

POSTER

The Characteristics of Cu-Cr-Ag Impregnated Carbonaceous adsorbents

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INTRODUCTION

Carbonaceous adsorbents have been used as an adsorbent to remove poisonous contaminants from air or other gases. It has been principally used in gas masks to provide protection against civilian or military agents. Additional metals have been impregnated in activated carbon to improve its adsorption capabilities: e.g. a copper, silver and chromium impregnated carbon (ASC Whetlerite). Big molecular weight compounds, which are easily adsorbed, are removed primarily by physical adsorption. Low molecular weight compounds such as hydrogen cyanide and cyanogen chloride, which are weakly adsorbed, are removed by chemical reaction with the metal impregnants. Therefore, a good Whetlerite carbon product must combine the physical adsorption properties of activated carbon with impregnated chemical reactants to remove toxic gases from air. Recently, activated carbon fiber(ACF) was developed and supposed to be the substitute of conventional activated carbons. As most of the pores of ACF are located on external surface, mass transfer rate is fast. The mass transfer coefficient on ACF is 10-100 times higher than that of granular activated carbon[1]. Its adsorption and desorption rate is 2-15 times higher than that of granular activated carbon.

EXPERIMENTAL

Activated carbon(coconut shell and bituminous based) and activated carbon fiber(coal tar pitch based) referred in the following ACC, ACB and ACF were used as a carbon adsorbents. Activated carbons were sieved to particle size ranging from 0.8 to 1.7 mm. Felt-type ACF was crushed by Fine Impact Mill and sieved to 20 mesh size. Then, the fraction which is smaller than 20 mesh size was used as a adsorbent.

Carbon adsorbent was treated with an aqueous solution of copper ammonium carbonate complex, then dried and heat treated to produce a copper

oxide impregnated carbon suitable for poisonous gas remover. The impregnating solution is made up to contain approximately 7 % copper, 2 % chrome, and 0.5 % silver. The activated carbon is wetted by soaking in the impregnating solution, drained to remove excess liquid, dried by contact with a stream of hot drying air, then finally oven-dried until its temperature reaches about 363 K.

The sorption capacity of the several carbon adsorbent samples was measured. The adsorption capacity of hydrogen chloride was reported in terms of break-through curve (Fig. 1).

The adsorption of nitrogen at 77 K was performed in a gravimetric apparatus equipped with Cahn balance in order to investigate the pore structure. Specific surface areas (BET equation), total pore volumes (Gurvitsch rule), and total micropore volumes (α_s -plot) were calculated from the nitrogen adsorption isotherms. Narrow micropore volumes (Dubinin-Radushkevich equation) and mean pore radii (Dubinin equation) were obtained from the adsorption isotherm of carbon dioxide. The wide micropore volumes were calculated by subtracting narrow micropore volumes from total micropore volumes.

RESULTS AND DISCUSSION

The physical and chemical adsorption capacities were measured. For the physical adsorption properties, specific surface area, pore size and pore volume are calculated. Carbon adsorbent possesses a large variety of pore shapes and pore size. A part of the pore volume is supposed to be blocked by impregnants. The blocking effect is supposed to take place in the neck of the pore, leaving the inner surface of the pore unimpregnated. The SSA of ACF decreases more seriously than that of activated carbon (Table.1). The possible explanation is that as most of the pores of ACF exposed to external surface, the pore mouth can be blocked easily by the impregnating solution. As ACFI is microporous[2] and its SSA is lower than that of ACBI and ACCI, its physical adsorption

capacity, especially on big molecular weight compounds, seems to be lower than that of AC based ASC Whetlerite

TABLE 1 Specific surface area(SSA) of adsorbents

items	SSA (m ² /g)	SSA decrease during impregnation (m ² /g)
ACF	1236	
ACFI*	764	472
ACB	1120	
ACBI*	910	210
ACC	1160	
ACCI*	950	210

* ASC Whetlerite soaked in solution containing 7 % copper, 2 % chrome and 0.5 % silver.

The chemisorption capacity was measured indirectly by using HCl simulator. This test was carried out by HCl pick-up experiments as a warfare acid gas simulator such as HCN and CNCl. Fig.1 shows the HCl adsorption capacity of

several adsorbents. The HCl adsorption capacity of impregnated carbon was 2~3 times higher than that of carbon itself. Although the SSA of ACFI is lower than that of ACBI and ACCI, its HCl up-take is the largest. The result suggests that the activity of impregnated metals on ACF may be higher than that of impregnated metals on AC. The spontaneous ignition temperature of ACFI was around 540 K (TGA).

CONCLUSION

The physical adsorption capacity of ACF-based ASC Whetlerite is lower than that of AC-based ASC Whetlerite. However, the chemisorption capacity is higher. Therefore, ACF-based ASC Whetlerite may be useful of removing the acid gas chemically.

REFERENCES

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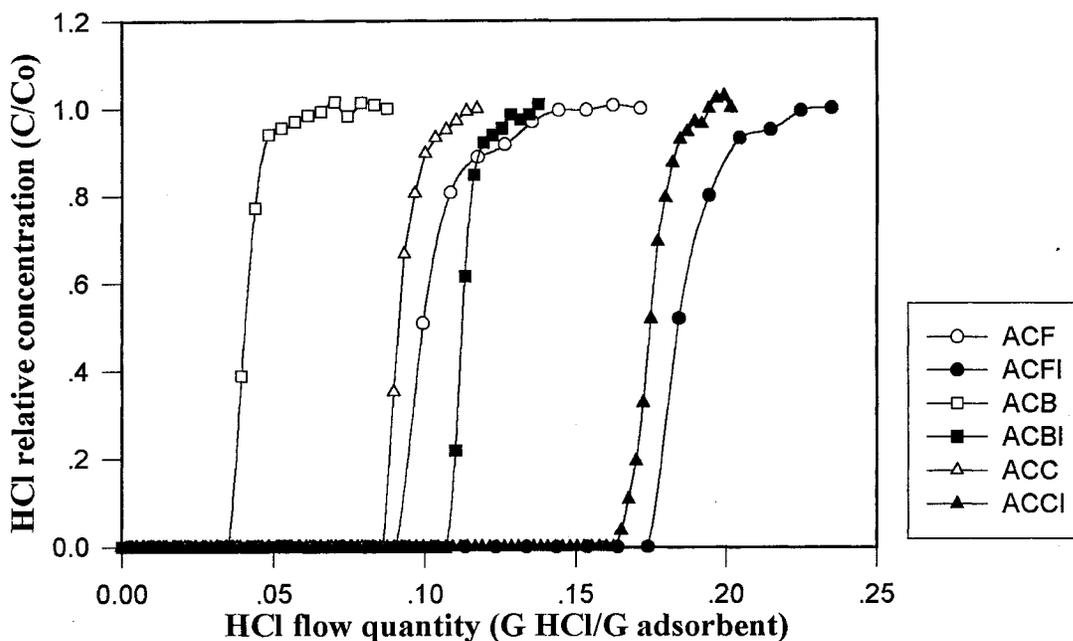


Fig. 1. HCl up-take breakthrough curve