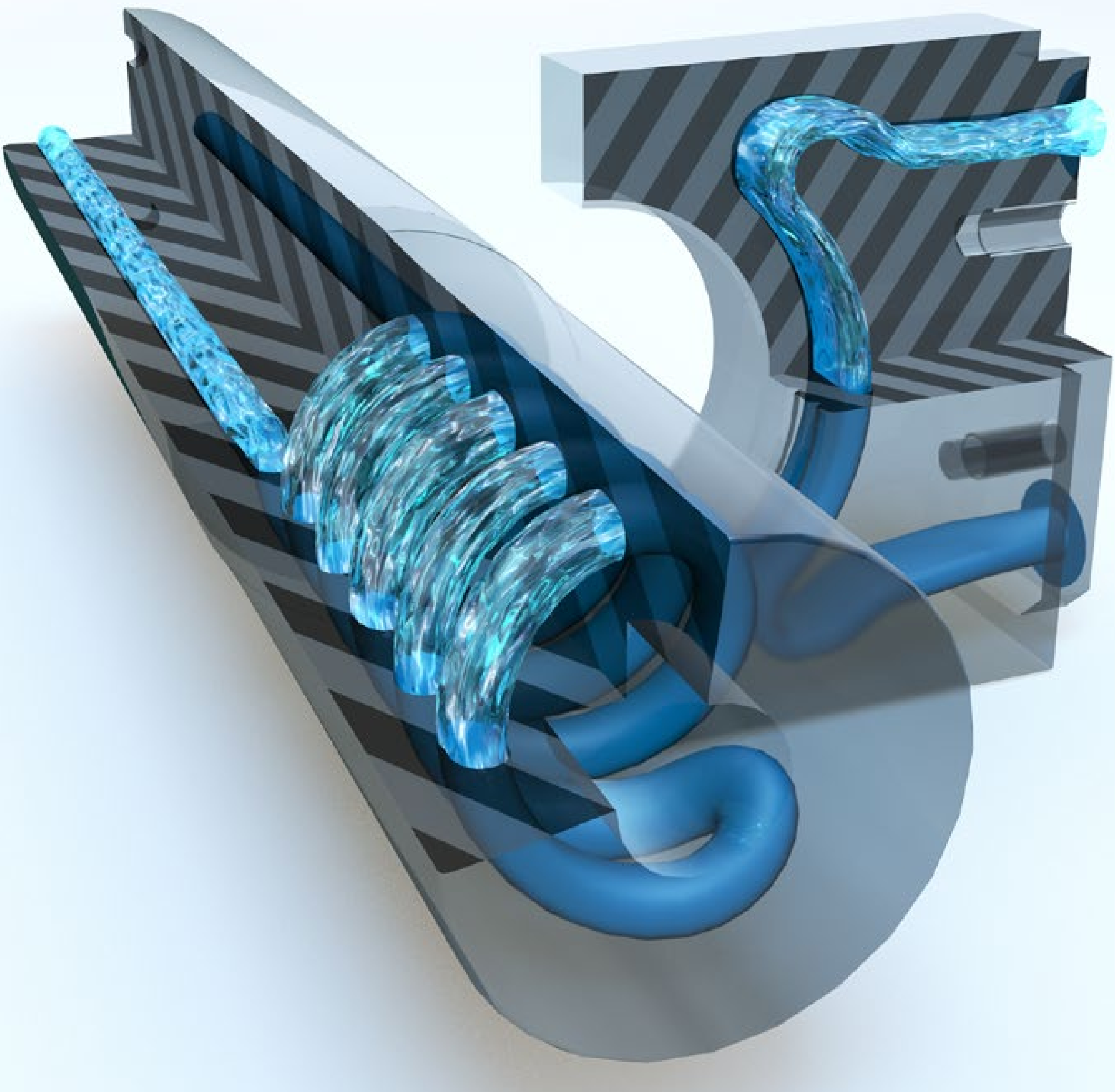
CASE STUDY: MEDICAL CONTAINER

Additive Manufacturing in the tooling industry



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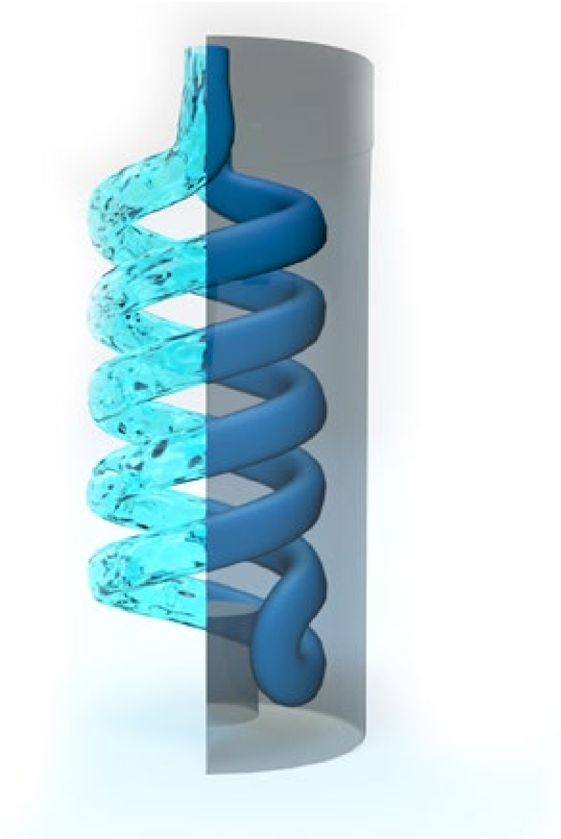
ONE STEP AHEAD.

