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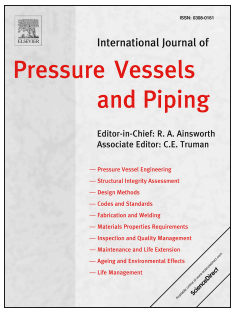

Microalloyed steel welds by HF-ERW technique: Novel PWHT cycles, microstructure evolution and mechanical properties enhancement

Gholamreza Khalaj, Hesam Pouraliakbar, Mohammad Reza Jandaghi, Abbas Gholami

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Microalloyed steel welds by HF-ERW technique: Novel PWHT cycles, microstructure evolution and mechanical properties enhancement

Gholamreza Khalaj [1,*], Hesam Pouraliakbar [2], Mohammad Reza Jandaghi [1], Abbas Gholami[1]

[1] *Young Researchers and Elites Club, Saveh Branch, Islamic Azad University, Saveh, Iran*

[2] *Young Researchers and Elites Club, Science and Research Branch, Islamic Azad University, Tehran, Iran*

* ***Corresponding author**; E-mail: **gh.khalaj@srbiau.ac.ir**; Tel: **+98 912 617 6472***

Abstract

Novel post-weld heat treatment (PWHT) cycles consisted of multiple austenitizing, normalizing, quenching and tempering steps had been introduced and examined in order to improve the toughness of high-frequency electrical resistance welded (HF-ERWed) microalloyed line pipe steel joints. Comparison was made to commercial PWHT route of API X60 grade steel which has been used widely for pipeline parts. Effects of applied cycles on microstructural evolution were investigated by optical and scanning electron microscopy techniques. Meanwhile, Vickers hardness and Charpy V-notch impact toughness tests were conducted to evaluate the mechanical properties of the treated weldments. Based on the obtained results for the proper quenching and tempering heat treatment at 600 ◦C for 30 min, both hardness and ultimate strength remained unchanged related to the classic treatment (172 Hv and 535 MPa); however, it eventuated the absorbed energy enhancement to nearly two-times greater than that for the commercial treatment (33 J versus 17 J at -25 ◦C). While the mechanical properties of one-step normalizing treatment satisfied the API specification, the two-step quenching and tempering PWHTs were recommended for API X60 grade steels.

Keywords: *Microalloyed steel; Electrical resistance welding (ERW); Post-weld heat treatment (PWHT); Microstructure; Toughness; Fractography.*

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