Simultaneous removal of As, Cd, Cr, Cu, Ni and Zn from stormwater using high-efficiency industrial sorbents: Effect of pH, contact time and humic acid

The effect of contact time, solution pH, and the presence of humic acid (HA) on the combined removal of As, Cd, Cr, Cu, Ni and Zn is investigated in batch tests using alumina, granulated activated carbon (GAC), and bauxsol coated sand (BCS) as sorbents. It is found that the equilibrium time for Cd, Cu, Ni and Zn is about 4 h, while no clear equilibrium is observed for As and Cr. It is also found that increasing the pH until pH ~ 8 enhanced Cd, Cu, Ni and Zn removal, but increasing the pH above this point had no major effect. In the cases of As and Cr, higher pH values (i.e. > 7) decreased their removal. The presence of both 20 and 100 mg/L HA suppressed the heavy metal removal except for Cr, and the suppression was higher at the higher HA concentration. Geochemical simulations suggest that this is due to the formation of dissolved HA-metal complexes preventing effective metal sorption. In the case of Cr, the presence of HA increased the removal when using alumina or BCS, while hindering the removal when using GAC. The findings show that the pH-value of the stormwater to be treated must be in the range of 6-7 in order to achieve removal of the full spectrum of metals. The results also show that natural organic matter may severely influence the removal efficiency, such that, for most metals the removal was reduced to the half, while for Cr it was increased to the double for alumina and BCS. Consequently, a properly working filter set up may not work properly anymore when receiving high loads of natural organic acids during the pollen season in spring or during defoliation in autumn and early winter, and during mixing of runoff with snowmelt having a low pH.

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