Subsea Corrosion & Scale

Presented by

Oseghale Lucas Okohue  BEng.  Msc. CIPMP

www.chesssubseaengineering.com
Course Instructor

Name: Oseghale Lucas Okohue

Position: Subsea Engineer – Production Systems | Drilling Systems Specialist

Website: www.chesssubseaengineering.com

Email: oseghaleokohue@chesssubseaengineering.com

oseghaleokohue@gmail.com
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Lecture 1: Subsea Corrosion & Scale

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Introduction

- In most subsea developments, oil and gas products are transported from subsea wells to platforms in multiphase flow without using a separation process.

- Corrosion, scale formation, and salt accumulation represent increasing challenges for the operation of subsea multiphase pipelines.

- Corrosion can be defined as a deterioration of a metal, due to chemical or electrochemical interactions between the metal and its environment.

- The tendency of a metal to corrode depends on a given environment and the metal type.
Introduction

- The **unprotected buried or unburied pipelines** that are exposed to the atmosphere or submerged in water are susceptible to corrosion in external pipe surfaces.

- Thus, without proper **maintenance**, the pipeline will eventually corrode and fail, because **corrosion** can **weaken** the **structure of the pipeline**.

*Note:*

*This make it unsafe for transporting oil, gas, and other fluids.*
Introduction

- A strong **adhesive external coating** over the whole length of the pipeline will tend to prevent **corrosion**.

- However, there is always the possibility of **coating damage** during handling of the **coated pipe** either during **shipping or installation**.

- Cathodic protection is provided by **sacrificial anodes** to prevent the damaged areas from corroding.

- The presence of **carbon dioxide (CO2), hydrogen sulphide (H2S), and free water** in the internal production fluid can cause severe corrosion problems in oil and gas pipelines.
Introduction

- Internal corrosion in wells and pipelines is influenced by:
  - temperature,
  - CO2 and H2S content,
  - water chemistry,
  - Flow velocity,
  - oil or water wetting, and the
  - composition and surface condition of the steel.

- Corrosion-resistant alloys such as 13% Cr steel and duplex stainless steel are often used in the downhole piping of subsea structures.
Introduction

- However, for long-distance pipelines, carbon steel is the only economically feasible alternative and corrosion has to be controlled so as to protect the flowline both internally and externally.

- Scale is a deposit of the inorganic mineral components of water.

- Solids may precipitate and deposit from the brine once the solubility limit or capacity is exceeded.

- The solid precipitates may either stay in suspension in the water or form an adherent scale on a surface such as a pipe wall.
Introduction

- Suspended scale solids may cause problems such as 
  formation plugging.

- Adherent scale deposits can restrict flow in pipes and 
  damage equipment such as pumps and valves.

- Corrosion and microbiological activity are often accelerated under 
  scale deposits.
Introduction

The purpose of this module is to evaluate the effects of corrosion and scale deposits on subsea oil and gas pipelines and describe protection methods.

The evaluation focuses on the following three aspects:

✓ Pipeline internal corrosion and protection;
✓ Pipeline external corrosion and protection;
✓ Scale.