Failure analysis of 316 stainless steel corrosion fatigue test fixture

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Abstract: 316 stainless steel was widely used in nuclear power and chemical industry due to its good corrosion resistance, mechanical properties and high-temperature performance. In pressurized water reactor nuclear power plants, stainless steel was commonly used as the pipeline and reactor internals[1, 2]. The engineering design models usually based on the experimental data, and the stable service of fixtures is an important guarantee for the reliability of experimental data. The corrosion fatigue failure behavior of 316 stainless steel fixture used in high-temperature pressurized water environment was analyzed. It was found that the stress concentration at the right-angle transition position of the fixture was obvious which promoted the corrosion damage during fatigue test in high-temperature pressurized water. Inclusions were also observed at the crack initiation and propagation areas. The interaction between mechanical damage and environmental damage during fixture service was discussed and a rounded corner transition was proposed and analyzed for retarding stress concentration at transition position of the fatigue fixture.

Keywords Stainless steel, High-temperature pressured water, Corrosion fatigue, Finite element

Reference

[1] P.J. Maziasz, J.T. Busby, Properties of Austenitic Steels for Nuclear Reactor Applications, Comprehensive Nuclear Materials2012, pp. 267-283.

[2] S.L. Sunde, B. Haugen, F. Berto, Experimental and numerical fretting fatigue using a new test fixture, International Journal of Fatigue 143 (2021) 106011.