使用 Aethalometer 光吸收模型辨識台灣北部的黑碳排放源

Identifying Black Carbon Emission Sources Using an Aethalometer Light Absorption Model in Northern Taiwan

薩普特 (Ramadhan Saputra), 程裕祥*

明志科技大學環境與安全衛生工程系 ramadhansaputr9@gmail.com
yhcheng@mail.mcut.edu.tw

Abstract

Black carbon (BC), a by-product of incomplete combustion of fossil fuels, biofuels, and biomass, poses significant risks to human health and exacerbates climate change due to its fine particle size and light-absorbing properties. Addressing this issue is paramount globally. This research focused on monitoring the mass concentrations of $PM_{2.5}$ and BC in New Taipei City, Taiwan. The study utilized an aethalometer (AE33; Magee Scientific) to provide real-time monitoring of BC, employing a light absorption observation method across seven different wavelengths. A source apportionment model was deployed to estimate the contributions of various sources of BC in the ambient environment, such as fossil fuel combustion (BC_{ff}) or biomass combustion (BC_{bb}), with respective Absorption Ångström Exponents (AAE) of 1.1 and 2.2. Over one year of monitoring, the mean mass concentrations of $PM_{2.5}$ and BC were determined to be 13±8 μg/m^3 (ranging from 1 to 67 μg/m^3) and 1016±816 ng/m^3 (ranging from 14 to 11284 ng/m^3), respectively. The average AAE was calculated to be 1.21±0.05 (ranging from 1.10 to 1.71), with BC_{ff} accounting for a significantly higher proportion (87%) compared to BC_{bb} (13%) of the total BC mass. Seasonal variations revealed elevated $PM_{2.5}$ and BC concentrations in spring, peaking at 17±10 μg/m^3 and 1357±1037 ng/m^3, respectively, whereas the lowest concentrations were observed in autumn, registering only 10±6 μg/m^3 and 822±631 ng/m^3, respectively. Furthermore, the one-year monitoring period indicated that the average $PM_{2.5}$ concentration exceeded the annual standard recommended by the World Health Organization (WHO) of 5 μg/m^3. These findings underscore the pressing need to mitigate BC emissions, particularly from fossil fuel sources, to alleviate pollution in northern Taiwan.

關鍵字： 黑碳、Ångström 吸收指數、化石燃料燃燒、生質燃燒、空氣品質

Keywords: Black Carbon、Absorption Ångström Exponent、Fossil Fuel Combustion、Biomass Burning、Air Quality