CHAPTER I
INTRODUCTION

1.1 Introduction

Particulate air pollution has received much more attention since the announcement of the finding that health problems appear to be increased significantly where ambient particulate concentrations are high. Many epidemiological studies, which investigate the relationships between exposure and the resulting health effects of air pollution, have shown that PM-10 particulate matter is responsible for several serious health effects, such as allergy, irritation, respiratory symptoms, cardiovascular disease and cancer (1-4). However, the relationships between the physical/chemical properties and the toxicity as well as the mechanisms of how the particles are related to health effects are not yet clearly understood (5). A key factor of this current state of uncertainty is the fact that, in epidemiological studies, the results can be severely skewed in cases where the estimation of exposure does not really reflect 'true' exposure.

The term "exposure" is defined as an event that occurs when a person, with an emphasis on the human being who is the most important receptor in the given situation, comes into contact with a pollutant of a certain concentration during a certain period of time (6). In fact, because the PM-10 levels vary spatially and temporally, the total personal exposure therefore should be determined by integrating the concentration over time when concentration and duration of exposure are taken into account (7). Personal exposure can be determined by either direct or indirect approaches. The direct approaches are measurement of biological dose or the personal exposure monitoring method, whereas the indirect approaches use ambient monitors or microenvironmental measurements or models to estimate personal exposure (6-7). Human exposure data collected from direct measurements are more precise than data obtained by the use of ambient concentrations to estimate exposure, but the personal monitoring method is much more expensive and requires more time and effort (7).

In practice, most of the air pollution-health effects studies have been relied on using the daily average of ambient air concentrations as indices of exposure for the population. At present, the validity and reliability of the use of ambient air concentrations as surrogate of exposure remain to be determined by actual comparison with personal exposure measurements obtained simultaneously (8). Currently, a number of studies on personal exposure to PM assessment have shown that there are relationships between personal PM concentrations and ambient PM concentrations although the correlation coefficients were varied widely (9-11). For instant, the Particle Total Exposure Assessment Methodology (PTEAM study) in which PM-10 personal exposure was assessed has shown that the correlation coefficient of personal exposure with ambient air concentrations was 0.48 (9). Another observation has concluded that the ambient air PM-10 concentration could be used as an indicator of indoor PM-10 (10). However, the studies are still quite limited in spatial, temporal and demographic coverage.

People normally move from place to place throughout a day, therefore, they would be exposed to different types of particulates generated from several types of sources during their daily time spent in many different microenvironments. All these indoor and outdoor sources must be taken into account for total personal exposures and they may result in different adverse health effects. In case of using ambient PM-10 as total exposure, it could result in misclassification of individual exposure and health impact assessment. Thus, contributions of indoor and outdoor sources to personal exposure to PM-10 materials should be quantified in order to obtain a better understanding of the relationship between PM-10 exposure and health outcomes. As a result of such increased understanding of the relationships, air pollution control policies could be developed that more efficiently minimized health risk by linking measured air levels with acceptable risk conditions.

Most urban areas can be characterized by the presence of particulate air pollution. The major contributing source of particles in ambient urban air is road traffic (12). Typically, along most of the roads in Bangkok are numbers of commercial curbside buildings called "shop houses" where people usually work on the ground level and live

in the upper levels of the building. This group of people is face with PM-10 air pollution even though they spend most of their time indoors because of the exposure of the shop front to outdoor air conditions. At present, the available information about the exposure of people to air particulates under these conditions is still quite limit for a city like Bangkok. The differences in climate, demographic, culture, and living style from the areas in several developed countries where most of the recent studies have been carried out do not allow for obvious relationships with Bangkok shop house situation. Moreover, there are very few studies that have reported simultaneous measurement of personal exposure, compared with both indoor and outdoor PM-10 concentrations. While the existing ambient air concentrations taken at the street level in Bangkok have significant values, a question still remains as to whether they could accurately represent the personal exposure of people in this life-style situation. This thesis research is carried out in the Bangkok metropolitan area to evaluate exposure to PM-10 of the urban shop houses population and also to assess source categories related to PM-10 exposure.

1.2 Research hypothesis

Ambient PM-10 particulate concentrations measured from a fixed site station can be used as a surrogate for personal exposure for people who spend most of their time indoors. The contributions of PM-10 particulates originating outdoors and indoors to personal exposure can be determined by using factor analysis and multiple regressions.

1.3 Research objectives

1.3.1 To evaluate personal exposure to PM-10 materials in the context of the distributions of measured personal exposure, indoor and outdoor PM-10 concentrations

1.3.2 To determine the relationship of personal exposure to PM-10 with outdoor PM-10 concentrations and to evaluate factors affecting the relationship

1.3.3 To identify the possible sources of personal exposure PM-10 materials based on the trace element compositions

1.4 Scope of the Study

The research focused on assessment of personal exposure to PM-10 for the shop house dwellers who spent most of their time indoors. The study is divided into two parts as follows.

1.4.1 Part 1: PM-10 exposure measurements

PM-10 field measurements were conducted in the chosen study area in Bangkok. The shop houses residents, who both work and living in the same structure, are the interested group. The participants were chosen based on their willingness to volunteer and on the location of their homes. Repeated measurements of outdoor, indoor and personal exposure levels were performed in all three Bangkok seasons to quantify personal exposure to PM mass, to determine the relationships between personal exposure and either indoor or outdoor PM-10 concentrations and to evaluate factors affecting the relationship

1.4.2 Part 2: PM-10 compositional analysis

After mass determination by the gravimetric method, elemental constituents of PM-10 were characterized by Inductively Coupled Plasma Mass Spectrometry (ICP/MS). Then, elemental compositional data are used for source identification. The statistical technique, Factor Analysis and Multiple Regression Analysis (FA/MR) was applied to identify source categories and also to estimate their contributions to personal PM-10 exposure concentrations.

1.5 Overview

Chapter 2 summarizes the available information regarding the properties of air-borne particulate matter properties and its health effects. The relevant literature on human exposure data including the relationship between personal exposure and ambient PM concentrations is provided. The method to derive the source category and to estimate the contribution of each source to personal PM-10 exposure levels is also reviewed.

หอสมุดกลาง สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

Chapter 3 describes the overall methodology applied to the PM exposure study. Personal exposure monitors, filter collection and gravimetric analysis, were used to quantify the personal, indoor and outdoor PM concentrations. The analytical procedure to determine the elemental compositional of PM-10 materials and statistical techniques employed to analyze data are presented and discussed.

Chapter 4 provides the findings of this study. The distributions of personal, indoor and outdoor PM-10 concentrations are described. The relationship between personal exposure and outdoor PM-10 concentrations and the factors affecting the relationship are presented. Sources of PM-10 exposure are identified and their relative contributions are estimated.

Chapter 5 presents a general discussion of the findings. The implications of using outdoor PM-10 concentrations as personal exposure indices are discussed. The determinants for personal PM-10 concentrations and sources of PM-10 are also explained.

Chapter 6 the important findings have been concluded. In addition, further research needs are discussed.