

## Materials Selection

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# Outline

Types of corrosion

Basic choices and considerations

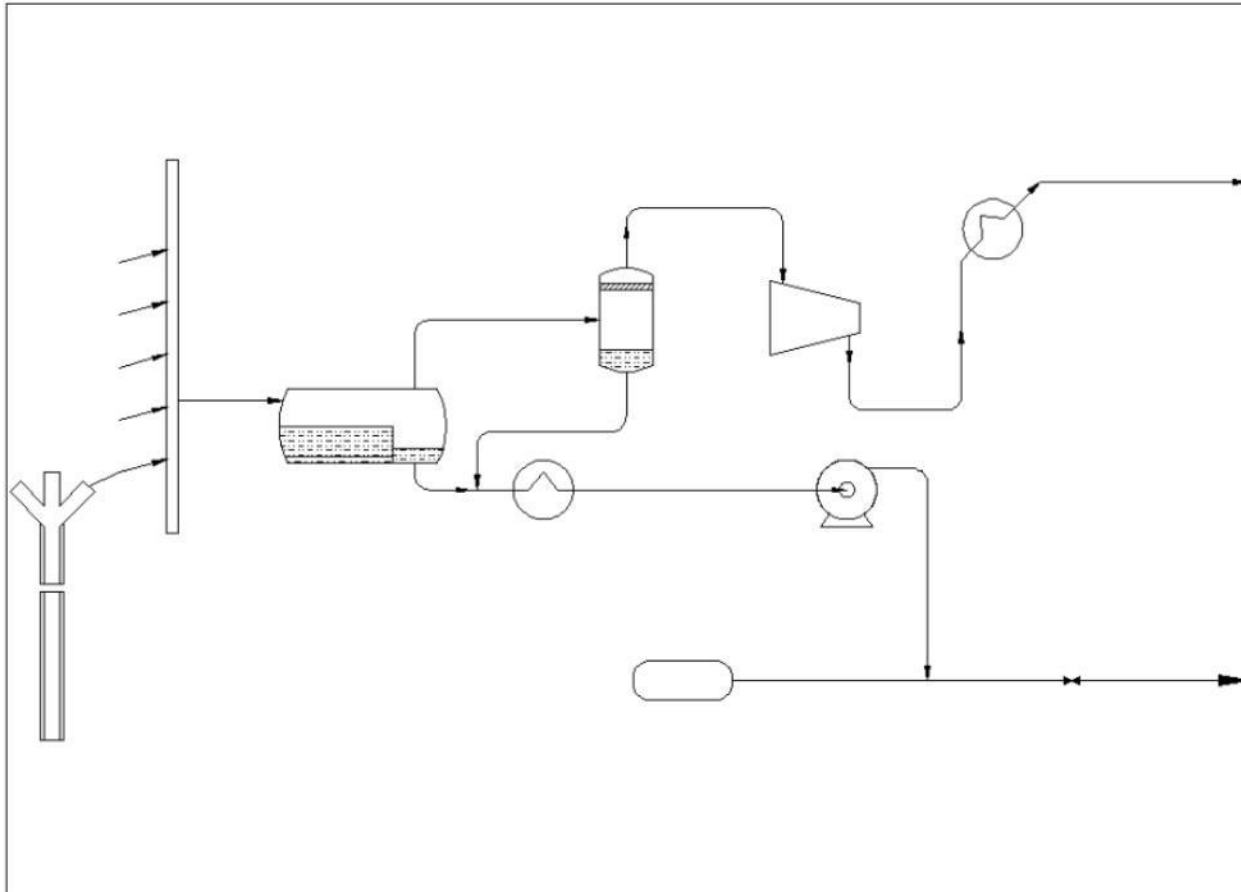
Standards and guidelines

Other important considerations

Typical material selections

Further resources

# Outline – oil and gas processing



# Common types of corrosion

- Carbonic acid corrosion
- Environmental cracking
- Dissimilar metal/ galvanic corrosion
- Microbially-influence corrosion
- Oxygen corrosion
- Erosion

