Dust fall in the residential air environment of northern part of Thailand: Chiang Mai, Lampang and Phitsanulok province

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Abstract

This research aims to study the concentration of dust fall samples collected from three provinces, Chiang Mai, Lampang and Pitsanulok in northern part of Thailand. The dust fall samples were collected by a dust fall jar container adapted from the environmental sampling manual of Pollution Control Department. The sampling period was set to be 30 days for each sample according to the sampling from October 2014 to February 2015. Studies parameters and sample analysis, the concentration of the dust fall 30 days was analysed by weight measurement or Gravimetric Method. It was found that the dust value of 20 - 62 microgram per square meter per day, recorded at residential are in Chiang Mai area. The dust value of 18 - 75 microgram per square meter per day, recorded at residential are in Lampang area. The dust value of 24 - 64 microgram per square meter per day, recorded at residential are in Phitsanulok area. The mostly of dust fall sample (90%) were not exceeded the residential standard value of 65-130 microgram per square meter per day.

Introduction

Chiang Mai is the largest town in northern Thailand, 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 (Chiang Mai, 2015). This problem affects the respiratory system and human health. Lampang Province is the third largest town in northern Thailand. The city is still growing rapidly as trading and transportation centre. It offers much of the historic interest of Lanna as well as Chiang Mai, but without the overt commercialization. Located in the heart of the North, Lampang is also a good base for excursions and travel within northern Thailand (Lampang, 2015). Phitsanulok province, is located in the lower northern part, is one of the important economic areas in which there is a rapid growth of industry, transportation, traffic, and construction activities. The expansion causes air pollution problem because the dust quantity increases as the city expansion increases. The dust has an adverse effect to health and visibility. It adsorbs metal, organic substances and inorganic substances on its surface. The adsorbed matters could transform to an acid when combined with water stream in the air, either rain and stream. It can damage buildings, because troubles and annoyance among people. (Pajaree, 2015) Many reports indicated that the quantity of dust has effect on human and it has been found to be associated with the daily mortality rate (Kim *et al.*, 2015; Pajaree *et al.*, 2003; Niran & Pajaree, 2010;

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Pajaree & Maesinee, 2015). This objective of this research is to study on the concentration of dust fall in residential area in northern part of Thailand.

Background Theory

Particulate Matter (PM) is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids such as nitrates and sulfates, organic chemicals, metals, and soil or dust particles. The size of particles is directly linked to their potential for causing health problems. United States Environmental Protection Agency (USEPA) is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. USEPA group particle pollution into two categories: "Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter. "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air (Particulate Matter (PM), 2015).

Dust fall is the term used to describe air particles that settle down over a given area and time under the influence of gravity. Measuring dust fall can determine if a particle source is causing unacceptable dust nuisance in surrounding areas. Dust fall is measured with a dust fall deposit gauge, typically mounted on an elevated stand to avoid surface dust interference. This simple piece of monitoring equipment comprises a glass funnel supported in the neck of a large glass bottle. The diagram below shows how the gauge is typically set up on the elevated stand. Diagram showing a typical dust fall bottle set up. It is usually necessary to sample dust fall over 1 month to ensure a measurable quantity of dust is captured in the gauge and can be sent to a laboratory for analysis. The dust fall rate is calculated by dividing the weight of insoluble material collected (in milligrams) by the cross-sectional area of the funnel (square meters) and the number of days over which the sample was taken. The units of measurement are milligrams per square meter per day. Dust fall is not affected by the color of the dust but darker dust is usually perceived by the public as having more impact than light-colored dust. Levels in industrial areas are usually higher than in residential areas. Chemical analysis of the collected dust can help identify pollutants and locate likely emission sources.

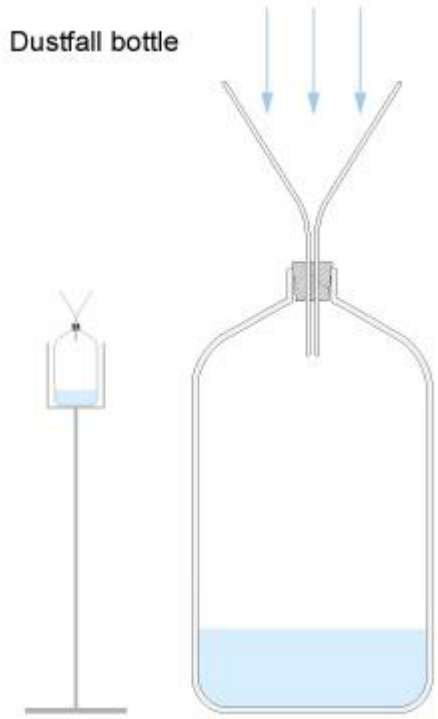

Figure 1: Typical dust fall bottle set-up

Source: https://www.qld.gov.au/environment/pollution/monitoring/air-pollution/dustfall/

Methodology

Studied locations: the total dust fall samples were collected from residential area of two spots in Chiang Mai area, two spot in Lampang area and two spot in Phitsanulok area. Two sampling sites of Chiang Mai area were at Doi Saket district area and Mae Rim district. Two sampling sites of Phitsanulok area were one in Phitsanulok city area and one community near Naresuan University, 15 km far from Phitsanulok city. Two sampling sites of Lampang were one of community near Mae Moh district, and one in Lampang city.

