STUDY ON THE PITCH—BASED ACTIVATED CARBON FIBERS

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INTRODUCTION

Activated carbon fibers (ACF) is a new kind of absorbent materials with lots of the function and the effection. It has more abundant micropore and the narrow pore diameter distribution than the granular activated carbon (AC). Therefore, it has a serise of the excellent properties such as the great absorbent capacity and the fast absorbent—deabsorbent velocity. But its price is higher than the granular activated carbon. In oredr to reduce the cost and expand the application, the researchers are developping the pitch — based carbon fibers in recent years.[1-5]

In this paper, the authors select a low—priced carbon felt carbonflex as the materials. The steam was selected as the cativator. Variety of temperatures at which the starting activator was passed and their offection on the PACF yield, the absorbent specific surface area, the Porons texture, the crystal structure and morphology were mainly studied.

EXPERIMENTAL

Material: The general carbon felt of the carbonflex used in this study was produced by Ashland Oil, Inc. U.S.A.

Activated equipment: The vertical tube furnace. The temperature of this furnace can be arised to 1200℃.

Activated condition: The steam amount was 1.0—70 ml/min, The steam was passed under the temperature 200—1000℃.

Final activated temperature: 800—1000℃.

Activation time: 0.5—3(h).

Pore structure: The characteration of the porous texture of PACF was used the absorption of nitrogen by micromeritic AS-AP—200M (77.2K).

According to BET absorption model and Dubinin—Radushkevich micropore stuffing model, calcutating the specific sureface area, the pore diameter and the classification.[6-7]

Crystal structrue: X—Ry diffraction patterns were observed using D/max RB model diffractomer with Cukα—ray source. Tube voltage: 40kv, Tube current: 80mA. Measuring angle: 8—100°(2θ), 4°/min.

Morphology: The morphology of PACF was investigated by cambridge S—250 SEM.

RESULTS AND DISCUSSION

The anthors of this paper studied the interrelationship among the activated condition, the yield, the properity and the structure of the PACF. The results show that the specific surface area (S_{BET}) and the absorption ability of the PACF were in creased when the activated temperature was arisen from 800℃ to 1000℃, the residence time was delayed from 0.25(h) to 1.5 (h), and the activator concentration was gone up from 30% to 70%.

In this paper, mainly studied the influence of the PACF's yield, the properity and the strncture when the activator passed through at different temperature. We can obviously know from Table 1 when the temperature was 400℃ and at which the steam was passed through, the yield was the lowest in the activated process. The yield had an inceasing tendence when the temperature of the steam passing though went up. This result shows that the activated reaction conforms with: $Cx+H_2O \rightarrow H_2+CO+Cx-1$. Because the longer the time of which the steam contacted with the pitch—based carbon fibers in activation process, the lower the yield. However, the study result is interesting. This is that the specific surface area of absorption was increased with the yield going up. In order to look into the causes (see Table 1). The pore structure, the crystal structure and mophology were studied. The experimental results of the pore structure was listed to Table 2. We can see from Table 2 when the steam was put to pass through at 620℃, the specific surface area of PACF was the largest.

Vmi/V had the enhancing tendency with the temperature of beginning steam risen. It reduced a little after 800℃. But Vme/Vhas had the cutting down tendency. It increased a little after 800℃. Because the reaction of the carbon atom and steam was intense after 600℃, PACF created more the micropore and the middle pore.

The pore diameter distribution shows at Figure 1. Figure 1 indicates that the pore diameter distribution gradually becomes narrow when the temperature of the activator initial passed through was arisen. No. 3 sample put to pass throngh steam at 400℃, the pore diameter distribution was the widest (13—19 Å), the specific surface area was the least (see Table 2) and the absorption was the lowest (see Figure 2). The reason of the getting this result may be that the reaction of carbon atom and the steam was less active at 400—500℃. The steam first etches amorphous carbon of the carbon net layer. The burnning —off of the microcrystal carbon wasn't easy. It is useful to arrange along C axle for the carbon net layer. Therefore, Lc increased a litle (see Table 3)

The creating and expanding pore accelerated with the temperature of the activation going up. However, the initial activated temperature of No 3 sample was low. Therefore, the specific surface area of No. 3 sample was the smallest, the pore distribution was the widest. For No. 2 sample the steam was passed through at 620℃. The reaction of the carbon atom and the steam was violent to become more the micropore, then the micropore expanded middle pore with the activated time proloning. For No. 1 sample the steam was passed through at 800℃, the reaction of the carbon atom and the steam was most acute. It became more the micropore because the activated time of No. 2 sample was longer than of No. 1 sample, the micropore may expand to become middle pore. As a reault, The pore distribution was wider.

The parameter of the microcrystal structure: It list at table 3. The result shows that PACF's d_{002} was increased with the temperature of the steam passed through going up. La was reduced. Lc increased a little at 400℃ and 620℃, it reduced a little at 800℃. PACF's d_{002} is bigger 0.5—0.6 Å than that of the graphite. The size of the microcrystal is smaller. PACF is more turbulent than felt carbonflex.

