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INVESTIGATION OF THE GRAVITATIONAL INFLUENCE ON THE IMPREGNABILITY OF FIBER-THERMOPLASTICS

Abstract

An ongoing area of research is the in-situ production of fiber composites through extrusion-based additive manufacturing, which facilitates sustainable and rapid production of customizable, net-shaped sub-assemblies. Incorporation of continuous fibers in composites enables the production of materials with improved properties, such as increased specific tensile strength and added multifunctionality. Although process and material efficient, this coextrusion approach is highly susceptible to void formation at the fiber-matrix interface. This is disadvantageous as it compromises the enriched material properties through fiber reinforcement. Molten thermoplastic exhibits the behavior of a non-Newtonian fluid, changing wettability under varying gravitational conditions. Therefore, manufacturing under microgravity could result in a different void fraction. To achieve prolonged microgravity conditions, a REXUS sounding rocket is utilized. The objective of the Carbon REinforced Additive manufacturing Technology Experiment (CREATE) is to improve the understanding of the influence of gravity on fiber-matrix impregnation in additive manufacturing of fiber composites. In the evaluation, the samples are examined microscopically and material properties such as tensile strength and electric conductivity are measured. A comparison with samples produced on Earth will show the gravitational influence on the interfacial behavior. The

investigated material combination is a polylactic acid (PLA) matrix reinforced with endless carbon fibers. These were selected due to availability, modularity, and comparability reasons. Furthermore, PLA has a lower melting point than PETG or PEEK, thus less energy is required to melt the filament. CREATE will perform fundamental research in the field of fiber-reinforced additive manufacturing, while simultaneously improving composite manufacturing technologies for terrestrial applications.