LOCAL LASER HEAT TREATMENT OF HOT STAMPED STEEL

Task

Lightweight construction is an effective method for reducing fuel consumption and CO₂ emissions in the automotive industry. At the same time, crash safety specifications are constantly being tightened. The use of thinner but stronger high strength steel especially for crash relevant parts is an effective option to meet both requirements. With hot stamping, complex geometries can be formed, while high strength is achieved when the part is hardened in a cooled die. In the case of the widely used Manganese Boron Steel 22MnB5, the tensile strength is 1600 MPa after hot stamping. But such high strength is not desired in the whole part. Deformation zones for better crash performance and zones for joining require a more ductile material.

The LOKWAB project (reference number: 02PU2020), which was funded by the German Federal Ministry of Education and Research (BMBF), has been investigating local heat treatment of hot stamped parts with laser radiation. The aim was to soften the desired zone of hot stamped parts to improve crash performance and subsequent joining operations. Distortion of the heat treated part had to be minimized.

Method

With laser heat treatment, the microstructure of hot stamped 22MnB5 steel is locally softened in a desired zone. A temperature-controlled fiber-coupled 12 kW diode laser and a zoom-optics with a rectangular laser spot size up to 52 x 52 mm² is used. The flexible laser spot size also allows softening of small zones down to 10 x 10 mm² e. g. for joining by spot welding.

Result

In the heat treated zone the microstructure is changed (tempered of the martensite or austenitization followed by transformation to ferite/pealite) which results in an increase of the breaking elongation from 4 % to maximum 19 %. A heat treatment strategy was developed to minimize distortion. With an adapted strategy the maximum distortion of a local heat treated B-pillar was reduced from 10 to 1.7 mm. The corrosion protective AlSi-coating of the parts is not affected by the laser heat treatment. Using maximum laser power, a processing rate of up to 15 cm²/s is achieved.

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1 Laser heat treatment of a hot stamped B-pillar.
2 Laser heat treatment of the flange of a hot stamped part.