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Residual stress and surface properties of stainless steel welded joints induced by ultrasonic pulsed water jet peening

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Abstract

The residual stress and subsurface hardness of welded joints treated by peening using an ultrasonic pulsed water jet at pressures of 20–60 MPa with various traverse speeds and standoff distances were measured. The effect of the treatment was quantified by measuring the residual stress using X-ray diffraction in three regions (the welded zone, heat-affected zone, and base metal). To analyse the depth of the plastic deformation induced by the pulsating water jet, microstructural analyses and micro-hardness measurements were conducted. The surface topography of the treated samples was examined by measuring the surface roughness using a contact surface roughness profilometer. After pulsating water jet treatment, the samples showed both increased residual stress and surface roughness at pressures of 20–60 MPa. Increased subsurface hardness of the treated region was observed up to a depth of 200–250 µm at pressures of 40 and 60 MPa, deeper than that of the sample prepared at 20 MPa. The microstructural analysis identified the involved plastic deformation phenomenon occurred during the treatment process. This method of surface treatment, where the efficiency of the jet is enhanced by the generation of pulses using an acoustic generator, showed promising results for its practical application as a post-weld treatment method.

Keywords: Pulsating water jet; Welded joints; Peening; Residual Stress; Micro-hardness; Surface roughness.

List of symbols:

f	frequency	[kHz]
d	nozzle diameter	[mm]
z	standoff distance	[mm]
A	amplitude	[mm]
p	pressure	[MPa]
v	traverse speed	[mm/s]

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