SYNTHESIS OF A POROUS MAGNESITE-BENTONITE CLAY COMPOSITE AND ITS APPLICATION FOR NEUTRALISATION AND ATTENUATION OF INORGANIC CONTAMINATS IN ACIDIC AND METALLIFEROUS MINE DRAINAGE

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ABSTRACT

This paper evaluates the application of cryptocrystalline magnesite-bentonite clay composite for treatment of acid mine drainage. Bench laboratory studies were used to evaluate the treatment of AMD. The composite was mixed with simulated AMD at specific solid–liquid (S/L) ratios, equilibrated and its capacity to neutralize and remove selected and potentially toxic chemical species from synthetic and field AMD evaluated under optimized conditions. Interaction of the composite with AMD led to an increase in pH (pH >11) and lowering of metal concentrations. The removal of Al^{3+}, $Fe^{3+/2+}$, Mn^{2+} and SO_4^{2-} was optimum at 20 min of equilibration and 1g of adsorbent dosage. The composite removed ≈99% (Al^{3+}, Fe^{3+}, and Mn^{2+}) and ≈90% (SO_4^{2-}) from raw mine effluent. Minor elements such as Co, Cu, Zn, Ni and Pb were also removed significantly. Adsorption, ion exchange and precipitation are the main mechanisms for chemical species attenuation. Precipitation of metal hydroxides incorporates sulphate to form various oxyhydroxysulphates and also adsorb sulphate. The composite managed to remove the contaminants from AMD to below South African legal requirements for water use. Henceforth, It was concluded that the composite has the potential to neutralize and attenuate potentially toxic chemical species from acidic and metalliferous mine drainage.

Keywords: Acid mine drainage; Magnesite-Bentonite clay; Composite; Heavy metals