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The Contribution of the Rheology to Reactive Processing

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Reactive processing involves the difficulties of molten polymer processes (complex geometry, viscoelasticity, viscous dissipation,..) and the problems of controlling a chemical reaction in very specific conditions (high viscous medium, high temperatures, short residence times). Consequently, reactive processing developments require basic researches in the domain of the chemistry, rheology, flow modeling, mixing, in line instrumentation and process control. On the other hand, a lot of typical reactive systems can be considered in reactive processing as for example: chemical modification of molten polymers, bulk polymerisation, reactive blending of immiscible polymer blends by reaction at the interface, and in situ polymerisation and/or crosslinking of one of the two phases. However, there is still a fundamental question to be solved in reactive processing: What is the local concentration of reactants at the different length scale of mixing from macro-mixing to micro-mixing (or nano-mixing to be in fashion)? Actually, the role of diffusion and mixing is emphasized by the high viscosity of the molten polymers and the drastic variation of the viscosity with the extent of the reaction. The aim of this lecture is to present an overview of our last contribution in the domain of the rheology as for example the determination of the diffusion coefficient of monomer (and/or plasticizer) in molten polymers. More precisely, the present talk will be focused on the diffusion of the dicumyl peroxide(DCP) into an ethylene-octene copolymer. Actually, the competition between reaction (copolymer crosslinking) and diffusion was used to calculate the coefficient of diffusion from an inverse rheological procedure. Following this, a general equation of diffusion of the dicumyl peroxide into an Ethylene-Octene copolymer was derived.