4-9-2015

Joint Design and Analysis of Leakage in Movable Extrusion Dies.

Joint Design and Analysis of Leakage in Variable Geometry Dies for Polymer Extrusion

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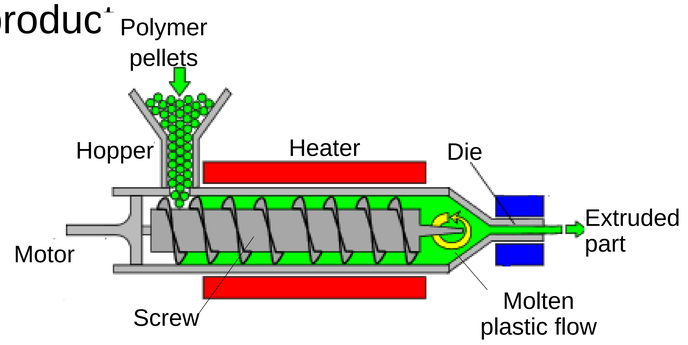
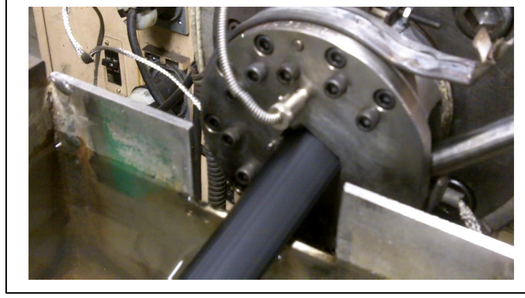
Research objectives: Computational fluid dynamics models have been constructed and used to assess the effect of the clearance size on the leakage through the joints, The goal of this analysis is to optimize the geometry of the joints.

Polymer extrusion

Extrusion is the process of utilizing pressure to force melted plastic through die orifice. The channel shape of the die is what primarily defines the cross section profile of the extruded product.

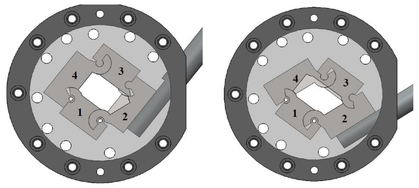


A variable geometry die allows the cross section of the extruded part to change over its length, thereby introducing the capacity to manufacture plastic components faster and with lower tooling costs than injection molding.



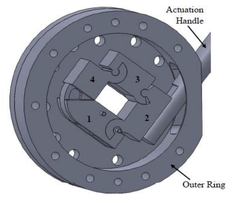
Joints used in Variable Geometry Dies

- Crescent joint
  Deemed as best option when sharp corner is not required in extrudate.

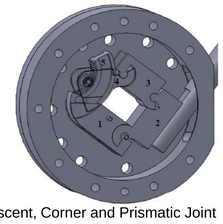


a & b Shown in Limit positions

- Corner Joint
  Considered as best option when a sharp corner is required.
- Prismatic Joint
  Necessary when a cross-sectional feature changes length.

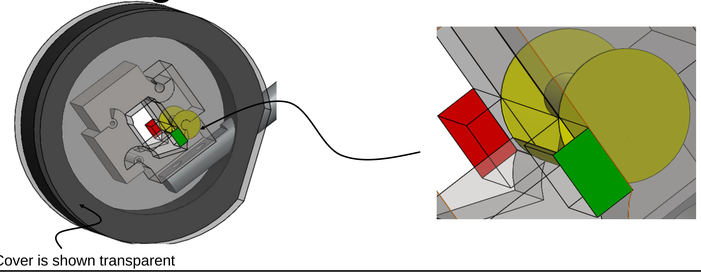


One Crescent and 3 Corner Joint



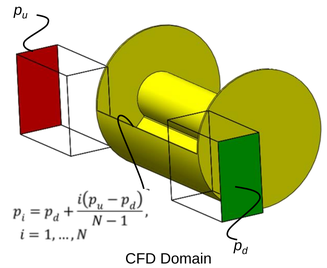
Crescent, Corner and Prismatic Joint

CFD Model to Assess Leakage at a Single Joint for Crescent Die

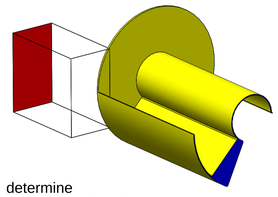


Cover is shown transparent

Initial CFD Domain



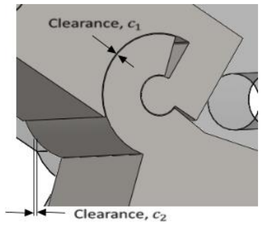
CFD Domain



determine $\dot{m}_u, \dot{m}_i, \dot{m}_d$

Sectional View

Assessment of Leakage



From 1-D incompressible flow, we have

$$\dot{m}_u = CA\sqrt{2\rho(p_u - p_d)}$$

Calculate Resistance to Flow CA, For various clearance's c_1 and c_2

Project Objectives:

1. Since clearance = f (cost $^{-1}$), select clearance that balances cost and flow resistance.
2. Determine the flow resistance of different joint designs.

Future Perspective

CFD model will be altered to incorporate flow through the die and to measure leakage flow through the joint.