Modelling the long-term behaviour of carbon fibre composites

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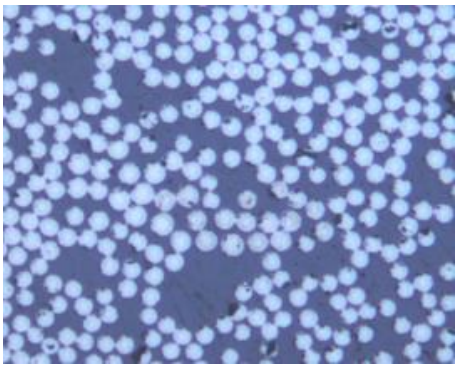

- Fibre-reinforced composites show time-dependent behaviour.
- Local variations of morphology and properties are important.
- Better understanding is necessary to make better structures.

Abstract:

The starting point of the thesis is a multiscale modelling approach for tensile failure of unidirectional fibre-reinforced composites, developed by Alain Thionnet and Anthony Bunsell. At the base of the modelling stands the realization that composites are time-dependent materials. To account for it, stochastic character of fibre strength and matrix viscosity are taken into account. This allows a successful representation of phenomena observed in real-life composite structures, such as filament-wound composite pressure vessels.

The objective of the thesis is to work on phenomena that have not been accounted for so far by the existing model. For instance, large porosity ratios present in some pressure vessels can have an important influence on mechanical properties. Tomography allows a characterization of voids present in real-life structures and together with numerical modelling provides a deeper understanding of the influence they have on damage processes taking place in the composite.

Another important factor is the environmental conditions. Composites are often used in parts of the world where extreme temperatures or high humidity are common. Taking this into account is necessary to correctly assess the safe operating conditions of such structures. This is particularly important in light of the rapidly increasing demand of the transport industry for light-weight, composite-based structures.

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