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Removal of arsenic from wastewaters by cryptocrystalline magnesite: complimenting experimental results with modelling

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ABSTRACT:
Availability of arsenic in waterbodies has posed devastating impacts to terrestrial and aquatic organisms. As such, prudent and pragmatic technologies need to be developed to troubleshoot and solve the problem of arsenic in aquatic ecosystems. This study was designed to investigate the potential use of cryptocrystalline magnesite for removal of arsenic from aqueous solution. Removal of arsenic was done in batch laboratory procedures. Parameters optimized include: Contact time, adsorbent dosage, arsenic concentration and supernatant pH. Modelling was applied to complement experimental results. Experimental results revealed that the optimum conditions for removal of arsenic are 15 min of agitation, 1 g of dosage, 20 mg L_1 of arsenic concentration. Contact of magnesite with aqueous solution led to an increase in pH (pH > 10) which is suitable for removal of arsenic as an oxyanion. PH redox equilibrium (in C language) (PHREEQC) indicated that arsenic existed as an oxyanion at alkaline medium. It also predicted that arsenic is adsorbed by magnesite and precipitate out of solution as Mg3(AsO4)2$4H2O. Adsorption isotherms fitted well to Freundlich adsorption isotherms than Langmuir adsorption isotherm hence proving multisite adsorption. Adsorption kinetic fitted well to pseudo-second-order kinetic hence proving that chemisorption is the rate limiting step. Magnesite has attenuated the concentration of arsenic to below prescribed water quality guidelines. This comparative study proved that magnesite can be used as an adsorbent with higher adsorption capacity for removal of arsenic in contaminated waterbodies. This novel technology will go a long way in curtailing the impacts of arsenic in contaminated waterbodies emanating from industrial activities.