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Low-temperature oxidation of river industrial deposits: formation and mobilisation of hazardous pollutants

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Steelmaking activities produced large quantities of wastes dumped in the neighbouring river generating industrial deposits highly contaminated in Polycyclic Aromatic Compounds (PACs), Zn and Pb. After being kept under water for decades, these deposits were recently emerged and suffered oxidation and dehydration, especially during warm seasons, as well as leaching processes.

To simulate the impact of emersion on those industrial wastes, kinetic oxidation experiments were performed at 45°C, followed by a leaching step to estimate the potential release of contaminants towards the aqueous media. Polycyclic Aromatic Hydrocarbons (PAHs), furans as well as most polar PACs containing ketones (Keto-PACs) were monitored in both solid and aqueous phases whereas major and trace elements, anions and global parameters were measured in the aqueous phase. Along the 112 days of oxidation, PAH contents in the solids decreased, whereas Keto-PAC reached concentrations four times higher than initial levels, representing from 5 to 25% of total PAC investigated. The Low molecular PAHs (LPAHs) were the main compounds affected by the PAH decrease. The evolution of Keto-PAC/(Keto-PAC+PAH_{par}) ratios confirmed the transformation of PAHs into Keto-PACs. Following the leaching of solids at each oxidation step, a rapid depletion in PAH concentrations in water with time was observed whereas concentration of Keto-PAHs in water increased with time. High molecular weight PAHs were not found in water due to their strong interaction with the matrix. LPAC and most of Keto-PAC concentrations measured in leachates were positively correlated with solid phase concentrations. In leaching solutions, the detection of sulphate anions and trace elements such as Zn, demonstrated the oxidation of sulfides inducing the release of Zn in waters and a slight pH decrease.

These experiments evidence the occurrence of an aging process leading to the attenuation of PAH concentrations in steelmaking wastes. However, this decrease is partly explained by their rapid oxidation (as soon as the 24h-step) into keto-PACs, more soluble and then more hazardous than PAHs. These simulating experiments strongly suggest that after emersion, oxidation and leaching processes could enhance the release of contaminants in the water column.