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Creep resistance and fracture toughness of recently-developed optimized Grade 92 and its weldments for advanced fast reactors

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Optimized Grade 92 has been developed at Oak Ridge National Laboratory in support of the USA Sodium-cooled Fast Reactor program. Composition modification and processing optimization successfully achieved the development of optimized Grade 92 with desired microstructures for superior properties. A variety of properties have been assessed for optimized Grade 92, which include tensile, creep, fatigue, creep-fatigue, impact and fracture toughness, weldability, thermal aging resistance, and sodium compatibility. This paper focuses on presenting the results of creep and fracture toughness tests of optimized Grade 92 and its weldments. Compared to the literature data of Grade 92 and similar 9Cr ferritic-martensitic steels, optimized Grade 92 exhibited significantly enhanced creep resistance, together with superior or comparable fracture toughness. Creep rupture ductility of the ruptured samples is discussed by comparing to the reference steels. Samples extracted from tungsten-inert-gas fabricated weldments showed slight reductions in creep life and creep strength compared to the base metal of optimized Grade 92. The reductions, however, are noticeably smaller than that of the reference steels. Satisfactory fracture toughness was observed for the weldments of optimized Grade 92. Hardness measurements and microstructural characterization following the tests shed light on the superior properties of optimized Grade 92 and its weldments. The enhanced properties are expected to favor the application of optimized Grade 92 for advanced fast reactors.

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