



SmartMine Processing Plant

Leak Detection Solutions Furnace Cooling System Value of Diagnostics

Improve Furnace Performance Reduce Costs with Furnace Leak Detection

- Reliably Detect Cooling Water Leaks
 - Improve furnace performance
 - Reduce hazardous safety condition
 - Reduce repair costs
- Reliably detect Oxygen Injection
 - Decrease oxygen usage
- Value that advanced diagnostics provide
 - Assuring initial installation delivers performance
 - Insuring ongoing performance for life of measurement



Agenda

- **Understanding the value of improved furnace leak detection**
- Historic Approaches and Challenges
- SmartMine Technology and Approach
 - Review SmartMine Case Study
- Group Discussion

Value of Improved Furnace Leak Detection



Ultimate Goals:

- Operations Stability
- Minimized Stoppages
- Increased Safety
- Reduce Operating Costs

Ultimate Results:

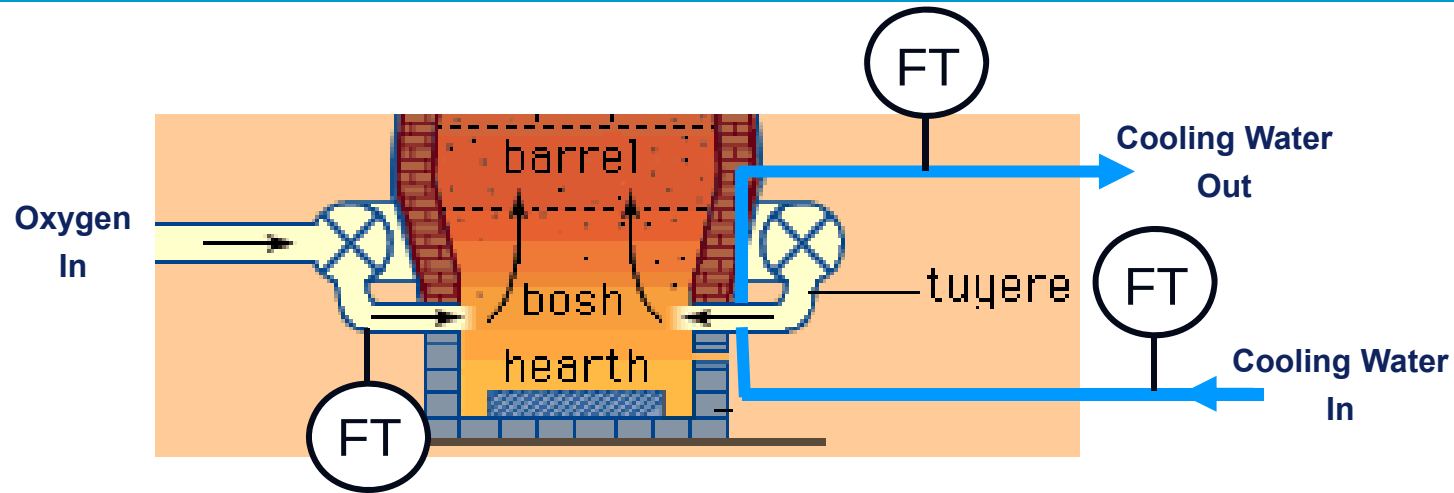
- Maximize furnace performance
 - Tuyere cooling water leaks reduce performance
 - Prevent unnecessary stoppages
- Reduce safety hazards caused by leaks
- Minimize maintenance costs
- Decrease Oxygen Use
 - Injection leaks increase costs

Agenda

- Understanding the value of improved furnace leak detection
- **Historic Approaches and Challenges**
- SmartMine Technology and Approach
 - Review SmartMine Case Study
- Group Discussion

Oxygen Measurements and Leak Detection

Blast Furnace Tuyere Application Example



Oxygen Leaks Issues

- Inconsistent furnace performance
- Adds cost to operations
- Requires accurate performance in less than ideal installations

