Journal of Environmental Chemical Engineering, vol. 6(2): 1634-1650

Fractional and step-wise recovery of chemical species from acid mine drainage using calcined cryptocrystalline magnesite nano-sheets: An experimental and geochemical modelling approach

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ABSTRACT:

In this study, a process of fractional and step-wise recovery of metals from Acid Mine Drainage (AMD) using calcined cryptocrystalline magnesite was explored. pH Redox Equilibrium (in C language) (PHREEQC) was used to complement the experimental studies. Half a litre (1/2 L) of coal mine drainage was used for chemical species recovery. The metal recovery process was done using an overhead stirrer in a step-wise fashion. Chemical species were recovered via a sequential and fractional precipitation of chemical components at varying pH gradients. Both experimental and modelling results revealed that chemical species were recovered at varying pH ranges. Fe was recovered at pH = 3–3.5, gypsum at pH = 4–10, Al at pH = 6.5, Mn at pH = 9.5, Cu at pH = 7, Zn at pH = 8, Pb at pH = 8 and Ni at pH = 9. Greater than 99% efficacy was achieved for all the chemical species at given pH regimes. The experimental results corroborated the geochemical modelling and XRD results. This technology successfully proved that calcined cryptocrystalline magnesite can be used as a seeding material to facilitate a fractional and sequential recovery of chemical species from acid mine drainage. This will go a long way in minimising the disposal cost incurred from the generated sludge, thus, off-setting the running cost and making the acid mine drainage (AMD) treatment process environmentally friendly. This will also contribute significantly in environmental engineering processes.