Extrusion Processing of 3D Printer Filament

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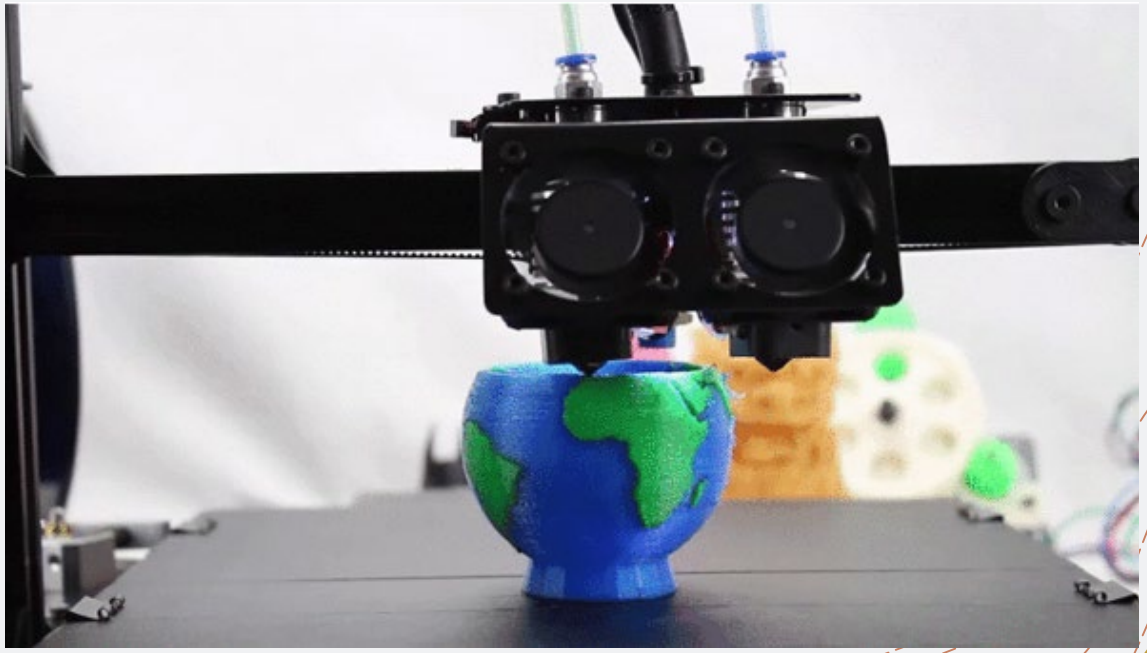
Contents

3D Printing Filament in Plastics

- 3D printing is gaining popularity
  - Ability to process prototypes quickly
  - No purchase of a mold required
  - No tooling allows for lower costs
- Little design time is required for parts
- Newer studies are moving towards the creation of parts, rather than just prototypes.



Objective:

To develop the capability to produce commercial quality filament

- Problems:
  - Low quality commercial filament
    - Inability to print
    - Did not meet industry standard
  - Lack of material and 3D printing knowledge
    - Bed adhesion
    - Under extrusion
- Solutions:
  - Revise processing
  - Print and test multiple materials

