CO₂ Capture Process and Corrosion of Carbon Steel in [Bmim][Lys]-K₂CO₃ Aqueous Solutions

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The corrosion of carbon steel in carbonated 1-butyl-3-methylimidazolium lysinate ([Bmim][Lys])-potassium carbonate (K₂CO₃) aqueous solution was investigated by using a CHI602E electrochemical analyser. The time-dependent absorption capacity, polarization behaviour and corrosion rate of carbon steel in carbon dioxide (CO₂)-loaded K₂CO₃ aqueous solution and [Bmim][Lys]-K₂CO₃ aqueous solution were measured. The effects of temperature, the mass fraction of [Bmim][Lys]/K₂CO₃ and CO₂ loading on the corrosion rate were demonstrated. The pH values of CO₂-loaded K₂CO₃-[Bmim][Lys] aqueous solutions were measured, and the variations in H⁺ concentration and the effect of H⁺ concentration on the corrosion rate were analysed. Our experiments showed that when activated by [Bmim][Lys], K₂CO₃ aqueous solution demonstrated a higher CO₂ absorption capacity, higher CO₂ absorption rate and lower corrosion rate for carbon steel. Compared with the commercially applied diethanolamine (DEA, 3%) - K₂CO₃ (25%) aqueous solution, the [Bmim][Lys] (7.5%)-activated K₂CO₃ (25%) aqueous solution can not only achieve a higher CO₂ absorption capacity, lower the corrosion of carbon steel and achieve a similar CO₂ absorption rate but also decrease the energy cost due to its advantages of higher concentration and lower water content; thus, the investigated solution has very good application potential in the CO₂ capture process.

Keywords: K₂CO₃, [Bmim][Lys], CO₂, absorption, corrosion.

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