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Investigation of cure kinetics in a system with reactant evaporation using the combination of DSC and TGA method

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The utilization of combined differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) techniques with equivalent temperature programs revealed itself as a useful tool for investigation of cure kinetics, where one of the reactants evaporates during the process. Due to evaporation, the observation using only DSC method resulted in difficulties in quantitative data analysis and examination of curing characteristic and kinetics. The case study of aforementioned technique was performed on bio-based resins (epoxidized vegetable oils, bio-benzoxazines), specifically on epoxidized soybean oil and maleic anhydride mixture, where maleic anhydride reacts and evaporates during the process. The open pan system against high pressure sealed pans was used, since the open process is most likely to be used on industrial base. Experimental data determined by the DSC associated with TGA analysis were successfully applied in the model-fitting procedure. Typical autocatalytic characteristic of the reaction was determined by Malek statistical method and further the Sestak–Berggren autocatalytic model was successfully applied. Additionally, kinetic parameters were determined via model-free method as non-isothermal experiments were performed. The curing kinetics is fundamental in understanding structure/property/processing relationships for manufacturing and utilization of high-performance composites. The main advantage of the designed method is its extension over any curing system with reactant evaporation.

Biography

Aleš Ručigaj has completed his PhD from Faculty of Chemistry and Chemical Technology, University of Ljubljana, Slovenia and continues his work as a Researcher. His current work is oriented around the field of benzoxazines and their appliance in self-healing processes.

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