Development of Bio-Based PLA/NR Blends and DIY Mini-Extruder for Fabrication of 3D Printing Filaments

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3D printing is an innovative technique that is applicable to many fields. Biodegradable polylactic acid (PLA) is widely used as a filament in 3D printing, but its properties, such as its high brittleness, poor crystallization, and cost, make it unsuitable for making commercial products. Herein, our project studies ways to minimize the cost of 3D printing filament as well as ways to improve the toughness of PLA. We made “do it yourself” (DIY) filaments containing PLA and natural rubber (NR). The PLA:NR blends featured proportions by weight of 90:10, 85:15, and 80:20. PLA/NR blends were extruded using the mini-extruder, which was designed and assembled by our team to produce filament (1.75 mm in diameter). The optimum conditions were 145°C, 50 rpm, and 38 rpm for die temperature, screw speed, and feed motor speed, respectively. From characterizations, SEM images show that the NR phase was dispersed in PLA as an immiscible characteristic. For mechanical properties, tensile strength increased with increasing NR content. The 3D-printed prototype sample was fabricated using the obtained PLA/NR filaments in a fused deposition modeling (FDM) 3D Printer. Future plans include using maleic anhydride (MA) and dicumyl peroxide (DCP) to enhance the compatibility of NR in the PLA matrix, which may improve the tensile toughness of PLA/NR filaments.

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