Autodesk® Moldflow 2021.2

Burn-mark Prediction for 3D Injection Molding Processes

Executive summary

This report is about the burn-mark prediction for 3D injection molding processes in Autodesk Moldflow Insight 2021.2 including some example cases. The feature allows the identification of potential burn mark locations.

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Introduction

Burn marks are discolored regions appearing as streaks or small spots on the surface of some molded parts. There are several causes of the burn marks. One of the common causes is an air trap. When air venting is not sufficient, air can be trapped in some regions, and the temperature of the air in that region can become very high due to compression. This high temperature air can cause degradation of the resin and thus burn marks may be seen in the neighboring region.

The burn mark analysis which is part of a venting analysis will show potential burn mark locations at the air trap locations. The calculation uses temperature and pressure results from the flow analysis to calculate the Burn Mark index value for the potential burn-mark location.

Burn marks can be produced from other causes such as high melt temperature, high screw rotation speed or restricted flow path. However, burn marks produced from these causes will not be predicted by the venting analysis.

Burn Mark Index

The burn-mark analysis will produce a “Burn-mark index” result. The Burn-mark index result shows the locations where burn marks are likely to occur. The analysis will show potential burn mark locations only at the air trap locations. Therefore, the burn-mark result is available only when the option to perform a venting analysis is enabled. This result is generated for thermoplastics molding processes using 3D analysis technology. No additional input data are needed for this analysis.

The Burn Mark index result can have 3 values (high, medium and low).

- If the likelihood of burn marks at that location is high, the burn-mark index will be “High”.

- If the likelihood of burn marks at that location is medium, the burn-mark index will be “Medium”.

- If the likelihood of burn marks at that location is low, the burn-mark index will be “Low”.

- If the likelihood of burn marks at that location is very low, nothing will show for the burn-mark index at that location.

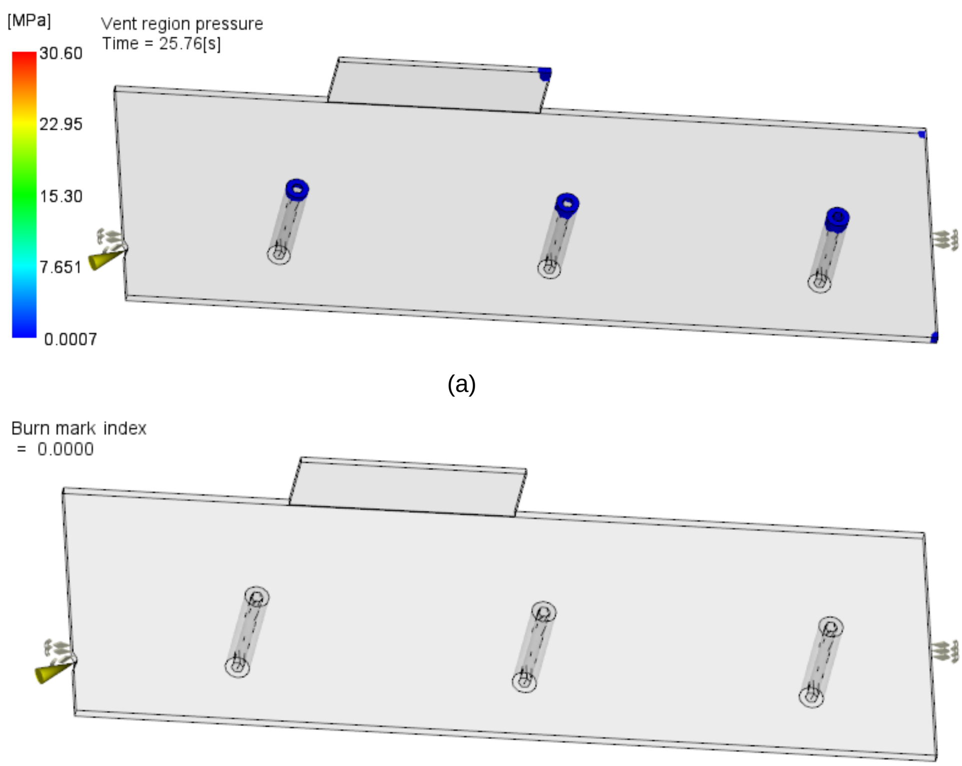
Example Cases

In this report, 2 example cases will be shown where the burn-mark predictions are made.

1. A Plate with Deep Bosses

The first case is a flat plate with deep bosses. The material is ABS. The mold temperature is 50ºC and the initial melt temperature is 250ºC. The filling time is 2.5 sec. The packing time is 8 sec. Two different packing pressures were tried to examine the effect of packing pressure (30 and 60 MPa). Air vents are located near the gate as well as at the end of the plate, but not at the bosses.

The simulation results are shown in Figure 1 and 2. Figure 1 is for a packing pressure of 30 MPa. The vent pressure at the end of molding is shown in Figure 1(a). It shows air traps at 4 locations. Figure 1(b) shows burn mark index predicted. At this packing pressure, there is no potential burn mark location predicted. Figure 2 is for a packing pressure of 60 MPa. For this case, among 4 air-trap locations, 1 location has a medium burn mark index value, 2 locations have low burn mark index values, and 1 location has no burn-mark index (which means that a burn mark is not likely at this location). The results from Figure 1 and 2 illustrates that packing pressure plays an important role in the prediction of burn marks.



