

# Comparison Of Simulation Results When Using Two Different Methods For Mold Creation In Moldflow Simulation

Kaushikbhai C. Parmar, Dr. H. Kaiser

**Abstract:** Simulation gives different results when using different methods for the same simulation. Autodesk Moldflow Simulation software provide two different facilities for creating mold for the simulation of injection molding process. Mold can be created inside the Moldflow or it can be imported as CAD file. The aim of this paper is to study the difference in the simulation results like mold temperature, part temperature, deflection in different direction, time for the simulation and coolant temperature for this two different methods.

**Index Terms:** Injection Molding Simulation, Autodesk Moldflow Simulation, Different methods for Mold Creation, Simulation Result Comparison.

## 1 INTRODUCTION

SIMULATION is playing key role in industry for injection molding process and prediction of defects that may occur before starting the production [1]. Autodesk Moldflow Simulation is most used simulation software for simulation of different injection molding processes to optimize the processing parameters [2]. It is possible to do Fill, Pack, Cool, Cool (FEM) and Warp analysis. It provides results like fill time, air traps, weld lines, pressure distribution, temperature distribution, volumetric shrinkage distribution and deflection which are very useful for optimization of processing parameters like fill time, injection time, pressure profile, packing time, mold temperature, melt temperature, coolant temperature, cooling time and prediction of problem in advance [3]. The software is provided with two different methods for creation of injection mold for Cool (FEM) analysis. The mold surface any size can be created inside moldflow software, which is further meshed and use for carrying out the simulation. The other method is to import a CAD model of injection mold, designed using any CAD software available, can be imported. It is important to see the difference in simulation results and time needed for the simulation when using two different methods.

## 2 SIMULATION PROCEDURE

The part used for the study is Valve Cover as shown in Fig. 1. The material used for this product is PA6 with 35% glass fiber. Before carrying out Cool (FEM) analysis, it is require to have optimized processing parameters like filling time, packing time, packing pressure profile, mold temperature, melt temperature and additional cooling time. The part is cooled using combination of conventional and conformal cooling channel. Conformal cooling channel gives better cooling, uniform temperature distribution and reduction in cycle time [4], [5], [6]. These injection molding parameters were optimized by doing Fill, Fill+Pack and Cool analysis.



**Fig. 1.** Part for Study

It is important to note that for Cool analysis mold is note require. The optimized processing parameters are shown in Table 1.

**Table 1**  
PROCESSING PARAMETERS

Sr. No.	Parameters	Value	Unit
1	Melt Temperature	80	°C
2	Mold Temperature	281	°C
3	Filling Time	1.7	sec
4	Packing Time	15	sec
5	Coolant Type	Water	-
6	Coolant Inlet Temperature		°C
7	Additional Cooling Time	1	sec

For carrying out Cool (FEM) analysis 3D meshed mold is require [7]. Before creating mold make sure, that the meshed elements of part, cooling channels, gating system and other elements are available then follow the steps explained below for Cool (FEM) analysis.

### 2.1 Creation of Mold Surface for Analysis

The two different methods for creating mold for Cool (FEM) analysis are as follow.

#### 2.1.1 Creating Mold inside Moldflow Software

The software provides facility of creating mold of any size inside itself. The steps for creating mold inside the software are as below.

- Kaushikbhai C. Parmar has finished Master Degree Program of Polymer Technology in Aalen University, Germany, PH+918460502782. E-mail: [kaushikparmar13@gmail.com](mailto:kaushikparmar13@gmail.com)
- Dr. H. Kaiser is currently working as professor in Polymer Technology Department in Aalen University, Germany. E-mail:

- Create Mold surface of require size using mold surface available in Geometry tool by simply entering the dimension. It is important that size should be same as that of actual mold size. The mold surface for the study is shown in Fig. 2.

