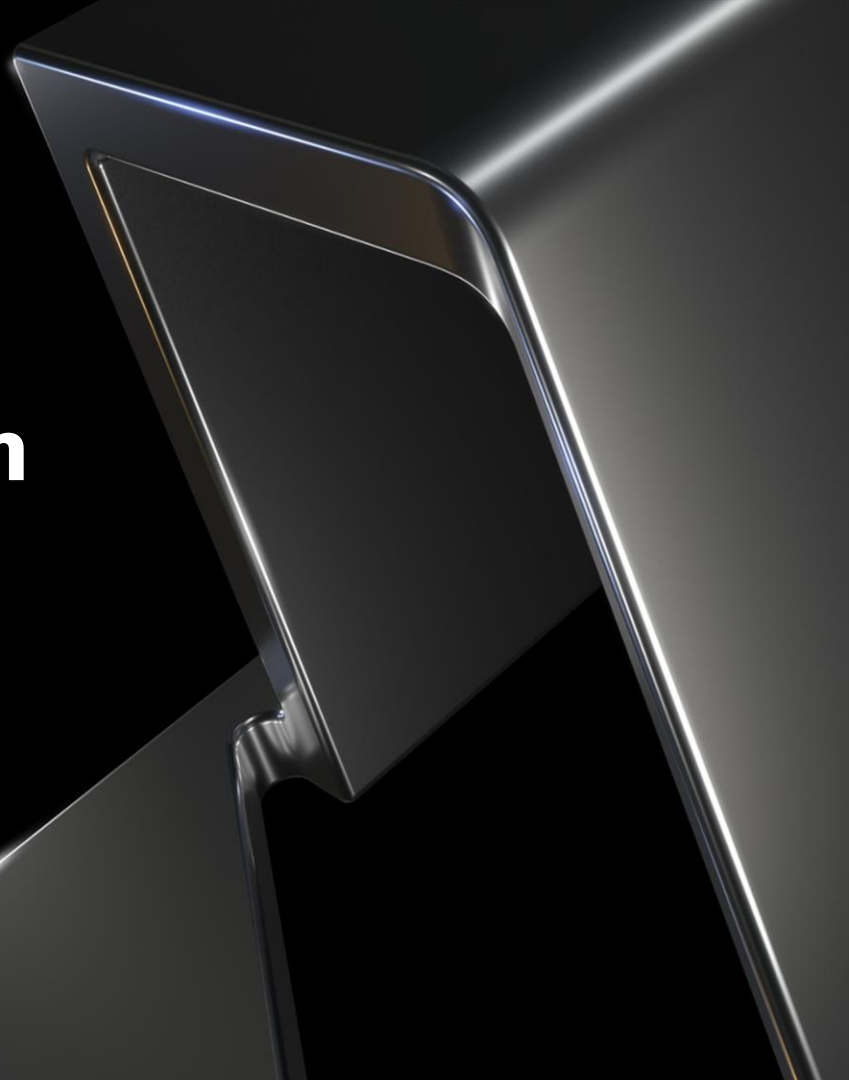
AUTODESK UNIVERSITY

Importance of Venting in Injection Molding

Pandiarajaguru

VentingInjectionmolding | @twitter



About me

Profile

About me

- B.Tech- Polymer Technologist with 14 yrs of experience, lives in Chennai, India
- Autodesk Certified Moldflow simulation engineer (Associate certification completed)
- Currently working as Senior Engineer in **Newell brands, R&D Chennai**
- Previously worked in Hero Moto corp ltd , Delphi connection systems , Thomson
- Supports **various divisions / Businesses like writing, baby, Appliances, Food etc. of Newell Brands.**
- Carries out preliminary DFM with the help of Moldflow software. Works closely with the Design team & PD team in validating the design.

Agenda

Objectives of the session

Venting is crucial in injection molding and let’s see how it is important in driving the product quality and process

Objectives :

- Causes of short fill in injection molding
- Importance of venting in molds
- Using simulation to predict failure
- How to avoid flow marks / Weldmarks

Causes of Short fill in Injection Molding

Reasons behind the filling concerns

Short shot is a filling issue / quality issue as the mold cavity is not filled completely. Short shot or short fill issue are generally due to the few of the below listed causes

- Material selection
- Process – Molding parameters
- Mold / Part design
  - Flow restriction
  - Hesitation
  - Lack of Venting

Material Selection

Reasons behind the filling concerns

Selecting a right material is a key to achieve 100% cavity filling.

- During molding, the molten resin / plastic flows through the cavity
- The resin is generally selected based on flow properties mainly MFI
- Improper material selection might lead to short fills - High viscous material on thin walls of the mold cavity.

