Annals of DAAAM for 2010 & Proceedings of the 21st International DAAAM Symposium, Volume 21, No. 1, ISSN 1726-9679
ISBN 978-3-901509-73-5, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2010
Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird
Annals of DAAAM International

ALGORITM FOR REALIZATION OF A DIE USED IN MICRO INJECTION MOLDING

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Abstract: *The paper presents the methodology to obtain a die used to study the flow in cavities witch has applications in microinjection molding process. To realize the die it was used the next algorithm: conception and designing of die in CAD the FEM simulation of the part G-code generated program in CAD software and the manufacturing of tool.*
Key words: *micro injection molding, flow simulation, mold, g-code, die*

1. INTRODUCTION

The micro injection molding process is known in special literature to be a little different from normal standard one because of his particularities. The engineer's purpose is to minimize everything we know in almost every industry. The parts obtained by microinjection molding have applicability in most of industries: medical research, mechanics, electronics, micro fluidics, automotive, recreational and optics.

The dimensions of the parts in this industry are somewhere below 10mm and they have weights witch not pass 1gram (Wintermantel & Ha, 2009). Unlike conventional injection molding the micro injection is different; in fact the process must be redesigned step by step in making parts. The advantages of this method are:

- Parts more accurate;
- Very fast cycles;
- Tooling is less expensive;
- Process specialized for miniature parts;

2. THE ALGORITHM USED

For making the die we used a simple algorithm that is presented in figure 1. The die for the mold is made from aluminum and the part we want to obtain is from ABS polymer. The algorithm had four stages between we obtained the physical part.

The first step contains the conception and design of the die in CAD which must be simple and easy to draw. After we make the CAD design we try some flow simulation of the part with FEM analysis. The testing includes simple parts and the simulation of flow in the interior of the mold – injection system and two cavities. If the analyses will give positive results we will continue the experiment by exporting the CAD file into a neutral file for CAM program. In CAM software it will chose the tools and the manufacturing strategies fabrication conditions to manufacture the part.

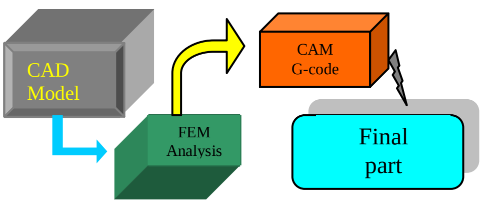

Fig. 1. The used algorithm

3. EXPERIMENTAL RESEARCH

3.1 CAD modeling part

Die dimensions must be chosen according as the mold size. So the die size will be under restraint by the mold concept and the size of cavities.

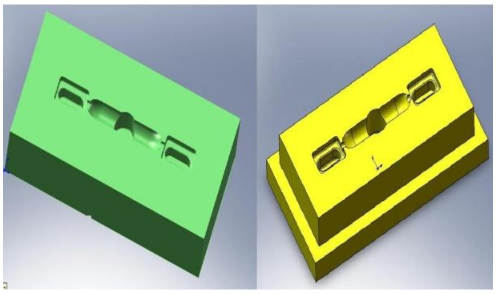

Fig. 2. CAD model of die

The CAD model of die was made in Solid Works and it could bee saw in figure 2. During the design we make the pieces we want to obtain in the first case and then we draw the die. The part we want to obtain from ABS has embarrassment of 0.04 grams and the form of a stamp.

The option for die was chosen for two cavities and the sizes for these are length 40 mm width 20 mm and height 10 mm (Jones, 2008).. The die design is simple because we aimed to achieve during the time to make the part to be short so that the platform be made operational at a time more efficiently.

3.2. Flow simulated part in CAE

After we completed the CAD model for part and die with two cavities we make tests in FEM simulations (Karlberg & Pacey, 1989).. For simulations in CAE software were used for the first piece from Solid Works software the MoldflowXpress module were we try 10 simulations at different temperatures (Klein, 2007). The material chosen from the part was ABS and the weight of a piece is about 0.04 grams.

Temperatures used in simulations are random selected that will permit us to observe which combination is the most effective and which is lowest efficiently.