Geometry tool → Mold Surface → Enter Dimension

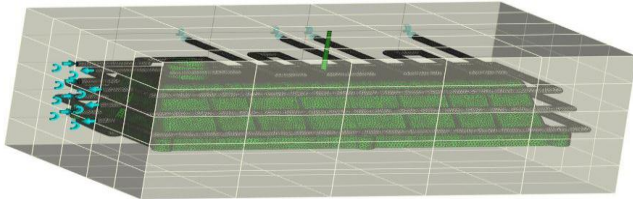


Fig. 2. Mold Surface Created Inside Moldflow

**2.1.2 Importing Mold as CAD Model**

Firstly, the mold is created using any CAD software available. Then the CAD model of mold is imported inside Moldflow. The steps for this method are shown below.

- Import CAD model of the mold in study using Add option available in toolbar. The imported mold is shown in Fig. 3.

Toolbar → Add

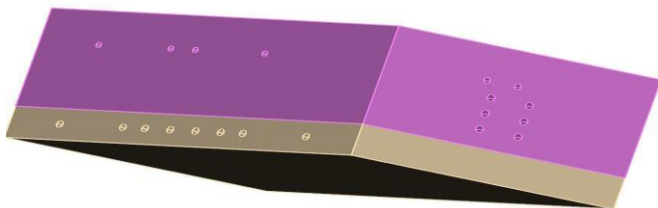


Fig. 3. Mold Imported CAD Model

**2.2 Meshing of Mold**

3D Mold Mesh option available in Mesh tool is used for generation of mesh for mold.

- The meshing of mold surface created inside moldflow is done in two steps. Firstly, the mold surface is meshed. If there is no error then 3D mesh is generated.
- 3D mesh of the mold imported as CAD model is generated in single step only.

**2.3 Set Optimized Processing Parameters for Analysis**

Use the optimized parameters from the Table 1 and enter into the processing setting tool available in study task. Also, provide the inputs for the processing parameter of cooling channels like coolant type, coolant inlet temperature and flow rate. Make sure to create different study file for two methods.

**2.4 Strat Cool (FEM) and Cool (FEM) + Fill + Pack +Warp analysis**

- Cool (FEM) gives results related to temperature distribution and cooling only.
- To have results related to volumetric shrinkage distribution, weld lines, air traps and warpage it addition to above-mentioned results, it is require to do Cool (FEM) +

Fill + Pack + Warp.

After getting the simulation results from the both study. Next comes the comparison of the simulation results to see how they differ from each other.

**3 COMPARISON OF RESULTS**

Comparison of the results helps user in deciding the better method in terms of part quality and time needed for the simulation. Comparison of some of the simulation results is done in the following section.

**3.1 Part Temperature Distribution Comparison**

Part distribution results when using two different methods are shown in

Fig. 4 and Error! Reference source not found..

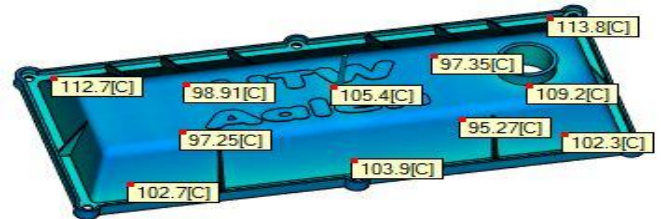


Fig. 4. Part Temperature Distribution for Mold Created Inside Moldflow

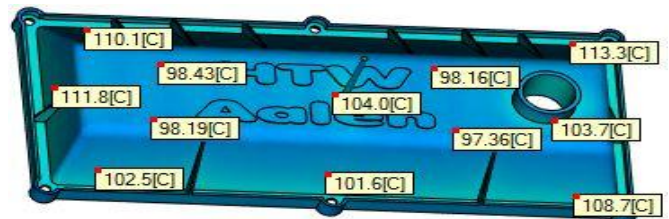


Fig. 5. Part Temperature Distribution for Imported Mold

From both results, it is clear that the temperature distribution over the part is almost same. It means that for selected part, there is no difference in part temperature distribution no matters which method is used for creating the mold. The part temperature is between 95[°C] and 115[°C] for both methods.

