Variable Extrusion Dies that Exhibit Significant Changes in Exit Area
Heather Smith

Advisors: Dave Myszka, P.hD, Andrew Murray, P.hD

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