In-situ characterisation of elementary dispersion mechanisms of silica granules in a polymer matrix under the action of shear

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The paper reports on the characterisation of elementary mechanisms of dispersion observed on silica granules embedded in a styrene-butadiene rubber (SBR) matrix under the action of shear. Dispersion experiments were performed using a rheo-optical device. The behaviour of two grades of precipitated amorphous silica (different by their specific area) in a common polymer matrix was investigated. Dispersion mechanisms were studied both in diluted and model concentrated systems. Two dispersion mechanisms were observed in the diluted regime: the successive disintegration (breakage where the detached fragments are immediately dispersed down to a few micron size) or the rupture (sudden breakage resulting into a few large fragments) of granules. Both dispersion mechanisms were found to occur above a critical hydrodynamic shear stress, which increases as the granule size decreases. The dispersion mechanism and the level of hydrodynamic stress for dispersion were found to depend on the intrinsic parameters of the silica granule. The concentrated model medium was constituted by a suspension of glass beads in the SBR matrix in which the behaviour of silica granules was observed. Similar dispersion mechanisms were observed in the diluted and concentrated regimes. Erosion by friction was observed in the concentrated regime and not evidenced in the diluted one. The size of the glass beads was found to affect the dispersion kinetics. This is explained by the stress generated by the passing by of two particles which depends on the particle size.

Keywords: silica, granule, shear, dispersion, desintegration, rupture.