

CHAPTER 1

Introduction

1.1 Statement and significance of the problem

Increases in the consumption of energy, traffic and the demand for waste material treatment associated with rapid population growth have also increased and insufficient pollution control devices and facilities have compounded serious environmental impacts in the many areas of Thailand such as Chiang Mai-Lamphun basin and Mae Moh basin, Lampang province. Air pollution is an expected factor that has been recognized by the local population.

The Mae Moh basin is situated in the Mae Moh District of Lampang Province. It is distributed in the area of about 135 square kilometres and 7 kilometers in east-west and 16 kilometers in north-south [1]. It is surrounded by high mountain ranges. Due to its geographical features, Mae Moh basin, as well as some areas in the northern part of Thailand has been annually facing source and sink of air pollution problem [2]. The causes are from agricultural burning, forest fires, energy consumption, such as power generation for electricity, burning fuels for cooking, traffic and waste incineration. In addition, the eastern part of the basin contains large coal mine and power plant operated by the Electricity Generating Authority of Thailand (EGAT) and represents a heavy pollution source. Although the power stations use high performance equipment to eliminate their exhausts, sometime, the local peoples report suffering from the observed concentration levels of gaseous and particle pollution [3]. Monitoring data obtained from the Pollution Control Department (PCD) show that in this area has experienced problematic high levels of air pollution such as the peak sulfur dioxide (SO₂) concentration on October 1992 at 3,418 µg/m³ that higher than Thailand's acceptable

safety concentration of $1300 \mu\text{g}/\text{m}^3$ [44]. The initial observed of high levels of hourly Ozone (O_3) concentrations were mostly exceeded the standard at 100 ppb/hr in March and April 2014 [4]. The 4.3 million tons of fly ash has been produced in this area every year. Moreover, fly ash is found to contain concentration of inorganic mercury, such as methyl mercury is extremely dangerous to living things and the environment. One of the major serious pollutants affecting air quality is particulate matter (PM) and especially particulate matter having less than 10 micrometers in diameter (PM_{10}) which have been paid attention because of their reached concentration and typically higher than Thailand's acceptable concentration standard of $120 \mu\text{g}/\text{m}^3$ on March of every year. Most of particulate problem was found in dry season. Many studies reported that the high level of PM_{10} is strongly related to number of hospital and clinic patients. From the studies of Pimonsree and Arrin in 2011, the number of day that PM_{10} exceeded the daily standard in Lampang is in range of 14-30% during 1999-2008. They found that the average number of hospital admissions for respiratory disease in exceeded days is higher than that in non-exceeded days 39% and the most health effects appeared on group of newborn to five year. As the results shows the people who living in Lampang have been faced with acute and chronic health effects of particulate matter for long period [5].

Not only particulate but also the chemical compositions are related to adverse health effects of particle exposure [6]. Among them, polycyclic aromatic hydrocarbons (PAHs) have been classified as potential human carcinogens and have received widespread interest in air pollution studies. These compounds contain two or more condensed aromatic rings. PAHs are formed mainly incomplete combustion of organic materials during human activities, such as combustion of coal, including for cooking and power generation, vehicle traffic, agricultural burning. PAHs are ubiquitous persistent organic pollutants which are well known to be toxic, carcinogenic and mutagenic. The sixteen species PAHs are listed as priority pollutants by the United States Environmental Protection Agency (US EPA). They can be found not only in the air associated with the gas or the particle phase, but also in other environmental matrices like soil, sediment or vegetation [7]. Recently, PAH emissions have decreased in some developed countries [8]. However, they have become more prevalent in many developing countries, including Thailand [12]. Long term exposure to high

concentration of PAHs is associated with adverse health problems. Since some PAHs are considered carcinogens, inhalation of PAHs in PM₁₀ is a potentially serious health risk linked to an excess risk of lung cancer. In recent years, Lampang Cancer Center (LCC) has been reported lung cancer was the most common cancer in men and second after cancer of cervix in women [9]. The lung cancer incidence and mortality rate in Lampang have been increased from 30 to 39 cases per 100,000 populations during 2004 to 2014, which is much higher than those other province in Thailand [10]. Above all, the result shows the people living in Lampang not only have been facing with particulates problem for long period also have high potential risk of lung cancer.

Several studies have been carried out and published on the air pollution in Lampang, northern of Thailand [5, 11, 14]. However, there have been few studies focusing on PAHs in PM₁₀, which typical hazardous and carcinogenic pollutants. Therefore, this study reports the concentration levels, characterization and patterns of ten species PAHs including Fluoranthene (Flu), Pyrene (Pyr), Benz[*a*]anthracene (BaA), Chrysene (Chr), Benzo[*b*]fluoranthene (BbF), Benzo[*a*]pyrene (BaP), Benzo[*k*]fluoranthene (BkF), Dibenz[*a,h*]anthracene (DBA), Benzo[*g,h,i*]perylene (BghiPe) and Indeno[1,2,3-*cd*]pyrene (IDP) surrounding Mae Moh basin, Lampang province. The findings of this study are expected to define a potential environmental impact and implication of population health effects in this area.

1.2 Purpose of the study

The aims of this research work can be summarization as follow

1.2.1 To determine PM₁₀ and PM₁₀-bound PAHs concentrations

1.2.2 To study the characterizations and patterns of PM₁₀-bound PAHs