ABSTRAK

PENGARUH KECEPATAN DAN JARAK NOZZLE TERHADAP KEKUATAN BENDING LAS MIG OTOMATIS PADA GERAKAN LENGKUNG

Fadila

(2026: xii + 93 Halaman, 5 Gambar, 11 Tabel, 4 Lampiran)

Penelitian ini bertujuan untuk menganalisis pengaruh variasi kecepatan pengelasan *(travel speed)* dan jarak *nozzle (Contact Tip to Work Distance/CTWD)* terhadap kekuatan bending hasil las *MIG* otomatis pada gerakan lengkung. Material yang digunakan adalah baja karbon rendah ST37 dengan diameter 2 inci dan ketebalan 3,91 mm. Proses pengelasan menggunakan pola gerakan melingkar *(circular motion)* 360° yang dikendalikan menggunakan sistem berbasis *Arduino* dan motor *stepper.* Variasi kecepatan pengelasan yang digunakan adalah 10 mm/s, 15 mm/s, dan 20 mm/s, sedangkan variasi *CTWD* adalah 15 mm, 20 mm, dan 25 mm. Parameter lain seperti arus (110 A), tegangan (20 V), dan sudut torch (75°) dijaga konstan. Pengujian kualitas sambungan las dilakukan menggunakan uji bending dengan *Universal Testing Machine (UTM).* Data dianalisis menggunakan metode Taguchi dengan pendekatan karakteristik kualitas *larger the better.* Hasil penelitian menunjukkan bahwa kecepatan pengelasan merupakan faktor paling dominan dengan kontribusi 56,62%, diikuti *CTWD* dengan kontribusi 25,52%. Kombinasi parameter optimal berdasarkan analisis Taguchi adalah kecepatan 15 mm/s dan *CTWD* 15 mm yang menghasilkan tegangan bending rata-rata 599,73 MPa *dengan S/N Ratio* 55,56 dB. Validasi eksperimen menunjukkan error sebesar 0,43%, yang membuktikan keakuratan metode Taguchi dalam optimasi parameter. Penelitian ini diharapkan menjadi referensi dalam pengembangan proses pengelasan otomatis pada lintasan lengkung di industri manufaktur.

Kata Kunci: *Gas Metal Arc Welding (GMAW), MIG Welding, Welding Speed, Contact Tip to Work Distance (CTWD),* Bending Strength, Taguchi *Method*

ABSTRACT

Analysis of the Effect of Welding Speed Variations and Nozzle Distance on the Bending Strength of Automatic MIG Welding Joints in Curved Motion

Fadila

(202: xii + 93 pp., 5 Figures, 11 Tables, 4 Attachments)

This study aims to analyze the effect of welding speed (travel speed) and Contact Tip to Work Distance (CTWD) on the bending strength of automated MIG welded joints produced along a curved welding path. The material used was ST37 low-carbon steel pipe with a diameter of 2 inches and a wall thickness of 3.91 mm. The welding process employed a 360° circular motion controlled by an Arduino-based system and a stepper motor. The welding speed was varied at 10 mm/s, 15 mm/s, and 20 mm/s, while the CTWD was varied at 15 mm, 20 mm, and 25 mm. Other welding parameters, including welding current (110 A), voltage (20 V), and torch angle (75°), were kept constant throughout the experiment. The quality of the welded joints was evaluated using a bending test conducted with a Universal Testing Machine (UTM). The experimental data were analyzed using the Taguchi method with the larger-the-better quality characteristic. The results indicated that welding speed was the most influential factor, contributing 56.62% to the bending strength, followed by CTWD with a contribution of 25.52%. Based on the Taguchi analysis, the optimal parameter combination was a welding speed of 15 mm/s and a CTWD of 15 mm, resulting in an average bending strength of 599.73 MPa and a Signal-to-Noise (S/N) ratio of 55.56 dB. Experimental validation showed an error of only 0.43%, demonstrating the reliability of the Taguchi method in optimizing welding parameters. The findings of this study are expected to serve as a reference for the development and optimization of automated welding processes along curved welding paths in the manufacturing industry.

Keywords ***Keywords*** : Gas Metal Arc Welding (GMAW), MIG Welding, Welding Speed, Contact Tip to Work Distance (CTWD), Bending Strength, Taguchi Method, Curved Welding Path.