Chemistry Laboratory Idea Presentation
L 39+40
Group: 6

Industrial Pipeline Corrosion

Problem Definition

The notion of a country in the world without a large and complex network of pipelines is similar to a human body with no arteries. Pipelines that transport and distribute oil, gas, chemicals, water, steam, petroleum products and other substances are of critical significance for the economy. And the health of these critical assets is severely endangered by electrochemical deterioration, or corrosion.Corrosion is a leading cause of storage tank and piping failures. Reports around the world have confirmed that some oil companies had their pipeline ruptured due to corrosion and that oil spillages are experienced which no doubt created environmental pollution; in addition, resources are lost in cleaning up this environmental mess, and finally, large-scale ecological damage resulted from corrosion effects.

The UCCP(Underground Cross Country pipelines) lines are made to transport crude and gas which are inflammable and can catch fire if released due to some accidental leak or damage. That is why the first and prime safety factor considered for UCCP is the earth itself, which acts as the first defense to contain fire or release of the inflammable material to the environment.

Corrosion-related costs for monitoring, replacing, and maintaining gathering and transmission of UCCP lines are estimated at Rs 14.5 billion annually in India.

CAUSES OF PIPELINE CORROSION

WATER PH

If the water's ph level is below 8,then the barrier within your copper pipes can dissolve, leaving pipes exposed.This can lead to corrosion and eventually leaks.

HIGH OXYGEN LEVELS

High O2 levels than normal oxygen levels can rust metal through internal oxidation and can cause corrosion in pipelines.

WATER TURBULENCE

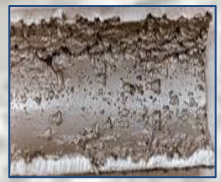
High velocity water causes corrosion by sharp turns, elbows and obstacles. All this commotion lead to pipeline corrosion down the road..

POOR INSTALLATION

Pipelines that were installed improperly will be more exposed to dirt,debris, and other factors that can cause corrosion.

Problem Identification

Sweet /sour Corrosion



Sweet corrosion is due to the presence of CO2 and water forming carbonic acid, which reacts with the steel pipeline causing corrosion damage

Pitting Corrosion

Pitting corrosion in pipelines is due to weak spots in the metal's natural passivating/protective oxide film. These areas result in a concentrated and localized type of corrosion that is highly penetrative and destructive

Crevice Corrosion

A common form of crevice failure occurs due to stress corrosion cracking, where the crack develops from the base of the crevice where the stress concentration is greatest.

O2 Corrosion

Oxygen corrosion is the degradation of metals and the reaction of dissolved ions in the presence of oxygen to form insoluble deposits due to the rapid rate of oxidation.

Galvanic Corrosion

When a metal gives away electrons,galvanic corrosion starts and the metal rusts.It is when one metal causes another metal to corrode and break down.

Microbial Induced Corrosion

MIC takes place when sulphate reducing bacteria produce by-products from the organisms which promote several forms of corrosion.

Our Solution

We researched through several sources and came up with a new combination of corrosion protection and monitoring system. We combined 4 methods to form our own PCCD method for Industrial Pipeline Corrosion. The methods we combined are given below:

Polyurethane Coating

- Protect substrates from various types of corrosion
- Very low cost
- Thermosetting in nature
- Absorb sharp impact loading.
- High Durability
- Resistant to abrasion and less prone to dents and scratches.
- Improved elasticity, able to maintain their shape and mechanical properties
- Non-flammable hence used in environments where combustion is likely to occur
- Exhibit superior resistance to acids, making them ideal for industries
- Huge ability to adhere well to a wide variety of substrates in a broad range of temperatures.

Cathodic Protection

- Cathodic protection is used to enhance the protection provided by the pipeline coating.
- A piece of 'sacrificial' metal that easily corrodes is installed near the pipeline.
- When corrosion occurs, it is drawn towards the sacrificial metal
- using a rectifier and cables, leaving the pipeline protected
- the sacrificial metal to corrode instead.

Corrosion Monitoring system/ Test Tap Survey

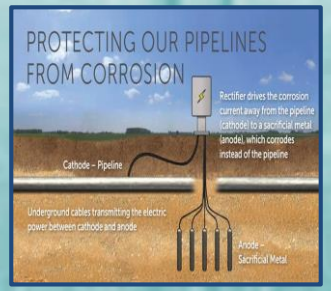
- To ensure adequate protection of pipelines, 2 types of surveys are done.
- A Test Tap Survey involves a technician assessing existing test tap stations along pipeline way.
- Readings at the stations and the obtained data will indicate the level of external corrosion mitigation at the specific test tap locations.

Design Modifications

Design modifications can help reduce corrosion and improve the durability of any existing protective anti-corrosive coatings. Ideally, designs should avoid trapping dust and water, encourage movement of air, and avoid open crevices. Ensuring the metal is accessible for regular maintenance will also increase longevity.

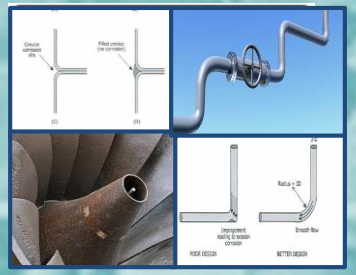
Methodology

Polyurethane Coating



Cathodic Protection (Sacrificial)

Corrosion Monitoring system/ Test Tap Survey



Design Modification

PCCD METHOD

Result

The proposed PCCD method being highly durable, cheap and technically advanced stands out to be the optimum solution to prevent industrial pipeline corrosion.

References

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Thank You !

Team Members:

- 20MIC0060- Madhusruti Das
- 20MIC0061- Vaidik Chiroliya
- 20MIC0062- Hariharan
- 20MIC0063- Ananya Ghosh
- 20MIC0064- Saharsh Justin Mathias
- 20MIC0065- Laasya Ojaswini Bulusu