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MECHANISTIC INSIGHTS INTO THE FUNCTION AND PERFORMANCE OF POLYMERIC VISCOSITY MODIFIERS

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ABSTRACT

Viscosity modifiers (VM), or viscosity index improvers, are additives used in lubricants to mitigate the decrease of fluid viscosity with temperature [1]. Most VMs are long chain polymers that provide a thickening effect at elevated temperature. However, exactly how a given polymeric additive performs this function is not fully understood. For example, some viscosity modifiers are believed to expand with temperature, thereby providing additional thickening at high temperatures [1]. However, experiments and simulations have shown that not all VM polymers expand with temperature [2,3], so this is unlikely to be a universal mechanism. An alternative proposal is that polymers are more likely to associate or aggregate at higher temperatures, such that their effect on viscosity is correspondingly larger [5]. In this work, we use molecular dynamics simulations to model polymer-base fluid blends for several different additive molecules. The simulation-based approach enables us to isolate specific viscosity enhancing mechanisms and the findings show that indeed the mechanism by which a VM functions is related to the polymer itself. In general, this work suggests ways to tune polymer chemistry for a given VM application which in turn has the potential to improve the efficiency of lubricated interfaces, particularly in high temperature conditions.

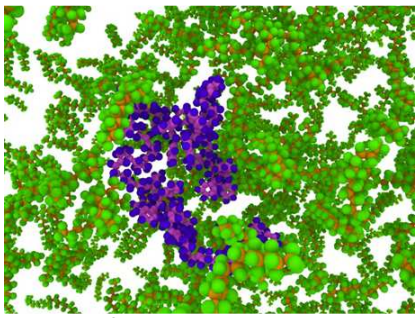

Fig.1 Snapshot of an atomistic simulation of a polymeric viscosity modifier (purple/blue) whose function is to increase the viscosity of the base fluid (green/orange) at elevated temperatures.

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