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An Introduction to Blow Molding Production Using Additive Manufacturing

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Blow molding is a ubiquitous and inexpensive manufacturing process for applications including bottles, automotive and aircraft ducting, interior parts, double-walled parts, and much more. Traditional blow mold manufacturing relies on CNC machining, which can be an expensive and time-intensive process, requiring days of skilled operator time, material waste, and expensive material stock. Leveraging additive manufacturing (AM) for blow mold production is the answer to many of these challenges.

In this introduction to blow molding production using AM, discover tips for enhancing blow molding capabilities using expert material selection, post-processing techniques, design considerations, and slicing methods to produce high-quality tools for blow molding.

MATERIALS SELECTION

The key to producing a quality blow mold tool is selecting the appropriate material for a given application. For example, tools for PET bottle blow molds get the best results from printing with Essentium PA-CF (carbon fiber-filled Polyamide). Alternatively, high-temperature applications that use Polypropylene or similar polymers to produce ducting or air intakes, need a material like Essentium HTN-CF25 (high-temperature nylon with 25% carbon fill) due to its relatively low cost and great mechanical properties.

POST-PROCESSING

Before a blow mold tool is designed, consider which post-processing method to use. For an AM blow mold, the best post-processing technique is traditional machining to ensure a clean finish surface. Unfortunately, due to the nature of printing parts layer by layer, final tools are left with a tiered surface that make impressions on the final product. Tumbling and vapor honing can polish surfaces but can also smooth critical surfaces such as the pinch point.

DESIGNING

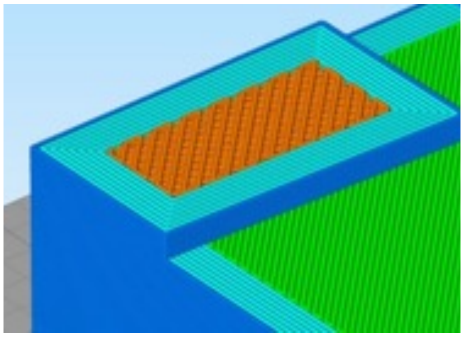
While many of the design rules used in traditionally machined blow molds still apply, there are a few extra considerations for AM-produced tools. First, it is beneficial to adjust the scaling factor so that there is roughly 0.5mm-1mm of material that will be machined away.

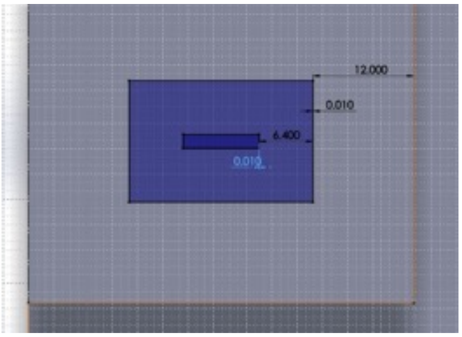
Secondly, polymers are more susceptible to wear and damage than metal, so design the pinch edge to be 0.080” wider, making it 0.120” instead of 0.040” wide.

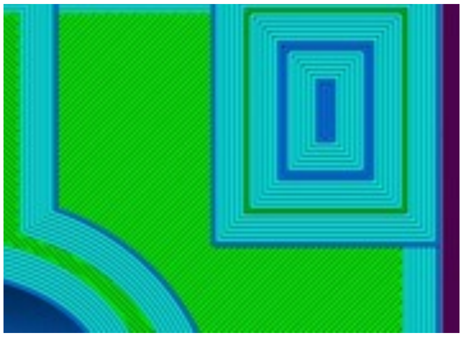
Finally, consider the design of mold cooling vents, or in the case of an AM mold, the lack thereof. It isn’t possible to run cooling lines through the mold because AM-produced blow mold tools are not watertight. This limits the number of cycles that can run successively before needing to cool the mold, but the cooldown time can be accelerated by blowing cool air over the mold halves during the resting period.

SLICING

A strong mold will have 50% infill and a six millimeter shell. This dense infill and thick shell allow molds to withstand the pressure of clamping during the blowing process. Additionally, the pinch edge and crash pads should be solid throughout to withstand the pressure, which is difficult to ensure in slicers that control processes at various heights throughout the build. One solution that tricks the software into creating solid crash pads while allowing the proper infill in less critical areas, is to adjust the CAD file by creating 10-micron cuts, creating separate solid bodies. This method makes it possible to export the .stl file as a single file while allowing the slicer to interpret them as separate parts. This creates a solid footprint, while still enabling the rest of the part to generate its necessary infill. Since this will be machined, speed can be adjusted to print very fast becuase the surface quality in the flash pockets will not matter.







Using traditional manufacturing methods, an aluminum mold like the example above would cost $20,000-$25,000 and a four to five-week lead time. To produce this part with Essentium HTN-CF25, it would take five days to print and three days to post-process, getting the lead time down to just under two weeks. As for cost-savings, with ~$5,000 for material, ~$3,500 for post-processing, and ~$3,000 for print time, the total cost of the product order would be ~$12,000.

With AM, blow mold tools can be produced in half the time at half the cost. This enables manufacturers to produce fewer parts to hit an ROI, making AM ideal for low volume production runs for blow molded parts.

Essentium, Inc. provides industrial 3D printing solutions that are disrupting traditional manufacturing processes by bringing product strength and production speed together, at scale, with an open ecosystem and material set. Essentium manufactures and delivers innovative industrial 3D printers and materials enabling the world’s top manufacturers to bridge the gap between 3D printing and machining and embrace the future of additive manufacturing.