# Density and Isobaric Heat Capacity of CO2-Loaded Aqueous Amines for Carbon Capture

Yisel Pérez-Milian[1], Juan Diego Arroyave[1], Alejandro Moreau[1, S], Fredy Vélez[1] and David Vega-Maza[1, C]

[1]*Energy Engineering and Fluid Mechanics, University of Valladolid, Valladolid, Castilla y Leon, Spain*
*david.vega@uva.es*

Human activities have led to a substantial increase in carbon dioxide ($CO_2$) emissions. This has caused global surface temperatures to rise. Amine-based $CO_2$ capture has become a promising technology to tackle this problem. The thermophysical characterisation of fluids is crucial for understanding carbon capture performance. Properties such as density ($\rho$) and isobaric heat capacity ($c_p$) play an essential role in the design of energy efficient systems. In addition, these properties are valuable for predictive modeling. Nevertheless, literature lacks practically all essential $CO_2$-loaded thermophysical properties over a wide range of concentrations, temperatures, and pressures.

To fill this gap, we measured $\rho$ and $c_p$ of two systems consisting of $CO_2$-loaded aqueous solutions of amines, monoethanolamine (MEA) and *N*-methyldiethanolamine (MDEA). A predetermined amount of $CO_2$ was mixed with an aqueous amine solution in an equilibrium cell. This method allowed us to establish a fixed $CO_2$-loading state in terms of mol $CO_2$/mol amine. Experimental measurements were carried out at temperatures between (293.15 and 393.15) K, pressures up to 100 MPa in $\rho$ and 20 MPa in $c_p$, and $CO_2$-loading up to 0.6 mol $CO_2$/mol MEA and 0.8 mol $CO_2$/mol MDEA. Density was measured using a vibrating tube densimeter, with an expanded ($k$ = 2.0) relative uncertainty of 0.1 %. A flow calorimeter with an expanded relative uncertainty better than 1 % was used to measure $c_p$.

It was found that an increase in temperature resulted in a slight increase in $c_p$. Pressure had no effect on $c_p$. We observed that an increase in $CO_2$-loading led to a 8 % $\rho$ increase and a 11 % $c_p$ decrease with $\alpha$ = 0.6 in 30 % $MEA_{\{aq\}}$. Comparison with the scarce experimental data available in literature is in good agreement within uncertainty. The experimental measurements were fitted with an empirical correlation, achieving standard deviations better than the uncertainty.

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