ASSESS THE APPLICATION OF METAL ADDITIVE IN EXTRUSION BLOW MOULDING

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INTRODUCTION

Nowadays, with the availability of powerful numerical codes processing tool designers are able to conceive, theoretically, very high performance tools. However, in several situations, conventional machining methods limit significantly the geometries that can be manufactured, due to either technical or budget limitations. With the advent of additive manufacturing, the boundaries of the machinable geometries are being pushed forward.

OBJECTIVE

The objective of this work is to assess if the freedom to design more complex shapes provided by Selective Laser Melting (SLM) can be used to design more effective tools for the Blow Molding. This processing technology is used to manufacture containers and other type of hollow products and, comprises by 3 main tools: Extruder, Extrusion Die and Mold.

The extruder melts and homogenizes the polymer and generates the required pressure to force it through the Extrusion Die, which forms a tube. The tube is then collected by the mold and pushed to the cavity walls with pressurized air. The low mold temperatures assure the final part cooling and solidification.

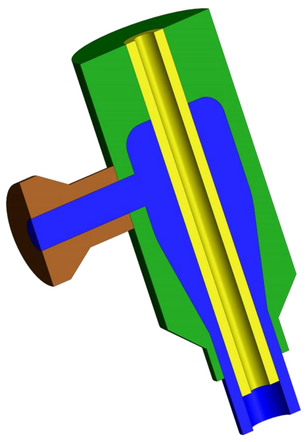

Fig.1:Conventional Die Head

Fig.2:Selective Laser Melting[SLM]

https://www.ganoksin.com/wp-content/uploads/2016/06/IMGA0016.jpg

The works covers the design of the extrusion die (Fig.1), which should promote the lowest possible residence time and reduce the time required for color changes, to avoid large amounts of wasted material. Thus, we aim to take advantage from the geometrical freedom provided by SLM (Fig.2) technology to achieve the above referred aims.

CASE STUDY

To minimize the time for color change mixing elements (Fig.3) were added to the conventional tool (which is a straight channel flow). This should redirect the flow from the middle of the channel to the walls and, with that, increase the speed of change color near the wall, that is the place with the highest residence time in the flow channel.

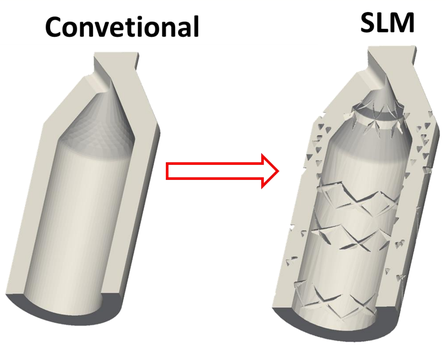

Fig.3: Conventional tool(left) and new design(right)

Will the mixing webs reduce the color change time?

RESULTS AND DISCUSSION

The geometries to analyze are, T0 that is the conventional tool, T1 the first trial made with mixing elements and T2 is the second trial, which was designed to minimize the drawbacks observed on T1, which was accomplished by adding more mixing elements.

