Pengaruh masukan panas, tebal pelat, dan perlakuan pengelasan terhadap tegangan sisa dan sifat mekanik hasil las mag pada pelat sm490 = Effect of heat input, plate thickness, and welding treatment on residual stress and mechanical properties of mag welding results on sm490 plates

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Abstrak

Alat berat membutuhkan kualitas dan kehandalan yang tinggi untuk menunjang produktivitas dan kepuasan pelanggan. Konstruksi utama rangka pada alat berat terbuat dari material baja pelat dan coran yang disambungkan melalui proses pengelasan Gas Metal Arc Welding (GMAW). Kondisi saat ini, produsen belum melihat tegangan sisa dari proses manufaktur sebagai pertimbangan khusus terhadap kualitas produk. Pada penelitian ini, pelat baja SM490 berukuran 200x100 mm disambungkan dengan pengelasan robot GMAW secara butt joint single V 45. Kawat las AWS A5.18-05 ER70S-G berdiameter 1,4 mm digunakan dengan polaritas DCEP bersama gas pelindung CO. Masukan panas, tebal spesimen, dan perlakuan pengelasan divariasikan untuk mengetahui efeknya terhadap tegangan sisa dan sifat mekanik yang dihasilkan. Tegangan sisa diukur tanpa merusak menggunakan mesin portabel berbasis X-Ray Diffraction (XRD). Nilai kekerasan diuji dengan mesin uji keras Microvickers, kekuatan tarik diuji dengan mesin Universal Testing Machine (UTM), serta struktur mikro diamati dengan mikroskop optik strereo dan Electron Probe Micro Analyzer (EPMA). Hasil pengujian menunjukkan kenaikan masukan panas sebesar 350 J menit meningkatkan tegangan sebesar 50-90 MPa pada arah x. Peningkatan ketebalan hingga 30 mm, tidak memberikan perbedaan tegangan sisa yang signifikan. Namun, tebal 40 mm, tegangan sisa justru turun 250 MPa. Ketebalan spesimen hingga 40 mm memberikan penurunan tegangan sisa arah y hingga 400 MPa. Proses gerinda memberikan tegangan sisa tarik hingga 800 MPa lebih tinggi dari tegangan sisa spesimen 2 (tanpa perlakuan). Penambahan preheat dan postheat 150oC tidak memberikan efek terhadap tegangan sisa. Proses gerinda menurunkan tegangan sisa hingga 480 MPa. Hanya jet chisel yang konsisten memberikan tegangan sisa kompresi hingga 480 MPa pada arah x dan y. Kenaikan masukan panas hingga 350 J menit menyebabkan nilai kekerasan HAZ dan logam las turun hingga 50 HB. Ketebalan spesimen hingga 30 mm, cenderung meningkatkan kekerasan hingga 30 HB. Perlakuan preheat dan postheat mengurangi nilai kekerasan hingga 10 HB. Kebalikan dari itu, perlakuan jet chisel mampu meningkatkan kekerasan hingga 12 HB, terutama pada kampuh las. Berbagai variasi masukan panas, ketebalan, dan perlakuan pengelasan tidak memberikan perbedaan yang signifikan kekuatan tarik. Peningkatan ketebalan hingga 40 mm cenderung menurunkan kekuatan hingga 70 MPa. Perlakuan jet chisel memberikan tegangan sisa dan sifat mekanik paling optimal di antara preheat, postheat, dan gerinda.
<hr><i>Heavy equipment requires high quality and reliability to support productivity and customer satisfaction. The main frame construction on the machine is made of steel plate and castings which are connected through the Gas Metal Arc Welding (GMAW) process. Current conditions, manufacturers have not seen the residual stress from the manufacturing process as a special consideration to product quality. In this study, a 200x100 mm SM490 steel plate was connected by GMAW robots welding with a single V 45 butt joint. AWS A5.18-05 ER70S-G welding wire 1.4 mm in diameter is used with DCEP polarity and CO2

protective gas. Heat input, specimen thickness, and welding treatment are varied to determine their effect on residual stresses and mechanical properties. Residual stress is measured using a non destructive portable machine based on X-Ray Diffraction (XRD). Hardness values were tested with Microvickers Hardness Tester, tensile strengths with Universal Testing Machine (UTM), and microstructure was observed with optical strereomicroscope and Electron Probe Micro Analyzer (EPMA). The test results show an increase in heat input of 350 J / min increases the stress by 50-90 MPa in the x direction. Increased thickness up to 30 mm, does not provide a significant residual stress difference. However, 40 mm thick, the residual stress would drop 250 MPa. Specimen thicknesses of up to 40 mm provide a reduction in the residual stress in the y direction up to 400 MPa. The grinding process provides tensile residual stresses of up to 800 MPa higher than specimen 2 residual stress (without treatment). The addition of preheat and postheat 150oC had no effect on residual stress. The grinding process reduces the residual stress to 480 MPa. Only jets chisel that consistently provide compression residual stresses of up to 480 MPa in the x and y directions. Increase in heat input up to 350 J/min causes the HAZ hardness value and weld metal to decrease to 50 HB. Specimen thickness up to 30 mm, tends to increase hardness up to 30 HB. The preheat and postheat treatments reduce the value of hardness to 10 HB. In contrast, jet chisel treatment can increase the hardness to 12 HB, especially in weld joints. Various variations in heat input, thickness, and welding treatment do not provide a significant difference in tensile strength. Increasing thickness up to 40 mm tends to reduce strength up to 70 MPa. Jet chisel treatment provides the most optimal residual stress and mechanical properties between preheat, postheat and grinding.</i>