Manufacturing Process Simulation – on its way to industrial application

Manufacturing Process Simulation (MPS) for composite materials is on the way to becoming a vital part of the tooling design. Reliable and efficient simulations are the key to industrial application. By means of a case study Airbus GmbH presents the manner in which MPS can support the tooling design.

Manufacturing of high performance composite parts is expensive and requires sophisticated molds and processes. An experienced based mold and process design followed by trial-and-error optimizations is just not up-to-date anymore in today's competitive industrial environment.

Computed and tested

Airbus Helicopters succeeded in reducing model set-up times for thermal autoclave simulation significantly by introducing an automation process for pre-processing. By means of the automation process, case studies for tooling concept selection and optimization can be performed in a reliable and efficient manner (Fig. 1).

The diagrams in Figure 2 illustrate the heat-up of both molds for a generic autoclave cycle. The coldest point of the composite part manufactured on mold B reaches 175 °C (minimal curing temperature) approximately 9 percent faster than the part on mold A. The improvement of mold B is even more pronounced, when temperature inhomogeneity is considered. The part cured on mold A shows a maximum difference between hottest and coldest spot of approximately 44 °C, while mold B has an only 18 °C difference (reduction of temperature inhomogeneity by 58 percent). Mold B is obviously the better choice, when heat-up and temperature homogeneity are concerned.

This small case study constitutes a good example of the capabilities of MPS. Enabling the prediction of manufacturing outcome within the virtual design phase of the product development process is the main and major benefit of MPS. It helps improve part design, manufacturing process and tooling design while at the same time significantly reducing NRC by avoiding costly experimental studies and time consuming tooling re-work.

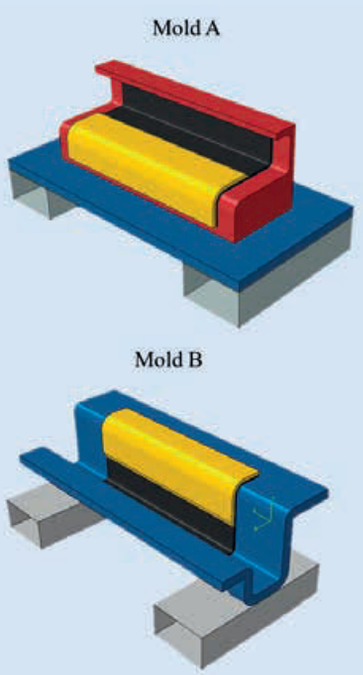

Fig. 1: Original (mold A) and optimized (mold B) molds for the production of a z-shaped composite part

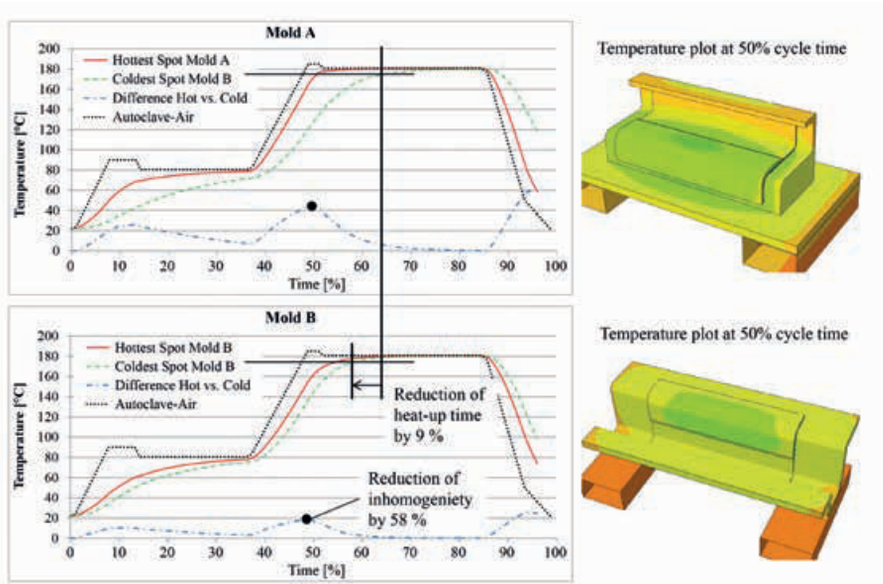

Fig. 2: Comparison of temperature distribution for molds A and B

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