Design and Production 2016
OMICS International conferenceseries.com
International Conference on
Design and Production Engineering
Berlin, Germany July 25-26, 2016

Thermal behaviour of RHCM mold with different heating/cooling channels design

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Computational Fluid Dynamic and Transfer Phenomena



PLAN

- Introduction
- Presentation of the RHCM producing automotive part
- Thermal behaviour of RHCM mold with classic conformal design
- Thermal behaviour of RHCM mold with new conformal design
- Conclusion

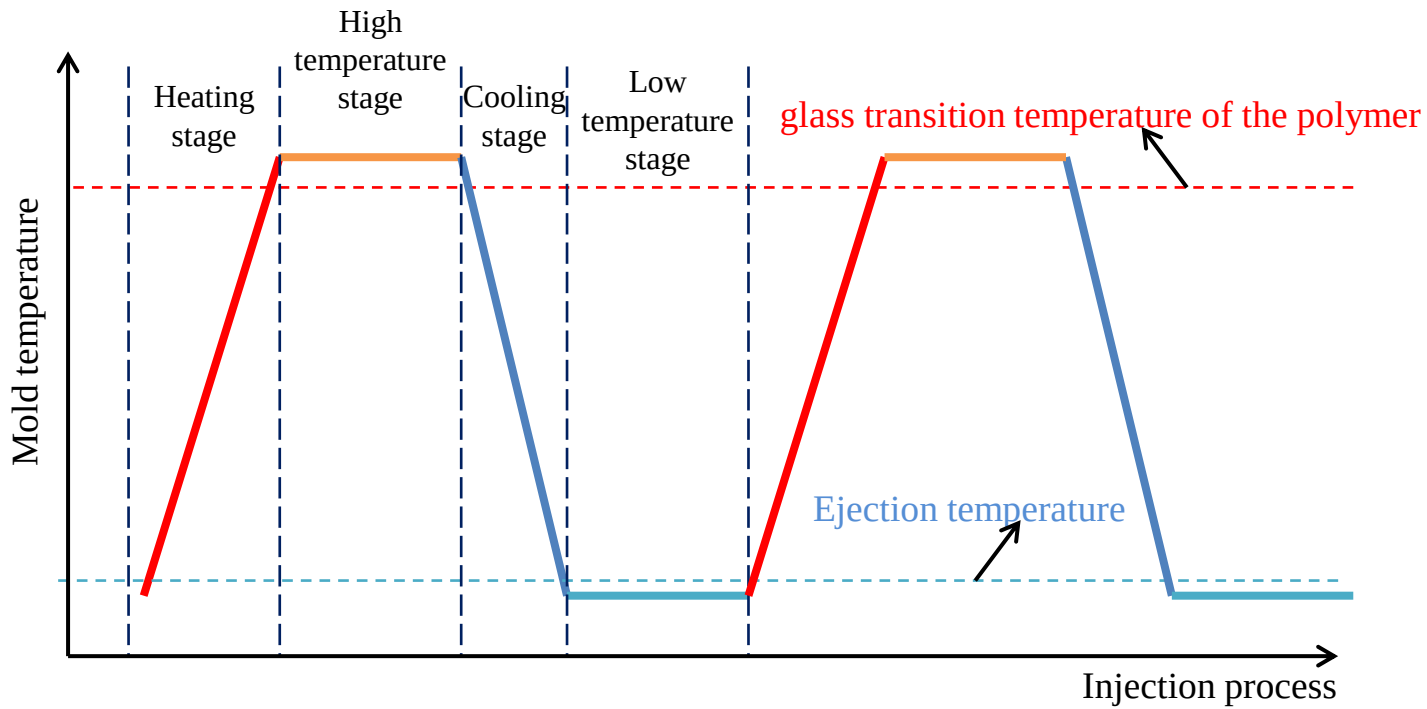


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Introduction

Principle of 'Rapid Heat Cycle Molding' process



To succeed an RHCM operation, we should know how to promote rapid and uniform heating/cooling of the mold.

