Variable Extrusion Dies that Exhibit Significant Changes in Exit Area

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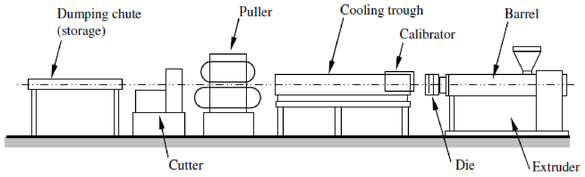
Polymer Extrusion

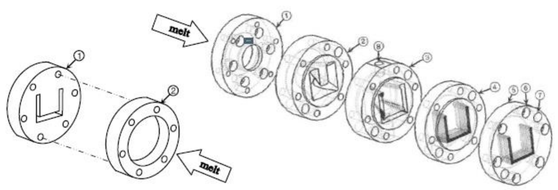
- Plastic resin is melted then pulled through a fixed geometry die plate
- Process creates longs parts with uniform cross-sectional area such as pipes and molding
- Screw pressurized material by decreasing flow area
- Product may be cooled by fluid convection with water.



- Area may be altered by changes in:
- Screw speed
- Extrusion speed

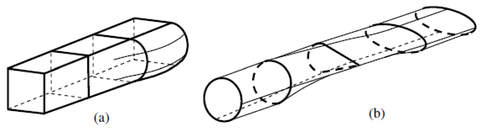
Current Die Technology

- Flat plate design
  - less expensive, more stagnation points
- Streamlined
  - less burnt material from stagnation zones



Variable Extrusion

- Expand the capabilities of extrusion by allowing the cross-sectional area to change over the length of the part.

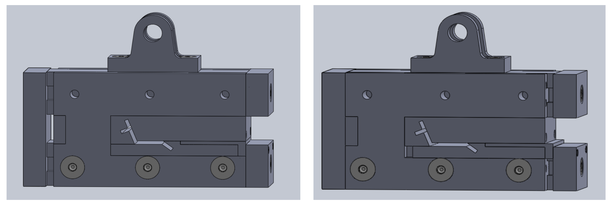


Various Extruder Models

Goal: To create an extruder which may produce a part with a variable cross section

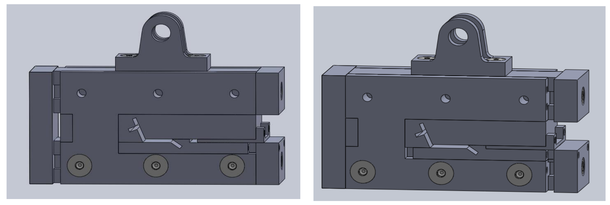
Variable Area

- cross sectional area varies with extrusion
- 3 unique parts
- Consistent exit plane



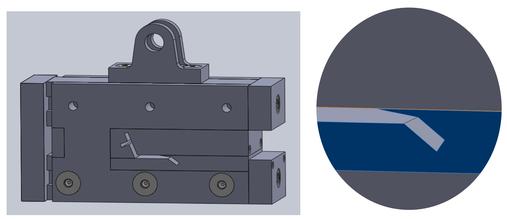
Constant Area

- Side channel closes as cross section opens
- 3 unique pieces
- Consistent exit plane



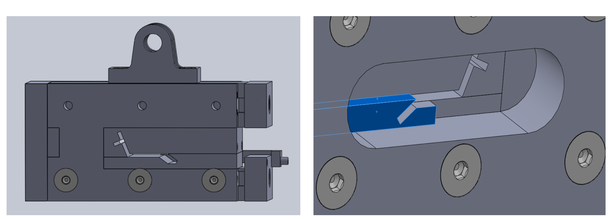
Knife Edge

- 2 unique pieces
- consistent exit plane



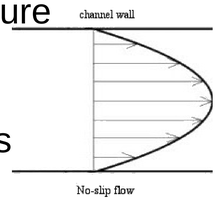
Dipper

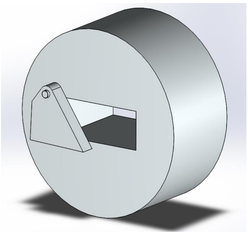
- 3 unique pieces
- Variable exit plane



Design Challenges

- Combat high pressure and temperature
  - Polymer extrusion
    - Barrel temp: 300-500°F
    - Back pressure: 300-5000 ps
- Minimize leakage/provide adequate flow path
- Smooth die land during actuation to minimize turbulent flow
- Flat exit plane to prevent curling
- Prevent material from entering joint





Future Dies

- Increase die complexity drastically
- Replace more costly processes of current products with variable extrusion
- Optimize currently extruded products for application

Conclusion

- Variable Geometry Polymer Extrusion Dies
  - 1st batch of prototypes show promising results
  - Constant Area and Variable area have been tested.
  - Relative application of rigid body shape change
  - Has potential to improve manufacturing efficiency in extrusion area