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Modelling and Optimization of Nanostructered Polymer Blends Elaboration by Reactive Extrusion

*S. Hoppe, R. Rached, C. Fonteix, F. Pla

Laboratoire des Sciences du Genie Chimique, UPR 6811 Ecole Nationale des Industries Chimiques, INPL Nancy,.1, Rue Grandville, BP451, 54001 NANCY Cedex. France,

The high demand of new technical materials with specific properties implies the development of new concepts for their design and their optimization. In this study, a new strategy consisting in the design of a process for the elaboration, by reactive extrusion, of polymers blends by mixing a polymer A (polydimethylsiloxane: PDMS) with a monomer of a polymer B (lauryllactam: monomer of polyamide12) was developed. Compatibilization of this system can be achieved by in-situ formation of a B-A-B block copolymer. This copolymer is obtained by adding a fraction of functionalized polymer A, which allows the initiation and the growth of the polymer B at the end of its chains. Simultaneously to this process, the homopolymerization of B takes place owing to the addition of another activator. The aim of this method is to achieve a nano-scale dispersion of PDMS in polyamide12. For this purpose, an experimental strategy allowed to elaborate a model able to predict the influence and the interactions between, in one hand, the operating variables such as the screw speed, the feed rate, the ratio of the reactants and in the other hand, the number average diameter of the dispersed phase, the amount of residual monomer, and the mechanical properties of the resulting blend. This model is then used to simulate these data, under several operating conditions. The simulator is used in a multicriteria optimization procedure to obtain a set of all the non dominated solutions called Pareto's domain. A specific decision engineering tool allows to classify all these non dominated solutions and to take into account the preferences defined by a decision maker. This method allowed to determine the best operating conditions for the production of a polyamide blend characterized by a nano-scale dispersion and a high impact behaviour.