A Comprehensive Understanding to the Slurry Impregnation Technique

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Introduction

Unidirectional carbon fibre-reinforced polymers are strong, stiff and lightweight. These material properties make them attractive to a variety of industries, including aerospace, marine and automotive. In manufacturing of unidirectional tapes, thermoset or thermoplastic polymers can be used. Thermoplastic polymers have certain advantageous over thermosets such as remelted, recyclability and sustainability. On the other hand, the high viscosity of the thermoplastic polymer makes direct melt impregnation challenging, especially at high fibre volume fractions. One way to address this, is to impregnate the dense fibre bundles with a water-based polymer slurry rather than molten polymer: polymer-based particles are suspended in water as transfer liquid which spontaneously penetrates fibre bundles due to its low viscosity and strong capillary action, followed by water removal, and melt consolidation. In this techniques, the fundamental understanding of thermoplastic particle movement through the high fibre bundle is an essential requirement to obtain a better impregnated and eventually better performing unidirectional tape.

In this research, we replicate the thermoplastic particle movement through carbon fiber bundle in a similar but smaller setup, which allows to obtain influencing parameters and optimize the slurry impregnation technique.

Aim: The main aim of this research is to replicate the slurry impregnation method in a small-scale setup to investigate the effect of parameters such as thermoplastic particle size and concentration, fibre type, spreading and tension.

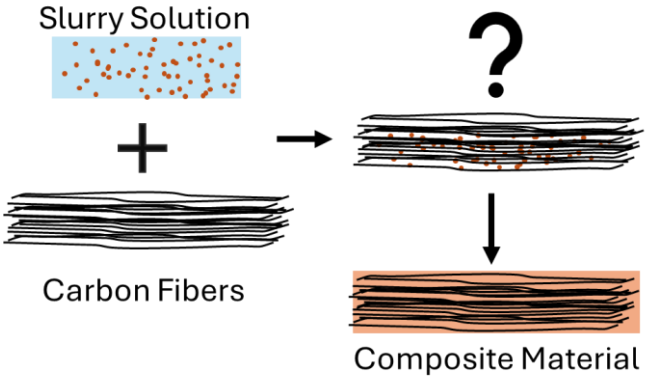
Activities & Expectations

To reach the aim of the research study, the main activities are listed below.

- Prepare slurries with varying particle sizes and concentrations.
- Perform impregnation experiments with different fibre types and consulate the thermoplastic particles.
- Characterize the capillary action based on the tension.
- Investigate the effects of fibre spreading and tension during processing.
- Characterize the resulting materials and analyze the influence of process parameters based on volume fraction and fiber distribution.

This study will enrich your understanding of colloids, and unidirectional carbon fibre-reinforced thermoplastic composite manufacturing methods. Moreover, you will be familiar with characterization methods.

The student is willing to learn new concepts. Background in composite has an advantage but not necessary.



This work is suitable for Master students. Sounds interesting? Please get in touch!