Material Selection

Reasons behind the filling concerns

List of commercially available plastic materials used in consumer goods industry

- PP
- PS – GPPS
- HIPS
- ABS
- SAN
- PC
- HDPE
- Copolyester

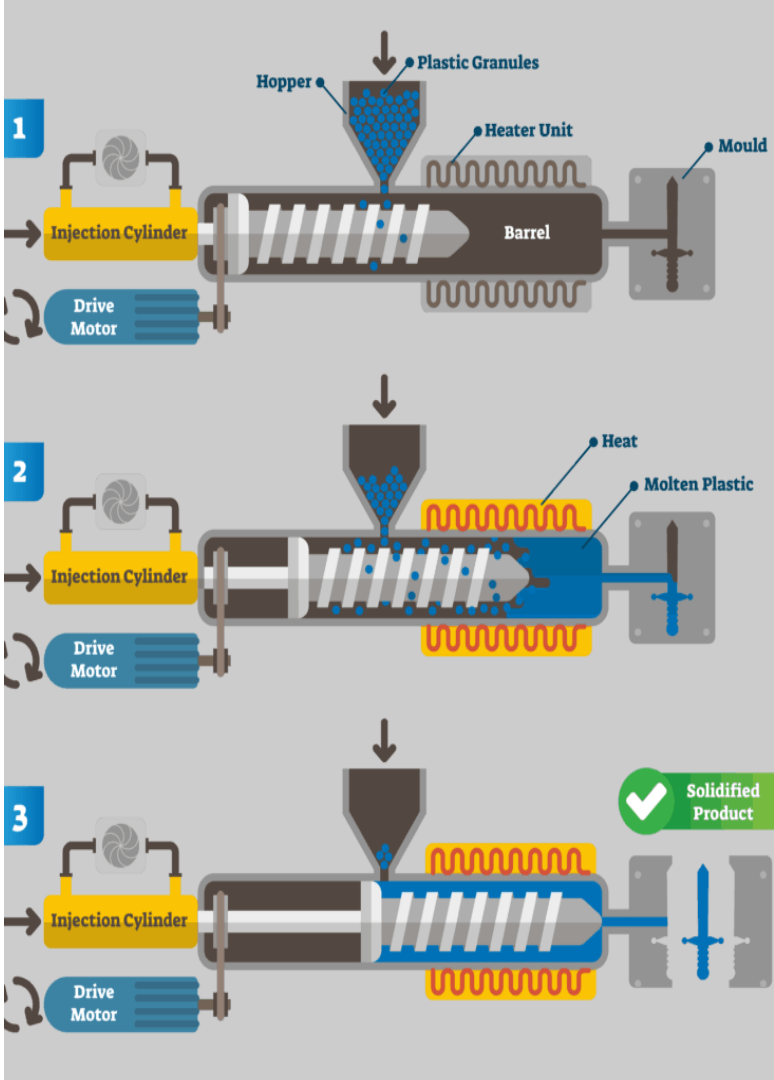
* Improper material selection leads to short fill

Process–Molding parameters

Reasons behind the filling concerns

Processing is another important factor which may cause filling concerns

- Injection pressure
- Injection speed / RAM speed
- Melt temperature
- Mold temperature
  - Core / Cavity temperature
- Packing / Holding pressure
- Packing / Holding time
- Fill time

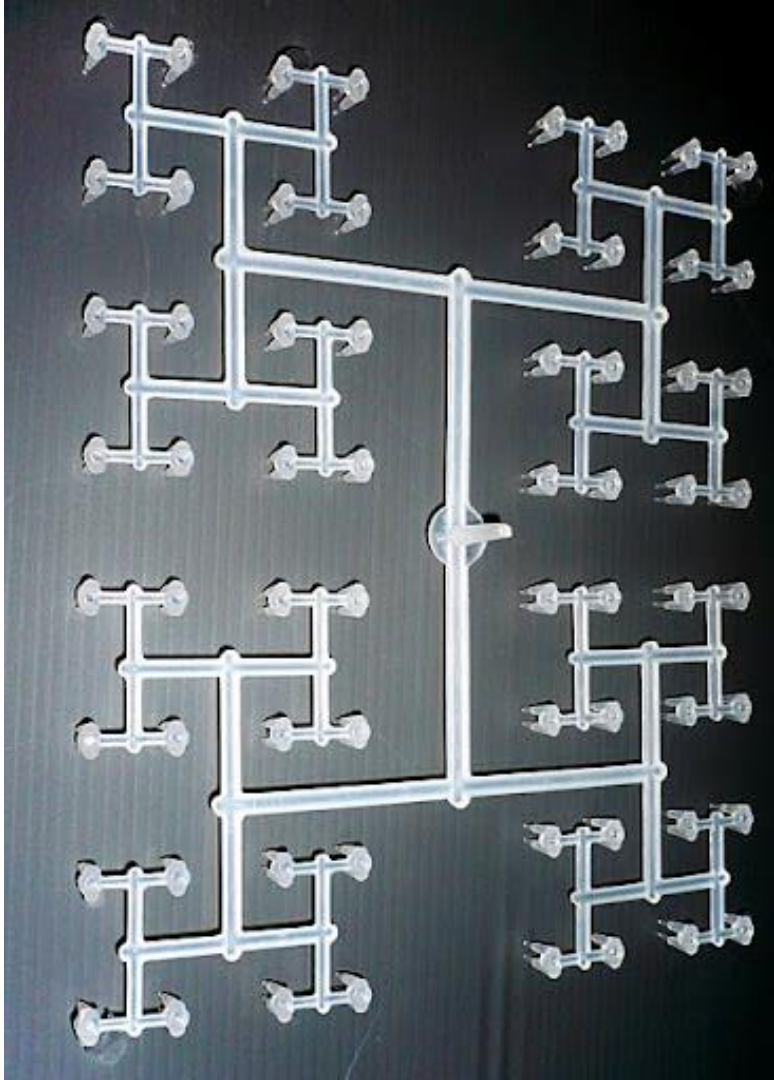


Mold / Part design

Reasons behind the filling concerns

Mold and Part design also plays a major role in cavity filling

- Flow Restriction :
  - Restriction in the flow due to gate location position
  - Gate placed at wrong location might lead to filling imbalance / longer flow lengths
  - Inappropriate gate / runner dimensions

