REMOVAL OF HYDROGEN SULFIDE OVER COPPER-DISPERSING PAN-BASED ACF

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Introduction

Granular activated carbon (GAC) and activated carbon fiber (ACF), are used for treatment of sulfur-containing ill-smelling gas pollution by removal of hydrogen sulfide and other sulfur-containing, and have made some progress[1-3]. And the metal compound loaded on the micropore surface of ACF enhances the adsorption and conversion capacity of H_2S over ACF. In the present study, the adsorption and conversion behavior of H_2S over copper-dispersing PAN-ACFis discussed.

Experimental

The copper-dispersing PAN-ACF (abberivated as Cu-ACF) is prepared by following processes. First, soaking the PAN-ACF(790m^2/g) in copper acetate and copper nitrate solution of concentrated concentration and certain PH value, respectively. Then, drying the samples at certain temperature in air, and copper-dispersing PAN-ACF is prepared, and the former is Cu2-ACF, and the latter is Cu120-ACF.

The dynamic adsorption of H_2S was conducted in fixed bed. The model inlet gas mixtures were N_2+H_2S(300 mg/m^3) and N_2+O_2 (6.5v%) +H_2S (300mg/m^3) . The weight of samples packed, inlet H_2S concentration, inlet total flow rate were 200mg , 300m/g and 270ml/min, respectively. The inlet and outlet H_2S were analyzed by GC-FPD.

XPS tests were conducted by PHI5300 ESCA , SEM characterization was conducted by AMRAY 1910 FE SEM.

Results and Discussion

1.Different dispersion properties and dynamic adsorption behavior of two kinds of copper-dispersing PAN-ACF

Cu-ACF is of much higher adsorption capacity than original PAN-ACF. Moreover, different kinds of Cu-ACFs are of different adsorption capacity(fig.1). Cu2-ACF is of longer breakthrough time (the adsorption time when the ratio of outlet and inlet concentration is up to 5%), and larger adsorption capacity, which is possibly related to different dispersion properties of two kinds of Cu-ACF.

Under the same preparation condition and similar copper loading amount (table 1), copper salt dispersed on PAN-ACF show different dispersion properties (see fig.2). Ultra-fine copper compound particle (several to several hundred nm) disperses on surface of Cu2-ACF, and it is likely that even smaller particle is in the micropore of ACF. While, relative large copper compound particle is dispersed on the surface of Cu120-ACF, which is the reason of greater reduction of its specific surface area, compared with original PAN-ACF(table 1). Since de-sulfur behavior is connected with copper loaded, dispersion properties effect the adsorption process.

2.Comparison of adsorption of H_2S over Cu2-ACF in absence and in presence of ocxygen

In presence or in absence of inlet oxygen, the adsorption amount and breakthrough time is of little difference(see fig.3). However, the adsorption mechanism is of great difference.

In fact, the adsorption of H_2S over Cu2-ACF contains chemical conversion. After adsorption, sulfur-containing complexes are formed on the surface of ACF. Based on XPS results (Fig.4), after adsorption of H_2S, there are usually two electron binding energy peaks connected with sulfur. One is in the range of 162.5~163.4ev, corresponding to the thiophene-like structure and/or other organic structure containing C=S, C-S-C and C-S-H bonds. The other is in the range of 169.0~169.5ev, and this complex is possibly SO_4^{2-} group[1]. In absence of inlet oxygen, most of sulfur on surface tends to exist in the latter state. While, in presence of inlet oxygen, more sulfur exists in former state. And the surface elements taking parting in the electron transfer with sulfur make difference changes in two adsorption condition.

Conclusion

Copper-dispersing PAN-ACF is of much higher adsorption capacity than original PAN-ACF. Dispersion properties of copper particles on Cu-ACF effect the adsorption behaviors. Additional oxygen exerts little effect on adsorption amount, however, have greater influence on adsorption mechanism.

Reference

1. Mikhalovsky SV and Zaitsev YP. Catalytic properties of activated carbons. Carbon 1997; 35(9):1367-1374.
2. Lu GQ and Lau DD. Sewage sludge-derived adsorbents. Part 2. Gas.Sep.Purif. 1996;10(2):103-110
3. Hiroshi K, Kuniyoshi I, Hirai M, Shoda M. Studies of the oxidation mechanism of sulphur-containing gases on wet activated carbon fiber. Applied catalysis B: Environmental 1995; 6:255-262

Table1 S.S.A. and Copper content of Cu-containing ACFs

	ACF	Cu2-ACF	Cu120
S.S.A.(m^2/g)	790	450	198
Cu content(%)		5.17	5.76

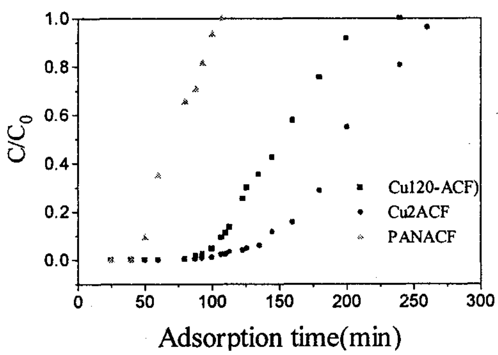

Fig.1 Breakthrough curve of H2S over ACF andu-ACF

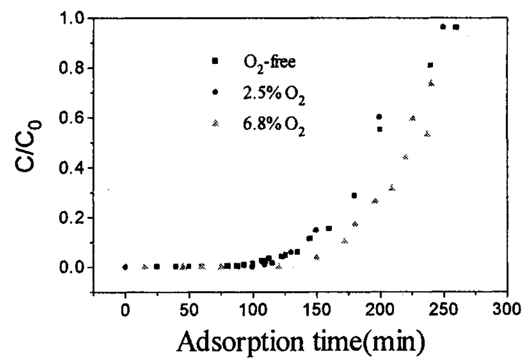

Fig.3 Effect of inlet oxygen on breakthrough behavior of H2S over Cu2-ACF

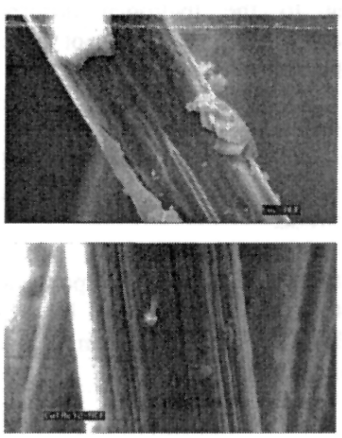

Fig.2 SEM image of Cu-ACF
(upper: Cu120-ACF; lower: Cu2-ACF)

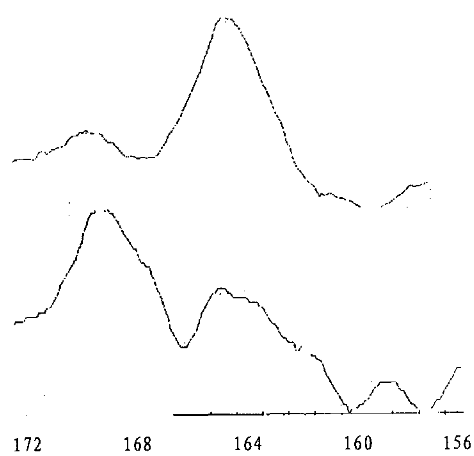

Fig.4 S2P XP spectra of Cu2-ACF after adsorption of H2S
(upper: 6.5% inlet oxygen: lower : without oxygen)