Concentration and Temperature Dependence of Viscosity in Mode-Coupling Theory of Binary Mixture of Water and Phenol

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Abstract

The dynamic shear viscosity of a binary liquid mixture of water and phenol has been measured at different temperatures ($32.0\ ℃ \leq T \leq 75.0\ ℃$) and different concentrations (0.00% up to 100.00% by weight of phenol) by using glass capillary viscometer and Brookfield viscometer model DV-I+. The critical temperature and critical concentration have been determined to be 67.0 ℃ and 33.90% by weight of phenol respectively. The mode coupling theory (MCT) has been used to calculate the value of background viscosity (noncritical part of shear viscosity) $\eta_0 = 0.684$ cP, the Debye momentum cutoff $q_D = 0.786\ Å^{-1}$ and the MCT constant A = 0.050. The intermolecular force range L of water and phenol molecules in a binary mixture has been calculated to be 11.17 Å. The large value indicates that the mutual force between binary mixture molecules can be considered as a week attractive force. The critical amplitude of specific heat under constant pressure at critical concentration and above critical temperature C_{pc} has been found to be $259.16 \frac{J}{kg.K}$ by using the two scale factor university.