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The effect of absorption with aqueous blends of 2-amino-2-methyl-1-propanol and Piperazine for appliance to $^{14}CO_2$ absorption removal

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1. Introduction

The neutron irradiated graphite has an internal energy which has been known for the wigner energy.[1] It has been reported that it simultaneously generates gas such as, ^3H, ^{14}C, ^{36}Cl, during heat treatment process for elimination wigner energy of neutron irradiated graphite and the radioactive carbon exists mostly as $^{14}CO_2$, as gas phase. The gas, $^{14}CO_2$, is generated during treating neutron irradiated graphite.

The purpose of this work is the investigation of the blends of absorbent and absorption conditions in $^{14}CO_2$ absorption removal and then to apply to the removal process of $^{14}CO_2$ practically.

Industrially, the amine compounds are typical absorbents in CO_2 removal. Among them, we have chosen 2-amino-2-methyl-1-propanol(AMP) and Piperazine(PZ) as absorbent. In previous studies, it was reported that it improved absorption capacity and reaction rate, especially, those were affected by concentration of PZ.[2] Besides, There is a reaction that recovers PZ by the reaction of AMP and intermediate from reaction of PZ and CO_2.[3]

$$(C_2H_4)_2(NHCOO)_2 + 2(CH_3)_2C(CH_2OH)NH_2$$
$$\leftrightarrow (C_2H_4)_2(NH)_2 + 2(CH_3)_2C(CH_2OH)NH_2COO \quad (1)$$

As a result of the reaction, it improves an absorption rate and an absorption capacity. According to those studies, we chose AMP as additive to PZ. The reason why add AMP to PZ is to give it durability. Therefore, we compared absorption capacity in order to choose the absorption conditions to remove effectively CO_2.

2. Methods and Results

2.1 Experiment

We set up absorption bottle containing absorption solution in water bath and flow labeled 10% CO_2 gas as the rate of 0.5 ㎖/min. The concentration of CO_2 was measured using Model 8730 Q-CHECK^{TM} CO_2 Meter (TSI Inc., USA, Max. 6000ppm CO_2, marked Max. 94% using 10% sample) connected to absorption bottle. The aqueous solution was prepared to mix 1.0, 1.5M PZ with 0.1~0.4M AMP and the temperatures were various at 25~45℃.

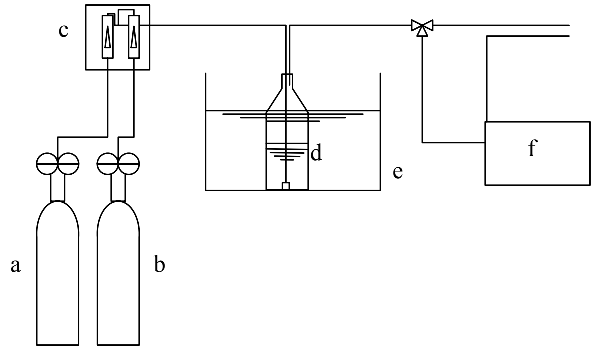

Fig.1. The Schematic diagram of Experimental apparatus

a. N_2 cylinder	d. Absorption bottle
b. CO_2 cylinder	e. Thermostat
c. Gas mixer	f. Analyzer(CO_2 meter)

2.2. Results

In using single absorbent, an AMP absorbent slowly reduced the absorption efficiency but absorbing amount was much. And then PZ reacted fast but, after consumed almost aqueous solution, the absorption efficiency dropped sharply. Also, it showed high absorption efficiency when remained aqueous solution to react with.

In the range of 25~45℃, mixed absorbent showed rapid reaction according to the various temperatures and fast reached saturation amount of absorption of 10% CO_2.(Fig.2) Increasing temperature, the absorption capacity dropped sharply. This is in accord with general gaseous absorption.

In the constant temperature conditions, 0.1~0.4M AMP showed increased time in time-to-efficiency but no differentiation at 0.3 and 0.4M. It shows that an addition of AMP in little quantity even can extend continue the absorption time. As shown in Fig. 3.

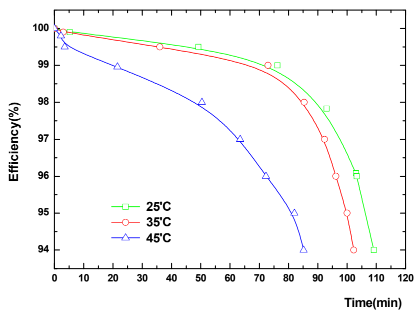

Fig.2. CO_2 absorption efficiency with time at 0.3M AMP/ 1.5M PZ (inlet CO_2 conc. 10%, gas flow rate 0.5ℓ/min)

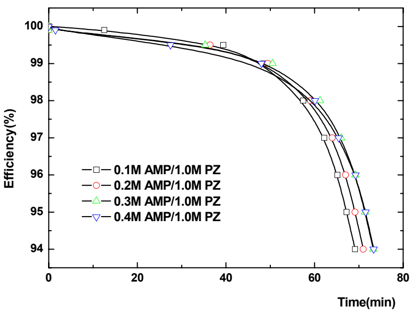

Fig.3. CO_2 absorption efficiency with time at 25℃ (inlet CO_2 conc. 10%, gas flow rate 0.5ℓ/min)

3. Conclusion

PZ is an absorbent to be reactive and good at absorption capacity. Because it is identical to gaseous absorption property, the lower temperature, the more absorption. The results were differentiated by addition of AMP in little quantity in an identical temperature.

We conformed that the time-to-efficiency curve was smooth in absorption experiment with only PZ. These results suggest that it is possible to extend the time with maintenance of total absorption ability, when use absorbents and their mixtures.

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