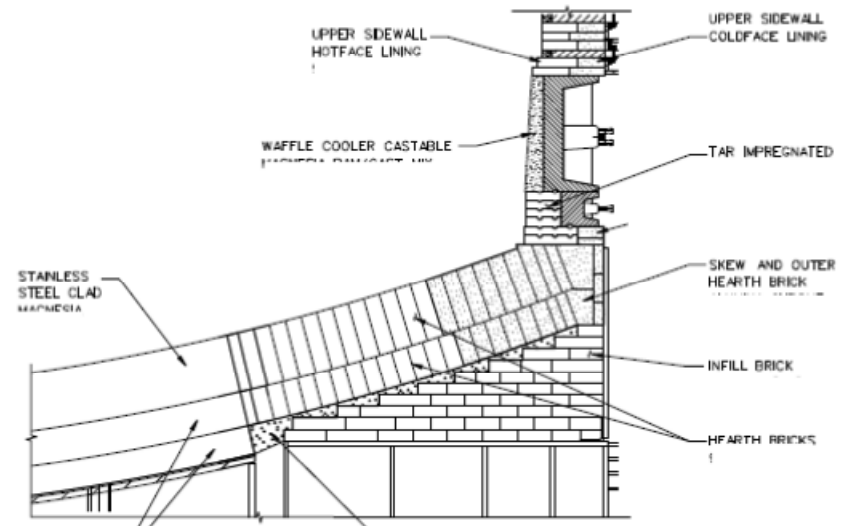
Cooling Water Leaks Issues

- Decreases furnace performance
- Creates dangerous safety conditions
- Causing expensive repairs
- Reliable, high accuracy performance in noisy environment

Water Cooling Leak Detection

Applicable across different furnace applications

- Non-ferrous furnaces to prevent walls/roof erosion
 - Waffle -coolers
 - Roof panel coolers
 - Metal tapping coolers
 - Slag tapping coolers
- Blast furnace walls



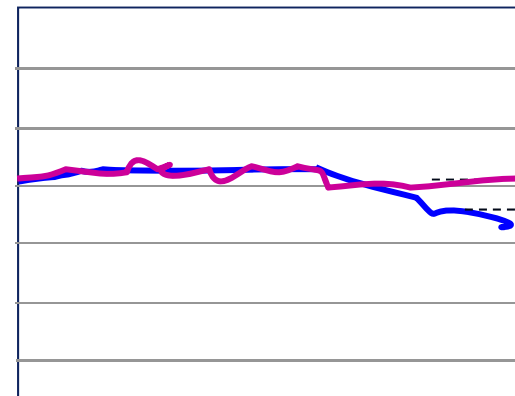
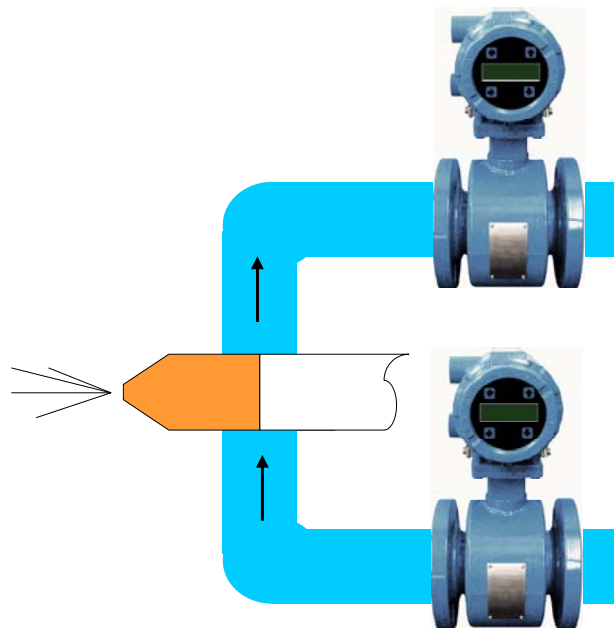
Cooling Water Leaks Issues:

- Decreases furnace performance
- Creates dangerous safety conditions
- Causing expensive repairs if not caught immediately
- Reliable, high accuracy performance in noisy environment

Leak Detection Methods

Input / Output Method

- Requires the meters to be within $\frac{1}{4}\%$ accuracy of each other to detect a leak as low as $\frac{1}{2}$ gpm.
- Requires superior accuracy
- Diagnostics to maintain performance and ensure operators

