TRAFFIC DERIVED HEAVY METALS IN ROADSIDE SOILS FROM SÃO PAULO, BRAZIL

INTRODUCTION

Petrol and diesel exhausts are now the major cause of urban pollution, through a combination of noxious gases and airborne particulates. Cars, buses and trucks are a source of air pollution. When their engines burn fuels (gasoline or diesel), they produce large amounts of chemicals that are emitted in engine exhaust. Diesel engines are an important part of the world's transportation and are one of many contributors of fine and ultrafine particles in urban areas. Cu and Zn accumulation in particulate matter is due to the wear and tear of certain automobile materials and parts during driving (Hildemann et al., 1991). Heavy metals resulting from traffic related activity are of particular interest because they are not degraded in the environment. There is little information about the distribution patterns of traffic related heavy metals in environmental samples, and an increasing interest in determining these elements in different environmental matrices. In the present work, the elements Pb, Zn, and Cu were determined in roadside soils collected at the SP348 road, in São Paulo, Brazil.

EXPERIMENTAL

Sampling

Four sampling locations were chosen for this study adjacent to a major road (SP348), with high traffic flow (ca. 30000 vehicles/day), running between São Paulo city and another important industrial regions of São Paulo State. Sampling points were between the cities of São Paulo and Jundiaí, where there is the highest density of traffic of the road, at 31, 39, 45 and 55 km from São Paulo. Due to the Southeast preferential direction of the wind in the area of the study, soil samples were collected between the motorways, in the 30 m wide strip of grass. Areas of 20 m^2, forming a rectangular grid, were sampled. Composite samples were prepared, taking 5 samples, collected at each 1 m, along 4 m of the road. And other 6 samples were so prepared at farther distances from the road. The sampling took place from the grass strip 40 cm beside the asphalt up to 540 cm from the roadway. The sampling depth was 5 cm. The ground covering vegetation was separated. Roadside soil sampling locations were carefully selected to represent a cross-section of traffic volumes and driving styles (stop/start vs. constant speed). A polyethylene tube with 4 cm diameter was used to take the samples, which were stored in inert plastic bags. In the laboratory, the samples were dried at 40-50°C and were sieved through plastic-only sieves into <2 mm fraction. Before and after sieving, the samples were homogenized and quartered. The samples were homogenized and were ground in agate mortars.

Analytical Methods

Instrumental neutron activation analysis (INAA) was used to analyze Zn. One hundred to one hundred and fifty mg of each sample and of the geological reference materials BE-N (ANRT) and Soil-7 (IAEA) were accurately weighed in polyethylene bags. Samples and reference materials were irradiated for 8 hours at a

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thermal neutron flux of 10^{13} n cm^{-2} s^{-1} at the IEA-R1 nuclear reactor of IPEN. The measurements of the induced gamma-ray activity were carried out in gamma-ray spectrometer with a GX20190 hyperpure Ge detector (Canberra).

X-ray florescence (XRF) was employed to determine Pb, and Cu. Pellets (40 mm diameter) consisting of a mixture of 9 g of the sample and 1.5 g of powdered wax (Hoechst) were prepared and measured in a sequential XRF spectrometer (PW2404, Philips), equipped with a rhodium tube.

RESULTS

The distribution patterns of Zn, Cu and Pb for the samples collected are presented in Figure 1. The pattern of the heavy metals distribution in the analyzed roadside soils was characterized by a strong decrease of the heavy metals content with increasing distance from the traffic lane, mostly for Zn and Cu. The concentration levels were obtained in a range from 16 to 150 mg kg^{-1}, for Pb; from 17 to 110 mg kg^{-1} for Cu; from 49 to 587 mg kg^{-1} for Zn. The results obtained near the road showed concentration levels much higher than the values considered as reference values for soils in São Paulo, according to the Environmental Protection Agency of the State of São Paulo (Casarini et al., 2001). The high concentrations of Pb, Zn and Cu found in the roadside soils suggest an anthropogenic source. Positive correlation coefficients between Pb, Cu and Zn points to a common source, in this case, the automobile exhausts. The results obtained indicate that the Zn, Cu and Pb concentrations in the roadside soils are directly influenced by traffic conditions and distance.

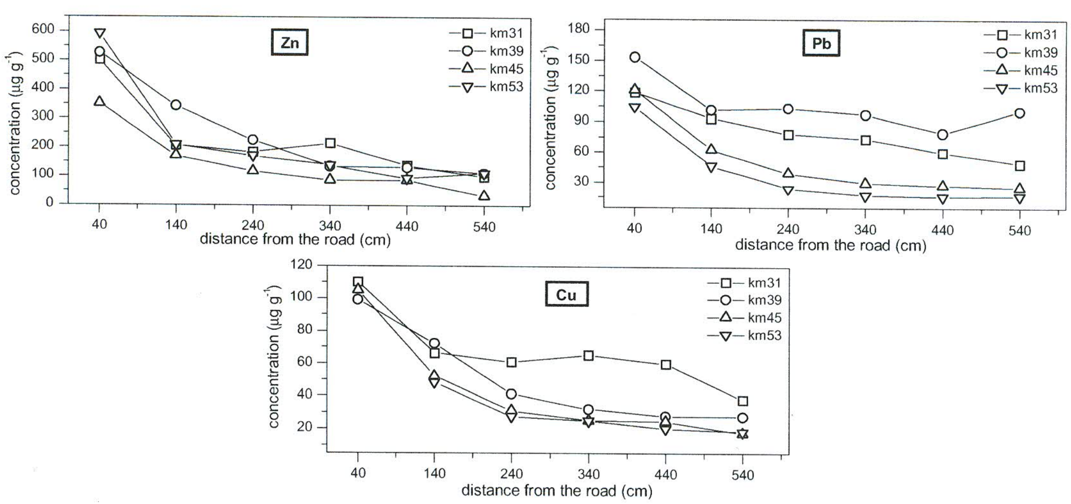

Figure 1 - Zn, Pb and Cu distribution patterns in roadside soil samples collected at SP348

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