Reclaimed Consumer Waste and Additive Manufacturing: The Perfect Blend

Bobbitt, Daniel (School: Niceville High School)

The goal of my project was to develop a polymer blend that would allow the consumer waste stream to be used as an additive manufacturing feedstock. I designed my experiment to determine if adding various ratios of maleic anhydride-graft-polypropylene(MAgPP) as a compatibilizer in a polymer blend of poly(ethylene terephthalate)(PET) and polypropylene(PP) creates a printable filament for extrusion additive manufacturing, commonly known as 3D printing. PET and PP are primarily used in the lightweight packaging of mass-produced foods and beverages. I hypothesized that increasing the compatibilizer would increase the mechanical strength of the extruded parts, but decrease their print quality. I tested three novel blends with 0%, 5%, and 10% compatibilizer. To determine print and filament production parameters, I conducted thermal analysis of the blends by running Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC), and Rheology tests. After manufacturing my filament, I conducted mechanical analysis of the printed parts. This consisted of ultimate tensile strength (UTS) testing and oscillatory tensile testing (DMA). After analyzing my data, I found that the different ratios of compatibilizer did affect the mechanical properties and print quality. But, my hypothesis was proven incorrect. The polymer blend with 0% compatibilizer was the strongest. It also had the lowest print quality. The third polymer blend, however, had the highest print quality and only slightly decreased mechanical strength. Thus, I was successful in creating a novel polymer blend for use in additive manufacturing extrusion that allows the consumer waste stream to be used as an additive manufacturing feedstock.

Awards Won: