Creep Life Prediction of P91 Steel Using Omega Method

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Abstract Martensitic P91 steel is desirable for structural components operating at elevated temperatures. It is extensively used in nuclear power plant boilers, pipelines, reactor pressure vessels, and steam generators due to its high creep strength and corrosion resistance. Predicting the P91's creep rupture life is critical for safe operation. Numerous creep laws have been developed throughout the years to anticipate the deformation, propagation of damage, and rupture of materials subjected to the creep phenomena. The Omega method is one of the most widely used in API RP579 on fitness-for-service purposes. In this study, the creep tests have been performed at 600 °C for 160, 180 and 190 MPa. In order to predict the rupture life, the omega method has been employed, which utilised the initial creep strain rate and creep strain. The experimental data has been compared to available literature data for P91 material. The predicted life was always more significant than the experimental result, and it was strongly linked to the omega value. The result shows that the value omega value of the test data are in line with the available data and the initial creep strain rate increased linearly with increased of stress and temperature. The predicted rupture life values are consistent and close to the experimental results.

Keywords P91 · Creep behaviour · Omega method

1 Introduction

Modified 9Cr-1Mo ferritic steel (also known as Grade 91 or P91) is one of the best Cr-Mo alloys for high-temperature applications due to its creep strength and mild oxidation resistance up to 650 °C. It is frequently utilised in construction and piping systems of fossil-fuel power plants [1, 2]. Despite its excellent creep and corrosion resistance at elevated temperatures, P91 steel may experience failure due to

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