Magnetic Decontamination and Water Valorization

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Abstract

The hydrosphere hosts a wide variety of organisms and compounds in natural balance, yet anthropogenic activities are increasingly disrupting this equilibrium. Among the emerging environmental threats are contaminants of emerging concern (CECs) such as microplastics, PFAS, and hormones, as well as heavy metals. Heavy metals are particularly worrisome due to their toxicity and bioaccumulation potential. Moreover, their toxicological profiles and physicochemical behaviors depend on their specific chemical forms, making it essential to develop advanced methods for their detection, quantification, speciation, and remediation at ultra-trace levels in water.

In this study, novel magnetic nanomaterials have been synthesized and applied as an innovative strategy to address this challenge. A new methodology has been developed for the determination, quantification, and speciation of several priority heavy metals—specifically chromium, antimony, and arsenic.

The nanomaterials consist of magnetite nanoparticles coupled with green graphene oxide and further functionalized to enhance selectivity. Magnetic solid-phase extraction (MSPE) techniques were employed, in combination with atomic spectroscopy, achieving detection and quantification limits in the ppb and ppt range. The developed methods were validated and successfully applied to various environmental water matrices, including river, marine, spring, tap, coastal, lake, and canal waters from Spain, Canada, and France.

Keywords

Include sustainability, graphene oxide, magnetic nanoparticles, MNPs, GO.