

Environmental Effect on Corrosion Fatigue Behaviors of Steam Generator Forging in Simulated Pressurized Water Reactor Environment

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Abstract : An experimental investigation of environmental effect on fatigue behavior in SA508 Gr.3 Cl.2 Steam Generator Forging CAP1400 nuclear power plant has been carried out. In order to simulate actual loading condition, a range of strain amplitude was applied in different low cycle fatigue (LCF) tests. The current American Society of Mechanical Engineers (ASME) design fatigue code does not take full account of the interactions of environmental, loading, and material's factors. A range of strain amplitude was applied in different low cycle fatigue (LCF) tests at a strain rate of $0.01\%s^{-1}$. A design fatigue model was constructed by taking environmentally assisted fatigue effects into account, and the corresponding design curves were given for the convenience of engineering applications. The corrosion fatigue experiment was performed in a strain control mode in $320^{\circ}C$ borated and lithiated water environment to evaluate the effects of a mixed environment on fatigue life. Stress corrosion cracking (SCC) in steam generator large forging in primary water of pressurized water reactor was also observed. In addition, it is found that the CF life of SA508 Gr.3 Cl.2 decreases with increasing temperature in the water environment. The relationship between the reciprocal of temperature and the logarithm of fatigue life was found to be linear. Through experiments and subsequent analysis, the mechanisms of reduced low cycle fatigue life have been investigated for steam generator forging.

Keywords : failure behavior, low alloy steel, steam generator forging, stress corrosion cracking

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