AP&T LAUNCHING TEMPERBOX®

AP&T launching TemperBox®: a new cycle time neutral production solution that enables tailored properties in press hardened components.

AP&T is introducing a patented solution for partial press hardening of structural parts for passenger cars. TemperBox® allows hard and soft zones to be combined in a single part, paving the way for innovative body designs and cost-efficient production. TemperBox® can be integrated with AP&T's new and existing Multi-Layer Furnaces as well as with any other type of heat treatment equipment.

With over 100 press hardening line installations for customers all over the world, AP&T is now taking an important step in the development of its press hardening technology. The company's most recent product innovation - TemperBox® - offers entirely new opportunities to design and produce structural parts cost efficiently.

The patented invention TemperBox® is based on what was originally developed by Agim Ademaj, (Metakus Automotive, Kassel, Germany). In 2013 a cooperation initiative between AP&T and GEDIA Automotive Group (Attendorn, Germany) was launched for the further development and industrialization of the technology, which has now resulted in a fully commercial solution.

- AP&T's patented furnace module for partial hardening, TemperBox®, can be installed in AP&T's new and existing Multi-Layer Furnaces, and is also available for any other type of heat treatment equipment.

"The patented solution enables several material properties to be combined in a single finished part. Some sections can be hardened to maximize strength while others are made softer to achieve the desired ductility and to facilitate post processing such a joining or mechanical cutting," says Dr. Christian Koroschetz, CTO at AP&T.

The process involves precision-controlled heat treatment, which takes place in a special furnace module known as TemperBox®. After being heated up to 930 degrees Celsius in a conventional austenization furnace, e.g. AP&T's Multi-Layer Furnace, the blank is moved to the TemperBox®, where selected sections are blocked from radiation and cooled down while the rest of the part is kept hot. The blank is subsequently formed and quenched to produce the finished part.

The final result is a part with tailored properties, customized to the required performance of the component. This means designers and manufacturing engineers can work more freely without considering costly reinforcements or cycle time intensive processes such tailored tempering in press hardening tools, which are frequently implemented to improve the collision safety of body parts. The new method offers clear production-related advantages compared to today's press hardening such as easy integration in new and existing press hardening lines. The TemperBox® production solution enables short cycle times in the same range as the industry is accustomed to today when producing press hardened components with monolithic properties over the cross section.

"Not only new possibilities in crash performance design are possible, post processing is also much easier since specific areas of the component, such as flanges, can be kept soft, enabling them to be punched or trimmed using conventional methods - which is much less expensive than laser cutting, for example."

TemperBox® can be installed in AP&T's new and existing Multi-Layer Furnaces, and is also available for press hardening lines that have any other type of heat treatment equipment.

"This means the new technology can be used with basically any press hardening line in the market, regardless of brand," says Christian Koroschetz.

- FACTS

The first full capacity TemperBox® production line will be installed at GEDIA Automotive Group in Attendorn, Germany, where it will be used for production of press hardened components with tailored properties for various European OEMs. Production is planned to start by the end of 2019. GEDIA has also had a TemperBox® prototype line in use since 2017.

In Europe, GEDIA and AP&T closely cooperate on the TemperBox® technology. AP&T is the owner of the patent rights and GEDIA is the owner of an exclusive production license for the European market.

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DEVELOPMENTS IN HFQ® PROCESS FEASIBILITY SIMULATION

Damian Szegda of Impression Technologies explains the benefits of Hot Form Quench (HFQ) technology, with real life examples of the application of a CDM model in predicting the effectiveness of the HFQ process.

Strict EU emissions regulations are driving reduced weight and greater efficiency in vehicles. Aluminium alloys offer excellent lightweighting potential at progressively more affordable cost. New manufacturing technologies allowing the forming of high and ultrahigh strength aluminium alloys continue to emerge.

One such technology is HFQ, which enables formation of very strong, extremely complex aluminium parts in a single operation.

HFQ involves heating an aluminium alloy blank sheet to its Solution Heat Treatment (SHT) temperature, producing a homogeneous solid solution with high ductility and good formability. The blank is transferred to the press where a high forming speed is set. The formed part is held in the tool for a few seconds to quench, to avoid precipitate formation in the microstructure. The technology combines mechanical deformation with alloy tempering, with forming and in-die quenching completed in one step.

Having previously verified the integration of the continuum damage based (CDM) material model against simple test cases, a complex, deep-drawn high-strength automotive door inner was selected for detailed validation. The HFQ stamping trials started from an oversized blank shape with induced splits in the panel. A blank shape optimisation was undertaken, with a successful panel produced by removing material in critical areas.

In all trial cases, lubrication was applied to the punch and the die. The hot aluminium blanks were dry, non-lubricated, on delivery to the tool.

For the pressings themselves, the panels were cut into several sections, with thickness measured using Vernier callipers. Approximately 40 measurements were taken in critical locations along selected cut planes. The simulation results were sectioned along the corresponding planes.

An HFQ® simulation was performed using ESI PAM-STAMP for two different blank shapes. The computational model comprised three stages: gravity, holding and stamping. The gravity stage was simulated using the Implicit FE Solver in PAM-STAMP while the Explicit Solver was used for both holding and stamping stages. The friction coefficient between the blank and the tool was assumed to be constant and independent of contact pressure, temperature, velocity or sliding distance. Simulations were performed with friction coefficients of 0.5 and 0.8 for both blank shapes. The die and blank holder velocity was set to 0.2 m/s with no velocity scaling. A ramp curve was used to accelerate the velocity to the set speed over 1 ms.

Two blank shapes were used in simulation of this case – the first was the initial blank shape, designed as over-sized prior to the stamping trials. The blank shape was optimised during the trials to yield successful panels.

Simulations with user subroutine were run with initial element size of 5.8mm for the blank. This yielded a total of approximately 42,000 elements for the blanks.

The results demonstrate that friction significantly affected model prediction accuracy. Simulations run with the 0.5 friction coefficient generally failed to predict splits. Increasing the friction coefficient to 0.8 allowed prediction of all splits but also highlighted areas where splits didn't occur. The key conclusion was that the apparent coefficient of friction is likely to depend significantly on draw distance.

Taking the findings from simulation of the failed panels, simulations for the successful panel were set up with distributed friction coefficient. For areas - or draw fillets - where draw depth was estimated below 40mm, an apparent friction coefficient was assumed at 0.3. Everywhere else, this was assumed at 0.5. In this test, a much closer correlation was found, with the model meeting the target of less than 5% deviation at more than 90% of measurement points.

The CDM model offers advantages over simulations based on look-up table material models as it allows capture of the effects of path and history of deformation on flow curves and ductility - particularly useful for complex applications like deep drawn door inners.

Simulative studies based on the door inner indicated the friction value depended strongly on draw depth. Using distributed coefficient of friction, a strong correlation was found.

For further information visit: www.hfqtechnology.com

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