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Design and manufacture a cost-effective, high-performance plastic injection mould using a hybrid additive-subtractive manufacturing strategy

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Conformal cooling channels (CCC) are essential in plastic injection moulds to enhance cooling and reduce the cycle time. Recent advances in metal additive manufacturing (AM) make such fabrication possible. However, the utilisation of AM in modern mould-making is still low due to higher manufacturing costs. This article reports designing and manufacturing an 8-cavity plastic injection mould using a hybrid additive-subtractive manufacturing (HASM) strategy to complement an existing 4-cavity mould to meet increasing demand. Inserts in the new mould were designed with CCC, made of hybrid maraging 300 steel powder-wrought 17-4 PH stainless steel, fabricated using laser powder-bed-fusion and finished with conventional mould-making methods. From the cost analysis, the AM tooling cost incurred in building this new mould was about 10% of the total tooling cost. When equipped with conformally cooled hybrid-built inserts, the new 8-cavity mould ran with 56% shorter cooling time and 15% faster overall cycle time than the existing 4-cavity counterpart. Considering the additional tooling cost but faster moulding cycle time that reduced the moulded part cost by $0.01 per unit, the break-even point for this new mould was about 29 days of run time. The HASM strategy used in this project has proven to be a cost-effective solution for high-volume run injection moulds.

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