Contents

Introduction

- **Corrosion is the degradation of a metal due to a reaction with it's environment.**

- **Metals corrode because they are thermodynamically unstable in their environment.**

  Most metals exist as oxides, sulphides...

  Only Au and Hg exist as metals at normal temperature.

- **Corrosion cannot be avoided. It can only be controlled.**

Introduction

- **Early knowledge of corrosion can help in:**
  - Minimizing the corrosion source
  - Implementing preventive measures.
  - Precise identification of failure can minimize repair expense.
  - Remedial action can be taken before the part is seriously damaged.
  - An understanding of the corrosion pattern may help in optimizing the completion design.

Introduction

- **Three primary mechanisms :**
  - Mechanical
  - Chemical
  - Electrochemical
- **Mechanical Corrosion is caused by stress and erosion.**
- **Chemical Corrosion is caused by a direct chemical reaction of the metal with its surroundings.**
- **Electrochemical Corrosion results from a chemical reaction involving the transfer of electrons.**

Introduction

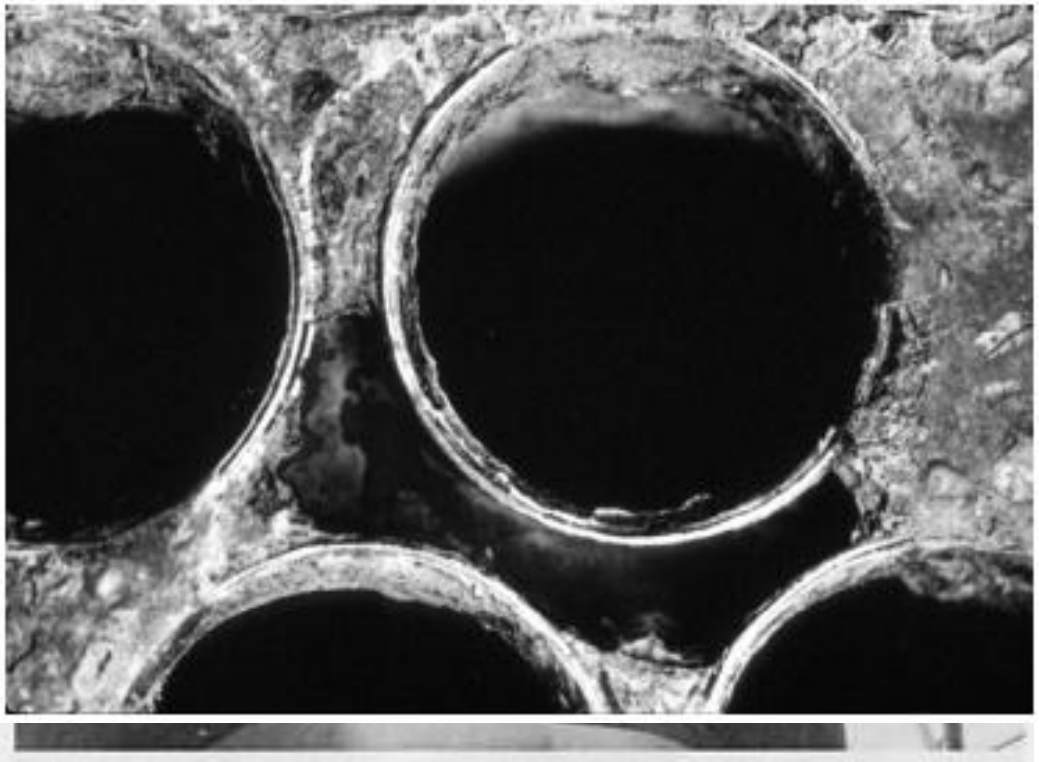
- **ELECTROCHEMICAL**
  - GALVANIC
  - CREVICE -PITTING
- **CHEMICAL**
  - BIOLOGICAL EFFECTS - Sulphate Reducing Bacteria (SRB)
  - H2 (Hydrogen) EMBRITTLEMENT
- **MECHANICAL**
  - EROSION
  - CORROSION FATIGUE

General Corrosion

General corrosion is typically characterized by an oxidizing reaction.

