POSTER

CHARACTERISTIC COMPARISON OF PAN- AND PITCH-BASED CARBON FIBERS ACTIVATED WITH CARBON DIOXIDE

B.B. Park, Y.S. Lee, H.B. Shim, S.K. Ryu, B.S. Rhee
Department of Chemical Engineering, Chungnam National University,
Taejon 305-764, KOREA

INTRODUCTION

Because of their excellent surface properties and adsorption capacity, activated carbon fibers have attracted increasing attention. As advantage of fibrous active carbon over a finely divided active, powdered, carbon is the higher bulk volume of the former which can lead to higher adsorption rates because of the more open base structur(1-2). Activated carbon fibers are microporous materials, possessing a low mesoporsity, a high specific surface area, and an enormous adsorption capacity.

The present paper deals with the preparation of pitch and PAN-based activated carbon fibers from a general-purpose carbon fiber, obtained from an isotropic petroleum and PAN fiber. The effect of the activating gas (CO_2 and steam) and the burn-off is analysed, with the development of porosity and porosity distribution of the activatel carbon fibers obtained. Moreover, the differences between CO_2 and steam in relation to their reactivity in highly microporous materials.

EXPERIMENTAL

Starting from a isotropic petroleum pitch, pitch fibers have been obtained by spinning at 300℃. The pitch fibers were stabilized at atmosphene for heating at 1℃/min to 280℃, holding time for 1hr. After that, the pitch fibers carbonized in N_2 for 1/2h at 1000℃ but the PAN fibers carbonized were used raw material. The activation of carbon fibers (5g of sample in each experiment) was made at 800, 850, 900℃ with both CO_2 and steam / N_2 mixture in a horizental furnance.

The surface area of the fiber before and after various treatments was measured by adsorption of nitrogen at 77K using a Quantachrome Autosorb. Elemental analysis was carried out with a YANACO CHN CODER MT-3 elemental analyser. Dye adsorption studies were carried out by a dynamic process. The amount of dye adsorbed was determined by the concentration difference before and after immersion in the solution.

RESULT AND DISCUSSION

Both with CO_2 and steam, pitch-and PAN -based activated carbon fibers have a wide burn off range. Fig 1 shows the devolution of burn-off percentage of with time activated PAN fibers. It can be noticed that a higer reactivity is achieved with steam. In comparison between reaction rate, activation in steam is faster than CO_2, which is in good agreement with the literature(3).

N_2 adsorption isotherms for Pitch-based activated carbon fibers activated by steam with different burn-off are shown in Fig 2. It was showed that all adsorb N_2, showing type I isotherms, which proves that they are essentially microporous materials. As burn-off increases, the isotherm been widens, showing an increase in micropore distribution.

The Dubinin-Radushkevich(DR) equation(4) has been used to culculate the micropore volume, while the BET equation(4) has been used to study the surface area of activated carbon fibers. The volumes of micropores, BET surface area obtained for both CO_2 and steam of pitch-based activated carbon fibers are show in Table 1. It can be noticed that Bet areas increase considerably as the burn-off percentages increases, reaching at burn-off percentages of 67%, 75%, specific surfaces near 2200㎡/g and 2000㎡/g for the Pitch-C(Pitch carbon fibers activated with CO_2) and Pitch-S(Pitch carbon fibers activated with steam) series, respectively.

CONCLUSION

In preparing activated carbon fibers by CO_2 and steam activation of a ptich and PAN-based carbon fiber, reactivity with steam larger than CO_2. In general, the pitch-based activated carbon fibers were highly microporous and had a high surface area (about 2200㎡/g, 2000㎡/g

after 67, 75% burn-off with CO_2 and steam, respectively). However, CO_2 and steam activation produced a different development of the porosity.

REFERENCES

1. G.N. Arons and R.N. Machair, Textile Res. J. 42, 60(1974)
2. R.Y. Lin and J. Economy, Applied Polymer Symposium. 21, 143(1973)
3. P.L. Walker, F. Rusinko, and L.G, Austin, Advances in Catalysis 11, 133(1959)
4. S. Brunauer, P.H. Emmet, and E. Teller, J. Am. Chem. Soc. 60, 309(1938)

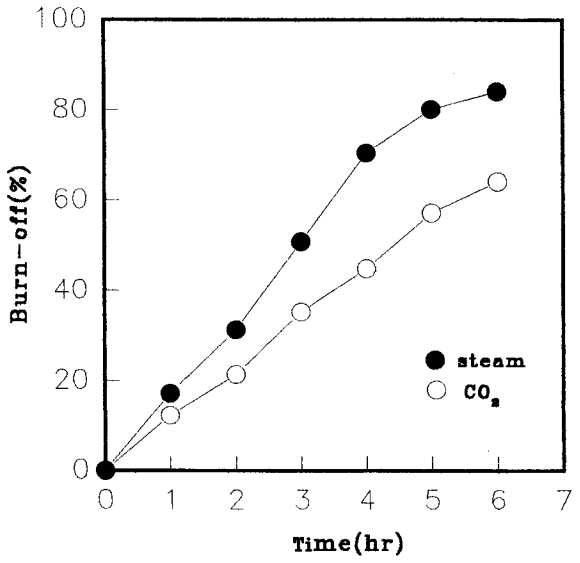

Fig.1. Burn-off with time for PAN carbon fibers activated with steam and CO_2 (800°C)

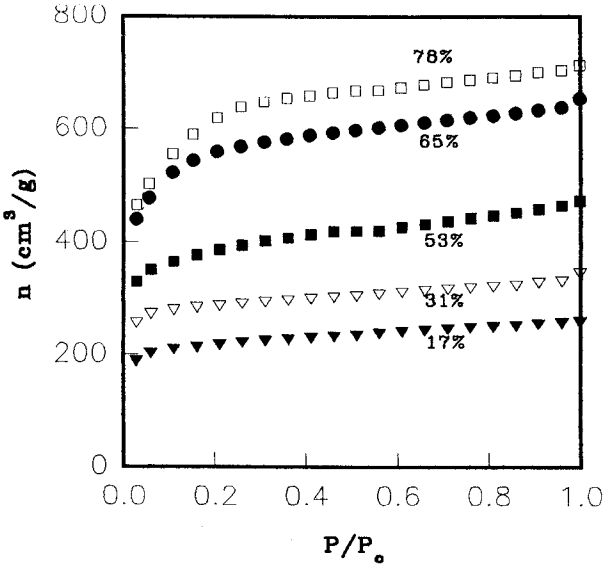

Fig.2. Nitrogen(77K) adsorption isotherms of Pitch-ACF with burn-off(steam)

Table 1. Adsorption properties of Pitch-C, -S with burn-off

Sample	S BET (m^2/g)	V(N_2) (cm^3/g)	Vα_s (cm^3/g)
CF	34	0.29	0.016
Pitch-C-17	590	0.34	0.338
Pitch-C-30	1013	0.43	0.426
Pitch-C-42	1632	0.54	0.530
Pitch-C-55	1886	0.78	0.771
Pitch-C-67	2183	0.81	0.785
Pitch-S-19	730	0.36	0.351
Pitch-S-37	1025	0.48	0.470
Pitch-S-51	1420	0.72	0.703
Pitch-S-64	1780	0.81	0.790
Pitch-S-75	2046	0.90	0.871