SICK HOUSE SYNDROME INDUCED GAS ADSORPTION CHARACTERISTIC OF OXYGEN PLASMA – TREATED ACTIVATED CARBON FIBERS

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Introduction

Acetic acid gas, one of the volatile organic compounds (VOCs), can cause various diseases when exposed to human body. Many techniques have been developed for the removal of VOCs such as acetic acid gas, including adsorption, ion exchange, chemical precipitation, reverse osmosis, and electrolysis. Among them, adsorption is one of the representative methods for the removal of VOCs. Generally, activated carbon fibers (ACFs) are used as an adsorbent for removing acetic acid gas. However, ACFs has a limited ability to adsorb because it is only based on physical adsorption due to micropore[1)]. In the other side, oxygen functional group on the surface of ACFs is well-known to help adsorb acetic acid gas. In this study, oxygen functional groups were introduced on the surface of ACFs through the oxygen plasma treatment.

Materials and Methods

The surface of pitch-based ACFs (Ad'all-10, Osaka Gas Co. Ltd, Japan) was modified by oxygen plasma treatment at room temperature with various oxygen flow rate (20, 40, 60 sccm) and reaction time was fixed for 10 min. Changes in pore structure of the ACFs after oxygen plasma treatment are measured by N_2 adsorption at 77 K. The surface properties of samples were examined by X-ray Photoelectron Spectroscopy (XPS). Adsorption performance on acetic acid gas of samples were evaluated by Gas Chromatography (GC).

Results and Discussion

Table 1 shows change of functional groups on the surface depending on flow rate of injected oxygen gas. As flow rate of injected oxygen gas increased, oxygen functional groups were introduced on the surface of the ACFs tended to increase. The acetic acid gas adsorption performance of each sample is shown in **Figure 1**. The removal efficiency about 100 ppm of acetic acid gas in oxygen plasma treated ACFs was improved by 43% compared to the untreated ACFs. It is attributed to the formation of the hydrogen bonding due to the dipole moments between acetic acid molecules and oxygen functional groups such as O=C-O introduced in the oxygen plasma treatment

Table 1. C1s peak parameters of the samples

Component	Peak position (eV)	Concentration (%) Raw	20 sccm	40 sccm	60 sccm
C-C (sp^2)	284.5	82.78	53.82	52.73	51.49
C-C (sp^3)	285.4	10.30	15.55	14.69	12.64
C-O	286.1	4.82	3.44	4.13	5.97
C-O-C	287.2	1.82	16.75	17.12	17.48
C=O	288.0	0.21	7.49	7.90	8.08
O=C-O	289.0	0.07	2.96	3.44	4.34

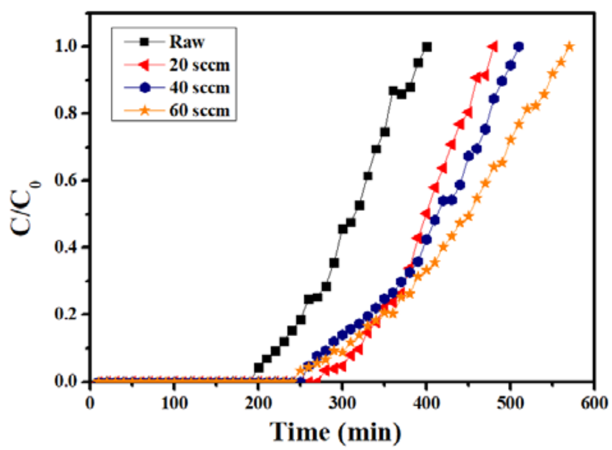

Figure 1. Breakthrough and saturation behavior of acetic acid for the samples.

Conclusions

As the flow rate of injected oxygen gas increased during oxygen plasma treatment, the adsorption efficiency of acetic acid gas increased as compared to the untreated ACFs, and the breakthrough time and saturation time were delayed by 90 and 170 min, respectively. This is due to the effect of hydrogen bonding with a large amount of oxygen functional groups and acetic acid molecules introduced on the surface of ACFs.

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References

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