Corning Future Innovator Program 2025

Corning Research Centre India

Instructions

- Form a team of **two** – comprising of any combination of undergraduate, graduate and PhD students. You are not eligible to enter the competition individually.
- The problem is designed to encourage interdisciplinary thinking, combining principles of engineering, material science, and sustainability. Remember, the best solutions balance technical ingenuity, practicality, and environmental responsibility.
- Follow the instructions provided for submitting your abstract.
- Teams shortlisted for the final round will be emailed by **Friday, July 11, 2025**.
- All the necessary information is provided about the problem. In case additional information is required, make suitable assumptions, and clearly state them.

Evaluation Criteria:

- **Literature Review:** How well does your submission demonstrate an understanding of existing solutions and their limitations?
- **Innovation:** How unique and creative is your approach?
- **Feasibility:** Is the solution realistic and scalable?
- **Impact:** How well does your solution address the problem? (Provide calculations/ simulation results and supporting evidence as suitable)
- **Presentation:** Thoroughness and clarity of concept explanation.

By participating, you are agreeing to following terms and conditions:

- Any information provided to Corning shall be considered non-confidential. You shall not share any information that is protected under any law, patent, confidentiality, or other contract, etc.
- Nothing provided by you shall prohibit or restrict Corning's right to develop, make, use, market, license or distribute products or services. You acknowledge that Corning may already possess or have developed products or services similar to or competitive with those provided by you.
- You shall not use any AI/chatbot generated solutions.

Problem 2: Optimizing vent size in Injection Molding

Injection molding is a high-volume manufacturing process used to produce parts by injecting molten material (typically thermoplastic polymers) into a precisely machined mold cavity. The material cools and solidifies, taking the shape of a cavity. This process is favored for its ability to produce complex geometries with high precision and repeatability at low per-part costs. As molten polymer fills the mold cavity, the air and gases initially present within the cavity, as well as any gases generated from the polymer itself (volatiles), must be evacuated. Mold vents are shallow, narrow channels machined into the parting line of the mold. Their primary function is to allow these trapped gases to escape efficiently. Proper venting is crucial for producing high-quality parts and ensuring a stable process. Figure 1 shows basic venting terminology.

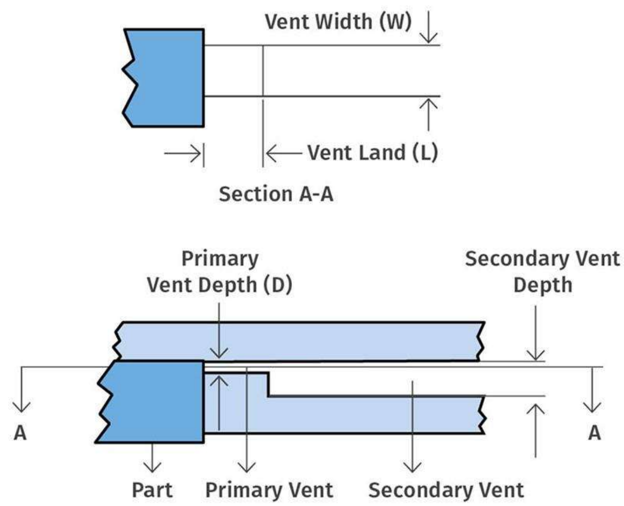

Figure 1: Schematic of a typical injection molding vent

During the venting process, as the polymer front advances the trapped air gets compressed, resulting in an increase in its pressure and temperature. This increased pressure forces trapped air to move out of the vent. However, if the vents are not adequately designed, then the air flow through the vent gets choked. This limits the venting rate and leads to under venting.

Under venting can lead to a variety of molding defects and operational issues, including:

- **Short shots or incomplete filling**: Trapped air prevents the polymer from completely filling the cavity.
- **Burn marks**: Rapid compression of trapped air can cause it to heat up significantly, scorching the mold.
- Increased cycle times and process inconsistency.

These issues can lead to part rejection, increased production costs, and reduced mold lifespan. It is therefore highly desirable to design vents that ensure complete and rapid gas evacuation. While ensuring sufficient venting is crucial, vents cannot be too deep either. Excessively large vents may result in the flow of molten polymer out of mold, resulting in a flash. Flash is an unwanted thin layer of plastic appendix to the part which affects the part quality and appearance.

