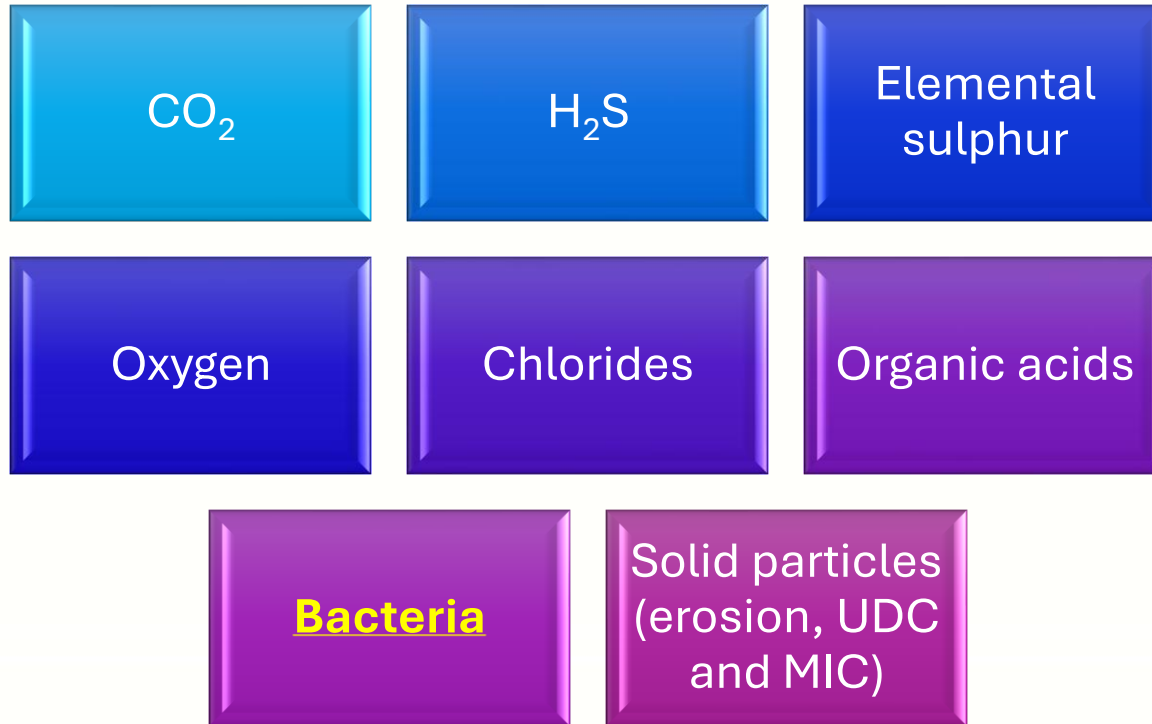


Dry Natural Gas Pipelines Internal MIC Failures: Root Causes and Remedies

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Agents Promoting Internal Pipeline Corrosion



Several Relevant Pipeline Standards

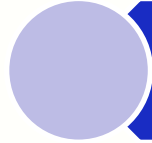
Organisation	Standard Number	Standard Title
NACE/AMPP	NACE SP0206	ICDA Methodology for Pipelines Carrying Normally Dry Natural Gas
NACE/AMPP	NACE SP0106	Control of Internal Corrosion in Steel Pipelines and Piping
NACE/AMPP	NACE TM0194	Field Monitoring of Bacterial Growth in Oil and Gas Systems
NACE/AMPP	NACE TM0212	Detection, Testing and Evaluation of MIC on Internal Surfaces of Pipelines
ASME	ASME B31.8	Gas Transmission and Distribution Systems
ASME	ASME B31.8S	Managing System Integrity of Gas Pipelines
API	API-RP-1160	Managing System Integrity for Hazardous Liquid Pipelines
ISO	ISO-13623	Petroleum and Natural Gas Industries – Pipeline Transportation Systems
ISO	ISO-23221	Pipeline Corrosion Control Engineering Life Cycle – General Requirements

MIC at a Glance

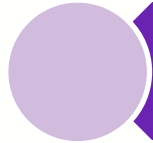
MIC at a Glance



1- Corrosion initiated or promoted by the presence or activity of microorganisms or both.



2- Bacteria are divided into two main classifications: planktonic and sessile.

