

Using MOLDFLOW to Optimize the Pouring System of Bucket Injection Mould

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Abstract: Combining the structure of the product and the molding material, the mold flow analysis (CAE) was carried out. From the filling process and the pressure at the time of pressure switching, the mold flow analysis was performed on the two buckle-in injection molding process of the insert buckle. And put forward the optimization of the gating system, providing some guidance experience for the repair work.

Keywords: moldflow optimization buckle

1. Introduction

With the continuous advancement and development of scientific and technical heritage computer technology, CAD/CAE/CAM technology is widely cited in today's injection mold design and production. It can not only improve the success rate of a trial, but also shorten the production cycle and reduce the production cost.

This article uses the injection molding process of the Moldflow software simulation program to study the optimization of the gating system shown in Figure 1. Allow the product to be filled and balanced during the injection molding process, and the injection pressure is reduced.

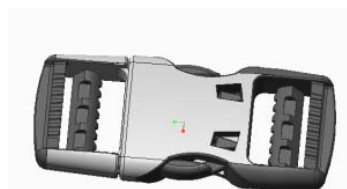
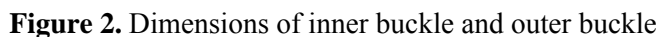


Figure 1. Buckle Combination Chart

2. The structural analysis of the buckles and buckles in plastic products.

As shown in picture 2: The maximum size of the inner buckle is 33.12x52x9.44mm. The outer size of the outer buckle shown in Fig. 3 is 34x53.2x11mm. It can be seen that the dimensions of the two products are not the same.



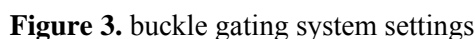


The inner and outer buckles are made of polyoxymethylene (POM). The fatigue resistance of POM is the best among all plastics. The POM has a high heat distortion temperature of about 172°C. The high degree of crystallinity of the POM leads to a very high shrinkage, which can be as high as 2%-3.5%. The shrinkage of POM is sensitive to injection molding parameters and the size is difficult to control [1].

First, the three-dimensional model of the IGES buckle was imported into the CAD Doctor software. The model was simplified and repaired. The features such as the rounded corners, chamfers, and round holes were removed, and the simplified model was exported to the udm format.

Import cad imported udm format into the Moldflow software for double-level meshing. In the grid statistics, it can be seen that the number of model grid elements after division and repair is 73626, 36793 nodes, 2 connected areas, 0 free edges and non-overlapping edges, no intersecting or overlapping elements, minimum length The ratio is 1.16, the maximum aspect ratio is 8.52, the mesh matching rate is 91.6%, and the meshing quality is good [34].

The mold uses a cold runner, and a side-inside pouring scheme is shown in Figure 3. The gate adopts side gate, small head is 2x1mm, large head is 3.5x2mm side gate size is the same as the size of the two cold runners, and the runner section diameter is Ø4mm. The cold main channel has a cross-section diameter of Ø5 mm and a small head cross-section diameter of Ø2.5 mm.



The material used is POM Delrin 100T NC010 produced by DuPont Company. The material has high strength, good rigidity, hardness, impact resistance, good surface gloss, and good wear resistance [1].

The specific process parameters were as follows: melt temperature was 205°C, mold temperature was 50°C, fill control was set to automatic, speed/pressure switch control was set to automatic, hold

pressure was 80% of injection pressure, hold pressure was 10 seconds, analysis Sequence selection Fill + hold pressure + warp to analyze.

5. Buckle original feeding program simulation results

5.1. Raw Feeding Program Filling Process

Through filling simulation analysis, the filling time shows that the melt filling changes with time. From the filling time, it can be seen whether the filling of the product is balanced. [5] The filling completion time of the two ends of the product is: the external buckle is 3.281 s, the inside buckle is 3.418s. It can be seen from this original gluing scheme that two products of different quality are unbalanced.

5.2. Pressure at the time of speed/pressure switching of the original feeding scheme

The pressure at the time of speed/pressure switching is in the filling stage. At the beginning, it is the speed control of the screw of the injection molding machine. After filling a certain state, the control mode is changed from speed control to pressure control. The pressure at the speed/pressure switching is a single set of data. Usually, the pressure at the V/P switching point is the highest during the entire injection molding cycle, and the unfilled area is shown in gray in the figure. The more balanced the product, the unfilled area is equal, and the smaller the pressure is [5]. As shown in Figure 4, we can see that the V/P switching pressure is 77.59Mpa, and the area of the gray area is not equal. After the outer buckle has been filled, the inner buckle is only used for speed and pressure conversion, and the two products are unbalanced.

