

SEMESTER PROJECT – LPAC- AUTUMN 2024

Processing and characterization of healable composites

SUPERVISION: Léa Damiano (MXH147, lea.damiano@epfl.ch)

DIRECTION: Véronique Michaud

KEYWORDS

Self-healing, composite, processing (RTM), mechanical properties, characterization, healing

DESCRIPTION

The current structural product market requires high strength/stiffness materials with low weight to reach high efficiency in many industrial applications. Fibre reinforced polymer composite materials (FRP), which fulfil this requirement, are thus increasingly used in mobility, energy generation, or sport equipment. However, these are marked by a design limitation: the brittleness of the thermoset matrix results in sensitivity to small damage events. These damage events need to be addressed to prevent their propagation or repair them, thus avoiding failure of the structure. A commercially available approach to limit damage growth in FRPs is to provide toughening to the matrix by dispersing small rubbery or thermoplastic particles in the thermoset matrix; however this tends to impact production processes, and does not prevent costly repair operations. On the other hand, the difficulty to provide maintenance and repair of damaged FRPs, due to limited detection and accessibility, has motivated the creation of “smart” composite materials. These integrate new functionalities having the ability to detect damage, react to it and repair it if needed. However, major hurdles to the implementation of self-healing FRPs beyond laboratory demonstrations remain the potential downgrading of the composite intrinsic properties, the challenge of manufacturing, characterization and validation.

Research on self-healing systems for FRPs has been conducted at our laboratory (LPAC) for the past 12 years through several PhD theses. An efficient strategy has been developed, which is currently commercialized with the start-up CompPair Technologies. Demonstration of this concept, so far, has been carried out with composites parts made by LCM and prepregs with different textiles. The goal is now to broaden the manufacturing processes and try to produce healable composites by Roll to Roll and Resin Transfer Moulding. RTM implies to have a textile which is placed in a mould and impregnated with resin. To control the time for the processing, it is crucial to characterize the permeability of the textile.

The semester project will be inscribed within the framework of the research presented briefly above, focussing on characterising and processing a healable composite. The project specifications and tasks still has to be defined in detail. But if the subject is of your interest feel free to apply!