THE PREPARATION OF PAN-BASED ACTIVATED CARBON FIBER BY CHEMICAL ACTIVATION

K.W. Kim[1], S.H. Jung[1], D. Cho[2], M.S. Kim[1] Y.J. Chung[1] and Y.S. Lim[1]
1) Division of Ceramic and Chemical Engineering, Myongji Univ., Korea
2) Dept. of Polymer Sci. and Eng., Kumoh Nat. Univ. of Technology, Korea

Introduction

Activated Carbon fiber (ACF) were practically very interesting and important adsorbents due to high adsorption capacity [1-2]. The high adsorptive capacities of activated carbons are associated with their internal porosity and are related to the structural characteristics such as surface area, pore volume and pore size distribution.

PAN-based carbon fiber is considered to be the best precursor for making high performance activated carbon fibers [3-4]. However, PAN-based carbon fibers were not activated well as precursor because of the inherent structure. Therefore, it was thought advantageous to perform a study on the development of the activated carbon fiber from stabilized PAN fiber.

Experimental

The ACFs were prepared from stabilized PAN-based carbon fiber (SCF) by the chemical activation using potassium hydroxide. SCF was mixed with a KOH solution for 24 hours at room temperature and then dried at 100°C. KOH activations were carried out in a nitrogen atmosphere from 500 to 900°C for 15 minutes with KOH/fiber ratio of 1, 2 and 3. After cooling, the activated products were washed by distilled water and diluted HCl solution for several times to remove the remaining KOH. The washed products were then dried at 100 °C for several hours.

Surface area and pore size distribution of the samples were determined from the application of the BET and Dubinin-Astakhov (DA) equations to the adsorption isotherms at 77K by a Quantachrome automated adsorption apparatus (Autosorb-I). Iodine adsorption was studied by a volumetric method.

Results and Discussion

Fig. 1 shows the changes of the specific surface area and yield of KOH activated carbon fiber at the different activation temperature and different KOH/fiber ratio. As shown in Fig. 1-A and B, the surface area of the activated carbon fibers increases with the temperature up to 800 °C. However, the increasing the amount of KOH leads to a decrease of the surface area. Fig. 2 shows the amount of adsorbed iodine in the various ACFs produced. The amounts of adsorbed iodine were increased with the increased surface area. ACF J-1 and L-1 adsorbed large quantity of iodine in spite of the low surface area. Activated fibers produced at 700-900°C with KOH/fiber ratio 1 and 2 (J-3 to 5 and K-3 to 5) adsorbed large quantity of iodine with high surface area. Fig. 3 shows the nitrogen adsorption isothem of ACFs at 77K. The results show PAN based ACFs have the type I isotherms in the B.D.D.T classification indicating the pores are microporous. However, K-4 and J-4 show the intermediate tendency of type I and II. This means that the micro and meso-pores were well developed in K-4 and J-4.

Conclusions

In the chemical activation of PAN based carbon fiber using potassium hydroxide, BET surface area of 2545 m^2/g and amount of iodine adsorption capacity of 2049 mg/g were obtained at the condition of KOH/fiber ratio of 1 and 800°C.

References

1. Teng H, Yeh T-S and Hsu L-Y, Carbon 1998; 36(9), 1387 –1395.
2. Suzuki M, Carbon 1994; 32(4), 577-586.
3. Manocha S M, Bhagat J, Manocha L M, and Jasara R V, Preparation and characterization of activated carbon from banana stem. Extended abstracts, 23rd biennial conf. On carbon. Penn St. (University Park. USA): American Carbon Society, 1997; Vol. I; 118-119.
4. Martin-Gullon I, Jagtoyen M, Kimber G and Derbyshire F, Activated carbon fibers from PAN I: Steam and KOH activation, Extended abstracts, 23rdbiennial conf. On carbon. Penn St. (University Park,

USA): American Carbon Society, 1997; Vol. I; 120-121.

Acknowledgement

Financial support of the research by the Regional Research center of Myongji University is gratefully acknowledged.

