Different Types of Corrosion

- Recognition, Mechanisms & Prevention

Microbiologically Influenced Corrosion (MIC)

Recognition

What is MIC? **Microbiologically-Influenced Corrosion (MIC)**, also known as **microbial corrosion** or **biological corrosion**, is the deterioration of metals as a result of the metabolic activity of microorganisms.

There are about a dozen of bacteria known to cause microbiologically influenced corrosion of carbon steels, stainless steels, aluminum alloys and copper alloys in waters and soils with pH 4~9 and temperature $10^{o}C$~$50^{o}C$.

These bacteria can be broadly classified as aerobic (requires oxygen to become active) or anaerobic (oxygen is toxic to the bacteria). Sulphate reducing bacteria (SRB) is anaerobic and is responsible for most instances of accelerated corrosion damages to ships and offshore steel structures. Iron and manganese oxidizing bacteria are aerobic and are frequently associated with accelerated pitting attacks on stainless steels at welds.

Many industries are affected by MIC:

- Chemical processing industries: stainless steel tanks, pipelines and flanged joints, particularly in welded areas after hydrotesting with natural river or well waters.
- Nuclear power generation: carbon and stainless steel piping and tanks; copper-nickel, stainless, brass and aluminum bronze cooling water pipes and tubes, especially during construction, hydrotest, and outage periods.
- Onshore and offshore oil and gas industries: mothballed and waterflood systems; oil and gas handling systems, particularly in those environments soured by sulfate reducing bacteria (SRB)-produced sulfides
- Underground pipeline industry: water-saturated clay-type soils of near-neutral pH with decaying organic matter and a source of SRB.
- Water treatment industry: heat exchangers and piping
- Sewage handling and treatment industry: concrete and reinforced concrete structures
- Highway maintenance industry: culvert piping
- Aviation industry: aluminum integral wing tanks and fuel storage tanks
- Metal working industry: increased wear from breakdown of machining oils and emulsions
- Marine and shipping industry: accelerated damage to ships and barges

Positive identification of microbiologically influenced corrosion requires chemical, biological and metallurgical analysis of the waters, soils and the metal samples.

Mechanisms

What causes MIC? **MIC** is caused by specific genera of bacteria which feed on nutrients and other elements found in waters and soils. Sea water is a primary source of sulphate reducing bacteria (SRB). The biological activities modify the local chemistry (acid-producing) and render it more corrosive to the metals. For example, iron-oxidizing bacteria can perforate a 5mm thick 316 stainless steel tank in just over a month!

Prevention

How to prevent MIC? **Microbiologically influenced corrosion**, or **microbial corrosion** or **biological corrosion** can be prevented through a number of methods:

- Regular mechanical cleaning if possible
- Chemical treatment with biocides to control the population of bacteria
- Complete drainage and dry-storage

For more details

More details on microbiologically influenced corrosion or biological corrosion are included in the following corrosion short courses which you can take as in-house training courses, online courses or distance learning courses:
Corrosion and Its Prevention (5-day module)
Corrosion and Its Prevention (2-day module)
Corrosion, Metallurgy, Failure Analysis and Prevention (3 days)
Marine Corrosion, Causes and Prevention (2 days)
Materials Selection and Corrosion (2 days)
Stainless Steels and Alloys: Why They Resist Corrosion and How They Fail (2 days)