Kinetic modeling of mechanical properties of reactive thermoplastic resins with calorimetric cell mounted on DMA

Fabien Cara[1, a)], Brice Taillet[2, b)] and Pierre Gérard[3, c)]

[1]*TFX SA, route de France 17 CH-2926 Boncourt*
[2]*Metravib – acoem, 200 Allée des Ormeaux, FR-69578 Limonest*
[3]*Arkema, Groupement de recherches de Lacq RD817 - BP 34 FR-64170 Lacq*

[a)]*Corresponding author: Fabien.Cara@thermoflux.ch*
[b)]*Brice.Taillet@acoemgroup.com*
[c)]*Pierre.Gerard@arkema.com*

Abstract. Complete thermo-mechanical kinetic model of thermoplastic reactive material can be characterized in a few short experiments performed in a calorimetric cell placed inside a Dynamic Mechanical Analyzer. In similarly conditions to real processing (like in Resin Transfer Molding), the highly reactive resin can be injected inside the cell and characterized a different curing temperatures. In each isothermal shot, the system provide heat flux linked to reaction rate, sample shrinkage along with its dynamic mechanical properties (modulus and tanδ) according to time. Reactive cycles as short as one minute can be characterized by this method. The results obtained for example at three different curing temperature can be used to fit complete kinetic models of resin formulations: conversion level α(t,T), but also viscosity, elastic modulus, tanδ and shrinkage. The fact that all results are obtained on the same experiments repeated at different temperatures ensure minimum experimental drift linked to samples size and characterization methods and very efficient operations. Results obtained on an Elium® reactive thermoplastic resin will be presented and discussed. The kinetic model will be used in thermo-mechanical simulation in order to predict mechanical properties changes and shrinkage during the curing of real composite parts.