Prediction of the creep behavior of P91 Steel at 873 K using continuum damage mechanics model

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ABSTRACT
Creep deformation is one of the life-limiting factors for the high-temperature components. As a result, there is a considerable amount of interest in predicting the creep rupture life of the high-temperature component during the design stage. The present paper intends to predict the creep rupture behaviour of the P91 steel using the Kachanov's continuum damage mechanics (CDM) at 873 K. The uniaxial creep rupture test was conducted at 873 K using three specimens, extracted from a commercial P91 steel pipe. Two different sets of material parameters for short-term and long-term creep prediction were determined using experimental data and NIMS data, respectively. Using the estimated material constants, creep behaviour in terms of creep strain–time and time to rupture at different stress levels have been predicted. In the case of lower stress level (long-term creep), Kachanov's CDM model underestimates the creep rupture life, whereas, for higher stress levels (short-term creep) the predicted data showed a good agreement with the experimental data except for the stress of 145 MPa which may attribute by the transition of creep damage mechanism. It is worth to be noted that, all the predicted lives are fall within a factor of two.

KEYWORDS
Continuum damage mechanics; Creep; Creep strain rate; P91 steel; Rupture

ACKNOWLEDGEMENTS

The author(s) would like to thank the Ministry of Higher Education Malaysia for financial support under Fundamental Research Grant Scheme FRGS/1/2019/TK03/UMP/02/2 (university reference RDU1901107).