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Tecnalia-Labein successfully use PAM-STAMP 2G to optimize the process design of an industrial hotformed part

tecnalia
Corporación Tecnológica

DIEDE
Die Development

RENAULT

THE PROCESS

Hotforming involves the stamping and press hardening of high-temperature heated blanks with active cooled tools.

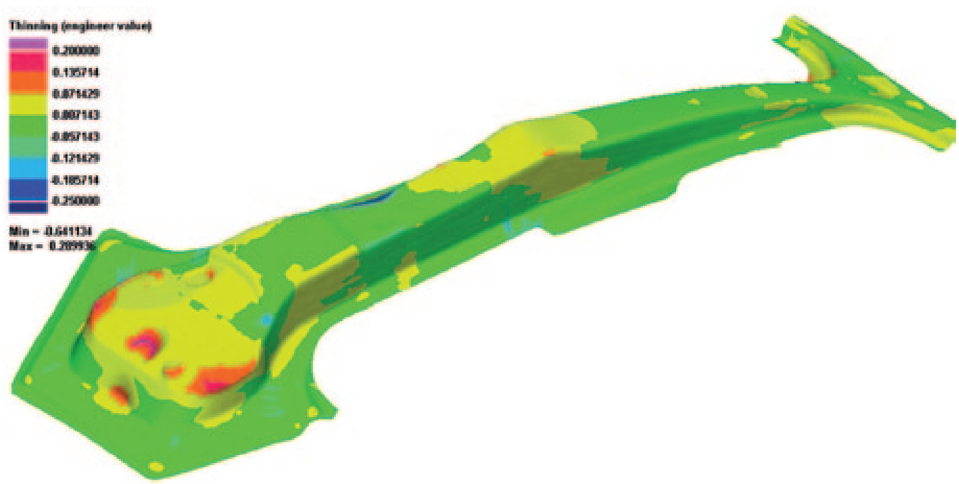
THE STORY

Tecnalia-Labein, a research center located in the Basque country, has experimented a simulation methodology specific for hot-forming processes, in a R&D project for the companies DieDe and Renault. Physical tests with a prototype tooling manufactured by DieDe were used to validate the methodology and results, leading to notably reduced quenching times and direct cost savings.

THE BENEFITS

- Reduced hotstamping cycle time and tooling complexity,
- Improved cooling and quenching design,
- Cut in die costs,
- Improved draw depth,
- Manufacturing of tailored parts, due to a better understanding of the process,
- Robust design thanks to short preparation times to launch simulation and process the results.

HOTFORMED AUTOMOTIVE B-PILLAR



Hotforming of a boron steel part is a complex process in which a high number of physical phenomenon occur simultaneously. Therefore the question arises whether it is possible to use a fully coupled simulation handling all these parameters, or if uncoupled simulation is still the best way for optimum process design.

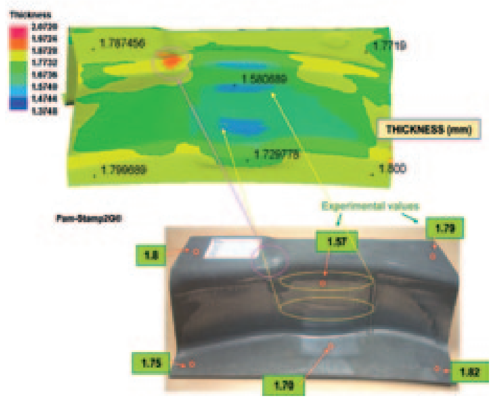
SIMULATION PARAMETERS

To assess the capabilities of PAM-STAMP 2G, Tecnalia-Labein chose to simulate the hotforming of the central part of an automotive B-pillar, geometry courtesy of Renault. To do so, the following parameters were fed into PAM-STAMP 2G:

- Thermal dependent material properties of the USIBOR 1500P, as provided by ArcelorMittal,
- Dynamic thermal exchange between blank and tools throughout the press cycle,
- Friction coefficient between blank and tools.

Simulation was performed in terms of draw-in shape and value, thinning, thickness, radius runover, wrinkling, thermal distribution within the blank, press force, and hardness. Simulation results were then confronted to experimental results.

The results of the simulation correlated accurately with the prototype results. The next step was to determine the die behavior and identify potential cooling improvements that could be applied on the final tool design, by using another general purpose Finite Element Method (FEM), in an uncoupled way.

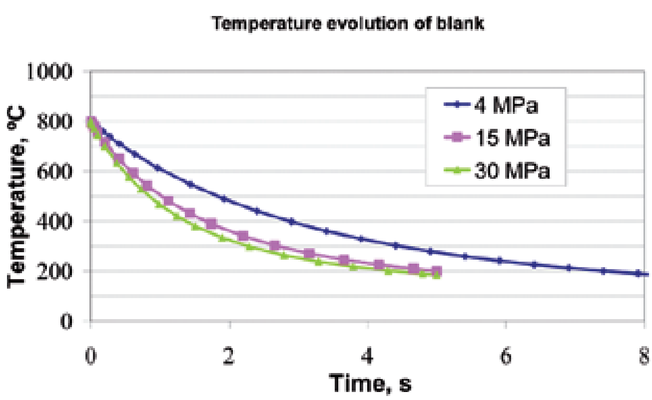


Thickness correlation

The optimization of factors affecting heat transfer from the hot blank to the cooling fluid within the tooling is essential to ensure completely quenched parts whilst reducing cycle time, thermal stresses and tool wear.

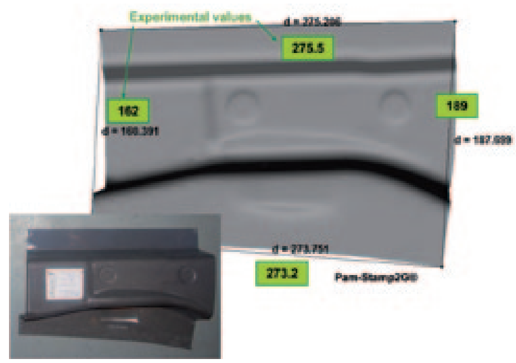
Several conclusions were reached through simulation concerning tooling design :

- Blank cooling increase exponentially as initial tool temperature decreases.
- High contact pressure between tool and blank greatly increases heat transfer and thereby improves blank cooling.
- Highly conductive tool material influences as well the blank cooling speed.
- The size and position of cooling channels under the surface of the tool significantly affects the thermal stability of the tool.
- Finally, greater cooling fluid speed and lower inlet temperature also favor thermal exchanges between blank and tool.



Influence of contact pressure

Using thermal simulations with the general purpose FEM code, the final tool's cooling channels were redesigned to eliminate hot spots while achieving a low and uniform temperature distribution, ensuring proper quenching of the part, following DieDe and Renault specifications.



Draw-in correlation

Uncoupled thermo-mechanical simulations and hotstamping simulations with PAM-STAMP 2G have proven to correlate accurately with experimental results. They can therefore be used for the effective design of a hotstamping tooling for an industrial part.

« PAM-STAMP 2G has enabled a fast design of the hotforming tooling, and due to the high level of accuracy of the results, it has allowed the validation of the tooling and simulation results with the experimental tests.»

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