Morphology: The experimental reults of morphology show Figure3. The surface of the unactivated caroon fibers is more smooth than that of the activated carbon fibers. The surface of the activated carbon fibers has the projecting blister. We can show from SEM potograph that the pore mainly made up burn —off of the carbon fibers surface. The N0. 3 sample was an example. We can see dark dot which was brought about by the blisters and becam the pore besides the crude surface of the carbon fibers and the blisters. In a word, when the activated condition changed, the structure of ACF will also vary. So we can control the property of ACF.

CONCLUSIONS

We discover that the pore diameter distribution became gradually narrow when the temperature of the steam initial passed through was increased in the preparation of the activated carbonfelt. We can get high yield (69—74%), high specific surface area (1038—1128m^2/g), abundent micropore (>80%) and low price pitch—based activated carbon felt when the temperature of the steam passed through was higher than 620℃. The specific surface area was the highest when the temperature of the steam initinally passed though was at 620℃.

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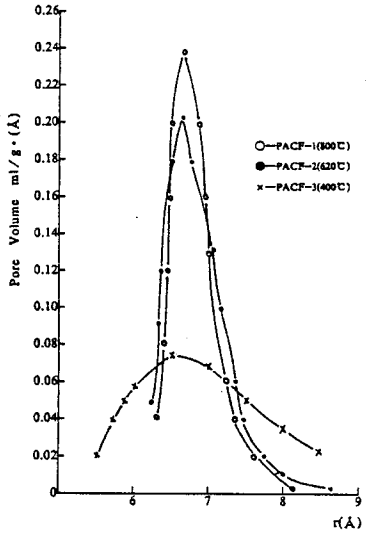


Fig.1 Pore Sige Distributiong

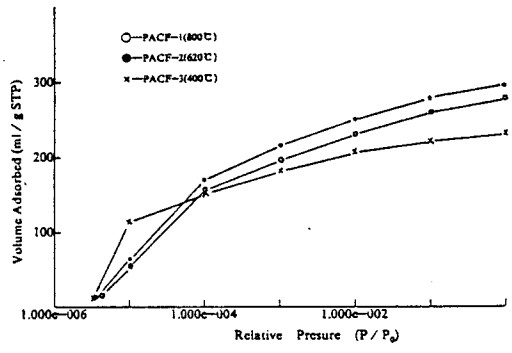


Fig2 Adsorption Isotherms of nitrogen at77.2°K

Table 1: The eflect of the temperature of the activator was passed on the yield and the specific surface area

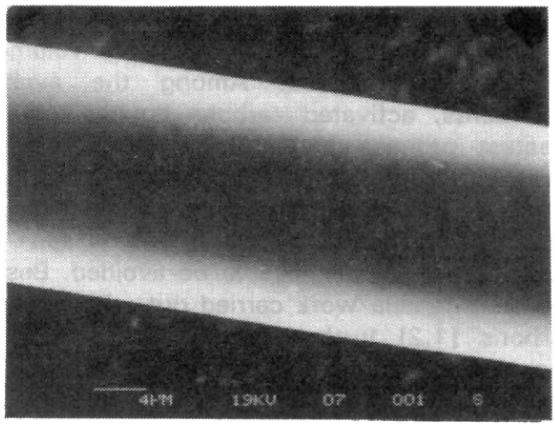
Item name / Code	Activater passed pemperature (℃)	Activator concentration (%)	Activatied final temperature (℃)	Final Temperature Coonsistent time (min)	Yield (%)	S_{BET} (m^2/g)
PACF—1	800	50	850	60	74.1	1037.6
PACF—2	620	50	850	60	69.1	1127.6
PACF—3	400	50	850	60	61.2	959.0

Table 2: The interrelation of the temperature of the activator passed through and the pore structure parameters

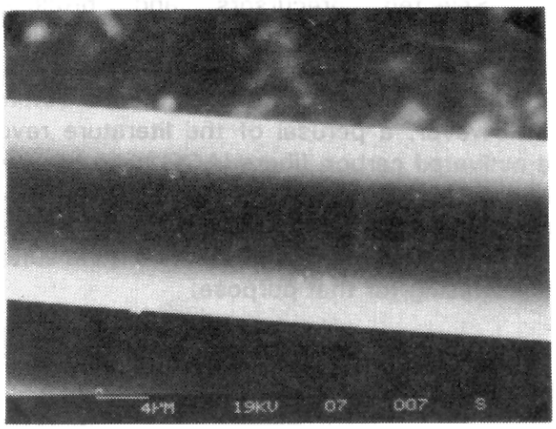
code	Activator Cpassed temperature (℃)	S m^2/g	Smi m^2/g	Sme m^2/g	V ml/g	Vmi ml/g	Vme ml/g	Vmi (Å)
PACF—1	800	1037.6	818.5	219.1	0.4352	0.3584	0.0768	7.8
PACF—2	620	1127.6	887.3	240.3	0.4669	0.3895	0.0744	7.4
PACF—3	400	959.0	740.3	218.7	0.3616	0.2771	0.0845	8.1

Table 3: The interrelation of the temperature of the actiovator passed through and the microcrystal structure parameters

Code	D_{002} (Å)	Lc (Å)	La (Å)
PACF—1	3.9729	9.5358	27.7269
PACF—2	3.9073	10.8796	25.1634
PACF—3	3.9046	10.7471	25.3438
PCF—0	3.8483	9.9487	31.3191



a PCF



b PACF(No.3)

Fig.4 morpholigy (bySEM)