DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Mechanical Capstone Project
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SHIFTING SHAPES™

Department of Mechanical Engineering

3D Printing Plastic Filament Recycler

PROBLEM

3D printing is a highly promising manufacturing technique with continuously rising implementation. There is currently limited existing technology that encapsulates the recycling process for failed prints, while in 2021, 8000 tons of 3D printed plastic was landfilled [1].

Inspired by the ease of prototyping, Shifting Shap3s aims to fill the gap for an affordable and complete system for recycling 3D printing plastics.

GOAL

Design a SINGLE device to perform ALL the following steps to recycle 3D printed plastic waste:

Scrap PLA → **Shred & Dry** → **Extrude** → **Spool**

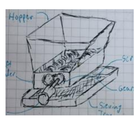
DESIGN REQUIREMENTS Included

- Parameters refined for PLA extrusion
- Closed structure to safely contain moving parts
- Desktop size and weight
- 1.75 +/- 0.5mm filament output

DESIGN PROCESS

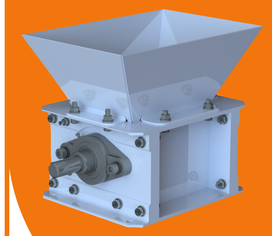
Designs for each of the 4 recycling steps were determined using the following process:

1. **Ideation**
2. **Prototyping**
3. **Engineering Justification**
4. **Modelling**



Each subsystem was then tested, improved, and integrated with the other steps.

SHREDDING



Scrap plastic enters the shredder where it is sheared, and circulates through the blades until reaching an acceptable size to pass through the sieve

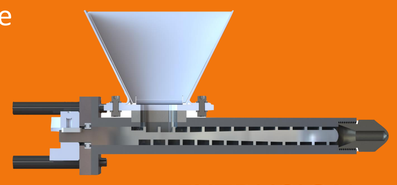
DRYING

Regrind is dried after shredding prior to extrusion for improved filament quality

Filament is measured, tensioned to size, and wound onto the spool while aligned with a guiding mechanism

SPOOLING

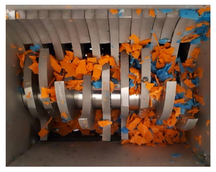
Shreds enter the extrusion screw where they are melted and compressed to exit through the nozzle



EXTRUSION

PERFORMANCE

Average shred rate of **1.2 kg/hr**

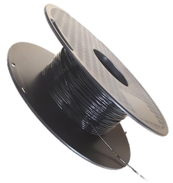


With all shreds of diameter **¼ in** or less

0.41% of initial mass removed in baseline drying test

0.27% of initial mass removed using PFR drying method

Average extrusion rate of **1 kg/hr**

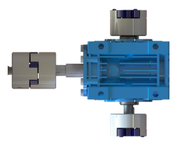


Diameter output measurable to the nearest **0.05 mm**

NEXT STEPS

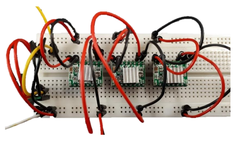
The scope of this project was to design and create an initial prototype, leaving room for future improvement. Key next steps in improving this design include:

- Reconfiguration of the drivetrain to make the machine footprint SMALLER



- Analysis of power requirements to determine the ideal MOTOR for size and torque

- Merging of electrical systems into a single control system and INTERFACE



[1] Griffin, M. (2021, July 20). *Is PLA Recyclable? – Simply Answered.* All3DP..