Corrosion Performance and Testing of Materials in Marine Environments - D. Shifler (Naval Surface Warfare Center)

Seawater is an aggressive, complex fluid that interacts with structural materials to varying degrees. There are two competing processes that operate simultaneously in seawater environments: (1) a chloride ion activity tends to destroy the passive film, and (2) dissolved oxygen, which acts to promote and repair the passive film on metallic materials of construction. In addition, seawater is a living medium by which microbiological films can modify the expected performance of materials.

Corrosion testing depends on the extent and type of information desired and the environmental conditions expected in service for the alloy component. Corrosion in seawater environments is dependent on a number of factors such as alloy composition, water chemistry, pH, biofouling, microbiological organisms, pollution and contamination, alloy surface films, geometry and surface roughness, galvanic interactions, fluid velocity characteristics and mode, oxygen content, heat transfer rate, and temperature. Understanding how these factors interact and affect materials performance is essential in order to design seawater corrosion tests that minimize experimental variations and best simulate service conditions.

However, accelerated tests may generate performance results that have no correlation with performances in actual service environments. Ideally, the mechanism of materials degradation during an accelerated test needs to duplicate the corrosion mechanism that is operative in a natural service environment. However, accelerated tests tend to breakdown materials by different, often unknown, pathways than those observed in natural environmental exposures. Using preliminary models and precise surface analytical techniques, research can evaluate materials breakdown leading to verification or modification of our understanding of mechanisms by which materials degrade and fail. Improved understanding of materials degradation modes can lead to more accurate physical models which can hopefully lead to accelerated corrosion tests that can mimic natural exposures and reliably predict materials performance.