Introduction

Principle of ‘Rapid Heat Cycle Molding’ process

Part obtained by CIM



Heating of the mold

Part obtained by RHCM



- Weld mark

  poor appearance

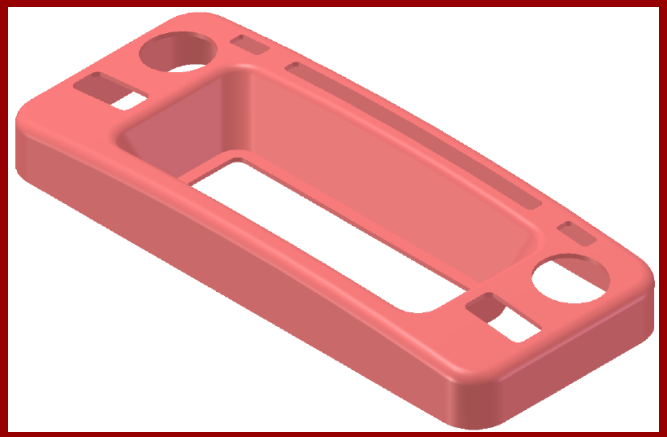
- No weld mark

  Excellent appearance

Introduction

Our objectives

- Predict the heating/cooling scenario of RHCM producing automotive part for several cycles in mold, polymer and coolant fluid domains.





- Improve the design of the heating/cooling channels to enhance finished part quality and process productivity.