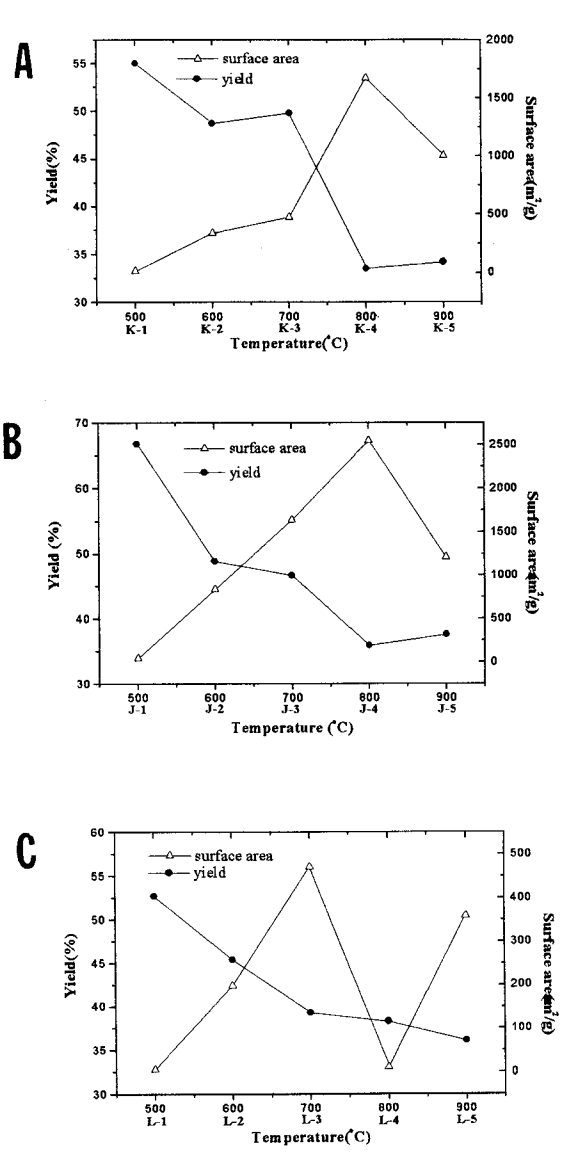

Figure 1. Change of the specific surface area and yield of KOH activated carbon fiber at the different condition
(A) KOH/fiber ratio of 1 (B) KOH/fiber ratio of 2
(C) KOH/fiber ratio of 3

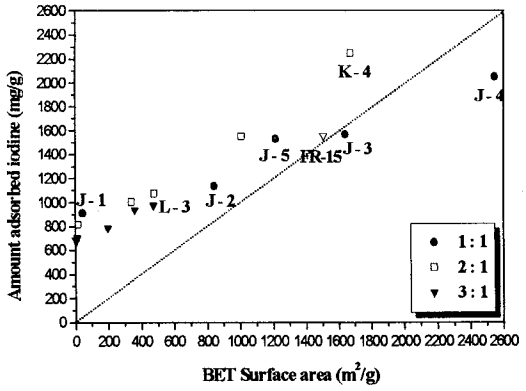

Figure 2. Amount of the adsorbed iodine of ACF as function of surface area

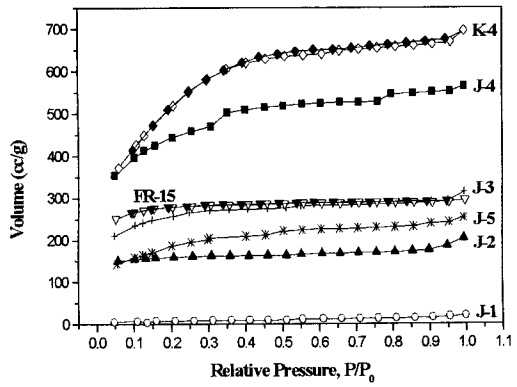

Figure 3. Nitrogen adsorption isotherm of ACF at 77K