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# In Situ Measurement of Physical Solubility of Carbon Dioxide in Loaded Aqueous Monoethanolamine by Raman Spectroscopy

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**Abstract**—Physical solubility is a physicochemical parameter necessary for reaction kinetic study and modeling CO<sub>2</sub> separation process. When CO<sub>2</sub> absorb into liquid phase and react with solvent, shift in chemical composition and equilibrium results in change in properties of solvent. As CO<sub>2</sub> absorption is a continuous process with CO<sub>2</sub> dissolving into partially loaded solution most of the time, availability of a robust technique to access unreacted CO<sub>2</sub> dissolved in aqueous phase is crucial to study effect of CO<sub>2</sub> loading on physical solubility. Current work investigates physical solubility of CO<sub>2</sub> in loaded monoethanolamine (MEA) solution at elevated pressure conditions by direct measurement of unreacted CO<sub>2</sub> dissolved in the solution using Raman spectroscopy. This spectroscopic method does not require N<sub>2</sub>O as surrogate gas, hence eliminates the need of N<sub>2</sub>O analogy to estimate solubility of CO<sub>2</sub>. Impact of varying CO<sub>2</sub> loadings on Henry's constant is examined.

**Keywords**—CO<sub>2</sub> absorption; CO<sub>2</sub> loading; equilibrium; Henry's constant; MEA;

## 1. Introduction

CO<sub>2</sub> capture from gas stream is one of the most crucial strategies to reduce greenhouse gas emission from various industries and combat global climate change due to increasing atmospheric CO<sub>2</sub> concentration. Besides, CO<sub>2</sub> separation, also known as gas sweetening, is necessary in natural gas industry to comply with consumers' requirement. In addition, acid gas purification increases calorific value of natural gas, improves pipeline capacity as well as reduces risk of corrosion in pipeline and process equipment. Technologies for CO<sub>2</sub> removal include absorption, adsorption, membrane separation and cryogenic process. Separation by aqueous alkanolamine is broadly applied in large scale acid gas treatment. Monoethanolamine (MEA) is the

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