The core challenge is to determine the optimum vent size (cross-sectional area) required to ensure adequate evacuation of air and gases from an injection mold cavity during the filling stage. This will help mold designers and process engineers avoid the issues associated with under venting/flash and optimize the injection molding process.

Problem Statement

You are tasked with developing a physics-based method to address the challenge of mold vent design.

Develop a model or methodology to predict the minimum required total vent cross-sectional area A (= W x D, as shown in Figure 1) for the given injection molding scenario to avoid choking in vents. Your model should establish a relationship between factors such as Cavity volume, Polymer melt front velocity / injection time, and air properties (Assume air to be a compressible ideal gas). The following sample problem should be used to develop the methodology and then test it.

Assume a rectangular plate mold with dimensions L x B x H (in mm), featuring a single inlet point (known as gate) positioned on one side. The mold is equipped with three vents located at specific points as illustrated in Figure 2. Each vent has a cross-sectional size of W x D, where W represents the width, and D indicates the depth of the vent. All three vents are of the same size. The vent depth is empirically predetermined based on the polymer resin being used. Since the depth is predetermined, calculate the minimum width required (W) in mm once you calculate the cross-sectional area A. Assume that the polymer flow front is uniform along the cross-section and is moving with a constant velocity. All the required information is mentioned in the Appendix. Make suitable assumptions if something is not available in Appendix and state the assumptions clearly.

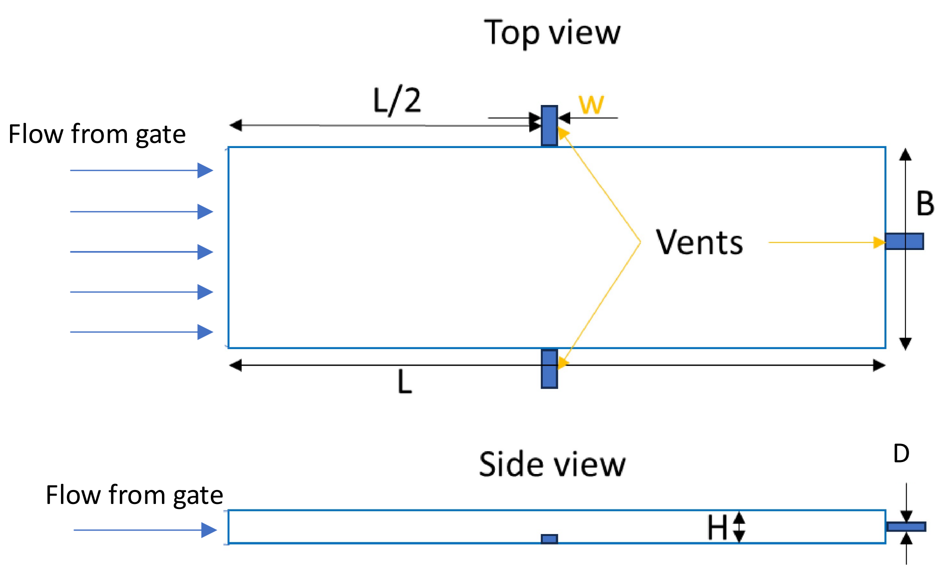

Figure 2: Schematic showing the model setup.

Deliverables:

A) For Abstract: A 3-content slide PowerPoint presentation (in pdf format) containing:

1. Literature review
2. Modeling approach (Assumptions, governing equations, simplifications, etc.)
3. Execution plan

B) For Final submission:

1. Presentation describing methodology and approach taken, assumptions made, and mathematical derivations/formulas/models developed.
2. Provide minimum vent size based on the provided parameters and discussion of the results (e.g., sensitivity to key parameters)

Appendix:

1. Dimension of plate mold: L = 10 cm, B = 4 cm, H = 0.2 cm.
2. Time required to fill the mold = 1 sec (only rectangular plate)
3. Vent depth, D (Value depend on the type of polymer resin):

   For Polycarbonate : D = 0.015 mm