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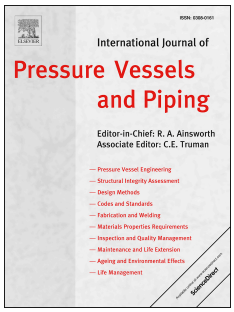

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Evolution of Microstructure and Toughness in 2.25Cr-1Mo Steel Welds

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Abstract

In oil and gas and other industries, valve bodies are often manufactured using a 2.25Cr-1Mo steel which, if welded, requires post-weld heat treatment (PWHT) in order to restore toughness. The safe operation and long-term integrity of such welds is critically dependent on achieving adequate toughness across the welded joint. In this work, mock-ups were manufactured for the purpose of assessing the effects of the weld heat input on toughness. The assessment was made by carrying out crack tip opening displacement (CTOD) and Charpy-impact tests in different metallurgical regions and, after testing, by examining the fracture surfaces using optical- and scanning-electron microscopy, and energy-dispersive spectroscopy. There did not appear to be an effect of weld heat input on toughness at a test temperature of +20°C. However, for the case where a high weld heat input was employed, the toughness of the weld metal dropped by close to 50% when the temperature was decreased to -20°C. These results suggest that inadequate control of the welding process may lead to significant variability in weld toughness, and that high weld heat inputs should be avoided when welding or buttering 2.25Cr-1Mo steel components.

Keywords

Buttering layer, dissimilar metal weld, ductile-to-brittle transition, fracture toughness, heat-affected zone, subsea systems.