EMERSON

JUBCOR 2024

CONFERENCE & EXHIBITION

INNOVATIVE SOLUTIONS FOR CORROSION CHALLENGES

Jubcor Presentation

Wireless Corrosion & Erosion Monitoring
to Enhance Safety, Reliability and Profitability

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Industry Challenges – Missing Asset Health Data Means the Plant Is Not Being Driven to Maximum Capability

- Avoiding unplanned outages and incidents
- Longer runs between maintenance shutdowns
- Tighter H&S regulations
- Limited CAPEX budgets
- Limited availability of experienced personnel

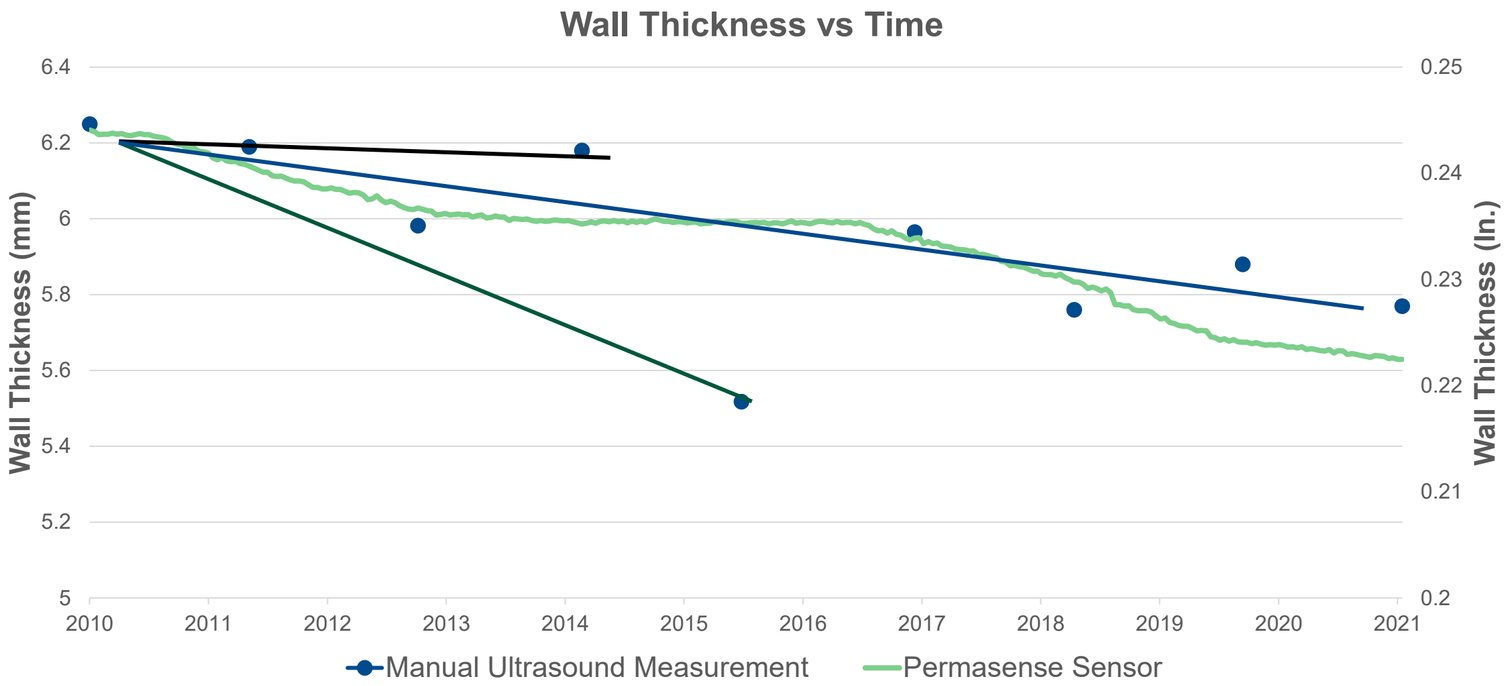
Increased margin

Improved availability

Leaks/loss of containment

Conservative operations – poor profitability

Existing Inspection Techniques Lack Granularity and Repeatability



With Manual Ultrasound Measurements

Continuous measurements with high repeatability and accuracy

With Permasense Sensor Installed

Corrosion rate calculation accessible continuously

Granular data readings allow unrivalled insight into plant health

Other Techniques

Deploying Corrosion Resistant Alloys

- Expensive
  - Some alloys could be 30x more expensive than carbon steel
- Does not eliminate risk
  - Merely slows down corrosion
- Cannot retrofit
  - Can only be designed in build

Manage Corrosion through Integrity Operating Windows (IOW's)

- Based on theory
  - Assumes continuous process conditions which is unrealistic
- Corrosion is rapid and unexpected
  - If it does happen, process fluids can be highly aggressive and cause damage very quickly

Your Corrosion and Erosion Challenges Require a Complete Sensing Portfolio

MONITOR RISK

Non-Intrusive Wired

Sand Acoustic Monitor (SAM)

- Quick response time
- Enables production optimization and sand seperator efficiency monitoring
- Single cable ExD design

Intrusive Wireless

Probe Digitalisation

- Wireless data retrieval from probes
- Real time risk data to desk from any manufacturer probe
- Compatible with both ER and LPR

High sensitivity, quick response

MONITOR IMPACT

Non-Intrusive Wireless

Ultrasonic Thickness (UT)

- Flexible, highly distributable, single point wall thickness integrity measurements
- Wireless data retrieval to desk or cloud

Patented measurement technology
Unique patented signal processing
Automatic temperature and material compensation.

