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Physico-chemical characterization of playground sand dust, inhalable and bioaccessible fractions

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Abstract

Dust is a mixture of natural and anthropogenic particles originated from multiple sources, which can represent an hazard for human health. Playgrounds are a site of particularly concern, due to sand dust ingestion by toddlers and inhalation. In this study, 37 sands used in public playgrounds in the city of Barcelona were physico-chemically characterized also in relation to routine maintenance activities such as disinfection and sand renewal. The analyzed sands show a felsic mineralogy dominated by Na-feldspar, quartz, and, to a lesser extent, K-feldspar, with minor amounts of clay minerals, carbonates and hematite. Particle fractions below 10, 2.5 and 1 µm represent, on average, 0.65%, 0.17% and 0.07% of bulk volume, respectively, although, due to the human grinding, these initial fractions increased every year by a 18%, 5% and 2% respectively. Disinfection of sands effectively reduced only the NH_4^+ concentration, among inorganic species. The average metal content was anthropogenically enriched, with respect to the upper continental crust, only for Sb and As. Both elements show high spatial variation indicating local sources such as road traffic for Sb (contributing mostly to the total concentration), and industry for As (also contributing with highly bioaccessible Sb, Cu and Zn). A clear inverse relationship between total concentrations of some elements and their leachable (Sb) and bioaccessible (Sb and Cr) fractions is observed. The most bioaccessible elements were Ca>Ni>Cu>Sr>Cd>Pb, all above the 25% of the total concentration. Bioaccessibility was higher for the carbonate-bearing particles and for the anthropic emitted metals (>50% of Ba, Cu, K, Pb and Zn).

Keywords