DETERMINATION OF LEAD AND ATMOSPHERIC PARTICULATES
BY FLAMELESS ATOMIC ABSORPTION SPECTROMETRY

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(Received December 15, 1994)

Flameless atomic absorption techniques were used to determine the lead and other atmospheric particulate in the city of Tehran. 640 samples were collected in 20 different stations around the city during four seasons in 1992. The radioactivity of the air samples was also measured by γ-ray spectrometry using high purity Ge/Li detectors, and a multichannel analyzer. The results were compared with previous measurements in the city of Tehran.

There is presently a great concern about the quality of the air in big cities, and the conservation of living environment. Therefore, the determination of trace elements in atmospheric particulates, especially the lead content has received a special attentions. Several methods were suggested for the determination of lead and other toxic trace elements in the environment.1,2 Air pollution in the urban areas of Tehran is a problem indeed, and the monitoring of lead concentration were reported earlier.3 Due to very rapid expansion of the city, like other big cities in developing countries, it was necessary to expand the sampling stations around the city.

In our previous paper,4 we could find some radioactivity in the air samples, which could be related to the Chernobyl nuclear reactor accident.5 Therefore, γ-ray spectrometry was applied for a series of the collected air samples.

In this paper the results of lead concentration and radioactivity measurements in the air samples are reported.

Experimental

Apparatus and materials: Atomic absorption techniques are widely used for trace element determination in air samples.6–8 The flameless atomization devices can increase the sensivity of the measurement. A flameless atomic absorption apparatus Varian Model AA-20 was used for lead determination. The air samples were taken during 24 hours, using a GMW-L-2000 high volume air sampler. The air filters used were
EPM-2000 of high chemical purity made of quartz micro fiber QM-A, and were used in a high volume air sampler of 8" x 10".

Gamma-ray spectrometry using a high purity Ge/Li detector, and multichannel analyzer coupled to a personal computer, and a recorder was used for the measurement of the airborne radioactivity. The detector was high purity p-type germanium for X and γ-rays with high resolution capability (model GMX Ortec Company).

Procedure: The air samplers were installed at 120 cm above the ground level in each sampling stations. The samples were taken at the same date at all of the stations and were analyzed immediately after removing the filters. To prepare the air samples for the lead measurements, several acid washing techniques were used. The best results were obtained using a mixture of HNO₃ and HCl. Adding HF to the acid mixture could increase the leachability of lead from the filter surface by about 3.6%. After dissolution, the samples were injected into the carbon-rod atomizer of an atomic absorption spectrometer. Four series of samples were collected at each station, one series of samples were chosen for airborne radioactivity measurement and particulate matters determination, whereas the other three series were used for lead determination.

Results and discussion

Tehran is a very rapidly growing city with a highly dense population. Twenty sampling points were chosen around the city circle, and the sampling devices were installed. More than 640 air samples were collected from the sampling stations during four seasons, beginning April 1992 and ending March 1993. Figure 1 shows the selected sampling stations. Due to the very dense population, and industrial activities in 16 sections of the city, three sampling stations were installed in different parts of each section.

Table 1 and Fig. 2 show the annual mean values of airborne particulate matters in 20 sampling stations, ranging from minimum value of 299.8 µg/m³ (in sampling station No. 15) to a maximum value of 850.3 µg/m³ (sampling station No. 7). The mean value of particulate matters of all sampling stations were found to be 669.4 µg/m³ in spring, 494.97 µg/m³ in the fall and 448.98 µg/m³ in winter.

The reduction of particulate matters in the fall and winter can be interpreted by windy weather and rain washing, respectively. Table 2 shows the average lead concentration during the four seasons in all sampling stations. As indicated in Table 2 the maximum average mean value of lead concentration was 4.853 µg/m³ in spring in sampling station No. 6 and 6.520 µg/m³ in summer in sampling station No. 7, and 8.703 µg/m³ in the fall and 6.733 µg/m³ in the winter in sampling station No. 3. The annual maximum mean value of lead concentration 6.272 µg/m³ could be found in