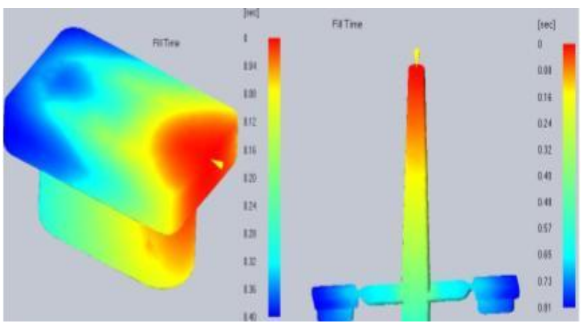

Fig.3. MoldflowXpress analysis

Nr. Curt.	Melt Temp [deg C]	Mold Temp [deg. C]	Fill Time [sec]	Part & Runner Fill Time
1	200	40	0.4	1.22
2	210	45	0.4	1.11
3	225	55	0.3	1.02
4	240	67	0.3	1
5	258	78	0.3	0.91
6	260	42	0.2	0.81
7	245	50	0.3	0.91
8	230	58	0.3	1.01
9	215	66	0.4	1.22
10	207	80	0.51	1.52

Tab. 1. Results of flow simulations

From figure 3 and table 1 we observe there are no problems in filling the part and the cavities. The part will fill quickly if the melt temperature is high and the temperature of the mold is set to minimum. From the same table we can see if the melt temperature is low and the mold temperature is high the fill time will grow.

The flow study is a very important rheology phenomenon and several factors involved in the filling piece like: temperatures, pressures, material viscosity and fill time (Han, 2007).

3.3 Die simulation in CAM and manufacturing

CAM programming and processing represent the last level for the engineer to materialize the finished part he want to obtain. So after we make the geometrical model and the flow simulation we need to make the CAM analyses.

CAM programming is considerate more complex than product design and the engineer must have good knowledge about the process, the machine, tools and work piece material.

The tools chosen for simulation software must be suitable for roughing operation or finishing operation. In some cases of roughing the tool can not process certain sections from part due to his large diameter. This disadvantage will be eliminated in the finishing phase when we must choose a tool with the smallest diameter possible.

In our project the file of the die created in Solid Works software was saved to a STL file to be imported into Edge CAM software. In the program were chosen the specific tools for milling operation and processing simulation were performed (figure 4). If the simulation gives some errors they will be seen on the bottom of the program page and the red color will show on the screen. If there are not problems is generated the g-code to machine to fabricate the die.

The tool chosen for manufacturing was an end mill with a diameter of 1 mm and 38 mm in length. Clamping of the tool diameter was 3 mm and the machine which performed the part was ISEL GFM - 4433.

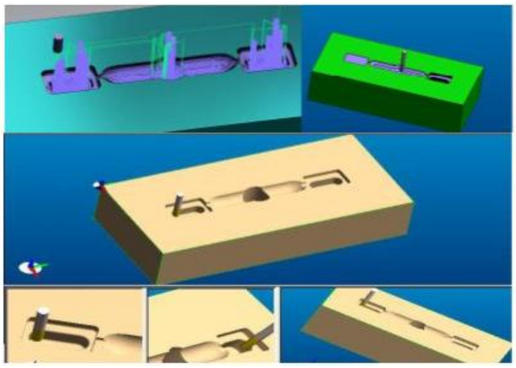

Fig. 4. Processing in CAM software

Fig. 5. Final part manufactured

The die for mold was made in aluminum material and the working time for roughing was two hours and at the finishing operation working time were almost 4 hours with over 18,000 lines to G-code.

Figure 4 is apparent from the tool path generation processing and simulation of various aspects of die making. In figure 5 is shown the final part model compared to a lead pencil, a coin and a paper clip.

The finally stage is to measure the part obtained and give some conclusions about the whole process.

4. CONCLUSION

This paper aims to achieve the technology and obtain the final part using a simple algorithm. We followed the steps through all three processes CAD, CAE and CAM to obtain the final part.

- ✓ The piece was make in good conditions using the selected tools;
- ✓ Design was done correctly;
- ✓ FEM simulations have given positive results;
- ✓ Working time was 2 hours and 4 from roughing to finishing operation because of small depth used at 0.05mm

In conclusion we can say the objectives of research were achieved therefore the die for mold made from aluminum material can be used to obtain such pieces of ABS.

Making this die was conditioned by the fact that in the future we want to make a mold for it for microinjection to witch we can implementation on it.

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