Galvanic Corrosion

- Galvanic (Two Metal) Corrosion occurs when two dissimilar metals are immersed in a conductive medium.
- Corroding tendency is determined by the relative position of the metals in the Galvanic series.



Crevice Corrosion

- **A crevice is a small gap created by contact of a material with another material. The crevice area of a metal or alloy in contact with another material, metal or nonmetal tends to get corroded preferentially in a corrosive environment compared to the area outside the crevice. This type of localized attack is known as crevice corrosion.**

Crevice Corrosion

- **Steam generators, condensers and feedwater heaters all experience similar problems with regard to crevice corrosion, especially between tubes and tube sheets or tube support plates.**

Preventing measures

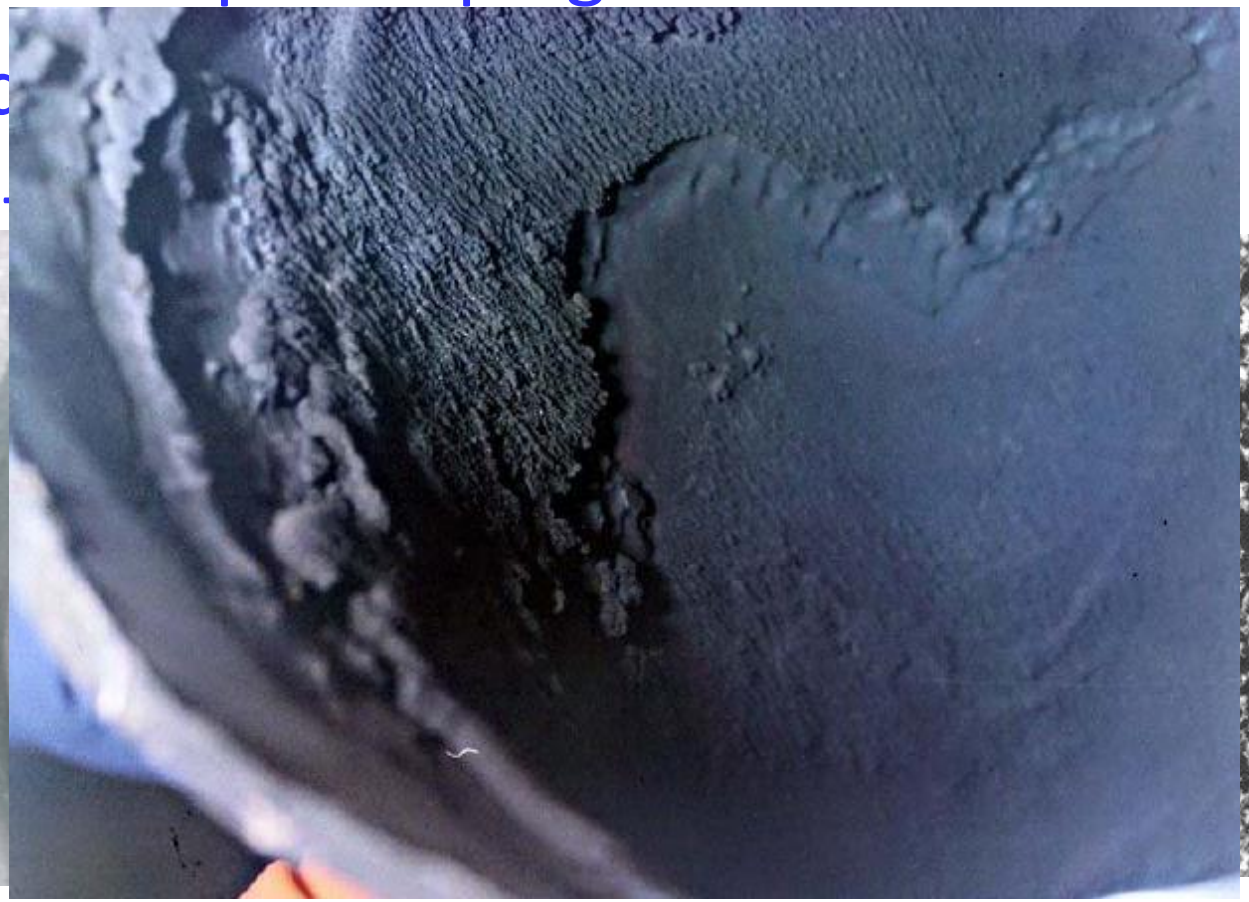
- **Good design to avoid stagnant areas and to prevent crevice**

