CHAPTER 1

INTRODUCTION

Background

Every time we breathe, we risk inhaling dangerous pollutants that have found their way into the air. Every day, the average person inhales about 20,000 liters of air. Air pollution includes all contaminants found in the atmosphere. These dangerous substances can be either in the form of gases or particles. Air pollution can be found both outdoors and indoors. Pollutants can be trapped inside buildings, causing indoor pollution that lasts for a long time. The sources of air pollution are both natural and human-based. As one might expect, humans have been producing increasing amounts of pollution as time has progressed, and they now account for the majority of pollutants released into the air. Because it is located in the atmosphere, air pollution is able to travel easily. As a result, air pollution is a global problem and has been the subject of global cooperation and conflict. The effects of air pollution are diverse and numerous. Air pollution can have serious consequences for the health of human beings, and also severely affects natural ecosystems. Some areas now suffer more than others from air pollution. Cities with large numbers of automobiles or those that use great quantities of coal often suffer most severely from problems of air pollution. As for Thailand, the air pollution problems are mainly caused by particulate matters and ozone(Air Quality Department, 2000), especially, in some areas of Bangkok and industrial cities e.g. Saraburi province, Rayong province, Chonburi province and Samutprakarn etc.

There are many different chemical substances that contribute to air pollution. These chemicals come from a variety of sources. Among the many

types of air pollutants are nitrogen oxides, carbon monoxide, and volatile organic compounds that can evaporate and enter the atmosphere. Air pollutants have sources that are both natural and human. Now, humans contribute substantially more to the air pollution problem. Forest fires, volcanic eruptions, wind erosion, pollen dispersal, evaporation of organic compounds, and natural radioactivity are among the natural causes of air pollution.

Usually, natural air pollution does not occur in abundance in particular locations. The pollution is spread around throughout the world, and as a result, poses little threat to the health of people and ecosystems. On the other hand, man-made air pollution is responsible for major health effects. Every year, the health of countless people is ruined or endangered by air pollution. Many different chemicals in the air affect the human body in negative ways. Just how sick people will get depends on what chemicals they are exposed to, in what concentrations, and for how long. Older people are highly vulnerable to diseases induced by air pollution. Those with heart or lung disorders are under additional risk. Children and infants are also at serious risk. Because people are exposed to so many potentially dangerous pollutants, it is often hard to know exactly which pollutants are responsible for causing sickness. Also, because a mixture of different pollutants can intensify sickness, it is often difficult to isolate those pollutants that are at fault. Many diseases could be caused by air pollution without their becoming apparent for a long time. Diseases such as bronchitis, lung cancer, and heart disease may all eventually appear in people exposed to air pollution.

Air pollutants such as ozone, nitrogen oxides, sulfur dioxide, and particulate matters also have harmful effects on natural ecosystems. Though some pollution comes from these natural sources, most pollution is the result of human activity. The biggest causes are the operation of fossil fuel-burning power plants and automobiles that combust fuel. Combined, these two sources are responsible for about 90% of all air pollution in the United States. Some cities suffer severely because of heavy industrial use of chemicals that cause air pollution. In thailand, stone crushing industries are also a main source of

particulate matter emission from stone processing and its downstream activities especially in Saraburi province. Particulate matters mainly affect human heaths in term of respiratory system diseases such as chronic cough, bronchitis symptoms and lung cancer etc. The air-borne dust pollution problems were once intimately critical in Saraburi area because of lack of good environmental measures and its topography which is hilly area. Since the topography of the terrain not only strongly influences the local flow field but also may alter the dispersion characteristics due to such phenomena as flow separation, stagnation, impingement, upwash and downwash, pollutant dispersion are harder to predict. At present, there are several commercial models for atmospheric dispersion in complex terrain. Each model still has its own strength and limitation and the better ones are costly.

As a result, this study is to investigate and apply a model for air pollutant dispersion using a generalized coordinate system adapted to the topography (curvilinear coordinates) and computational fluid dynamic techniques.

Objectives of the thesis

1.To implement and investigate a mathematical model suitable for simulation of dispersion of air pollutants over non-planar terrain using 3 dimensional generalized coordinate system.

2.To simulate the effects of wind speed and direction on the concentration distribution of air pollutants over non-planar terrain.

Scopes of the thesis

1. Air pollutant or PM_{10} (which has motion like Brownian diffusion), are investigated.
2. Assumptions in the thesis are the following:

-Investigated system consists of chemically unreactive air pollutants.

-Atmospheric stability class is mainly stable.

-Distribution of horizontal wind velocity in the upper layer and on the ground surface are described by a power law.

3. Math model adopts computational fluid dynamics using a three dimensional generalized coordinate system which transforms the topography hugging coordinate to the rectangular coordinate system.
4. Prediction of the concentration distribution in ambient air over the interested topography uses measured meteorological data and significant assumption for missing data as input.
5. Investigation of effect of major parameters such as wind velocity, wind direction as well as non-planar topography on air pollutant dispersion.

Obtained benefits

1. Suitable math model for the simulation of air pollutant dispersion over non-planar topography is obtained.
2. From the trend of concentration distribution of air pollutants over non-planar terrain the effect of topography on the dispersion of air pollutants and their critical level are understand.
3. Better understanding of the effect of major factors such as wind speed, wind direction, atmospheric stability, and topography on air pollutant dispersion.

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