The physicochemical properties of medicinal material treated activated carbon fiber and their antibacterial effects

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Introduction

One of the undesirable features of the modern day world is widespread contamination associated with the release of a large number of chemicals into the atmosphere. Recently several approaches have been examined to improve the chemical and physical properties of these materials, mainly in the field of metal treatment[1,2]. Preparation of an antibacterial metal treat ACFs was attempted by several workers[3] using silver and typical transition metals as an antibacterial agents. In this study, we have studied the physical properties and biological effects of the medicinal material treated ACFs. In order to investigate the properties, adsorption isotherms, BET surface area and pore analysis for the medicinal material treated ACFs be obtained. Finally, antibacterial effects were investigated to estimate the competitive that of metal treated ACFs. Special emphasis was placed on antibiological effects for the extracted medicinal frozen dried powders from the oriental medicinal plants.

Experimental

The ACFs used as a media material was prepared from pitch based fiber. The fiber was heated first at 500 for the sizing elimination in the Ar gas atmosphere, then physically activated with water vapor at the temperature range 750 780 . *Coptis Chinensis Franch, Cimicifuga foetida L., Rheum officinale Bbaill* and *Myrrha ; Commiphora* were used as the source of antibacterial materials. For the preparation of the medicinal powdery type, medicinal herb materials were extracted from dried medicinal plants growing oriental areas using solvent method. Nitrogen adsorption isotherms at 77 K measured on the Digisorb 2500(Micrometrics Instruments Co., USA) volumetric adsorption analyzer, were used to characterize the porous structure of medicinal material treated ACFs. For quantitative analysis of antibacterial effects, shake flask method was employed. The antibacterial activity against *Escherichia coli* was examined in cultivated culture medium. For the test, the solution was sterilized first. Then, *Escherichia coli* was cultivated for 24 h under the conditions of constant humidity and temperature of 37^{0}C Finally, the cultivation was carried out again for 10 min and 200 400 min under the constant humidity and temperature, after medicinal material treated ACFs were dropped on to the cultivated culture media solution. Detailed procedures were described elsewhere [4].

Results and Discussion

For the purpose of illustration, Fig. 1 shows nitrogen adsorption isotherms for medicinal material treated ACFs. For the series these ACFs type I isotherms were obtained. Also, for the all samples studied the isotherm knees become slowly increase with increasing relative pressure, which indicates that microporosity range is distributed. It is noticed that the amount of adsorbed N_2 is slowly increased in the region where the relative pressure is lower than 0.4, but the volume is nearly constant once the pressure becomes higher than 0.4. And also, all isotherms at higher relative pressures exhibited an almost flat plateau. It is means that almost all of the external surface areas is negligible and adsorption properties determined mainly in micropores. For the medicinal material treated ACFs consisted only with fine micropores, the mechanism of adsorption can be explained by surface coverage rather than pore filling. The BET surface areas of medicinal material treated ACFs are in the range of 2182.17 2394.31 m^2/g. It is must note that the specific surface area for all samples of treated ACFs is formed very large range. Also, the reported specific surface areas for the metal treated ACFs were 113.18 1574.13 m^2/g for Ag, 692.58 895.24 m^2/g for Ni[1] and 688.20 887.75 m^2/g [2], which is smaller than this results. Therefore, the increase of specific surface area depends on kind of treated materials. It is suggest that the formation of surface area is attribute to the filling of micropores, monolayer formation on the pore walls, and condensation of inside and outside micropores and mesopores. The pore volumes and average pore radii are distribute in the range of 2.85 5.22 cm^3/g and 24.19 52.46 , respectively. Although many studies on catalytic effects of metal have been reported, very few studies on the antibacterial effects of metals treated on the activated carbon have been reported[1,2,4]. In this study, various types of medicinal herb materials are employed to compare antibacterial effects. For the test, *E. coli* known as a kind of colon bacillus is employed. For the comparing of two types, antibacterial activity against *E. coli* is examined in cultivated culture medium for 10 and 200 400 min, respectively. The results of antibacterial activity of medicinal material treated ACFs against *E. coli* are shown Fig. 2. For comparison of antibacterial effects among the treated materials, almost all of samples are shown excellent antibacterial effects after 200 400 min. For the quantitative analysis of antibacterial activity, shake flask method is employed. Number of bacteria caused by antibacterial effects were counted.

Conclusion

For the series these ACFs type I isotherms were obtained. Also, for the all samples studied the isotherm knees become slowly increase with increasing relative pressure, which indicates that microporosity range is distributed. The BET surface areas of medicinal material treated ACFs are in the range of 2182.17 2394.31 m^2/g. It is must note that the specific surface area for all samples of treated ACFs is formed very large range. The results of antibacterial activity of medicinal material treated ACFs against *E. coli* are discussed. For comparison of antibacterial effects among the treated materials, almost all of samples are shown excellent antibacterial effects after 200 400 min.

Reference

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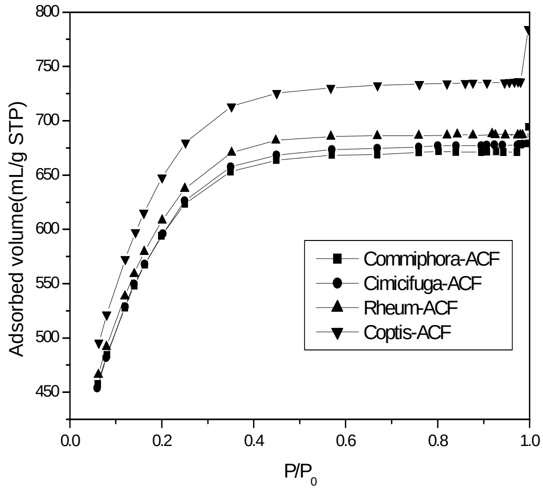

Fig. 1 Comparison of nitrogen adsorption isotherm plotted on the relative pressure scale for the medicinal material treated ACFs at 77.3 K.

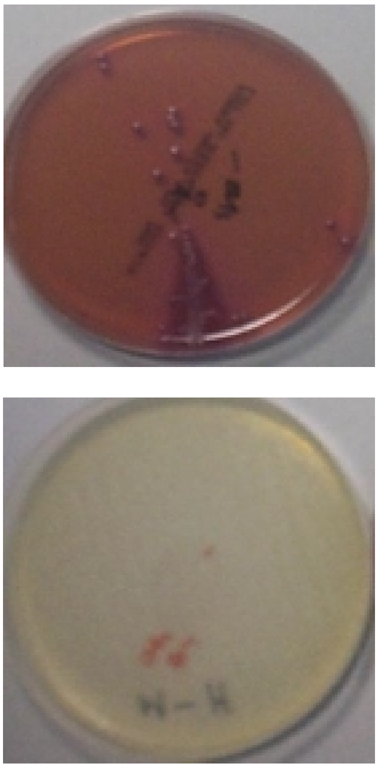

Fig. 2. Photographs of antibacterial test for the typical medicinal herb material treated ACFs ; . *Myrrha ; Commiphora* ; above : after 10 min, bottom : after 200 min