

EXPERIMENTAL CHARACTERIZATION ON THE ORIENTATION DEPENDENT FATIGUE RESPONSE OF STRAND-BASED CARBON SMC

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Abstract

In the last years, the automotive sector has shown great interest in Carbon Fibre-Sheet Moulding Compound materials (CF-SMC). These materials are made chopped carbon fibre strands dispersed in uncured thermoset resin. The resulting malleable sheets are then compression moulded into the final desired shape, allowing fast manufacturing and lightweight capabilities with fair mechanical properties. However, for CF-SMC components to break through in high volume industries, it is necessary to understand the fatigue response of the material and how it is affected by its microstructure.

While several works exist on fatigue of short FRP, very few focus on strand-based composites. Selezneva and Lessard. (2016) proved that the fatigue response of randomly oriented strand thermoplastics is comparable to the one of quasi-isotropic composites. However the work was focused on low-flow moulding SMC, with random strand orientation: when taking into account oriented tows, it is reasonable to expect that this no longer holds true. Fleckenstein (2011) proved that glass SMC specimens having tows mainly aligned with the loading direction have higher fatigue life than those with tows mainly in the perpendicular direction; carbon fibre SMC was however just mentioned, but not investigated.

The present work focuses on the experimental evaluation of carbon fibre SMC fatigue response. First, static tests are conducted to obtain the ultimate tensile strength at different fibre orientation. Then, cyclic tensile-tensile tests are performed to retrieve Wohler S-N curves for each orientation. Besides the evident and profound impact that fibre orientation has on the fatigue performance of CF-SMC, it was found that, if normalized by its static strength, each set of data tend to collapse to the same curve (within scatter range) as shown in fig. 1. This interesting result can be the basis for the development of predictive techniques of CF-SMC components' life.

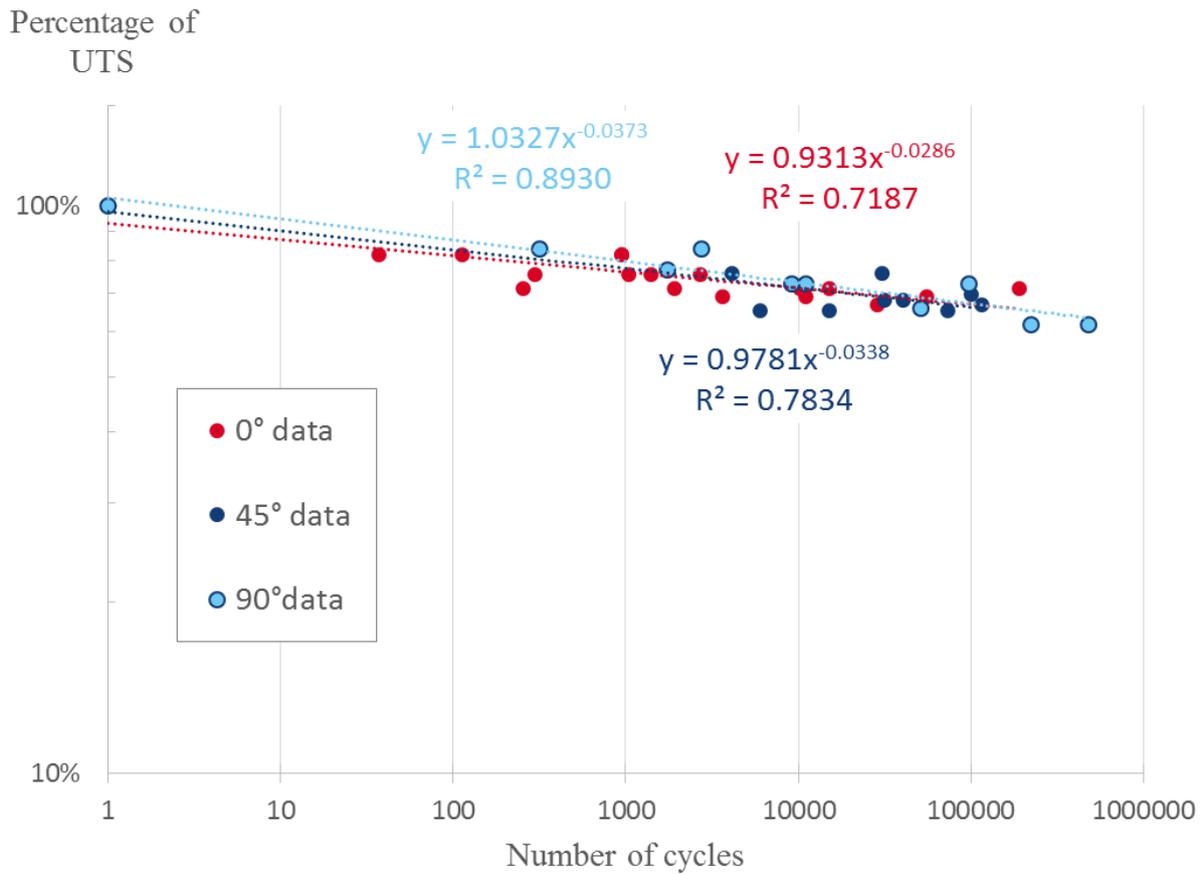


Figure 1: SN curves in terms of percentage of Ultimate Tensile Strength (UTS) against number of cycles to failure

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