CO_2 Absorption Characteristics with Promoted Aqueous Potassium Carbonate Solution

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Abstract

Carbon dioxide accounts for 77% of greenhouse gases and is considered to be a primary cause of global warming and controllable because of gas from fixed sources like large size processes. Carbon dioxide emissions from the use of fossil fuels account for more than half of the total greenhouse gas emissions. In general, the exhaust gases of coal-fired power plants contain carbon dioxide about 14%. Carbon dioxide in combustion exhaust gases is generally removed using absorption methods, which are convenient method for applying large scale processes. Among these methods, carbon dioxide absorption processes using alkanolamines and alkali salts are widely used by many advantages.

Aqueous potassium carbonate solution has several advantages, such as higher absorption capacity, lower solvent cost, lower energy requirement for regeneration, and high resistance of oxidation, in comparison with aqueous MEA(monoethanolamine) solution. In spite of the many advantages of promoted aqueous potassium carbonate solution, it has a relatively slow CO_2 absorption reaction rate and corrosiveness. Therefore, many investigators have used promoters to increase the CO_2 absorption rate of this solution and inhibitor to protect corrosion.

In this study, absorption rate was measured using a WWC(wetted-wall column) apparatus, and absorption capacity was estimated in the semi-batch absorption reactor. We proposed to use 2-methylPZ(2-methylpiperazine), cyclic diamine compound as a promoter of K_2CO_3 solution, to increase absorption rate of aqueous potassium carbonate solution. The effects of the concentration of the promoter and the solution temperature are analyzed in this study as a

function of the experimental conditions, which include various concentrations of 2-methylPZ (2.5wt%, 5wt%, 7.5wt%, and 10wt%) and solution temperatures (40℃, 60℃, and 80℃). The measured absorption rate and absorption capacity are compared to MEA solution at the same conditions. It was determined that the addition of small amounts of 2-methylPZ to potassium carbonate results in significant enhancement of the CO_2 absorption rate through these experiments. Figure 1 shows the overall mass transfer coefficients by absorption rate. We can know the result that the slope of the tangent line of flux vs P_{lm} became larger than that in the case of pure aqueous potassium carbonate solution as the promoter 2-methylPZ was added to the aqueous K_2CO_3 solution,. Since the slope of the tangent line means mass transfer coefficient values, it can be seen that absorption rates have been increased by the addition. Table 1 shows the absorption capacity based on the results of each experiment in comparison with MEA solution. The results also show that certain concentration of potassium carbonate with 2-methylPZ is superior to 30wt% MEA at 40℃.

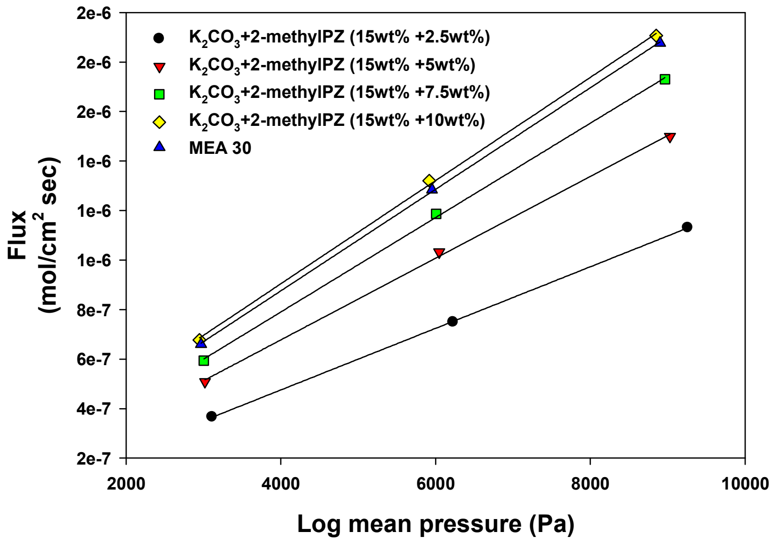

Figure 1. Overall mass transfer coefficients for different chemical absorbents at 40℃.

Table 1. Comparison of absorption capacity for different chemical absorbents at 40℃.

Chemical solvents	Absorption Capacity (mol CO_2/mol absorption)
MEA 30wt%	0.46
K_2CO_3 15wt% + 2-methylPZ 10wt%	0.86