Comparison of wood ash, compost and peat-calcite for passive treatment of contaminated neutral drainage in column reactors

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A promising approach to treat the typically low metal concentrations in contaminated neutral drainage (CND) is through the sorption of metals onto low cost materials. Metal ions can be immobilized rapidly and efficiently by various natural sorbents and industrial waste materials, either by adsorption, precipitation, or a combination of both mechanisms. Selection of a filter material is a challenge because various materials are rarely compared under identical experimental conditions. Moreover, it is unclear if one removal mechanism offers a better potential to treat large volumes of CND and if it should be favored over the other. The Ni-CND of Lac Tio mine (QC, Canada) is a good case study to compare retention mechanisms of different sorbent materials because a slight pH increase of this effluent leads to nickel removal by precipitation. In the present study, wood ash, a material characterized by high pH and good sorption capacity, is compared with two neutral pH and high sorption capacity materials: namely compost and a mixture of peat and calcite (peat-calcite). Materials were tested in 4.8L fixed bed columns at a hydraulic retention time of 16.5 hours over the course of 2.5-4 months. Results indicate that all three materials successfully treated over 400L of synthetic Ni-CND containing 4 mg L^{-1} Ni. Breakthrough curves obtained from sampling at mid-column ports indicate that Ni breakthrough was fastest in the order peat-calcite>compost>wood ash. Hydraulic conductivity was high in all columns (10^{-2} to 10^{-1} cm s^{-1}) and did not change significantly during the course of the experiment. Overall, both the adsorption capacity by unit of volume of material and the pH of the material played a role in the performance of the system. Future work will include the design, installation and monitoring of an on-site pilot reactor.