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Dynamic Study of Acid Gas Absorption Using Promoted Absorbent in Bubble Column Reactor

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Abstract

The most common process to remove carbon dioxide from natural gas and the flue gasses is absorption into suitable solvents. In the present work was to study the effect of parameters that play predominate role in the absorption of carbon dioxide namely reaction kinetic regime, superficial gas velocity, absorbent types, promoter types and concentrations.

The absorption of carbon dioxide from gaseous mixture was studied by using four types of chemical absorbent in bubble column reactor (7.5 cm inside diameter × 140 cm height and inside diameter of connection pipe is 0.6 cm), at operating conditions (25 °C and atmospheric pressure). Experimental runs were planned to work (30%DEA, 30%MEA, 30%K_2CO_3 and 10%NH_3) solution for a period of (5400 sec) and superficial gas velocity from (0.014 to 0.035) m/sec, and concentration of prompters were (0.05 to 1.0) kmol/m^3.

The results obtained before adding the promoters showed that the dissolved gas undergoes a pseudo-first order reaction, and the optimum superficial velocity of gas given a higher reaction rate is (Ug=0.025 m/sec). At this velocity, the reaction rate of monoethanolamine with carbon dioxide is higher than reaction rate of (potassium carbonate, diethanolamine and ammonia) with carbon dioxide.

The promoters added to the solution enhanced the reaction between (diethanolamine, ammonia and potassium carbonate) with carbon dioxide, and increased the reaction rate when increase the concentration of promoters to the critical concentration. The results summarize that the piperazine is a better promoter from other types of promoter used.

The results obtained before adding the promoters revealed the reaction rate of (monoethanolamine, potassium carbonate, diethanolamine and ammonia) with carbon dioxide is (94.1%, 29.3%, 46.7% and 75%) respectively, while after the addition (1 kmol/m^3) of piperazine to solutions (potassium carbonate, diethanolamine and

ammonia) results became (82.1%, 87.5% and 93.3%) respectively. Therefore results before adding the promoters revealed that the rate of increase in the reaction of monoethanolamine with carbon dioxide compared with the reactions of (potassium carbonate, diethanolamine and ammonia) with carbon dioxide is (64.8%, 47.4% and 19.1%), respectively. While after the addition (1 kmol/m3) of piperazine to solutions, the rate of increase in the reaction of monoethanolamine with carbon dioxide compared with the reactions of (potassium carbonate, diethanolamine and ammonia) with carbon dioxide is (12%, 6.6% and 0.8%), respectively.