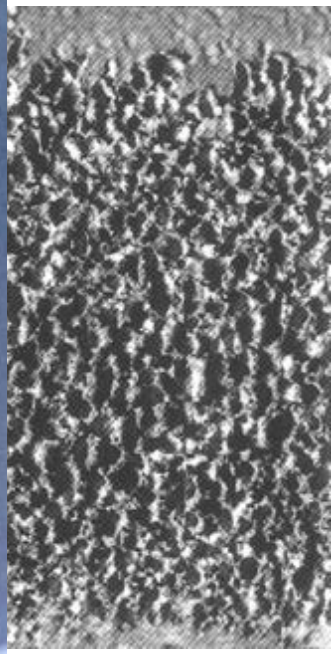
Pitting

- Pitting corrosion forms on passive metals and alloys like stainless steel when the ultra-thin passive film (oxide film) is chemically or mechanically damaged and does not immediately repassivate. The resulting pits can become wide and shallow or narrow and deep which can rapidly perforate the wall thickness of a metal

Erosion

- Liquid Droplet impingement
- Solid
- Cavi





Liquid Droplet impingement

Solid particle erosion

Cavitation

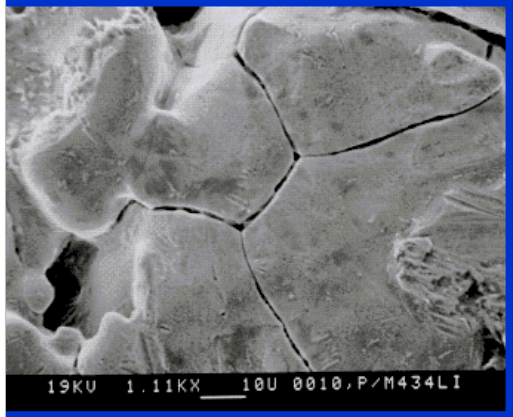
If the local pressure passes below the vapor pressure at the liquid temperature, then small bubbles are formed.

When the downstream pressure rises above the vapor pressure, these bubbles collapse.

Intergranular Attack

The temperature range of approximately 750 to 1500°F (400 to 815°C) chromium carbides can be formed, thus depleting the grain boundaries of chromium and decreasing their corrosion resistance.

