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## Hot Desulfurization by Alkali Carbonates and their Regeneration Characteristic

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### 1. Introduction

$H_2S$ and COS in gasified gas must be removed almost completely in coal gasification technology. The hot gas desulfurization technique will increase the overall efficiency of the system[1,2]. This paper studies hot desulfurization and their regeneration characteristic by the molten alkali carbonates ($43Na_2CO_3$-$57K_2CO_3$) called MACs as a solvent.

### 2. Experimental conditions and procedure

Fig. 1 shows the alumina reactor for desulfurization experiments. Gaseous sulfur is analyzed by GC-FPD.

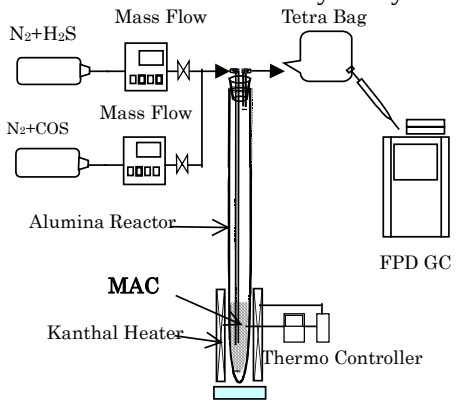


Fig.1. Experimental apparatus

TG combined with GC-FPD is used to study the regeneration characteristic of the used MACs. Simulated used MACs (mainly $Na_2S$ and $K_2S$) are reacted with $CO_2$ gas at elevated temperatures. Gaseous sulfur emitted from TG was analyzed by GC-FPD.

### 3. Results and discussion

Fig. 2 shows that $H_2S$ and COS concentrations in the exhaust gas become lower than 0.5 ppmv during desulfurization experiments at 1173K. Consequently, sulfur species are completely captured by the MACs to form $Na_2S$ and $K_2S$.

In the regeneration experiments, TG results display the weight increase of sample after introducing $CO_2$, which indicates the formation of alkali carbonates. The mechanism can be suggested as follows: (M: Na or K)

$M_2S(s)+2CO_2(g) \rightarrow M_2CO_3(s)+COS(g)$

Fig. 3a and 3b shows the sulfur balance in the TG experiments for $Na_2S$ and $K_2S$ case, respectively. According to Fig. 3a, the regeneration process at 650K seems to be the optimum temperature for $Na_2S$ case. While, 873K seems to be the optimum temperature for $K_2S$ conversion as shown in Fig. 3b. Therefore, these results suggest that it is possible to regenerate the used MACs by using $CO_2$ as a regeneration agent.

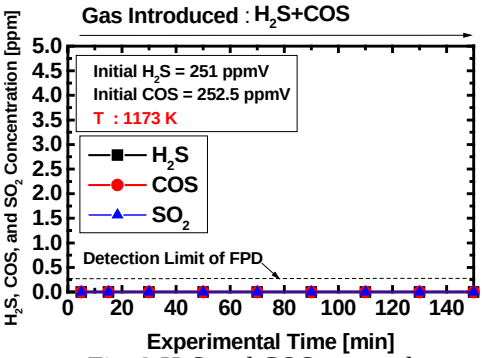


Fig. 2 $H_2S$ and COS removal

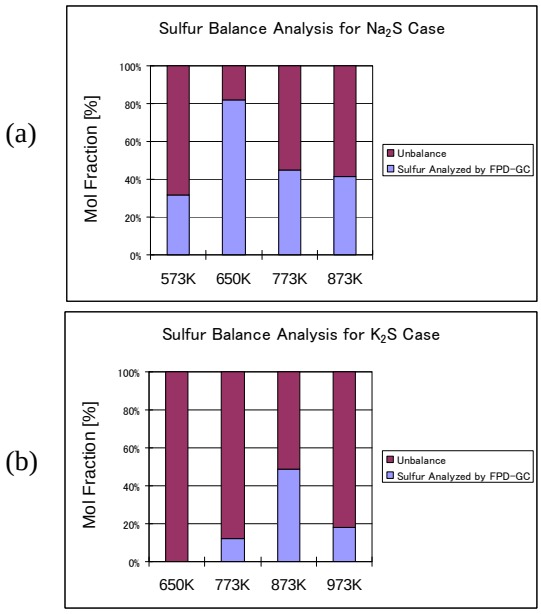


Fig.3. Sulfur Balance : a) $Na_2S$ case; b) $K_2S$ case

### 4. Conclusion

MACs were employed as a solvent for hot gas desulfurization of gasified gas at 1173K, which result in complete removal of $H_2S$ and COS. TG results of the regeneration experiment and their sulfur balance analysis show that the used MACs can be regenerated sufficiently by using $CO_2$ gas.

### References

1) C. Henderson, Understanding Coal-Fired Power Plant Cycles. IEA Clean Coal Center, 2004.
2) E. Furimsky, M. Yumura. Erdol und Kohle-Erdgas-Petrochemie. 1986, (39): 163.

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