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Effect of Dissolved Oxygen and Temperature on Fatigue Crack Growth Rate Behaviour of SA312 Type 304L(N) material in Water Environment

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Abstract:

The present study aims at quantification of Fatigue Crack Growth Rate (FCGR) parameters under different dissolved oxygen levels in water at room temperature (RT) and 300°C for SA312 Type 304L(N). The tests were conducted under 0.005Hz loading frequency. With a presumption that strain rate (or frequency) does not affect FCGR in air at RT, a reference test was carried out in air under 10Hz frequency for comparison purpose. The FCGR in water (0.005Hz) is significantly higher than air reference test (10Hz). The microscopic investigations revealed corrosion-fatigue synergy to be leading factor for higher FCGR in water at 300°C. However, strain rate dependent Deformation-Induced-Martensite (DIM) transformation was predominant in water at RT. Recent studies on this material brought out higher DIM formation under 0.01 Hz compared to 10 Hz at RT in air environment. The FCGR results in air environment are consistent with that in water at RT under lower frequency regime.

Keywords: Fatigue crack growth rate, stress intensity factor range, dissolved oxygen, striations, deformation induced martensite

Nomenclature			
NPP	Nuclear Power Plants	SEM	Scanning Electron Microscope
LBB	Leak Before Break	L	longitudinal
C(T)	Compact Tension	C	circumferential
TPB	Three Point Bend	P_{max}	maximum load in one cycle
FCG	Fatigue Crack Growth	P_{LIM}	limit load
FCGR	Fatigue Crack Growth Rate	ΔP	load range
DO	Dissolved Oxygen	OD	Outer Diameter
EC	Electrolytic Conductivity	σ_y	yield strength
LPLT	Low Pressure Low Temperature	σ_u	ultimate tensile strength

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