**3.2 Mold Temperature Distribution Comparison**

Mold temperature distribution when using different methods for creating are shown in

Fig. 6 and Error! Reference source not found..

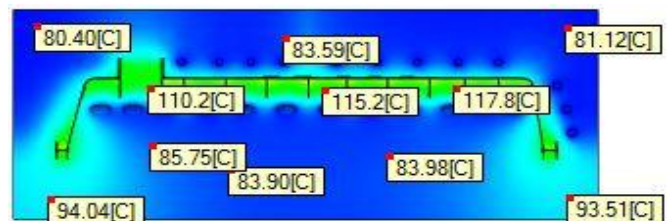


Fig. 6. Mold Temperature Distribution for Inside Created Mold

The mold temperature is between 80 [°C] and 120 [°C] for both methods. The result shows that the temperature distribution over mold is almost same; it does not depend on the method for creation of mold.

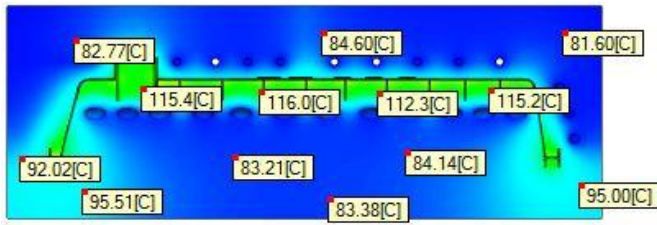


Fig. 7. Mold Temperature Distribution for Imported Mold

The result shows that the temperature distribution over mold is almost same; it does not depend on the method for creation of mold.

**3.3 Coolant Temperature Distribution Comparison**

Temperature distribution in cooling channel for two different methods are shown in **Error! Reference source not found.** and Fig. 9.

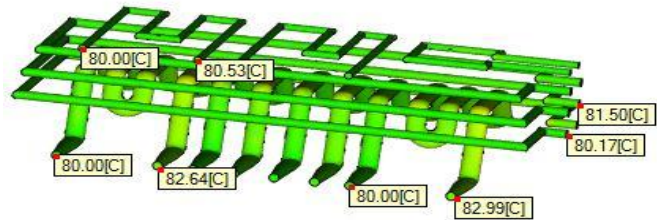


Fig. 8. Coolant Temperature Distribution for Inside Created Mold

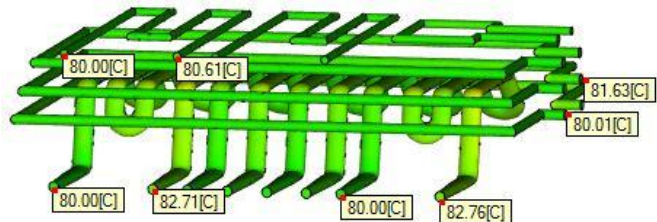


Fig. 9. Coolant Temperature Distribution for Imported Mold

The difference between the inlet and outlet temperature is around 3 [°C] for both results. It is clear from the results that the inlet and out temperature are nearly same for both the methods. They are independent of method of creating the mold.

**3.4 Comparison of Deflection**

Simulation gives the estimation about the deflection of the part that may occur in three different direction. The deflection results helps the user in deciding whether the part will remain within require dimension tolerance or not.

**3.4.1 Comparison of Deflection in X-Direction**

Deflection of the part in X-direction is shown in **Error! Reference source not found.** and **Error! Reference source not found.**. The minimum and maximum deflection of part in X-direction is around -0.85 [mm] and 1.19 [mm] respectively for both methods. It is clear from the results that the deflection of part in X-direction is nearly same and the difference is very small which is negligible. The deflection of part in X-direction does not depend on the method of creating mold.

