

FUNCTIONAL GROUP OF CARBON FIBERS AND ACTIVATED CARBON FIBERS TREATED WITH OZONE

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Introduction

The oxidation process of carbon fibers with steam at high temperature, and the surface and adsorption characteristics of fibers at that condition were reported already[1]. But, the gaseous treatment is generally very drastic and causes severe degradation and excessive pitting of the carbon fiber surface. Most liquid-phase oxidative treatment are milder and generally do not cause excessive pitting and degradation of carbon fiber[2]. The previous study[3] shows that surface area and surface functional group of pitch-based carbon fibers treated with ozone in aqueous solution were developed.

The aim of this study is to investigate the changes of surface area and surface functional group of carbon fibers and activated carbon fibers treated with ozone in different concentration of alkali solution, furthermore to increase the adsorption capacity of heavy metal ion such as chromium.

Experimental

Pitch based CF (Kureha, Japan), PAN based CF (Taekwang, Korea), phenolic-resin based ACF (DaeDong, Korea) and pitch based ACF (AD'ALL, Japan) were dehydrated at 110°C for 24 hour, and were soaked in different NaOH, KOH, Ca(OH)₂ concentration for 30 min, respectively. Pre-treated fibers were reacted in fluidized reactor with some variables such as treatment time, alkali concentration, amount of inert ozone. after reaction, fibers were neutralized with acid solution, and were rinsed with distilled water.

N₂ adsorption isotherms were measured at 77K by volumetric method (Autosorb-1, Quantachrome). Surface acidities were determined by Boehm's method (Metrohm titroprocesser

Model 602)[4]. Surface functional groups were detected by FT-IR spectrophotometer (Model IFS88, Burkert). The changes of elemental component were measured by elementary analyzer. TGA/DSC curves for heat stability, SEM photographs for surface investigation were acquired.

Adsorption amounts of Cr⁶⁺ were measured by UV-Vis spectrophotometer (spectronic 601, Milton Loy) at 540nm.

Results and Discussion

CFs and ACFs treated with ozone in alkali solution were arrived at adsorption equilibrium rapidly and show type I isotherm likewise non-treated CFs and ACFs. This result shows hydroxy radical generated from ozone and alkali solution react uniformly with surface of CFs and ACFs and micropores are generated in fiber.

Fig.1 shows that specific surface area and total pore volume of CFs and ACFs were increased with increasing of treatment time. on the other hand, CFs increased slightly, ACFs, especially pitch-based ACFs, increased apparently. From this result, it was known that pore development is easy in case of ACF having existing pore. Hydroxy radical prefers developing pre-existing pore to preparing new pore.

The surface acidity of pitch based ACFs measured with Boehm method increased with increasing treatment time and surface area. As showed maximum 0.7 meq/g, it was known that a large number of surface functional group such as phenolic, lactone, carboxyl calculated from NaOH solution were existed on surface of ACFs treated with ozone.

Table 1 shows that contents of hydrogen and oxygen were increased after treatment with ozone, especially pitch based ACFs and phenolic resin based ACFs. which results from

development of surface functional group.

Fig. 2 shows that amounts of Cr(VI) adsorbed on ACFs and CFs were increased with increasing treatment time. In case of CFs, surface functional group were highly developed respectively compared with pore development.

The relation specific surface area and amounts of Cr(VI) adsorbed to flow rate of ozone are illustrated in Fig. 3.

From the analyses of FT-IR spectra, surface functional groups ACFs and CFs treated with ozone in alkali solutions are different from non-treated ACFs and CFs. It seems that most carboxylic groups are transformed to $-O^-$ and CO_2 by reaction of $-COO^-$ with hydroxyl radicals. from the analyses of SEM photographs, a small groove and nap are observed on the surface of ACFs and CFs treated with ozone in alkali solution.

Conclusion

As a result of introducing of functional group, ACFs and CFs treated with ozone in alkali solution show a development of surface area, pore volume, surface functional group and adsorption capacity.

References

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Table.1 Elemental compositions of CFs and ACFs before and after treatment with ozone.

Item	State	Elemental analysis (wt %)			
		C	H	O	N
Pitch based CF	before	87.17	0.70	8.73	0.37
	after	82.65	0.71	13.03	0.41
Pitch based ACF	before	65.75	2.56	26.45	0.74
	after	59.98	3.51	32.15	0.51
Phenolic resin based ACF	before	76.35	1.93	16.99	1.30
	after	67.80	2.65	24.40	1.16
PAN based CF	before	56.38	3.76	17.39	18.87
	after	52.88	3.91	22.40	16.50

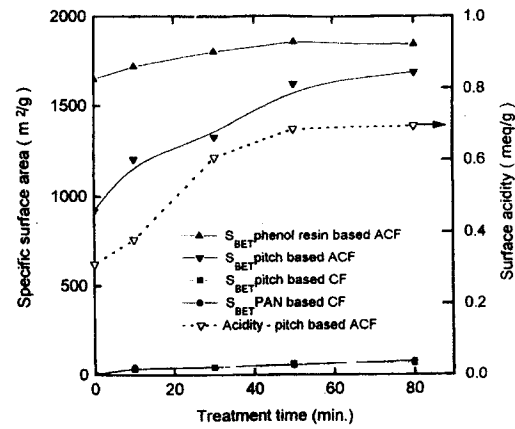


Fig. 1 Development of specific surface area and surface acidity on treatment of CFs and ACFs with ozone in 1M NaOH solution.

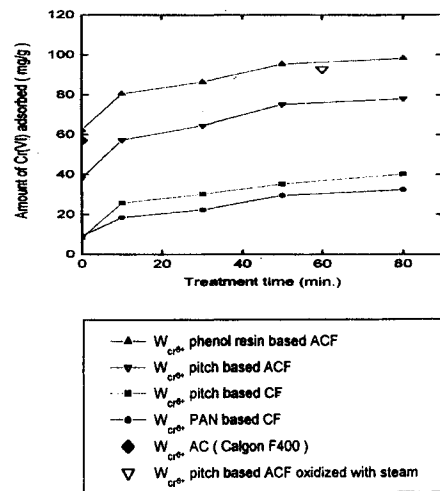


Fig. 2 Amounts of Cr(VI) adsorbed on CFs and ACFs treated with ozone in 1M NaOH solution.

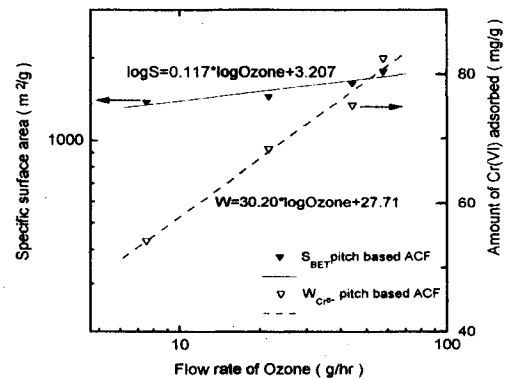


Fig. 3 Development of specific surface area and amount of Cr(VI) adsorbed with respect to flow rate of ozone on treatment of pitch-based ACFs with ozone in 1M NaOH solution.