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Abstract

Pulsed gas metal arc welding (P-GMAW) is one of the most effective joining methods used for mainline field girth welding of large diameter, long distance pipelines. Single torch and single wire P-GMAW utilizing narrow-groove weld geometry has been applied extensively in both onshore and offshore pipeline constructions. The industry has a desire to increase welding productivity by the development and application of multi-wire variants of P-GMAW such as tandem-wire and dual-torch processes. These varieties of P-GMAW processes have their unique characteristics which affects the heat transfer and resulting microstructures in the heat-affected zone (HAZ) and deposited weld metal. These unique features need to be considered in the welding heat transfer analyses. This paper presents heat transfer analyses of various P-GMAW processes with a consistent heat source model and its associated thermal boundary conditions. The objective of the study is to extend the thermal analysis procedures of single-wire P-GMAW to the wider range of P-GMAW processes. To validate the thermal analysis models, the predicted temperature histories (cycles) and cooling times for welds produced under different pre-heat temperatures and different P-GMAW processes were compared with experimentally measured thermal histories. Generally good agreement between the predicted and measured thermal histories was achieved. The areas of further refinement of the thermal analysis models and experimental measurement procedures were identified.

Keywords

P-GMAW, Narrow groove, Heat transfer, Girth weld, Pipeline