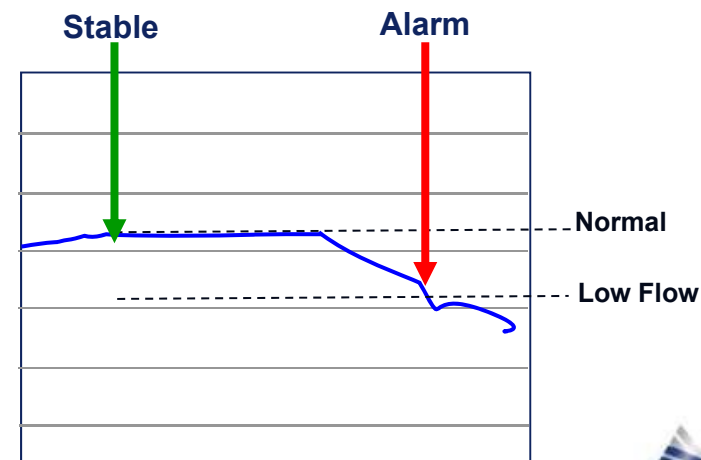
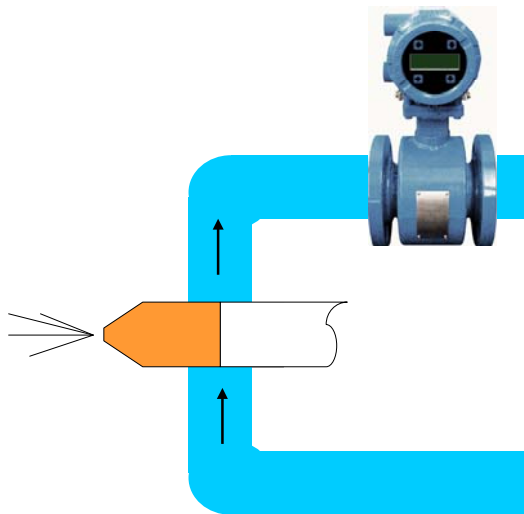


$\Delta > \frac{1}{4}\%$

Leak Detection Method

Normal Flow Method

- Furnace is brought up to operating levels and stabilized
- The rate is checked and the 4 and 20 mA points set accordingly
- Alarm on low flow conditions; process is shut down
- Alarm on sudden rate change
- Requires superior accuracy
- Diagnostics to maintain performance



EMERSON
Process Management

Leak Detection Challenges

- High accuracy required to discover small leaks
- Reliable measurement needed to prevent false alarms
 - Furnace shutdown and startup is timely and expensive
- Leaks must be discovered early
 - Water in touch with hot metal can cause explosion
- Continuous and tandem operations
- Instrument intelligence and self-testing

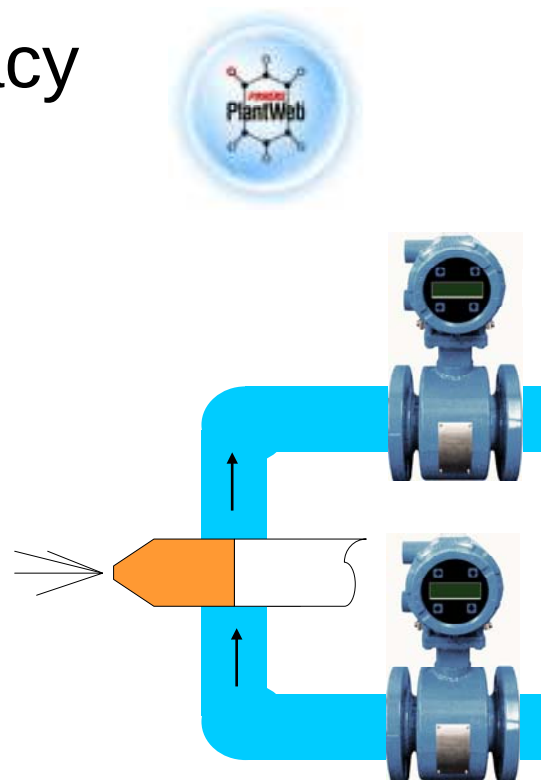
Agenda

- Understanding the value of improved furnace leak detection
- **Historic Approaches and Challenges**
- **SmartMine Technology and Approach**
 - **Review SmartMine Case Study**
- Group Discussion

