Pengaruh Geometri Tools Proses Friction Stir Welding (FSW) Terhadap Kekuatan Tarik, Struktur Makro Dan Kekerasan Pada Sambungan Butt Joint AA7075 = The Influence of Tool Geometry in the Friction Stir Welding (FSW) Proses on Tensile Strength, Macro Structure, and Hardness of AA7075 Butt Joints

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Abstrak

Friction Stir Welding (FSW) merupakan teknologi pengelasan solid-state yang menggunakan prinsip gesekan tanpa mencairkan material, sehingga lebih hemat energi dan ramah lingkungan karena tidak memerlukan consumable part. Teknologi ini memiliki potensi besar dalam industri transportasi seperti otomotif dan dirgantara karena efisiensi dan hemat energinya. Namun, tantangan utama FSW adalah cacat pengelasan seperti tunnel defect, yaitu rongga yang terbentuk dalam sambungan akibat parameter atau geometri tool yang tidak sesuai. Penelitian ini bertujuan menganalisis pengaruh variasi kecepatan translasi (traverse speed) dan geometri tool terhadap kualitas sambungan pada material aluminium AA7075 dengan ketebalan 6 mm khususnya untuk mengurangi tunnel defect. Kecepatan putar dijaga konstan pada 1400 RPM, dengan kecepatan translasi 10, 12, dan 15 mm/min, serta tiga geometri tool berbeda pada shoulder end surface: rata, cekung, dan cembung. Setelah pengelasan, dilakukan pengujian tensile strength sebanyak 5 kali repetisi, uji kekerasan, dan analisis struktur makro. Hasil penelitian berhasil menunjukkan bahwa geometri tool memengaruhi terjadinya tunnel defect. Tool dengan shoulder cekung menghasilkan ukuran tunnel defect paling kecil dibandingkan tool rata, sementara tool rata menghasilkan tunnel defect lebih kecil dibandingkan tool cembung. Tool cekung juga memberikan nilai Ultimate Tensile Strength (UTS) tertinggi, menunjukkan efektivitasnya dalam meningkatkan kualitas sambungan.

.....Friction Stir Welding (FSW) is a solid-state welding technology that operates based on the principle of friction without melting the material, thereby offering greater energy efficiency and environmental sustainability due to the absence of consumable parts. This technology holds significant potential in transportation industries such as automotive and aerospace, owing to its efficiency and energy-saving characteristics. However, one of the primary challenges associated with FSW is the occurrence of welding defects, particularly tunnel defects, which are voids formed within the weld due to inappropriate parameters or tool geometry. This research aims to examine the influence of traverse speed variations and tool geometry on the weld quality of AA7075 aluminum with a thickness of 6 mm, focusing specifically on mitigating tunnel defects. The rotational speed was maintained constant at 1400 RPM, with traverse speeds set at 10, 12, and 15 mm/min, and three different tool geometries for the shoulder end surface: flat, concave, and convex. Post welding evaluations included tensile strength testing conducted in five repetitions, hardness testing, and macrostructure analysis. The findings indicate that tool geometry has a substantial impact on the occurrence of tunnel defects. The concave shoulder tool produced the smallest tunnel defects compared to the flat tool, while the flat tool yielded smaller defects than the convex tool. Furthermore, the concave shoulder tool demonstrated the highest Ultimate Tensile Strength (UTS), underscoring its effectiveness in enhancing weld quality.