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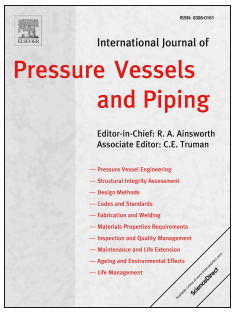

Finite element based parametric study on the characterization of weld process moving heat source parameters in austenitic stainless steel

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Finite element based parametric study on the characterization of weld process moving heat source parameters in austenitic stainless steel

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Abstract:

In this paper, significant aspects of weld process double ellipsoidal moving heat source geometric parameters are investigated. A three-dimensional finite element analysis is performed for AISI 304 stainless steel thin cylindrical components. During simulations, a sequentially coupled thermo-metallurgical-mechanical analysis is employed for sixteen different geometrical conditions of heat source model. The results reveal that there is a marginal affect on weld pool size and shapes, temperature distributions with the variation in moving heat source geometric parameters; whereas no influence on the residual stress distributions. Moreover, the validity of the numerical simulation results is validated through full-scale shop floor welding experiments.

Keywords: Finite element simulation; Moving heat source; Weld pool size; Thermal cycles; Residual stress distributions.

1. Introduction

In Gas Tungsten Arc Welding (GTAW) process, a moving heat source is applied at the interface of the two parts which are to be joined so that they will be connected after liquid metal solidification. GTAW process simulation is a complex phenomenon and involves an accurate application of moving heat source geometric parameters. Detailed literature review [1-5] reveals that number of investigations have been undertaken by various authors through numerical analysis coupled with experimental validation to understand the effect of different geometrical moving heat source parameters. It is noticeable from the literature [1-5] that the modeling of moving heat source is an important concern in numerical simulation studies of various metal joining processes. For instance, Yadaiah et al. [1] studied the influence of ratio of rear and front length of double ellipsoidal heat source and found that it has a significant effect on the weld pool dimensions. Fachinotti et al. [2] considered three different cases,