Treated multiwalled carbon nanotubes for divalent and trivalent metal removal from acid mine drainage contamination

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Acid mine drainage (AMD) is a growing problem that affects natural watercourses and soils. Northern Chile is typified by its great mining activity and consequently is highly affected by AMD. The generation of AMD from the mining industry is one of the main sources of heavy metal release to surface watercourses. Several technologies have been studied to remove heavy metals from AMD waters. In recent years, nanotechnology has introduced different nanomaterials, such as carbon nanotubes (CNT), which have a high potential for water remediation through the adsorption of heavy metals. However, CNTs has poor selectivity for metal ions, so additional treatments are necessary for improving selectivity for metals of interest. CNTs and treated or oxidized CNTs have been shown that has affinity only for divalent metals, so it is required a functionalization for aluminum removal. In this study, we investigate the affinity of multiwalled carbon nanotubes (MWCNT) raw, oxidized and functionalized for removal of heavy metals. For this, acidic waters derived from a mining area in Northern Chile with pH around 4 and high concentrations of aluminum (~40 mg/L), copper (~16 mg/L), manganese (6 mg/L) and zinc (3 mg/L) were used as a synthetic water model of AMD for laboratory experiments. We observed removal rates between 50-70% with MWCNTs and enhanced adsorption with treated nanotubes. In addition, the removal rates were affected by pH according to the point of zero charge in each case (raw, oxidized and functionalized). Also, several studies to characterize the MWCNTs were carried out, such Brunauer-Emmet-Teller analysis (BET) and Scanning electron microscopy (SEM). These results can improve the knowledge about the benefits of using carbon nanotubes for the treatment of acidic waters, which could enhance its use as an AMD remediation alternative in the future.