# ADSORPTION OF DMMP(dimethyl methylphosphonate) ON ACTIVATED CARBON FIBERS

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## Introduction

Metal impregnated activated carbon is using to remove toxic gases from air. In general, DMMP(dimethyl methylphosphonate), one of the phosphorous organic compounds, is used as a model gas of such toxic gases. Activated carbon fiber(ACF) has larger surface area, low diffusional resistance and low pressure drop than activated carbon. Mark[1] reported that ACF typically exhibit higher adsorption capacities and faster adsorption kinetics than GAC. However few researches have been conducted to characterize the adsorption of phosphorous organic compounds by ACF. In this research, adsorption and desorption of DMMP were investigated by ACFs in various conditions.

## Experiment

Liquid DMMP(97%, Aldrich) contained in a bubbler was placed in a temperature controlled water bath to maintain saturated DMMP vapor pressure. The vapor was continually generated by air bubbling and flowed into the adsorption test column. The column(ID: 1.2cm) was filled with carbon adsorbents(ACF, ASC). Various type ACFs were used. Some ACFs were metal impregnated. ASC activated carbon(Ag, Cu, Cr impregnated, 12x30 mesh Grade VI, 850 $m^2/g$ ,Calgon Co.) was also filled to compare the adsorption capacity with ACFs. The DMMP concentration of influent and effluent were measured with GC(HP 5890). The breakthrough time was denoted as the time when the effluent vapor concentration reached to 0.04 mg/l. Desorption of DMMP from carbon adsorbents were carried out in autoclave or furnace and tested again the adsorption capacities.

## Results and Discussion

Adsorbent behavior can be depicted by the breakthrough curve which gives the pollutant concentration at the outlet of the adsorption column as a function of time. Fig.1 shows the breakthrough curves of DMMP for the carbon adsorbent column. The breakthrough curve of ACF is very steep just after the breakthrough time($t_b$), which means the mass transfer zone of ACF is narrow relative to the bed length and most of adsorption capacity of ACF was utilized. A narrow mass transfer zone is desirable to make efficient use of the adsorbent and to reduce the energy costs in regeneration. The breakthrough curve of ASC is typically extended and shows less efficient the adsorption capacity than ACF. The adsorption amounts of DMMP on ACF(A-15, 1500$m^2/g$) and ASC were 4.96g/g-ACF and 0.66g/g-ASC, respectively at the breakthrough time. Fig.2 shows the adsorption capacities of DMMP on ACF(A-15) at different influent concentration. The breakthrough time decreased as increasing the influent concentration. However the adsorption amount of DMMP at the breakthrough time increased in proportion to concentration. Fig.3 shows the adsorption capacities of DMMP on regenerated ACFs. The ACF was repeatedly regenerated in autoclave at 121$^oC$, 1.2 atm. All the regenerated ACFs show the same adsorption capacities to the original ACF. Therefore, ACF can be effectively used for the adsorption of DMMP, one of the organic phosphorous compounds. Fig.4 shows the TGA curve of DMMP containing ACF in air. The weight of ACF was almost constant up to 500 $^oC$. The DMMP did not desorbed from the ACF in room temperature. The weight of DMMP containing ACF slowly decreased over 100 $^oC$ showing the desorption of DMMP.

## Conclusion

The adsorption capacity of activated carbon fiber was 7.5 times higher than ASC activated carbon for

DMMP, one of organic phosporous compounds. The higher adsorption capacity of ACF is because of uniformly developed micopore structure, besides of higher specific surface area, to that of ASC activated carbon. Desorption of DMMP was slowly performed over 100 °C. Regeneration of DMMP containing ACF was completely performed at 121 °C, 1.2 atm, while ASC activated carbon was difficult to regeneration at this condition. ACF can be used as a proper adsorbent for the removal of air contaminants, especially toxic gases.

