EFFECTS OF SEVERAL ACTIVATION AGENTS ON SURFACE AREA OF STABILIZED PAN-BASED FIBERS

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Introduction

Chemical activation is a well known method for preparing activated carbons which has been object of great study in the last years as it presents several advantages compared to the physical activation [1-2]. The raw material is mixed with an activation reagent and the mixture is heated in an inert atmosphere in chemical activation. Therefore, the carbonization and activation steps proceed simultaneously.

A number of active agents including KOH [2-3], NaOH [4], Na_2CO_3 [1], $ZnCl_2$ [5] and H_3PO_4 [5] and a lot of carbon precursors such as coal, coconut shell and coke have been tested for producing activated carbon with high BET surface area []. The literature survey shows that KOH is one of the most widely used active agents [2], and the best value for the weight ratio of KOH to precursor material is about 400-600% in order to produce high performance activated carbons [2].

Experimental

To fabricate activated carbon fibers (ACFs), stabilized PAN fibers were infiltrated in potassium hydroxide (KOH) solution for 24 h. The stabilized PAN fibers were mixed with KOH in the weight ratio of 1:1, 1:2 and 1:3. The mixture was kept in dry oven at 30 or 60°C for 24 h, respectively. The carbonization was carried out in a tube furnace; the infiltrated stabilized PAN fibers were heated at 800°C for 1 h in nitrogen atmosphere. The ACFs were repeatedly washed in 5M-HCl solution then in distilled water until chloride ions are completely removed. Once the ions were removed, the activated carbon fibers were dried at 110°C for 24h.

The ACFs were characterized by both nitrogen adsorption isotherms at 77K to evaluate the BET surface area, and scanning electron microscopy to observe the microstructure changes of the fiber surface.

Results and Discussion

Table 1 and 2 show the yields and BET surface areas of the ACFs by KOH and NaOH, respectively. Drying temperatures affected to yields and specific surface areas after activation in both activation agents. Higher drying temperature (60°C) produced the lower yield amounts and lower specific surface areas compared in the same conditions.

KOH used as activation agent shows higher specific surface area rather than NaOH activation compared in the same conditions.

Table 1. Activation Conditions, Yield and Specific Areas of Resultant Activated Carbon Fibers by KOH

Activation Method	Sample	Amount of Activation Agent	Activation Temperature (℃)	Drying temp. (℃)	Yield (%)	Specific Surface Area (m^2/g)
Chemical Activation by KOH	K-0.5-8/6	0.5:1 of KOH/fiber	800	60	50.62	1.717
	K-1.0-8/6	1.0:1 of KOH/fiber	800	60	38.12	197.8
	K-1.5/8/6	1.5:1 of KOH/fiber	800	60	29	1095
	K-2.0-8/6	2.0:1 of KOH/fiber	800	60	24.22	1272
	K-0.5-8/3	0.5:1 of KOH/fiber	800	30	78.36	5.523
	K-1.0-8/3	1.0:1 of KOH/fiber	800	30	47.24	541.9
	K-1.5-8/3	1.5:1 of KOH/fiber	800	30	38.72	1311
	K-2.0-8/3	2.0:1 of KOH/fiber	800	30	25.02	2050

Table 2. Activation Conditions, Yield and Specific Areas of Resultant Activated Carbon Fibers by NaOH

Activation Method	Sample	Amount of Activation Agent	Activation Temperature (℃)	Drying temp. (℃)	Yield (%)	Specific Surface Area (m^2/g)
Chemical Activation by NaOH	N-0.5-9/6	0.5:1 of NaOH/fiber	800	60	76.64	2.199
	N-1.0-9/6	1.0:1 of NaOH/fiber	800	60	61.72	1.985
	N-1.5-9/6	1.5:1 of NaOH/fiber	800	60	28.08	868.1
	N-2.0-9/6	2.0:1 of NaOH/fiber	800	60	44.48	240.8
	N-0.5-9/3	0.5:1 of NaOH/fiber	800	30	76.94	1.167
	N-1.0-9/3	1.0:1 of NaOH/fiber	800	30	68.08	26.72
	N-1.5-9/3	1.5:1 of NaOH/fiber	800	30	41.12	602.5
	N-2.0-9/3	2.0:1 of NaOH/fiber	800	30	36.7	999.1

Fig. 1 shows the amount of iodine adsorption from the fabricated ACFs. Iodine adsorption depends on the amount of specific surface areas and drying temperature. ACFs that fabricated at lower temperature (30°C) dried fibers adsorbed the iodine well than that of higher temperature dried ACFs in both activation agents.

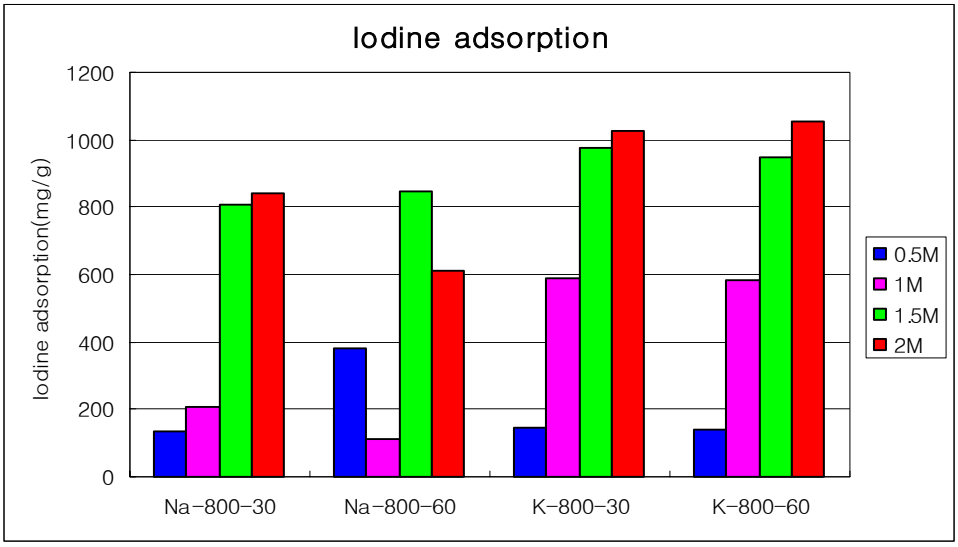

Figure 1. Iodine adsorption amount on the fabricated activated carbon fibers

Conclusions

ACFs that have high specific surface area had fabricated by chemical activation using KOH or NaOH at 800°C from stabilized PAN-based fibers. In the process, the drying temperature of the infiltrated stabilized PAN-based carbon fiber with activation agent affected the specific surface areas. Lower drying temperature (30°C) ACFs showed the higher specific surface areas than that of higher drying temperature (60°C) ACFs.

Acknowledgement

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References

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