OPTIMISATION OF DISCONTINUOUS COMPOSITES FOR CRASHWORTHINESS

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Chopped tape based discontinuous composites (CTCs) are a good material solution that offer improved manufacturability compared to long fibre continuous composites, and mechanical property improvements compared to short fibre composites- which are widely used in the automotive sector. Energy absorption characterisitics of tape based discontinuous materials are not very well eastablished. Bearing mode energy absorption has been characterized by Heimbs and Bergmann [1] for different material combinations. The results showed that bearing failure can be a predictable and efficent mechanism for energy absorption. The suitability of the bearing mode for tape based discontinuous composites has been studied in the current work by conducting a series of bearing tests on specimens with different width to hole diamater ratios. The specimens were loaded through bearing to produce progressive damage until complete failure of the specimen in quasi-static conditions in order to characterize the energy absorption capacity of the material. The results show that CTCs have high specific energy absorption capacity compared to traditional composites.

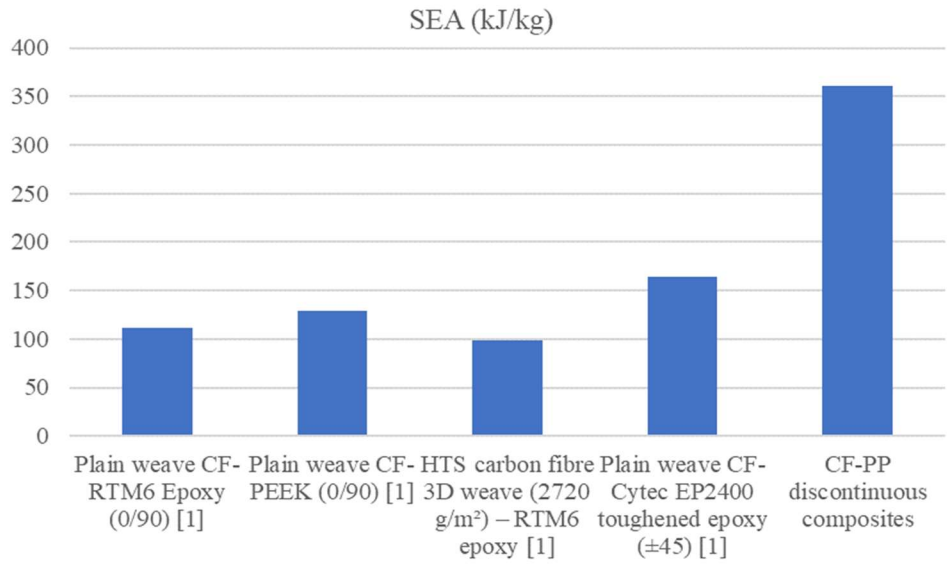

Figure 1. Specific energy absorption of the traditional composite materials and discontinuous composites.

In addition to bearing tests to measure energy absorption, the specific material being studied is tested in tension, compression, and shear in order to characterize its behaviour and establish a simplified material model capable of predicting the behaviour of the material in bearing failure.

Based on this model, a multi-objective optimisation framework is created in order to study the trade-offs between performance, weight, cost etc. by using a parameterised FE model of a bolted joint. The goal is to have a simplified tool which can find the optimal design for an energy absorbing component making use of the tearing (or bearing) mode of material failure. The optimisation must consider several competing and potentially conflicting design criteria such as weight, cost, and energy absorption. The framework, when validated, could be used for design and preliminary analysis in practical applications such as crash absorbers for automotive applications.

[1] Heimbs & Bergmann (2014). *Procedia Engineering*. **88**, 149-156.