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# Comprehensive Air Quality Assessment Using Portable Devices: A Pilot Study for an In-Class Project

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According to the World Health Organization (WHO), 92% of the world's population lives in a polluted environment. WHO estimated 6.5 million deaths associated with both indoor and outdoor air pollution in 2012. [1] Air pollution had drawn increasing attention from the public due to its effect on human health. Studies have shown that breathing in air pollutants could trigger health problems or worsen respiratory and cardiac conditions. [2] There are two types of air pollutants, primary and secondary pollutants. Primary pollutants are produced from processes, such as nitrogen oxides (NOx) from high temperature combustion and particulate matter (PM) from the burning of fossil fuels. Secondary pollutants are not directly emitted, but they are formed in the air as a result from primary pollutants' interactions. An example of secondary pollutants is ground level ozone ($O_3$), it is created by the chemical reactions between nitrogen oxides and volatile organic compounds in the presence of sunlight. [3]

This project aimed to develop a course project for the undergraduate curriculum. It contained three sub-objectives, two being validation of methods and one being preparation of course materials. Portable devices were validated via collocation measurement at the New Haven Criscuolo Park, an Environmental Protection Agency (EPA) air monitoring site that monitors NOx, $O_3$ and PM. For each measurement, the local weather conditions were recorded by a handheld weather station. Hourly averaged data for each day are uploaded by the EPA site quarterly to an EPA database available to the public, with a delay of one quarter. Data of the same day and time interval were downloaded from the EPA database and compared statistically to determine the reliability of low-cost portable device for air quality monitoring.

The validation of using potassium iodide (KI) paper to determine the averaged ground level ozone concentration was fulfilled by extensive testing. Three groups of papers were exposed for four, six and eight hours respectively, they were collected and analyzed immediately after the exposed time. Relative humidity of the test site was recorded every hour during the test period. These results were compared to the Air Quality Index updated by the Connecticut Department of Energy and Environmental Protection throughout the day. This method was determined to be inconclusive due to the inconsistency of the results.

Course materials, including standard operation procedures (SOPs) for instrument handling and data collection, KI paper method, and navigation of the EPA database, were drafted for the incorporation of these air monitoring methods into the course. These resources could be used by the instructor of the Environmental Chemistry course as part of the course project, allowing students in the class to gain hands-on experience with air quality monitoring.

Future work for this project includes conducting more collocation measurements at the EPA air monitoring site, and statistical analysis of those data. The ozone sensors will also be calibrated in the laboratory to study the sensor durability. These results will contribute to the study on the viability of implementing this low-cost device in the community as a supplimentory method of air quality monitoring.

Reference


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