Filament Recycler

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Abstract

Many of the big companies start to depend on 3D printers to make their products. Our project is about making our planet cleaner by recycling the plastic waste and turn it into a 3D printer filament. The recycling process consists of two main steps, plastic shredding and plastic extrusion. Our team was able to build a plastic shredder that can shred the plastic into small pieces. Also, the team was able to build an extruder that can take the shredded plastic and turn into a 3D printer filament.

Project descreption

The project consists of two machines, a plastic shredder and a plastic extruder. The plastic shredder is a device that is used to shred the plastic into a very small pieces. The other machine is the plastic extruder which is a machine that takes the shredded plastic and melt it inside a pipe using band heaters. The pipe contains a shaft that rotates to push the plastic through a nozzle hole with a diameter of 1.75mm. The diameter of the nozzle is the standard size of 3D printer plastic filament.

Customer requirement

The customer requirements are to build an easy to use, reliable, affordable, and safe machines which gives a consistent output of extruded plastic. Another requirement is to build a machine that can recycle the same type of plastic that is used in the cline library which is called polylactic plastic (PLA).

Shredding Machine

The shredding machine consists of three main components:

- motor
- Worm gearbox
- shredder

The Motor is a 2hp single phase Ac motor. It rotates with a speed of 1425 rpm when we run it on 110 volts. The gearbox has a reduction ratio of 30:1 which brings the motor speed down to 47.5 rpm. The shredder design is inspired by Dave Hakkens.[1] The shredder has a single shaft with 13 rotary blades and 13 stationary blades. The shredder final design can be seen in figure 1.

Extrusion Machine

The Components of the Extrusion machine consists of:

- Auger
- Motor
- Variable Frequency Drive
- PID Controller

The Auger Bit is made of steel. The bit diameter is 0.75” with a length of 19.5”.The motor is a 1hp single phase AC motor. There electric power in our project is used for two objectives. The first objective is controlling the speed of the extrusion motor. The second objective is to control the temperature of the band heaters that will heat the extrusion pipe. The VFD enables us to control the frequency supplied from the power supply, thus controlling the speed of the motor. Moreover, our team was able to control the temperature of the band heater through the use of the a PID controller.e. The final shredder final design can be seen in figure 2.

Figure 2. Extrusion Machine

Testing and Results

Shredder results:

The shredder shred the plastic into small pieces that have width of less than 0.25”.

Extruder Results:

The extruder took 30 to 45 minutes to warm up. The plastic took a long time to melt and longer time to come out of the nozzle hole. The filament output has a diameter of 1.75mm.

Theoretically, the plastic melting point is 220 to 270 degrees celsius, but in our experiment the PID controller was reading 365 degrees celsius when the filament start to come out of the nozzle. The reason behind this is the huge amount of heat loss from the pipe and the non uniform distribution of heat along the pipe.

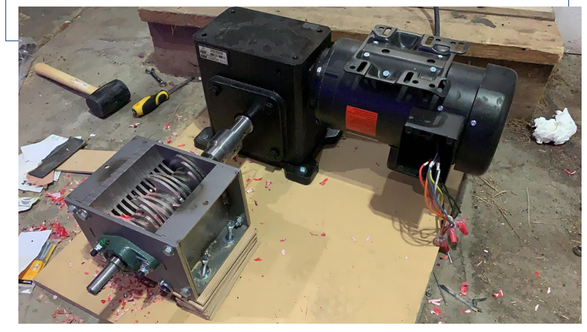

Figure 1. Shredding Machine

Conclusion

In conclusion, the shredder was shredding the plastic into a small pieces with width of less than 0.25”. The extruder produces a filament of 1.75mm diameter. The PID reading was way higher than expected due to the huge amount of heat loss and the non-uniform heat distribution along the pipe.

References

[1] “Precious Plastic,” *Precious Plastic*. [Online]. Available: https://preciousplastic.com/. [Accessed: 09-Dec-2019].

Acknowledgements

We would like to thank Dr. David Trevas, Dr. Sarah Oman, and Nau workshop for helping us with this project.