SmartMine Solution

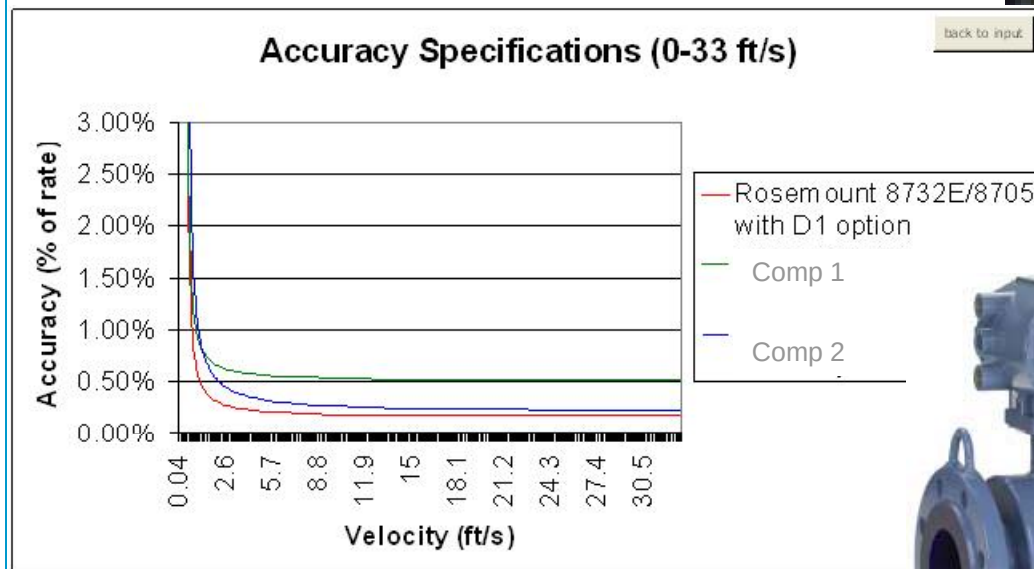
Cooling Water Leak Detection

- Maximum Measurement Accuracy
 - Best in class Magnetic Flow Meter
 - Best Installed Performance
- Advanced Diagnostics are Must
 - Simple installation & configuration
 - Continuous testing w/ alarms
- In-situ Meter Verification is necessary
 - Ongoing Performance tests expected
 - No need to stop operations



Step Change Improvements in Magnetics Impact Accuracy

- Reduced Variability Enabled by Magnetics Improvements result in higher base accuracy and repeatability
- Better performance across the flow range