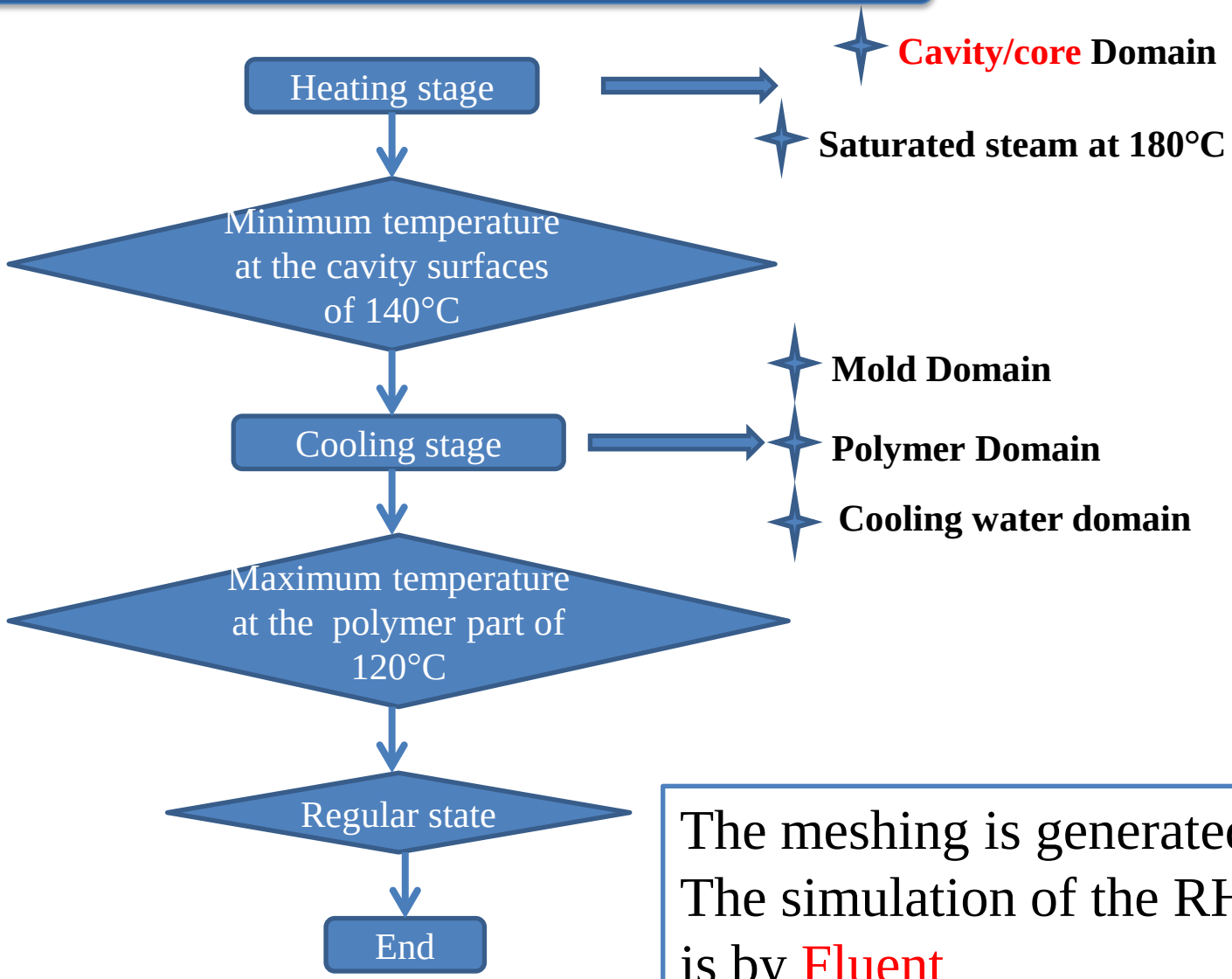


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- New conformal design
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Presentation of RHCM producing automotive part