Highest accuracy wall thickness measurements of any fixed sensor available today

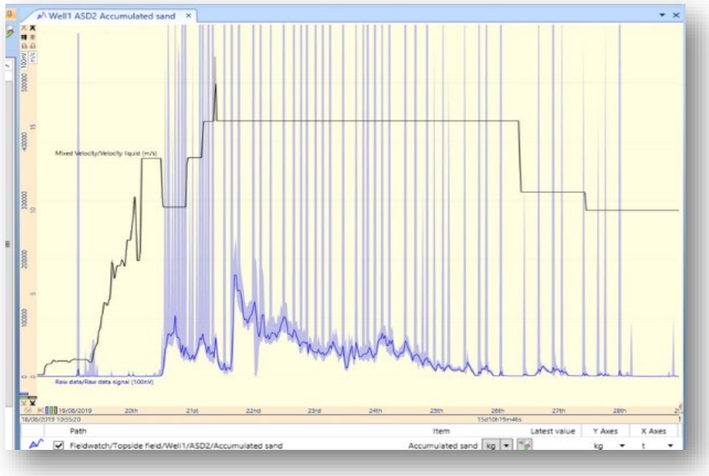
No consumable parts
9-year battery life
No couplant required

All hazardous areas
(Zone 0 / Class 1 Div. 1)
Any metals
Up to 600°C (1100°F)
Through paint/coating

Actual metal thickness and loss

Roxar SAM42 Acoustic Sand Monitor

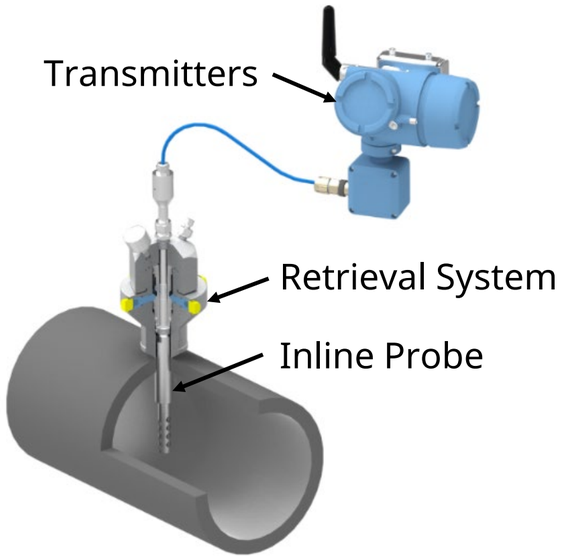
SAM42 detects and quantifies sand production, allowing maximized oil and gas production rates.



Benefits	Features
Direct measurement of sand production	Real-time sand production rate output
Fast detection of sand production changes	Real-time data collection and analysis
Installation without stopping oil and gas production	Non-intrusive
Easy to deploy in remote locations with no data infrastructure	Local data store

Emerson Transmitters and Probes for Inline Corrosion and Erosion Monitoring

Emerson's probes provide the highest sensitivity for fast detection of changes in corrosion and erosion risk. Combine the probes with our Transmitters to continuously deliver data to desk.



Benefits	Features
Fastest possible detection of changes in fluid corrosivity and erosivity	Highest Sensitivity probes and Best-in-Class Resolution Transmitters
Detects risk of erosion across the pipe section	Unique Multiple Element ER Probe
Real time data-to-desk Easy to deploy at scale on operating plant	Wireless or Wired Transmitter options
Change monitoring from offline to online, reducing manual rounds	Transmitters are compatible with existing third-party probes
Probes can be retrieved without lowering the process pressure or reducing production	Retrieval System that operates at up to 10000 psi

The Permasense Sensor Portfolio is Broad and Capable for Any Application - All Sensors Send Wall Thickness Data Twice per Day With 9 Year Battery Life

38cm / 15”

ET210	ET310	ET310C	ET410	WT210
120°C / 250°F Limit	160°C / 320°F Limit		270°C / 520°F Limit	600°C / 1100°F Limit
Magnetic EMAT, strap mounted				Stud or clamp mounted
Measures through coatings		Measures on all metals	Measures through coatings	Measures on all metals
<2.5µm (0.0001”) Repeatability & 1µm (0.00004”) Resolution*				
Class 1 Div 1 / Zone 0 with WirelessHART Data Retrieval				
Embedded Temperature and Material Compensation				

<10µm (0.0004”) Repeatability for ET210

A Range of Mounting Options Suits Any Application

ET210, ET310/C, ET410

WT210

Metal or plastic strap

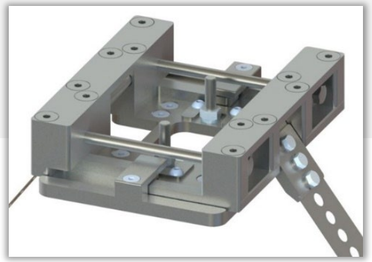
For pipe diameter 4” (10cm) to 80” (2m)

Magnetic mount

For large diameter geometry, above 2m (80”) diameter

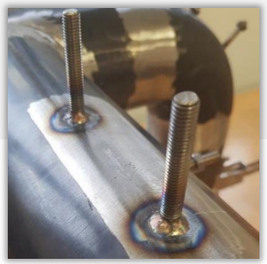
Universal Mount

Weld free installation up to 425°C (797°F)



