Abstract

Within this thesis, a process technology has been developed that can enhance the field of application of continuous fibre reinforced thermoplastic polymer in the domain of fast-moving transmission components for mechanical engineering.

For the first time ever, inductive heating was deployed as the source of heat to thermoform carbon fibre reinforced thermoplastics. Hereby, the semi-finished product (CF-PA66) under examination was heated to deformation at two locally limited areas within less than 30 seconds. This local application of energy represents the foundation for the subsequent partial thermoform process, the aim of which is the simultaneous thermoforming of multiple mould cavities on a semi-finished product.

This procedure was coupled with the development of an idea for a tool for thermoforming with in-situ thickness variation, which enables an increase in the thickness of the semi-finished product of up to 200% in the defined area. Within this thesis, bearing carriers with a width of 6mm have been moulded into organic sheets with a thickness of 2mm without either adding material from an external source or externally introducing material to the process. In addition, a procedure to thermoform bearing carriers and simultaneously join metallic bearings has been developed. Furthermore, a model that defines geometrically-possible bearing dimensions in relation to the thickness of organic sheets has been set up.

The combination of redevelopment and enhancement of this process leads to a reduction in the process chain and therefore to a saving of time that results in a decrease in manufacturing costs.

The process chain was exemplarily mapped to a demonstrator component, a fast-moving take-up lever of an industrial sewing-machine. This thread take-up lever possesses two metallic grooved ball bearings that were moulded and joined simultaneously to a previously planed semi-finished product. The component testing resulted both in a net decrease in weight of 50 % compared to the existing aluminium alternative and a reduction of the acoustic emission of up to 1 dB(A). This can be ascribed to the high absorbability of the thermoplastic source material and demonstrates the huge potential of the carbon fibre reinforced thermoplastics in dynamically loaded components.