

Measurement of Binary Diffusion Coefficients of CO₂ in Several Liquid Alkanes

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Diffusion coefficients of CO₂ in hydrocarbons is relevant to many disciplines, with the field of enhanced oil recovery being one contemporary example. Diffusion not only plays a central role in mass transport in porous material at low flow rates but is also one of the determining factors in the rate of absorption of CO₂ into the reservoir fluids. However there is a lack of reported measurements in the literature for CO₂-hydrocarbon mixtures under relevant (HTHP reservoir) condition. The Taylor dispersion technique has been used to measure diffusion coefficients of CO₂ in a homologous series of alkanes over a range of temperatures, (298 – 423) K and pressures from (1 to 69) MPa. Six hydrocarbons, ranging from hexane to hexadecane, were studied as representative model components of a typical reservoir fluid. Measurements were performed using a Taylor dispersion apparatus. The results have an estimated relative uncertainty of 1.5% with a coverage factor of 2. It is found that, in contrast to aqueous systems where there is a negligible effect of pressure on the measured diffusion coefficients, diffusion of CO₂ in hydrocarbons is a strong function of pressure, with up to a 45% decrease in values between (1 and 69) MPa at a given temperature. The data have been correlated using a model based on the rough hard sphere theory. This correlation requires knowledge of the molar volume of the solvent at the specific state point and two fitted parameters. The effect of the solvent on the two fitted parameters will be discussed further.