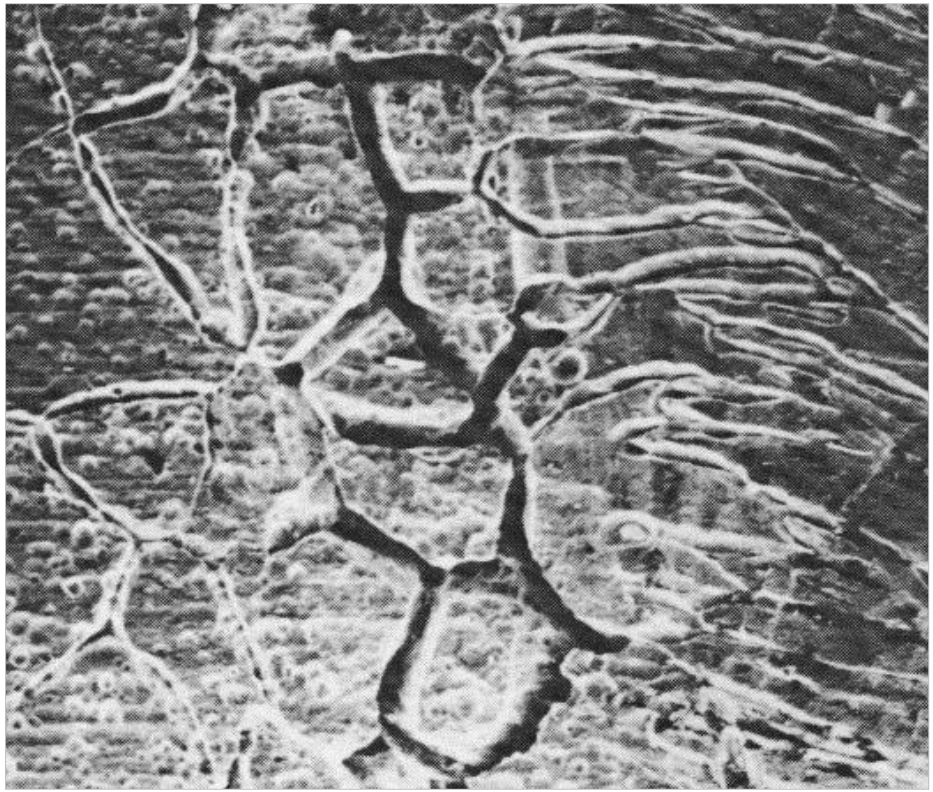
Intergranular Corrosion



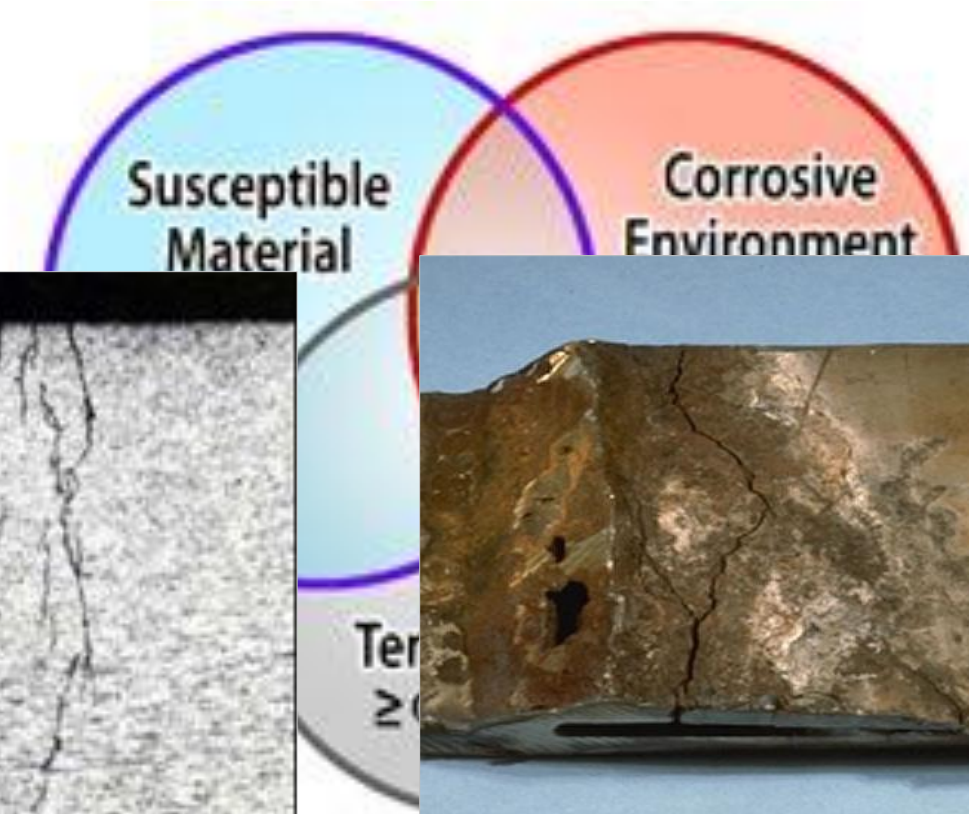
Corrosion along grain boundaries because of difference in composition

Sensitization - depletion of Cr near GB in stainless steel because of Cr carbide precipitation.

