Decontamination and adsorption modelling of aqueous Pb$^{2+}$ and Co$^{2+}$ ions using natural inorganic materials: tripoli (NT) and bentonite (NB)

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ABSTRACT

Decontamination and adsorption modelling of Co$^{2+}$ and Pb$^{2+}$ ions from a model aqueous solution have been studied in batch system using natural tripoli (NT) and bentonite (NB). The adsorption study is controlled by a number of factors such as adsorbent dosage, contact time, initial metal ion concentration, and temperature effect. The adsorption equilibrium is achieved during the first 60 min. The maximum removal 97\% (approx.) is obtained at 10 g/L and 20°C. The dynamic isotherm has been successfully modelled by the Langmuir ($R^2 = 0.98$). The negative thermodynamic parameter $\Delta G$ indicates for the spontaneous adsorption. The pseudo-second-order kinetic model has much more reasonable for metal ions adsorption process ($R^2 = 1.0$ approx.).

Keywords: Lead; Cobalt; Tripoli; Bentonite; Langmuir isotherm; Adsorption modeling; Pseudo-second order

1. Introduction

Heavy metals are generally considered the most contaminant in the ecosystem. In particular, the presence of lead and cobalt in the environment has led to a number of environmental problems. The high level of these metals must be reduced to achieve the standard concentration before discharging to the environment. The discharge of cobalt and lead in the environment is a matter of concern for both toxicological and esthetical reasons [1–4]. According to the European Union (EU) has stated the limited standard concentration for lead (10 µg/L) and cobalt (below 5 µg/L) ions [5,6]. In general, the heavy metals may be introduced into the aqueous system by many industrial processes that involve metal in their productive cycle [7].

In order to solve the problem of heavy metals in the ecosystem, many treatment processes have been applied. The most common methods are precipitation, ion exchange, solvent extraction, photoextraction, ultrafiltration, reverse osmosis, electrodialysis, and adsorption [8].

Generally, the ion exchange and sorption by using natural adsorbents are reported to be the potential alternative for removing the heavy metal ions from aqueous mixtures. Recently, these alternatives have been chosen due to several reasons, for example, it is easy to be handled, low cost, and safe for the