MODELING AND SIMULATION OF RECYCLED CARBON FIBER REINFORCED COMPOSITES WITH VARYING FIBER LENGTHS

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Due to the current trend towards lightweight design across diverse disciplines, the usage of composites such as carbon fiber reinforced polymers has increased enormously in the last decade. With the rising usage of carbon fibers, topics like repurposing of fibers are gaining more importance. One current approach is the production of hybrid yarns from recycled staple carbon fibers and thermoplastic fibers. During each processing step from fiber to hybrid yarn, the fibers are partially damaged [1]. The resulting broad fiber length distribution considerably affects the mechanical properties of the composite. Therefore, the influence of the different fiber lengths on the fiber structures and composite properties should be investigated thoroughly.

This work proposes a micro-scale modelling method for predicting the strength of composites of hybrid yarns made of carbon staple fibers, while paying a special attention to the influence of the fiber length. To consider their irregular nature, a method to generate stochastic fiber unit-cell models is established. The input parameters (e. g. length, cross section, orientation, waviness, tensile strength) are specified using stochastic data. By simulating the compaction of the generated fibers, the composite manufacturing process is considered. Finally, the compacted fibers are coupled within a matrix using kinematic constraints in the model. Along the fiber axis, a bond-slip model based on fiber-pullout-tests is applied [2]. The composite model is validated by comparing virtual mechanical tests with experimental test results.

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References

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