Preliminary

NO_x Purification by Wood Charcoals and Their Composites with Metal Oxides*[1]

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Introduction

In recent years, much attention has been paid to environmental problems such as acid rain, photochemical smog and water pollution[1]. In particular, the situation of NO_x emissions from factories, automobiles, etc. in urban areas have been becoming worse. The use of wood-based charcoal materials in reducing air pollutants, of which functional capability is not yet fully known, is considered to be one of the solutions to solve such problems. When NO_x passes through wood-based charcoal materials, some possibilities are expected to remove NO_x or converse it into harmless gasses such as N_2[2]. In this study, the adsorption of NO_x over wood charcoal or metal oxide dispersed wood charcoal was investigated.

Materials and Methods

Wood powder of Sugi (*Cryptomeria japonica* D. Don; 20 mesh pass) was dried at 105°C for 24 hours, and then carbonized in an electric furnace at the desired temperatures from 200°C to 2,400°C. The temperature was increased at the rate of 4°C/min, and then kept constant for 1 hour after reaching the target temperature. Wood charcoal was taken out of the furnace after natural cooling. For the preparation of metal oxide dispersed wood charcoal, wood charcoals were soaked in the solutions of metal alkoxide dissolved in 1-propanol, and ovendried at 105°C for 24 hours, and then heated at 500°C for 3 hours. NO_x gas of about 100 ppm was passed through the reaction tube plugged with the wood charcoal or metal oxide-dispersed wood charcoal. The concentration of NO_x gas after passing through the reactor was measured by gas detectors at the outlet. To evaluate the

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photocatalyst effect, the reaction tube was radiated by monochromator or covered by black shield during the measurement. The physical and chemical characteristics of the wood charcoal were also evaluated.

Results and Discussion

Wood powder carbonized at 1,000°C and 1,400°C, and activated charcoal had considerably large specific surface areas compared to those carbonized at 200, 600, 1,800 and 2,200°C. No large difference was observed on the pore size distribution and specific surface areas between the wood powder and wood powder carbonized at 200, 600, 1,800 and 2,200°C. The wood powder carbonized at 1,000°C and 1,400°C as well as activated charcoal created more micropores with radii below 10 nm.

Figure 1 shows the relationship between time and NO_x concentration after passing 96 ppm-NO through the wood charcoals and activated charcoal. When the carbonized wood at 600°C was used as the reactive material, the concentration of NO was mostly lowered among all the samples, indicating the best adsorption ability of this wood charcoal. Since the specific surface area and pore-size distribution of wood powder carbonized at 600°C were not remarkably large compared to the wood powder carbonized at 1,000°C and activated charcoal, it was assumed that the adsorption ability was a little affected by these physical properties. On the other hand, NO_2 was not in the least detected at the outlet of flow in

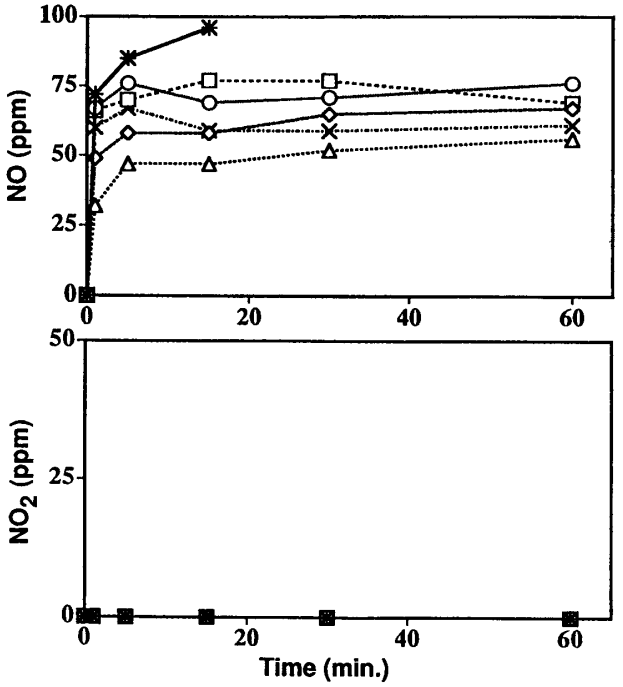

Fig. 1. Time and NO_x concentration after passing NO (96 ppm) through wood powder and charcoal. Legend: —*—: Wood powder, —○—: 400°C, ···△···: 600°C, ···◇···: 800°C, ---□---: 1,000°C, ···×···: Activated charcoal.

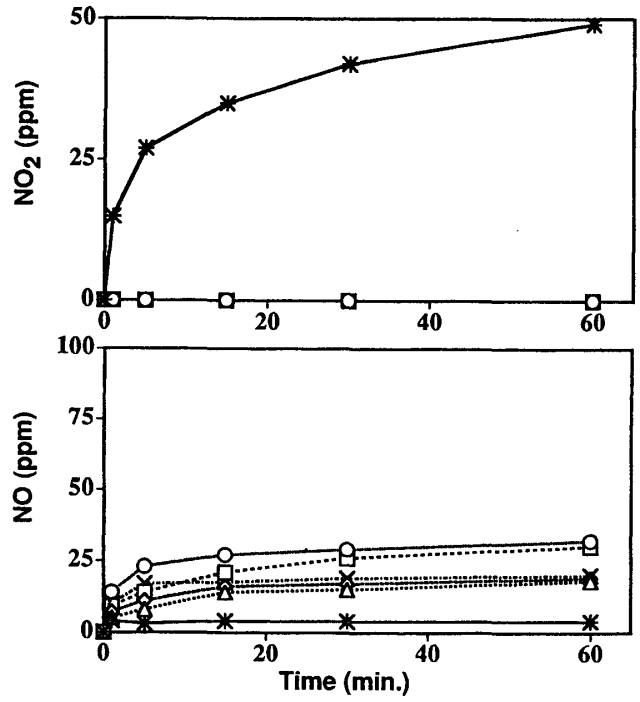

Fig. 2. Time and NO_x concentration after passing NO_2 (88 ppm) through wood powder and charcoal. Legend : —*— : Wood powder, —○— : 400°C, ···△··· : 600°C, ···◇··· : 800°C, ···□··· : 1,000°C, ···×··· : Activated charcoal.

every sample. The relationship between time and NO_x concentration after passing NO_2 through the wood charcoals and activated charcoals is shown in Fig. 2. It is clearly shown that all charcoal specimen except raw wood powder had good NO_2 adsorption ability. However, NO was detected after passing NO_2 through wood charcoal and activated carbon, which suggested that the reduction of NO_2 to NO occurred.

When metal oxide dispersed wood charcoal ovendried at 105°C was subjected, the NO adsorption and the reduction efficiency from NO_2 to NO decreased compared to simple wood charcoal. The capacity to adsorb NO was more improved by heat treatment of the composite at 500°C. Particularly, the vanadium oxide-dispersed wood charcoal showed the highest capability to adsorb greater amount of NO. When the metal oxide dispersed wood charcoals were illuminated by monochromatic light with wavelength close to ultraviolet rays, titanium oxide dispersed wood charcoal remarkably decreased the concentration of NO. The shorter the wavelength, that is, as the light energy increased, the better the adsorption ability. It was found that titanium oxide performed as photocatalyst[3], and oxidizing or reducing NO by light energy.

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