VALIDATION OF A LOW INERTIA MOLD WITH RECTANGULAR HEATING CHANNELS FOR INJECTION PROCESS

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Abstract

Current molding processes for high performance composite materials do not meet future expectations of composite manufacturers in terms of cadence, particularly for aeronautics and automotive [1]. Researches are currently being carried out on resin, reinforcements and process automation, with the aim of increasing composite production line productivity for being competitive in terms of cost-quality-cadence. However, current molds are designed according to rules from the field of plastic injection, which leads to massive structures and low thermal performances [2]. For efficiency on the complete production line, it is essential to conduct research on molds to increase their thermomechanical responses. In a previous study [3], it was demonstrated that the transition from circular to rectangular heating channels, with consideration of technological aspects (pump and pressure drops) could significantly increase heating rates of the structure. The main purpose of this study is to experimentally validate thermal performances of an innovative low inertia mold with rectangular channels compared to a massive reference RTM mold as presented in Figure 1.

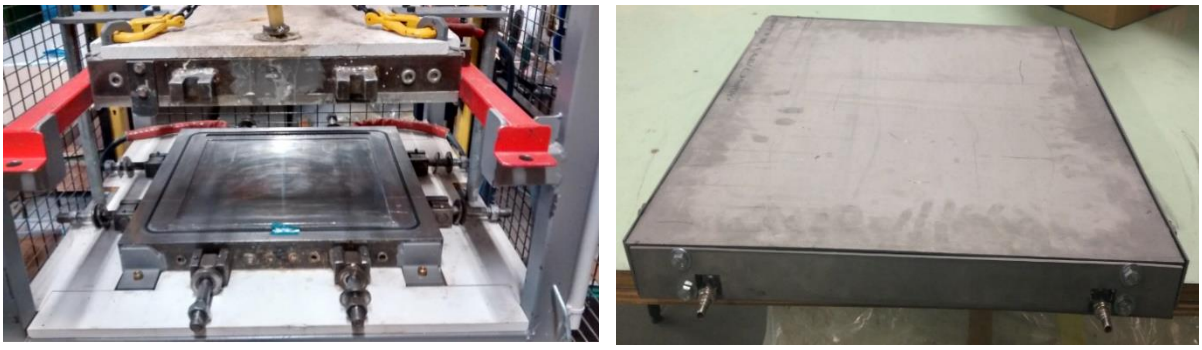

Figure 1: *Massive reference RTM mold (left) and innovative low inertia mold with rectangular heating channels (right).*

First experimental results are presented Table 1 and Figure 2. For these experiments, the heating of the mold is carried out with a thermal power of 12kW and a circulation of water. The temperature setpoint is set at 80°C. The improvement of thermal performances, thanks to rectangular heating channels and low inertia mold design, is confirmed with a heating rate more than 4 times greater and a temperature difference on the cavity mold 2 times lower.

Table 1: *Experimental comparison of thermal performances*

	Heating rate (°C.min^{-1})	$\Delta T_{max}^{cavity\ mold}$ *(°C)*
Reference massive mold	1.9	11.5
Low inertia mold with rectangular heating channels	8.1	5.0

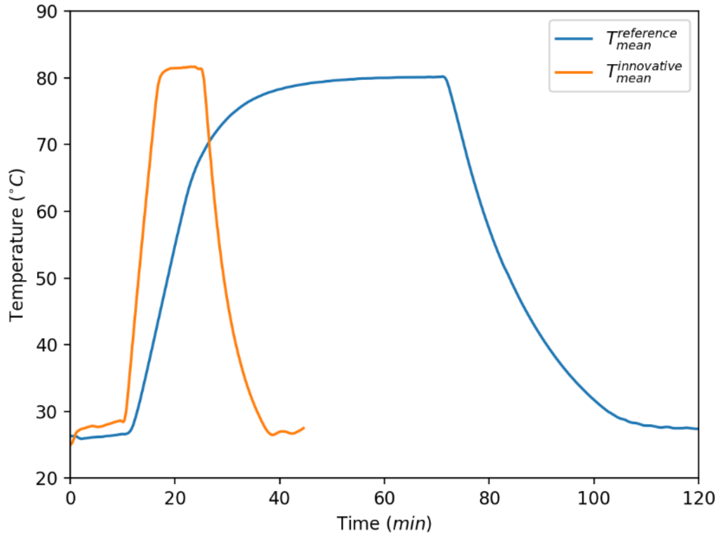

Figure 2: *Thermal gain of innovative mold for a production cycle compared to the reference mold.*

Moreover, a finite element model of the innovative mold, presented Figure 3, is defined with consideration of technological aspects: heating power, regulation and pressure drop. A numerical-experimental confrontation is also presented in Figure 3 and highlights the good prediction of the numerical model.

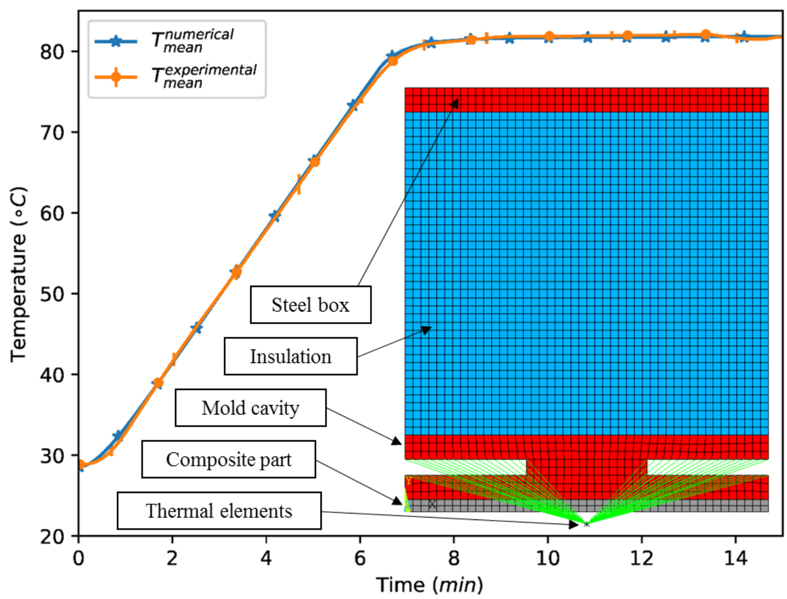

Figure 3: *Numerical and experimental temperature comparison on the cavity surface for the innovative mold.*

This comparison of a conventional massive mold and an innovative low inertia mold with rectangular heating channels clearly confirms the improvement of thermal performances and the interest of this concept. With the numerical model, a thermomechanical multiparameter geometric optimization of this mold concept will be conducted in a future study.

References

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