CHAPTER I

INTRODUCTION

Like many countries, Thailand has been facing many environmental problems caused by growth of human activities. The heavy concentration of vehicles in most big cities seriously causes a large amount of toxic and obnoxious automobile emissions. In addition, city air may have an unacceptable level of various gaseous pollutants as well as particulate matter because of a sizable number of industrial plants. It has been reported that these gaseous pollutants significantly contribute to global impacts such as the greenhouse effect, acid rain, urban smog, and depletion of ozone layer in the upper stratosphere. It is also known that even though the concentration levels of the gases (toxic gases, malodorous gases, ozone-depleting gases, etc.) released are very low in the ppm or ppb orders, they not only lead to environmental deterioration but also cause public nuisances and may be detrimental to public health. Because of greater public awareness of the danger associated with polluted air, more attempts at environmental treatments have increasingly been made.

Recently, a latent source of public nuisance has become prominent. It is the crematoria of nearly 20,000 temples in Thailand, particularly the approximately 300 temples in the Bangkok Metropolitan Area. Besides particulates, malodorous gaseous components are emitted during cremation, causing frequent complaints from local communities. This is because emission from the furnace of the crematorium is directly released from the stack to the atmosphere without any effective treatment. It is reported that nearly all of the approximately 20,000 temples in Thailand lack appropriate emission control systems, including most of the nearly 300 temples in Bangkok having frequent crematory activities. A few rich temples have installed furnaces with after-burning systems, which used to cost around 3~5 million bahts per system before the baht devaluation. However, shortage of funds has impeded even the upgrading of the existing furnaces. Most temples nationwide and even some well-known ones in Bangkok still use firewood as the main fuel. Thus the chances of them installing the imported after-burning systems are slim, if not nil, unless some novel and economical control system can be developed to remove the dilute obnoxious gaseous components in crematory emission with high efficiency. The removal of particulates is easier but should also be achieved by the same system.

Though the problem is much less severe, similar complaints about crematory emission are heard in several countries, including Japan, the United Kingdom and Germany. In order to meet the emission control standards, a typical modern Japanese crematorium generally installs an after-burner furnace to decompose the malodorous organic gaseous components at high temperature. Next fresh air is drawn to cool down and further dilute the residual gaseous components by one or two orders of magnitude before sending the cooled-down gas through a dust collector (Nishida, 1981, 1988a, 1988b).

Nishida reports that exhaust gas from one gas-fired crematory in Japan consists of the following average gaseous composition after 100-fold dilution with fresh air.

High-concentration components:

N_2	78%
O_2	20~21%

Low-concentration components:

CO_2	0.01~0.02%
H_2O	0.22%
NO_x	80 ppm (max)
SO_x	5.8 ppm (max)
Acetic acid (CH_3COOH)	24 ppm
Hydrocarbons	230 ppm (as propane)

Very low-concentration malodorous components:

Acetaldehyde (CH_3CHO)	0.04 ppm
Styrene ($C_6H_5CH{=}CH_2$)	0.01 ppm
Hydrogen sulfide (H_2S)	0.01 ppm
Methyl mercaptan (CH_3SH)	0.001 ppm
Dimethyl sulfide ($(CH_3)_2S$)	0.0005 ppm
Ammonia (NH_3)	0.37 ppm (max)
Trimethylamine ($(CH_3)_3N$)	0.023 ppm (max)

It can be seen that, besides NO_x and SO_x, various kinds of dilute gas components are present as malodorous gases. It should be noted that the above concentrations of such malodorous gases have been diluted 100 times with ambient air. Hence, the concentrations are nearly 100 times higher before dilution.

Because of greater public awareness of nuisances and health risks associated with crematory emission, the Parliamentary Committee on Science and Technology, House of National Representatives is much interested in some appropriate technology to solve the problem of the malodorous gases. This has motivated Wiwut Tanthapanichakoon, et.al. on the Thai side and Hajime Tamon, et.al. on the Japanese side to jointly carry out a basic study on the application of electron attachment reaction to the treatment of crematory emission gas. The present work is a part of this research collaboration.

1.1 Objectives of research work

1.1.1 Carry out experiments to find out the removal efficiency of gas components from an inert gas at an atmospheric pressure using the deposition-type reactor at various conditions.

1.1.2 Investigate the influence of coexisting gas components on the removal efficiency of such malodorous gas components.

1.2 Scope of research work

1.2.1 The experimented gases in this research are trimethylamine, acetaldehyde and ammonia.

1.2.2 The influence of coexisting gas components are:

- oxygen, water vapor and sulfur dioxide on removal of trimethylamine
- oxygen, water vapor, sulfur dioxide, carbon dioxide and nitrogen dioxide on removal of acetaldehyde ·
- oxygen, water vapor and carbon dioxide on removal of ammonia

1.2.3 The ranges of experimented conditions investigated are as follows:

- Discharge current between 0-3 mA
- Space velocity between 50-80 hr^{-1}
- 2 reactors in series