Modifying the pom-pom model for extensional viscosity overshoots

We have developed a variant of the pom-pom model that qualitatively describes two surprising features recently observed in filament stretching rheometer experiments of uniaxial extensional flow of industrial branched polymer resins: (i) Overshoots of the transient stress during steady flow and (ii) strongly accelerated stress relaxation upon cessation of the flow beyond the overshoot. Within the context of our model, these overshoots originate from entanglement stripping (ES) during the processes of normal chain retraction and branch point withdrawal. We demonstrate that, for a single mode, the predictions of our overshoot model are qualitatively consistent with experimental data. To provide a quantitative fit, we represent an industrial melt by a superposition of several individual modes. We show that a minimal version of our model, in which ES due to normal chain retraction is omitted, can provide a reasonable, but not perfect, fit to the data. With regard to stress relaxation after (kinematically) steady flow, we demonstrate that the differential version of tube orientation dynamics in the original pom-pom model performs anomalously. We discuss the reasons for this and suggest a suitable alternative.