Resource-efficient production of organo sheets from rCF for thermoformed aerospace structures

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Abstract

Climate-neutral aviation requires innovative manufacturing technologies and alternative propulsion concepts. Carbon fiber–reinforced polymers are highly suitable for lightweight structures due to their low density and high strength. Thermoplastic fiber-reinforced polymers enable efficient, high-volume production thanks to process flexibility, weldability, recyclability, and short cycle times. Recycled carbon fiber nonwovens can be manufactured industrially. Sächsisches Textilforschungsinstitut e.V. (STFI) and Faserinstitut Bremen e.V. (FIBRE) developed a process chain for the quasi-continuous production of highly integrated organic sheets based on reinforced nonwovens with locally variable thickness, followed by a two-step thermoforming and joining process on final contour. Integrating organic sheet production into component development enhanced the efficiency of industrially established thermoforming process and shortens the process chain. The project demonstrated the process chain for a generic spoiler with an integrated Z-stringer. STFI developed a quasi-continuous process on an interval hot press for production of locally thickness-variable organic sheets from recycled carbon fiber nonwovens (production speed 0.6 m /min; throughput up to 155.52 kg /h). During the manufacturing process, load-optimized reinforcements are locally incorporated, in this case the integrated Z-stringer. Additional load-optimized reinforcement strips further enhance performance. In the thermoforming process developed by FIBRE, an organic sheet for the lower spoiler skin is heated in the IR field, formed in the press, and cooled. A swivelled IR emitter heats only the joining area. A detachable section of the upper mold serves as core and pressing surface. Meanwhile, a second heated sheet is then formed and simultaneously joined to the first, creating a closed box structure with an integrated Z-stringer with process time of approx. 10 min. The processes are transferable to other applications, structures, and material combinations.

Keywords: Recycling, thermoforming, nonwovens, joining, aviation, thermoplastics, TFP, AFP, continous compression moulding, profiled organo sheets, functional integration

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