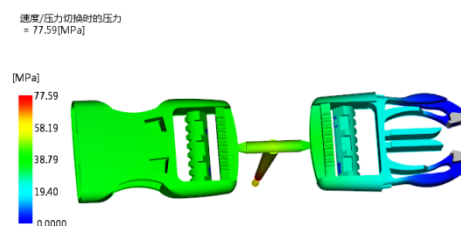


Figure 4. Pressure diagram for speed/pressure switching in the original feeding program

5.3. raw plastic program conclusion

Therefore, the POM used in plastic materials is more sensitive to pressure. The pressure at V / P conversion is the highest during the whole injection cycle. The pressure is 77.59Mpa. If the plastic material POM withstands a large injection pressure, it will be subject to the inside of the cavity. The possibility of material degradation under shear stress.

Degradation is a plastic under the external conditions of high temperature, stress, oxygen and moisture, chemical reactions, resulting in polymer molecular chain fracture, so that the elasticity disappears, the strength is reduced, the product surface roughness, shorten the service life.

From the filling time and pressure, it can be seen that the original feeding program was unbalanced and the injection pressure was higher, so we optimized the gating system.

6. Buckle optimization program setting and result optimization

6.1. Optimization Principle

The size and structure of the outer buckle and inner buckle are not the same, so the required weight of the filling material is also different. Plastic products on the injection molding machine stage are required to complete injection molding and pressure maintenance at the same time, ie, flow balance. But how to produce different quality products in the same time? The weight of the product is calculated as $m = \rho V$ ie: mass = density X volume. The materials are all POM, so the density is the same. We can calculate the volume of the cavity by calculating the volume of material passing through

the flow channel. This mold is a circular runner + side gate into the plastic. Keep the side gates unchanged and change the volume of the circular cold runner. Circular flow volume = $\pi \times r^2 \times h$. h is the length of the flow channel, which is the same, so you can control the flow channel cross-sectional area size is not the same to control the volume size [2].

6.2. Optimization Program Casting System Design

The mold continues to use a cold runner. A side-inside pouring scheme is shown in Figure 14. The two gates use a side gate, and the outer buckle and the inner side gate are 2x1mm, the large head is 3.5x2mm, and the gate size is the same. The size of the two cold runners is $\varnothing 4$ mm. The cold main channel has a cross-section diameter of $\varnothing 5$ mm and a small head cross-section diameter of $\varnothing 2.5$ mm.

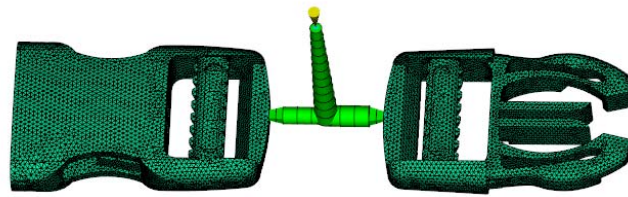


Figure 5. Optimize the design of the plastic design

6.3. Optimized solution filling results.

Through the filling simulation analysis, the filling completion time of the two product ends after the optimization of the feeding program is respectively: The outer buckle and the inner buckle are both 1.09s and the filling is completed at the same time as shown in FIG. 6.

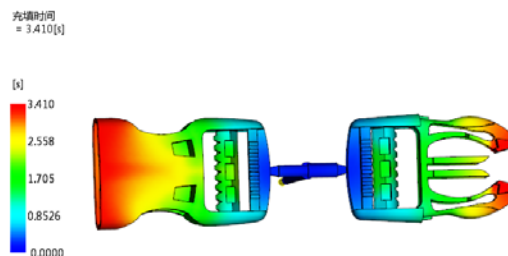


Figure 6. The optimized solution is completely filled

6.4. Optimized Solution Pressure Results at Velocity/Pressure Switching

Through filling simulation analysis, as shown in Figure 7. The pressure at the time of speed/pressure switching is 64.58Mpa, and the speed/pressure of the original scheme is switched to 77.59Mpa. The optimized scheme is 13.01Mpa less than the original scheme, and the area of the gray area is almost equal, indicating that the scheme is filled and balanced, reducing the risk of plastic materials being degraded by pressure.

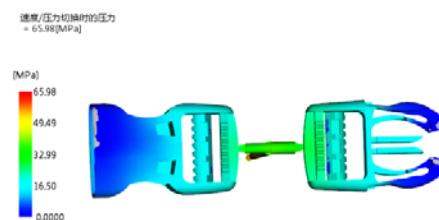


Figure 7. Pressure diagram for speed/pressure switching of optimized solution

7. Conclusion

In this paper, Moldflow software is used to optimize the glue-inserting scheme of the buckle from the pressure during the filling process and pressure switching, which reduces the time for the repair of the mold in the later period. Through the simulation analysis of the existing molds, it can be found that there are deficiencies in the design, to provide guidance for the repair work.

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