FATIGUE THRESHOLD $K_{max,th}$ AFFECTED BY STATIC THRESHOLD K_{1scc}

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For a given alloy composition, at near threshold crack growth rates at a given R-ratio and frequency, corrosion fatigue is characterized by both DK_{th} (cyclic component) and $K_{max.th}$ (static component). Under static load, threshold is represented by only K_{1scc} since the cyclic part is absent. In the absence of a chemical environment, threshold can be related to the fracture toughness K_{1c}. Both environmental fatigue and static thresholds being subcritical cracking mechanism, it is commonly considered as a separate phenomenon. K_{1c} is not considered as a subcritical cracking mechanism.

McEvily and Wei (1972) schematically showed that the typical material behavior in a chemical environment under cyclic loads, can be depicted three distinct limiting thresholds, ΔK_{th} threshold for fatigue, K_{ISCC} threshold under static loads, and K_{IC} for fracture toughness for overload fracture. These authors did not discuss the role of load ratio R and frequency in their classification.

Type-A: $K_{app} << K_{ISCC}$; the environmental contribution to fatigue depends predominantly on the time of exposure of the crack tip to the environment. We have an interplay of cycle-dependent processes due to fatigue and time-dependent processes due to crack tip chemical driving forces. The time-dependent accentuation of crack growth due to environment is dependent on frequency and R-ratio of testing. R-ratio allows for environmental access to the crack tip through COD.

Type-B: $K_{app} >> K_{ISCC}$: behavior involves contribution from fatigue and stress corrosion crack growth. The contribution from the stress corrosion becomes important only when the applied K_{max} at the crack tip exceeds K_{ISCC}. This stress-dependent contribution increases with the increase in stress although the time of exposure of crack tip decreases with increasing crack growth rate. Hence, this environmental contribution is more of a stress-dependent process than a time-dependent process. There may be additional synergetic effects as a function of R-ratio and frequency.

Type-C: behavior is a combination of both Types-A and -B.
We use the fatigue & static data in a 3.5%NaCl solution for a 5083 alloy where the mechanism is predominantly an “anodic dissolution” type to characterize the overall behavior of damage at threshold region. We are interested in the mechanical DK and K_{max} and chemical K_{ISCC} driving forces affecting the damage in the presence of a chemical environment (anodic overpotential). Detailed discussions involve how these parameters are interrelated.