

# INTERNAL CORROSION CONTROL MONITORING METHODS FOR OIL&GAS PIPELINES

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## Abstract

The project presents learning about basic of Internal corrosion control monitoring methods for oil and gas pipelines (ICP), and it details about the internal corrosion monitoring basics and problems caused in the petroleum industry and it uses . because Corrosion in process industries is becoming bigger issue day to day and is also the most common cause of assets failure in plants.

The project of this paper is to present to present a new non intrusive technology to monitor corrosion, using ultrasonic , this paper include different kinds of corrosion and it happens. and corrosion control monitoring techniques is ultrasonic (UT) based solutions that can help in continuous monitoring of thickness with installed sensor. A case study of the ultrasonic technology used in the monitoring of internal corrosion of pipelines and their applications that can be used in petrochemical industries, gas, oil, sanitation, etc..

key words - corrosion , internal corrosion , ultrasonic testing (UT), pipelines.

## 1) INTRODUCTION

The world energy transportation system consists of over a million miles of pipelines is similar to a human body with no artery, pipeline that shipping and distribute oil, fuel, chemical compounds, water, steam, petroleum merchandise, and other substance are of vital significance for the economic system and fitness this critical asset is significantly endangered by means of electrochemical deterioration or corrosion.

**The controlling methods of oil and natural gas are : -**

1. The Cathode protection
2. The Coating and lining
3. The Corrosion inhibitors

No metal would corrode until it has four essential constituents which constitute the corrosion cell.

1. Anode
2. Cathode
3. Electrolyte
4. Metallic path

### **Corrosion Process**

Corrosion in the main occurs in pipelines due to an electrochemical response within reach of an electrolyte. The electrochemical idea of the system additionally encourages the detection and relief of this deterioration, that is completed by using monitoring the voltages and the flows related to the corrosion fee.

The price of corrosion of a piping system is normally associated with outside and internal factors. outside elements comprise a running environment of pipes, soil technology and moisture for buried pipes or water technology due to submerged pipes.

Internal corrosion factors are take in :

- oxygen content or reactivity of beverages and gases carried
- use of numerous metals in the piping machine
- temperature, go with the flow charge and strain of the fluids and gases

### **Internal corrosion mechanisms.**

1. The General corrosion
2. The Pitting Corrosion
3. The Crevice Corrosion
4. The Stress Corrosion Cracking (SCC)

## **2 ) LITERATURE REVIEW**

### **Internal corrosion monitoring using non -intrusive and high resolution probes with ultrasonic technology.**

The ultrasonic generation used in the monitoring of inner corrosion of pipelines and their programs in mining that may be utilized in petrochemical industries, gas, Oil, Sanitation, and lots of others... This system has the feature of being of the non-intrusive technique of sensible probes that are established on the ground of the pipeline. . A distinction among this device is to offer a excessive choice of 0.00254 mm (zero.0001 inches) to diploma the thickness of the pipelines storing this facts over time is used in the calculation of inner corrosion with excessive precision. shielding pipelines from inner corrosion or erosion may be a hard and steeply-priced enterprise. enterprise gauges rushed to a few billion dollars each one year within the U.S. alone. A united states of the us business enterprise, which suits more or much less 29 km (18,000 miles) of interstate pipelines, carried

out more than 300 irregularity examinations. They deliberate US\$50,000 consistent with exam in u.s. zones, yet if it's far in town territory, US\$50,000 may not thru any technique unfold allowing. additionally, a solitary burrow for studies of 1 area may also need to value over US\$250,000. within the worst cases, we want to include not unusual punishments and fines amongst US\$25,000 and US\$ 1,000,000 for infringement or injuries because of internal corrosion or erosion.