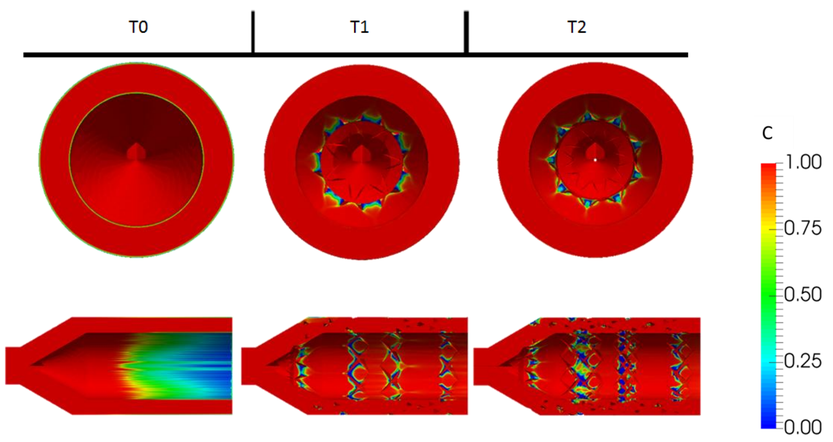

Fig.4: Concentration field at t=10 seconds

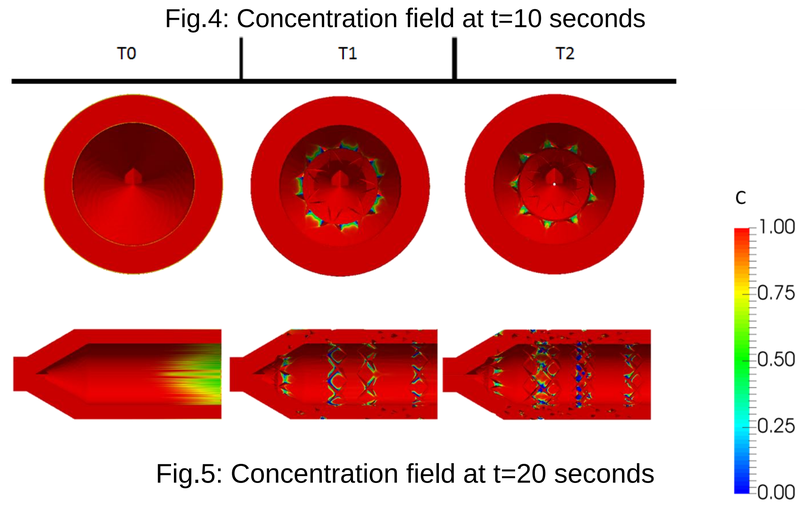

Fig.5: Concentration field at t=20 seconds

Fig.4 illustrates the material distribution in the flow channel 10s after the material change (from concentration C=0 to concentration C=1), for all the tools. As shown, T0 still presents a large amount of the initial material (C=0) near the wall. This is mainly a consequence of the low velocities in that region, which restricts the material renewal. On the other hand, in both extrusion dies T1 and T2 the initial material (C=0) is almost absent on the same problematic regions. The results plotted in Fig.5 also confirms the above statements .

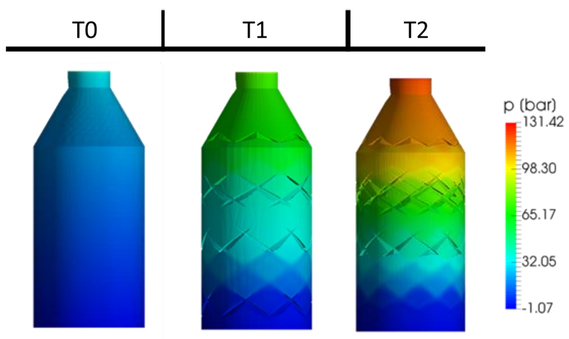

Fig.6: Pressure field

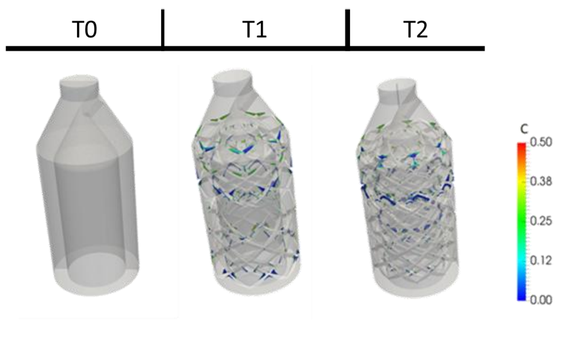

Fig.7: Stagnations points at 20 seconds

A drawback of this design approach is the increase in pressure drop (Fig.6) and also the creation of stagnation points as shown in Fig.7, were is possible to view some points where the older material presents a larger residence time.

CONCLUSIONS & FUTURE WORK

The results obtained allow to conclude that SLM has the potential to increase the performance of the Blow Molding Extrusion Die, when compared with the same tools machined by conventional techniques. The downside of the current geometry is the appearance of stagnation points, which should be corrected in subsequent trials.

SLM has potential to be used in Blow Molding Extrusion Dies Manufacturing

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