TAILORED TEMPERING

Lightweight construction plays an important role in the automotive industry, particularly in the reduction of fuel consumption and CO₂ emissions. A considerable contribution to this end must therefore also be made by the body-in-white. This can be achieved by tailored tempering of high-strength and ultra-high strength steels, which is the key to success – but also entails many challenges.

Simulation-based design

Daimler solves these challenges by using computer simulation with software from AutoForm Engineering. Determining what the particular forming tool should look like and how the process of tailored tempering should be carried out in detail are demanding tasks. They require a comprehensive understanding of material behaviour, heat flow and the kinetics of phase transformation. In-depth insight into the structural transformation of material is necessary for the analysis and subsequent control of the tailored tempering process.

It is precisely the complexity of this process that makes simulation-based process design on the computer so helpful. The simulation software, however, must be able to realistically represent the forming and quenching processes as well as reliably predict the final part properties and thereby deliver the tooling expertise for this special type of hot forming,” AutoForm Engineering told ISMR.

The objective of this collaboration was to develop a testing tool that could be used to apply the tailored tempering process to real parts and to check the quality of the simulation results. A small batch of B-pillars was thus produced at the Sindelfingen plant and mechanical properties were closely and extensively examined. Samples from various areas of the part were tested in tensile tests and results were discussed among the experts at Daimler and AutoForm.

AutoForm offers software solutions for die making and sheet metal forming industries along the entire process chain. With 275 employees dedicated to this field, AutoForm is a leading provider of software for product manufacturability, tool and material cost calculation, die face design and virtual process optimisation. All of the Top 20 automotive OEMs and most of their suppliers have selected AutoForm as their software of choice. See www.autoform.com

Refining the process

AutoForm-ThermoSolver enables automotive manufacturers and suppliers to develop and define the processes involved in the hot forming of parts in real time. A B-pillar, door, and rear bumper supports and other parts. The software simulates direct and indirect press hardening and supports the tailored tempering process. The development of stamped parts with locally pre-defined strength properties is therefore possible. The simulation takes into consideration the real strength distribution in hot formed parts which improves accuracy in crash simulations.

AutoForm-ThermoSolver graphically illustrates final part properties such as thickness distribution and stress distribution as well as hardness and martensite distribution. This offers engineers insight into the structural transformation of the material.

Successful collaboration

The objectives set for the collaboration between Daimler and AutoForm were therefore achieved. Following a one-year test phase, AutoForm-ThermoSolver has been in productive use at Daimler since 2012.

Even complex process strategies can be calculated with AutoForm-ThermoSolver. Thermo-mechanical influences on material behaviour during part production can now be better taken into consideration. Additional data on the metallurgical calculation model increases the validity and information content of the simulation.

“Last but not least, intensive examination of the tailored tempering process also provides important insights for conventional press hardening. The need for further development on the calculation of thermal distortion was also identified. As a result, intensive work has been carried out over the past five months. The next step in this collaboration is to verify the practical suitability of the latest development and then release it as a future product version of AutoForm-ThermoSolver,” the software manufacturer concluded.

In co-operation with Daimler AG, an experimental testing tool was developed.