

DIOXIN PREVENTION & REDUCTION

ACTIVATED COKE FOR THE REMOVAL OF DIOXINS

Kyong-Tae Kim¹, Dong Jun Koh¹ and Jin Hong Kim²

¹Environment and Energy Research Center, Research Institute of Industrial Science and Technology (RIST), P.O.Box 135, Pohang 790-330, Korea

²Environment Team, POSCO, Koedong-dong, Pohang 790-600, Korea

Introduction

A primary measure for removing dioxins from a variety of incinerators is still injection of powdered activated carbon into exhaustive gas followed by capture of the resultant particulates adsorbing the dioxins through dust collectors^{1,2}.

In the steel making plant, the coke produced by the coal pyrolysis is used as a primary reducing agent in the blast furnace. During the cooling of the carbonized coke, the fine dust is produced from the coke as a byproduct. This fine coke could not be used as an adsorbent for the air pollutants because of very low surface area of 3 ~ 6 m²/g. However, if the surface area is increased by an activation method, it could be tried to use as an adsorbent. In this study, we activated the fine coke by a several method for the increasing of the surface area. And the adsorption ability of dioxins was tested in a commercial industrial waste incinerator.

Materials and Methods

Activation of the fine coke

The fine coke from the CDQ(coke dry quenching) system was sieved to 200 ~ 270 mesh. Its surface area was 3.7 m²/g. The activation of the fine coke was performed in the several atmospheres. The fine coke was activated in the flow of air, air/steam mixture and N₂/steam mixture with different temperatures.

Adsorption test

The increase of the adsorption ability was tested by the measure of the adsorption amount of 1,2-dichlorobenzene(DCB). First, a mixture of 50 mg of the PAC and 50mg of small glass beads was placed on the top of glass wool layer inside a quartz column, where the glass beads were used to protect the pressure drop across the column. After being purged with the flow of nitrogen gas for 30 min, the column was heated to a given temperature, that is, 150°C which was controlled within ±1 °C. Once the temperature was reached, a mixed flow of the carrier nitrogen and another nitrogen flow containing an adsorbate, DCB vapor was introduced into the column. The total flow rate was 300 ml/min, and the concentration of DCB was fixed at 400 ppm which was produced by bubbling a liquid DCB placed in a temperature-controlled bath at 16 ± 0.5°C. The concentration of DCB at the outlet was analyzed using GC-FID(HP5890) with an interval of several minutes.

Field test

To examine the effectiveness of the activated coke on dioxins removal, the activated coke and commercial activated carbon(Calgon) were employed in an industrial solid waste incinerator with its capacity of 40 ton/day. The incinerator is equipped with an injection facility followed by fabric filter house(FF) operated at about 150°C. In our injection tests, the adsorbent was injected into the flue gas at a position of 20 m ahead of the FF with the rate of 50 mg/Nm³ to 200 mg/Nm³. The flue gas samples

DIOXIN PREVENTION & REDUCTION

were simultaneously taken at two points, that is, before the injection of adsorbents and after the FF. The sampling and analysis of the samples were performed according to the Korea standard methods. The quantitative analysis was done using a High Resolution GC/MS.

Results and Discussion

Activation of the fine coke

The fine coke was activated in the flow of air. The change of the surface area and the yield are shown in Fig.1. The surface area was increased with increasing the treatment temperature. In the treatment temperature of 500°C, the surface area was about 49 m²/g. However, the yield of the coke was suddenly decreased above the temperature of 400°C. The loss in the amount of the coke is due to the gasification of the carbon.

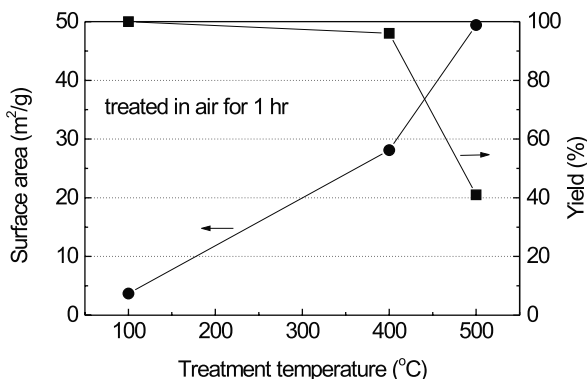


Figure 1. The change of the surface area and yield by the activation in air.

Figure 2 shows the results of the activation in the flow of air/steam mixture. When the treatment temperature increased, the surface area increased and showed a maximum at around 400 to 500°C. Further increase of the treatment temperature decreased the surface area because of the formation of ash. Compared with the results of Fig.1, the addition of steam accelerated the activation of the coke and increased the yield.

