Creep deformation and rupture behaviour of P91 steel thick weld joint at 923 K

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P91 steel is extensively been used in the nuclear and fossil power plants. The reduction in creep rupture strength of the P91 steel weld joint as compared to the base metal under creep exposure is the main concern in this steel. In the present study, creep behaviour of P91 steel 17 mm thick weld joint fabricated using activated-tungsten inert gas (A-TIG) welding process has been investigated, and the results were compared with that of 10 mm thickness P91 steel A-TIG weld joint. Creep tests at 923 K in the applied stress range of 100-50 MPa were performed on both the joints. Creep strain accumulation in the 17 mm thick weld joint was lower than the 10 mm thick weld joint. Both the weld joints have exhibited lower creep rupture life than the base metal over the investigated creep exposure and the difference increased with decrease in applied stress. The rupture life of 17 mm thick weld joint is 124% lower than the rupture life of 10 mm thick weld joint. The creep rupture strength of 10 and 17 mm thick weld joints are about 22 and 35% lower (weld strength factor (WSF) about 0.78 and 0.65 for 10 and 17 mm thick weld joints respectively) than the base metal at 923 K for 5400 hour. The type-IV cracking failure and drastic reduction in ductility have been observed in the investigated stress level. The reduction in area (%) of 10 and 17 mm thick weld joints are in the range of 70-35% and 24-10% respectively. Significant reduction in creep rupture strength (13%) and ductility (25%) have been observed under lower applied stress in the thicker weld joint than the thin (10 mm) weld joint of P91 steel.