Fibre-reinforced composites based on blends of thermoplastics and epoxy resin

Fibre-Reinforced Composites based on Blends of Thermoplastics and Epoxy Resin

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Introduction

Fibre-reinforced composites based on thermoplastics are often produced by way of melt- or solution fibre impregnation routes. Because of the relatively high melt viscosities of thermoplastic polymer melts, melt impregnation is often only achieved using low molecular weight polymer, resulting in poor mechanical properties. In the case of solution impregnation techniques, the solution provides a low viscosity media that can easily impregnate the fibres. After impregnation the solvent is removed by conventional drying operations. However, the presence of residual solvent can result in a reduction of Tg and in poor fibre-matrix interface conditions, which is widely recognised as a major problem.

In order to overcome these drawbacks in conventional solution impregnation, a new processing route based on the use of epoxy resins as reactive solvents is currently under development at the Centre for Polymers and Composites, see [1, 2].

In this route the epoxy resin acts as an effective solvent by lowering the viscosity and (or) the processing temperature of the polymer matrix material and therefore facilitating the impregnation of fibres. By means of in-situ curing of the reactive solvent after impregnation, phase separation and phase inversion occurs. In this way the solvent will become the dispersed phase and a structural part of the material.

Moreover, it has been shown that upon this chemically induced phase separation the epoxy can preferentially migrate to the reinforcing fibre surface. This phenomenon of interfacial phase separation creates the potential to tailor the macroscopic properties of the fibre-reinforced composites based on these blends by changing the chemistry of the in-situ formed epoxy interlayer, see [3]. A schematic representation of this process is shown in figure 1.

Research Topics

- The influence of processing conditions and constituent properties on the occurence of interfacial phase separation in fibre-reinforced composites based on a model thermoplastic - epoxy blend.

- The influence of the properties of the phase-separated matrix morphology and interlayer (glassy versus rubbery epoxy phase) on the macroscopic composite properties such as strength, fracture tougness and impact resistance. This is studied for a number of amorphous and semi-crystalline thermoplastics.

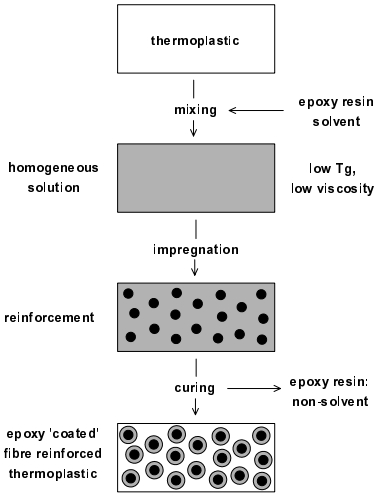

Figure 1 *Schematic representation of the concept of processing of thermoplastic composites using reactive solvents and the occurence of interfacial phase separation.*

References:

[1] R.W. Venderbosch, H.E.H. Meijer and P.J. Lemstra, *Polymer* (1995), **36**, 1167.

[2] H.E.H. Meijer, R.W. Venderbosch, J.G.P Goossens and P.J. Lemstra, *High Perf. Polym.* (1996), **8**, 133.

[3] R.W. Venderbosch, T.Peijs, H.E.H. Meijer and P.J. Lemstra, *Composites* (1996), **27A**, 895.