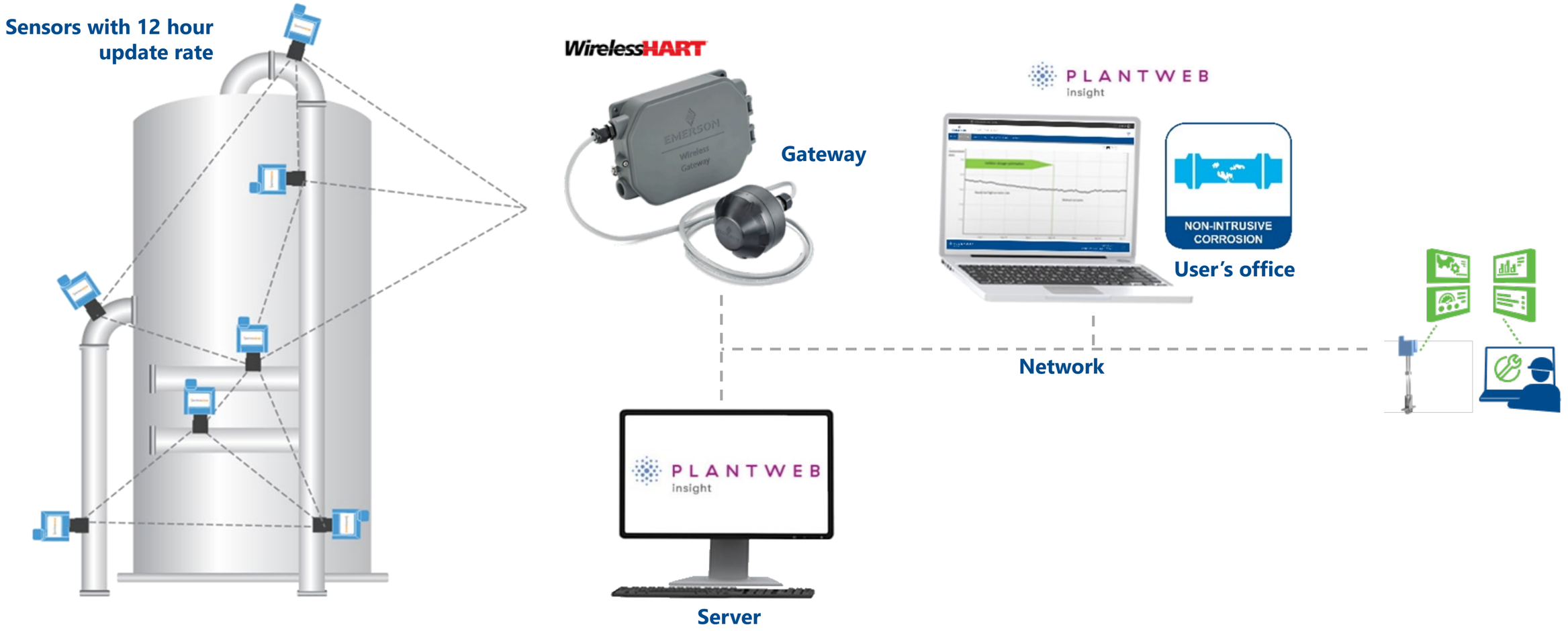
Welded studs

Deploy anywhere up to 600°C (1100°F)

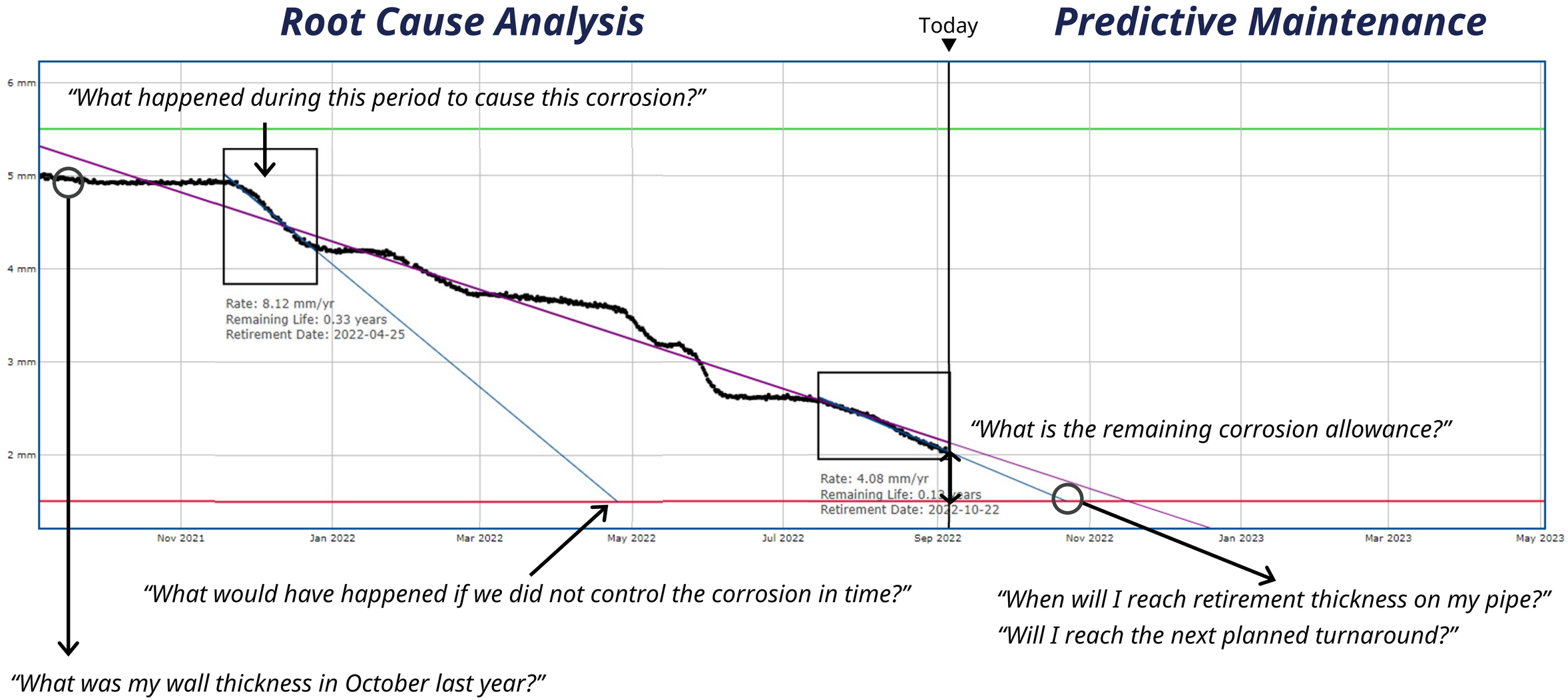


Continuous Integrity Monitoring Delivers Real Time Asset Health Data Directly to Desk