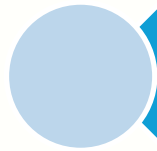


3- It is the sessile bacteria that promote MIC at metallic surfaces.

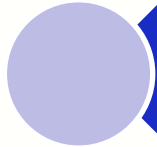


4- Killing planktonic bacteria is significantly faster, easier and cheaper than killing sessile bacteria.

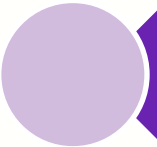
MIC at a Glance



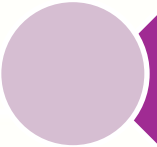
5- Presence of water is a prerequisite for bacterial survival and activity.



6- Prevention is better than cure; because microbial control once lost, may take years to restore.

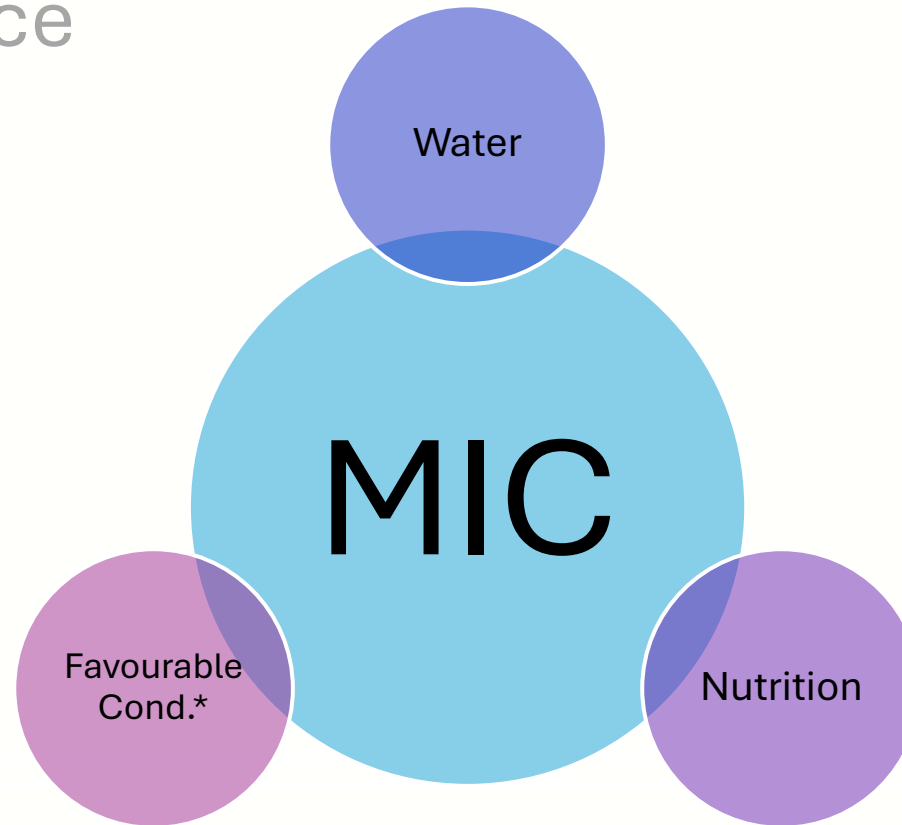


7- MIC corrosion rates could exceed 5.0 mm/yr.



8- MIC is highly localised and often manifests itself at the 6 o'clock position.

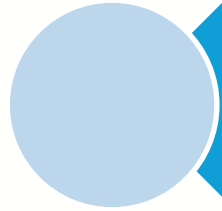
MIC at a Glance



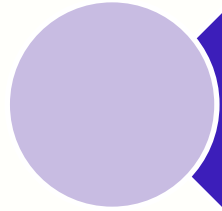
* Temperature, stagnation, pH and Salt Content

Dry Natural Gas Pipelines: Internal MIC Cases - Root Causes and Findings

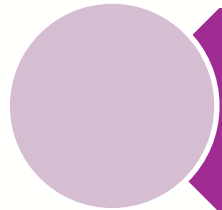
Dry Gas Pipelines at a Glance



1-A gas company is located downstream of a gas refinery and delivers gas to household and industrial customers.



2- Pipelines carry dry natural gas (< 7 lb water/1 mmscf gas or < 112 mg water/1 M³ gas).

