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Extensional Flow, Rupture and Foaming of Nanocomposites Containing Recycled HDPE

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Research has been carried out to measure the shear and extensional flow characteristics of various compounds based upon post-consumer, recycled HDPE, including nanoclay / recycled HDPE composites in order to predict foaming behaviour in extrusion processes. Montmorillonite-based composites were prepared by melt-state mixing and the influence of temperature, compatibiliser and degree of mixing was investigated in terms of intercalation and flow behaviour. Shear flow characteristics show conventional pseudoplastic behaviour and temperature sensitivity; 3-parameter Carreau model constants have been obtained, in order to model extrusion behaviour in predictive mode. There is a tendency to observe wall slip in HDPE recyclate at a critical shear stress level and slip velocity has been related to shear stress, using a power law model. Constrained extensional deformations within fixed flow boundaries do not clearly discriminate the influence of nanoclay addition to HDPE. However, free surface measurement of extensional deformation and rupture are presented, so that the influence of recycled polymer and nanoclay content are fully characterised. To complement the rheological data, practical foam extrusion processing (using chemical blowing agents) of both recycled polymer and HDPE nanocomposites has also been investigated and attempts have been made to correlate the rheological data with practical foaming response.