Field | **Data Transfer** | **Analytical Software** | **Connected Services**



Thickness Monitoring Data for Root Cause Analysis of Corrosion Events and Turnaround Scope and Timing Improvement



Sensors **don't need to be everywhere**, just enough to give you insight into the plant health at any point

Rosemount Wireless Permasense Corrosion and Erosion Monitoring Sensors

Sensors are simple to deploy anywhere, with best-in-class quality and frequency of wall thickness measurements delivered to desk.

Benefits	Features
Class leading thickness data quality and robustness	Patented measurement technology Unique patented signal processing Automatic temperature and material compensation.
Direct measurement of asset integrity	Highest accuracy wall thickness measurements of any fixed sensor available today
Easy to deploy at scale on operating plant	Non-Intrusive Wireless
Maintenance-free	No consumable parts 9-year battery life No couplant required
Monitor anywhere	All hazardous areas (Zone 0 / Class 1 Div. 1) Any metals Up to 600°C (1100°F) Through paint/coating

Unrivalled Field Experience and Install Base

30,000+
PERMASENSE SENSORS

7000+
SAND DETECTORS

OPERATING IN
1000+
PROCESS FACILITIES

ACROSS
76
COUNTRIES

DELIVERING
35
MILLION
WALL THICKNESS READINGS

CORROSIVITY AND EROSIVITY READINGS
40
MILLION

500
MILLION
OPERATING HOURS

120+
CORROSION REPORTS DELIVERED ANNUALLY

Industry Challenges and Applications

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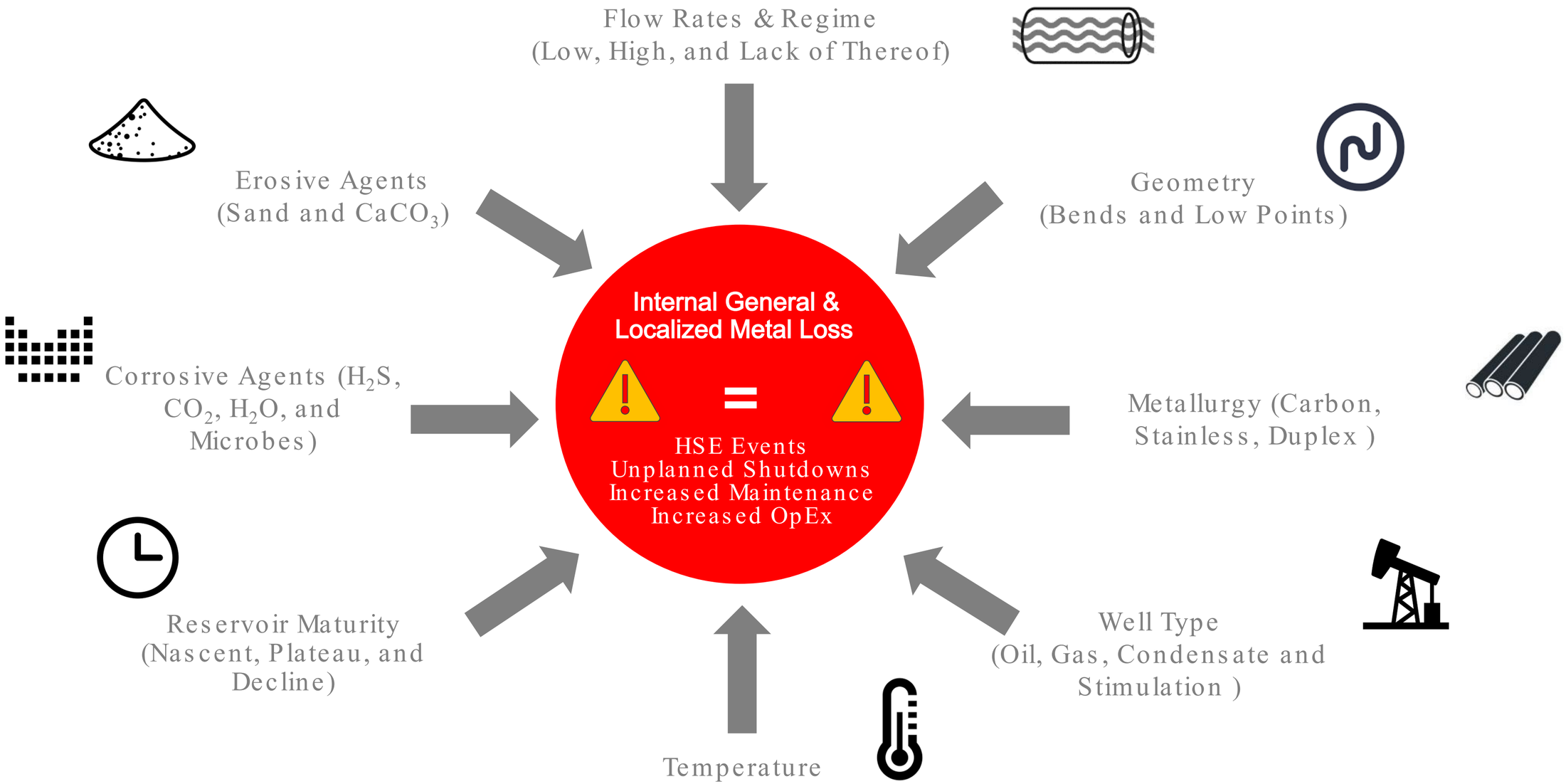
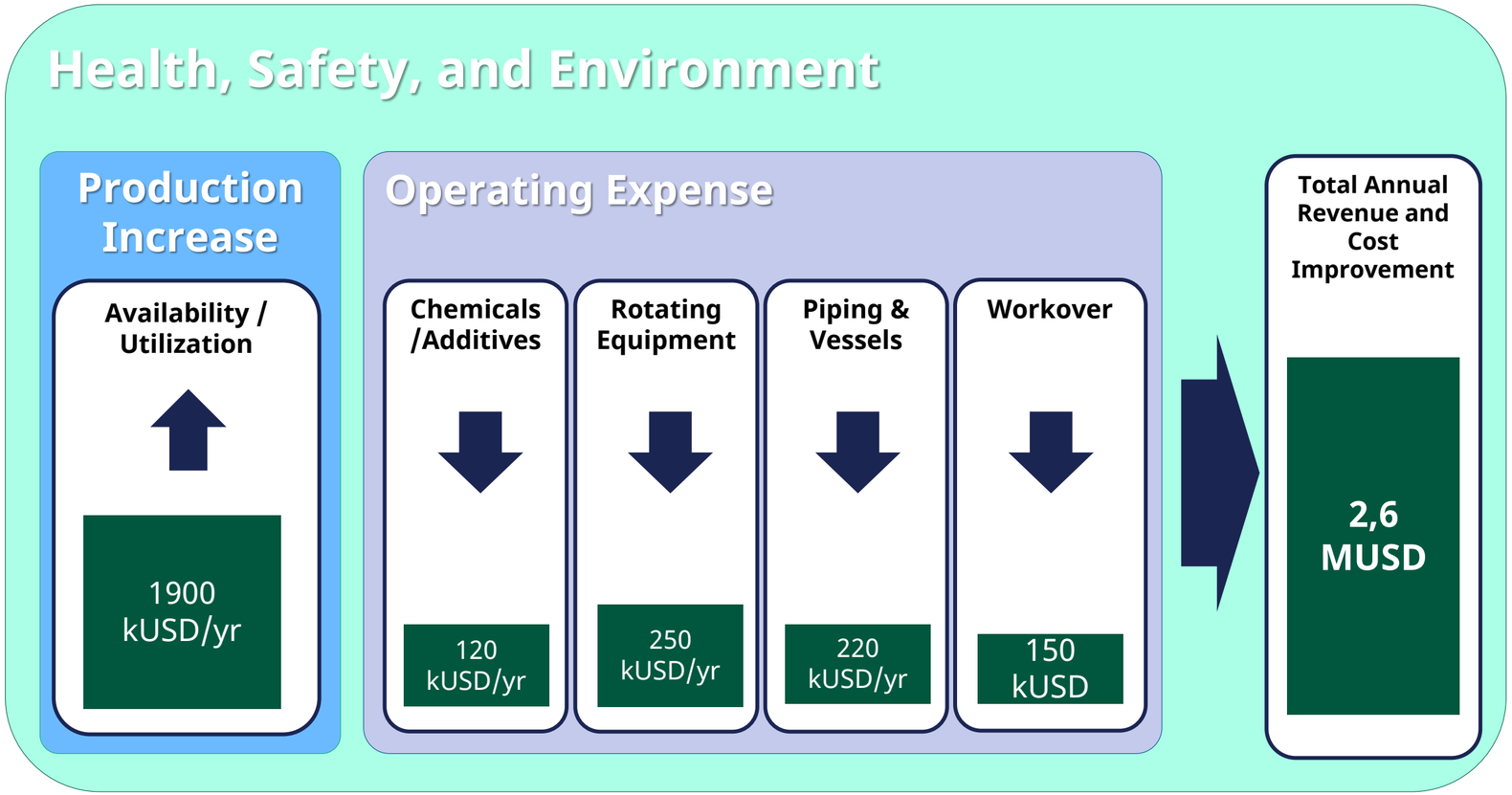
Corrosion and Erosion Depend on Time-Varying Factors and Affect Operator's Profitability



Data-Driven Decision-Making Drives Returns from Multiple Sources



Business impact model based on the following assumptions

Asset Characteristics

- Production of 10.000 barrels per day
- Oil price = 60 USD per barrel
- Eight wellheads + Two Production Separators

Production Increase

- ≈1 % production increase because of decreased planned and unplanned shutdowns
- Three days of additional production

Operating Expenses

- ≈ 15% savings in pumps, valves, and piping maintenance because of better chemical control and minimized erosion / corrosion damage

Typical Corrosion & Erosion Challenges in Production Flowlines, Injection Flowlines, and Separators

