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Heavy metals partitioning as base for risk assessment in urban environment

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Trace metals are useful indicators of contamination in surface soil environments. Such elements tend to accumulate in topsoils, and may affect population health if they reach levels above current health regulations. Some of these areas in urban environment with highest risk for human health are the playgrounds, especially young children who are highly susceptible to a low dose of toxin and the likelihood to inadvertently ingest significant quantities of dust. Although the total concentrations of bulk samples are used to determine the soil pollution degree, the concentration of heavy metals and its accumulation in soils is inversely related to particle size. The objective of the present study is to evaluate the effect of particle size in the total concentration of heavy metals from different playgrounds in Murcia city.

Murcia city is located in the southeast of Spain, and the most important urban area of Murcia Province. It has 370 000 inhabitants or 30% of the provincial population. The climate is typically Mediterranean with an annual average temperature of 18 ºC and precipitation of 350 mm. These weather conditions and traditional Spanish social habits encourage outdoor activities for children, particularly enjoying games in playgrounds after school and during weekends. To achieve the proposed objective, four soil samples were collected from different parks; the sampling depth was from 0 to 5 cm because playing children are in contact with superficial soil and most of the metals are accumulated in this layer of soils. The bulk samples were air-dried and sieved to pass through a 2-mm sieve, and then divided by particle diameter into seven physi-

cal size fractions, 2000–850, 850-425, 425-180, 180-150, 150-106, 106-75 and <75 μm. Total digestion of the samples was carry out with microwave using a combination of nitric, hydrofluoric and boric acids and the Mo, Co, Pb, Cu, Zn, Cd, Ni, Cr and Mn concentrations were measured by inductive couple plasma atomic emission spectrometer (ICP-AES).

Result shows that most of the heavy metals exhibit a substantial accumulation in the finest particles. Such a pattern is usually attributed to the increase in specific surface area and concomitant increase in the proportion of reactive substrates. About 20% of the concentrations for all studied heavy metals are contributed by the particle grain size fraction of 0–75 μm while the fractions from 75 μm to 180 μm contribute less than 10 % each one to the total heavy metal concentrations. It is important to highlight that soil particles finer than 125 μm could be problematic in that they are easily transferred into surface waters or into the atmosphere. Moreover, more than 50% of the concentrations for all heavy metals are contributed by the particle grain size fractions from 180 to 850 μm, being from180 to 425 μm the fractions that more contribute to the total heavy metals concentration (about 30%). Future weathering of these size fractions can eventually release heavy metals into the finer fractions (< 75 μm).

The results are of importance for understanding heavy metal transport and are useful to apply preventive measures for reducing risk for children.

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