Conditions of switching between phases



The meshing is generated by Gambit
The simulation of the RHCM process is by Fluent

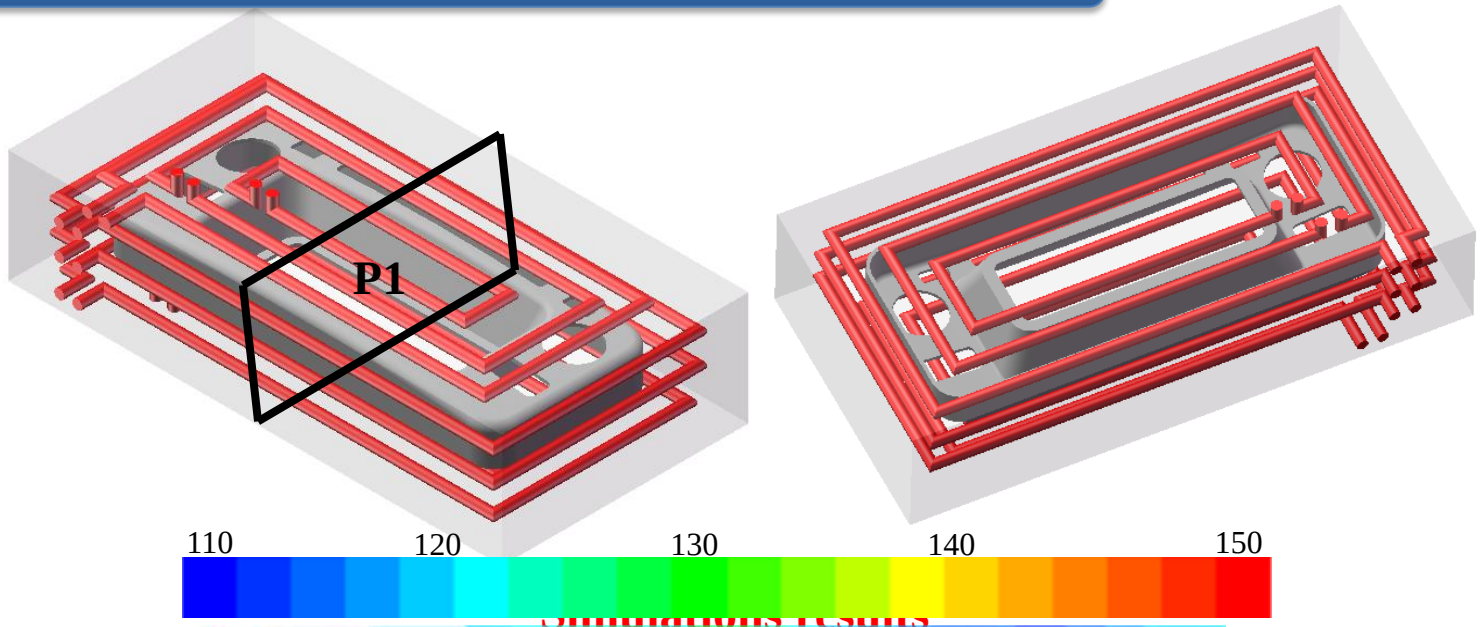


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Thermal behaviour of RHCM mold

