Assessment of thermomechanical treatment in ferritic phase field condition on tensile, creep deformation and rupture behaviour of Reduced Activation Ferritic-Martensitic steel

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ABSTRACT

Reduced Activation Ferritic–Martensitic (RAFM) steel is an important structural material for test blanket module in nuclear reactors. In the present study, microstructure, hardness, tensile, creep deformation and rupture behaviour of RAFM steel subjected to thermomechanical treatment (TMT) in ferritic phase filed condition were assessed. The results are compared with those obtained on the steel in conventional normalized and tempered (N+T) condition. Optical, scanning and transmission electron microscopic investigations have been carried out to assess the microstructural changes in the steel prior to and post creep studies for both the conditions of the steel. While N+T steel reveal tempered martensitic structure with finer prior austenitic grain boundaries with coarser $M_{23}C_6$ and MX precipitates, the TMT processed steel resulted in coarser prior austenite grains and exhibited ferrite phase with fine distribution of $M_{23}C_6$ and MX precipitates. The TMT steel in ferritic phase exhibited lower hardness but higher tensile strength values compared to the N+T condition. The creep deformation of both the steels shows relatively shorter primary regime followed by tertiary stage with virtually no secondary regime. Time to rupture of the steel is observed to be higher in TMT condition than that of N+T condition for all the stresses (200-280 MPa) at 823 K. The higher tensile and creep strengths of TMT steel can be attributed to high dislocation density and large quantity of finer distribution of precipitates than in N+T condition.

Keywords: *Reduced activation ferritic-martensitic steel; Normalized and Tempered condition; Thermo-mechanical treatment; Electron microscopy; Tensile and creep strengths.*