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CO_2 Absorption Studies Using Amine Solvents with Fourier Transform Infrared Analysis

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Abstract : The increasing global atmospheric temperature is of great concern and this has led to the development of technologies to reduce the emission of greenhouse gases into the atmosphere. Flue gas emissions from fossil fuel combustion are major sources of greenhouse gases. One of the ways to reduce the emission of CO_2 from flue gases is by post combustion capture process and this can be done by absorbing the gas into suitable chemical solvents before emitting the gas into the atmosphere. Alkanolamines are promising solvents for this capture process. Vapour liquid equilibrium of CO_2-alkanolamine systems is often represented by CO_2 loading and partial pressure of CO_2 without considering the liquid phase. The liquid phase of this system is a complex one comprising of 9 species. Online analysis of the process is important to monitor the concentrations of the liquid phase reacting and product species. Liquid phase analysis of CO_2-diethanolamine (DEA) solution was performed by attenuated total reflection Fourier transform infrared (ATR-FTIR) spectroscopy. A robust Calibration was performed for the CO_2-aqueous DEA system prior to an online monitoring experiment. The partial least square regression method was used for the analysis of the calibration spectra obtained. The models obtained were used for prediction of DEA and CO_2 concentrations in the online monitoring experiment. The experiment was performed with a newly built recirculating experimental set up in the laboratory. The set up consist of a 750 ml equilibrium cell and ATR-FTIR liquid flow cell. Measurements were performed at 400°C. The results obtained indicated that the FTIR spectroscopy combined with Partial least square method is an effective tool for online monitoring of speciation.

Keywords : ATR-FTIR, CO_2 capture, online analysis, PLS regression
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