Development of Convenient Sustainable Recycle and Reuse Technology for Plastic Bottles in 3D Printing

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Introduction

Waste plastic accounts for a sizeable portion of our modern global environmental crisis. When plastic waste, like a common disposable water bottle for example, enters our oceans natural processes batter and break up the plastic into smaller and smaller pieces over time. As these plastic shards become collections of yet smaller plastic bits, it becomes easier and easier for the toxic material to enter into the food chain. This can be extremely disruptive to entire ecosystems.

Most common plastic bottles are made of PET plastic or a variant thereof. PET has one of the highest recycle rates of common plastics, with about 27% of the original material retained after melting it down. This relatively high recycle rate combined with the physical properties of PET make it an ideal material for making recycled filament for 3D printing.

This project was conceived to search for a cost effective, convenient way to collect recyclable plastic bottles and transform them into filament that can then be used with a 3D printer to construct physical designs.

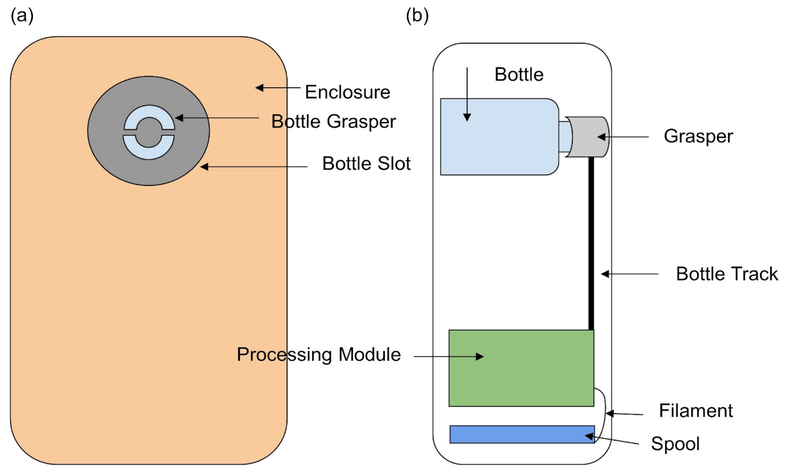
Materials

Materials: PET plastic bottles

Recycle Code	Type	Melting Point	Recycle Rate
1	PET	260ºC	27%
2	HDPE	130ºC	31%
3	PVC	100-260ºC	3%
4	LDPE	105ºC	7%
5	PP	160ºC	18%
6	PS	240ºC	2%
7	Other	Various	Various

Method and Design

Original Design:



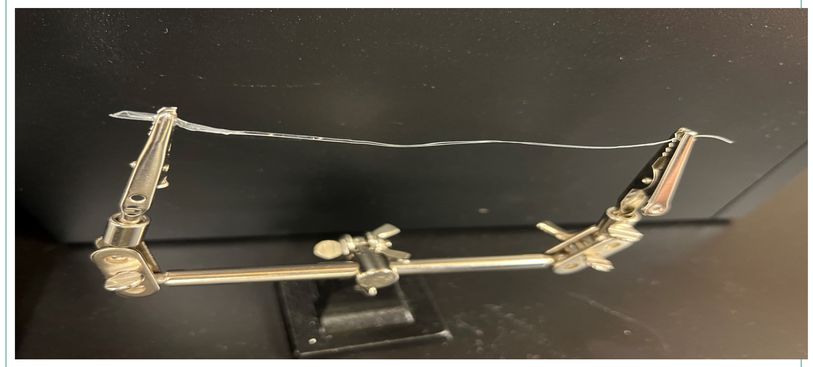
This design was the original aim of the project, a self contained unit capable of collecting recyclables and creating filament with minimal upkeep and operational costs.

Methods: For this project the heater end of a 3D printer was brought up to 260ºC, the melting point of PET plastic To create the filament the bottle is first sliced into thin ribbons no more than 1.75mm in width, 1.75mm being the diameter of the nozzle. The ribbon is inserted into the top of the heater and pushed through the nozzle. This melts our ribbon and reshapes it to more closely match the profile of traditional filament. Once this reshaped plastic starts coming out of the nozzle, it is grabbed and gently pulled through, winding the filament onto a spool as it is produced.

References

Lehrer, Jason and Marietta R. Scanlon. “The Development of a Sustainable Technology for 3D Printing Using Recycled Materials.” (2017).

Results and Current Progress



Bottle strand ready to be transformed into filament. Produced with a lathe machine while the primary device is still in production

Discussion

Other projects in a similar vein also explored creating an intermediate step in the process where the long strips of filament are ground into small pellets. These pellets can more easily be combined with other materials to alter the properties of the resulting filament

Future Works

- Finish construction of the hardware
- Perform extrusion and quality tests
- Make design improvements
- Experiment with feasibility of adapting to other, possibly more exotic recyclable materials

Acknowledgements

I’d like to thank Dr. Jheng-Wun Su, Dr. Zink and the URSCA Advisory Committee for this incredible opportunity