### 3) Methodology

#### The ultrasonic technique theory of operations

In Ultrasonic is the most common non-intrusive device for internal corrosion tracking and detection. The utilization of high recurrence sound waves for the estimation of ferrous and non-ferrous substances has been utilized considering the fact that the second international warfare. Mechanical headways during that time have improved the dreams of the estimations and the speed of hobby, notwithstanding the decrease in the length and weight of the instrumentation. Wavelength is subject to the speed of sound spread through the material under test however stays consistent in a given material. Since various materials proliferate sound waves at various paces, the wavelength in the various materials will differ. It is imperative to pick a transducer recurrence that is most appropriate for the material under test. Wavelength (as portrayed in) fig can be dictated by the formula : .

$$\lambda = v/f$$

Where

- $\lambda$  = wavelength
- v = ultrasonic velocity in inches per microsecond
- f = the center frequency of the transducer in megahertz

### 4) Solution:

To A modern-day ultrasonic generation with permanent sensor and temperature repayment have been mounted instead to make use of conventional ultrasonic hardware and protected walled in location or uncovering pipelines. due to the fact the damaging section or disintegration movement inside the framework is within the base quadrant of the road, a sensors protected walled in location or uncovering pipelines. due to the fact the damaging section or disintegration movement inside the framework is within the base quadrant of the road, a sensors emerge as installed at 6 o'clock function with extra sensors balanced via the use of 15° and 30° each factor; those two sensors need to be located to such an extent that they're surely under the placement adjacent to the not unusual fluid/gas interface, tailings concentration, when you consider that this is frequently the locale of most wonderful consumption or disintegration. the ones three transducers (take a look at) of two, fifty four mm (1 inch) diameter by way of 2, fifty 4 mm (1 inch) immoderate were completely established to the watching factor on each location. study about the failure of measurement while drilling MWD tool in Directional drilling

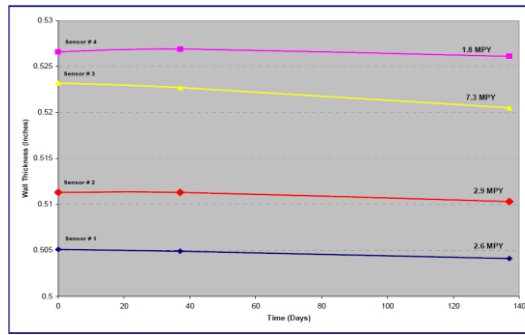
#### 4) Discussion

After set up all sensors along the fifty four km pipeline, first readings become completed. those are recorded inside the table below. The results of facts have been appealing. those readings have been contrasted and the existing thickness mass of the pipeline which changed into stated through the cease client as an legit capabilities, manifestly thinking about the tolerance of each devices. Dead sensor A summary of rate powerful among uses the conventional method (buried enclosure and digging) as opposed to new era is shown inside the table X. This desk consists of CAPEX for preliminary advent of the buried enclosure or Ultrasonic equipments.

**Table 4.1 A outline of outlay effective between uses the traditional method (buried enclosure and digging) versus new technology :**

	New ultrasonic technology	Buried Enclosure	Digging
Stage (Level) of difficult to carry out measurement	The difficult of the access road	Rubbish contact with poisoned insect or reptiles , water , accumulation	Rocks , cross roads pipeline exact location
Measurement	+/- inch 0.0001 in just one fixed cm point	No exact or accurate because never will be exactly the same point or position +/- 0.0004"	
Damage to the pipeline	None	Eradicate (remove) coating ( material , fatigue damage during the digging up and constant error as potential	
(Equipments) tools and material needed	Handheld	Minor equipment (tools) and cleaner tools , illumination escalators	Weight (Heavy) trucks , build wall supports , minors tools and cleaner tools
Time to take measurement	5 minute	Mini 2 hrs	Mini 6 hrs
skilled personnel	1	2	5
Venture(investment) to make the measure (USD)	7000 once time	55,000 each time to take reading	12,000 each time to take reading
CAPEX (USD)	270000	3,700,000	3,700,000

Bad connection within evaluation of this, a new opportunity and invention(new) in ultrasonic device could set up for less than 10% of the purchase of Buried Enclosure or digging pipeline. This technology represent a in truth device and provide better records.



