CHAPTER V

CONCLUSONS AND RECOMMENDATIONS

5.1 Conclusions

Basic investigations into the important effects, namely, discharge current, inlet gas concentration, space velocity, and coexisting oxygen, carbon dioxide, sulfur dioxide, nitrogen dioxide and water vapor on the individual and binary removal efficiency of three kinds of gaseous pollutants, namely, trimethylamine, acetaldehyde and ammonia have been carried out experimentally. It can be said that the electron attachment method shows good promise for treating several of the gaseous pollutants found in crematory and industrial emissions.

According to the experimental results, a faster space velocity or higher inlet gas concentration generally results in a lower removal efficiency. On the other hand, a higher discharge current generally leads to a higher removal efficiency. The presence of O_2 in a gas mixture enhances the removal efficiency of each of the above impurity gases. The enhancement is experimentally shown to be attributable to the ozonation reaction in the removal of trimethylamine from N_2-O_2 mixed gas. The presence of water vapor enhances the removal efficiency of trimethylamine and acetaldehyde but retards that of ammonia. The coexistence of SO_2 promotes the removal efficiency of trimethylamine from N_2-O_2 mixed gas but retards that of acetaldehyde. Regarding the influence of coexisting NO_2 on the removal of CH_3CHO from N_2-O_2 mixed gas, it is found that the lower the inlet NO_2 concentration, the lower the discharge current that still yields beneficial effect. At higher discharge currents, the retarding effect of CO_2 on CH_3CHO removal from N_2-O_2 mixed gas is obviously significant.

In addition, the application of electron attachment to the removal of binary gaseous pollutants has been investigated experimentally. The high selectivity of electron attachment to electronegative gas molecules is beneficial to the simultaneous removal. The binary pollutant systems investigated are trimethylamine-acetaldehyde and ammonia-acetaldehyde in N_2-O_2 mixture. Generally, the higher the discharge current, the higher the binary removal efficiency. The exception to this general rule is trimethylamine-ammonia. Since undesirable reaction by-products are produced on the removal of sulfur dioxide-trimethylamine from air, a system of two-reactors in series has been proposed and shown to remove the binary pair with negligible reaction by-product by independently adjusting the discharge current in each reactor. Compared to the individual removal of trimethylamine, the case of sulfur dioxide-trimethylamine shows that the presence of a second impurity greatly enhances the removal efficiency in a single reactor, but some reaction by-products are generated. The problem of undesirable reaction by-products can be avoided by using two independently operated reactors in series.

5.2 Problems and recommendations for future work

After the corona-discharge reactor had been put in the long use, the deposition of negative ions and formation of particulate matter on the anode surface gradually accumulate. Consequently, the removal efficiency gradually decreases. To recover the removal efficiency, the anode surface should be periodically cleaned, which does not present a frequent problem when the pollutant concentrations are very dilute.

Investigation on the types and concentrations of malodorous gas components emitted from a crematory furnace can not proceed without cooperation from a temple. So the reported exhaust components from a gas-fired crematory in Japan have to be used as reference data.

When basic experiments are to be carried out in a laboratory, it is advisable to experiment on some synthetic gas mixture. In view of the large number of components reported, it would be impractical to include all the detected components in the synthetic mixture. More experimental data on individual and binary removal efficiencies should be accumulated before studying multicomponent removal efficiencies in the laboratory.

The actual exhaust gas temperature from a well-operated furnace outlet may be as high as 800~900 °C whereas the stack temperature may range from 150~300 °C. The high temperature condition might affect the removal efficiency and/or induce more production of by-products. For on-site tests, the reactor must be constructed with materials that can withstand the high temperature. More investigation into the temperature effect on the electron attachment reaction should be carried out.