PREPARATION AND PROPERTIES OF PITCH BASED ACTIVATED CARBON SPHERES

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INTRODUCTION

Compared with the irregulate activated carbons , activated carbon spheres (ACS) (1,2) have many advantages. For example , because of their rolling property , ACS can be easily filled uniformly . Moreover , ACS show low resistance to a flow of gas or liquid when applied in a packed bed , and can be also used in a fluidized bed with easy handling . So ACS have been studied since 1970's and produced commercially in recent years . ACS are made from either powdered coal or pitch . However,ACS from pitch have more excellent properties (stronger mechanical strength , higher adsorptive capacity,and lower ash content,etc) .

In this paper , pitch based activated carbon spheres (PACS) were prepared from high softening point pitch (250℃) through phsical activation (water vapor). Activation conditoins were investigated , and the properties of typical PACS were also studied .

EXPERIMENTAL

Preparation of PACS

The raw materials to be activated were influsible pitch spheres. PACS were prepared in a fluidized bed activation apparatus (heating rate : 200 ℃/h). The preparation prosess of PACS was given in Fig. 1 (Coal-tar pitch was provided by Shanghai Coking & Chemical Plant General).

Characterization of PACS

Surface areas of PACS were measured by nitrogen adsorption (at 77K) using ASAP2000 adsorption apparatus . Surface areas, and pore structures of tytical PACS (PACS1,PACS2) were studied . Shapes and surface structures of PACS2 were observed by Scanning electron microscopy (SEM).

RESULTS AND DISCUSSION

Preparation of PACS

Fig.2~4 depicted the effects of activating temperature , atmosphere (ratio of H_2O to N_2 , Vol/Vol) ,and time on the activated products,respectively.The effects of activation conditions on the resultant products were similar to those of general physical activation . So, good sample of PACS (BETsurfacearea=1014m^2/g , yield=40%) can be achieved under 900℃ (activating temperature) ,1.5:1 (ratio of H_2O to N_2) ,and one hour (activating time) .

Properties of typical PACS

Properties of typical PACS(PACS1 and PACS2) were summarized in Table 1 . Pore size distribution (micropores) and SEM micrographs of typical PACS were shown in Fig.5 and 6 , respectively .

Table 1 and Fig.5 illustrate that PACS are rich of micropores and possess narrow pore size distribution . Fig.6 shows that PACS have good spherical shape (the average ratio of minor axis to major axis is about 0.96) (seen in Fig.6-c)and exhibit uniform pore structures on the surface of PACS (seen in Fig.6-d).

Under the same activation conditions (900℃, activating temperature; 1.5:1 , ratio of H_2O to N_2 ; and one hour ,activating time) , properties of obtained PACS vary with the size of spheres . The BET surface area and total pore volume of PACS2 are larger than those of PACS1 , and it is the same with the ratios of S_{micro} to S_{BET} and V_{micro} to V_{total} . The reason why PACS with larger diameter (PACS2) have higher surface area and larger pore volume is not clear now .

REFERENCES

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Coal-tar pitch (S.P. , 72℃) —oxidization, air→ High softening point pitch (S.P. , 150℃) —spherulitization→ Pitch spheres

Pitch spheres —stabilization, air→ Influsible pitch spheres —carbonization, activation→ PACS

Fig. 1, The preparation process of PACS

Table 1, Properties of typical PACS

Sample	Size mm	S_{BET} m^2/g	Smicro m^2/g	Vtotal ml/g	Vmicro ml/g	Average pore radius Å
PACS1	0.35~0.15	932	750	0.40	0.26	10.60
PACS2	1.00~0.60	1118	908	0.48	0.36	10.47

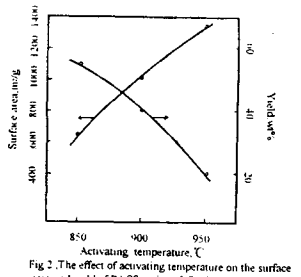

Fig.2 ,The effect of activating temperature on the surface area and yield of PACS (size of PACS : 0.35~0.15 mm, activating ratio 1.5, activating time : one hour)

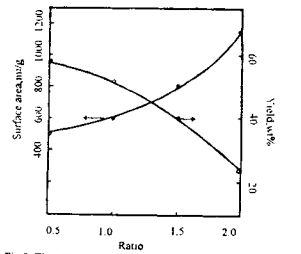

Fig.3, The effect of activating ratio of H_2O to N_2 on the surface area and yield of PACS(size of PACS:0.35~0.15mm, activating temperature, 900℃ , activating time:one hour)

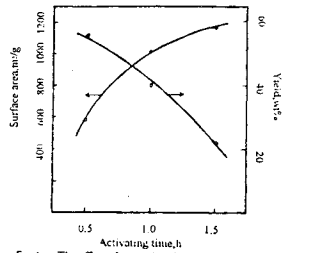

Fig.4 , The effect of activating time on the surface area and yield of PACS(size of PACS : 0.35~0.15mm activating temperature 900℃ ; activating ratio 1.5)

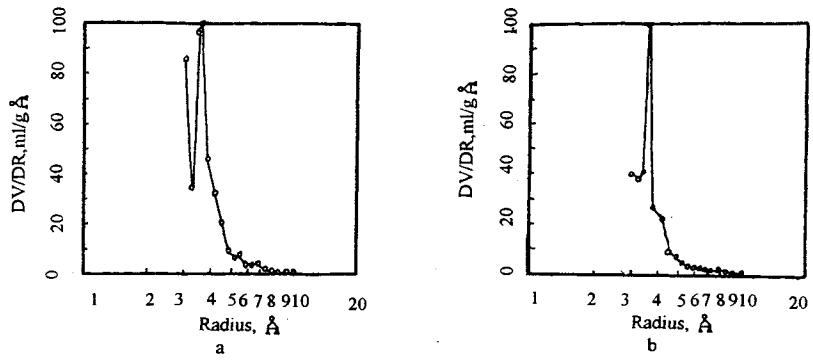

Fig.5, Microporous distribution of PACS
(a : PACS1;b : PACS2)

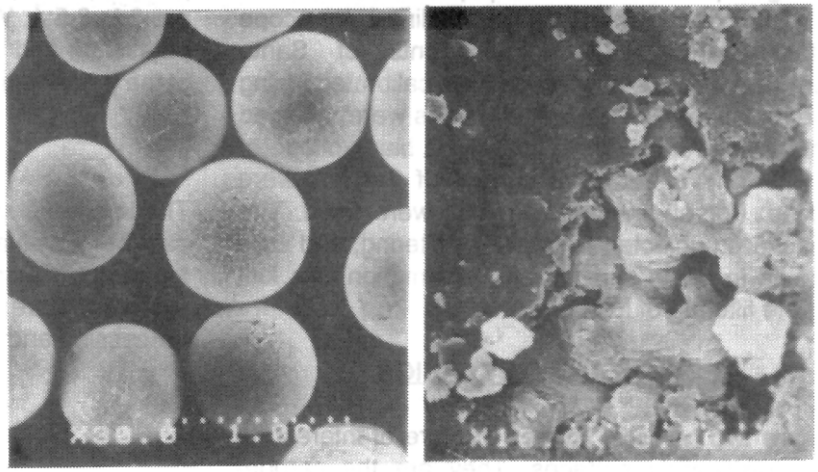
c d

Fig.6, SEM micrographs of PACS2 (c : x 30 ; d : x 10,000)