World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Adsorptive Removal of Cd(II) Ions from Aqueous Systems by Wood Ash-Alginate Composite Beads

Authors : Tichaona Nharingo, Hope Tauya, Mambo Moyo

Abstract : Wood ash has been demonstrated to have favourable adsorption capacity for heavy metal ions but suffers the application problem of difficult to separate/isolate from the batch adsorption systems. Fabrication of wood ash beads using multifunctional group and non-toxic carbohydrate, alginate, may improve the applicability of wood ash in environmental pollutant remediation. In this work, alginate-wood ash beads (AWAB) were fabricated and applied to the removal of cadmium ions from aqueous systems. The beads were characterized by FTIR, TGA/DSC, SEM-EDX and their pHZPC before and after the adsorption of Cd(II) ions. Important adsorption parameters i.e. pH, AWAB dosage, contact time and ionic strength were optimized and the effect of initial concentration of Cd(II) ions to the adsorption process was established. Adsorption kinetics, adsorption isotherms, adsorption mechanism and application of AWAB to real water samples spiked with Cd(II) ions were ascertained. The composite adsorbent was characterized by a heterogeneous macro pore surface comprising of metal oxides, multiple hydroxyl groups and carbonyl groups that were involved in electrostatic interaction and Lewis acid-base interactions with the Cd(II) ions. The pseudo second order and the Freundlich isotherm models best fitted the adsorption kinetics and isotherm data respectively suggesting chemical sorption process and surface heterogeneity. The presence of Pb(II) ions inhibited the adsorption of Cd(II) ions (reduced by 40 %) attributed to the competition for the adsorption sites. The Cd(II) loaded beads could be regenerated using 0.1 M HCl and could be applied to four sorption-desorption cycles without significant loss in its initial adsorption capacity. The high maximum adsorption capacity, stability, selectivity and reusability of AWAB make the adsorbent ideal for application in the removal of Cd(II) ions from real water samples. Column type adsorption experiments need to be explored to establish the potential of the adsorbent in removing Cd(II) ions using continuous flow systems.

Keywords : adsorption, Cd(II) ions, regeneration, wastewater, wood ash-alginate beads
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020