## References

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

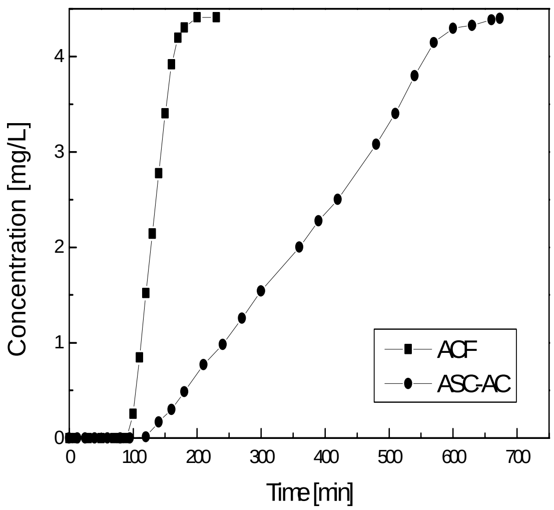


Fig.1 Breakthrough curves of DMMP on ACF(A-15) and ASC.

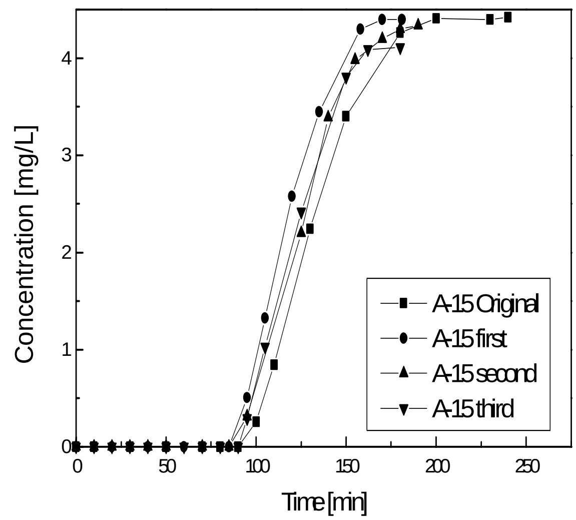


Fig.3 Breakthrough curves of DMMP on regenerated ACFs.

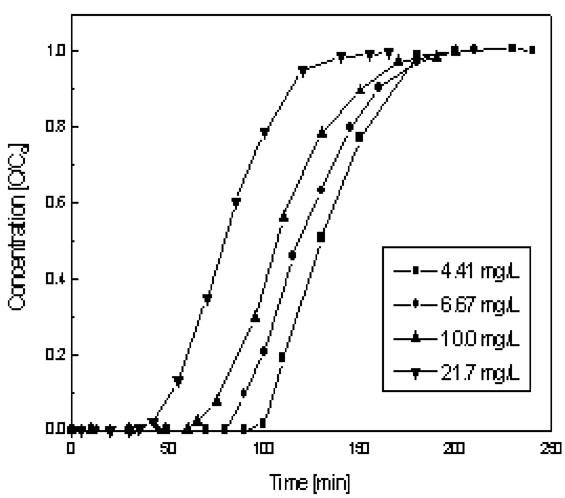


Fig.2 Breakthrough curves of DMMP on ACF(A-15) at different influent concentration.

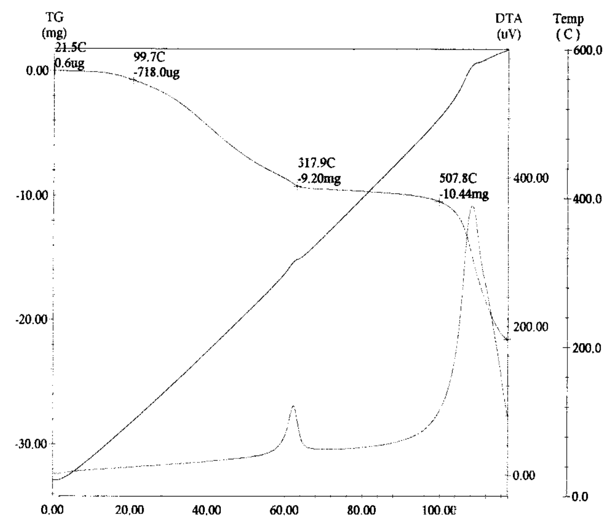


Fig.4 TGA curve of DMMP containing ACF in air.