(a)

(b)

Figure 1: Simulation results for a plate with deep bosses with packing pressure of 30 MPa: (a) Vent region pressure and (b) burn mark index.

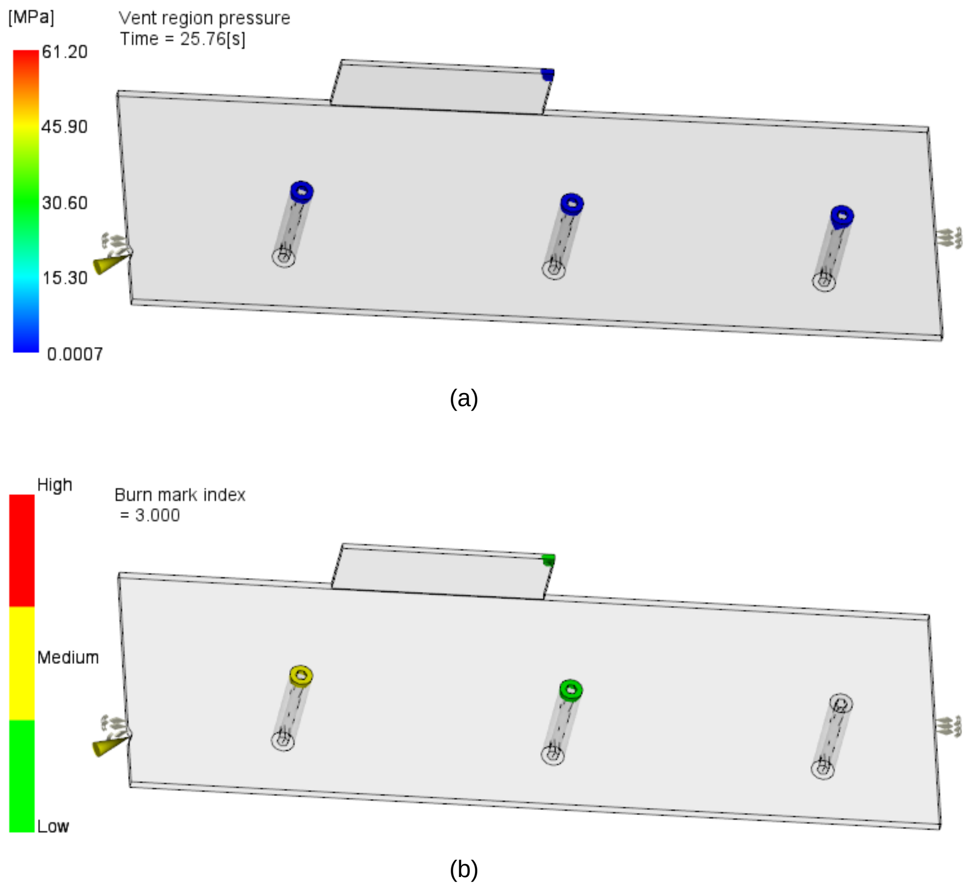


Figure 2: Simulation results for a plate with deep bosses with packing pressure of 60 MPa: (a) Vent region pressure and (b) burn mark index.

2. A Ribbed Plate Case

The second case is a ribbed plate used for validation studies in the Autodesk Moldflow Laboratory. The mesh used in the simulation is shown in Figure 3. As can be seen, the cavity is a rectangular plaque with a fanned gate. The rectangular cavity is 150 mm long, 75 mm wide and 2 mm thick. It has ribs perpendicular to the flow direction. The rib closest to the gate will be labeled as Rib1, and the one furthest Rib3. Also, each rib has 3 regions with different heights and widths. The region with the smallest height and width (1 mm width) will be called the "narrow" region, the one with medium height and width (2 mm width) will be called the "medium" region, and the region which has the largest height and width (3 mm width) will be called the "wide" region (Fig. 3). Air vents are located at the end of the plate.

