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Simulation of the Influence of Process Parameters Using the Quasi-Simultaneous Laser Transmission Welding Process

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The laser transmission welding of thermoplastics becomes more and more important since its introduction to the industrially series production 15 years ago. Despite the widespread use with many series applications, finding the optimal setting of the process-parameters in practice is still difficult. The influence of the laser intensity, warming up time and joining pressure and joining displacement respectively on the weld quality normally found through experimental studies.

In order to be able to make a forecast of the temperature, of the melt shift profiles and the remainder melt layer thickness in the welding zone, calculations were made with the finite element method on basis of a simplified mathematical-physical model. The quasi-simultaneous laser welding process was simulated, including the heating and cooling phase using temperature dependent data. The convective cooling and emissivity at the surface of the adherents were considered. As influence parameters for the computation, the distribution of intensity, the pressure and the warming up time have to be specified. Therefore - like in prac-tice mainly used - pressure-regulated welds with the abort criterion time were simulated. The simulation results have been adapted continuously over the experimental determination of the melt layer thickness with different process parameters, so that a good agreement of the meas-ured and computed melt layer thickness could be achieved.

By the example of a PA 6, in this paper the influence of the process parameters on the tem-perature and remaining melt layer thickness for quasi-simultaneous welding will be presented. It will be shown, how the process parameter affect the resulting melt layer thickness and the shift profiles of the flowing material. It turned out that the melt temperature reaches a final value and a stationary melt layer thickness is present after reaching the maximum temperature in dependence of the process parameters. The simulation data going confirm with the ob-served weld strength in dependence of joining displacement: once the steady conditions have been achieved, no changes in the remaining weld strength have been observed.