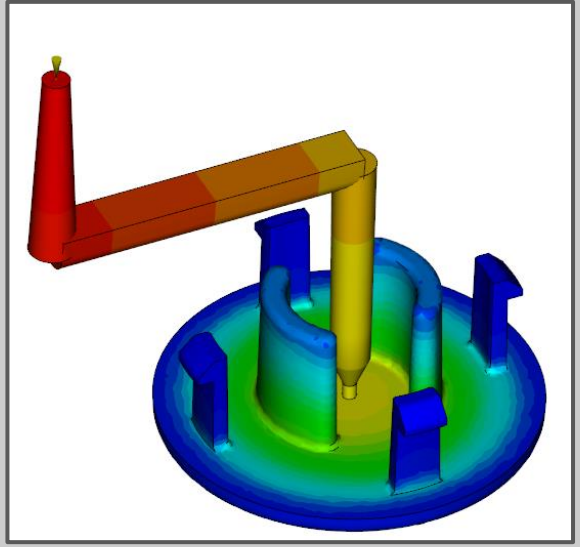


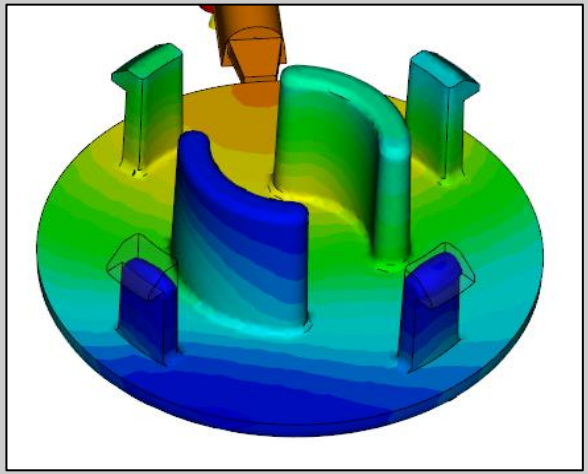
Mold / Part design

Reasons behind the filling concerns

Mold and Part design also plays a major role in cavity filling

- Hesitation :
  - Melt hesitates to flow easily through the cavity due to variable wall thickness in the part design
  - Melt stops or slows down in the cavity due to the thickness variations
  - Thicker areas filled at first
  - Thinner areas filled at last



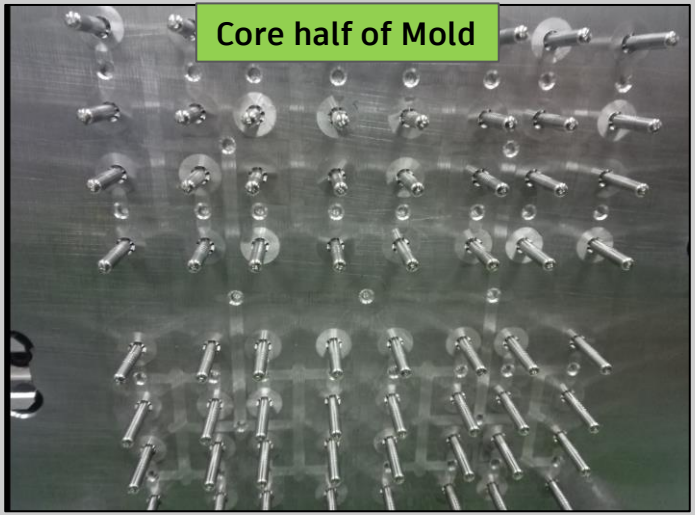


Mold / Part design

Reasons behind the filling concerns

Adequate venting is required for producing good quality molded components

- Lack of Venting :
  - During mold filling, the melt flowing through the runners / cavity pushes the air trapped inside the cavity
  - The air will try to escape out of the cavity through the venting in the mold cavities
  - Airtrap / gas trap will occur due to lack of venting



Mold / Part design

Reasons behind the filling concerns

Adequate venting is required for producing good quality molded components

- What is Airtrap :
  - Airtrap is a molding defect which commonly occurs in the last filling area of the cavity
  - Airtrap is nothing but air trapped in the cavity walls during molding due to the converging flow fronts.
  - As these airtraps can’t escape from the cavity they will cause short shot or burn marks

