



UNIVERSITY OF THE PHILIPPINES
Master of Science in Environmental Science

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*Source Identification and Elemental Quantification of Airborne Particulate Matter
(APM) in Central Business District, Baguio City Philippines*

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ABSTRACT

SOURCE IDENTIFICATION AND ELEMENTAL QUANTIFICATION OF (APM) AIRBORNE PARTICULATE MATTER IN CENTRAL BUSINESS DISTRICT, BAGUIO CITY PHILIPPINES

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The City of Baguio is popularly known as the ‘Summer Capital’ of the country because of its pleasant pine-scented air and cool climate. The city is frequented by many local and foreign tourists, especially during the Lenten season and the Panagbenga Flower Festival. However, the once ‘cleanest and greenest city’ has undergone drastic changes due to rapid population growth and unrestrained urban expansion. Adequately characterizing the air quality of the city, and correctly identify potential air pollution sources, will aid in formulating strategies towards air pollution abatement for the protection of public health, while improving the local economy.

In order to recommend solutions for better air quality management in Baguio City, this study is specifically intended (1) to investigate mass concentrations and size distributions of inhalable fractions of particles in Central Business District (CBD); (2) to identify the directionality of the sources of airborne particulate matter pollution using Conditional Probability Function receptor model (CPF) for surface winds, and associate the directionality with chemical markers using surface dust analysis; and (3) to conduct a survey of emissions-related activities.

The results of the Clean Air Scorecard Tool administered for the year 2013 classified Baguio as an “Emerging City,” having majority of key components of clean air management in place. However, policies and actions to reduce emissions from identified major sources need to be enhanced and sector-based institutions need to upgrade technical and management capacity. The results of this study confirm the hypothesis that the general population of Central Business District (CBD)-Baguio is already exposed to high health risk levels of particulate matter concentration most especially in the Baguio City Police Office (BCPO), UP-Baguio and Veteran’s Park. Airborne PM₁₀ (APM) mass concentrations in the 10 monitoring sites around CBD in Baguio City has an average value of 92.8±32 ug/Nm³ (n=232) with 20% data capture. Five (5) out of ten (10) sampling sites showed exceedance in the 24-hour NAAQ guideline values of 150 ug/Nm³ while all sites showed exceedance in the 24-hour WHO guideline value of 50 ug/Nm³, identifying BCPO having the most exceedance in both guideline values. The results of independent samples t-test analysis showed that the mean PM₁₀ concentrations was significantly higher during the wet season. However, both seasons showed exceedance to the WHO 24-hour AQG average PM₁₀ concentration value of 50 ug/Nm³. ICP-MS identified Zn and Na in APM, with the highest mean concentration at 28.88 ug/Nm³ and 15.61 ug/Nm³, respectively. Cd with a mean concentration of 0.06 ug/Nm³ and Pb with a concentration that reached as high as 1.17 ug/Nm³ exceeded the allowable limits set by WHO. The analysis of particle size and volume distribution of APM showed that a rise in the volume of vehicles accompanied by low wind speed, decrease in temperature and high relative humidity equates to higher emissions of fine and ultrafine mode particles. Particle emissions from traffic during the rush-hours show similar peaks in the morning and evening rush hours. High anthropogenic activities (continuous movement of people,

increase in vehicular use, and festival activities such as fireworks) would equate to increase in APM. Calculation of enrichment factors (EF) identified the elements Zn, Cd, Pb and As to be enriched in both PM₁₀ and surface dust samples. PM₁₀ and surface dust samples, and the compositional signature of local surface dust was found to be strongly correlated to that of coarse particles thus suggesting significant contribution of resuspended road dust to this particle fraction. Principal Component Analysis (PCA), correlation matrixes and enrichment factor (EF) were used to determine sources affecting of APM pollution in Baguio-CBD. The results identified three common sources 1) soil sources 2) soil-road dust resuspension and 3) vehicular emissions. CPF analysis plots showed several elements coming from the same possible location which points to SW and NE wind sector. However, the NE wind sectors were dominant for most of the identified sources in Baguio City. The results of the study should therefore be used as basis in forming policies and actions to reduce emissions from identified major sources, which is one of the categories where the city needs improvement.

Keywords: airborne particulate matter, surface dust, traffic emissions, conditional probability function, enrichment factor, principal component analysis