Customer Challenges

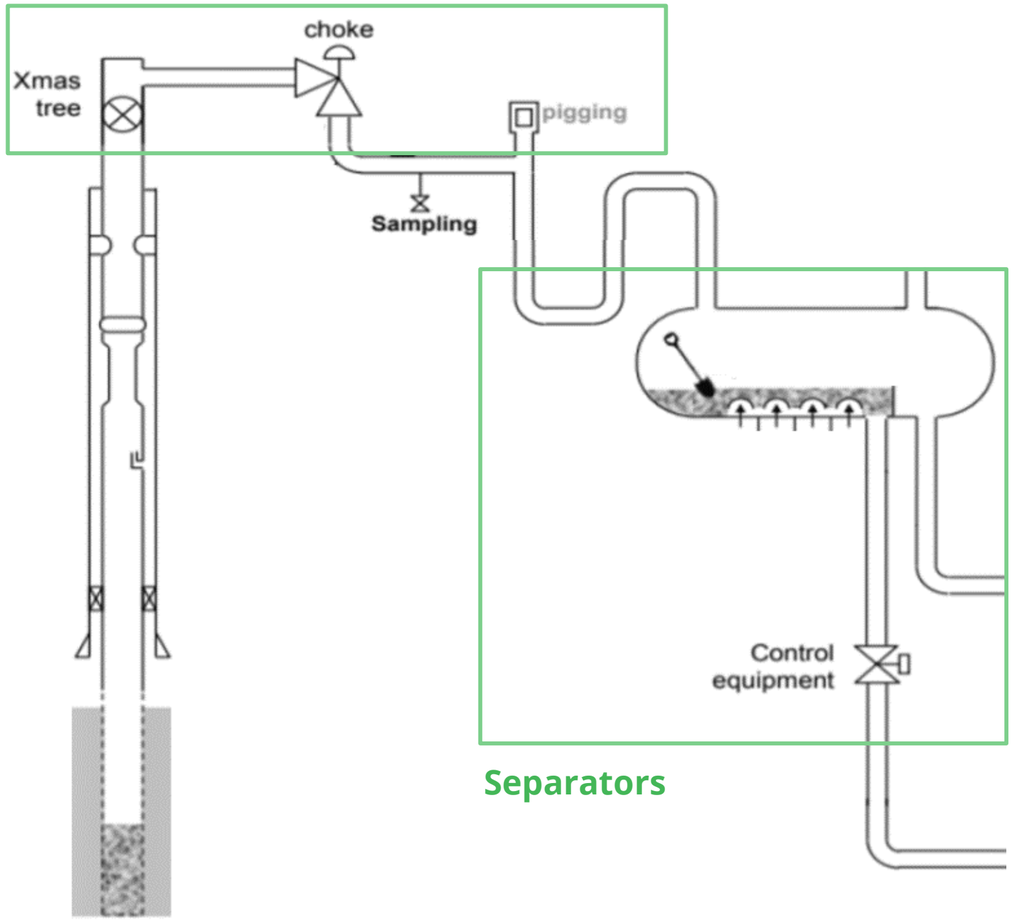

Corrosion

- **Corrosion** = Shutdowns & Increased maintenance
  - Uniform metal loss across all piping and production units
  - Localized metal loss due to H_2S and CO_2 in carbon steel flowlines
  - Under deposit corrosion in pipe low points

- **Erosion** = Reduced production rate, shutdowns, and increased maintenance
  - Flow lines damage and possible loss of containment
  - Reduced flow because of solids deposits
  - Chokes, pumps, and valves damage

Erosion

Production, Test, and Injection Flow Lines



Separators

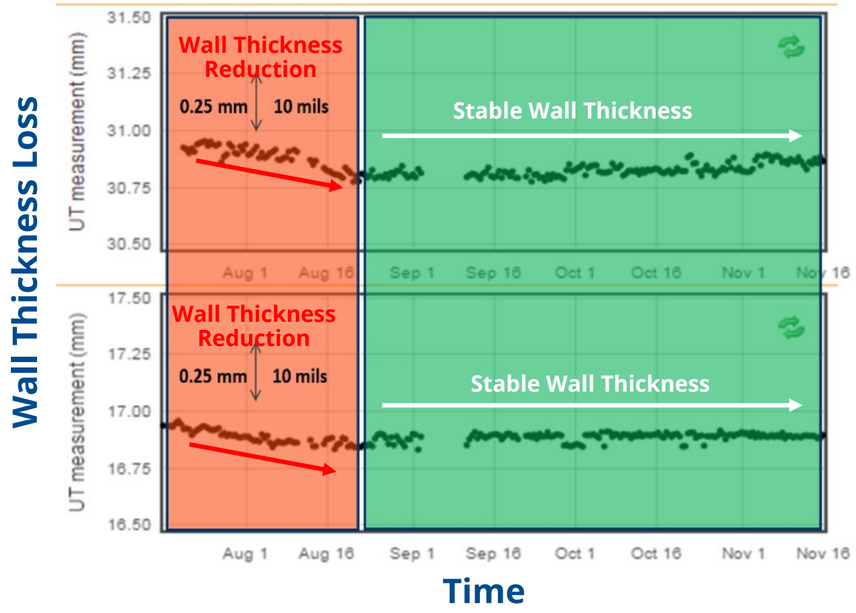
Wet Gas Corrosion Monitoring – Case Study

Leading oil and gas operator in the North Sea

Challenges

- *Several corrosion monitoring points in hard-to-access locations for inspection activities*
- *Because of few existing monitoring points, lack of data to confidently inject inhibitors*
- *Loss of revenue because of reduced gas production*

Solution



x 30

Results

- *Gas production **increased by 1% (1,46 MUSD/Yr.)***
- *Data-driven injection activities **stopped metal loss proliferation and shutdowns***
- ***Decreased OpEx** because of avoidance of inspection activities*
- ***Safe** operation based on real-time data*

Benefits of Continuous Monitoring in Chemical Applications

Proven Result: Nylon - Ube Group (Thailand)

Managing Corrosion in Polymer Production

Challenges

- ***Sulphuric acid** is critical in the Nylon production process*
- *Sulphuric acid can cause extremely **high rates of metal loss** in steel meaning that good data on asset integrity is essential.*

