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The effects of temperature, stress, and type of materials and their interactions on the creep rate and rupture time

Dr. Pravin S. Nerkar[1], Ms. Himani H. Nawalkar [2], Ms. Simran K. Thakre [3]

[1,2,3,] Mechanical Engineering Department,

St Vincent Pallotti College of Engineering and Technology, Nagpur-441108, Maharashtra, India.

**Corresponding author Email:psnerkar@yahoo.co.in*

ABSTRACT

The prediction of crack propagation at elevated temperatures is important and this paper provides a critical review of available information and models for behavior. Creep is very slow and permanent deformation of materials at constant temperature and under constant stress. It is a phenomenon accelerated by higher temperatures at stress level below yielding strengths. Knowledge of creep deformation is necessary for design and application of materials at elevated temperatures. This Review focuses on aspects with particular reference to creep-fatigue failure diagnosis. Creep-fatigue cracking due to a spectrum of loading conditions ranging from pure cyclic to steady loading with infrequent off-load transients.The possible grain-boundary behaviors, such as the mismatch behavior at grain boundary due to creep deformation, are studied. It implies that at high crack growth rates these hold-time effects arise mostly from creep-fatigue interaction rather than environment fatigue interaction. The effects of temperature, stress, and type of materials and their interactions on the creep rate and rupture time were considered. Results showed that the main effects of factors and their interactions are significant on the creep rate and rupture time. The effects of temperature and stress are factors which affect creep phenomenon. In the fast fracture of high strength, low toughness materials and in fatigue crack growth, it is established that data from tests can be confidently applied to predict the integrity of a structure or crack extension in service using sharp crack stress intensity factors. More recently, a study of fatigue crack initiation from sharp notches in mild steel has shown that the number of cycles to initiate a crack also be calculated using stress intensity factors. In components which operate at elevated temperatures there is a need to develop methods which describe the growth of crack-like defects in creep conditions.

Keywords: Creep;Creep-Fatigue Interaction; Stress; Temperature;Permanent deformation
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