Low Cycle Fatigue Behaviour of Grade 92 Steel Weld joints

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Abstract

In the present study, low cycle fatigue (LCF) behaviour of tungsten (W) alloyed 9Cr steel (Grade 92 steel) base metal and its weld joints has been investigated. LCF tests on both base metal and weld joint were conducted under fully reversed, total axial strain control mode employing a triangular waveform at 823 K, under a constant strain rate of $3 \times 10^{-3} s^{-1}$ with strain amplitudes varying from ±0.25% to ±1%. Both base metal and weld joint exhibited continuous softening with the weld joint exhibiting a lower stress response than base metal. At lower strain amplitudes, weld joint exhibited lower fatigue life than that of base metal whereas at higher strain amplitude, both the materials exhibited comparable fatigue life. Weld joints failed in the base metal for all the strain amplitudes at 823 K except at the strain amplitude ± 0.25% where weld joint failed in inter -critical region. Effect of temperature on LCF behaviour of weld joints and base metal at various temperatures ranging from 300 K to 873 K under constant strain amplitude of ± 0.6% and strain rate $3x10^{-3}$ has been investigated. At all the temperatures, weld joints failed in the base metal region. The material exhibited dynamic strain ageing phenomenon in the temperature range 473 K to 673 K. Oxidation was found to show more adverse effects on fatigue life beyond 673 K.

Key Words: Low cycle fatigue; Grade 92 steel; Weld joint failure location; Temperature effect; DSA.

1. Introduction

Grade 92 steel which belongs to the 9Cr-ferritic-martensitic steels family is one of the reliable materials for steam generator components in the fossil and nuclear power plants **[1-3]**. It has been chosen over Grade 91 steel (9Cr-1Mo-VNb) because of its improved mechanical properties at high temperature and good weldability **[1]**. Grade 92 steel has been