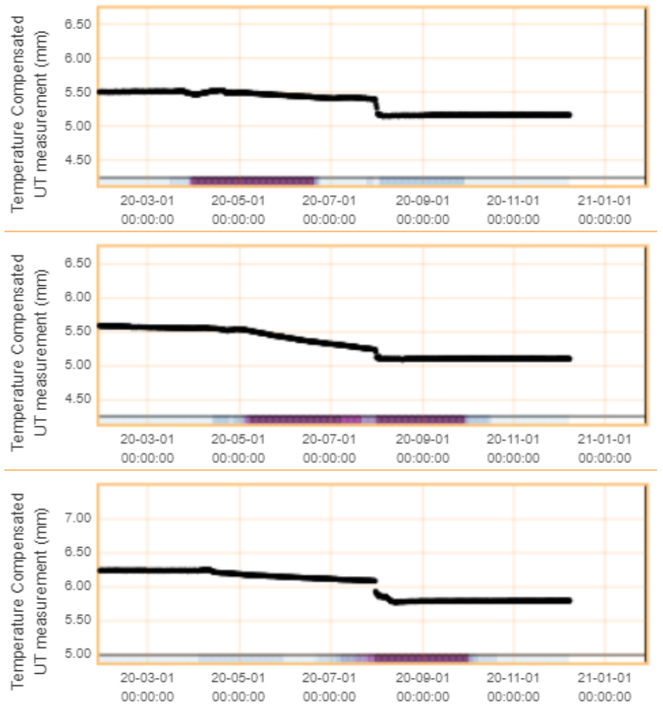
Solution

- *Installation of **10x Permasense** ultrasonic thicknesss monitoring sensors at critical points in the sulphuric plant.*
- *The customer elected to take up a **connected service** package to ensure that the data generated by their Permasense system was regularly reviewed by subject matter experts*
- *The connected service **analysis identified severe sulfuric acid corrosion**, enabling the customer to take **corrective action** before significant damage was done to their plant*

Key Emerson Technology

- *10x Permasense sensors, supported by an Emerson Connected Services package*

Region: *Thailand* | **Industry:** *Chemical*



Proven Results

Early Warning
Expert analysis identified unexpected high rates of metal loss

Plant Availability
Unplanned shutdown avoided

>USD200,000 per day*
Avoided production capacity loss

* Based on production capacity, market price of product and impact on plant

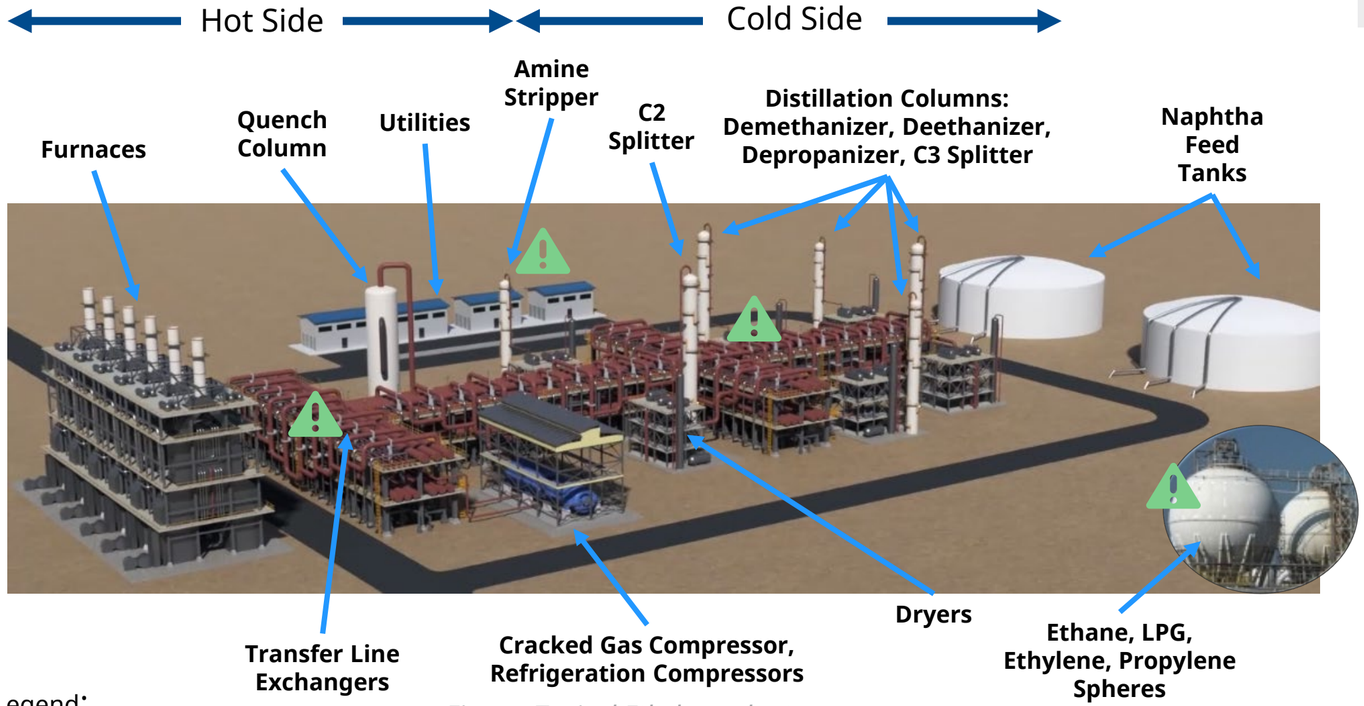
Ethylene Plants - Challenges & Solution –

Ethylene Plants

Olefin crackers are the workhorses of the petrochemical industry, producing mainly ethylene, propylene, and butadiene.

