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Influence of boehmite nanoparticle on the curing kinetics and rheology of an epoxy matrix for liquid composite molding process

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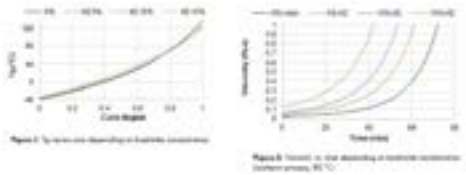
Modifying the resin matrix with nano-scale additives is especially attractive in the liquid composite molding (LCM) processes in order to increase the matrix performance, by effectively reducing the shrinkage and improving the mechanical properties without compromising the flow and impregnation behavior of the matrix. Main target of this paper is to characterize and model curing kinetics and rheological behavior of the boehmite (AlOOH) nanoparticle-modified epoxy matrix, regarding to the application in LCM processes for fabrication of fiber-reinforced plastics (FRP), which are not yet covered in the literature. Based on the curing behavior and rheological characteristics, the curing kinetics and rheology of the boehmite nanoparticle-filled epoxy matrix is modelled by Kamal-Sourour and Castro-Macosko models, separately. Based on the cure kinetics, the boehmite nanoparticles showed an accelerating effect on the reaction up to a cure degree of about 0.82. However, then the Tg of the reference system becomes higher than that particle-filled suspensions, indicating an inhibiting effect of the nanoparticle on the cure and negative effect on Tg. The final Tg value showed a reverse trend with the particle content: the higher the particle concentration, the lower the final Tg, indicating a decreased network stability of the particle filled suspension compared to that by the reference system. According to the rheological investigations, the effective processing time is inevitably decreased by about 28 % at 10 wt% and 40 % at 15 wt% boehmite concentration. The effects of the nanoparticles on the curing kinetics and rheology of the matrix exert extra requirements and restrictions on the processing strategies and parameters considering the decreased impregnation length for the fabrication of FRP structures.



Biography

Dilmurat Abliz is a PhD student in the Clausthal University of Technology and working as a scientific assistant since 2012 in the Institute of Polymer Materials and Plastics Engineering, TU Clausthal. His main research focus lies in the material, process and property characterization and modelling/simulation regarding nanoparticle-modified epoxy matrix for application in high-performance fiber-composites. This work originates from the Research Group Program FOR 2021"Acting Principles of Nano-Scaled Matrix Additives for Composite Structures" funded by the German Research Foundation (DFG: ZI 648/42-1; ZI 648/43-1).

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