ADSORPTION OF VOC ON MODIFIED ACTIVATED CARBON FIBER*

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Abstract Activated Carbon Fiber (ACF) has been widely applied in environmental treatment, especially in the adsorption of Volatile Organic Compounds (VOC) for the purification of waste air due to their plentiful micropore, higher specific surface area and higher external surface area. In this paper, the adsorption behavior of VOCs on modified ACF was studied. The surface chemistry of activated carbon fibers was modified by various inorganic agents. The static adsorption capacities of ACF for different VOCs were examined. The result of experiment indicates that Activated Carbon Fiber impregnated with copper sulfate solution could have higher adsorption capacities for the vapors of benzene, toluene, methanol and ethanol compared with virgin Activated Carbon Fiber, which may be due to modification of copper sulfate to the surface chemistry of the Activated Carbon Fiber.

Key words Activated carbon fiber, Chemically modification, Volatile Organic Compounds (VOCs), Adsorption

1 Introduction

In recent years, volatile organic compounds (VOCs) have become one of the most harmful pollutants to human health. Even the concentration of many pollutants in indoor air is higher than that in atmosphere. A high concentration of VOCs can cause a series of symptoms such as headache, nausea, coryza, pharyngitis, emphysema, lung cancer, and even death. So it is necessary to take some measure to remove the deleterious volatile organic compounds from indoor air.

So far, adsorption by carbonaceous adsorbent is the most widely used method to purity air. Activated carbon fiber (ACF) is a novel and fibrous adsorbent, which has been developed by carbonization and activation of organic fiber; and has more unique pore size distribution compared with conventional activated carbons. The high special surface area (SSA) and proper pore size distribution of ACF make them have high adsorption capacity for volatile organic compounds. In this paper, several ACFs were modified by supporting some metals on them, and the adsorption behavior of VOCs on these modified ACF was studied.

2 Experimental

Viscose fiber was first impregnated in $(NH_4)_2HPO_4$ solution for 24h, then dried; the treated fiber was heated to a certain high temperature in an inert atmosphere, then

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activated at the predetermined temperature with steam for different time. The resulted ACF was noted as VACF. Then, VACF was soaked in a series of different contention of copper sulfate solution for 24 hours to support certain amount of copper on to the ACF.

The pore structure was evaluated using 77K nitrogen adsorption isotherms by a ASAP2010 adsorption-meter. The VOC adsorption properties were evaluated by their static adsorption amount for several organic compounds at room temperature.

3 Result and analysis

Figure 1 showed the adsorption amounts of ACF cloth modified by a series concentration of $CuSO_4$ solution for benzene and toluene. The result indicates that the adsorption amounts of benzene and toluene on activated carbon fiber modified with lower concentration of $CuSO_4$ are higher than that on virgin ACF, however, the adsorption capacity tends to decrease when the concentration of $CuSO_4$ increased. Comparing the adsorption amounts of benzene and that of toluene also shows that the adsorption capacity of ACF for benzene is a little higher than that for toluene. Data in Figure 1 also show that the adsorption capacity for the mixture gas of benzene and toluene on modified ACF is higher than for individual benzene or toluene, which may indicate the different adsorption site of ACF for these organic compounds.

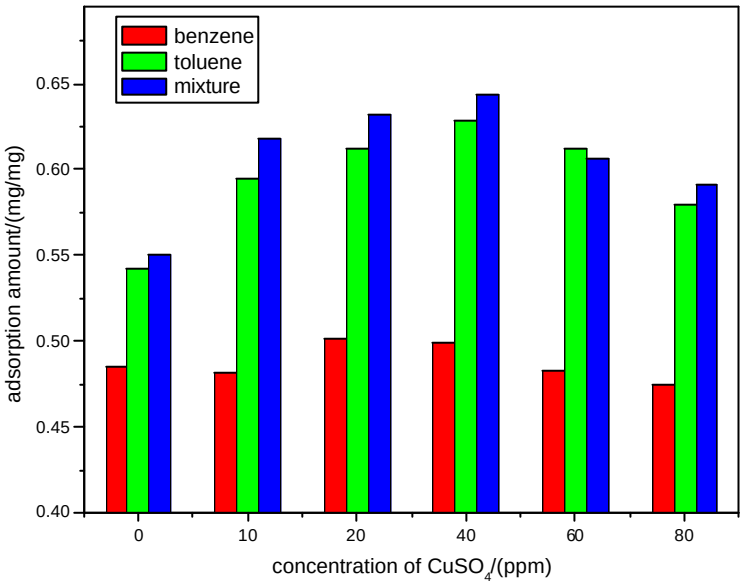

Figure 1 Adsorption of benzene, toluene and their mixture

Fig.2 shows the adsorption capacities of ACFs modified by copper sulfate solution for methanol and ethanol. Similarly, the adsorption capacity of modified ACF for these two compounds is higher than the virgin ACF without modification. And when the concentration of copper sulfate solution is 60ppm the adsorption of methanol on modified ACF reach its maximum adsorption amount, 0.60g methanol /g ACF. However, the adsorption amount decreases with the concentration of solution increase. The

comparison of data in Fig.2 also shows that the adsorption capacity of VACF for methanol is a little higher than that for ethanol.

