Heat Transfer in the Fusion Zone during Electron-Beam Welding

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Abstract

An analytical model is developed to investigate the heat transfer in the fusion zone during electron-beam welding. The keyhole produced by an electron-beam is assumed to be a paraboloid of revolution and the profile of the intensity of an electron beam is supposed to be Gaussian distribution. In order to obtain an analytical solution, a quasi-steady heat conduction equation is utilized to analyze the heat transfer in the workpiece but the parameter approximating convection is proposed to account for the effect of heat convection of molten metal. Considering the momentum balance at the bottom of the keyhole and neglecting the absorption in the plume, an analytical solution is obtained for semi-infinite workpieces. As compared with other analytical models, this model provides the temperature distribution more consistent with the experimental data. The effects of various parameters on the temperature distribution are also discussed in this study.