ABSTARCT

Fusion welding is a joining process widely used in the industry. However, undesired residual stresses are produced once the welding process is completed. Post-weld heat-treatment (PWHT) is extensively employed in order to relieve the welding residual stresses. In this study, effect of PWHT time and temperature on the residual stresses of a ferritic stainless steel is investigated. Residual stress distributions in eight welded specimens were measured by using an ultrasonic method. Ultrasonic stress measurement is a nondestructive method based on acoustoelasticity law, which correlates mechanical stresses with velocity of an ultrasonic wave propagating within the subject material. The ultrasonic wave employed could be longitudinal or shear wave produced by the longitudinal (normal) or transverse (shear) transducers, respectively. Ultrasonic stress measurements based on longitudinal waves use longitudinal critically refracted (L_{CR}) waves in this direction, while shear wave methods use an ultrasonic birefringence phenomenon. The results show that the effect of PWHT can be successfully inferred by both longitudinal and shear wave methods, but the former is found to be more sensitive to stress variation. Furthermore, the distribution of subsurface residual stresses is found to be more distinguishable when the L_{CR}method is employed.

KEYWORDS: Acoustoelasticity, post-weld heat-treatment (PWHT), ultrasonic longitudinal wave, ultrasonic shear wave, ultrasonic stress measurement, welding residual stress