Experimental and Theorical Study of Surface Tension and Density of 1,2-Dimethylbenzene with Alkanes at 298.15K

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Introduction

Methylbenzenes occur in small quantities in naphtha and higher boiling fractions of petroleum. Those presently of commercial importance are toluene, 1,2-Dimethylbenzene (o-xylene), 1,4-Dimethylbenzene (p-xylene), and to a much lesser extent 1,3-Dimethylbenzene (m-xylene). Particularly, 1,2-Dimethylbenzene is mainly used to produce phthalic anhydride for plasticizers. The primary sources of xylenes are reformates from catalytic reforming units, gasoline from catcraking, and pyrolysis gasoline from steam reforming of naphtha and gas oils. Solvent extraction is used to separate these aromatics from the reformate mixtures[1]. For this reason, physical properties of pure liquids and liquid mixtures containing aromatic and aliphatic compounds and their dependence with composition are very important basic data for petrochemical industry.
Due to the lack of experimental information regards 1,2-dimethylbenzene, in this work, experimental data of surface tension and density of this compound with octane, nonane and decane at 298.15K and atmospheric pressure are presented. The surface tension deviation and the excess molar volume have been correlated by Redlich Kister polynomial equation. An theoretycal study has been applied in this mixtures using different models [2-3].

Experimental Section

Surface tension was determined using an automatic tensiometer Lauda TVT2 with a total accuracy of the surface tension determination better than 0.1 $mN.m^{-1}$. This property was assessed for both pure components and binary mixtures based on the principle of the pending drop volume.
On the other hand, densities measurement of binary mixtures and its respective pure compounds were carried out in a vibrating-tube Anton Paar DMA 4500 densimeter, with a density repeatability of 10^{-5} $g.cm^{-3}$.

Results and Discussion

Surface tension is a consequence of the difference in the molecules distribution between the bulk and the surface of the liquid. The surface tension of alkanes are lower than 1,2-dimethylbenzene, and the deviation surface tension of the binary mixtures increases with the chain length of the alkane because the strength of dispersion forces increases[4] as it can be seen from Figure 1(a).
Positives surface tension deviation represents chemical effects between the molecules while negatives

values are obtained when physical effects and dipolar-dipolar interaction are involved [5]. For the 1,2-dimethylbenzene + alkane binary systems studied in this work, physical effects are more dominant than chemical effects.

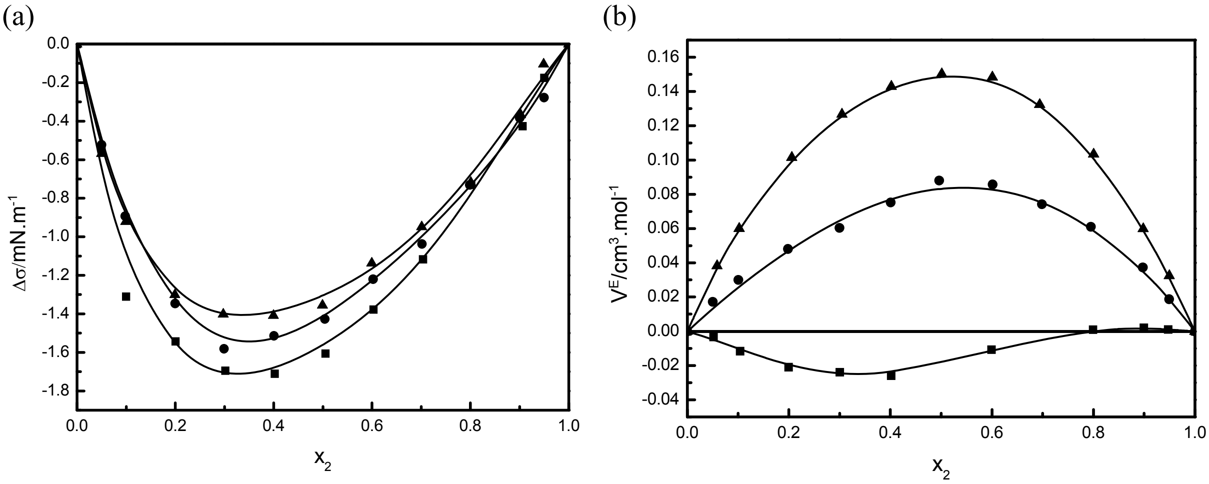

Figure 1. Experimental (symbols) and Redlich Kister (lines) correlation for the deviation surface tension (a) and excess molar volume (b) at 298.15 K for 1,2-Dimethylbenzene (1) with alkanes (2) binary mixtures: octane (■), nonane(●) and decane(▲).

The densities of the alkanes are lower than 1,2-dimethylbenzene, and the density and the excess molar volume of the binaries mixtures increases with an increasing of the length of the alkane. Regarding excess molar volume, in Figure 1 (b) it can be observed that 1,2-dimethylbenzene + octane presents an *S*-shaped dependence on composition with small positive values at the highest octane concentration and negative values on the other extreme. However the 1,2-dimethylbenzene + nonane and 1,2-dimethylbenzene + decane binaries mixtures present a maximum excess molar volume at the equimolar composition. Yang et al.[6] suggest no specific interactions in similars compounds such us 1,4-dimethylbenzene + alkane.

Conclusions

Surface tension and density of 1,2-dimethylbenzene + octane, nonane or decane binary mixtures at 298.15K and atmospheric pressure are presented. Surface tension deviation and excess molar volume have been calculated and correlated by Redlich Kister polynomial equation. These data allows comparing surface tension deviation and excess volume molar between the different dimethylbenzene isomers + alkane binary mixtures.

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