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Kinetics of CO_2 Absorption in Reactive Solvents

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The large anthropogenic increase in CO_2 emissions due to continued use of fossil fuels is believed to be adversely impacting global climate. Solvent–based CO_2 capture technologies have the potential for reducing up to 80-90% of CO_2 emissions from fossil fuel-based industrial point sources. However, wide-scale adaptation of such technologies is capital and energy intensive. For example, using commercially available aqueous monoethanolamine (MEA) technology for CO_2 capture from coal-fired power plant flue gas may increase the cost of electricity by 70-80%. Solvents with higher cyclic capacity, lower degradative and evaporative losses and significantly lower regeneration energies compared to MEA are therefore needed to significantly reduce the cost of CO_2 capture from flue gases.

In this paper we will present preliminary kinetic data for CO_2 absorption in aqueous alokanolamines and amino acid salts obtained using stopped flow technique over the temperature range of 25-45^{o}C. Aqueous solutions of monoethanolamine (MEA), diethanolamine (DEA) and methyl-diethanolamine (MDEA) in the concentration range of 5 mM to 550 mM were used to calibrate the experimental technique. The measured data were analyzed using pseudo first-order kinetic model and corresponding second order rate constants were obtained. The calculated rate constants for MEA, DEA and MDEA have been found to be in good agreement with the literature data. The kinetic measurements for the amino-acid salts such as β-alanine and sarcosine are under way. The absorption kinetics of these amino acid salts will be measured using the same stopped flow technique and data will be analyzed using pseudo first order kinetic model. A comparison of the absorption kinetics of the amino-acid salts with MEA, DEA and MDEA will be presented.

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