

ABSTRAK

PENGARUH TEMPERATUR DAN DIAMETER *NOZZLE* DENGAN MATERIAL PLA (*POLYLACTIC ACID*) TERHADAP KEKUATAN TARIK *FILAMENT* PADA MESIN *EXTRUDER FILAMENT*

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(2026: xv + 52 Halaman, 19 Gambar, 6 Tabel, 7 Lampiran)

Teknologi pencetakan 3D *Fused Deposition Modeling* (FDM) semakin banyak digunakan dalam industri manufaktur, yang menyebabkan meningkatnya permintaan akan filamen berkualitas tinggi. Kualitas filamen yang dihasilkan oleh ekstruder dipengaruhi oleh berbagai parameter proses, khususnya suhu ekstrusi dan diameter *nozzle*. Tujuan penelitian ini adalah untuk menentukan pengaruh variasi suhu dan diameter nosel terhadap kekuatan tarik filamen asam polilaktat (PLA) dan untuk menganalisis apakah terdapat interaksi yang signifikan antara kedua variabel tersebut. Penelitian ini dilakukan menggunakan ekstruder filamen pencetakan 3D dengan tiga variasi suhu (140 °C, 145 °C, dan 147 °C) dan tiga variasi diameter nosel (1,8 mm, 1,9 mm, dan 2,0 mm). Kecepatan *screw* diatur pada 10 rpm. Setiap kombinasi parameter diuji dengan tiga sampel (a, b, c), sehingga menghasilkan total 27 pengukuran. Pengukuran kekuatan tarik dilakukan secara manual menggunakan timbangan pegas digital, dan data dianalisis menggunakan analisis varians dua arah (ANOVA). Hasil menunjukkan bahwa suhu secara signifikan memengaruhi kekuatan tarik filamen PLA ($p = 0,001$; $F = 31,979$). Namun, variasi diameter *nozzle* memiliki pengaruh yang signifikan ($p = 0,001$; $F > 0,05$), demikian pula interaksi antara keduanya ($p = 0,001$; $F > 0,05$). Kekuatan tarik tertinggi, 21,95 MPa, diperoleh pada suhu 140 °C dan diameter *nozzle* 2 mm, sedangkan nilai terendah, 17,87 MPa, tercatat pada suhu 147 °C dan diameter *nozzle* 1,8 mm. Nilai R^2 sebesar 0,763 menunjukkan bahwa 76,3% variasi kekuatan tarik dapat dijelaskan oleh kedua faktor yang diteliti.

Kata Kunci : ANOVA, Diameter *Nozzle*, Kekuatan Tarik , PLA, Suhu.

ABSTRACT

THE EFFECT OF TEMPERATURE AND NOZZLE DIAMETER WITH PLA (*POLYLACTIC ACID*) MATERIAL ON FILAMENT TENSILE STRENGTH IN A FILAMENT EXTRUDER MACHINE

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Fused deposition modeling (FDM) 3D printing technology is increasingly used in the manufacturing industry, leading to a growing demand for high-quality filament. The quality of filament produced by an extruder is influenced by various process parameters, particularly extrusion temperature and nozzle diameter. The aim of this study was to determine the influence of temperature and nozzle diameter variations on the tensile strength of polylactic acid (PLA) filaments and to analyze whether there is a significant interaction between these two variables. The research was conducted using a 3D printing filament extruder with three temperature variations (140 °C, 145 °C, and 147 °C) and three nozzle diameter variations (1.8 mm, 1.9 mm, and 2.0 mm). The screw speed was set to 10 rpm. Each parameter combination was tested with three samples (a, b, c), resulting in a total of 27 measurements. Tensile strength measurements were performed manually using a digital spring scale, and the data were analyzed using a two-way analysis of variance (ANOVA). The results showed that temperature fluctuations significantly influenced the tensile strength of the PLA filaments ($p = 0.001$; $F = 31.979$). However, variations in nozzle diameter did not have a significant influence ($p = 0.001$; $F > 0.05$), nor did the interaction between the two ($p = 0.001$; $F > 0.05$). The highest tensile strength, 21,95 MPa, was obtained at a temperature of 140 °C and a nozzle diameter of 2 mm, while the lowest value, 17,87 MPa, was recorded at a temperature of 147 °C and a nozzle diameter of 1,8 mm. The R^2 value of 0.763 indicates that 76,3% of the variation in tensile strength can be explained by the two factors studied.

Keyword : ANOVA, Nozzle Diameter, PLA, Temperature, Tensile Strength,