.5% of Reading)
- Accurate (+/- 1% of Reading)
- No Obstruction to Flow
- No Pressure Drop
- No Maintenance
- No Calibration….ever
- No Impulse Lines to Maintain
- No Purging of Impulse Lines

- Increased Production Rates
- Reduced Maintenance Cost
Bundled Waveguide Solution

Replaced existing Vortex meter in (1) VDU Furnace Pass Line

Matched existing face-to-face dimension
After (2) weeks, the Refinery Installed Redundant BWT Measurements on each Pass Line (16 Redundant) of the VDU and Coker Furnaces
Bundled Waveguide Technology Performance

Since 2001....

• Totally Reliable Feed Flow Measurements
• No Pressure Drop or Obstruction to Flow
• No Maintenance or Re-Calibration required…ever
• Accuracy (+/-1%) & Repeatability (+/-0.5%), that never degrades
• No Moving Parts, Nothing to Wear Out
• No Wedge Meter Impulse Lines to Maintain
• Sensors are Retractable under Flowing Conditions
• Unlimited Redundant Configurations Available
• BWT’s require the same Face-to-Face dimension(s) as wedge elements
**Bundled Waveguide Technology Performance**

**Impact on the Bottom Line:**

- 80%+ Reduction in Feed Flowmeter Maintenance Cost (400 man hours/year)
- Improved Measurement Accuracy, Enables the Calculation of Mass Balance and Recycle Rate
- Safer Work Place (Less Hours in the Unit)
- Optimization of Furnace Balance Control:
  - Reduced Tube Fouling Rates
  - Reduced Heat Loss
  - Decreased Spalling, Steam-Air Decoking, Pigging Frequency
  - Reduced Tube Bend Wear
- Increased Production
  - No Purging of Impulse Lines (No Lost Volume)
  - Increased Unit Up Time
Scheduled Maintenance
Pulled Buffers to Inspect
Discussion
Questions & Answers