# Common types of corrosion



General internal corrosion of carbon steel assisted by flow



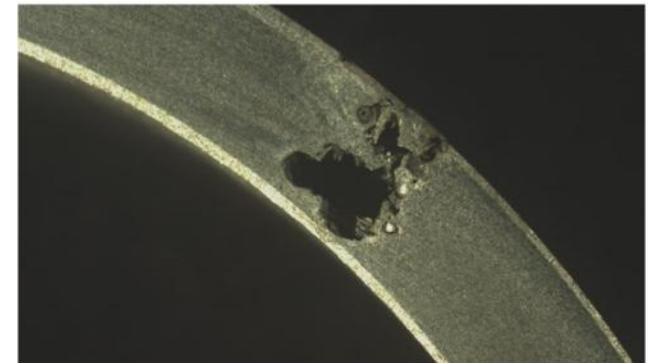
Pitting corrosion of stainless steel pipe carrying seawater



Pitting corrosion of stainless steel

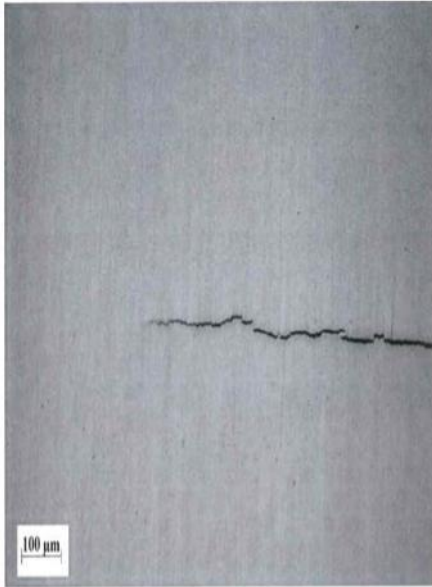


Localised internal corrosion of carbon steel

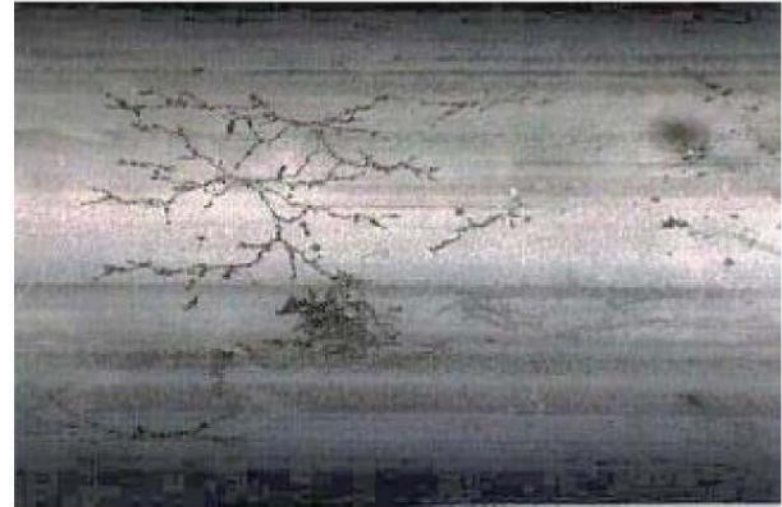




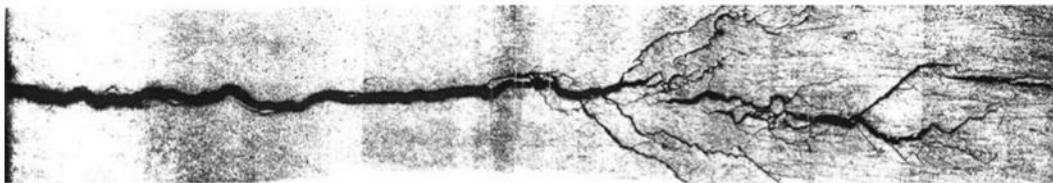
# Common types of corrosion



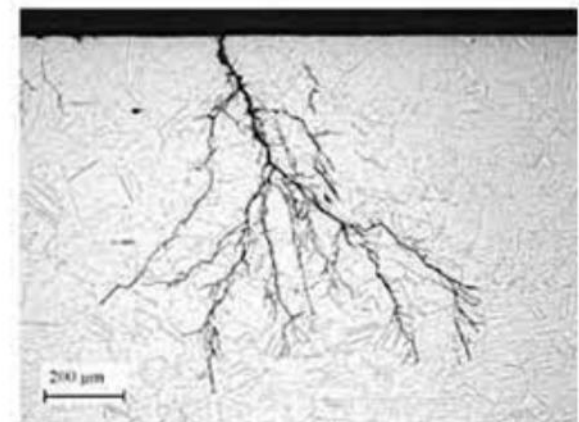
Hydrogen-induced crack (HIC) in a high tensile steel wire exposed to corrosion and hydrogen sulphide



