Synthesis, Characterization and Adsorption Performance Analysis of Polymer Treated Egyptian Clays

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Nomenclature

AAS	Atomic absorption spectrometry
AN-g-Cellulose	Polyacrylonitrile grafted cellulose
B	Untreated Bentonite
B_{ch}	Chitosan modified bentonite
B_{chg}	Crosslinked chitosan modified bentonite
B_s	Bentonite treated with sulphuric acid
b	Langmuir constants related to the maximum adsorption capacity
C_o	Initial ion concentrations (mg/L)
C_e	Equilibrium ion concentrations (mg/L)
EDX	Energy dispersive X-ray
EMH	Egyptian Ministry of Health
FT-IR	Fourier Transform Infrared
GA	GA Glutaraldehyde
K	Untreated kaolin
K_C	Kaolin treated with citric acid
$K_{i,ii,iii}$	Kaolin treated with different acid/alkali or polymer ;pH; Temp
K_F	Rough indicator of the sorption capacity ((mg/g)/ (L/mg))
$K_{H,p,T}$	Polymer modified kaolin
K_o	Kaolin treated with oxalic acid

K_N	Kaolin treated with sodium carbonate & sodium hydroxide
m	Weight of dry adsorbent (g)
Q_e	Amount of ions adsorbed in mg/g adsorbent
Q_m	Maximum adsorption capacity and the free energy of sorption
SEM	Scanning electron microscopy
STPP	Sodium tripolyphosphate
V	Volume of metal ion solution used (L)
WHO	World Health Organization
XRD	X-ray diffraction
1/n	Sorption intensity

Subscribes

$_T$	Temperature of polymer modification
$_p$	pH of acid, alkali and polymer kaolin or bentonite
$_{ch}$	Chitosan

Abstract

In view of pressing environmental impacts on soil earth and water it deemed necessary to develop and optimize appropriate low cost solutions for mitigating environmental pollution taking into consideration the current situation of industrial development and associated heavy metals pollution. Thus, this work has aimed at removal of specific heavy metals via treated and modified Egyptian clays (kaolin and bentonite). Both types comprising of bentonite and kaolin have been treated and modified by acids, alkali and polymer modification. Treated Egyptian clays have been characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Scanning electron microscopy (SEM). Moreover, the prepared adsorbents have been tested for the removal of some heavy metals (Co^{2+}, Cd^{2+}, Cr^{3+}, Cr^{6+} and Ni^{2+}). Kaolin treated using oxalic acid showed slightly higher adsorption capacity (13.5, 16, 10 and 9.8 mg/g) than alkali treated kaolin (11.9, 16, 9.8 and 8.9 mg/g) while, the untreated kaolin adsorption capacity approached 8, 8, 6 and 6.7 mg/g for Co^{2+}, Cd^{2+}, Cr^{3+} and Ni^{2+}, respectively. Isotherm investigations revealed that the maximum adsorption capacities of $Co^{2+}$and Cd^{2+} using acid, alkali treated and untreated kaolin were 25, 22.5 and 7.8 mg/g, respectively for cobalt. The corresponding values for cadmium were 23.8, 20.2 and 8.9 mg/g, respectively. An improvement has been attained via coating of kaolin