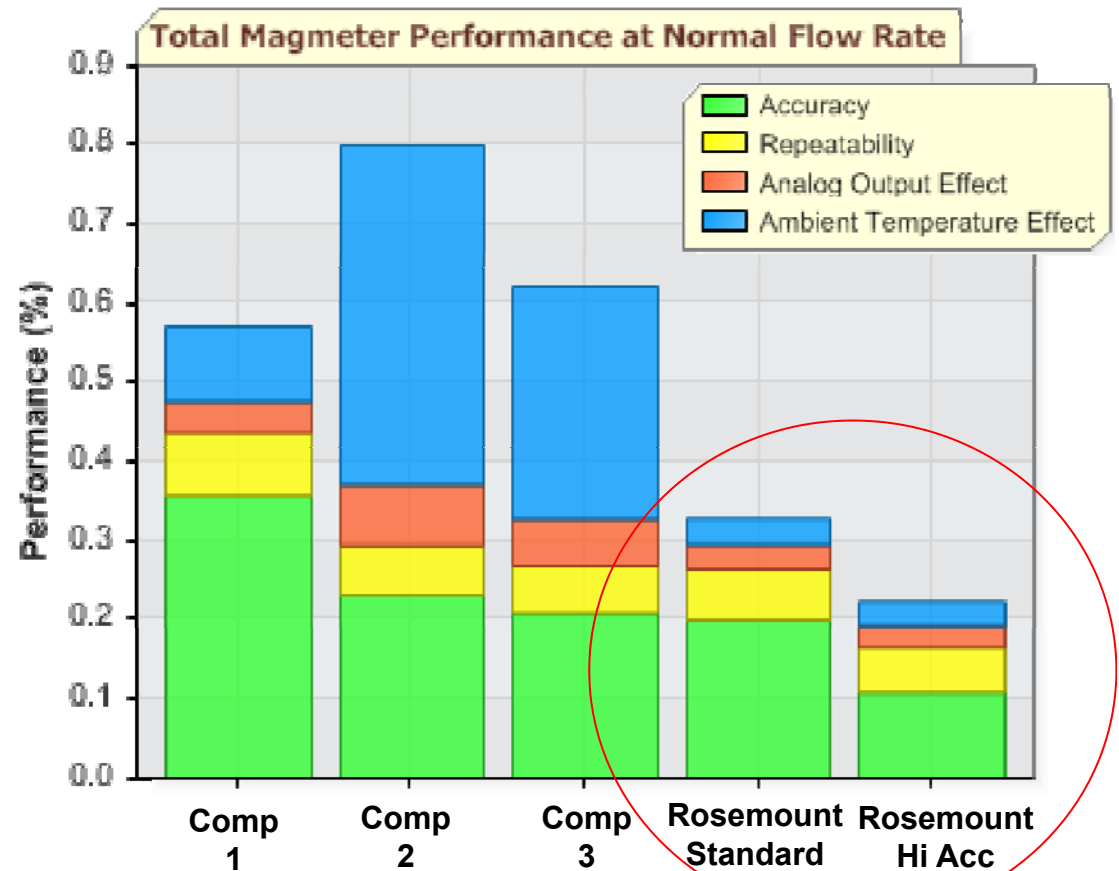


Run #	Deviation % rate
1	0.03%
2	0.00%
3	-0.02%
4	-0.11%
5	-0.08%
6	-0.10%
7	-0.01%
8	0.01%
9	0.01%

Improved Accuracy Provides Faster, More Reliable Leak Detection

When comparing flow meters, include effects of:

- Reference Accuracy
- Repeatability
- Analog Output
- Ambient Temp Effect



Application: 2", 0-200 GPM, 50-100 F Ambient Temps

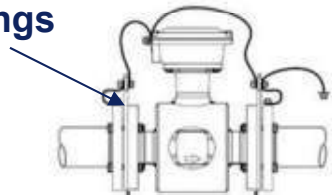


E-series Magnetic Flowmeter Diagnostic Ensures Proper Installation



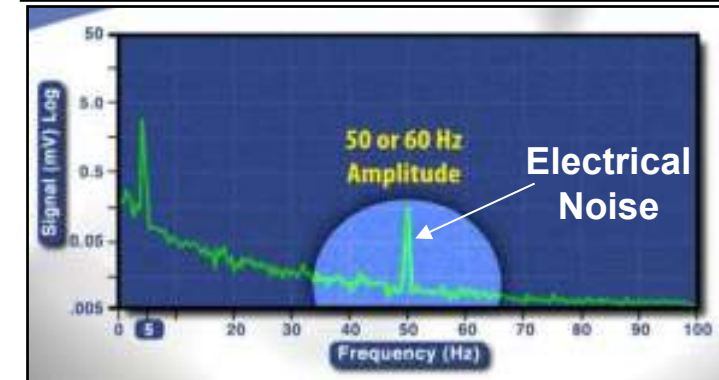
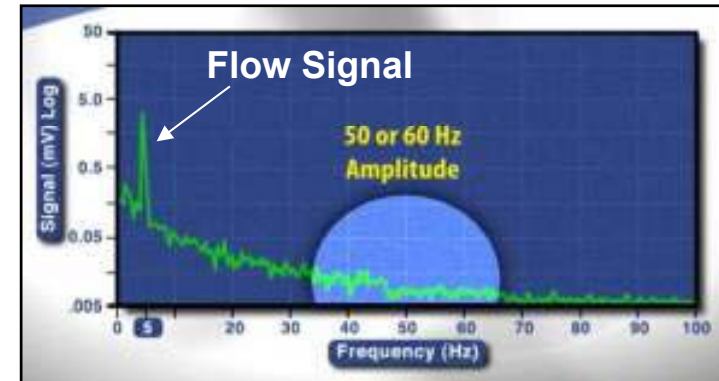
- Proper grounding is critical to deliver the best measurement from magnetic flowmeters

ground rings



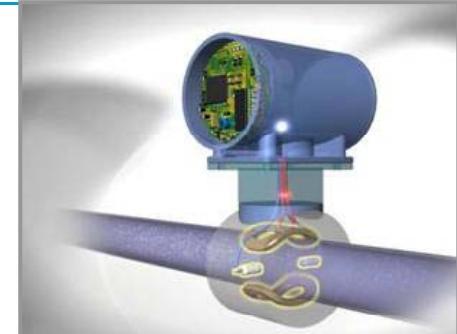
earth ground

- Diagnostics simplify installation



E-series In-situ Meter Verification Insures Ongoing Accuracy

- Confirms accuracy without removing flow meter from service
 - Compares magnetic field signature to baseline signature
- Verifies health of the transmitter, coil and electrodes
- No special equipment or third party services required



$$E = k * D * B * V$$

Where:

