REMOVAL OF METHYL MERCAPTAN BY IMPREGNATED ACF

C.S.Shin, K.H.Kim, B.K.Choi, †S.K.Ryu

Dept. of Safety Eng., Chungbuk Nat'l Univ., Cheongju 301-763, Korea

†Dept. of Chemical Eng., Chungnam Nat'l Univ., Taejon 305-764, Korea

Introduction

One of the major malodorous gas is methyl mercaptan and impregnated ACF was used as a sorbent to remove this gas. Activated carbon has been widely used for the removal of odor gases, however, ACF has larger surface area, low diffusional resistance and low pressure drop. Mark [1] has reported that ACF typically exhibit higher adsorption capacities and faster adsorption kinetics than GAC. Also Nitta [2] has reported ACF has two Favorable characteristics: 1) high mass transfer rate for adsorption and desorption, and 2) many forms of material, such as felt, sheet or honeycomb. ACF was used as adsorbent in this experiment with surface treatment and impregnation to increase adsorption capacity.

Experiment

Methyl mercaptan adsorption was performed in a ACF packed glass column and in a Cahn balance(D-200). The concentration of methyl mercaptan in inlet air was controlled 100ppm by flow controller and outlet concentration was analyzed by gas chromatography(FPD:CP-9001).

Five kind of ACFs were used as sorbent which have different precursors (cellulose-based, PAN-based, phenol resin-based and pitch-based). The adsorption capacity of these ACFs were measured and checked the effect of surface treatments. ACFs were treated with KI, Na_2CO_3, NaOH and analyzed the surface chracteristics.

Regeneration of methyl mercaptan adsorbed ACF was also performed with steam. Generated steam was heated up to 300℃ and introduced to regenerator. The effect of regeneration conditions were analyzed.

Result and Discussion

The removal efficiency of methyl mercaptan was showed at Fig.1 by using various ACFs. The total adsorbed amount were 75mg/g for PAN-based, 47.6mg/g for cellulose-based, 31.3mg/g for Phenol resin based, 19.2mg/g for pitch-based ACF respectively. PAN-based and cellulose-based ACFs are effective for the removal, and they were treated with Na_2CO_3, NaOH and KI to increase the adsorption capacity. Fig.2 shows the efficiency of these surface treated ACFs. Na_2CO_3 and NaOH are not effective however, the efficiency was highly increased by impregnation with KI. In this experiment, the concentration of methyl mercaptan was 100ppm, 0.5L/min flow inlet and 15mg sample. To measure the adsorption capacity of KI impregnated ACF, the concentration of methyl mercaptan was increased to 300ppm at Fig.3. Cellulose-based ACF is more effective than PAN-based ACF for KI impregnation, and the total adsorption capacity of methyl mercaptan is more than 8,000mg/g ACF.

Fig.4 is the SEM photos of ACF impregnated with KI before and after adsorption with methyl mercaptan. Impregnation of KI was done homogeneously and small particles were formed after adsorption of methyl mercaptan. By the analysis with EDX, there was sulfur on the surface of ACF. The weight change of KI impregnated ACF is showed at Fig 5. and with this data the adsorption equilibrium was calculated.

The effect of moisture on the removal efficiency was measured and adsorption capacity was decreased by 7.2% at RH 80.

References

[1] Mark PC, Susan ML, Mark JR. Experimental and modeled results describing the adsorption of aceton and benzene onto activated carbon fibers.Environmental progress 1994;13(1):26-30

[2] Nitta T, Suzuki T, Katayama T. Gas-phase adsorption equilibria for aceton, diethylether, methanol, and water on activated carbon fiber. J. Chem. Eng. Japan 1991;24:160
[3] Ermolenko IN. Lyubliner IP. Gulko NV. Chemically modified carbon fibers. : VCH. 1990:194-197

Acknowledgments

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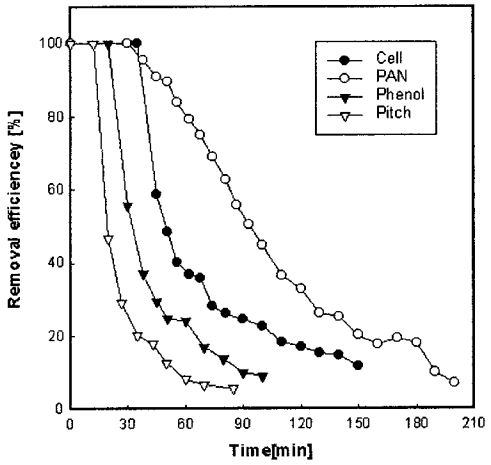

Fig. 1. Adsorption characteristics of Merthyl Mercaptan on ACFs.

