A new approach to predict creep rupture of Grade 92 steel under multiaxial stress states

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ABSTRACT

The extension of the available stress-based predictive models from uniaxial to multiaxial feature is uncertain due to the difficulty to justify the model transferability to the cases which involves complex deformation and fracture mechanisms. This paper presents a new approach to predict the creep rupture life of Grade 92 steel under multiaxial stress state as the case of notched bar samples using Kachanov's Continuum Damage Mechanics (CDM) model. Combining the CDM model with the concept of Hayhurst's representative stress and accounting two extreme conditions; fully dislocation-controlled and diffusion-controlled creep mechanisms provide the bounds for short- and long-term rupture data of notched bar up to 10,000 h. Although the CDM is scientifically relevant and fundamental in their approach, it is generally complex and contains too many variables. Therefore, it needs proper measurements or numerically intensive to make the model acceptable for industrial applications. Alternatively, the recent developed strain-based exponential-type predictive model which links globally uniform failure strain with a multiaxial constraint factor was employed with the intention to reduce the large number of CDM parameters. The approach is relatively simple yet reliable to be used for high temperature creep rupture assessment.

KEYWORDS

Creep damage; Constraints; Ductility; Multiaxial; Notch; Grade 92 steel; Triaxiality

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