BRITISH STAINLESS STEEL ASSOCIATION
Making the Most of Stainless Steel

Marine Corrosion and its Prevention in Small Vessels

Contents:

Stainless Steel Advisory Service
0114 292 2637

Marine Corrosion and its Prevention in Small Vessels

Key Learning Objectives:

- Recap on fundamental corrosion principles including, driving force for electrochemical activity and principles of galvanic corrosion
- Understand the corrosion mechanisms that undermine the performance of stainless steel and other 'marine metals' and associated metrics
- Appreciate what environmental factors influence corrosion above and below the waterline and how this impacts material selection
- Consider how to minimise corrosion through material selection, improved design and other strategies i.e. cathodic protection, changing electrode potential, surface treatments etc.
- Be familiar with important aspects of failure analysis; inspection, sample preparation, analytical techniques and diagnostic methodologies

Who Should Attend:

This course suits designers, specifiers, marine engineers and surveyors interested in material degradation mechanisms in the marine environment and selecting fit-for purpose materials.

The course gives a comprehensive overview of the fundamental principles of corrosion and forms of corrosion that beset marine metals including, stainless steels, aluminium alloys, copper/nickel and titanium alloys. The types of corrosion commonly found above and below the waterline of small vessels and the factors which influence the rate of degradation are considered. For completeness protection methods, elements of failure analysis and illustrated case studies are discussed.

Contacts:

Dr Mike Lewus:
Technical Advisor, BSSA
0114 2922637

mike.lewus@bssa.org.uk
http://www.bssa.org.uk

BSSA

INTERNATIONAL INSTITUTE OF MARINE SURVEYING

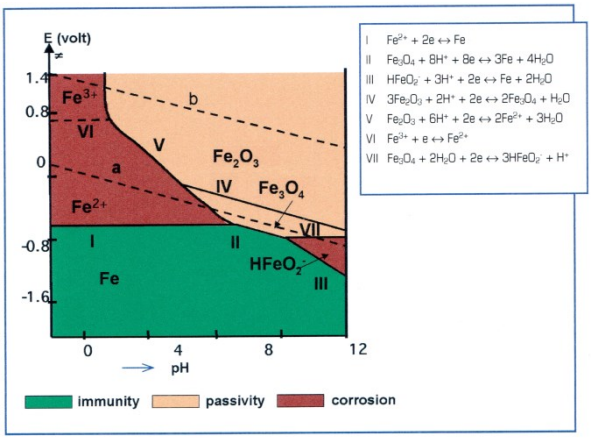
BRITISH STAINLESS STEEL ASSOCIATION
Making the Most of Stainless Steel

BSSA

British Stainless Steel Association

Section 1:
Corrosion: Fundamental Principles

- Electrochemistry:
  - cell potential & EMF series
- Galvanic coupling:
  - area ratios
  - cathodic protection
- Passive Metals
  - requirements for a stable film
  - film destabilisation & breakdown
- Pourbaix diagrams
- Chemistry of seawater and brackish waters
  - factors influencing corrosion rate



Simplified potential – pH diagram for the Fe-H_2O system

Section 2:
Forms of Corrosion (in stainless steel, aluminium, copper, nickel and titanium alloys): mechanisms and influential factors

- Uniform corrosion
- Galvanic corrosion
- Pitting and crevice corrosion
- Intergranular Corrosion (IC)
- Corrosion fatigue & stress corrosion cracking (SCC)
- Atmospheric corrosion
- Microbial induced corrosion (MIC)

Corrosion of Aluminium in sail drive coupled with Stainless Steel

Section 3:
Corrosion above the waterline

- Conditions above the waterline
  - Effect of meteorological conditions; evaporation and humidity
  - Influence of contact time and component design
  - Susceptibility of 'marine metals' to pitting, crevice & galvanic corrosion
  - Case studies: pitting, crevice, galvanic corrosion and corrosion fatigue etc.

Corrosion of swim platform support brackets

INTERNATIONAL INSTITUTE OF MARINE SURVEYING

BRITISH STAINLESS STEEL ASSOCIATION
Making the Most of Stainless Steel

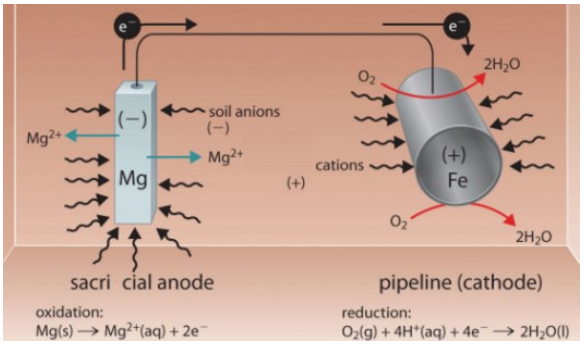
Section 4:
Corrosion below the waterline

- Pitting in quiescent and flowing water
- Cathodic protection and hydrogen embrittlement
- Accelerated low water corrosion (ALWC)
- Fouling and MIC
- Effects of fabrication (welding) and installation practices
- Cavitation and erosion corrosion
- Seawater fracture toughness

Corroding rudder stock, caused by electrical connection to prop. shaft

Section 5:
Corrosion Prevention Strategies

- Design and layout
- Cleaning and maintenance
- Choosing fit-for-purpose materials
  - stainless steel types/grades
  - aluminium types/grades
  - copper and it's alloys
- Cathodic protection
- Impressed current techniques
- Protective coatings



Principle of cathodic protection of iron using magnesium anode

Section 6:
Material Selection, Failure Analysis and Selected Case Studies

- Digital logic method and material performance index
  - keel bolt example
- Analytical methods:
  - visual inspection, macro & micro optical techniques, metallography, composition and structural assessment, NDT techniques
- Failure modes and effects analysis (FMEA) & Fault tree analysis (FTA)
- Selected case studies

Cracked prop. housing

BRITISH STAINLESS STEEL ASSOCIATION

Making the Most of Stainless Steel

Stainless Steel Advisory Service

0114 292 2637