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Modeling of Bending Properties of Stainless Steel 304 Sheets Welded by Tungsten Inert Gas Welding Process

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Abstract

In this research, the effects of both current and argon gas pressure on the bending properties of welded joints were studied. Using the possible ranges of welding gas pressures and currents, Tungsten inert gas welding (TIG) of stainless steel (304) sheet was used to obtain their influence on the maximum bending force of the (TIG) welded joints. Design of experiment (DOE) 'version 10' was used to determine the design matrix of experiments depending on the used levels of the input factors. Response surface methodology (RSM) technique was used to obtain an empirical mathematical model for the maximum bending force as a function of welding parameters (Current and Argon gas pressure). Also, the analysis of variance (ANOVA) was used to verify the adequacy of the resulted model statistically.

Keywords: *Bending Properties, Numerical Optimization, Stainless Steel (304), TIG Welding, Welding Parameters.*

1. Introduction

Welding is a critical process in the industry since it used to join different materials, especially stainless steels, which are presently used in various structural engineering parts. Welding of tungsten with inert argon gas (TIG) is one of the most important and common industrial processes. The weld efficiency is related to the best selection of main welding parameters, such as welding speed, current, filler material and welding gas pressure. In this section, a review of TIG welding research, welding parameters, the effective welding parameters, type of electrode, covering gases, and welding speed are illustrated.

Anand et al.[1] showed that the TIG welding current 120 A and 309L welding filler produced a higher tensile strength and maximum bending force of the welded joints 310 stainless steel. Tabish et al. [2] concluded that the tensile strength of the stainless steel 304 plate TIG joined specimens was higher than the base material, and the use of low heat input resulted in the best tensile strength and hardness results than other. Navid et al.[3] investigated the heat input in the TIG welding process of 316 stainless steel sheet. It was shown that the increase of current tends to increase the amount of heat input in the welding zone, and this leads to the enlargement of depth and width of the welding pool. Hussein et al. [4] used the (RSM) to develop the mathematical model of TIG welding parameters and the output of the joint strength of 304 stainless sheets. It was shown that 50 A current with 1.6 mm welding filler size and low gas flow rate produced finer weld microstructure without crack, and this leads to high tensile strength of joint. Vikarm and Sharma [5] showed that the lower welding speed range of stainless steel 430 joined by TIG welding produced a higher tensile strength as a result to the formation fine dendritic matrix in the weld zone microstructure. Rohit et al. [6] used the voltage, current, gas flow rate, and welding speed as the input parameters of 304 stainless steel sheets joined by TIG welding. It was