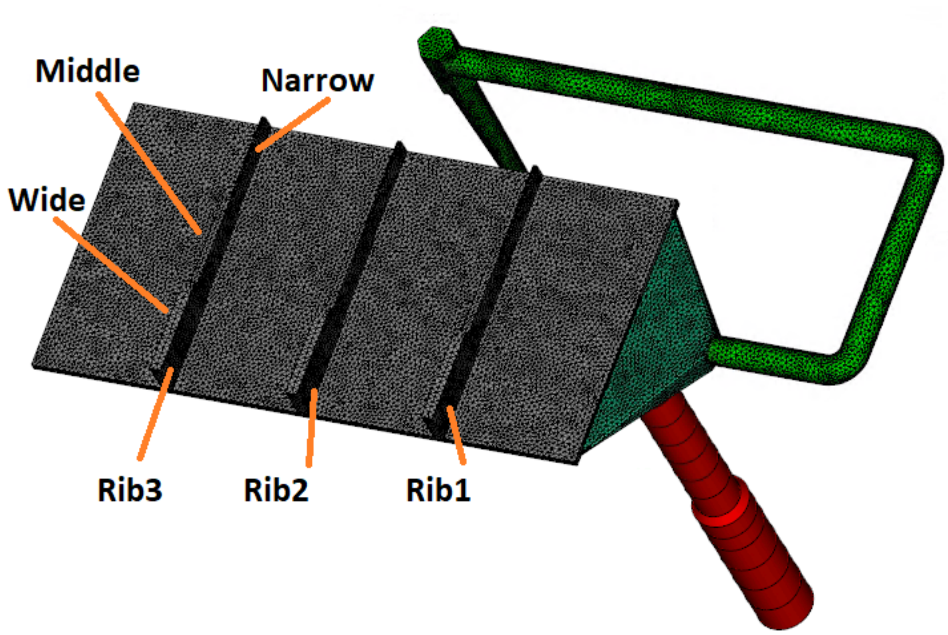


Figure 3: Mesh used in the case study of a ribbed rectangular plate.

The material used in the study was an Acrylonitrile Styrene Acrylate (ASA), with the material grade name of CSW860UV from Cepla Co. The mold temperature was 60°C, the initial melt temperature was 220°C, and the fill time was approximately 1 sec with flow rate of 40 cm^3/sec. The packing time was 8 sec, and the cooling time was 15 sec. Packing pressure was 60 MPa.

The simulation results are shown in Figure 4. The air trap result is shown in Figure 4(a). As can be seen, the air traps are present at the narrow regions of Rib2 and Rib3. The burn mark index result is shown in Figure 4(b). The burn mark index values at the 2 air trap locations are both high, which means that burn marks are likely at these 2 locations.

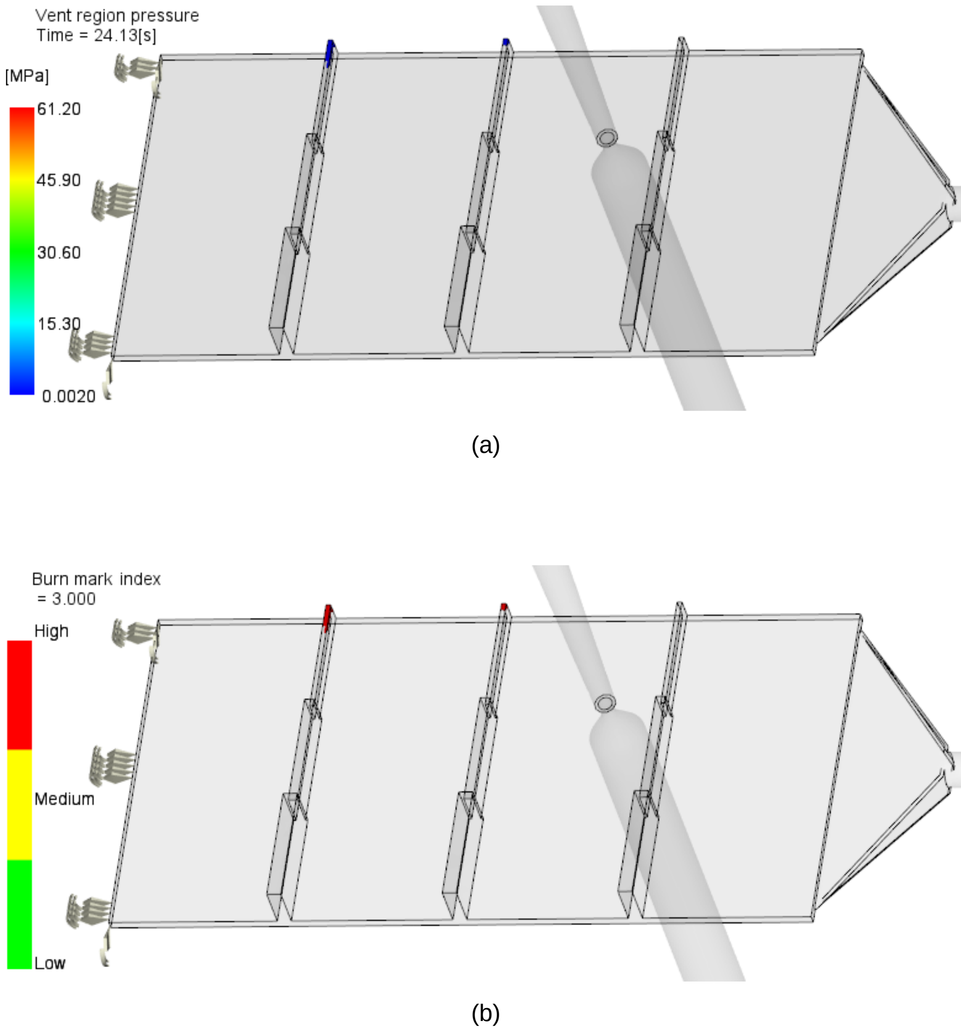


Figure 4: Simulation results for a ribbed plate case: (a) Vent region pressure and (b) Burn mark index.

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