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Removal of Volatile Organic Compounds Emitted from Food Waste using Hybrid Reactor System Comprised of Plasma and Catalyst

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Highlights

- Hybrid reactor system comprised of plasma and catalyst was developed.
- Acetaldehyde which was main component of food waste VOCs was completely removed using hybrid system.

1. Introduction

The removal of volatile organic compounds (VOCs) has been one of the important topics in the area of environmental catalysis research [1-3]. Especially, removals of food waste derived VOCs have been a significant problem of Korea government to enhance quality of life. Although the general method to treat food waste derived VOCs is adsorption, the efficiency is commonly low. In addition, the catalytic control can be applied at lower temperatures compared with thermal oxidation alone. However; in most cases the reaction temperature of catalytic reaction is higher than 200^{o}C. To reduce the operating temperature of VOCs removal to room temperature, ozone should be used. In this study, we developed a new hybrid system comprised of wet plasma and catalyst to remove food waste derived VOCs.

2. Methods

Reactor shown in Figure 1 was used for the removal of VOCs and the power of plasma system was 10W. A Mn based catalyst on a honeycomb base was used. The inlet concentration of acetaldehyde, which was found to be a predominant component of food waste derived VOCs, was 6 ppm.

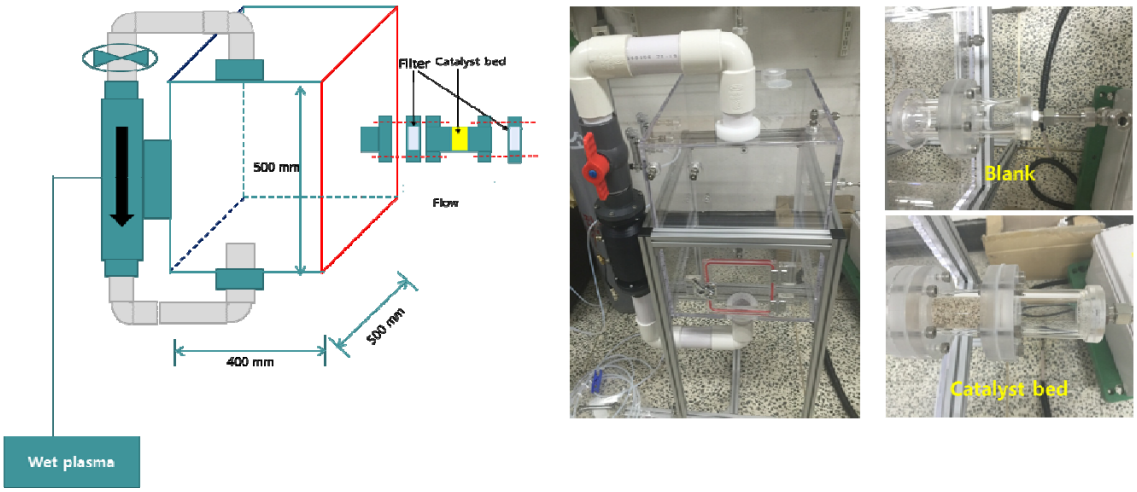

Figure 1. The hybrid system for food waste derived VOCs

3. Results and discussion

When plasma was connected to the reactor and 10W power was applied in the batch reactor, the produced ozone concentration increased at a rate of 1 ppm/min. After 6 ppm of acetaldehyde was injected to the reactor with plasma only, the amount of ozone generated was almost the same, and the concentration of acetaldehyde did not decrease. Thus, the acetaldehyde could not be removed by the plasma alone. When acetaldehyde was fed into the reactor comprised of plasma and MnO_2 coated honeycomb catalyst, acetaldehyde was completely removed after 90 minutes. On the other hand, the ozone concentration was detected to be about 10 ppm after 90 minutes from the start of the experiment. As a result, the ozone generated by the plasma was decomposed mainly by the catalyst, and a part of the ozone was utilized for the oxidation of acetaldehyde.

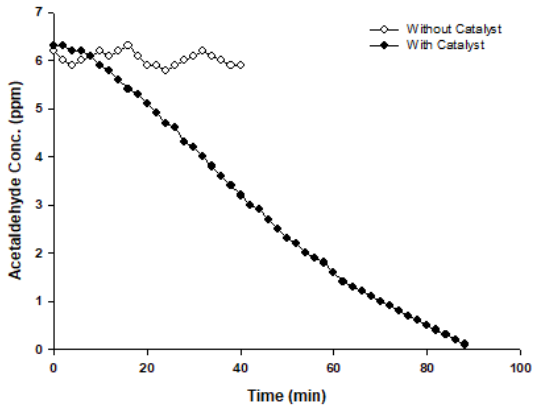

Figure 2. Removal of acetaldehyde using hybrid system

4. Conclusions

The new hybrid system comprised of wet plasma and catalyst was applied to remove food waste derived VOCs. Acetaldehyde could not be removed by the wet plasma alone; however, it was removed completely after passing the hybrid reactor with Mn-catalyst. Therefore, the hybrid system can be effectively applied to the control of VOCs generated from food waste.

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Keywords
Removal of food waste derived VOCs; Hybrid system; Plasma; Catalyst: Ozone