Sensitization can occur near welds in stainless steel.



Stress corrosion Cracking



Cathodic Protection

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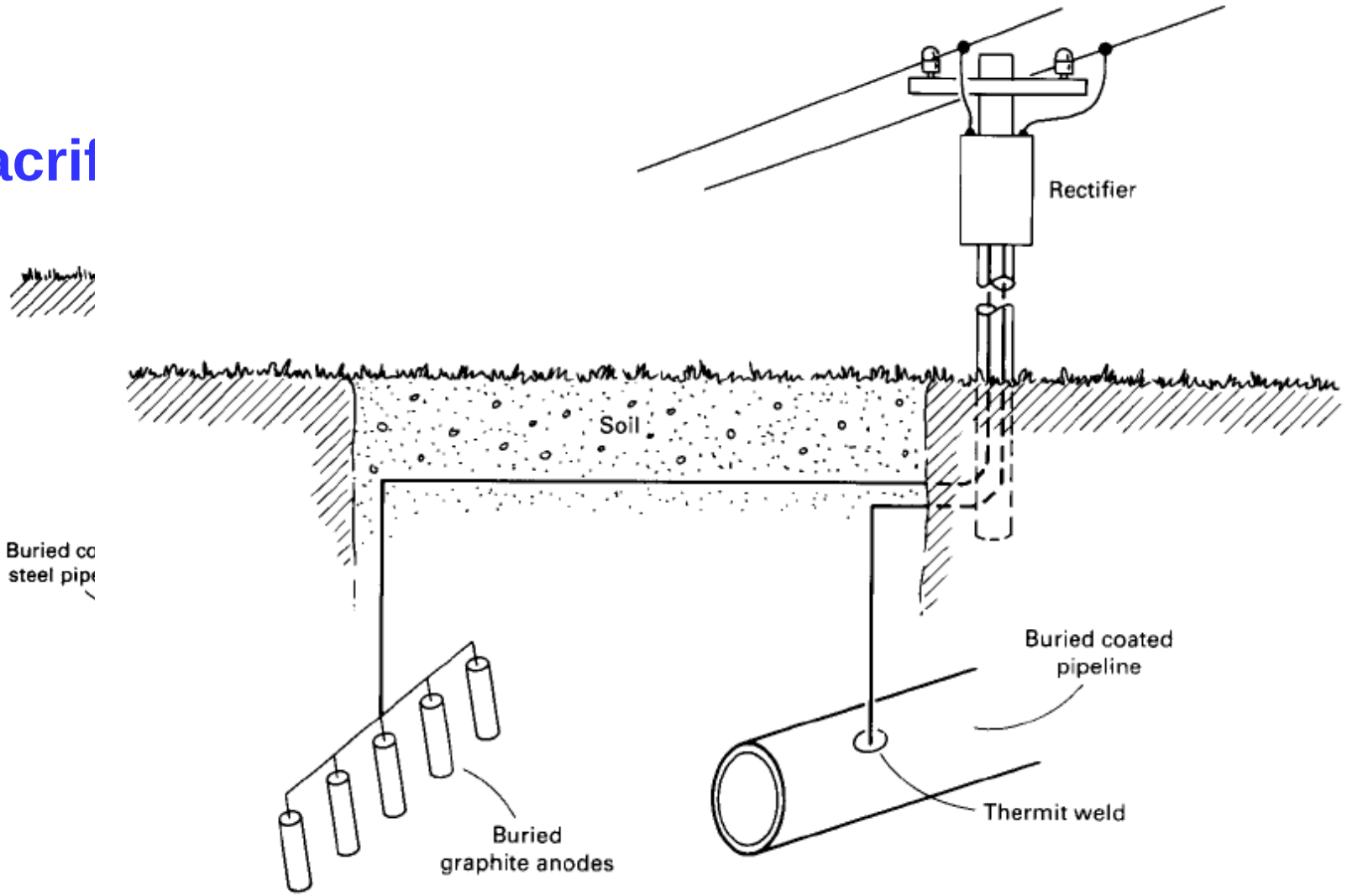

Impressed current