From Crude to Extrude: A Novel Approach to Combining Pultrusion and Extrusion Technologies Into a Single Filament Production System to Recycle PET Bottle Waste and 3D Printing Purge Materials Into Additive Manufacturing Filament

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With the increased use of 3D printers, there exists a need to recycle filament purge and failed prints. Traditionally, filament is produced via shredded material fed through an extrusion machine; this filament is of poor quality and requires re-extrusion. This project attempted a novel technique: combining extrusion with pultrusion; theoretically more energy and time-efficient. A compression auger was created and evaluated; various plastics, including purge material, failed prints, and PET bottles were sourced. An extrusion machine was constructed from wood, metal, and 3D-printed components; an original electronic system was designed. All elements were manufactured in a basic home workshop. Water-cooling, air-cooling, spooling, pultrusion, and filament-pulling units were incorporated. Energy consumption was tested through an integrated volt/amp meter. Over 30 temperature zone combinations were tested. After the filament was produced, quality and tolerances were assessed. Pultrusion and extrusion processes were tested and contrasted. The design encompassed over 50 iterations of components. The energy consumption of the machine was 0.89 kWh. The optimal temperatures for producing filament with each material were determined, including PLA: from zone 1-3 (degrees Celsius): 150, 202, 126. Produced filament tolerances were plus or minus 0.2 mm. The combination of extrusion and pultrusion was estimated to be ~45% more efficient than standard. Most engineering criteria were met. This project validated a proof-of-concept for combining extrusion and pultrusion, enabling the recycling of various plastics and averting landfills. There is a need for further testing to optimize the integration of the two technologies, and to enhance speed, size, and layout.

Awards Won: