# RELATIONSHIP BETWEEN PROCESSING PARAMETERS AND MECHANICAL PROPERTIES OF THICK GLASS FIBRE REINFORCED THERMOPLASTIC METHACRYLIC COMPOSITES

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As part of the energy transition, the recycling goals applicable to end-of-life materials are getting more and more demanding. Thanks to a recyclable matrix, continuous fibre reinforced thermoplastic composites have attracted growing interest over the past twenty years for the design of lightweight and high-performance structural parts. To produce such materials, specific monomers are usually vacuum-infused through glass or carbon fibres before undergoing in-situ polymerization. Though most composite parts obtained this way are only a few millimeters thick, certain applications require the manufacturing of much thicker components – up to several centimeters.

In this perspective, the present study focuses on the links between the infusion conditions, the physico-chemical state and the mechanical properties of 7-cm-thick glass fibre reinforced thermoplastic methacrylic composite plates, at both the micro- and macroscopic scales.

More precisely, composite plates are infused at different temperatures, and the evolution of the microstructure along the thickness of each sample is studied. Emphasis is placed on the characterization of porosity distribution and morphology by optical microscopy and X-ray microtomography. Additionally, chromatographic chemical analysis is carried out for the assessment of molecular weight distribution and residual monomer content. The local mechanical response is evaluated by carrying out nano-indentation tests inside the matrix pockets, while in situ transverse compression experiments are performed within a SEM. Thermal analysis as well as a simple thermomechanical method are used to quantify the amplitude of the residual stresses. In parallel, the viscoelastic-viscoplastic response of the bare matrix is determined by combining various macroscopic tests in order to allow micromechanical modelling of representative volume elements.

Current results suggest that, while the in situ micromechanical properties of the methacrylic matrix barely vary with the infusion temperature, it strongly affects the amount and distribution of porosity in the composite part – which, in turn, governs the macroscopic mechanical properties of the final composite part and their variability.