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Research Article

Iron removal from synthetic aqueous solution using amino functionalized commercial silica gel as adsorbent

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Abstract

The amino group (-NH_2) is one of the most important functional groups of ligands. Particularly, 3-aminopropyl-trimethoxysilane (APTMS) has relatively high affinity to bind various to metal ions. The present study was aimed to modify commercial silica gel (CSG) with the APTMS via silanization process to acquire amino groups (CSG-NH_2) as an adsorbent for the removal of iron from synthetic aqueous solution. For an optimal adsorption study, the effects of the initial concentration of Fe(II) (1-80 mg/L), pH of solution (pH 1-10), contact time (1-36 hours) and temperature (30-60˚C) were investigated. The results showed that the adsorption capacity of the obtained CSG-NH_2 for the Fe(II) was 60.80 mg/g at pH 4, and complete adsorption equilibrium was reached within 24 hrs. The adsorption isotherm of the CSG-NH_2 for Fe(II) was well fitted by the Langmuir isotherm. In addition, thermodynamic data demonstrated that the Fe(II) adsorption onto the CSG-NH_2 surface was mainly an exothermic spontaneous reaction. This implies that CSG-NH_2 can be used as a high potential adsorbent for the removal of ferrous ion from contaminated wastewater.

Keywords: Amino functionalized commercial silica gel, Iron removal, adsorbent

Introduction

As one of the most abundant elements in the Earth's crust, iron always coexists with nonferrous metals in their ore bodies (Zhang et al., 2016). It is often present in groundwaters worldwide and may existin a soluble form as ferrous iron (Fe^{2+}or Fe $(OH)^{+}$) or complexed forms as ferric iron (Fe^{3+}) forming colloidal minerals and/or associated with organic matter (Hamdouni et al., 2016). Although iron is an essential nutrient for humans and has beneficial effects on health, its presence in water may cause contaminations, particularly at high concentrations. It can influence the taste and esthetic quality of the water. Indeed, the oxygen from air induces its rapid oxidation to form ferric hydroxide or oxyhydroxide precipitates for pH>6, that can generate toxic derivatives and develop infections such as neoplasia, cardiomyopathy, and arthropathy (Hamdouni et al., 2016).

There are several efficient iron removal techniques, e.g., electrocoagulation (Ghosh et al., 2008), oxidation-coagulation (Bordoloi et al., 2013), solvent extraction (Quijada-Maldonado et al., 2016), microfiltration (Ellis et al., 2000), aerated granular filter (Bong-Yeon., 2005), ion