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Polycyclic Aromatic Hydrocarbons in an industrialized urban area

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Urbanization, agricultural intensification and industrialization are contributing to erosion, local and diffuse contamination and sealing of soil surfaces, resulting in soil quality degradation. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous in urban environments and considered good markers of anthropogenic activities such as traffic, industry, domestic heating and agriculture. Although they are subject to biodegradation and photodegradation, once in the soil, they tend to bind to the soil organic fraction.

Estarreja is a small coastal town in the Northwestern Portuguese coast, with a close relation with the lagoon of Aveiro which supports a variety of biotopes (channels, islands with vegetation, mudflats, salt marshes and agricultural fields) of important ecological value. It supports an intensive and diversified agriculture, a variety of heavy and light industries and a population of about half a million people which is dependent on this resource. This is a very industrialized area, due to its five decades of chemical industry. This study aims to assess the impact of the urbanization and of the chemical industry in PAHs distribution.

The survey and sampling method were based on pre-interpreted maps, aerial photographs, and directly checked in the field, in order to get an overall characterization of the area. Topsoils were collected from 34 sites, considering different land uses. Five land uses were chosen: ornamental gardens, parks, roadsides, forest and agricultural. Parameters such as soil pH (ISO method 10390:1994), total C, N, H, S percentages (microanalyser LECO, CNHS-932), organic matter (LOI at 430°), particle size distribution (Micromeritics® Sedigraph 5100), cation exchange capacity and exchangeable bases, were determined in order to have a general characterization of soil. Determination of the 16 EPA PAHs in soils was performed by GC/MS after a Soxhlet extraction and an alumina clean-up of extracts. Procedure blanks, duplicates and reference material were used in each extraction batch for quality control assessment.

In what concerns the general parameters, Estarreja soils were characterized as slightly acid, with a median pHCaCl2 of 5.15, ranging from 3.12 and 6.88. The content in organic matter observed was relatively high, with a median of 4.6% and ranging from 1.8 to 45%.

The median concentration of PAHs was 98 μg kg-1, ranging from 27 to 2,016 μg kg-1. The former value was found in an agricultural area and, together with another agricultural soil (with 1121 μgPAHs/kg), were considered heavily contaminated according to the classification given by Maliszewska-Kordybach. Moreover, eight samples were classified as weakly contaminated (PAHs between 200 and 600 μg/kg) and the remaining ones were not contaminated.

The relative abundance of individual PAHs in Estarreja soils was evaluated, being the most abundant Fluoranthene and Pyrene followed by Benzo(b)fluoranthene, Phenanthrene and Crysene. These PAHs are the ones usually associated with the combustion of fossil fuel and other burnable materials, being this composition is typical for topsoil of European industrialized countries.

Geostatistical methods were used to show the spatial variability of contaminants and the probability of exceeding the risk-based standards. The plots of concentration of PAHs on GIS highlight areas where the highest elements concentrations occur and the land use associated. These soil maps assemble important information for decision-making, allowing identifying possible sources of contamination, assess the suitability of soil to its use and to contribute for land use planning in accordance to soil characteristics.

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