They consist of three main areas:

- a hot section;
- a compressor section
- A distillation (recovery) section



Legend:

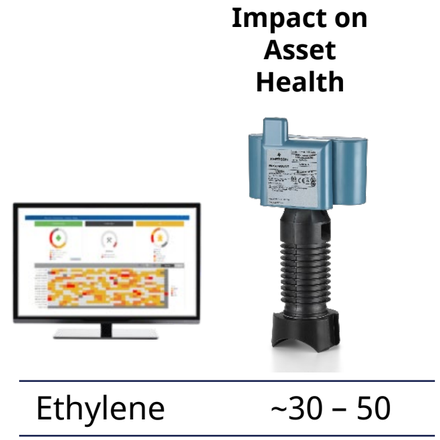
- Elevated Corrosion Risk

Figure: Typical Ethylene plant

Corrosion customer challenges

- TLE boiler feed water requires tight quality control to prevent corrosion
- Acid gas remaining in cracked gas can cause corrosion downstream in piping and caustic scrubber
- Furnace tubes, amine stripper overhead, cracked gas compressor inter-cooler vessels, dilution steam drums, de-ethanizer overhead system

Emerson Solution



Chlor-Alkali Plants – Customer Challenges & Solution

Chlor-Alkili Plants

Chlor-alkali plants use brine to produce chlorine, sodium hydroxide and hydrogen.

An electric current is passed through the brine, to form hydrogen gas at one electrode and chlorine gas at the other – leaving a solution of sodium hydroxide.

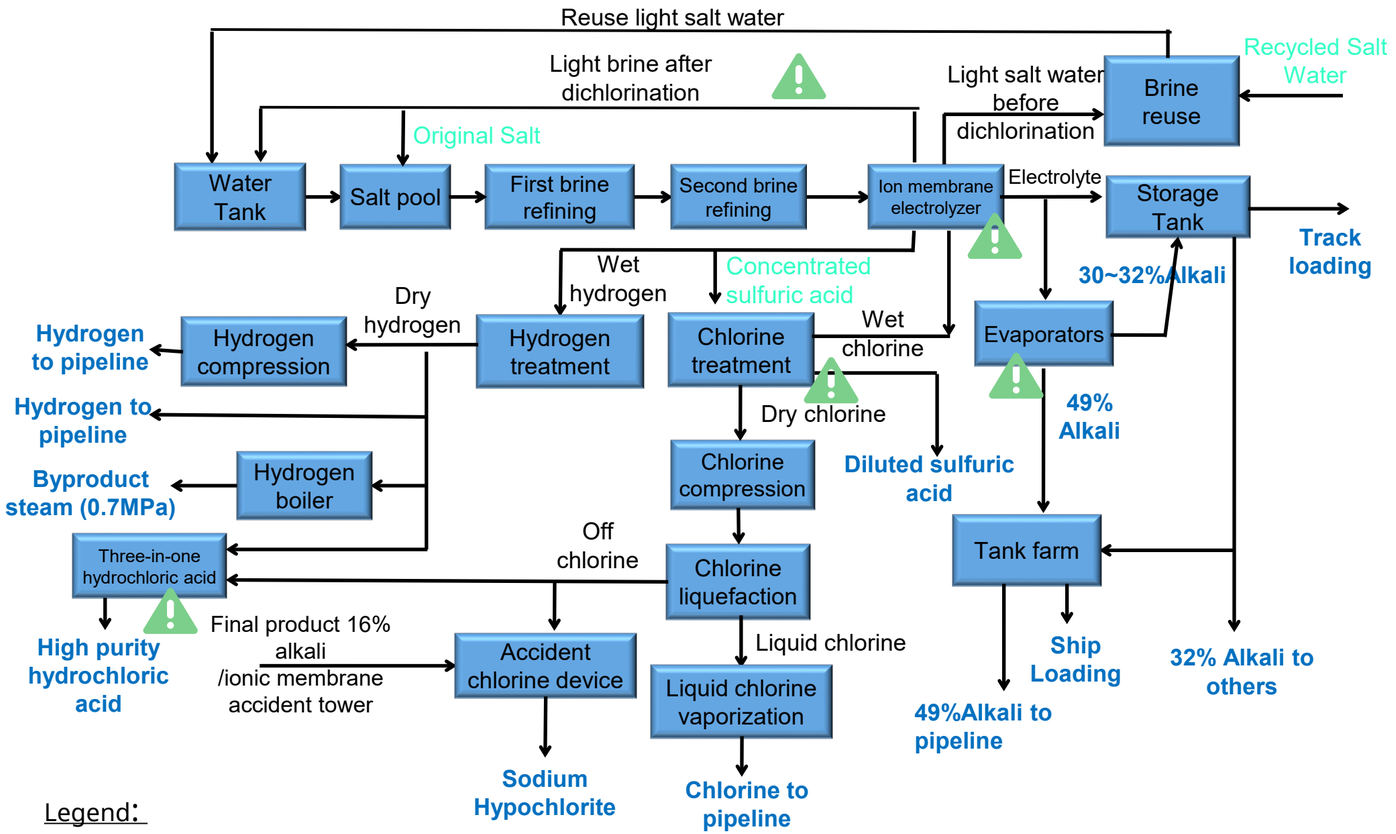


Figure: Typical Chlor-Alkali Plant.

Corrosion Customer Challenges

Handling corrosive chemicals which require special procedures (chlorine, caustic soda, hydrochloric acid, sodium hypochlorite, sulfuric acid, salt brine)

- Key areas of concern:
  - Electrolyzer outlet area
  - Wet chlorine treatment area including Diluted sulfuric acid equipment
  - Caustic product handling area
  - Hydrochloric acid area
  - Brine storage tanks

Emerson Solution

Impact on Asset Health

Chlor-Alkali	~20 - 40

Summary

Corrosion and/or Erosion are **ever-present threats**

Corrosion and/or Erosion **vary across the asset and over time**

Manual inspection is not frequent enough to understand asset health or corrosion rates

Monitoring of both **corrosion and erosion risk and their impact on the asset health is essential**

Emerson's *Wireless*HART® capability delivers best-in-class data to your desk

Use the data to better-operate your process plant, ensuring the asset is driven to its maximum capability

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THANK YOU

Reach out.

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