SAND2022-3795C

Towards Understanding the Controlling Nature of Crack Tip Chemistry on the Stress Corrosion Cracking of Austenitic Stainless Steels

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Localized corrosion and stress corrosion cracking (SCC) are potential degradation mechanisms for stainless steels (SS) when exposed to corrosive, marine environments. Under stresses (either external or residual), it is possible that localized corrosion features can nucleate a crack and potentially propagate to a through-wall failure. One potential scenario under which chloride induced SCC may pose a risk is the interim storage and the eventual transport of spent nuclear fuel (SNF) in SS canisters. In order to inform upon potential materials degradation in corrosive environments for SS alloys utilized in SNF storage, we present initial modeling and experimental efforts in determining SCC susceptibility for SS304L.

First, a reactive transport Finite Element Model (FEM) has been created to inform upon the crack tip chemistry (*i.e.*, chloride concentration and pH). Initial investigations have shown the strong influence of the external environment (brine thickness and cathode size). Second, *in-situ* crack growth rates have been measured in concentrated salt brines at elevated temperatures. The crack growth rates as well as fractography will be discussed in terms of testing methodologies and potential risks for canister degradation. Finally, *in-situ* crack tip measurements are proposed to assess the potential role of crack tip chemistry on crack growth rates as well as validate the presented model. By combining FEM with *in-situ* crack growth rate and chemistry measurements, the dominating factors of the crack tip chemistry can be understood helping to mechanistically understand SCC in austenitic SS.

Acknowledgements

SNL is managed and operated by NTESS under DOE NNSA contract DE-NA0003525. This document is SAND-###.