PREDICTION OF CO$_2$ GAS SOLUBILITY IN AQUEOUS SOLUTION OF POTASSIUM CARBONATE AND MDEA USING ELECTROLYTE UNIQUAC MODEL

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ABSTRACT

Removal process of CO$_2$ gas from process gas often applied in chemical industry is absorption with chemical reaction from CO$_2$ gas by using K$_2$CO$_3$ as a solvent with amine as a promoter, one of amine which can be used is MDEA, where this process is known as Benfield process. Vapor-liquid equilibrium data of CO$_2$-K$_2$CO$_3$-MDEA-H$_2$O system is needed for rational design and optimal operation from CO$_2$ removal unit. The purpose of this research is to predict solubility data of CO$_2$ gas in aqueous solution of potassium carbonate with MDEA as a promoter at various pressure 1 atm and 30 atm and K$_2$CO$_3$-MDEA composition 30% K$_2$CO$_3$–2% MDEA and 30% K$_2$CO$_3$–5% MDEA at 30°C by using electrolyte UNIQUAC model. The calculation uses Matlab program. The validation uses experiment data from literature with Average Relative Deviation (ARD) for partial pressure of CO$_2$ 10.26% - 28.64% and ARD for CO$_2$ loading 0.64% - 7.75%. For high pressure, ARD for partial pressure of CO$_2$ 89.57% and ARD for CO$_2$ loading 60.21%. The prediction is compared with experiment data with ARD for vapor fraction of CO$_2$ in range 4.95% - 8.32% and ARD for CO$_2$ loading 1.88% - 4.31%. In this research, the increasing of CO$_2$ loading makes the solubility of CO$_2$ and partial pressure of CO$_2$ increase. The increasing of weight percent of MDEA make partial pressure of CO$_2$ decrease. The increasing of pressure makes the solubility of CO$_2$, CO$_2$ loading, and partial pressure of CO$_2$ increase.

Keywords : electrolyte UNIQUAC model, CO$_2$-K$_2$CO$_3$-MDEA-H$_2$O system, vapor-liquid equilibrium
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