Abstract

The main objective of the present research work is to study the uniaxial tensile strength and the susceptibility to intergranular corrosion of 3-mm-thick Hastelloy C-276 sheets welded by Ytterbium-fiber laser beam and electron beam. To carry out the study, the main objective has been divided into three sub-objectives: (1) optimization of process parameters for obtaining minimum cross-sectional melt zone area in welded Hastelloy C-276 sheets; (2) study of the room temperature uniaxial tensile strength properties of welded Hastelloy C-276 sheets; and (3) study the susceptibility to intergranular corrosion of welded Hastelloy C-276 sheets. A fast and relatively simple method of optimization involving first order linear regression equation has been proposed in the present study. Bead-on-plate welding was carried out, and minimum melt zone cross-sectional area corresponding to minimum linear heat input was obtained for both the welding techniques. Laser beam welding and electron beam welding of Hastelloy C-276 sheets were carried out at the optimized combination of process parameters. When subjected to the uniaxial tensile test at room temperature, laser beam welded Hastelloy C-276 sheets and electron beam welded Hastelloy C-276 sheets showed a substantial increase in percent elongation as compared to the reported literature on laser welding and gas tungsten arc welding. As-welded Hastelloy C-276 sheet failed at the base metal with necking at the fracture zone showing the ductile mode of failure. It was observed that (a) reduction in micro-segregation of elements and (b) increase in apparent percent elongation of HAZ, were found to cause an increase in plastic deformation of welded Hastelloy C-276 sheets. Susceptibility of laser beam welded and electron beam welded Hastelloy C-276 sheets to intergranular corrosion has been studied using the Method A of ASTM G-28 standard for corrosion test. It was observed that laser beam welded Hastelloy C-276 sheets and electron beam welded Hastelloy C-276 sheets were found to have a higher susceptibility (but below the specified limit) to intergranular corrosion with respect to the base metal. Formation of numerous concentration cells due to the micro-segregation of elements within the weld zone was found to cause the intergranular corrosion of the weld zone.

Keywords: Hastelloy C-276; Laser Beam Welding; Electron Beam Welding; Tensile Test; Corrosion test.