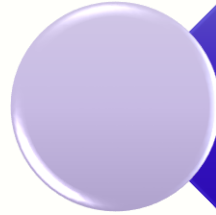


3- A typical downstream dry gas network consists of more than 10,000 km of pipelines and piping.

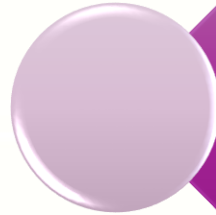
Water Ingress and Entry Sources



1- Gas refinery operating beyond nominal capacity (inadequate gas dehydration)



2- Poor hydrotest practices (no water treatment, no water removal & dehydration)

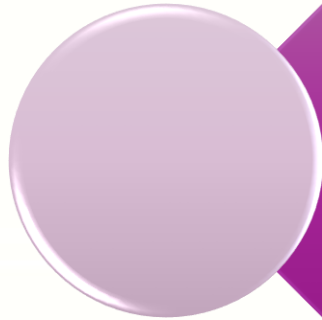


3- Not removing groundwater in trenches during pipeline installation, repair and maintenance

Bacterial Contamination Sources



1- Out of spec. hydrotest water

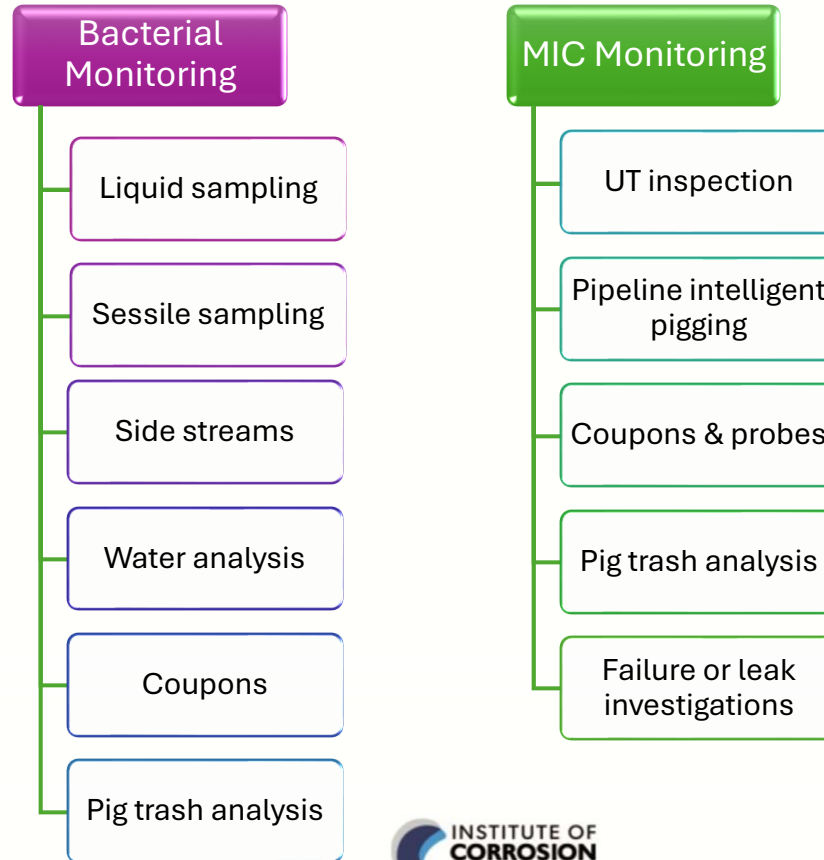


2- Not draining trenches during pipeline installation, maintenance and repair activities

Pipeline Internal Failure Root Causes

- 1- Exceeding nominal production capacity
- 2- Ignoring relevant (construction & maintenance) procedures
- 3- Inadequate quality control and supervision over contractors
- Lack of bacterial and MIC competency among relevant personnel
- 5- Inadequate communication between different parties

Inadequate MIC Competency: Case of Monitoring



Proposed Remedies

Recommendations

- 1- Don't exceed a gas refinery's nominal capacity
- 2- Follow relevant company procedures during construction and maintenance activities
- 3- Improve quality control procedures and contractor supervision
- 4- Provide proper and adequate MIC training for pertaining personnel
- 5- Improve communication between relevant parties

Unfortunately and fortunately a significant portion of corrosion failures encountered in the oil and gas (as well as other) industries are due to very simple and trivial causes which could be prevented easily, promptly and at no extra costs.

Thank you for your time and attention!

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