E2-31: A simple low cost semiquantitative approach to evaluate total lead in airborne dust

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Several methods are available to measure Pb content in airborne dust. However, these methods are expensive and time consuming. X-ray fluorescence induced by a primary source on proper targets provide a large number of X-ray energies offering the possibility of determining an element of interest with a high sensitivity and minimal or negligible matrix effect. Pb content in airborne dust has been previously determined based on the measurement of the transmission of photons of two energies chosen to lie within a very narrow range (13.02-13.37 keV).

The objective of the present study was to determine the possibility and the performance achievable by using cheaper and more readily available Sr and Bi as target materials to measure total Pb in airborne dust. Sr K_α which has a value of 14.14 keV and was used as the higher energy photon and Bi L_β which has a value of 13.02 keV as the lower energy source. An ^{241}Am source was used to excite $SrCO_3$ and Bi pellet. The fluorescent X-rays obtained were transmitted through TFA No. 41 blank and aerosol filters and detected using a proportional counter. The system was calibrated using a series of filters on which Pb solutions were deposited ranging from 0.005 to 0.1M. Counting times were selected as 10,000 and 50,000 sec for Sr and Bi targets respectively. The peak areas and background regions were processed with the aid of Aptec program. Airborne particles were collected for a period of 2h using a portable Staplex Hi-Volume air sampler at five different sites (University of Colombo, University of Sri Jayewardenapura (SJP), Nugegoda, Wijerama Junction and Maharagama).

The superficial density of Pb-W_{Pb}, collected on the filters ranged from a minimum of 132.71 and 398.63 $\mu g\ cm^{-2}$ at University of SJP and University of Colombo respectively. The weighted least squares fitting of the experjmental data resulted in a value of $0.46979 + 5.108 \times 10^{-4}\ W_{Pb}$. A correlation factor of 0.8726 was achieved. This relates to a mathematical model :

$$-\ln T_l/T_h = a x W_{Pb}$$

$T_{l,h}$ are the ratios of the counting rates of the acrosol filters to the counting rate for a blank filter at the corresponding low and high energies.

The results of the present study gives an intercept value. This could be due to a higher attenuation coefficient of particles at the higher energy due to the Sr X-ray energy 14.14 keV which is fairly distant from 13.02 keV of Bi. The minimum detection limit of this method was 47 μg cm^{-2}. This could be improved by using better quality filters and by increasing the total counts by about 10 times.

Understanding these limitations this method could be considered to be a simple, relatively low cost, rapid approach to ascertain total Pb content in airborne dust and to be used as a quasi-continuous control of Pb emission.