Abstract

Development and Use of Passive Monitors for Air Pollution Assessment

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Experiments and analyses leading to the development of passive monitoring methods for atmospheric SO_2 and particulate matter are described.

Adaptations of the chloranilate method for sulphate ion analysis were tested for usefulness in an SO_2 passive monitor. It was found that by using a 4 cm quartz cuvette and adjusting the pH of the final solution to about 1.8, the method was made more suitable for SO_2 determination in urban atmospheres. The method is easier to carry out routinely and significantly more cost-effective than the currently accepted ion chromatographic method.

Several geometric configurations of a possible passive monitor were tested, first in a glove-box and then in field exposures, at sites across the city of Kingston. A configuration based on a commercially available 3M monitor was found to give the most accurate and reproducible results.

The aim to measure particulate pollution indices like PM_{10} and $PM_{2.5}$ from the deposition of particles on sheltered glass slides was accomplished through a series of investigations of the relationships involved. Counting, sizing and shape determination of individual particles was done using a computer program called Image Tool to analyze light-microscopic images of the deposited particles. Projected area diameter based size distributions of particles determined by Image Tool analysis were converted to aerodynamic equivalent diameter distributions using the relationship between the two, determined in cascade impactor experiments. Glass slides were used as the collection substrate in the impactor in order that the two diameters could be determined for each particle collected. Some resolution of the ambiguities observed in the relationship was achieved by classifying particles as spheres, cylinders or ellipsoids based on their roundness and elongation as determined by the Image Tool analysis.

Particle deposition velocities were next determined in experiments in which sheltered glass slides were collocated with a cascade impactor. The deposition velocities obtained were used in conjunction with the aerodynamic diameter distributions of particles to derive $PM_{2.5}$ and PM_{10}.

Collocation experiments between sheltered glass slides and active monitors showed that the glass slide method underestimates $PM_{2.5}$ but overestimates PM_{10}

and indicated that significant overestimation occurs at sites that are noticeably windy.

Investigations of time-sequenced particle collection revealed that fine particles were being lost during long exposures. Preliminary investigations of the effect of better sheltering of the slides, using a Stevenson-Screen-like shelter, showed that improved correlation between active and passive monitor results can be achieved by employing such sheltering.

Keywords: Passive monitor, Sulphur dioxide, Chloranilate method, Particulate Matter, Glass slides, Light microscopy, Mark Andrew Richards, Kingston Jamaica.