ANALISIS KEKUATAN TARIK HASIL 3D PRINTING DENGAN MATERIAL *NYLON* (PA6 + CF) TERHADAP *INFILL PATTERN* DAN *INFILL DENSITY*

Imaduddin Aulia Lasmana

ABSTRAK

Additive Manufacturing (AM) atau 3D printing telah menjadi teknologi penting dalam industri otomotif karena mampu mencetak komponen kompleks dengan bobot ringan dan kekuatan tinggi. Salah satu material yang menjanjikan adalah *Nylon* 6 yang diperkuat serat karbon (PA6 + CF), karena kombinasi kekuatan mekanis dan ketahanan termalnya. Namun, performa material ini sangat dipengaruhi oleh parameter pencetakan, khususnya *infill pattern* dan *infill density*. Penelitian ini bertujuan menganalisis pengaruh pola isian (*Concentric*, *Gyroid*, *Honeycomb*) dan kerapatan isian (25%, 50%, 75%) terhadap kekuatan tarik spesimen hasil cetak 3D berbahan PA6 + CF20%. Sebanyak 27 spesimen dicetak menggunakan 3D Printer Bambulab P1S dan diuji tarik berdasarkan standar ASTM D638 Tipe I dengan kecepatan pengujian 5 mm/menit. Data dianalisis menggunakan metode Representatif Sampel dan Taguchi dengan pendekatan *Signal to Noise Ratio* (SNR) *Larger-The-Better*. Hasil uji tarik menunjukkan bahwa pola *infill* dan tingkat densitas isian berpengaruh signifikan terhadap nilai *Ultimate Tensile Strength* (UTS). Kombinasi terbaik diperoleh pada pola *Concentric* dengan densitas 75%, menghasilkan nilai UTS tertinggi sebesar 46,19 MPa. Sebaliknya, nilai UTS terendah tercatat pada pola *Gyroid* dengan densitas 25%. Peningkatan *infill density* memperbesar volume material yang dicetak, sehingga memperkuat struktur internal spesimen. Sementara itu, pola *Concentric* menunjukkan distribusi tegangan yang lebih merata, menghasilkan spesimen dengan kekuatan tarik yang lebih baik.

Kata kunci: *3D Printing*, PA6 + CF, *Infill Pattern*, *Infill Density*, Uji Tarik, Taguchi, SNR

ANALYSIS OF TENSILE STRENGTH IN 3D-PRINTED NYLON (PA6+CF) BASED ON INFILL PATTERN AND INFILL DENSITY

Imaduddin Aulia Lasmana

ABSTRACT

Additive Manufacturing (AM) or 3D printing has become a vital technology in the automotive industry due to its ability to produce complex components with lightweight and high strength. One of the promising materials is carbon fiber-reinforced Nylon 6 (PA6 + CF), owing to its mechanical strength and thermal resistance. However, its performance is highly influenced by printing parameters, especially infill pattern and infill density. This study aims to analyze the effect of infill patterns (Concentric, Gyroid, Honeycomb) and infill densities (25%, 50%, 75%) on the tensile strength of 3D printed specimens using PA6 + CF20%. A total of 27 specimens were printed using the Bambulab P1S printer and tested following ASTM D638 Type I standard at a speed of 5 mm/min. Data analysis was performed using the Representative Sample Method and Taguchi method with the Larger-The-Better Signal to Noise Ratio (SNR) approach. Tensile test results indicated that both infill pattern and density significantly affect the Ultimate Tensile Strength (UTS). The best result was obtained from the Concentric pattern with 75% density, yielding the highest UTS value of 46.19 MPa. In contrast, the lowest UTS was recorded for the Gyroid pattern with 25% density. Higher infill density increases the material volume inside the specimen, enhancing its internal strength. Additionally, the Concentric pattern provides better stress distribution, leading to superior tensile performance.

Keywords: *3D Printing, PA6 + CF, Infill Pattern, Infill Density, Tensile Strength, Taguchi, SNR*