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STUDY ON THE UTILIZATION OF POLYLACTIC ACID AS AN ENVIRONMENTALLY SUSTAINABLE MATERIAL IN GEAR MANUFACTURING

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Abstract

Considering the environmental footprint associated with gears made of plastic material, research is directed towards the identification of alternative materials that are characterized by a low long-term impact on the environment. One of these materials is represented by PLA(Polylactic Acid). The use of PLA to make gears through 3D printing represents a very good alternative from an environmental point of view, but the mechanical aspects need to be researched. In this context, the paper conducts an empirical inquiry into the potential of traditional Fused Deposition Modeling (FDM) 3D printing technology to produce PLA gears that adhere to established quality benchmarks for plastic gear components. The effect of printing layer height was evaluated by analyzing four gears 3D printed from PLA using the FDM process, with layer heights of 0.1 mm (PLA01), 0.2 mm (PLA02), 0.3 mm (PLA03), and 0.4 mm (PLA04). Subsequently, the gears underwent testing for resistance to abrasive wear using a mechatronic testing platform. The precision evaluation of the PLA wheels was carried out on the FRENCO ZWP 06 system. PLA01, PLA02 and PLA03 meet precision class 12 per DIN ISO 1328-1:2018-03. In contrast, PLA04 shows geometric deviations beyond industrial tolerances, likely due to exceeding the printer's capability. The wear evaluation was carried out with the ATOS CORE 135 3D scanner. The results point to a non-linear relationship between layer height and wear behavior, with PLA01 standing out as the best-performing sample. The conclusions validate PLA gears as a viable alternative to conventional plastic gears for specific applications. Combined with the aspects related to the minimal long-term impact of PLA on the environment, the transition becomes a necessity for specific applications. The studies remain open regarding the limitations regarding the operating conditions of the PLA gears 3D printed through FDM.

Key words: 3D printed gear, abrasive wear, biodegradable gears, environmental impact, FDM technology

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