COOLING
EXACTLY WHERE NEEDED

Conformal Cooling is the next dimension in tool design and optimisation. Additive Manufacturing allows the tool designer to place cooling channels exactly where need to maximise the cooling efficiency of the tool. Cooling channels can be designed to accommodate existing tooling hardware such as ejector pins and hot runner systems, allowing new and existing tooling to be improved with minimum disruption. This level of design freedom is only achievable with Additive Manufacturing and when used correctly can offer superior performance over conventional cooling systems.

However, barriers to adoption remain. These barriers usually relate to the initial cost of adopting AM, since AM inserts usually require a larger initial investment than their conventional counterparts. Therefore, understanding the benefits and potential return on that investment is critical to a successful business case or project justification.

This case study was developed in cooperation with the Advanced Remanufacturing and Technology Centre Singapore (ARTC), and industry partners. It discusses the advantages of Additive Manufacturing (Laser Beam Melting) when producing Plastic Injection Mould inserts for the medical industry.



PROBLEM

A standard Polypropylene medical container was selected for improvement. Typical production qty's of this part are 200,000 units per month.

Conventional "line-of-sight" cooling channels can result in temperature deviations across the surface of the tool, this can impact the quality of the moulded part, causing issues with material flow. The thin walls of these containers mean the moulding processes can be prone to quality defects, such as warpage and distortion, particularly when moulding larger or deeper product types.

IN SHORT

The adoption of Additive Manufacturing gives the tool design greater control over the thermal characteristics of the tool.

When implemented correctly AM can significantly improve tool productivity in a number of areas by reducing the cycle time per part, by reducing the number of part defects per batch, and (if the correct material is used) extend the life of the tool.

SOLUTION

An existing single cavity mould was selected for optimisation. The cavity, core and sliders all have the potential for re-design to incorporate conformal cooling. The following requirements where outlined as part of the tool re-design process:

» The printing material will be a dedicated plastic injection mould tool steel to improve overall tool life.

» Cooling channel design will improve cooling circuit efficiency to reduce overall cycle time.

» The diameter and shape of the cooling channels will be maximised to increase cooling circuit flow rates.

» Cooling channel design will address hot spots and temperature deviations to reduce potential defects.

» Use baseline data to estimate potential savings for 1, 4 and 8 x cavity tool systems.

COOLING
EXACTLY WHERE NEEDED

ANALYSIS

As stated, when used correctly 3D printed inserts containing conformal cooling are an excellent solution to improve productivity with minimum disruption to existing tool set-ups. Many customers view Additive Manufacturing as a potential solution for large multi-cavity projects. When the opposite is true. This project has shown that 3D printed tooling is cost effective when used to optimise both single and multi-cavity tooling, showing the benefits and technology are scalable.

25.6% CYCLE TIME REDUCTION (18.95 SECS TO 14.10 SECS)

$14,552 USD ESTIMATED COST SAVING 1 X CAVITY TOOL (1,500,000 UNITS)

$126,341 USD ESTIMATED COST SAVING 8 X CAVITY TOOL (12,000,000 UNITS)

COSTS

The table below shows the costs for each configuration of tool (1, 4 and 8 cavities) with an assumed insert tool life of 5 million shots. The additional cost of producing AM tooling was included in each tool calculation. As shown the additional benefits of AM tooling (cycle time reduction etc) outweigh the initial investment cost for all tool configurations.

BENEFITS

Parts produced using the AM tooling showed reduced temperature deviation from the neck to base and improved dimensional stability. Thus, resulting in a reduced number of defect parts across the production run.

In addition, the parts manufactured using AM tooling did not show any signs of cosmetic surface defects when compared to conventionally produced parts.

	Mould tool of		
Costs	1-cavity	4-cavity	8-cavity
with conventional inserts	23,525 USD	70,201 USD	120,209 USD
with conformal cooling inserts	28,025 USD	86,992 USD	146,282 USD
Tooling cost difference	-4,500 USD	-16,791 USD	-26,073 USD
Overall no. of parts	1,500,000	6,000,000	12,000,000
Cycle time difference	25.6%	25.6%	25.6%
Opportunity gain	19,052 USD	76,207 USD	152,414 USD
Overall gain (+) / loss (-)	**14,552 USD**	**59,416 USD**	**126,341 USD**

This dataset was created in cooperation with ARTC

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