Enhancing MIG Weld Bead Geometry in Hot Rolled Carbon Steel Through Response Surface Methods Optimization

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Abstract This study is focused on optimizing the geometry of weld beads in Metal Inert Gas (MIG) butt-welding of hot rolled carbon steel. The quality of welding holds significant sway over the integrity of joints, and various parameters during the welding process can influence this quality. With the advent of computerization and automation, innovative statistical techniques for modelling and optimization have arisen, obviating the need for traditional trial-and-error approaches to achieve desired performance and quality. The research employs experimental methodologies, incorporating critical process parameters like welding current, arc voltage, and welding speed. A central composite design utilizing Response Surface Methodology (RSM) is employed as a statistical approach to experimentally analyse the performance of weld bead geometry. This encompasses aspects such as bead height, bead width, and penetration. The ultimate objective is to establish a mathematical relationship between welding process parameters and output variables. The outcomes derived from these models yield precise predictions of weld bead geometry. By utilizing these mathematical models for specific bead geometries, the influence of process parameters can be estimated. It's evident that variations in parameters have a notable impact on bead height and width, in comparison to the effect on penetration alone.

Keywords Failure · Weld bead geometry · RSM · Optimisation

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