

**TITLE: HEAT OF DISSOLUTION MEASUREMENTS FOR CO<sub>2</sub> IN MIXED ALKANOLAMINE SOLVENTS**

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## **1. ABSTRACT**

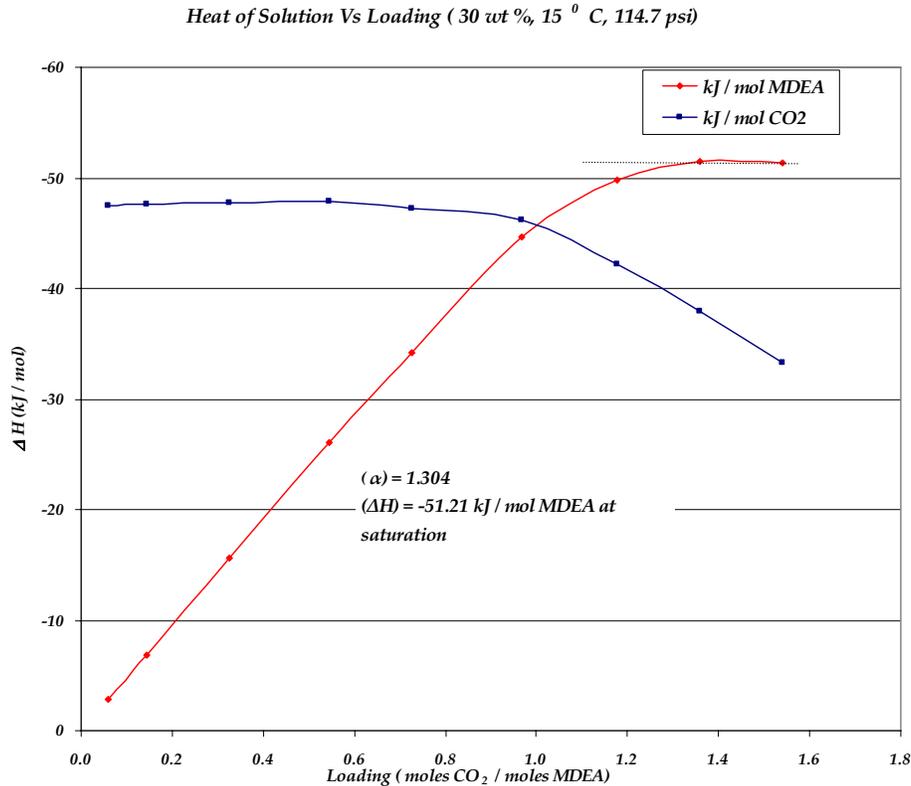
### **Objectives**

The main objective of this project is to measure heat of dissolution of CO<sub>2</sub> in carefully selected mixed alkanolamine solvent systems, and provide such directly measured data that might be used for efficient design of CO<sub>2</sub> capture processes, or for better understanding of thermodynamics of CO<sub>2</sub>- alkanolamine systems. For more economical CO<sub>2</sub> capture and regeneration, there is a need for development of more efficient solvent systems. In this project we will extend the thermodynamic database by measuring heat of solution data of CO<sub>2</sub> in mixed solvents made of MEA (monoethanolamine), MDEA (methyldiethanolamine), piperazine, and water. Mixed solvents of different compositions will be selected and in each case data will be measured over a temperature range and various partial pressures of CO<sub>2</sub>. At the end of the project, observations, conclusions, and recommendations will be derived for the choice of mixed solvents for efficient CO<sub>2</sub> capture with potential for commercialization.

### **Accomplishments To Date**

The data measurements for solubility and enthalpy of solution of carbon dioxide in aqueous MEA and MDEA solutions and their mixtures have been completed. For MEA-CO<sub>2</sub> system, data were measured at 15°C, 40°C and 70°C, and for aqueous solutions containing 15, 30 and 50 wt% MEA. For MDEA-CO<sub>2</sub> system, data were measured at 15°C, 40°C and 75°C, and for aqueous solutions containing 20, 30 and 50 wt% MDEA. Data have also been measured for three mixed solvents containing wt% of MEA and MDEA of (24,6), (18,12), and (6,24), each at temperatures 15, 40 and 75 degrees Celsius. Data measurements for mixed solvent containing MDEA and piperazine are currently in progress and will be completed shortly. All measurements were carried out using the isothermal micro-calorimeter made by Calorimetry Sciences Corporation. Measurements were at a total pressure of 100 psig. In a typical measurement, at a fixed flow rate of liquid solution, CO<sub>2</sub> rate was steadily increased. This resulted in an increase in the rate of heat generated, until the aqueous solution was saturated with CO<sub>2</sub>, at which point the heat

generation rate leveled off. This is shown in the diagram below for the MDEA-CO<sub>2</sub> data point for 30 wt% MDEA solution at 40°C and 100 psi. For this case the solubility of CO<sub>2</sub> was measured as 0.975 moles of CO<sub>2</sub> per mole of MDEA, and the heat of solution was -49.26 kJ/mol of CO<sub>2</sub>.



### Future Work

The work planned during the next phase of this project is outlined below.

- Data measurements for aqueous CO<sub>2</sub>-MDEA-PZ multi-component systems will be completed
- All our measured data and data available in the literature on CO<sub>2</sub>-aqueous alkanolamine systems are being compiled. Data will be regressed using simple correlations.
- Optimum compositions of alkanolamines in aqueous solutions will be recommended for CO<sub>2</sub> removal from gas mixtures.

## 2. LIST OF PUBLICATIONS AND SUPPORTED STUDENTS

**Publications:** None yet, an article and a presentation are in preparation.

### Students Supported Under the Grant

- Chaitanya Pendyala, M.S. student in chemical engineering, NC A&T State University