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The primary objective of this paper is to evaluate the effect of hydrogen on environment-assisted cracking of candidate target materials for transmutation applications. Transmutation refers to transformation of long-lived actinides and fission products from spent nuclear fuels (SNF), and occurs when the nucleus of an atom changes because of natural radioactive decay, nuclear fission, nuclear fusion, neutron capture, or other related processes. Martensitic Alloy EP 823 was selected to be the candidate alloy for this investigation. During the initial phase, the stress corrosion cracking (SCC) behavior of this alloy was evaluated in neutral (pH: 6-7) and acidic (pH: 2-3) environments using the smooth cylindrical tensile specimens under constant load (CL) and slow-strain-rate (SSR) conditions at ambient temperature and 90ºC. The extent and morphology of the broken tensile specimens were determined by scanning electron microscopy (SEM).

A calibrated proof ring was used to apply tensile loads corresponding to 90 and 95 percentages of the material's yield strength (YS) value to the specimen for 30 days in constant-load testing. For SSR testing, the specimen was strained in tension until fracture at a strain rate of 3.3×10^{-6} sec^{-1} using calibrated load cells and constant-extent-rate-test (CERT) machines. The cracking susceptibility under constant load was expressed in terms of the threshold stress (σ_{th}) below which cracking did not occur in 30 days. The cracking tendency in SSR testing was characterized by the time-to-failure (TTF), percent elongation (%El), percent reduction in area (%RA), and true failure stress (σ_f).

No failure was observed in the neutral solution at either temperature. However, a failure was observed in the 90ºC acidic solution, showing a σ_{th} value of approximately 95% of the material's YS value. The σ_f, the ductility parameters (%El and %RA) and the TTF were reduced due to the synergistic effects of the acidic pH and the elevated temperature. The fractographic evaluations revealed ductile failure in the neutral solution, but intergranular brittle failures were observed in the acidic environment.