INTISARI

Meningkatnya persaingan internasional dan kompleksitas manufaktur industri mendorong penggunaan teknik manufaktur tambahan seperti *Fused Deposition Modeling* (FDM), dengan material ABS. Teknik ini menawarkan fleksibilitas dan efisiensi, namun menghadapi tantangan seperti kekuatan mekanis rendah, ketidakakuratan dimensi, dan volume pembuatan terbatas. *Rotary Friction Welding* (RFW) digunakan untuk menggabungkan komponen polimer, termasuk ABS yang dicetak 3D, untuk mengatasi tantangan ini. Penelitian ini meneliti kekuatan tarik dari sambungan hasil RFW pada ABS yang difabrikasi dengan FDM.

Penelitian dilakukan menggunakan alat seperti mesin FDM 3D Print Flashforge Creator Pro, mesin CNC TU-2A, Universal Testing Machine. Bahan yang digunakan adalah filamen *Acrylonitrile Butadiene Styrene* (ABS) untuk mencetak spesimen uji dan ABS bulk sebagai pembanding. Metode penelitian meliputi desain spesimen, pencetakan 3D, proses friction welding dengan mesin CNC, dan pengujian kekuatan tarik.

Uji tarik dilakukan pada lima spesimen dengan variasi kecepatan putar 1.750 RPM, 2.000 RPM, dan 2.250 RPM. Hasil menunjukkan perbedaan rata-rata UTS antara spesimen FDM dan bulk. Struktur makro mengungkapkan pola patahan, craze, dan mikrovoid pada spesimen FDM yang dipengaruhi kecepatan putar. Temperatur pengelasan juga berperan, dengan rata-rata temperatur spesimen FDM lebih rendah dibandingkan bulk. Analisis ANOVA menunjukkan bahwa variasi kecepatan rotasi tidak memiliki pengaruh signifikan terhadap kekuatan tarik baik pada spesimen FDM maupun bulk ABS.

Kata Kunci : *Rotary Friction Welding*, kecepatan rotasi, kekuatan tarik, *Acrylonitrile butadiene styrene*, *Fused Deposition Modeling*, struktur makro

ABSTRACT

The increase in international competition and industrial manufacturing complexity has led to the use of additive manufacturing techniques such as Fused Deposition Modeling (FDM) with ABS material. This technique offers flexibility and efficiency but faces challenges such as low mechanical strength, dimensional inaccuracies, and limited production volumes. Rotary Friction Welding (RFW) is used to join polymer components, including 3D-printed ABS, to overcome these challenges. This research examines the tensile strength of RFW joints on ABS fabricated with FDM.

The research was conducted using tools such as an FDM 3D Print Flashforge machine, a CNC TU-2A machine, and a Universal Testing Machine. The materials used include Acrylonitrile Butadiene Styrene (ABS) filament for printing test specimens and bulk ABS for comparison. The research methods include specimen design, 3D printing, friction welding processes using CNC machines, and tensile strength testing.

Tensile tests were conducted on five specimens with rotational speed variations of 1,750 RPM, 2,000 RPM, and 2,250 RPM. Results showed average differences in tensile strength between FDM and bulk specimens. Macro structures revealed fracture patterns, craze, and microvoids in FDM specimens influenced by rotational speed. Welding temperature also played a role, with the average temperature of FDM specimens being lower compared to bulk at each rotational speed. The ANOVA analysis indicates that the variation in rotational speed does not have a significant influence on the tensile strength, both in FDM specimens and bulk ABS.

Keywords : *Rotary Friction Welding, rotational speed, tensile strength, Acrylonitrile butadiene styrene, Fused Deposition Modeling, macro structure*