Water Solubility in Ionic Liquids and Application to Absorption Cycles

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The absorption cooling cycle has been in use for more than 100 years. Although the vapor compression cycle is now used for most air-conditioning and refrigeration applications, the well-known refrigerant-absorbent systems (water + LiBr and ammonia + water) are still being used for space cooling and industrial refrigeration. Recently, absorption cooling cycles using water + room-temperature ionic liquids (RTILs) have been proposed as a replacement for the water + LiBr system. There have been a few reports in the literature since about the year 2000 on the solubility of water in RTILs, and some of the hydrophilic RTILs show extremely high mutual solubility with water, indicating formation of chemical complexes. Almost all solubility data have been correlated with the use of activity (or solution) models. In the present report, we apply an equation of state (EOS) model in order to understand the solubility characteristics, as well as the chemical complex formation, consistent with the same thermodynamic model. Also, such a model is convenient for estimating the performance of the absorption cooling cycle, as we have demonstrated in the past for the absorption cycle performance of various hydrofluorocarbons (HFCs) + solvents[1] and ammonia + RTILs[2,3]. The present purpose is to examine the feasibility of using water and RTILs in an absorption cooling cycle and to show some promising results for this application.[4]

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[4] A. Yokozeki, M.B. Shiflett, *Ind. Eng. Chem. Res*. *49*, **2010**, 9496-9503.