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Sorption of Persistent, Mobile, and Toxic (PMT) and very persistent, very mobile (vPvM) substances onto pyrogenic carbonaceous materials

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Chemical pollution is recognized as a global problem, arising from trace organic contaminants (TOrCs), such as the emerging persistent mobile, and toxic (PMT) and very persistent, very mobile (vPvM) organic compounds. Rapid urbanization has increased impervious surfaces, facilitating the deposition and accumulation of pollutants. Additionally, stormwater acts as a transportation conduit for this PMT/vPvM substances, functioning as a surface pollutant wash-off, discharges into water bodies, and decreases the urban water quality. Green infrastructure, mainly designed to mitigate flood risk and recharge aquifers, may contaminate the soil-groundwater system. It is therefore crucial to develop cost-effective remediation technologies to enhance the removal of polar contaminants before reaching the aquifer.

In this study, a laboratory-based removal evaluation for 20 cost-effective PCMs (e.g., activated carbons and standard biochars) towards 34 PMT/vPvM target compounds (covering a wide range of uses, e.g., biocides, additives, herbicides) has been conducted. Preliminary results show that activated carbon (GAC), regenerated activated carbon (RAC) and MSP700 biochar exhibit strong adsorption capabilities for PMT compounds. The pyrolysis temperature, surface area, and aromaticity of the PCM play a crucial role in the adsorption process. The sorption kinetics for a suite of eight representative PMT compounds (covering a broad range of physicochemical properties) is better reproduced using a pseudo-second order (PSO) model, indicating a diffusion-controlled process. Sorption equilibrium for most adsorbates is achieved within 48 h. GAC, with the highest specific surface area, exhibits rapid adsorption, whereas MSP700 biochar shows the slowest adsorption rates. Furthermore, the sequence of adsorption capacity for the studied adsorbates is: neutral > positive > negative. Finally, the identification of GAC, RAC, and MSP700 as effective adsorbents for PMT/vPvM substances offers valuable insights for next-generation urban water management.