

REMOVAL OF LOW CONCENTRATION NO_x WITH ACTIVATED CARBONS

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Introduction

High concentration NO_x (1000ppm-100ppm) by OG-20A-H1100 and urea supported Activated Carbon Fiber (ACF) was studied at the improvement of NO_x removal at lower concentration (20ppm) can be achieved with urea supported ACF [1].

The authors have reported that a pitch based activated carbon fiber which is heat-treated at 1100°C showed high catalytic activity in the oxidization of NO¹). However lower concentration of NO_x, the removal of NO_x is very difficult. In the present study, removal of the low concentration NO_x by ACF and Urea-ACF was examined to improve removal ability

Experimental

OG-20A-H1100 which is made from pitch based activated carbon OG-20A (Osaka Gas) by the heat treatment at 1100°C for 1 hr, was used as ACF catalyst. An Urea-ACF was prepared by soak in ACF for 24 hr at the room temperature in the urea (water solution), and then dried under nitrogen flow after the filtration. NO,NO₂ was flowed over ACF at 30 °C in the glass tube reactor. NO,NO₂ were analyzed by NO analyzer (Yanagimoto Co. Ltd, ECL-88US Kyoto)

Results and Discussion

Fig.1 shows a reaction with Urea (65.2 w%) and NO₂ (20 ppm) over OG-20A-H1100 (0.3 g). Only a few ppm of is discharged, indicating NO, shows that NO₂ is perfectly reduced by Urea-ACF.

It has been reported that at higher concentration of NO₂, discharged NO is reduced by increasing the amount of urea supported on ACF. At lower concentration of 20ppm, same tendency was observed ability of Urea-ACF. High reduction resolution was shown regardless of the NO_x concentration. Fig.2 shows a reaction of 20ppm NO and oxygen over ACF (w=3.0 g). Perfect adsorption of NO to ACF occurred from 0 h to 80 h. After 80 h a part of NO is discharged. It was found that no NO₂ was detected, indicating no oxidization of NO, and only adsorption of NO to ACF.

In order to prepare, the oxidization of NO occurred after 24h (Fig.3), higher concentration of NO pre-adsorbed on the surface of ACF. NO (1000ppm) and oxygen (21%) in nitrogen balance are flowed over ACF (w=3.0g). After NO₂ is discharged, high concentration NO_x inside the reactor was washed with N₂ gas (Modified-ACF).

The reaction of 20 ppm NO and oxygen over Modified-ACF is shown in Fig.4. The oxidization of NO began soon, and no less than 85 % of NO was oxidized.

It is suggested that only adsorption of NO happens over ACF. However oxidization of NO to NO₂ over Modified-ACF which is pre-treated in high concentration, and the removal rate of NO improves. In Fig.4, a main reaction is (1) $[2NO + O_2 \rightarrow NO_2(1), 2NO_2 \rightarrow NO_3-ACF + NO(2)]$. At the low concentration, a main reaction is (2).

Material balances of NO and NO₂ is not connect, since pre-adsorbed NO was desorbed as NO₂.

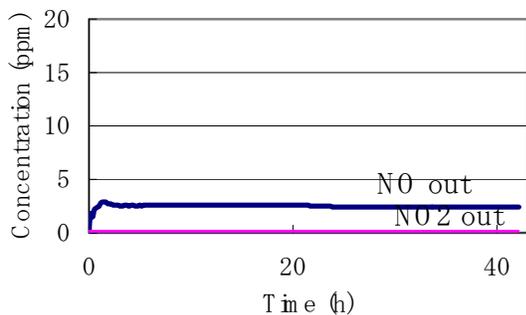


Fig.1 OG20A-H1100=0.3g+Urea65.2w%
NO₂:20ppm O₂:21% N₂;balance
F=100ml/min T=30C' RH=0%

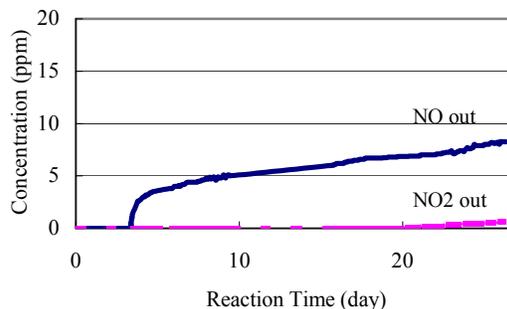


Fig.2 OG20A-H1100 w=3.0g NO:20ppm
O₂:21% N₂;balance F=100ml/min
T=30C' RH=0%

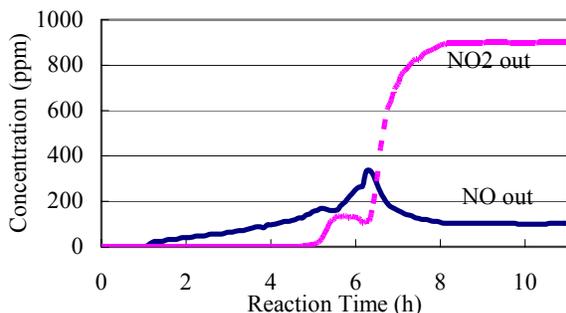


Fig.3 OG20A-H1100 w=0.6g NO:1000ppm
O₂:21% N₂;balance F=100ml/min T=30C'
RH=0%

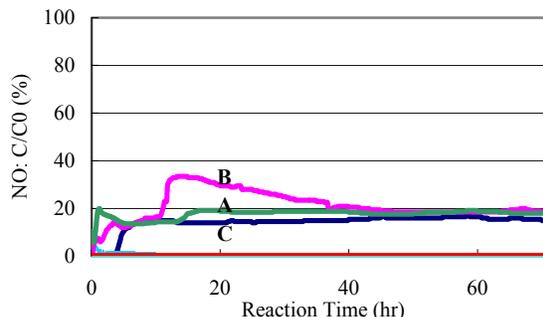


Fig.4 NO:5ppm(A) 10ppm(B) 20ppm(C)
ACF(3.0g)+Urea-ACF(1.2g,23w%)
O₂:21% N₂;balance F=100ml/min
T=30C*No NO₂ was found at the outlet of reactor.

Conclusions

More NO at lower (5,10,20ppm) concentration can be removed by combining Modified-ACF with Urea-ACF. It was found that it oxidation of NO to NO₂ over Modified-ACF, and followed by perfect reduction of NO₂ over Urea-ACF is effective to remove NO at lower concentration.

References

[1] Mochida I, Shirahama N, Kawano S, Korai Y, Yasutake A, Tanoura M, Fujii S, Yoshikawa M. Fuel 2000; 79: 1713-.