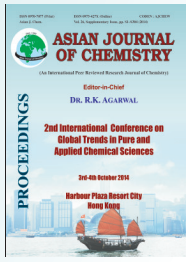
Asian Journal of Chemistry; Vol. 26, Supplementary Issue (2014), S85-S88

ASIAN JOURNAL OF CHEMISTRY

http://dx.doi.org/10.14233/ajchem.2014.19021



Removal of Hg(II) from Aqueous Solution Using Graphene Oxide as Highly Potential Adsorbent

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Published online: 24 December 2014; AJC-16444

Mercury and its compounds are neurotoxins, which simply cause any blockage of enzyme sites and interfere in related protein synthesis and generally found as much toxic metal contaminants in wastewater and environment. Removal of such metal ions by various adsorbents including chitosan, resins, ash, silica gel and activated carbon was reported. Presently, graphene oxide is one of the highly potential adsorbents used in numerous applications. Its main advantage consists of three main functional groups (carbonyl, hydroxyl and epoxide) on their surface giving anchored sites for metal ions complexation, namely for adsorption capabilities of Pb(II), Zn(II), Cu(II), Cd(II) and Co(II). The present study was thus subject to the adsorption of Hg(II) with graphene oxide compared with bare graphite. For an optimization study, the effects of pH solution (2-9), incubation time (10-240 min) and an initial concentration of Hg(II) (0.1-60 mg/L) were investigated. Mercury(II) ion was analyzed by FI-HGAAS. From the results, the adsorption capacity for Hg(II) removal from aqueous solution was 50.51 mg/g at pH 4.4 and their adsorption state was completed within 80 min. While bare graphite gave the adsorption capacity of 22.94 mg Hg(II)/g at pH 6.5 within 100 min. The adsorption isotherms of Hg(II) fit well with the Langmuir and Freundlich models for graphene oxide and bare graphite, respectively. It is demonstrated that graphene oxide can also be a highly potential adsorbent for toxic metals.

Keywords: Graphene oxide, Mercury(II), Adsorption capacity, FI-HGAAS.

INTRODUCTION

Some of toxic metals such as lead, cadmium, chromium and mercury contaminating in an environment are mainly released from industrial activities, for example; metallurgical and chemical manufacturing, automobile and battery factory and mining process[1-3]. When disposing of those toxic metals into the environments, they are bio-accumulated in an aquatic life[4-6]. Particularly a highly toxic and accumulative metal, mercury and its compounds are neurotoxins which cause blockage of the enzyme sites and interfere in protein syntheses. Moreover, the fate of inorganic mercury ion in nature is turning it into methyl mercury due to the aerobic action of microorganism[7] resulted in the food chain contaminated and further getting risk of human hazard. Thus, it is necessary to remove these metal contaminants from the wastewater before releasing into the environment to protect both environment and human being.

In the present, there are many removal methods of Hg(II) from wastewater such as coprecipitation, electrocoagulation, reduction reaction, membrane filtration, reverse osmosis, ion exchange, adsorption and other techniques[8-11]. Among these techniques, adsorption is the most promising process for the removal of metal ions from wastewater. Adsorption technique is basically relied on interactions between adsorbent and adsorbate. Several carbon-based adsorbents for metal removal include chitosan[12], longan shell[13], soybean stalk[14], resins[15], bamboo leaf powder[16], rice straw[17], rice husk ash[18], silica gel[19] and activated carbon[20-22]. However, disadvantages of these natural adsorbents are either low efficiency or low adsorption capacity, thus new adsorbents have been developed to maximize their adsorption property with higher capacity and selectivity.

Recently, graphene oxide is an alternative choice of the carbon-based adsorbents. It is an ideal adsorbent for wastewater treatment because of non-specific functional groups (carbonyl, hydroxyl and epoxide) on their surface providing anchor sites for metal ion complexation[2]. The abundance of the functional groups on the graphene oxide surface exhibits a capability of graphene oxide for metal adsorption such as Pb(II)[2], Zn(II)[23], Cu(II)[24], As(V)[25], Cd(II)[26], Cr(VI)[27] and Co(II)[28].

In this study, graphene oxide was prepared from commercial graphite and applied to remove Hg(II) from aqueous solution. An evaluation of the potential use of the graphene oxide for Hg(II) in a batch adsorption study was compared