ANALISIS PENGARUH VARIASI BESARAN ARUS PENGELASAN TERHADAP HASIL UJI MEKANIK *POST WELD HEAT TREATMENT* BAJA KARBON RENDAH

Abstrak

Struktur gerbong kereta api cepat menuntut sambungan las yang memiliki integritas tinggi untuk menjamin keselamatan dan ketahanan dalam kondisi operasional berfrekuensi tinggi. Proses pengelasan pada baja karbon rendah, yang umum digunakan dalam pembuatan gerbong, berpotensi menimbulkan perubahan mikrostruktur dan tegangan sisa yang dapat menurunkan sifat mekanik material. Untuk mengatasi hal tersebut, penelitian ini bertujuan mengevaluasi pengaruh variasi arus pengelasan terhadap karakteristik mekanik baja karbon rendah setelah perlakuan panas pasca-pengelasan (*Post Weld Heat Treatment/PWHT*) menggunakan metode *Quenching–Partitioning–Tempering* (Q–P–T). Penelitian dilakukan dengan memvariasikan arus pengelasan pada 100 A, 110 A, dan 120 A menggunakan metode *Shielded Metal Arc Welding* (SMAW). Pengujian meliputi uji tarik, uji kekerasan Vickers, serta pengamatan mikrostruktur pada daerah *base metal, heat-affected* zone (*HAZ*), dan *weld metal*. Hasil menunjukkan bahwa peningkatan arus berpengaruh terhadap kekerasan dan kekuatan tarik. Arus 120 A memberikan nilai kekerasan tertinggi sebesar 177,4 VHN, sedangkan arus 100 A menghasilkan kombinasi sifat mekanik paling optimal dengan kekuatan tarik 159 N/mm², *elongasi* 14%, dan nilai *Product of Strength and Elongation* (PSE) sebesar 7,1 kN/mm² %.Pengamatan mikrostruktur menunjukkan perbaikan distribusi fasa *ferit* dan *perlit* yang lebih homogen pasca PWHT. Keseluruhan hasil menunjukkan bahwa variasi arus pengelasan mempengaruhi sifat mekanik dan stabilitas struktur mikro material. Temuan ini penting dalam menentukan parameter pengelasan yang tepat guna meningkatkan kualitas sambungan dan ketahanan struktural gerbong kereta cepat.

Kata Kunci: Gerbong kereta cepat, PWHT, baja karbon rendah, arus pengelasan, sifat mekanik, mikrostruktur.

ANALYSIS OF THE EFFECT OF WELDING CURRENT VARIATIONS ON THE MECHANICAL TEST RESULTS OF POST WELD HEAT TREATMENT LOW CARBON STEEL

Abstract

The structure of high-speed train carriages requires welded joints with high integrity to ensure safety and durability under high-frequency operational conditions. The welding process on low carbon steel, which is commonly used in carriage construction, has the potential to cause microstructural changes and residual stresses that can degrade the material's mechanical properties. To address this issue, this study aims to evaluate the effect of welding current variation on the mechanical characteristics of low carbon steel after Post Weld Heat Treatment (PWHT) using the Quenching–Partitioning–Tempering (Q–P–T) method. The research was conducted by varying the welding current at 100 A, 110 A, and 120 A using the Shielded Metal Arc Welding (SMAW) method. Testing included tensile testing, Vickers hardness testing, and microstructural observation in the base metal, heat-affected zone (HAZ), and weld metal regions. The results showed that increasing the welding current affected the hardness and tensile strength. The 120 A current produced the highest hardness value of 177.4 VHN, while the 100 A current yielded the most optimal combination of mechanical properties with a tensile strength of 159 N/mm², elongation of 14%, and a Product of Strength and Elongation (PSE) of 7.1 kN/mm²%. Microstructural observations revealed improved and more homogeneous distribution of ferrite and pearlite phases after PWHT. Overall, the findings indicate that variations in welding current significantly influence the mechanical properties and microstructural stability of the material. These results are crucial in determining appropriate welding parameters to enhance joint quality and structural durability of high-speed train carriages.

Keywords*: High-speed train carriage, PWHT, low carbon steel, welding current, mechanical properties, microstructure.*