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Micronized talc-epoxy resin composites

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Abstract. Talc is a hydrated magnesium silicate with a plate-like structure and hydrophobic nature, which makes the mineral easily dispersable within an organic medium. This characteristic makes micronized talc (with average particle diameter of micrometer scale) a filler with potential to be dispersed in nanometer scale within polymer matrix composites. In this work we prepared composites with an epoxy resin matrix cured with aliphatic amine. The objective of this study is to verify the effect of addition of a reduced amount of micronized talc (up to 6 wt.-%) as reinforcing filler on the rheological, dynamic mechanical and thermal properties of the epoxy composites.

Talc is a hydrated magnesium silicate with a plate-like structure where the planar surfaces of the individual platelets are held together by weak van der Waals forces, which means that talc can be delaminated at low shearing forces [1]. This makes the mineral easily dispersable within an organic medium. The hydrophobic nature of talc allows it to be more compatible with polymer resins than clays which have hydrophilic nature. Albeit this potential few works were published on talc-epoxy composites [2] or its use as thermal stabilizer in thermoplastic polymer matrix [3]. In this work we prepared composites with an epoxy resin matrix cured at room temperature with aliphatic amine forming a relatively low-Tg thermoset polymer but with good thermal shock resistance. Commercial micronized talc supplied by Magnesita with D50 particle size of 1.7 µm was employed as reinforcing filler at compositions ranging from 0 up to 6 wt-%. The composites were analyzed through Brookfield rheology, dynamic mechanical tests and DSC measurements.

The Brookfield viscosity measurements performed on uncured samples (Fig. 1) have shown the initial viscosity reduction caused by the talc, and curing retardation. The dynamic mechanical results displayed in Fig. 2 (storage modulus) and Fig. 3 (*tan* δ) showed the reinforcing effect of talc for concentrations up to 3%. The storage modulus at 30°C showed an increasing of 9.4% for composite with 1% talc compared to neat epoxy resin; in the rubbery plateau (T = 100°C) the increment on storage modulus is 270% for composite with 3% talc. The peak on loss tangent curves was displaced towards higher temperature for talc composition up to 3% (80°C) in comparison to the neat resin curve. Above 3% talc concentration the peak is displaced to lower temperatures. These results were corroborated by T_g measurements which showed an increment from 62°C for the neat resin up to 71°C for the 3% talc composite and reduction to 64°C for the 4% talc concentration.

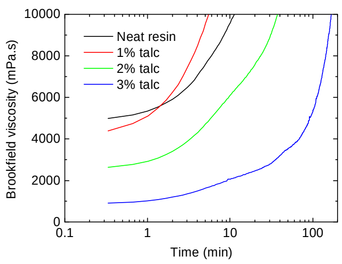

Figure 1: Brookfield viscosity curves for epoxy-talc composites curing at 20°C.

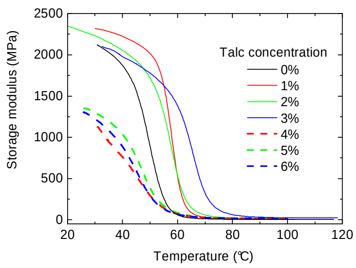

Figure 2: Storage modulus curves for composites with different talc concentration.

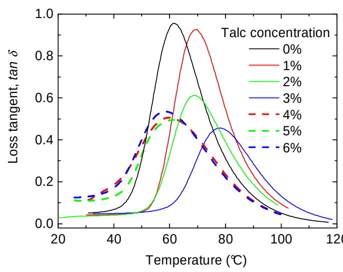

Figure 3: Loss tangent curves for composites with different talc concentration.

As conclusion we have shown that micronized talc acts as rheology modifier of the uncured epoxy mixes reducing its initial viscosity, and improving the both mechanical and thermal properties of composites up to 3% talc concentration.

References

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