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Parametric Optimization of Dissimilar TIG Welding of AISI 304L and 430 Steel Using Taguchi Analysis

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Abstract. Dissimilar welding of 3mm thickness of AISI 304L austenitic stainless steel plate and AISI 430 ferritic stainless steel plates were performed by Tungsten Inert Gas welding without any filler material by using argon as shielding gas. Welding is carried out according to set of combinations of welding parameters such as welding current (levels of 135,140,145 Ampere), welding speed (levels of 105, 110, 115 mm/min) and shielding gas flow rate (of levels 5,10,15 Litre/min) obtained through Taguchi L9 orthogonal approach for maximizing the ultimate tensile strength by using MiniTab software . Radiography test was performed to know the soundness of the welds. Tensile specimens are fabricated as per ASTM E8 standard for tensile testing. Microstructural observations of the weld are performed. Correlations have been obtained to know the effect of welding speed, welding current and shielding gas flow rate on tensile strength and an optimum level of parameter is obtained at welding current of 145 Ampere, welding speed of 115 mm/min and shielding gas flow rate of 5 Litre/min.

Introduction

Dissimilar welding is the joining between two different materials by any welding process. Joining of dissimilar materials may significantly reduce the weight of the product and minimize the cost of production as well, without compromising the safety and structural requirements. The dissimilar weld must possess sufficient tensile strength and ductility so that the joint will not fail within the weld. Dissimilar metal joints are used in various engineering applications such as nuclear power plants, coal fired boilers, automobile child part manufacturing industry etc. With the growing demand of new materials, industries, nowadays, utilize a variety of materials to make their products on a large scale in order to improve performance and reduce cost. Among the various material combinations, the demands for using ferritic/austenitic (F/A) joints used in power generation, chemical, petrochemical, nuclear and automotive industries are enormous [1-5]. The welding joints between austenitic and ferritic stainless steels [6-11] with low carbon content are extensively utilized in many high temperature applications such as energy conversion systems. For instance, in central power stations, sections of the boilers subjected to lower temperature are made from ferritic stainless steel for economic reasons. The other applications operating at higher temperatures are constructed with austenitic stainless steel. Therefore, the transition welds are needed between the two materials. This ultimately leads to an increased demand for techniques to weld these dissimilar materials and their use in large scale industrial production process [12].

However, the joining of austenitic and ferritic stainless steels involves challenges such as coarsening of grains and loss of mechanical properties on ferritic side [12]. Hence, many researches is going on with the welding of ferritic and austenitic steels using less heat input process such as Laser beam and Electron beam welding. But Gas Tungsten Arc Welding is the mostly used welding process among the arc welding process as it involves less heat input. Most of the studies are going