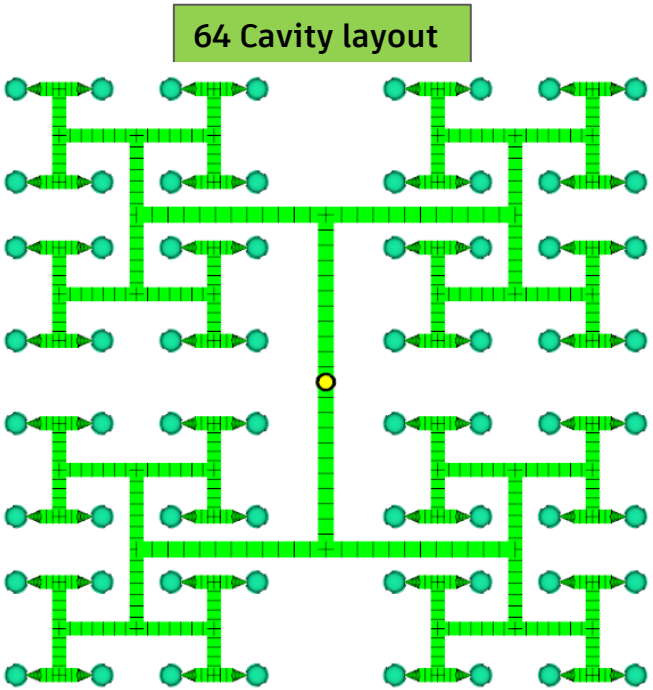
Example of Venting issue

Importance of Venting in Molds

Let us understand why venting is more important in molds through an example

Project information :

- Multicavity mold for making component of Pen
- 64 cavity tool
- Balanced layout



Example of Venting issue

Importance of Venting in Molds

Let us understand why venting is more important in molds through an example

Problem statement :

- Difficulties in molding the parts due to airtrap
- Short filling is noticed in all 64 cavities
- A hole is formed at the top of the plunger due to airtrap which aesthetically affects the quality and makes this component unusable
- On looking the samples closer, there were flow marks too
- Short fill noticed in all the 64 cavities are at the same place

Example of Venting issue

Importance of Venting in Molds

For better understanding, all the required information were checked

Observations :

- Tool drawing, Product drawing & the injection parameter sheet from the tool maker were checked
- Sub gate is used for filling the cavities.
- Gate location is noticed near the bottom of the component
- Modified trapezoidal runner
- High flow grade material used

Example of Venting issue

Importance of Venting in Molds

Based on the observations, the reasons for the filling issues are listed out

Causes of filling issue in this project :

- Airtrap or Gas trap formed during filling phase has resulted in Short fill
- Gate location is near the core side & hence the cavity side is expected to fill at last. Airtrap is expected at the last filling area.
- Lack of venting in the cavities. **Venting is not provided in the mold initially in the last filling areas**
- Traces of flow marks in the samples indicate the pressure / temperature drop in the cavities
- The runner & Gate dimensions controls the temperature drop in the cavity as well as the flow marks.

Example of Venting issue / Using Simulation to predict failure

Importance of Venting in Molds

Autodesk Moldflow simulation is used predict the failure. The molding defect observed in the Molding is replicated in Simulation

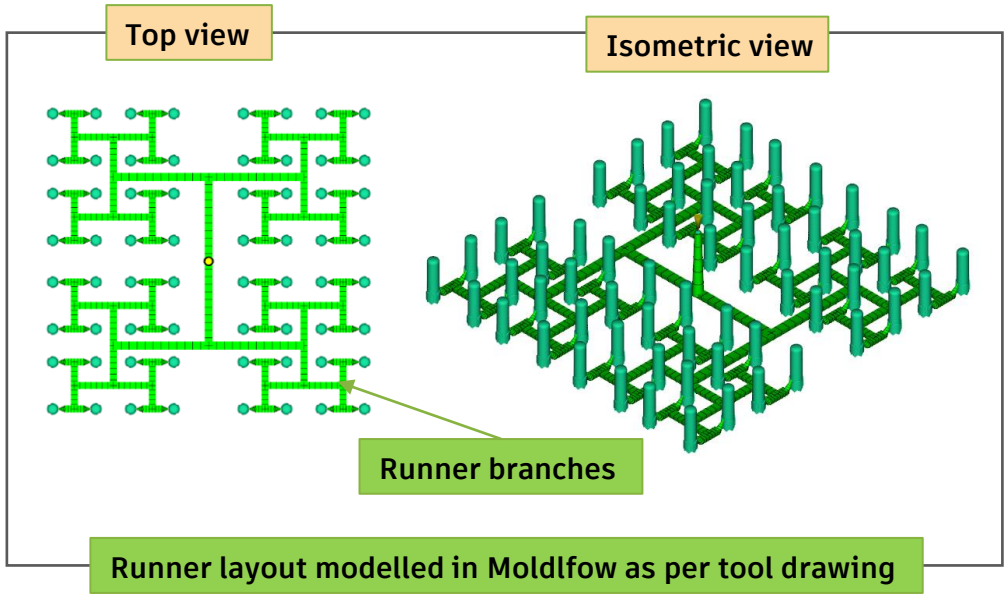
Analyzing the Mold with the help of Moldflow :

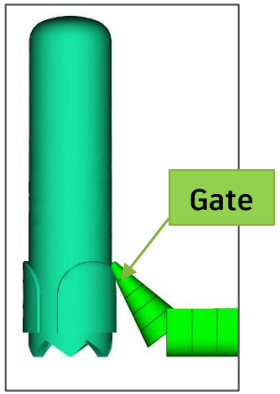
- Full mold drawing was obtained from the tool maker
- Moldflow software was used for replicating the molding scenario.
- Full mold set up is modelled in Moldflow simulation. 64 cavities were modelled along with the gate/ runner set up
- Multicavity flow simulation was carried out.

