8. PAH and heavy metal transport in soils: from laboratory tests to field scale experiments

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Abstract:
PAHs (Polycyclic Aromatic Hydrocarbons) and heavy metals are major pollutants of former industrial soils, and particularly former coking plant locations. Most of them are known to be carcinogenic and/or mutagenic. Thus, their migration and possible transfer to the water table and to human beings need to be investigated. Pollutant transport is generally studied at the bench scale through batch and/or column experiments. These set-ups may be not representative of the transport at the field scale, because (i) soil samples are sieved and (ii) experiments are most often run in saturated porous media with permanent flow. Experiments at a larger scale are then required to assess PAH and heavy metal transport at the field scale. But such experiments are time-consuming and expensive and not adapted to risk assessment studies. The aim of the present work was to design an original laboratory set-up able to represent and predict PAH and heavy metal migration at the field scale.
Two experimental set-ups were used. The first one consisted in a lysimeter vessel, which was a stainless steel column (2 m depth, 1 m2 section) equipped with three types of probes at three depths (0.5, 1.0 and 1.5 m): a TDR probe, a tensiometer and a suction cup. It was located in the experimental station of the GISFI (French Scientific Interest Group working on Industrial Wasteland, www.gisfi.fr), in Homécourt, France (49Â° 14' N, 5Â° 59' E). The lysimeter was submitted to natural atmospheric conditions and its surface was bare. The second one was a laboratory column of large dimensions (h = 0,30 m, d = 0,15 m) periodically fed by a transient flow to simulate autumn rain, with desiccation/humidification cycles.
These systems were filled with a polluted soil sampled at a former coking plant site. Soil had been previously excavated, homogenized by quartering and sieved at 40 mm. This sandy soil, exhibiting high organic carbon content (139 g kg-1) and slightly alkaline pH (8.3), was polluted with PAHs (5 g kg-1 soil) and heavy metals (e.g. Zn 391 g kg-1; Pb 153 g kg-1). Conductivity and pH were monitored at the system outlets and at the three sampling points; PAH, TOC, zinc and lead were analyzed as well as major cations and anions. Data were analyzed using an original approach based on principal component analysis method.
Results were very different from published data based on saturated flow conditions: PAH concentrations were lower and did not exhibit much variation over time. A comparison of the two studied systems showed that this large laboratory column, quick and easy to set, was a good mean to evaluate pollutant transport at the field scale, and could be an appropriate and relevant tool for risk assessment studies.

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