EXPERIMENTAL ANALYSIS AND SIMULATION OF THE DEFORMATION OF WOVEN TEXTILES MADE OF RECYCLED CARBON FIBRE

Tobias Georg Lang[1], Mir Mohammad Badrul Hasan[1], Anwar Abdkader[1], Chokri Cherif[1] and Thomas Gereke[1]

[1]TUD Dresden University of Technology, Institute of Textile Machinery and High Performance Material Technology (ITM), Hohe Str. 6, 01069 Dresden, Germany, e-mail: tobias_georg.lang@tu-dresden.de

Abstract: As a result of the increasing use of carbon fiber-reinforced polymers in industry (especially aerospace), aspects of the sustainability of carbon fibers are becoming more important. There is currently no commercially available solution that recycles carbon fibers obtained from end-of-life components into a new composite component without a major loss of stiffness and strength. The processing of recycled carbon fibers (rCF) in hybrid yarns is one possible solution to the problem. By using friction spinning, hybrid yarns with a high carbon fiber content (>90% by mass) can be produced with a high fiber orientation. Further processing in thermoset compounds shows promising results [1].

Due to the staple fibers and the manufacturing process, the mechanical properties of the dry yarns are not homogeneous, but stochastic. As the tensile properties of the yarns are largely driven by fiber-fiber sliding, significantly greater deformations are possible than with continuous filament yarns. This enables a much greater variety in the forming of textiles made of rCF. This yarn behavior and its effect on formability will be investigated.

The mechanical properties of woven fabrics made of rCF hybrid yarns will be presented. In addition, a meso-scale modeling approach using beam elements is introduced for the simulation of textile behavior. The material properties of the yarns will be varied stochastically based on experimental data. The irregularity of the textiles is reproduced by carrying out Monte Carlo simulations. In draping tests on several example geometries, critical areas are identified during forming.

REFERENCES

[1] Hasan M., Bachor S., Abdkader A., Cherif C.: *Tensile properties of thermoset composites based on yarn structures from recycled carbon fibre and low melting temperature Co-polyamide fibre*. Journal of Composite Materials. 2024;58(1):55-64. doi:10.1177/00219983231217138