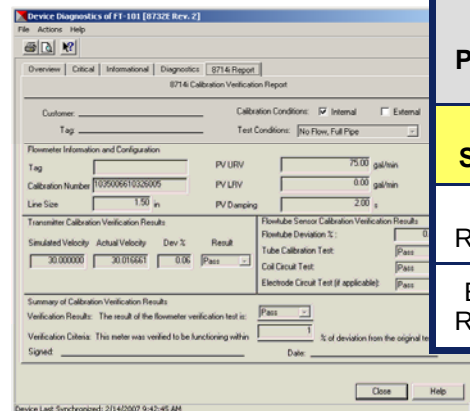
E = Induced Voltage (Measured by Electrodes)

V = Velocity of Conductive Liquid

k = Conversion Constant

D = Fixed Distance Between Electrodes

B = Magnetic Field Strength



Sensor Parameter	Signature Baseline Values	8714i Measure Values	Deviation	Criteria	Pass /Fail
Coil Signature	19.5	19.6	0.51%	1%	Pass
Coil Resistance	15.2	15.6		Range	Pass
Electrode Resistance	260.7	245.6		Range	Pass

EMERSON
Process Management

Furnace Leak Detection Application Challenge

Major Steel Mill

Site: United States



Scope: Tuyere Cooling
Water Leak Detection

Application

- Blast Furnace tuyeres cooling water leak detection
- Target flow rate 100 gpm

Pain Points

- Difficulty detecting leaks in a timely manner

Solution

- Rosemount E-Series magnetic flow meters on cooling water flows
- 1/4% accuracy at target flow rates
- Ability to suppress 4-ma point
- Enabled both types leak detection



Furnace Leak Detection Application Challenge



Site: Hamilton, Canada



Scope: Tuyere Cooling
Water Leak Detection

Application

- Blast Furnace tuyeres cooling water leak detection
- #2 Blast Furnace



Pain Points

- Difficulty detecting leaks in a timely manner

Solution

- Rosemount E-Series high accuracy Magnetic flow meters on cooling water flows
- superior accuracy at target flow rates
- Advanced diagnostics
- AMS



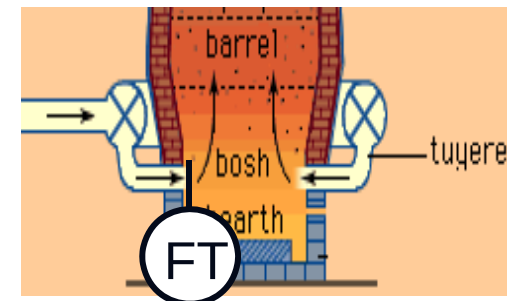
Tuyere Oxygen Leak Detection Example

An additional SmartMine Case Study

- Oxygen flow measurement and leak detection
 - blast furnace example

- **Challenges**

- Tight space and harsh conditions
- Good accuracy and fast response
- Minimal and simplified installation and maintenance



Smart Mine Tuyere Oxygen Leak Detection

- Highest performance DP Flow meter
- Accuracy and repeatability are critical
 - Direct mount
 - improve performance
 - reduce potential leak points
 - reduce installed cost



30% accuracy improvement for 90% straight-run reduction

Solution

- Conditioning Orifice Plate flow element
 - Improved performance
 - Minimum straight pipe requirements
 - Reduces effects from flow disturbances



Better Accuracy Than A Standard Orifice Plate

Unique Design Measures Accurately in Short Straight-Run

“Better accuracy than a standard orifice plate”

