

Aluminum, Lead, and Manganese in PM10 in the Air Environment of Chiang Mai Areas

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Abstract— This research aims to study the concentration of hazardous heavy metals such as Aluminum, lead, and manganese in Particulate matter size smaller than 10 micron (PM10) samples were collected from two sites in Chiang Mai areas. The PM10 samples were collected by a PM10 high volume air sampler dust. The sampling period was set every 12 days for each sample according to the sampling from December 2012 to April 2013. The composite elements, i.e., Aluminum (Al), lead (Pb), and manganese (Mn) were analyzed by Flame Atomic Absorption Spectrophotometry (FAAS). It was found that the dust value of 19.03-110.37 microgram per square meter per day, recorded on February 2013 at Thapae site and on March 2013 at Laguna house site. The daily dust fall concentrations were not exceeded the standard value of 120 microgram per cubic meter. The heavy metal concentration were not exceeded the air quality standard value.

Keywords—PM10, Heavy Metal, and Chiang Mai Province

I. INTRODUCTION

At present, the traffic in Chiang Mai city is quite dense. There are private cars, buses, and motorcycles. Therefore, it increases environmental impacts and, importantly, causes the problem of the particulate matter that is dust in the air. This problem affects the respiratory system and human health. Moreover, this dust can be an important accumulated source of heavy metals in the environment. Some heavy metals have adverse effects whereas other heavy metals are essential to human health but can be toxic if taken in excess quantity [1,2,3]

As a guideline for the study of environment in the habitation and a guideline for the risk assessment of people's health in the area of Chiang Mai city, this research emphasized on the study of the quantity of toxic heavy metals which were Aluminum, lead and manganese in PM10 and the study of the quantity of PM10 in area of Chiang Mai areas.

II. RESEARCH METHOD

Studied locations: collected the samples on two locations, e.g., Thapae site which set in the roadside area, and Laguna house site that is set in the residential area in Chiang Mai city

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areas. The PM10 samples were collected by by a PM10 high volume air sampler dust. The sampling period was set every 12 days for each sample according to the sampling from December 2012 to April 2013.

Studies parameters and sample analysis

(1) The concentration of the dust of which PM10 was analyzed by weight measurement (Gravimetric Method).

(2) The composite elements, i.e., aluminum (Al), lead (Pb), and manganese (Mn) were analyzed by Flame Atomic Absorption Spectrophotometry (FAAS).

III. RESULTS AND DISCUSSIONS

1. Concentration of PM10 in Chiang Mai Air Environment

The statistical summary of the PM10 data from two sites in Chiang Mai across the period December 2012 to April 2013 is show that the data maximum value of 110.37 microgram per cubic meter, on March 2013 at Laguna house site. The data minimum value of 19.03 microgram per cubic meter, recorded on on February 2013 at Thapae site. The daily dust fall concentrations were not exceeded the standard value of 120 microgram per cubic meter. The heavy metal concentration were not exceeded the air quality standard value. The PM10 level two site shows in figure 1. Major concerns for human health from exposure to PM-10 include: effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. The elderly, children, and people with chronic lung disease, influenza, or asthma, are especially sensitive to the effects of particulate matter. Acidic PM-10 can also damage human-made materials and is a major cause of reduced visibility in many parts of the U.S. New scientific studies suggest that fine particles (smaller than 2.5 micrometers in diameter) may cause serious adverse health effects. [4]