Example of Venting issue / Using Simulation to predict failure

Importance of Venting in Molds

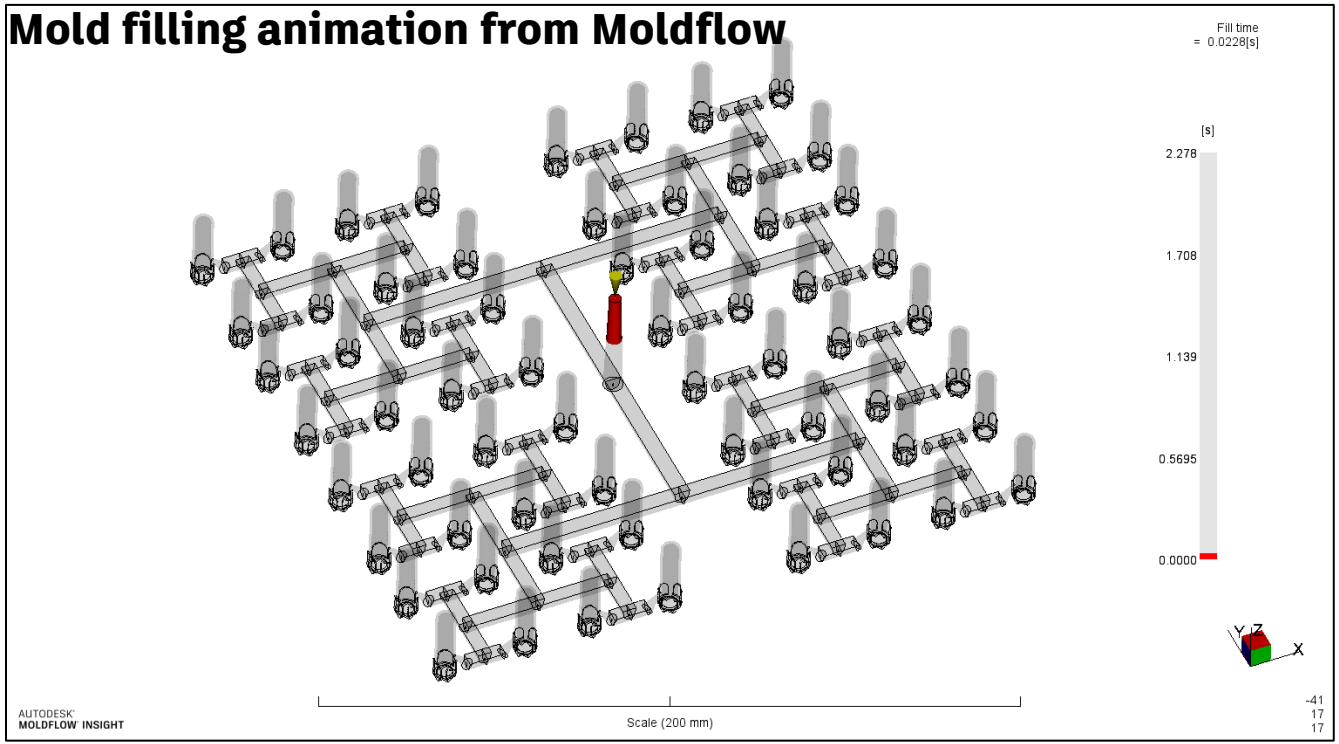
Mold layout modelled with the help of Autodesk Moldflow





