Investigation of The Thermo-Mechanical Behavior of Hybrid Metal-Thermoplastic Composite Tapes by Finite Element Modeling

Maissaloun El-Jakl (M.el-jakl@tudelft.nl), Clemens Dransfeld (C.A.Dransfeld@tudelft.nl)

Introduction

Unidirectional fibre-reinforced polymers (FRPs) are widely used in high-performance industries such as aerospace, marine, and automotive due to their high strength, stiffness, and low weight. Thermoplastic polymers offer key advantages over thermosets, including recyclability, reprocessability, and improved sustainability. However, their high melt viscosity makes direct impregnation of fibre bundles challenging.

This research is conducted within the Processing of Advanced Architectured Materials (PAAM) Research Group, which focuses on structure–processing–property relationships in lightweight materials. The group aims to develop advanced materials for high-performance applications. A key manufacturing route within the group is tapeline production, particularly melt impregnation, which serves as a foundation for continuous composite tape fabrication.

Aim

Thermo-Mechanical Modeling of Hybrid Metal–Thermoplastic Composite Tapes

Hybrid metal–thermoplastic composite tapes combine the high stiffness and conductivity of metals with the lightweight and formability advantages of thermoplastic composites. Their lightweight, corrosion-resistant, and thermally stable properties make them attractive for advanced structural applications. However, their mechanical behavior is complex due to the interaction between dissimilar materials and differences in thermal expansion, interfacial bonding, and failure mechanisms.

Research Question

How do interfacial properties and material architecture influence the thermo-mechanical behavior and failure of hybrid metal–thermoplastic composite tapes, and how can these effects be predicted using finite element modeling?

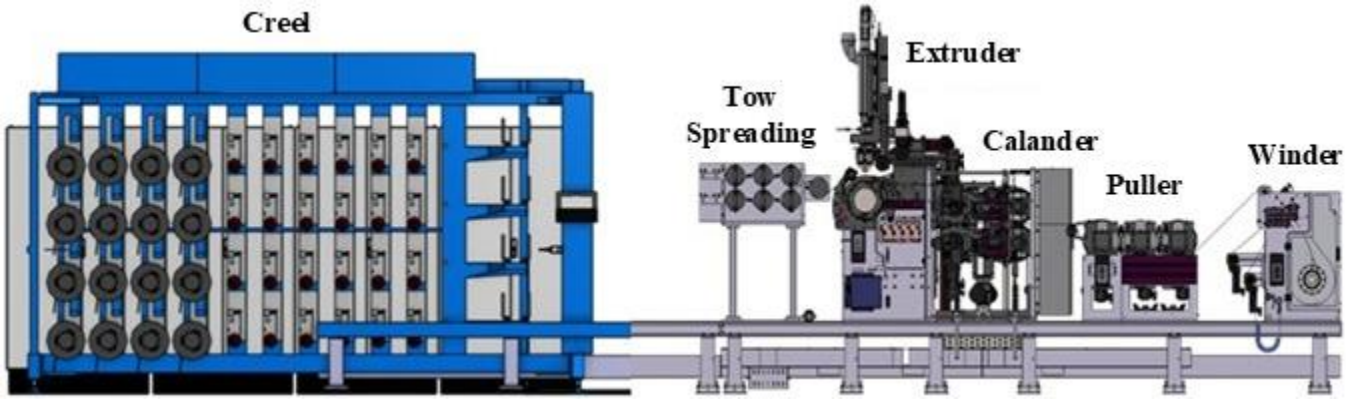
Activities & Expectations

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

- **Develop** a finite element model to predict thermo-mechanical behavior
- **Simulate** failure under combined thermal and mechanical loading
- **Evaluate** the effect of material architecture on performance and failure

This study will **enrich** your understanding of **hybrid composite materials**, interfacial mechanics, and **finite element modeling** of thermo-mechanical behavior.

The student is expected to be motivated to learn new concepts. A background in composite materials or numerical modeling is an advantage but not required.



Manufacturing process: Thermoplastic tapeline and its melt impregnation configuration

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