Recycling Polymers for Use in Additive Manufacturing Through Screw-Based Extrusion

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Only nine percent of polymers are recycled globally resulting in economic losses of $120 billion and environmental damages exceeding $40 billion annually. Unfortunately, these methods are rarely implemented in areas with a high density of polymer waste and recycling is often unattainable due to the high cost of machines needed to recycle plastics. My goal is to enable any community to reuse and prevent plastics from getting shipped overseas to developing countries, dumped in landfills, or illegally dumped in the ocean. This extruder uses shredded polymer waste, specifically poly(lactic acid) (PLA) and polypropylene (PP), to create a filament for use in Fused Deposition Modeling (FDM) additive manufacturing. To create a machine that allows for rapid prototyping and easy repairability while recycling polymer waste, my research combines the process of screw-based injection molding with an FDM 3D printer. Research proved that the utilization of screw-based additive manufacturing in the recycling of high crystallinity polymers, specifically High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), and PP, is more affordable than traditional recycling with total costs being reduced to under $2000. Constant revision of this prototype provided optimal print conditions for polypropylene and emphasized the potential for screw-based additive manufacturing as a viable solution to affordably mitigate polymer waste and degradation. This project further aims to optimize the print quality and reduce warping when constructing models through the utilization of this process.

Awards Won: