

3,4-Dihydroxybenzoic acid removal from water by goethite modified natural sand column fixed-bed: experimental study and mathematical modeling

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ABSTRACT

In this paper, a continuous adsorption of 3,4-Dihydroxybenzoic acid (3,4-DHBA) has been studied by using goethite modified natural sand (GMNS) as adsorbent in a fixed-bed column. Scanning electron microscopy coupled with energy-dispersive X-ray analysis, X-ray diffraction and Fourier transform infrared spectroscopy (FTIR), characterized the GMNS surface. The effect of various experimental parameters including pH (5 and 9), flow rate (1, 2, and 3 mL/min) and initial 3,4-DHBA concentration (15, 40 and 60 mg/L) on the transport and adsorption of 3,4-DHBA onto the column were investigated in detail. The obtained result shows that exhaustion time decreased with increasing initial 3,4-DHBA concentration, flow rate and pH. The highest value of adsorbed amount $q = 35.66$ mg/Kg was obtained from injection of 60 mg/L of initial 3,4-DHBA concentration solution with flow rate, $Q = 1$ mL/min, at pH = 5 in column packed with GMNS. The Thomas and Yoon–Nelson models were applied to describe the breakthrough curves of adsorption of 3,4-DHBA onto GMNS solid. The linear regression analysis demonstrated that the Yoon–Nelson model fitted well with the column adsorption data for 3,4-DHBA. In addition, adsorption mechanism was proposed based on the results FTIR before and after adsorption. The GMNS adsorbent can be regenerated for three adsorption–desorption cycles using sodium hydroxide solution.

Keywords: 3,4-DHBA adsorption; Goethite modified natural sand; Column fixed-bed; Transport; Modeling

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