Chloride stress corrosion cracking of stainless steel



Sulphide stress cracking - corrosion, stress and hydrogen sulphide



# Common types of corrosion



Flare tip – high temperature damage potential



Seawater corrosion of steel platform leg protected by coating



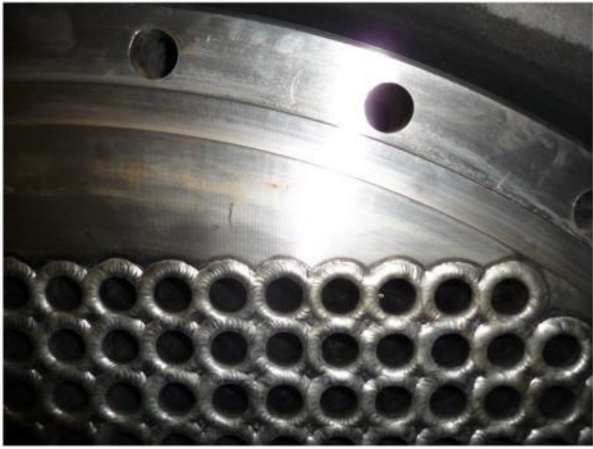
High temperature damage of flare tip



Corrosion under insulation



# Basic choices and considerations



Carbon steel bars for mooring chain manufacture



Corrosion resistant alloy (CRA)



Carbon steel clad with CRA

# Basic choices and considerations

- Choice: Carbon steel or corrosion resistant alloys?
- Key influencing parameters:
  - Corrosivity
  - Flow rates
  - Chloride and hydrogen sulphide
- Cost
- Mechanical properties
- Corrosion resistance
- Weldability
- Inspection, maintenance and repair

