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Efficiency of ball milled South African bentonite clay for remediationof acid mine drainage

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Abstract: The feasibility of using vibratory ball milled South African bentonite clay for neutralization and atten-uation of inorganic contaminants from acidic and metalliferous mine effluents has been evaluated.Treatment of acid mine drainage (AMD) with bentonite clay was done using batch laboratory assays.Parameters optimized included contact time, adsorbent dosage and adsorbate concentration. Ball milledbentonite clay was mixed with simulated AMD at specific solid: liquid (S/L) ratios and equilibrated on atable shaker. Contact of AMD with bentonite clay led to an increase in pH and a significant reduction inconcentrations of metal species. At constant agitation time of 30 min, the pH increased with the increasein dosage of bentonite clay. Removal of Mn2+, Al3+, and Fe3+was greatest after 30 min of agitation. Theadsorption affinity obeyed the sequence: SO_4^{2-}(221.8 mg g^{-1}) > Mn (30.7 mg g^{-1}) > Al (30.5 mg g^{-1}) > Fe(30.2 mg g^{-1}). The pH of reacted AMD ranged from ≈3 to 6. Bentonite clay showed high adsorptioncapacities for Al and Fe at concentration <500 mg/L, while the capacity for Mn was lower. Adsorptioncapacity for sulphate was >50%. Adsorption kinetics revealed that the suitable kinetic model describ-ing data was pseudo-second-order hence confirming chemisorption. Adsorption isotherms indicatedthat removal of metals fitted the Langmuir adsorption isotherm for Fe and sulphate and the Freundlichadsorption isotherm for Al and Mn, respectively. Ball-milled bentonite clay showed an excellent capacityin neutralizing acidity and lowering the levels of inorganic contaminants in acidic mine effluents.