Sampling Method: The dust fall sampling equipment includes of the water sampling cylindrical bottle with a diameter of about 13 cm, height 20 cm. The plastic cone shape with diameter of 8 inch is used for dust fall and rain collection. The plastic screening was covered to protect the sample. The stand of water samples container was 1.5 m long pipe. The basket for bottle samples was used. The dust fall equipment was shown in Figure 2. The sampling period was 30 days from October year 2014 to February year 2015. One spot gave five dust fall samples. Studies parameters and sample analysis; the concentration of the dust of which dust fall was analyzed by weight measurement or gravimetric method.

Figure 2: The dust fall sampling equipment

Result and Discussion

The statistical summary of the dust fall data from six sites in Chiang Mai, Lampang and Phitsanulok across the period October 2014 to February 2015 is shows that the data maximum value of 75 microgram per square meter per day, recorded on February 2015 at Mae Moh district site. Because this site set in community near Mae Moh power plant. The concentrations of dust fall at Mae Moh power plant were 21 to 75 microgram per square meter per day. At Mae Moh site, two samples in five samples were higher than the residential standard value of 65-130 microgram per square meter per day. The data minimum value of 18 microgram per square meter per day, recorded on October 2014 at Lampang city site. The mostly dust fall concentrations were not exceeded the residential standard value of 65-130 microgram per square meter per day excepting the level at Mae Moh site. The trend of dust level was low in October that is the beginning of winter season. The level was high in November to February, winter season period. The dust fall concentration was show in figure 3.

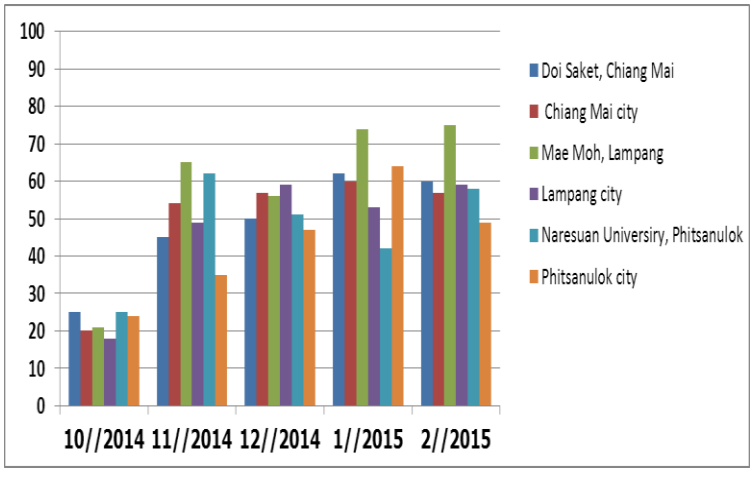

Figure 3: The dust fall concentration of Chiang Mai, Lampang and Phitsanulok areas

Figure 4 showed the dust fall data from three city sites in Chiang Mai, Lapang and Phitsanulok across the period October 2014 to February 2015. The maximum value of 64 microgram per square meter per day, recorded on January 2015 at Phitsanulok city site. The data minimum value of 18 microgram per square meter per day, recorded on October 2014 at Lampang city site. The dust fall concentrations in city do not exceed the residential standard value of 65-130 microgram per square meter per day. The dust fall concentration in city was shown in figure 4. The numbers of vehicle registered in three city of 31 January 2015 are 1,279,471 cars, 436,338 cars and 467,543 cars, respectively (Number of vehicle registered in Thailand, 2015). The volume of car is different but dust fall in three cities are not different. Because there are many sources of dust fall such as traffic, open burning, industry, construction, road dust. The sizing of dust fall or the deposited dust was 20-40 micron (Khommongkorn, 1994). The main sources of deposited dust are industry, construction, road dust.

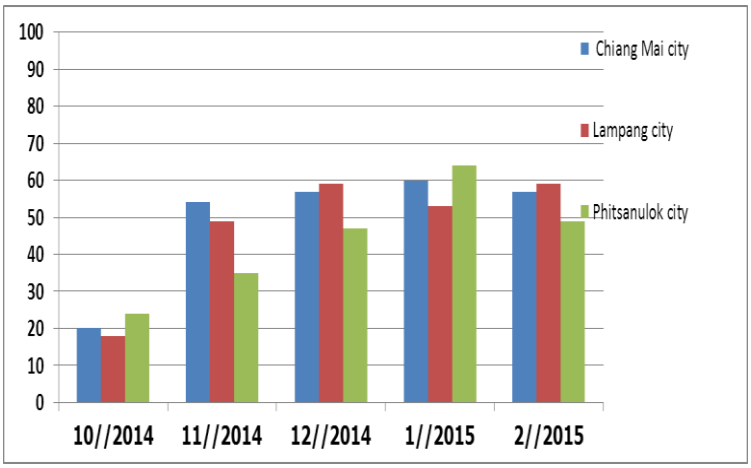

Figure 4: The dust fall concentration of three cities

Conclusion

The dust fall data from six sites in Chiang Mai, Lampang and Phitsanulok across the period October 2014 to February 2015 is shown. The maximum value of 75 microgram per square meter per day, recorded on February 2015 at Mae Moh district site. The minimum value of 18 microgram per square meter per day, recorded on October 2014 at Lampang city site. The mostly dust fall concentrations (90%) were not exceeded the residential standard value of 65-130 microgram per square meter per day excepting the level at Mae Moh site or industrial area.

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