Thermophysical Properties of [C2mim][CH3SO3] - Experimental and Heat Transfer Studies

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Ionic liquids have proved to be excellent heat transfer fluids and alternatives to common HTF's used in industry for heat exchangers and other heat transfer equipment [1,2]. One of the main arguments against its utilization in large scale units is the cost/kg of the ionic liquids. This argument is based on the selling price of ionic liquids produced at a laboratory level (300-2000 €/kg), where the price is inflated by the labour cost involved in the synthesis of small quantities. Although the cost of tonnage production is not usually disclosed, it is below 20 €/kg (a factor of 15-100 times lower), a value competitive for some industrial applications with biphenyl and diphenyl oxide, alkylated aromatics and dimethyl polysiloxane oils, which degrade above 200ºC and possess some environmental problems. 1-ethyl-3-methylimidazolium methanesulfonate [C2mim][CH3SO3] (CAS Number 145022-45-3), is actually produced by BASF, under the trade name of Basionics® ST 35, with an assay = 95% with = 0.5% water and chloride (Cl-) = 2%. An extensive search about the thermophysical properties of this IL using the ILThermo Database [3] shows that the data available is very scarce for density, viscosity and heat capacity, and non-existent for thermal conductivity. The study of the heat transfer coefficients of this fluids to be used in common heat exchangers (shell and tube, parallel plates, concentric cylinders) requires not only the thermophysical properties involved in the heat transfer process, but also the simulation of the real equipments in a pilot scale. A complete study of the thermophysical properties of [C2mim][CH3SO3] started in our laboratory, with the support of BASF SE. Density, speed of sound, heat capacity, viscosity and thermal conductivity of the industrial product, and after purification, are being obtained for the temperature range 293-353 K. In addition the heat transfer coefficients for the pairs water/IL and water/EG are studied for a parallel plates pilot heat exchanger, comparing the relative global efficiency. Details of the instruments and heat transfer pilot will be given.

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References

[1] J.M.P. França, C. A. Nieto de Castro, M. L. M. Lopes, V. M. B. J. Nunes, J. Chem. Eng. Data (2009) 54, 2569-2575.
[2] J.M.P. França, C.A. Nieto de Castro, S.M. Murshed, M.J.V. Lourenço, J. Chem. Eng. Data, (2013) 58, 467-476.
[3] Ionic Liquids Database - ILThermo (v2.0), NIST Standard Reference Database #147, ©2013 US Secretary of Commerce, USA.