Characteristics of Additives on the absorption of Carbon Dioxide into Tertiary and Hindered amine Solutions

Jeongho Choi[*], Seonggeun Oh[**], Min Jo [*], Sungyoul Park[*], Junghoon Park[*], Yeoil Yoon[*], Sungchan Nam[*,†]

[*]*Korea Institute of Energy Research, Daejeon 305-343, Korea*

[**]*Hanyang University, Seoul 133-791, Korea*

†*(scnam@kier.re.kr)*

Key word : carbon dioxide, absorption rate, hindered amine, tertiary amine

Tertiary and hindered amines react with carbon dioxide (CO_2) and form carbonated species. They are advantageous as thermally regenerated at low temperatures and have high absorption capacity. However, their reactivity with CO_2 is lowered and thus their reaction rates are low. Since improvement of their reaction rates and absorption capacity are desirable, a number of studies have been performed and blended together for this purpose.

In order to improve disadvantages of aqueous tertiary and hindered amines, selected amines have been used as a promoter. CO_2 absorption rate and loading capacity were measured by using a VLE (Vapor Liquid Equilibrium) and wetted-wall column equipments. Wetted-wall column to the radius of column was 1.26 cm in this study. The flow rate of aqueous solutions of alkanolamine and promoter was varied between 38.12 cm^2 to make stable film on the wall column surface. The system temperature was controlled within ±0.5℃ of the set point temperature. The total pressure of system was about 0.15 atm. The liquid feed enters at the bottom of column and passes through the inside of tube. The liquid runs down along the column surface and outside of tube, making smooth film,

VLE equipment was used in this study. The device consisted of a gas reservoir, a reactor, a temperature and pressure indicator, and a recorder that stored records in real time. The gas reservoir (internal volume; 300.29 cm^3) and the reactor (internal volume; 322.56 cm^3) were made of stainless steel and the reactor was equipped with a magnetic stirrer

in order to maximize the contact area with CO_2. The CO_2 gas was put into the reservoir and preheated to 40^{o}C by a constant-temperature water bath before being injected into the reactor. The reactor was maintained at 60^{o}C in order to measure absorption capacities in relation to temperatures. Before injecting CO_2, residual gases in the reactor were removed using a vacuum pump.

Experimental results showed that, the absorption rates of all amines were improved, and the CO_2 absorption rates were shown to be in the precedence of AMP+promoter > MDEA+promoter > TEA+promoter. The CO_2 absorption equilibrium of the 30 wt% aqueous solutions of TEA+promoter, AMP+promoter and MDEA+promoter are shown in Fig. 1 as equilibrium partial pressure of carbon dioxide (P_{CO2}^{*}) values relative to CO_2 loading in the aqueous solution The CO_2 loading refers to the amount of CO_2, in moles, absorbed by one mole of amine. A low value for the CO_2 equilibrium partial pressure at the same CO_2 loading indicates a large absorption capacity of the solution. AMP+promoter and MDEA+promoter absorbed CO_2 until CO_2 loading became close to 0.8. Their absorption capacities were largest when CO_2 loading was 0.85;

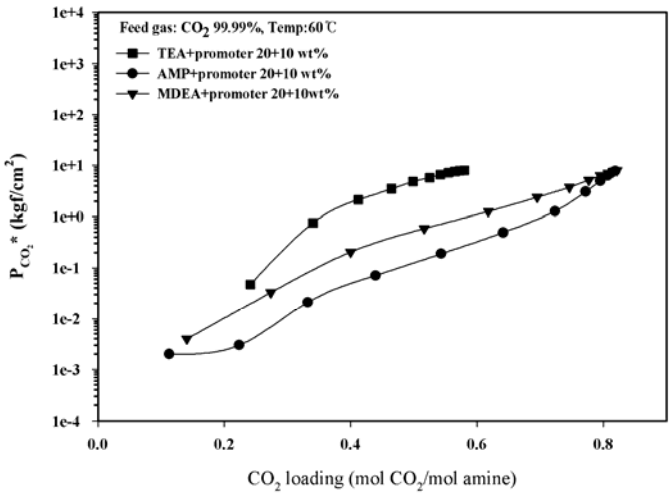

Fig. 1. CO_2 equilibrium into aqueous TEA/promoter, AMP/promoter and MDEA/promoter solution at 333 K