

Prediction of the Viscosity of Liquid Alkane Mixtures

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Kinetic theory forms a very useful starting point for the development of methods to predict the viscosity of a fluid. Although for dilute gases the accurate calculations of the viscosity are now possible from the realistic intermolecular potential surface, for dense fluids the situation is less satisfactory. At present no rigorous theory exists for an exact evaluation of the viscosity of a dense fluid. A number of models have been proposed, the earliest and most successful being a rigid-sphere model. It formed the basis of Enskog-Thorne theory [1] that allowed for the development of viscosity prediction methods. Although the scope of the theory initially was limited to gases, there have been a number of attempts to extend its scope of application to supercritical fluids and liquids. One of these attempts is the VW method [2]. It makes use of the Enskog-Thorne hard-sphere theory in a self-consistent manner to interpolate between the viscosities of the pure components, thus making full use of the very accurate body of work already completed on pure fluids. The VW method has been used to predict successfully the viscosity of mixtures of similarly sized molecules. Nevertheless, the VW scheme fails for highly asymmetric mixtures such as methane + n-decane. We have recently shown [3] that it is possible to extend the method to include the effects of the molecular shape on viscosity. The molecules of the fluid are modelled as chains of equal sized, tangentially-joined, rigid spheres; particles of intermediate length (fused-sphere models) can be treated by interpolation of the tangent description. It is assumed that the collision dynamics in such a fluid can be approximated by instantaneous collisions between two rigid spheres belonging to different chains. In this work, we use the same concepts to predict the viscosity of liquid alkane mixtures. Predictions were compared to experimental data for binary and multicomponent liquid alkane mixtures and the observed deviations are within approximately 5%. It would be possible to increase the accuracy of the method somewhat if more accurate correlations of the viscosity of the pure species were available. Nevertheless, considering that the model has no adjustable parameters, pertaining to dense fluid mixtures, at all, this would seem to be a satisfactory accuracy.

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