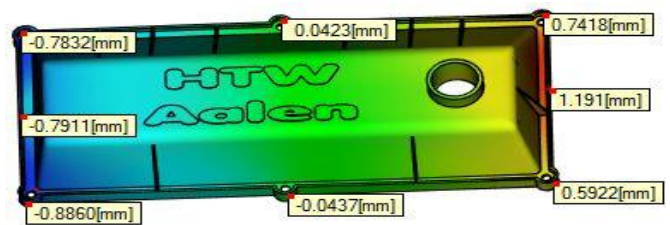


Fig. 10. Deflection in X-Direction for Inside Created Mold

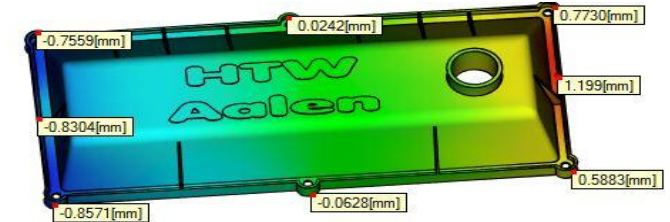


Fig. 11. Deflection in X-Direction for Imported Mold

**3.4.2 Comparison of Deflection in Y-Direction**

Deflection of part in Y-direction is shown in **Error! Reference source not found.** and **Error! Reference source not found.**.



Fig. 12. Deflection in Y-Direction for Imported Mold



Fig. 13. Deflection in Y-Direction for Imported Mold

The minimum and maximum deflection of the part in Y-direction are -0.85 [mm] and 0.70 [mm] respectively for both methods. In addition, the deflection results are almost same and do not depends on the method of creating the mold.

**3.4.3 Comparison of Deflection in Z-Direction**

Deflections of part in Z-direction are shown in **Error! Reference source not found.** and **Error! Reference source not found.** for both methods. The minimum deflection of the part in Z-direction are -1.66 [mm] and 0.82 [mm] respectively. The deflections for both methods are almost same, which means that the result does not affected by the method of creating mold.

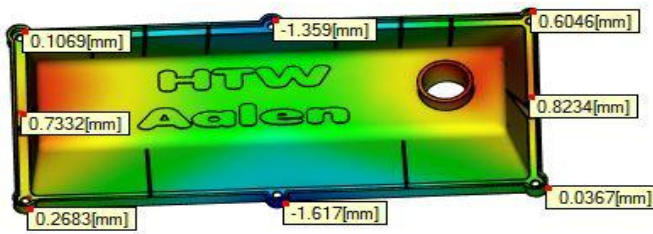


Fig. 14. Deflection in Z- Direction for Inside Created Mold



Fig. 15. Deflection in Z- Direction for Imported Mold

### 3.4.4 Comparison of Deflection in All Direction

This result provides the probable overall deflection of the part considering the all direction. The deflection of part in all direction for both methods are shown in **Error! Reference source not found.** and **Error! Reference source not found.**



Fig. 16. Deflection in All Direction for Inside Created Mold



Fig. 17. Deflection in All Direction for Imported Mold

The minimum and maximum overall deflection of the part are - 0.85 [mm] and 0.7 [mm] respectively for both methods. Like other deflection results, overall deflection does not affected by the method of creating mold for analysis.

### 3.4.5 Comparison of Time Needed for Simulation

The time is most important factor for comparison. Time needed for simulation when importing the mold as CAD model is 4hr 42min, which is around 20min more when creating mold inside moldflow for simulation. So, it can be said that the time needed for is little bit more when importing mold as CAD model.

## 4 CONCLUSION

The difference in results of part temperature distribution, mold temperature, coolant temperature distribution and deflection of part is very small and negligible. It means that the simulation results for the selected part does not depends on the method of creating mold for analysis. The time needed for the simulation when importing mold CAD model is little bit higher in comparison to the other method of creating mold for simulation. The study includes simulation of only one part. In future, it is recommended to compare the simulation results for more complex parts to see the effect of different methods of creating mold for analysis on different simulation results.

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