An evaluation of mechanical properties and estimation of environmental reduction factors in welded API X70 steel pipeline in natural seawater.

Abstract

Due to the detrimental effect of damage induced by seawater in pipeline structures, there is a need to investigate the effects of natural seawater and air environments on mechanical properties of representative pipeline materials, to obtain useful data for estimation of their service lives. Hence, in this work, a X70 steel pipeline plate was welded using submerged arc welding technique; and subjected to air and natural seawater environments. Test specimens were soaked in seawater for twelve months at 28 °C. The parent plates, weld regions and the heat affected zones were investigated by evaluating their mechanical properties and fracture surfaces. The experimental findings revealed that the tensile strengths of parent and weld were 634.00 MPa and 674.00 MPa respectively, while the compressive stresses were 750.10 MPa and 750.40 MPa respectively with highest hardness value of 239HV. The findings also revealed that weld area and heat affected zone depend on material thickness, heat input and possible effect of residual stresses in the weldment. The fracture surfaces of test specimens showed combination of brittle and ductile failure mechanisms. Comparison of the test results revealed that seawater had significant effect on the mechanical properties and surface morphology of the API X70 steel pipeline with respect to immersion time.

Keywords: Welding pipeline mechanical properties fracture air seawater

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