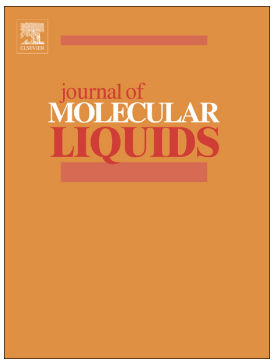

A novel and effective approach for viscosity prediction of binary and multicomponent liquid mixtures

Ranjan Dey, Piyashi Biswas

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A novel and effective approach for viscosity prediction of binary and multicomponent liquid mixtures

Ranjan Dey* and Piyashi Biswas

Department of Chemistry, Goa Campus,BITS Pilani, Zuarinagar, Goa-403726,India.

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ABSTRACT

For the first time, to the best of our knowledge, a volume fraction based model has been developed for prediction of viscosity. The proposed model has been tested on 200 binary, 20 ternary and 5 quaternary liquid mixtures over a wide range of temperature. The results have been compared with other well-known predictive equations taking average absolute percentage deviation(AAPD) as the criterion for predictive capability. Grand AAPDs show that the proposed model is outperforming al the well-known approaches in terms of predictive capability.

INTRODUCTION

Viscosity data for liquid mixtures are important for the engineering calculations having multiphase applications related to pipeline flow, heat and mass transfer operations, hydraulic calculations for surface facilities, flow through porous media etc. Knowledge of viscometric behaviour due to composition changes are crucial to overcome multifarious engineering challenges and for an in-depth understanding of binary and higher order liquid mixtures. Acquisition of viscometric data involves expensive, tedious and time consuming experimental set-ups. Consequently, over the past several decades, viscosity as a property has attracted significant attention specially keeping in view the development of models for viscosity estimation that can be implemented in various simulation programs.

There are several models present in literature to predict viscosity and they can be divided into two categories viz., predictive and correlative. These include several well-known approaches which have been employed globally by researchers, like Bingham, Kendall Munroe, Frenkel, Hind Ubbelohde, ECN, Sutherland Wassiljewa and correlative models like Grunberg-Nissan, Tamura-Kurata, McAllister, etc[1]. However, the biggest challenge is that these models are algebraically complicated and require a huge amount of data for evaluating the parameters for them to hold physical significance[2]. Since correlative approaches can be applied only to experimental data, there is always a demand for predictive models which are simple yet able to predict viscosity with a high degree of accuracy. Recently a modified Frenkel approach has been developed by Dey et al[3] and two more new models have been developed by Saini et al[4].

In the present investigation, a new approach has been developed for predicting viscosity of binary, ternary and higher order liquid mixtures including mixtures containing ionic liquids as one of the components over a wide range of temperature. The proposed model has been tested on 200 binary, 20 ternary and 5 quaternary systems.

THEORY