

REMOVAL OF NO_x OR ITS CONVERSION INTO HARMLESS GASES BY CHARCOALS AND COMPOSITES OF METAL OXIDES

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Keywords: adsorption, charcoal, metal oxide

Introduction

In recent years, much attention has been devoted to environmental problems such as acid rain, photochemical smog and water pollution. In particular, NO_x emissions from factories, auto mobiles, etc. in urban areas have become worse. To solve these problems on environmental pollution on a global scale, the use of activated charcoal to reduce air pollutants is increasing. However, the capability of wood-based charcoal materials is not yet fully known. The removal of NO_x or its conversion into harmless gases such as N₂ should be described.¹⁾ In this study, the adsorption of NO over wood charcoal or metal oxide-dispersed wood charcoal was investigated.

In particular, carbonized wood powder of Sugi (Cryptomeria japonica D. Don) was used to study the effectivity of using these materials in adsorbing NO_x. Since wood charcoal is chemically stable, metal oxide with the ability of photocatalysis was dispersed into wood charcoal to improve its adsorption and capability to use the light energy effectively.

Experimental method

1. Carbonization method

Wood meal of Sugi (Cryptomeria japonica D. Don) was carbonized in electric furnace with the desired carbonization temperatures of 300, 400, 500, 600, 700 and 800°C. The temperature was increased at the rate of 4 °C/min, and then kept constant for 1 hour after reaching the desired temperature.

2. Metal oxide-dispersed wood charcoal

Wood charcoal with a weight of 0.5 g was soaked in solution of Titanium (IV) alkoxide dissolved in about 5 ml 1-propanol. The charcoal was then oven-dried at 105 °C for 24 hours.

3. Adsorption method

NO_x gas of about 100 ppm was passed through the reaction tube with 0.5 g of wood charcoal or metal oxide-dispersed wood charcoal. The concentration of NO_x gas was measured by gas detectors. During measurement, the reaction tube was lighted up or covered by black shield.

Results and Discussion

The relationship between carbonization temperature and adsorption of NO in light and dark reactions is shown in Fig. 1. Based from the results, the adsorption was highest in 600°C. It was previously thought that in using wood charcoal, there will be no difference between light reaction and dark reaction. However, based from the results, adsorption was better in dark reaction than light reaction. As reflected, higher adsorption is observed in all the carbonization temperatures in the light reaction.

As shown in Fig. 2, adsorption of NO is different when charcoal is soaked in titanium oxide. Adsorption is better in light reaction when greater amount of titanium oxide is used as observed in all the carbonization temperatures studied. It seems that titanium oxide oxidized NO gas by light energy. However, in this study the source of light reaction was a fluorescent light. If the light with the suitable wavelength is irradiated to the titanium oxide-dispersed wood charcoal, the adsorption ability may be better.

Fig. 3 shows the relationship between carbonization temperature and adsorption of NO in light and dark reaction using the same percentage of titanium oxide. It is clear that adsorption is better in light reaction than dark reaction in all the carbonization temperatures. This is because titanium oxide plays an important role in the light reaction. Further, higher adsorption is observed in high temperature carbonized materials.

Conclusion

The adsorption of NO over wood charcoal was better in dark reaction than light reaction. Higher adsorption is observed in all the carbonization temperatures in the dark reaction although the highest adsorption is observed in 600 °C.

On the other hand, 800 °C was observed to adsorb more when soaked in titanium oxide. It can be concluded that the use of titanium oxide is very effective in improving the adsorption of NO especially in light reaction. Further, adsorption is better in light reaction when greater amount of titanium oxide is used as observed in all the carbonization temperatures studied. It seems that titanium oxide oxidized NO gas by light energy.

Reference

- 1) Imai, J. et al. 1993. N₂ formation from NO over metal oxide-dispersed microporous carbon fibers. Catalysis Letters 20, 133.

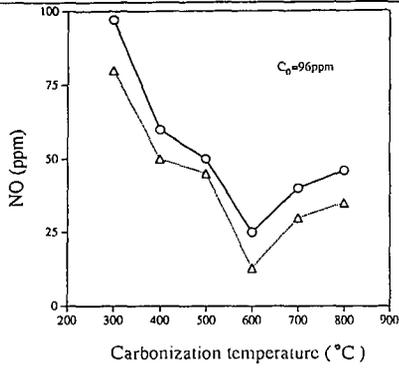


Fig.1 Adsorption of NO over charcoal
Notes: C_0 : Initial concentration of NO

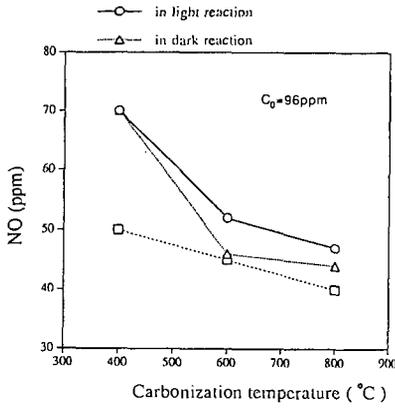


Fig.2 Adsorption of NO over charcoal materials in light reaction

Notes: C_0 :Initial concentration of NO

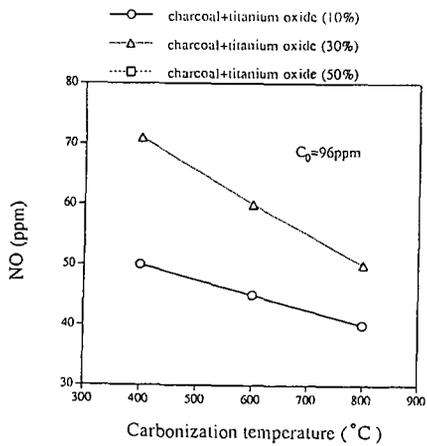


Fig. 3 Adsorption of NO over charcoal materials

Notes: C_0 :Initial concentration of NO

- charcoal+titanium oxide (50%) in light reaction
- △ charcoal+titanium oxide (50%) in dark reaction