STRONGER, FASTER, FLEXIBLE

Expediting induction welding of CFRPC

The application of carbon fiber reinforced polymer composites (CFRPC) in mass production is still hindered by a lack of lightweight and economical joining technologies. Therefore, the Institut für Verbundwerkstoffe (IVW) develops advanced joining technologies for thermoplastic FRPC which provide excellent bonding strengths combined with a high automatization level.

Based on fundamental investigations, several variants of the induction welding process were initially developed for different applications. Due to the special advantages, the induction welding process is quite appealing regarding an industrial application.

Potential tapping

Especially for the continuous induction welding of thermoplastic carbon fiber reinforced polymer composites (CFRPC) the enormous potential of this technology is not completely exhausted yet. Hence, IVW proposes to increase the welding speed at consistent welding quality and to consequently increase the efficiency of this particular process variant. For this purpose a "Process optimization of induction welding of continuous carbon-fiber reinforced thermoplastics by process simulation" is being currently conducted in the context of the same-titled project founded by Deutsche Forschungsgemeinschaft (DFG).

Features	Advantages
Additional materials for welding are not necessary	+ High level of lightweight + No compatibility problems (e. g. corrosion) + No thermal stresses due to different thermal expansion coefficients
Contactless Heating	+ Large geometry freedom of the joining zone + Welding jig is not necessary + Continuous joining is possible
Heat generation inside of the material	+ High heating rates + High welding speeds + Only minor additional oxidation in the joining zone
High flexibility regarding the possible material combinations	+ Joining of CFRPC-CFRPC/GFRPC-GFRPC + Joining of CFRPC-GFRPC + Joining of GFRPC-Metal + Joining of CFRPC-Metal

Advantages of joining thermoplastic CFRPC using induction welding technique

Test rigging

This project initially intends to systematically investigate influences of the textile parameters of the reinforcement fabric regarding the heating behavior of a CFRPC component. Subsequently, an ideal laminate structure for induction welding will be set up, ensuring the polymer can be melted locally in the joining zone at very high welding speeds, while the polymer on the surface of the laminate will not melt (Fig. 1).

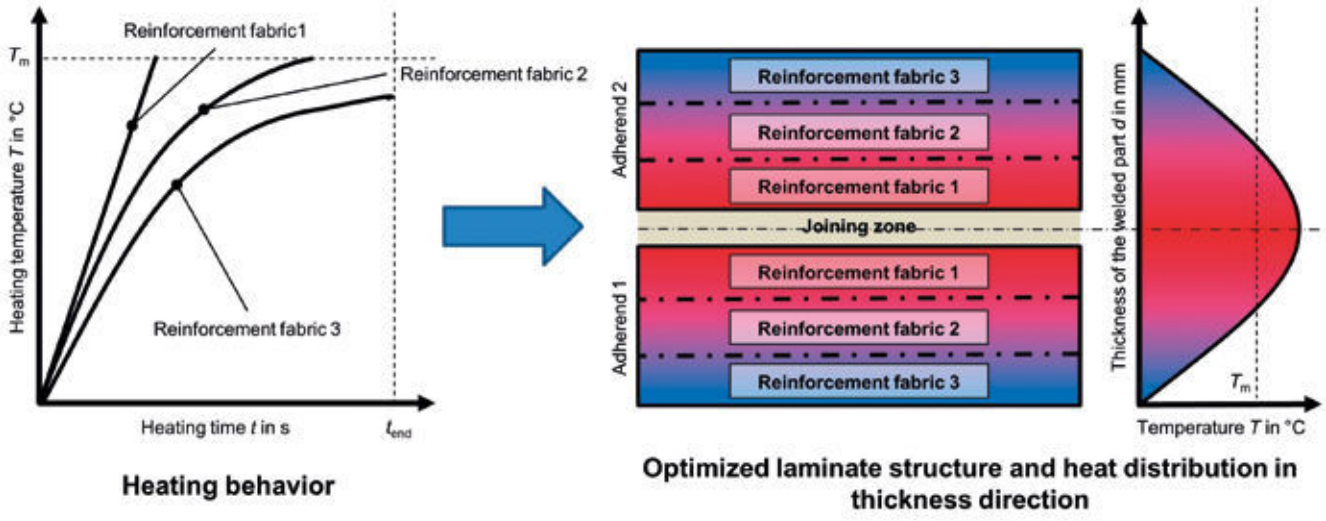

Fig. 1: Optimization of the laminate structure regarding higher welding speeds after heating-up tests of several reinforcement fabrics

Furthermore, a novel cooling device for the laminate surface shall be developed in order to attain a further increase of the joining speed. Simultaneously, a process simulation based on the Finite-Element-Method will be set up, which enables a prediction of suitable key parameter sets and provides a better insight of the process. Finally, based on the results of the investigations, the continuous induction welding process of CFRPC with maximum welding speed shall be verified with the induction welding head of IVW (Fig. 2).

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Fig. 2: Induction welding head for continuous induction welding of CFRPC (developed by Pfaff Industriesysteme und Maschinen).

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