Chapter I

Introduction

1.1 Rationale of the Study

The development of industries in Thailand is rapid. These industries release pollutants such as waste water, air pollutants, solid wastes and hazardous wastes which cause environmental problems. In this work, we focus on an air pollution problem which has deteriorated in recent years.

Secondary air pollutants such as sulfates and sulfuric acid are sometimes more dangerous to environment than primary air pollutants such as sulfur dioxide. Sulfate aerosols have caused the respiratory irritation, visibility reduction, an increase in acid rain, an increase in acidity of soil and watersheds, plants, animals and building damages. Due to the adverse effects of sulfate aerosols, the present research aimed to study sulfur dioxide oxidation in plume. The reaction occurring in plume differs from that occurring in fixed volume reactor because plume is an expanding volume reactor, thus, it is interesting to study how sulfur dioxide is oxidized in plume and what variable parameters influence significantly on sulfur dioxide oxidation.

The pollutant concentration in the atmosphere can be evaluated by the mathematical models or collected by the monitoring instruments. The mathematical models are more popular in practical use because they can evaluate the pollutant concentration faster and the expenses lower. The Gaussian plume model, which is at present widely used, can not apply to reactive substances such as the reaction of sulfur dioxide oxidation to sulfuric acid, etc. Due to this disadvantage, the Monte Carlo method, which is a numerical method, was used to solve this problem. Inspired by such a notion, the mathematical model of sulfur dioxide oxidation in plume using the

Monte Carlo method was developed to evaluate the dispersion and the chemical transformation of sulfur dioxide. This mathematical model can apply to the 0^{th} - n^{th} order of sulfur dioxide oxidation rate and the pollutant concentration was simulated by using a computer.

1.2 Objectives of the Study

The objectives of the present study are as follows:

1.2.1. To develop the mathematical model of sulfur dioxide oxidation in plume using the Monte Carlo method for a single point source and flat terrain.

1.2.2. To estimate the 0^{th} - n^{th} order of sulfur dioxide oxidation rate in plume by using the mathematical model of sulfur dioxide oxidation in plume using the Monte Carlo method.

1.2.3. To apply the mathematical model of sulfur dioxide oxidation in plume using the Monte Carlo method to a stack of the South Bangkok Power Plant in Samut Prakarn.

1.3 Scopes of the Study

The scopes of this study are as follows:

1.3.1. To develop the mathematical model of sulfur dioxide oxidation in plume using the Monte Carlo method for a single point source and flat terrain.

1.3.2. To verify the mass conservation of the mathematical model of sulfur dioxide oxidation in plume using the Monte Carlo method.

1.3.3. To evaluate the values of the simulated horizontal and vertical dispersion coefficients in comparison to Pasquill-Gifford dispersion coefficients.

1.3.4. To study the sensitivity analysis of chemical reactions of the mathematical model of sulfur dioxide oxidation in plume using the Monte Carlo method with a stack of the South Bangkok Power Plant in Samut Prakarn.

The chemical reactions used to analyze sulfur dioxide oxidation in plume are as below:

1.3.4.1. Brimblecombe and Spedding (1974)'s reaction rate

1.3.4.2. Freiberg (1974)'s reaction rate

1.3.4.3. Ibusuki, Ohsawa and Takeuchi (1990)'s reaction rate

The parameters of these reaction rates to be studied are

a) atmospheric stability class

b) temperature

c) relative humidity

d) iron concentration

e) ammonia concentration

1.3.5. To evaluate the simulated sulfate concentration in comparison to the measured sulfate concentration of a stack of the South Bangkok Power Plant in Samut Prakarn (JICA, 1990).

1.4 Expected Uses of the Study

The mathematical model of sulfur dioxide oxidation in plume using the Monte Carlo method developed can be applied to air quality impact analysis for a single point source and flat terrain. This mathematical model includes the 0^{th} - n^{th} order of sulfur dioxide oxidation rate which can not be used in the Gaussian plume model.