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Accelerated Atmospheric Corrosion Testing of Steel and AA5083

P. Khullar, R. G. Kelly
Center for Electrochemical Science and Engineering
Department of Materials Science and Engineering
University of Virginia
395 McCormick Road, Charlottesville, VA 22904

Conventional accelerated corrosion test methods such as ASTM B117 are often used to simulate and accelerate the atmospheric corrosion of materials under controlled lab conditions. The discrepancy between lab tests and field exposures is a well-known problem and undermines the use of lab results for corrosion prediction in natural conditions. The poor correlation is the effect of a number of key environmental variables that are not accounted for in ASTM B117. Corrosion testing of silver, a material used by Department of Defense for rapid corrosivity estimation, is an excellent case in point. Recent work has rationalized the differences between ASTM B117 results and actual field exposures in marine atmospheres for silver [1-3]. A key finding was the importance of the presence of oxidizers stronger than molecular oxygen in the natural environments. Rapid corrosion of silver was observed when ozone (a strong oxidizer) was introduced in the original ASTM B117 setup. The work [1] described a means of altering the B117 method to better capture the more oxidizing character of outdoor sites by including ozone and ultraviolet (UV) radiation for improved prediction of the corrosion of silver marine atmospheres.

Preliminary work along the same lines for low carbon steel and an aluminum alloy (AA 5083) has shown that similar discrepancies exist between ASTM B117 and natural atmospheric conditions. Hence, there is a need to better understand the underlying mechanisms of steel and AA5083 in natural service environment. This paper will quantify the effects of environmental variables that affect the atmospheric corrosion of steel and AA5083, namely, natural oxidizers (using ozone), salt loading density, and ultraviolet radiation. Under controlled conditions, steel and AA5083 samples were exposed to a combination of environmental parameters to study corrosion initiation and acceleration. For steel samples, mass loss, electrochemical measurements and surface morphology were used as corrosion metrics, whereas for AA 5083, intergranular corrosion (IGC) damage depth and surface morphology were used. Initial experiments with modified B117 tests show that ozone accelerates the corrosion of steel and AA5083. These results and their impact on improved accelerated testing will be discussed.

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