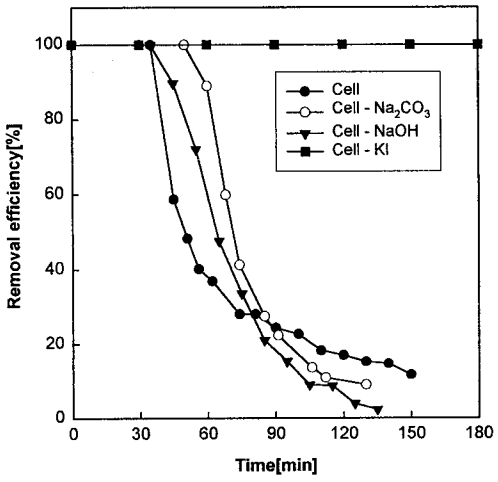

Fig. 2. Effect of chemical treatment and impregnation on the removal efficiency of Methyl Mercaptan.

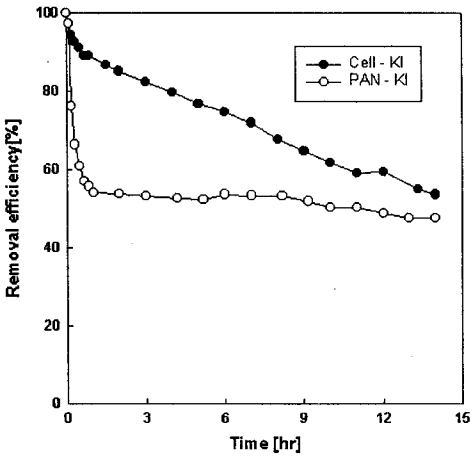

Fig. 3. Effect of KI impregnation on the removal efficiency of Methyl Mercaptan.

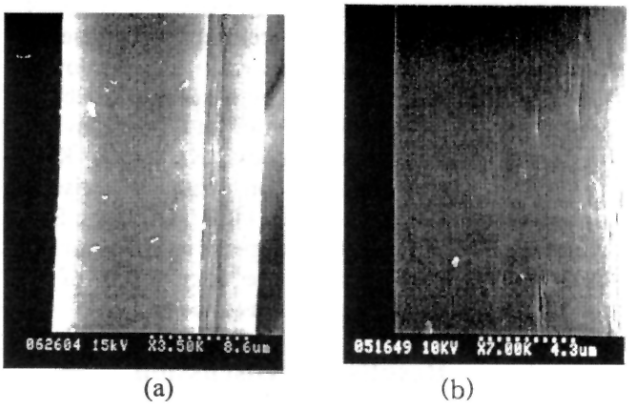

Fig. 4. SEM photos of ACF impregnated with KI before adsorption and (b) after adsorption with Methyl Mercaptan.

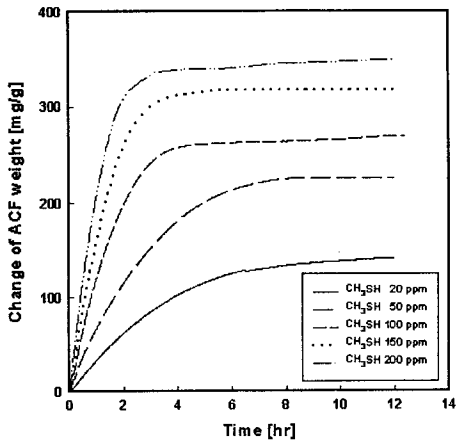

Fig. 5. Change of ACF weight by CH_3SH adsorption in the Cahn balance experiment.