Graph 4.1 Graphic comparing measurement at time

## 5) The weight loss & corrosion rate determinations

The metal coupons have been buried within the soil environments for a most of a 190 days. On days 40 and a hundred, duplication gadgets of the buried coupons had been retrieved for evaluation and the final set of coupons turned into retrieved on the very last day of exposure (one hundred ninety days).

coupons of 3 metallurgies have been used for the have a have a look at. they may be mild steel (MS) coupons, carbon steel (CS) coupons and stainless steel (SS) coupons. The Mild steel density =  $7.85 \text{ gm/cm}^3$ , The Carbon steel density =  $7.85 \text{ gm/cm}^3$ . The Stainless steel density =  $7.98 \text{ gm/cm}^3$

### Calculations

#### From the water logged site

##### For Mild steel:

For t = 40 days =  $40 \times 24$  hrs

$$W = \text{Initial weight} - \text{final weight} = 29.780 - 28.927 = 0.853$$

Density =  $7.85 \text{ gm/cm}^3$

Area =  $0.407 \text{ in}^2$

$$CR = \frac{W \times K}{D \times A \times t} \text{ (mpy)} = [0.853 \times 22300] / [7.85 \times 0.407 \times 40 \times 24] = 6.2 \text{ mpy}$$

#### From the Sandy soil site

##### For Mild steel:

For t = 40 days =  $40 \times 24$  hrs

$$W = \text{Initial weight} - \text{final weight} = 29.982 - 29.501 = 0.481$$

Density =  $7.85 \text{ gm/cm}^3$

Area =  $0.407 \text{ in}^2$

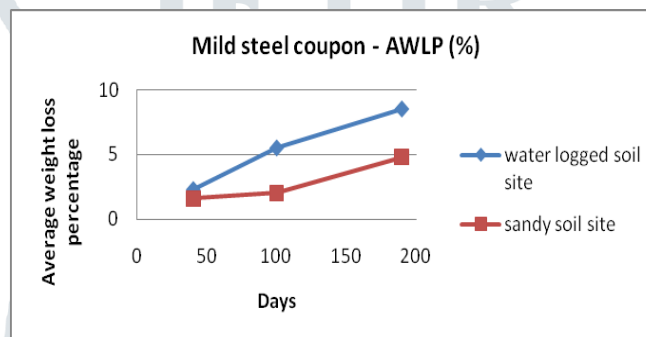
$$CR = \frac{W \times K}{D \times A \times t} \text{ (mpy)} = [0.481 \times 22300] / [7.85 \times 0.407 \times 40 \times 24] = 3.5 \text{ mpy}$$

**Table 5. 1 The Avg % corrosion rates (mpy) in coupons are after from 40, 100 and 190 days**

	Mild steel coupon			Carbon steel coupon			Stainless steel coupon		
Days	40	100	190	40	100	190	40	100	190
Water logged soil site	6.2	5.8	4.8	1.91	3.4	5.3	0.60	0.22	0.13
Sand soil site	3.9	3.0	2.6	4.4	3.8	2.8	0.36	0.06	0.14

### 7) THE OUTPUT GRAPHS

**Graph 5.2 Avg % wt.loss in mild steel coupons from water logged and sandy soil sites**



### Conclusion:

The primary blessings on this new era(generation), in truth it fees beneath 10% of a few distinctive traditional approach or approach with higher decision executed by using using the temperature reimbursement and in mild of the reality that it's far a forever brought presenting immoderate level of dependability. This lets in to this era pursue low corrosion charge faster than conventionally method.

### The summary of the results

As metallic undergoes corrosion in a soil environment, there has a tendency to be an inverse courting in the weight reduction and corrosion price traits inside the exposed metal. even as weight loss has a tendency to boom over the years, the very best being at the time that the corrosion procedure is initiated, corrosion charge tends to decrease simultaneously.

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