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Arsenic and copper sorption in multi-component sorbents: drinking water treatment residuals in Andean watersheds

ALEJANDRO E BRISO[1], ANA MACARENA TURRI[1,2], MAURICIO MONTECINOS[1,2], ALEJANDRA VEGA[1,2], MARÍA MOLINOS-SENANTE[1,2] AND PABLO PASTEN[1,2]

[1]Pontificia Universidad Católica de Chile

[2]Centro de Desarrollo Urbano Sustentable (CEDEUS)

Presenting Author: aebriso@uc.cl

Drinking water treatment residuals (DWTRs) are slurry residues produced by drinking water treatment plants during coagulation-flocculation processes. DWTRs typically include a complex mixture of sand, clays, and organic matter originally found in the raw inflow. They also may include amorphous aluminum and iron oxyhydroxide particles, the by-products of adding iron or aluminum salts, yielding highly reactive surfaces towards metal(loid)s. This work explores the fate of copper and/or arsenic when DWTRs are released to surface waters in Andean watersheds.

Model DWTRs were artificially generated by processing raw water from the Maipo River, main drinking water source in Chile. The physicochemical properties of model DWTRs and the fate of copper and arsenic were determined for different receiving water scenarios thought-out a multimethod approach, including FTIR, XRD, BET, electron microscopy, and ICP/AA. The results of equilibrium isotherm experiments were analyzed using a quantitative physicochemical reactivity model implemented with PHREEQC, which allowed testing different hypotheses regarding the possible dominant mechanisms controlling copper and arsenic speciation in this complex mixture.

A better understanding of the speciation of metal(loid)s in residues discharged to waters is needed to feed public policy and regulations controlling water pollution from water treatment operations. Since DWTRs are also formed from the coagulation of raw waters with low metal concentrations, this work also sheds light on the hydrochemical conditions that allow using their untapped reactivity towards arsenic and copper for the pre-treatment of metal(loid)-rich drinking water sources.