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Adsorptive Removal of Manganese (II) from Aqueous Solution using Graphene Oxide: A Kinetics and Thermodynamics Study

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ABSTRACT

An excess amount of manganese is known to affect neurological toxicity. This study focused on adsorptive removal of Mn(II) using graphene oxide, which was carried out under optimum conditions after varying some experimental effects including pH, an incubation time and an initial concentration. It was demonstrated that Mn(II) adsorption follows both Langmuir and Freundlich isotherms. The maximum adsorption capacity for Mn(II) removal from an aqueous solution was 41.67 mg/g at pH 5 and their adsorption state was completed within 30 min. The adsorption kinetics was in accordance with pseudo second-order kinetic model. In thermodynamics diversion, changes in free energy, enthalpy and entropy were also studied. Overall, the adsorption process was exothermic and spontaneous in nature.

Keywords: Graphene oxide; Manganese; Adsorption isotherm; Thermodynamics; Kinetics

INTRODUCTION

Manganese (Mn) is an abundant element in the Earth's crust and its presence in water is a result of leaching process.[1] Although Mn is an essential nutrient element in living systems, an excess of Mn can result in toxic neurological effects, and there are many neurotoxic effects that cause a series of symptoms.[2-4] Therefore, it is necessary to remove Mn(II) contaminants particularly from wastewater before it is released back to the environment. The adsorption process is one of the most promising for removal of metal ions. However, several carbon-based adsorbents for metal removal from wastewater are still limited in their use because of low efficiency and adsorption capacity. In order to improve capacity and selectivity of the adsorption, new adsorbents have been developed. Among these, graphene oxide (GO) is increasingly used as a new choice for carbon-based adsorbents. There are many applications of GO for removal from water samples of toxic metals and dye pollutants such as Hg(II),[5] Pb(II),[6] As(V),[7] Cd(II),[8] Cr(VI),[9] Co(II),[10] malachite green[11] and alizarin red S[12]. However, there have