Classic conformal design of heating/cooling channels



Horizontal channels folowing the general shape of the automotive part

The central zone allows the

			KJ)
First c			750
Second			637
Third c			36.8

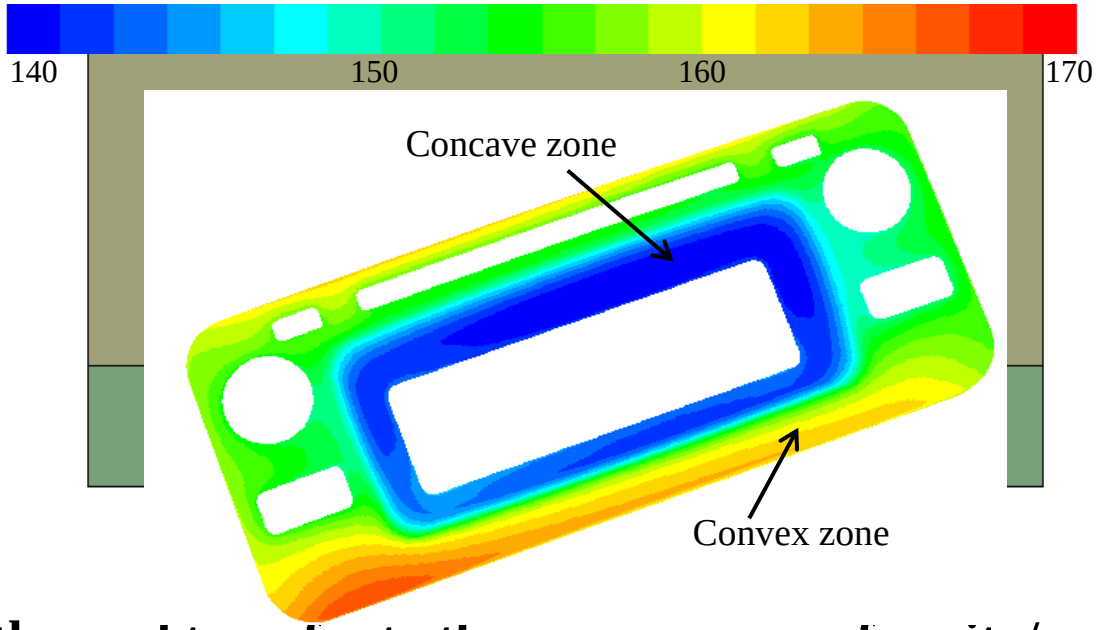
subsequent cycles, which can explain the reduction of the cycle time and the temperature gap

130°C

Temperature map at the end of the cooling phase of the first cycle

Thermal behaviour of RHCM mold

Classic conformal design of heating/cooling channels



- **Improuve thermal transfer to the convex zones of cavity/core plates.**
- **Concave areas with low heating rate and convex areas with high heating rate.**
- **Avoid two areas lead to an costly manufacturing process to produce conformal heating/cooling channels.**

These two areas lead to an uneven temperature distribution generating several problems on the final product quality.