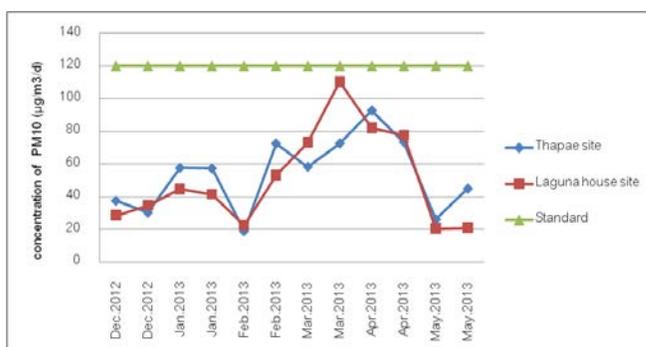


Fig. 1 Concentration of PM10 in Chiang Mai area

2. Concentration of Aluminum in Chiang Mai Air Environment

The statistical summary of the aluminum in PM10 data from two sites in Chiang Mai across the period December 2012 to April 2013 is show that the aluminum data maximum value of 5.43 microgram per cubic meter, recorded on December 2012 at Laguna house site. The aluminum data concentration was show in figure 2. Aluminium is not as toxic as heavy metals, but there is evidence of some toxicity if it is consumed in excessive amounts. [5] Aluminium toxicity can be traced to deposition in human bone and the central nervous system. [6]

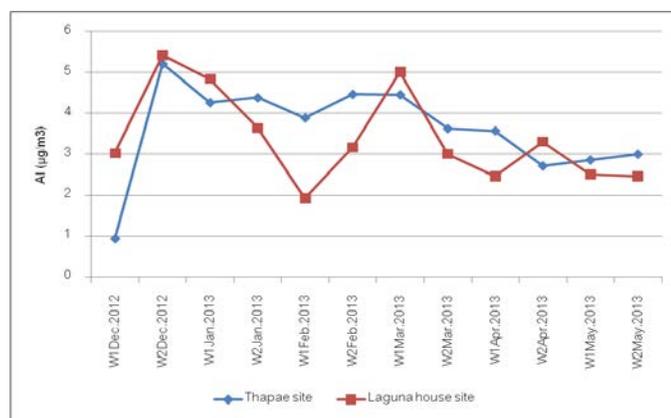


Fig. 2 Concentration of Aluminum in Chiang Mai area

3. Concentration of lead in Chiang Mai Air Environment

The concentrations of lead were not found in PM10 samples of two sites in Chiang Mai areas. The information of lead USEPA website was smelters and battery plants are the major sources of lead in the air. Exposure to lead mainly occurs through inhalation of air and ingestion of lead in food, paint, water, soil, or dust. Lead accumulates in the body in blood, bone, and soft tissue. Because it is not readily excreted, lead can also affect the kidneys, liver, nervous system, and other organs. Excessive exposure to lead may cause anemia, kidney disease, reproductive disorders, and neurological impairments such as seizures, mental retardation, and/or behavioral disorders. EPA's health-based national air quality standard for lead is 1.5 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) measured as an annual maximum quarterly average concentration. [7]

4. Concentration of Manganese in Chiang Mai Air Environment

The statistical summary of the manganese in PM10 data from two sites in Chiang Mai across the period December 2012 to April 2013 is show that the manganese data maximum value of 0.03 microgram per cubic meter, recorded on April 2013 at Tapae site. The minimum value of 0.01 microgram per cubic meter, recorded on February 2013 at Tapae site. The manganese data concentration was show in figure 3. Manganese makes up about 1000 ppm (0.1%) of the

Earth's crust, making it the 12th most abundant element there. Soil contains 7–9000 ppm of manganese with an average of 440 ppm. Seawater has only 10 ppm manganese and the atmosphere contains $0.01 \mu\text{g}/\text{m}^3$. [8] Methylcyclopentadienyl manganese tricarbonyl (MMT) is a gasoline additive used to replace lead compounds for unleaded gasolines, to improve the octane number in low octane number petrol distillate in developed countries (EU, Japan, etc.). In USA the imperative to provide the lowest possible price per volume on motor fuels (low fuel taxation rate) and lax legislation of fuel content (before 2000) caused refineries to use MMT. Compared to 1953, levels of manganese in air have dropped. [9]



Fig. 3 Concentration of Manganese Chiang Mai area

IV. CONCLUSION

PM10 samples were collected from two sites in Chiang Mai areas from December 2012 to April 2013. It was found that the dust value of 19.03-110.37 microgram per square meter per day, recorded on February 2013 at Thapae site and on March 2013 at Laguna house site. The daily dust fall concentrations were not exceeded the standard value of 120 microgram per cubic meter. The heavy metal such as Aluminum (Al), lead (Pb), and manganese (Mn) concentrations were not exceeded the air quality standard value.

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