Extrusion – Oblong Material

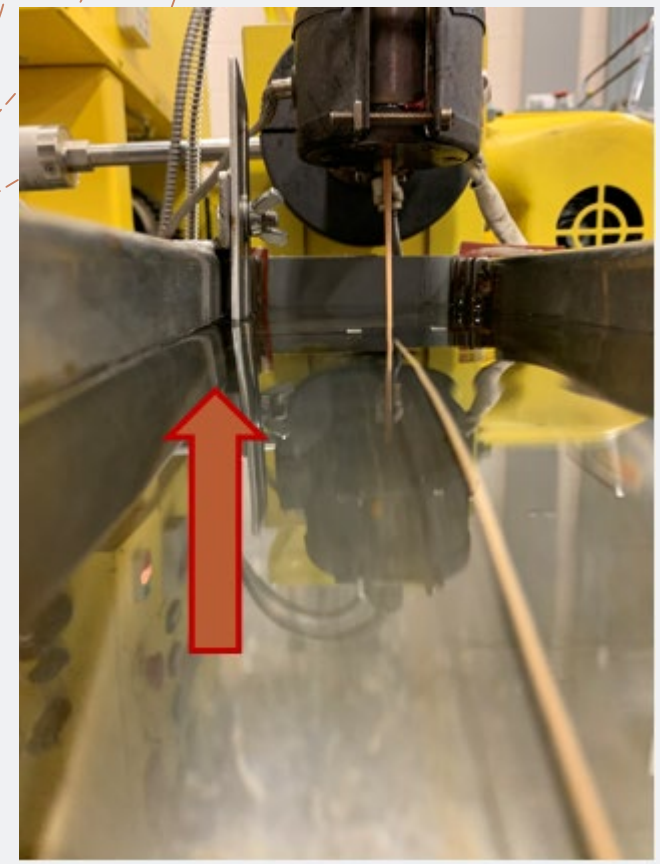


Figure 1: Raising the Water Level

Figure 2: Lowering the Temperatures

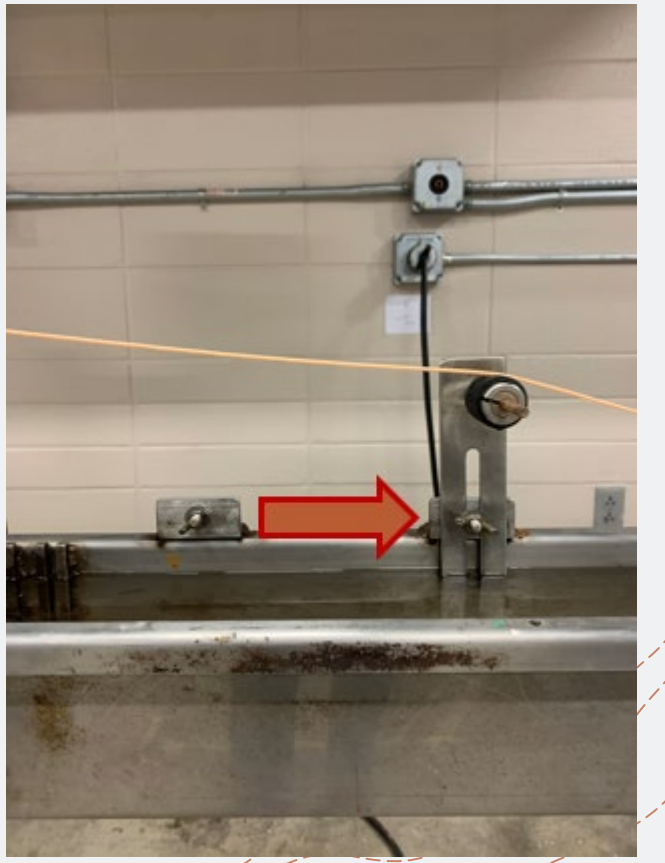


Figure 3: Adjusting the Rollers

3D Printing

- Printer
  - Creality Ender 3 Pro
  - Max printing temperature is 260 degrees Celsius
  - Max bed temperature 80 degrees Celsius
- Industry Standards
  - 1.75 mm +/- 0.05 mm

- Parameters

Figure 4: 3D Printing Parameters

Materials Extruded – Gray ABS

- Sample at 100% Fill
  - Strain @ Max Extension: 0.059 in
  - Max Tensile Extension: 0.117 in
  - Load @ Machine Break: 243.7 lbf
  - True Stress @ Max Extension: 258.44 psi
- Sample at 20% Fill
  - Strain @ Max Extension: 0.050 in
  - Max Tensile Extension: 0.100 in
  - Load @ Machine Break: 125.3 lbf
  - True Stress @ Max Extension: 2.737 psi

Figure 5: Gray ABS

Commercial Name: Polimaxx Acrylonitrile Butadiene Styrene – 0130979557 GA800 4B06