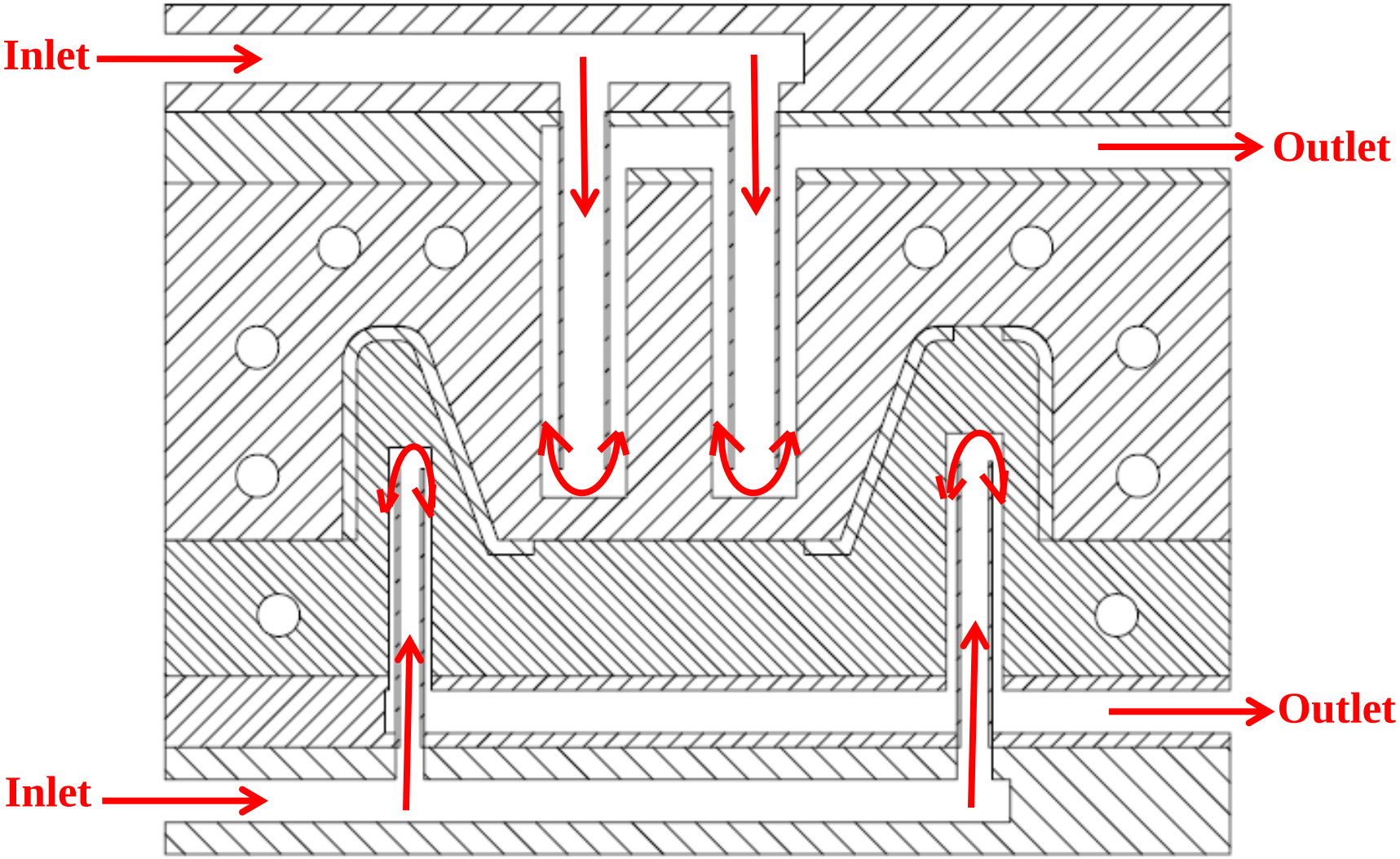


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Thermal behaviour of RHCM mold

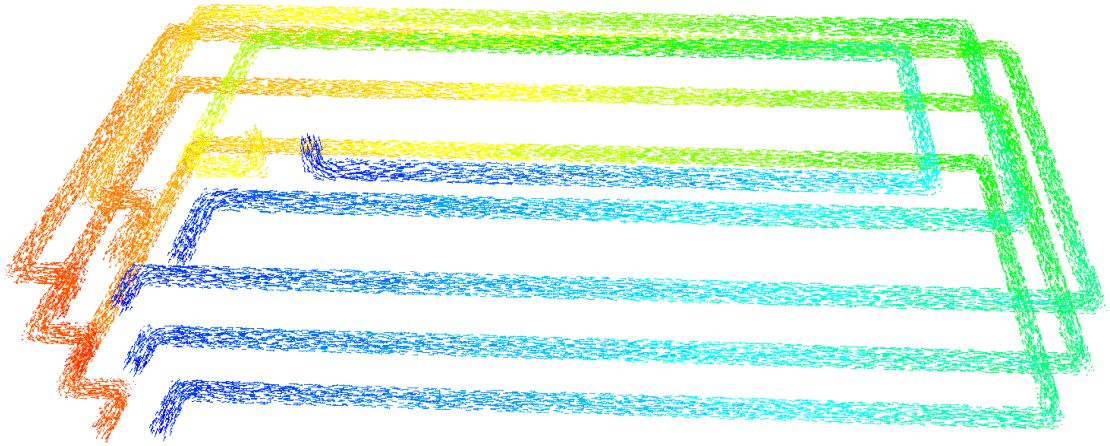
New conformal design of heating/cooling channels

