CHAPTER I

INTRODUCTION

1.1 General background

There is a strong indication that the adverse effects of airborne ambient particulate matter (PM) have become a well-recognized problem in urban areas. Besides the reduction of visibility and the deposition of trace elements, the direct impact on human health via inhalation is an important issue. The significant relation between health effects and concentrations of PM has been confirmed by several articles (Dockery *et al.*, 1993; Pope *et al.*, 2002).

Particulate matter (PM) have been of considerable environmental interest due to their impacts on visibility, human health, plants, aquatic life and materials (Brewer and Belzer, 2001; Ho *et al.*, 2003; Azimi *et al.*, 2003). They may be emitted directly or be formed in the atmosphere. Main sources of natural atmospheric particles are volcanic activities and dust storms. Industrial activities, energy production, construction, urban waste treatment and vehicle exhausts constitute anthropogenic sources (Bilos *et al.*, 2001). Because of their wide range of sources and their effects on human and ecosystems, elemental constituents of atmospheric particles have been widely studied in different parts of the world (Miranda *et al.*, 2002; Odabasi *et al.*, 2002). Trace elements are one of the important constituents of atmospheric PM. The chemical composition and levels of trace elements may vary according to the sources of the particles. For example, re-suspension has a major influence on the presence of many metals in air close to highways (Harrison *et al.*, 2003). Industries would be another important trace element source for inhabitants and concentrations are often well above natural background levels (Quiterio *et al.*, 2004). Moreover, traffic should be considered as an important source for the city atmosphere (Weckwerth, 2001; Sternbeck *et al.*, 2002).

The PM generated by road traffic can be categorized according to its mode of formation. Research has mostly focused on vehicle exhaust particulate emissions, because it was generally assumed that fuel combustion is the primary mechanism by which particles are formed. However, there are a number of other processes, involving mechanical abrasion and corrosion, which also can result in PM being directly released to the atmosphere. The most important processes include road surface wear, tire and brake wear. Other possible processes are clutch wear and corrosion of vehicle components. The direct emissions can also lead to the deposition of particles on the road surface. The material that collects on the road surface (road dust) can contain directly emitted particles, road salt and grit deposited during winter maintenance, and crustal and vegetative material from other sources that are not related to road transport. The emission of material due to road and tire wear may be impeded under moist conditions and suspended later when the roadway dries up. (Hewitt and Rashed, 1990; Hildemann *et al.*, 1991; Legret and Pagotto, 1999)

Emissions of metals arise from different parts of motor vehicles including exhausts, wheels and brakes (Weckwerth, 2001). Cu, Zn, Cd, Sb, Ba, Pb, Cr, Ni, Sn and Mo are considered to be emitted from road traffic (Sternbeck *et al.*, 2002; Harrison *et al.*, 2003). Meteorological conditions and local sources have an important role on trace element concentrations. Therefore, temporal fluctuations have been examined in many studies (Hrsak *et al.*, 2001; Morawska *et al.*, 2002). For example, Kim *et al.* (2002) reported that some metals tended to exhibit seasonal peaks and good correlation concentrations are seen with PM in winter months. In another study, Morawska *et al.* (2002) observed particle number on weekdays and weekends and they reported a statistically significant difference between weekdays and weekends. It is likely there are observable differences between day and night samples depending on sources including traffic and industry (Colombo *et al.*, 1999).

Recent epidemiological studies indicated that particulate matter (PM) is believed to associate with serious public health risks including increased risk of morbidity and mortality due to respiratory illness, cardio-vascular disease and cancer (Schwartz *et al.*, 1996). Based on epidemiological time series studies, dose-response functions were identified between an increase in PM and adverse health effects (El-Fadel and Massoud, 2000). In addition to negative health effects, particulate matter reduces visibility and accelerates the deterioration of buildings. Even major attention has been focused on PM in ambient air though few studies reported on the particle pollution in metropolitan areas, especially the spatial and temporal variations of pollution in air mass surrounding people's daily activities. The sources and loading of PM, and its degree of association with larger particles are presently poorly known.

The levels of air pollution concentrations are strongly related to combination of various meteorological factors. For that reason, air pollution concentrations and meteorological data should be evaluated statistically in order to correlate them, which can be used for designing pollution control strategies.

This study aims to characterize the levels of Al, Cd, Cr, Cu, Fe, K, Mn, Na, Ni, Pb and Zn which are toxicants in total suspended particulate (TSP) in Bangkok air. It is also to evaluate the spatial and temporal variations of toxic trace metals, and correlations of their concentrations with meteorological parameters, and to assess the contribution of anthropogenic sources. The final finding from the study can help to identify the possible sources of trace metals that contribute to TSP which will benefit to the air pollution control strategy.

1.2 Objectives

The objectives of this study are:

1.2.1 To characterize the levels of Al, Cd, Cr, Cu, Fe, K, Mn, Na, Ni, Pb and Zn in TSP in Bangkok air.

1.2.2 To evaluate the spatial and temporal variations of toxic trace metals, and correlations of their concentrations with meteorological parameters.

1.2.3 To assess the contribution of anthropogenic sources of toxic trace metals.

1.2.4 To identify the possible sources of trace metals that contribute to TSP.

1.3 Scope of this study

1.3.1 This study was conducted in four different air-sampling sites in Bangkok area namely, 1.Chulalongkorn Hospital (CH) represented the central business and commercial area, 2.Huay- Khwang Community Housing (HCH) represented the residential area 3.Ministry of Science and Technology (MST) represented the government offices' area with heavily traffic and 4. Ratburana Post Office (RPO) represented the industrial area.

1.3.2. The study was performed for all year long which includes three different seasons (Winter, Summer, and Rain) since March 2006 to March 2007.

1.3.3. The particulate samples of TSP were obtained from the Pollution Control Department (PCD) with the PCD standard sampling procedure.

1.3.4. The particulate samples of TSP was analyzed for chemical speciation, and the toxic trace metals analyzed in this study are Al, Cd, Cr, Cu, Fe, K, Mn, Na, Ni, Pb and Zn.

1.3.5. Enrichment Factor (EF) and Principal Component Analysis (PCA) are used to identify the possible source(s) of metallic elements.

1.4 Benefits of this study

1.4.1 The results of this study will help to understand the variations of atmospheric toxic metals in particulate matter and their influenced factors.

1.4.2 In addition, this study also reveals the relationship between toxic metals and meteorological parameters including the source(s) of pollutants.

1.4.3 This will be applied to provide the appropriate measurement for abating the airborne metal pollution in Bangkok.

1.4.4 This study will also help to evolve parameters needed for the future pollution abatement programs and will, in general, motivate similar studies on trend analysis and source identification for this region and other parts of the world.