Electrochemical Study of Interaction between Imidazole-Based-Ionic-Liquid and Light Petroleum in Oil/Water Emulsion

E.E. Villalobos-Neri¹, U. Páramo-García^{1,*}, R. Mayen-Mondragon^{2,*}, N.V. Gallardo-Rivas¹

¹ Tecnológico Nacional de México/I. T. Cd. Madero, Centro de Investigación en Petroquímica, Prol. Bahía de Aldhair y Av. de las Bahías, Parque de la Pequeña y Mediana Industria, 89600, Altamira, Tamaulipas, MÉXICO

² Polo Universitario de Tecnología Avanzada, Facultad de Química, Universidad Nacional Autónoma de México, Vía de la Innovación 410, Autopista MTY-Aeropuerto Km. 10, Parque PIIT, 66629, Apodaca, Nuevo León, MÉXICO.

*E-mail: uparamo@itcm.edu.mx; rmayen@unam.mx

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In the present work, the binding capacity of a 1-methyl-3-hexylimidazolium p-toluenesulfonate ionic liquid to Aragon light oil within a 70/30 oil/water emulsion was studied by cyclic voltammetry. The imidazole-based ionic liquid was synthesized by anion interchange reaction. Its chemical structure was confirmed by Fourier-Transform Infrared Spectroscopy and Nuclear Magnetic Resonance. Its Critical Micelle Concentration (CMC) in water was determined by Conductimetry, Ultraviolet-Visible Spectroscopy and Cyclic Voltammetry. The ionic-liquid-to-oil binding-constant and binding-free-energy were determined from the dependence of the voltammogram anodic-peak-current with the ionic liquid concentration in the emulsion. The diffusion coefficient of the free and bound forms of the oil within the emulsion were determined from the Randles-Sevcik equation. The measurements led to a CMC value of approximately 152 mg/L and a binding constant of $0.98 \times 10^4 \text{ M}^{-1}$, corresponding to a binding free energy of -22.78 KJ/mol. The negative value of the latter confirmed the ionic liquid spontaneously binds to the oil phase. The oil-droplets diffusion coefficient showed a 2.5-fold increase (up to $4.631 \times 10^{-7} \text{ cm}^2/\text{s}$) due to incorporation of the ionic liquid molecules. The information gathered can be helpful to design more efficient remediation processes of oil-contaminated water, as well as to improve the design of ionic liquid molecules, and to study their interaction with different oil components.

Keywords: Imidazole, diffusion coefficient, oil/water emulsion, critical micelle concentration, oil-contaminated waters

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