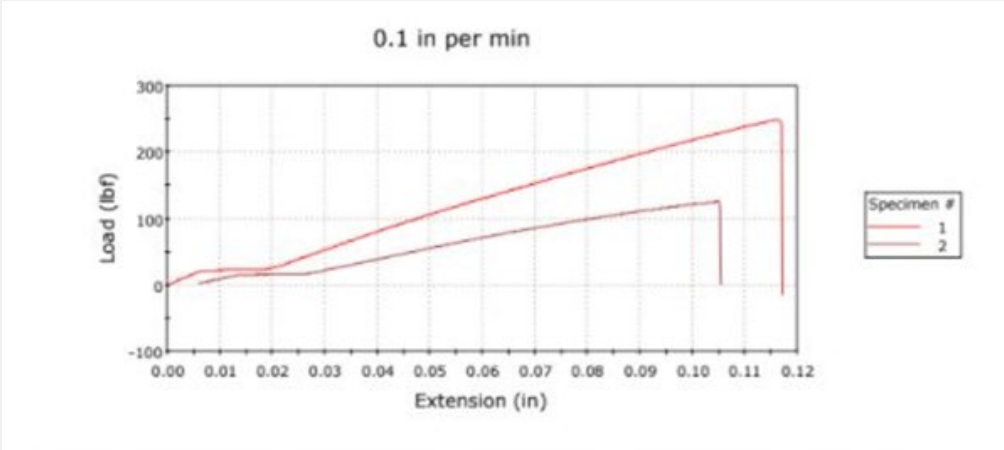


Figure 6: Gray ABS Tensile Testing Results

Materials Extruded – Red ABS

- Sample at 100% Fill
  - Strain @ Max Extension: .062
  - Max Tensile Extension: .123
  - Load @ Machine Break: 179.100
  - True Stress @ Max Extension: 154.542

Figure 7: Red ABS

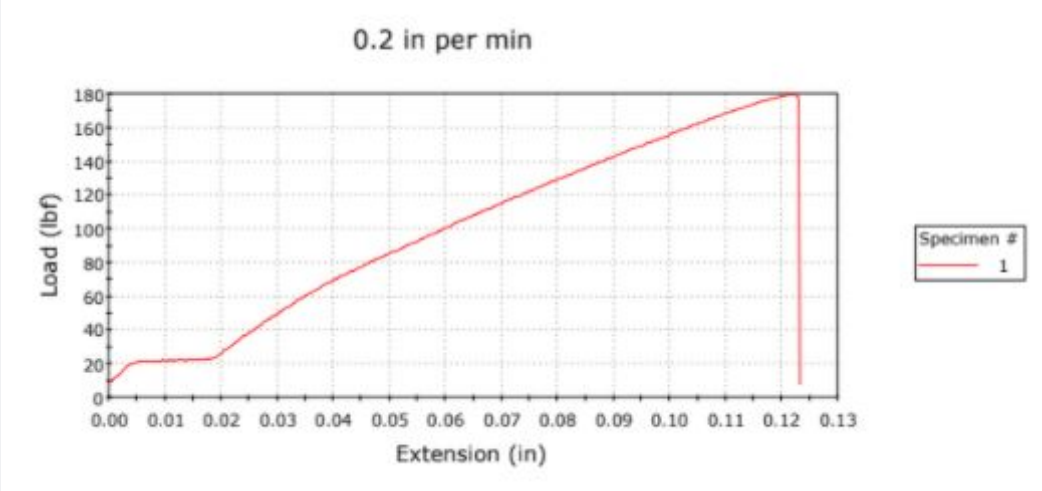


Figure 8: Red ABS Tensile Testing Results

Materials Extruded – Bioplastic Elastomer

Figure 9: Bioplastic Elastomer

Commercial Name: Green Dot Bioplastics - Terratek Flex GDH-B1FA

Figure 10: Result from 3D Printer

Conclusions and Future Work

Conclusions

- Gray ABS showed high toughness
- Red ABS was comparable, but difficult to print
- Bioplastic elastomer was unprintable

Future work

- Provide a basic guideline for filament extrusion
- Provide a basic guideline for 3D printing
- Allow for future students to produce and sell filament
  - $7.50 a pound
  - 1 pound every 20 minutes
  - 18,720 pounds of filament a year for $140,400

Acknowledgements

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