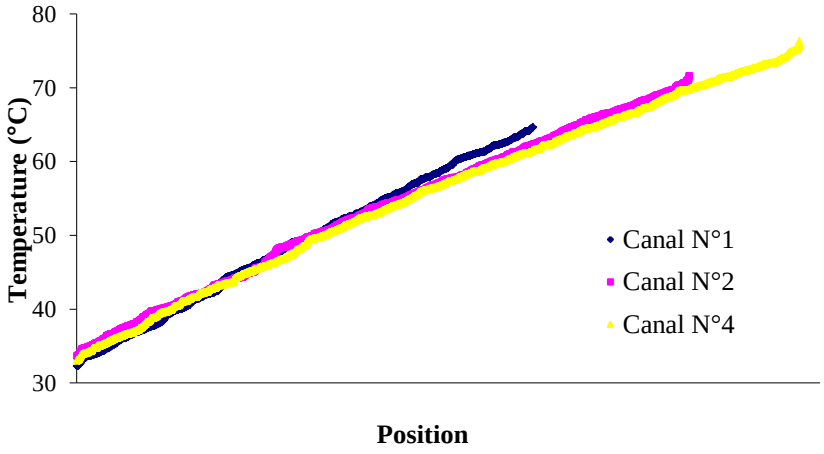


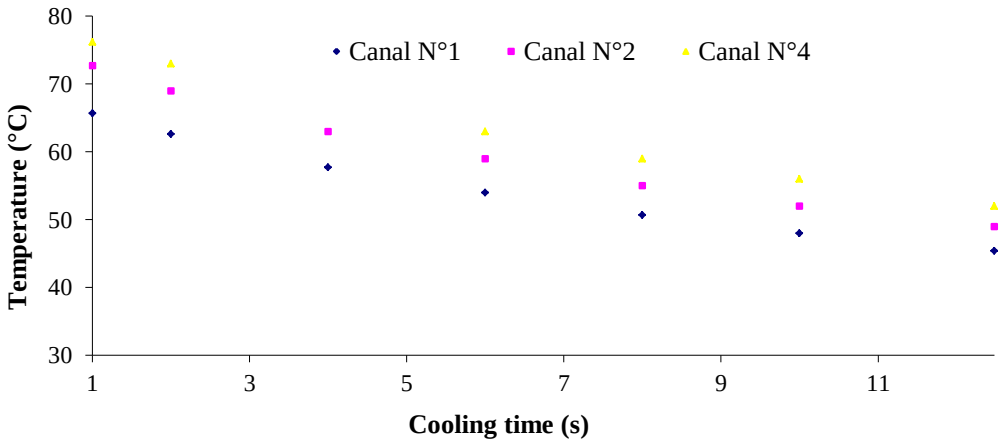
Thermal behaviour of cooling water

New conformal design of heating/cooling channels

Horizontal Channels



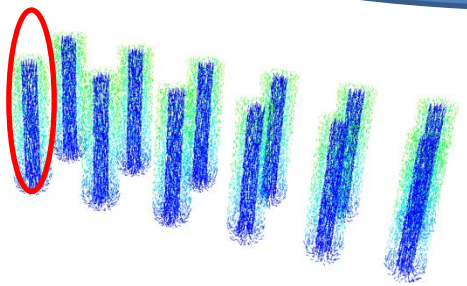


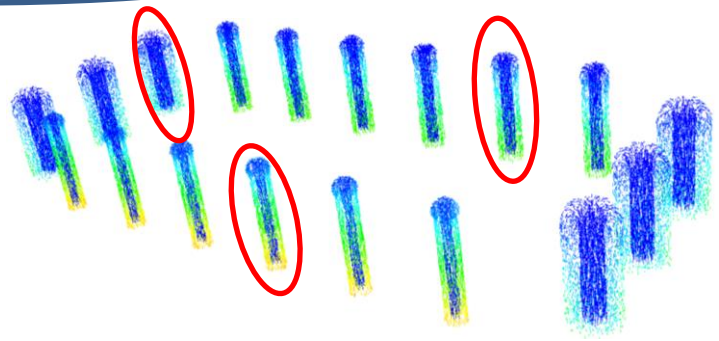


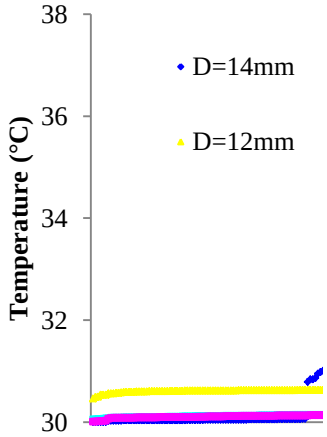
Thermal behaviour of cooling water

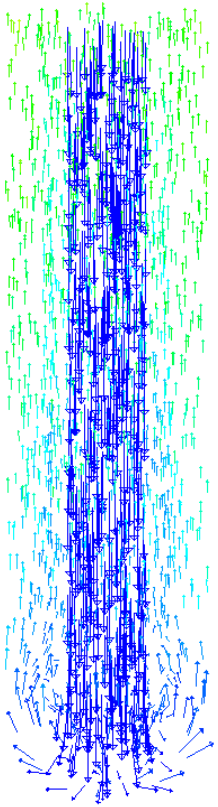
New conformal design of heating/cooling channels