# Standards and guidelines

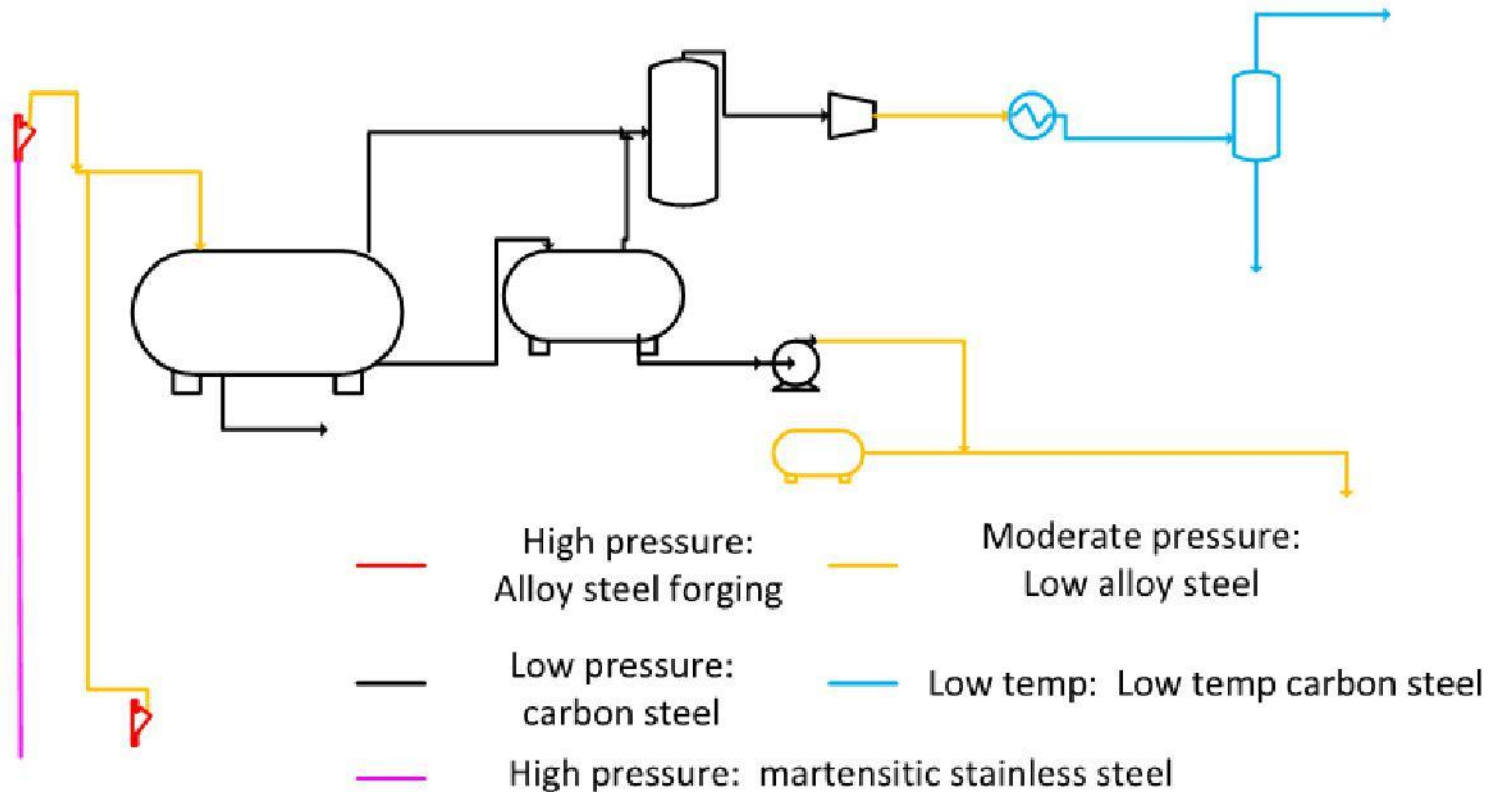
- Norsok M-001
- ISO 21457
- ISO 15156 (NACE MR-0175)
- Company standards

# Other important considerations

Once the basic selection has been made, consider also:

- Particular vulnerabilities & mitigations
- Materials heat treatment condition
- Mechanical property specification
- Quality control
- Manufacturer capability
- Welding

# Typical material selection - mechanical





# Typical material selection - corrosion

NORSOK standard M-001

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**Table 2 – Materials for production, process and produced water systems**

<b>Systems/equipment</b>	<b>Materials</b>
Wellhead equipment/X-mas trees	Low alloy steel with alloy 625 weld overlay on wetted surfaces.
Piping, valves, pumps and inline instruments	Type 22Cr duplex SS, type 25Cr duplex SS, type 6Mo SS.
Pressure vessels	Type 22Cr duplex SS, type 25Cr duplex SS, carbon steel with alloy 625, alloy 825 or alloy 904 clad or weld overlay
Vessel internals	316 SS, type 22Cr duplex SS, type 25Cr duplex SS
Piping and vessels in low corrosivity systems	CRA, carbon steel.
<b><u>Flare systems</u></b>	
Relief system	Type 6Mo SS, type 25Cr duplex SS for temperatures above – 46°C
Burner components	Alloy 800H, alloy 800HT, alloy 625, 316 SS or temperatures below 650°C.



# Further resources

- Principles and prevention of corrosion, Denny A. Jones
- Guidance for Corrosion Management in oil and gas production and processing, Energy Institute
- ISO 21457-2010: Petroleum, petrochemical and natural gas industries  
- Materials selection and corrosion control for oil and gas production systems
- Norsok M-001: Materials Selection
- Galvanic Corrosion – A practical guide for engineers, R. Francis
- EEMUA 218: Quality requirements for the manufacture and supply of duplex stainless steels
- Norsok M-650: Qualification of manufacturers of special materials
- Metallurgy for engineers, E.C. Rollason
- Offshore Engineering, An Introduction, Angus Mather



Thank you

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Thank you for your attention...

Q & A

