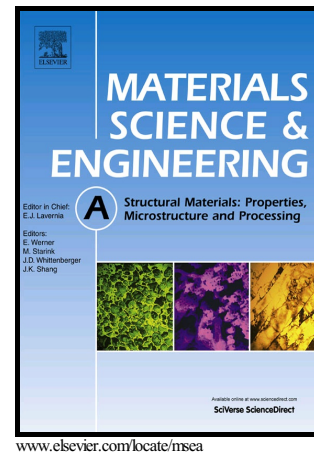


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Transition from Type IV to Type I Cracking in Heat-Treated Grade 91 Steel Weldments

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Abstract

Increasing the post-weld heat-treating temperature from 600 °C to 840 °C causes a transition of creep rupture locations from the Type IV cracking in the intercritical heat-affected zone to the Type I cracking in the fusion zone in the Grade 91 steel weldments. The specimens following a heat-treatment at temperatures below the A_1 temperature of the base metal failed in the Type IV cracking mode after high-temperature creep tests at 650 °C. The creep-damaged region associated with the Type IV cracking mode is consistently located in a softened zone, which is identified as the intercritical heat-affected zone. In the specimens heat-treated at temperatures close to or above the A_1 temperature of the base metal, the fusion zone enters the intercritical temperature between its A_1 and A_3 temperatures. The fusion zone experienced a partial austenitization to become a mixture of retained ferrite and new martensite, which is believed the most creep-susceptible. The same microstructure, a mixture of retained soft ferrite and new hard martensite, caused nucleation and growth of cavities in the both Type IV and Type I damaged regions. Therefore, it is suggested that the same creep mechanism may have contributed to both cracking modes in Grade 91 steel.

Keywords: Grade 91 Steel, Heat-Affected zone, Post Weld Heat Treatment, Type I Cracking, Type IV Cracking

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