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Study on the Trace Analysis of the Atmospheric Pollutants

Jae Young HWANG (黄 在 荣)

Because of the biological significance and erratic distribution of metals in our atmosphere, there is a need to strengthen the metal data that we have now. Traditionally, emission spectroscopy has been the analytical technique which has been used to obtain most of these data. A major obstacle to the use of the emission spectrograph is the complicated methodology necessary to obtain reliable data.

In addition, a large capital outlay is needed to obtain the original instrument and expensive technical personnel must be employed for its operation. Also, in order to obtain precise and accurate data, it is necessary to frequently standardize the instrument which can be an extremely lengthy and tedious procedure if a photographic type of instrument is used.

An attempt was therefore made to develop new method of analysis of the atmospheric particulates of chromium, nickel, manganese, and copper by the atomic absorption spectrophotometry.

The present experimental conditions developed eliminate the use of the additives to reduce or avoid the chemical interference while they can extend the working ranges by the factor of two or three times, retaining their linearities in each case.

The accuracy and precision of each element is quite compatible with those reported. The average accuracy of chromium is ± 3.6 with the average precision of ± 2.0 while nickel, manganese, and copper have average accuracies of 4.2, 1.3, and 1.7 with the average precisions ± 2.4 , 0.8, and 0.3 respectively.

Another new method for the trace analysis of the atmospheric particulates by X-ray fluorescence spectrometry is described. The trace element together with other pollutants is collected on the Millipore membrane coupled with a Low-volume air sampler. The samples collected, without sample preparation, are backed by the special sample backing device which is an inverted cup of polyethylene that reduces back-scattering and contains no residual impurity of iron.

The standards were prepared for iron determination using a series of ferric hydroxides of which concentrations are predetermined.

The optimum experimental conditions are studied with emphasis on the levels of the residual impurities in the filtering media, tungsten target, the degree of back-scattering due to the sample backings and the best signal to noise ratios.

The present method of analysis by X-ray fluorescence on iron is found to have an average precision of $\pm 5.4\%$ in the ranges of the 10 to 1,000 ppm, and an average accuracy of about $\pm 6.1\%$ in the above ranges of the concentrations.

The present method is simple and rapid with good precision and accuracy in comparison with the conventional emission spectrographic method of analysis. The method can be applied to other heavy elements in the same samples when the amounts of the elements are such that the degrees of the sensitivities provide no problems.

The method, however, has limit of application when the thickness of the sample exceeds the critical depth of X-ray penetration beyond which the effects of the inter-elements can occur.

Finally, an optical emission spectrographic method is described. The samples are treated by the method developed by NASN. Prior to packing the samples into the electrodes, several factors were modified to improve precision and accuracy of the analysis. Among them is the use of the higher current, higher dilution of the samples with graphite powder, sodium chloride in lieu of lithium chloride as buffer, and internal standard, strontium.

By the present method, the emission spectrographic analysis of calcium and magnesium is found to have precision and accuracy less than $\pm 4.0\%$.