Dynamic Study of Carbon Dioxide Absorption Using Promoted Absorbent in Bubble Column Reactor

Abstract—The most common process to remove carbon dioxide from natural gas and the flue gasses is absorption into suitable solvents. Absorption of carbon dioxide are studied experimentally in this work using bubble column reactor (glass cylindrical (QVF) of 7.5 cm i.d. × 140 cm height), where different types of absorbent (30%MEA, 30%K₂CO₃), promoter types (organic(piperazine) and inorganic(amino acids)) and concentrations were examined over a wide range of gas flow rate cover homogeneous to transition flow regime at ambient temperature and atmospheric pressure. The results showed that the dissolved gas undergoes a pseudo-first order reaction, and the optimum superficial velocity of gas given a higher conversion and rate of reaction at Ug=0.025 m/sec, at this velocity the reaction rate of monoethanolamine with carbon dioxide (94.1% conversion and \( R_A = 7.75 \times 10^{-3} \text{ Kmol/m}^3\text{.sec} \)) is higher than reaction rate of potassium carbonate with carbon dioxide (29.3% conversion and \( R_A = 2.73 \times 10^{-3} \text{ Kmol/m}^3\text{.sec} \)). Furthermore, the addition of promoters to the 30%K₂CO₃ absorbents enhanced the reaction between potassium carbonate with carbon dioxide and increased the reaction rate when increasing the concentration of promoters to the critical concentration. The results show that the piperazine is a better promoter from other types of the amino acid promoter used was 52.1% increase in carbonate conversion with carbon dioxide.

Keywords— Absorption, Carbon Dioxide Capture. Promoted Potassium Carbonate, Organic Promoter, Amino Acid.