ABSTRAK

ANALISIS PENGARUH *HOLDING TIME POST WELD HEAT TREATMENT* PADA HASIL LAS *FLUX CORED ARC WELDING* BAJA SS400 TERHADAP SIFAT MEKANIS DAN STRUKTUR MIKRO

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Komponen *bogie frame* pada *Light Rail Transit* (LRT) memiliki peran vital dalam menopang seluruh beban *carbody* dan memastikan keamanan selama pengoperasian. Penggunaan baja SS400 yang disambung dengan metode *Flux-Cored Arc Welding* (FCAW) cenderung menghasilkan tegangan sisa tarik yang tinggi, sehingga dapat menurunkan integritas mekanis material, khususnya pada daerah *Heat Affected Zone* (HAZ). Oleh karena itu, penerapan *Post Weld Heat Treatment* (PWHT) berupa *stress relief annealing* sangat diperlukan untuk mereduksi tegangan sisa tersebut dan meningkatkan keuletan material. Penelitian ini bertujuan untuk menganalisis pengaruh variasi *holding time* PWHT terhadap sifat mekanis dan evolusi struktur mikro pada sambungan las FCAW baja SS400. Proses PWHT dilakukan pada suhu konstan 680°C dengan variasi waktu penahanan selama 60, 90, dan 120 menit. Evaluasi dilakukan melalui pengujian tarik untuk menentukan kekuatan mekanis, uji kekerasan *microvickers*, serta pengamatan metalografi menggunakan mikroskop optik. Hasil penelitian menunjukkan bahwa peningkatan *holding time* secara signifikan menurunkan nilai kekuatan tarik (*Ultimate Tensile Strength* dan *Yield Strength*) serta kekerasan, namun meningkatkan keuletan (elongasi) material. Struktur mikro pada daerah HAZ dan *Fusion Line Zone* (FLZ) menunjukkan transformasi fasa *pearlite* menjadi *spheroidite* yang lebih homogen seiring bertambahnya waktu penahanan. Meskipun terjadi penurunan kekuatan, seluruh hasil pengujian tetap memenuhi standar JIS G 3101 dan regulasi keselamatan transportasi nasional yang berlaku. *Holding time* selama 120 menit direkomendasikan sebagai parameter optimal untuk memperoleh kombinasi keuletan dan homogenitas struktur mikro yang sesuai bagi aplikasi komponen *bogie frame.*

Kata kunci: *Annealing*, FCAW, *Holding time,* PWHT, SS400

ABSTRACT

ANALYSIS OF THE EFFECT OF POST WELD HEAT TREATMENT HOLDING TIME ON THE MECHANICAL PROPERTIES AND MICROSTRUCTURE OF SS400 STEEL FLUX CORED ARC WELDING RESULTS

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The bogie frame component of the Light Rail Transit (LRT) plays a vital role in supporting the entire carbody load and ensuring safety during operation. The use of SS400 steel joined by the Flux-Cored Arc Welding (FCAW) method tends to generate high residual tensile stresses, which can reduce the mechanical integrity of the material, especially in the Heat Affected Zone (HAZ). Therefore, the application of Post-Weld Heat Treatment (PWHT) in the form of stress relief annealing is essential to reduce these residual stresses and improve material ductility. This study aims to analyze the effect of PWHT holding time variations on the mechanical properties and microstructural evolution of SS400 steel FCAW weld joints. The PWHT process was conducted at a constant temperature of 680°C with holding time variations of 60, 90, and 120 minutes. Evaluation was carried out through tensile testing to determine mechanical strength, microvickers hardness testing, and metallographic observation using an optical microscope. The results showed that increasing the holding time significantly decreased the tensile strength (Ultimate Tensile Strength and Yield Strength) and hardness while increasing the ductility (elongation) of the material. The microstructure in the HAZ and Fusion Line Zone (FLZ) showed a more homogeneous transformation of the pearlite phase into spheroidite as the holding time increased. Despite the decrease in strength, all test results still met the JIS G 3101 standards and applicable national transportation safety regulations. A holding time of 120 minutes is recommended as the optimal parameter to achieve the combination of ductility and microstructural homogeneity required for bogie frame component applications.

Keywords: Annealing, FCAW, Holding time, PWHT, SS400