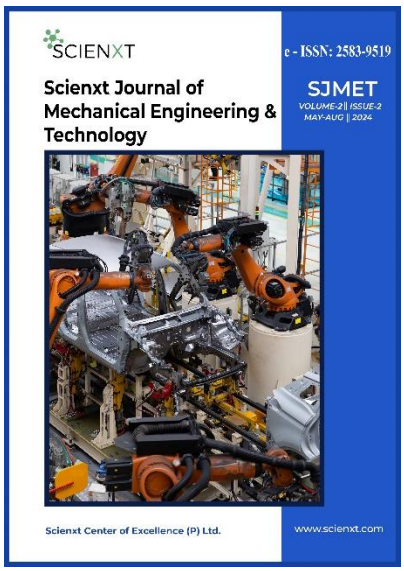

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Using response surface methodology to investigate the effect of TIG welding parameters on the microstructure and corrosion resistance of 2205 DSS welds

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Abstract:

Duplex stainless steel DSS offers high corrosion resistance and mechanical strength due to its alloying elements and equal austenite-ferrite ratio. However, in most DSS applications welding is necessary to join part together. Welding DSS affects microstructure and causes precipitation, leading to poor mechanical properties and corrosion resistance. Therefore, this study examines the impact of TIG welding parameters on the microstructure and corrosion resistance of DSS weldments. The corrosion penetration rate CPR of the DSS weldments was determined via electrochemical impedance technique. The correlation between welding variables and corrosion penetration rate was analyzed using response surface methodology and microstructure analysis. Results showed that statistically the welding current and welding speed had the most significant impact on the corrosion penetration rate. Increasing welding current and decreasing welding speed resulted in higher heat input, which led to the formation of Cr_2N precipitation and subsequently, an increase in corrosion penetration rate. On the other hand, low welding current and high welding speed, which correspond to low heat input, increase weld corrosion rates due to higher ferrite content. Adding a small amount of N_2 to Ar as a shielding gas reduces the corrosion penetration rate. However, if the N_2 amount exceeds 10%, it causes the reappearance of Cr_2N precipitates, increasing the corrosion penetration rate. Based on the response surface methodology, the optimum value of TIG welding parameters is welding current 200 a, welding speed 215 mm/min, and 12% N_2 addition with Ar as shielding gas. These TIG welding setups reduce the corrosion penetration rate to 0.0005 mm/y.

Keywords:

Duplex stainless steel, TIG welding process, N_2 shielding gas, Response surface method, corrosion resistance.