Example of Venting issue / Using Simulation to predict failure

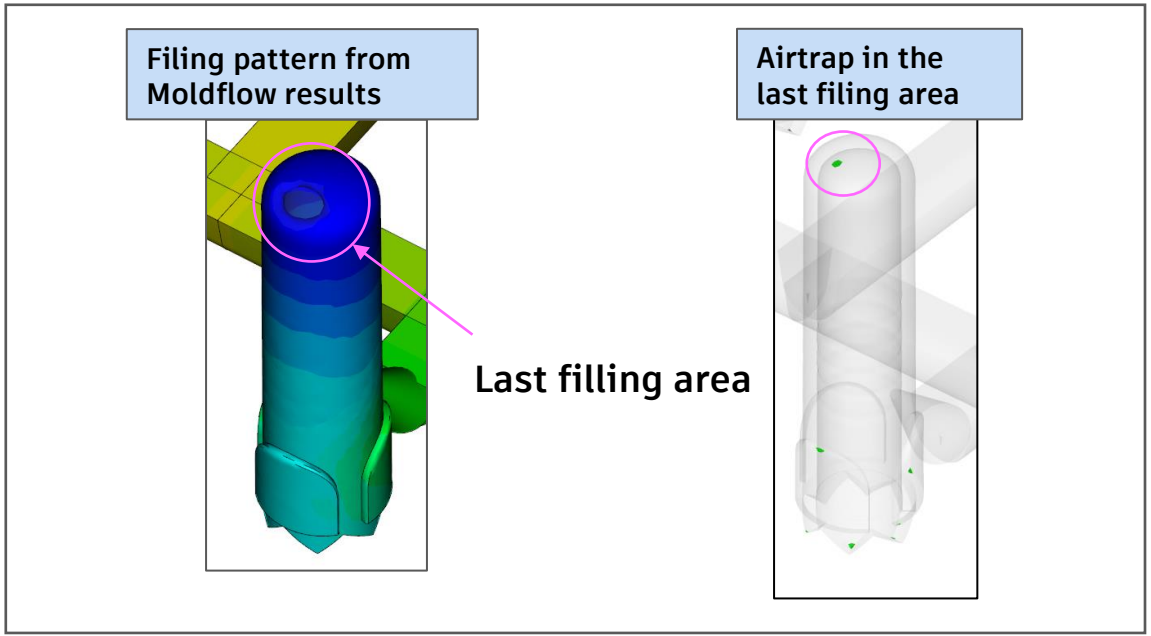
Importance of Venting in Molds



Example of Venting issue / Using Simulation to predict failure

Importance of Venting in Molds

Filling pattern and Airtrap



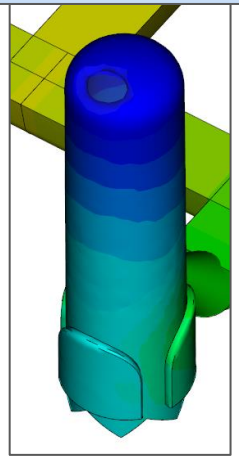
Example of Venting issue / Using Simulation to predict failure

Importance of Venting in Molds

Filling pattern and Airtrap

- As the gate location is near the core side, the last filling area is expected to be in the cavity side.
- The melt started to flow from the gate orifice near the petal area of the plunger, slowly filled the shroud area and the last filling area was expected to be the top of the plunger (opposite to the gating side). The air present in the cavity was pushed by the converging polymer flow front; Hence there was no venting provided to relieve the gas from the cavity, the air or gas could not escape and got trapped to form a hole or short shot in the part

Filing pattern from Moldflow results

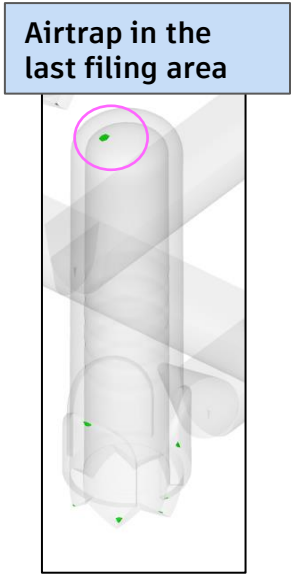


Example of Venting issue / Using Simulation to predict failure

Importance of Venting in Molds

From the Moldflow results

- Critical airtrap noticed in the last filling area in the cavity side at the top of the plunger
- Flow hesitation noticed and temperature drop(temperature of the molten material) & pressure drop also observed
- Airtraps formed in the core side can be always easily relieved with core pins, but airtrap in the cavity side is tough to eliminate without venting

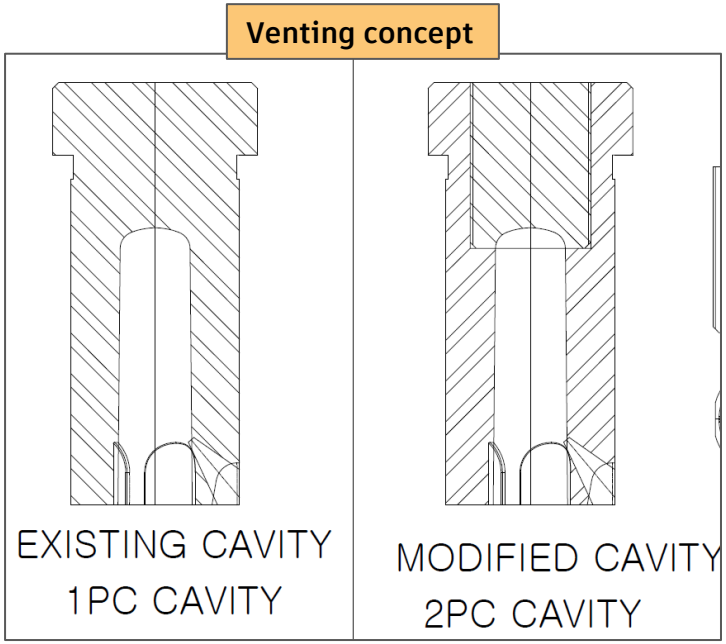


Example of Venting issue

Importance of Venting in Molds

Tooling recommendations

- To relieve the air trap or gas trap, it was recommended to provide venting at the top of the plunger where the hole is formed
- Cavity was split into two pieces. Two piece cavity insert concept used.
- Gas vent clearance to be provided in the tool

