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Microstructure-dependent fracture toughness (J_{IC}) variations in dissimilar pipe welds for pressure vessel system of nuclear plants

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Abstract

In present study, dissimilar metal weld (DMW) joints between SA508Gr.3cl.1 ferritic steel and SS304LN pipes were prepared using Inconel 82/182, and Inconel 52/152 consumables. Metallurgical properties and their influence on fracture toughness of weldment regions and interfacial regions could play a significant role in integrity assessment of these joints. Ni-based consumables exhibit complex metallurgical properties at interfacial regions. The metallurgical characterization and fracture toughness studies of Inconel 82/182 and Inconel 52/152 joints have been carried out for determining the optimum consumable for DMW joint requirements and the effect of microstructure on fracture toughness in weldment regions. The present codes and procedures for integrity assessment of DMW joints have not given due considerations of metallurgical properties. The requirements for metallurgical properties by considering their effect on fracture toughness properties in integrity assessment have been discussed for reliable analysis. Inconel 82/182 is preferred over Inconel 52/152 joints owing to favorable metallurgical and fracture toughness properties across the interfacial and weldment regions.

Keywords: Structural Integrity; Assessment procedure; Interface; Sigma phase; Crack growth; X-ray diffraction