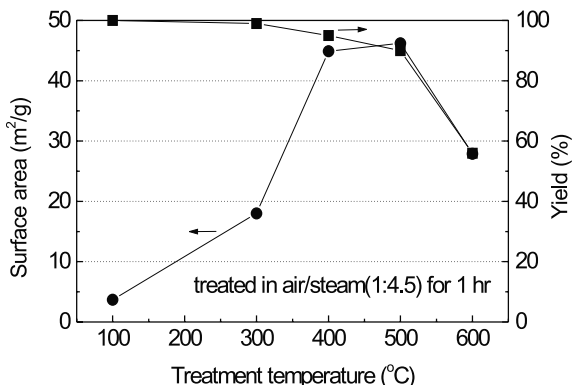


Figure 2. The change of the surface area and yield by the activation in air/steam mixture

DIOXIN PREVENTION & REDUCTION

Fig.3 shows the results of the activation in the flow of N_2 /steam mixture. The treatment to the temperature of $600^\circ C$ slightly increased the surface area. The activation of the coke is carried out by the reaction of the carbon and gas. The reaction of the coke and O_2 seems to be a major reaction step in the activation of the coke.

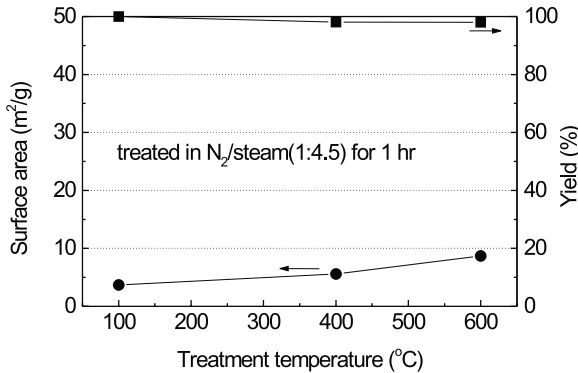


Figure 3. The change of the surface area and yield by the activation in N_2 /steam mixture

Adsorption ability of the activated coke

Fig.4 shows the adsorption amounts of DCB for the fresh fine coke and activated coke. The intensity indicates the column outlet concentration of DCB. The adsorption capacity of the fresh fine coke was very low because of the low surface area. However, the adsorption capacity was noticeably enhanced by the activation of the coke.

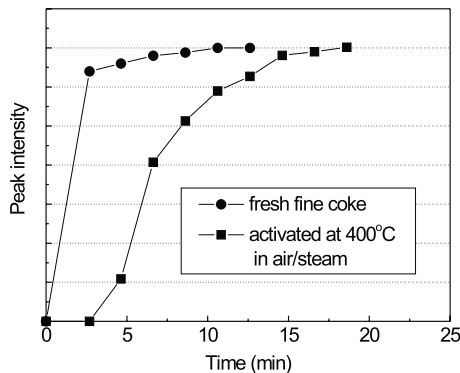


Figure 4. Adsorption tests of the activated coke.

Dioxins removal efficiency

Activated coke injection tests were carried out in the industrial waste incinerator to examine the dioxin removal efficiency. Fig.5 shows the dioxin removal efficiency of the activated coke and the commercial activated carbon. With the injection of the adsorbents, the dioxin concentration is sharply

DIOXIN PREVENTION & REDUCTION

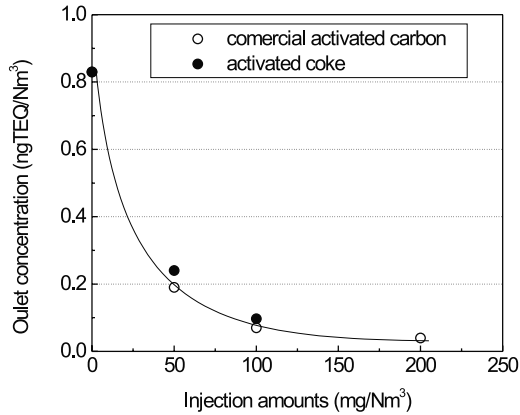


Figure 5. Reduction of outlet dioxin concentrations with injection amounts.

reduced until the injection amount increases to 100 mg/Nm³ and it is gradually leveled off. The dioxin removal efficiency of the activated coke was comparable to that of the commercial activated carbon.

References

1. Acharya P., DeCicco S. D., and Novak R. G. (1991) *J. Air Waste Manage. Assoc.* 41, 1605.
2. Griffith J. G., and Pitts D. M. (1995) *Pollution Engineering*, Nov., 50.