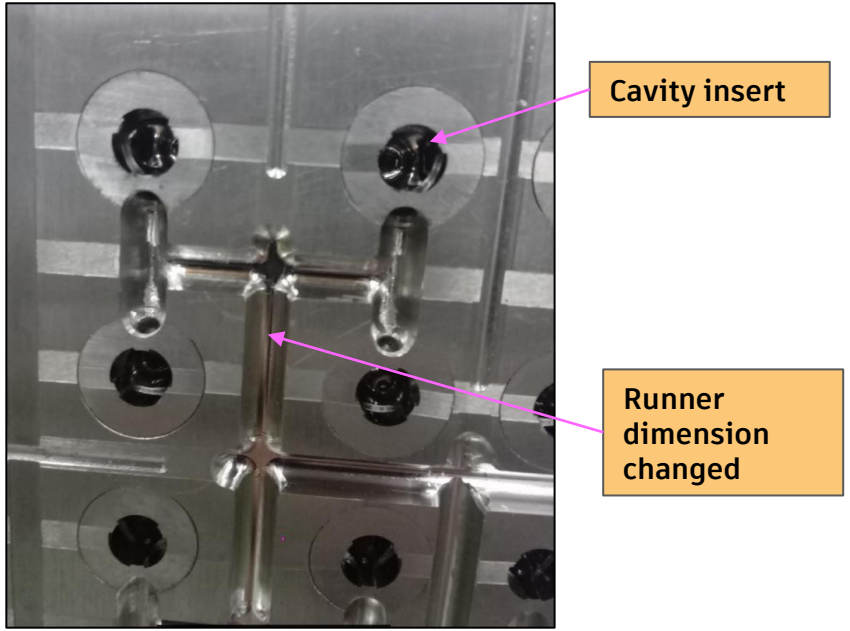


Example of Venting issue

Importance of Venting in Molds

Tooling recommendations

- It was suggested to increase the gate dimension allow more material into the cavity
- It was also suggested to increase runner dimensions to aid the flow



Example of Venting issue

Importance of Venting in Molds

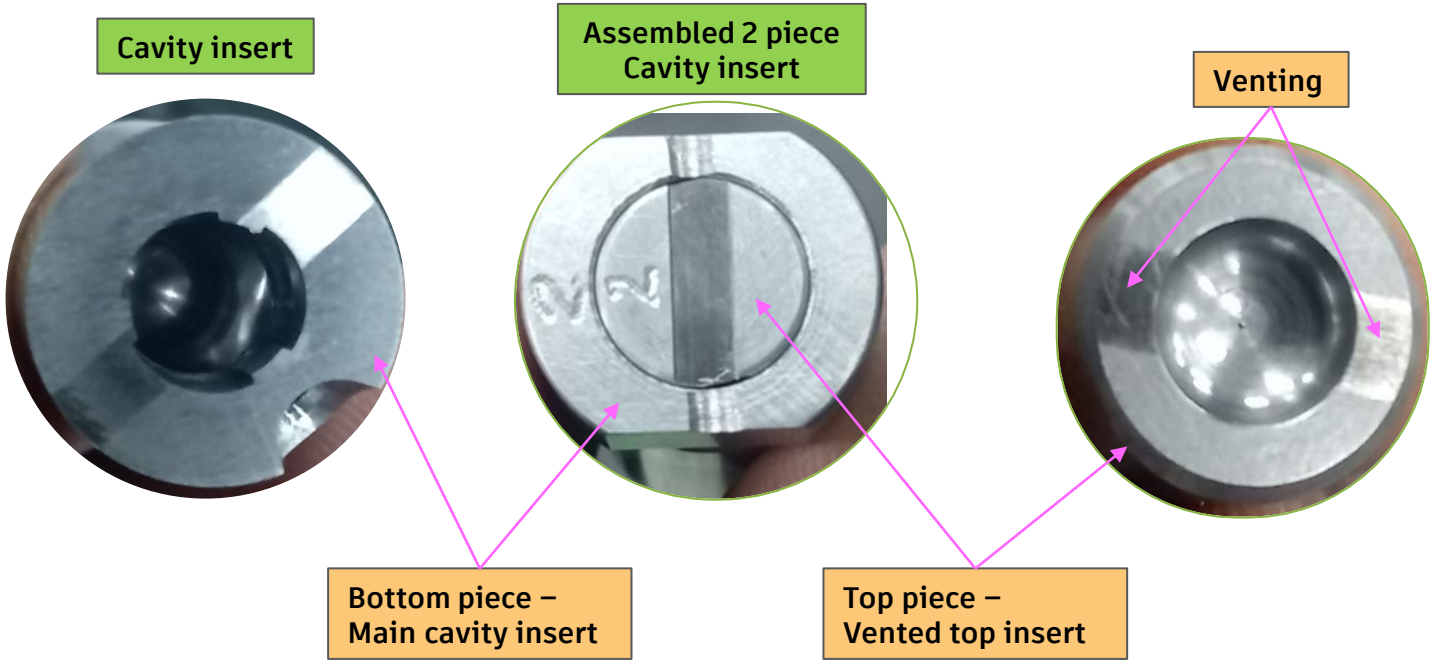
Tool trials after effecting tooling modifications