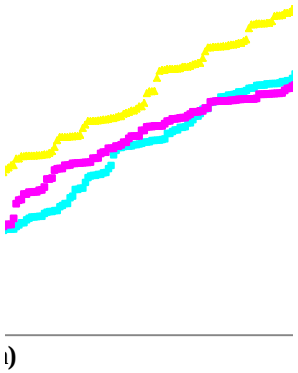
Vertical Channels

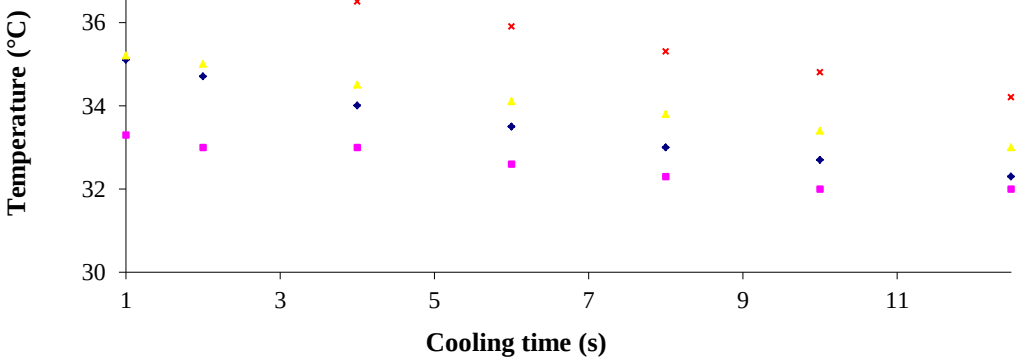




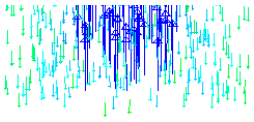




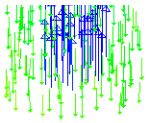




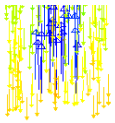
D=12mm



D=14mm



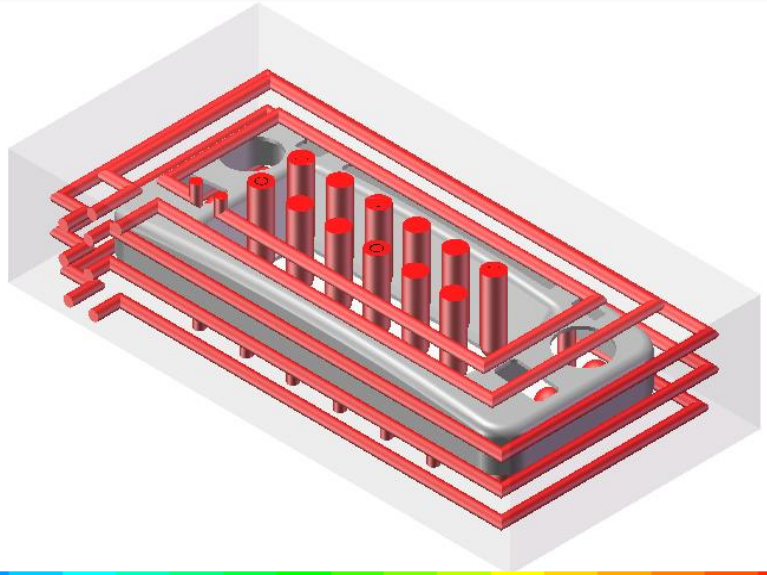
D=8mm

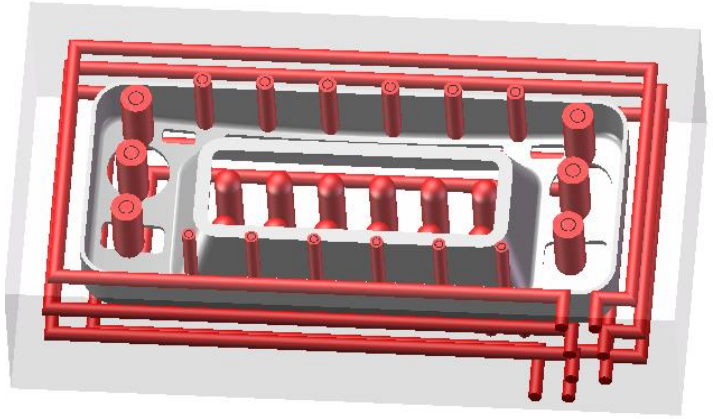


D=6mm

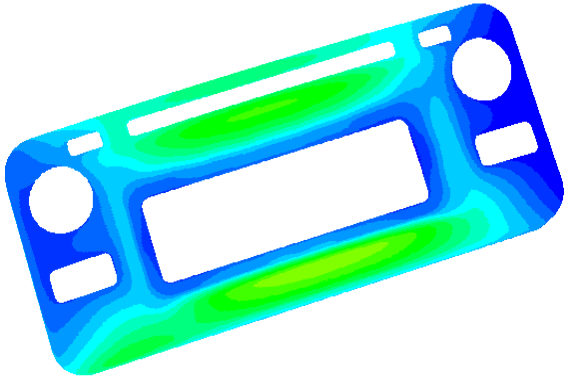
Thermal behaviour of RHCM mold

Conformal new design of heating/cooling channels









Cycle time (s)	23.3
Temperature gap (°C)	17
Comsumed energie (KJ)	550

The part quality and the process productivity are improuved

Thermal behaviour of RHCM mold

comparison between two approaches

- **First approach:** Temperature of cooling water have a constant and have a value of 30 ° C
- **Second approach:** temperature of cooling water at the inlet of cooling channels have a value of 30°C

	Heating time (s)	Cooling time (s)	Temperature gap (°C)	Consumed energy(KJ)
First approach	**14**	**9**	**16.8**	**616**
Second approach	**12,3**	**11**	**17**	**550**

Decrease in heating time by 12%

Increase in cooling time by 22%

Decrease in consumed energy by 12%



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Conclusion

✓With the new conformal design, we significantly improve heat transfer through concave areas of the automotive part.

✓the importance of taking into account of the cooling water domain flowing through channels.



THANK YOU FOR YOUR ATTENTION