Each orifice hole is positioned to help condition flow profile irregularities



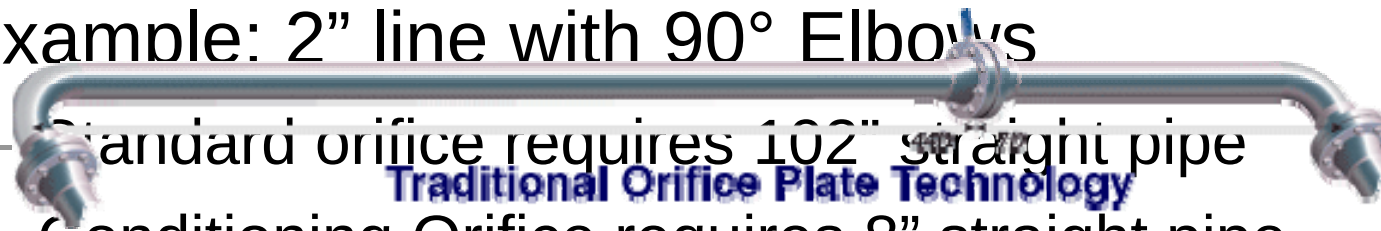
**Geometry reshapes
the flow profile across
the entire pipe**

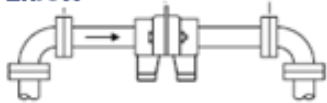
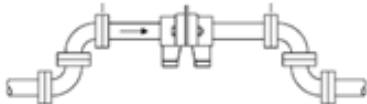


EMERSON
Process Management

Improved Performance in Tight Spaces

- Less straight pipe is required for accurate measurement
- Example: 2" line with 90° Elbows
 - Standard orifice requires 102" straight pipe
 - Conditioning Orifice requires 8" straight pipe



Disturbance	Standard Orifice Upstream (Downstream) ⁽¹⁾	Conditioning Plate Upstr (Dwnstr)	Reduction with CP
90° Elbow 	44 (7)	2 (2)	86%
(2) 90° Elbows in Plane 	32 (7)	2 (2)	90%
(2) 90° Elbows Out of Plane			

Furnace Leak Detection Application Challenge



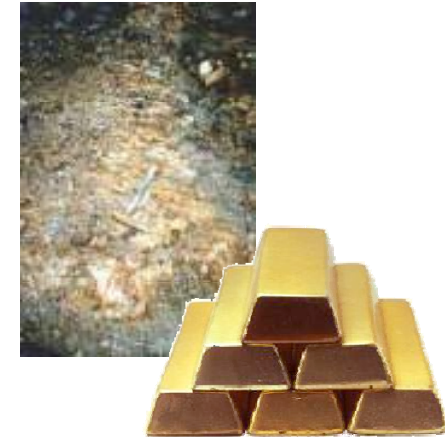
Site: United States



Scope: Oxygen injection in Autoclave

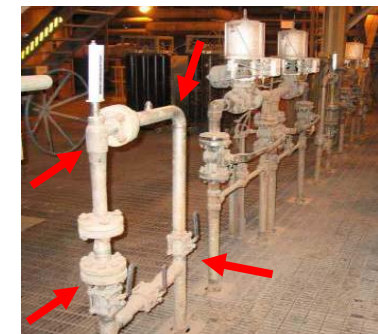
Application

- Oxygen is injected into hot, powdered ore to free gold from the solids
- The gold is then leached from the ore



Pain Points

- Current technology was to use a regulator and 5 fixed orifice's to equally measure flow
- Inconsistent readings and balance
- Adding more oxygen than needed
- Insufficient straight piping to improve measurement



Furnace Leak Detection Emerson Solution



Site: United States



Scope: Oxygen injection in Autoclave

Solution

- Barrick installed High Performance DP flow meter with Conditioning Orifice on 10 oxygen flows
- Improve measurement in short-runs to better manage oxygen usage.
 - Reduce cost
 - Improve quality



Furnace Leak Detection Barrick Results



Site: United States



Scope: Oxygen
injection in Autoclave

Barrick Results

- Oxygen in each chamber now balanced
 - Testing verified sum of 10 flow meters was within 0.5% of the sales meter rate
- Demonstrated flow could be equalized & flow rate control could run in automatic
- Reduced batch times
 - Throughput increased due to faster oxygenation
- Decreased Oxygen usage
- Simple, cost-effective installation



Agenda

- Understanding the value of improved furnace leak detection
- Historic Approaches and Challenges
- SmartMine Technology and Approach
 - Review SmartMine Case Study
- **Group Discussion**