ABSTRAK

Pengaruh Media Pendinginan *Filament* Terhadap Dimensi *Filament* Pada Proses Ekstrusi

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(2026 : xiv + 39 Halaman, 5 Gambar, 5 Tabel, 6 Lampiran)

Filament merupakan bahan baku utama dalam proses pencetakan tiga dimensi menggunakan metode *Fused Deposition Modeling* (FDM), sehingga kestabilan diameter *filament* menjadi faktor penting dalam menentukan kualitas hasil cetakan. Diameter *filament* yang dihasilkan pada proses ekstrusi sangat dipengaruhi oleh sistem pendinginan, namun banyak mesin *extruder* sederhana belum dilengkapi sistem pendinginan yang optimal sehingga menghasilkan *filament* dengan diameter yang tidak konsisten. Penelitian ini bertujuan untuk mengetahui pengaruh variasi media pendingin terhadap diameter *filament* PLA yang dihasilkan mesin *extruder* serta menentukan media pendingin yang paling optimal dalam menghasilkan *filament* yang stabil. Penelitian menggunakan metode eksperimen kuantitatif dengan rancangan *controlled experimental design*, di mana suhu pemanas dan diameter *nozzle* dijaga konstan, sementara media pendingin divariasikan menjadi air es bersuhu 5,5°C, air biasa bersuhu 28,5°C, dan air garam bersuhu 28,5°C. Pengukuran diameter *filament* dilakukan menggunakan jangka sorong digital pada beberapa titik sepanjang *filament*, kemudian data dianalisis menggunakan statistik deskriptif dan uji *One-Way Analysis of Variance* (ANOVA). Hasil penelitian menunjukkan bahwa media pendingin berpengaruh signifikan terhadap diameter *filament*, dengan nilai F hitung sebesar 10,953 yang melampaui F kritis 3,220 dan *P-value* sebesar 0,000149 (< 0,05), sehingga hipotesis nol ditolak. Air es menghasilkan diameter rata-rata terbesar yaitu 1,74 mm dengan deviasi standar terkecil 0,021 mm, sehingga paling mendekati standar diameter *filament* FDM sebesar 1,75 mm. Sementara itu, air biasa dan air garam menghasilkan diameter rata-rata 1,635 mm dan 1,669 mm dengan deviasi yang lebih besar. Pendinginan tanpa bak pendingin atau menggunakan kipas angin menghasilkan ukuran paling tidak stabil dengan rata-rata diameter hanya 1,41 mm. Berdasarkan hasil tersebut, air es direkomendasikan sebagai media pendingin paling optimal untuk menghasilkan *filament* PLA dengan dimensi yang stabil dan seragam pada proses ekstrusi.

Kata kunci: diameter *filament*, ektrusi, *filament* PLA, media pendingin, *One-Way ANOVA*.

ABSTRACT

The Effect of Filament Cooling Media on Filament Dimensions in the Extrusion Process

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Filament is the primary raw material in three-dimensional printing using the *Fused Deposition Modeling* (FDM) method, making the dimensional stability of the *filament* a critical factor in determining print quality. *Filament* diameter produced through the extrusion process is strongly influenced by the cooling system; however, many simple *extruders* lack an optimal cooling system, resulting in inconsistent *filament* diameters. This study aims to determine the effect of cooling medium variation on the diameter of PLA *filament* produced by an *extruder* machine and to identify the most optimal cooling medium for producing stable *filament*. The research employed a quantitative experimental method with a *controlled experimental design*, in which the heating temperature and *nozzle* diameter were kept constant while the cooling medium was varied into ice water at 5.5°C, plain water at 28.5°C, and salt water at 28.5°C. *Filament* diameter was measured using a digital caliper at several points along the *filament*, and the data were analyzed using descriptive statistics and a *One-Way Analysis of Variance* (ANOVA) test. The results showed that the cooling medium had a significant effect on *filament* diameter, with an F value of 10.953 exceeding the critical F value of 3.220 and a *P-value* of 0.000149 (less than 0.05), leading to rejection of the null hypothesis. Ice water produced the largest average diameter of 1.74 mm with the smallest standard deviation of 0.021 mm, closest to the FDM *filament* standard of 1.75 mm. Plain water and salt water produced average diameters of 1.635 mm and 1.669 mm, with greater deviation. Cooling without a cooling bath, using only a fan, produced the most unstable result, with an average diameter of only 1.41 mm. Based on these results, ice water is recommended as the most optimal cooling medium for producing PLA *filament* with stable and uniform dimensions during the extrusion process.

Keywords: cooling medium, exturison, *filament* PLA, *filament* diameter, *One-Way ANOVA*.