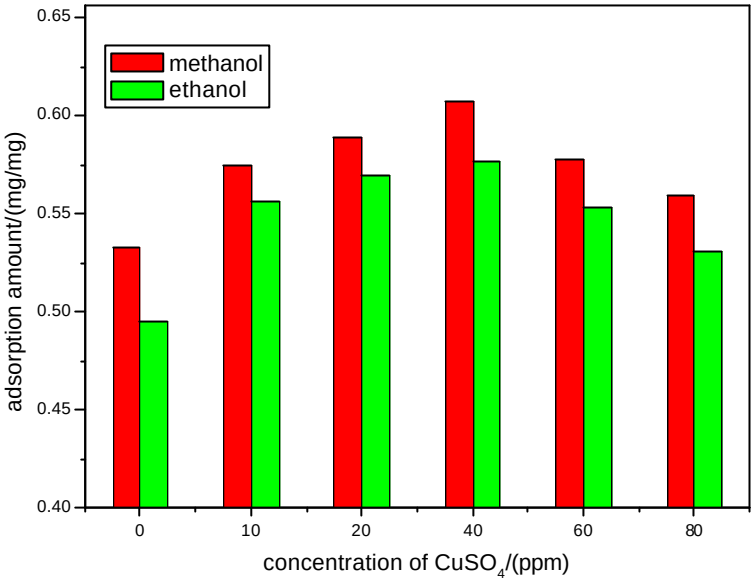

Figure2. adsorption amount of methanol and ethanol on modified ACF

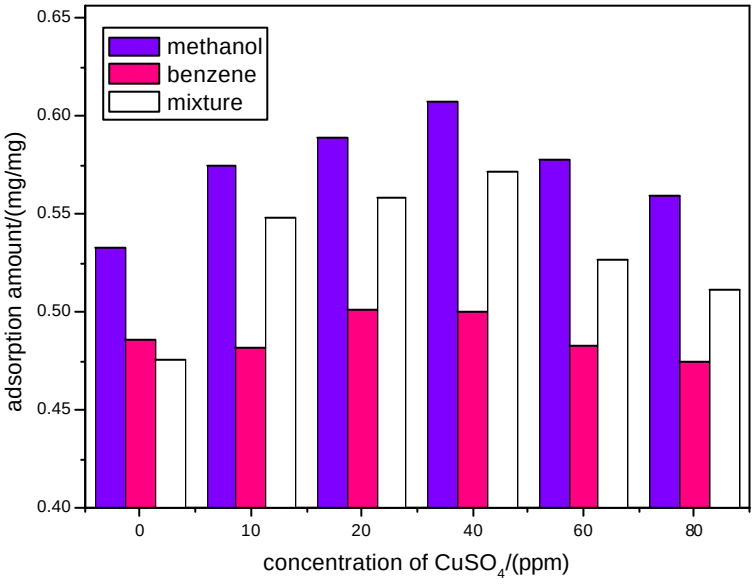

Figure 3 Adsorption of benzene, methanol and their mixture on ACF

Figure 3 compares the adsorption of individual benzene and methanol and their mixture vapors. The results showed that, unlike the adsorption of the mixture gas of benzene and toluene, the adsorption amount of the mixture gas of benzene and

methanol is higher than that of methanol, but lower than that of benzene, which means the strong competition of polar methanol molecule on modified ACF

Figure 4 shows the adsorption capacities of ethyl acetate and the mixture vapor of ethyl acetate and benzene on copper supported ACF. As expected, the adsorption capacity of modified ACF for the mixture gas of ethyl acetate and benzene is higher than for individual benzene or ethyl acetate, which is different from the case of the mixture of benzene and methanol, and may indicate the different adsorption site of ACF between non-polar organic compounds.

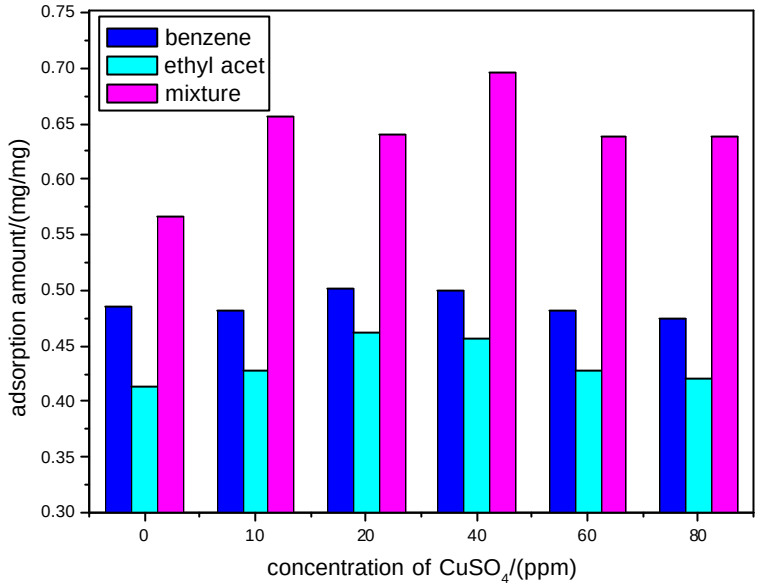

Figure 4 Adsorption of ethyl acetate, benzene and their mixture

4 conclusion

The adsorption capacities of VACF modified by $CuSO_4$ are higher than that of untreated VACF. And their adsorption capacities for polar VOC are still higher than that for non-polar VOC. The adsorption amount for the mixture vapors do not show the simple addition of their individual adsorption amount, which means the competition adsorption and the share of adsorption sites between the adsorbates.

Reference

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