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Absorption rates of carbon dioxide in amines in hydrophilic and hydrophobic solvents

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Abstract

The rate of absorption of CO₂ into amines in hydrophilic and hydrophobic solvent mixtures was studied in this work using a stopped-flow apparatus and a stirred-tank reactor. Monoethanolamine (MEA, primary amine) and N-methyl benzylamine (NMBZA, aromatic secondary amine) are chosen for this study and diluted in hydrophobic or hydrophilic solvents at different temperatures (295-343 K) and concentrations (0.01-4 kmol.m⁻³). It was found that the reaction rate between the secondary amine and CO₂ in water is faster than the reaction with the linear primary amine (MEA); however, in an ethereal hydrophobic non-aqueous system the NMBZA-CO₂ reaction is slower than the reaction of CO₂ with MEA. With respect to amine, the reaction orders were found to be 0.9 and 1.2 for hydrophilic systems (MEA + H₂O, NMBZA + H₂O). For hydrophobic system they were found to be 0.6 and 2.7 (NMBZA + ethereal hydrophobic solvent, NMBZA + MePhOH + ethereal hydrophobic solvent). When amine was mixed with hydrophilic solvent (H₂O), the activation energy of amine (NMBZA) to react with CO₂ was found to be 27.66 kJ.mol⁻¹ and decreased to 10.37 kJ.mol⁻¹ when mixed with hydrophobic solvent (ethereal hydrophobic solvent). The activation energy of hydrophobic solvent was found to increase by adding an alcohol to the solvent (MePhOH + ethereal

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