- The tool maker had made the corrections in the tool and tool trial was carried out
- Few key Process parameters were suggested to the tool maker based on the Moldflow simulation results
- Initially higher injection time was used by the tool maker, later it was reduced to 1.0s for better filing behavior
- After tool modification, the filling results were great and we have achieved 100% filling. The hole formed earlier doesn’t exist anymore

Example of Venting issue

Importance of Venting in Molds

Modified cavity inserts after adding venting slots



Example of Venting issue

Importance of Venting in Molds

After effecting modifications in all 64 cavities

- The tool maker had made the corrections in the tool in all the 64 cavities
- Successfully all 64 cavities filled completely.
- Few of the cavities showed some **visible weld marks and flow marks** which is a surface defect
- The weld marks were visible and deep
- These weld marks affects the product quality aesthetically
- And also there were few flow marks in few of the cavities

Example of Venting issue

Importance of Venting in Molds

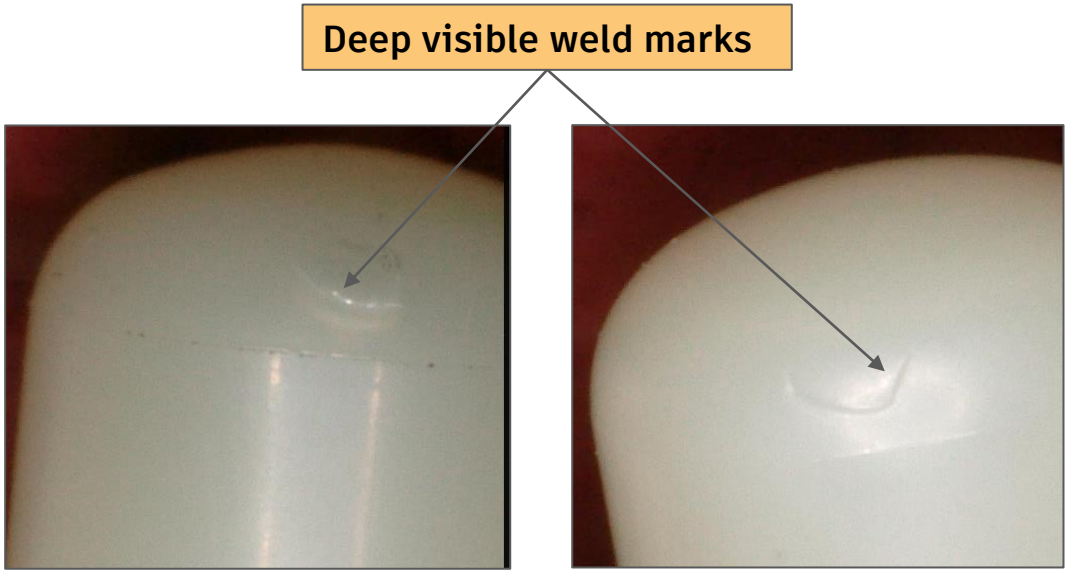
After effecting modifications in all 64 cavities

Successful molding after tool modification – 100%filled

Example of Venting issue / Avoiding Weldmarks

Importance of Venting in Molds

Weldmarks in the samples



Example of Venting issue / Avoiding Weldmarks

Importance of Venting in Molds

Optimizing the Venting issue

- To avoid the weld marks, it was recommended to increase the venting land to avoid visible weld marks
- As per the suggestion, the tool maker had widened the venting land area.
- Venting land area was increased
- Additionally venting was provided on four sides
- Trial has been conducted with this modified venting.
- Current samples looks free from visible weldmarks

Example of Venting issue / Avoiding Weldmarks

Importance of Venting in Molds

Optimizing the Venting issue

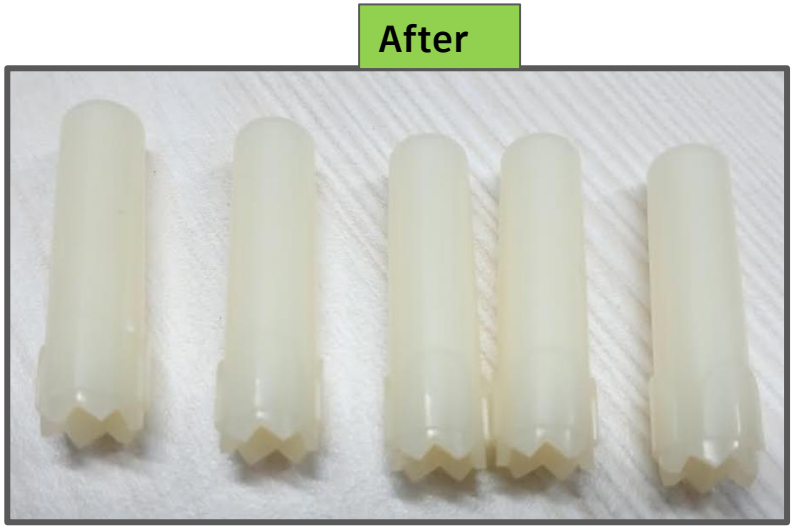
- The molded components looks free from visible weldmarks and flow marks

Example of Venting issue / Avoiding Weldmarks

Importance of Venting in Molds

Before and After providing vent

- The molded components are defect free now



Thank you

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