Potential of Graphene Oxide on Removal of Contaminants from Solutions

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The potential of graphene oxide (GO) as an efficient adsorbent for contaminants, such as radionuclides (RN) and heavy metals has been studied in recent years with growing interest. Romanchuk et al. (2013) demonstrated that GO can effectively remove diverse RN from aqueous solutions. Wang et al. (2016) have highlighted the importance of separation of GO from solution after the adsorption process as a factor for cost reduction in large scale processes. Identifying the mechanisms that influence the adsorption process of heavy metals and RN onto GO is key to understanding the potential of this material in the industry.

This study focuses on the adsorption efficiency of RN (Co-60, Sr-85, Cs-137, Pb-210, Ra-226) in presence of sodium chloride (NaCl); and heavy metals, zinc (Zn), lead (Pb), copper (Cu) and cadmium (Cd) onto GO together with flocculants developed in-house* (F1, F2, F3, F4).

Adsorption efficiency is defined as the percentage of metal ion adsorbed by GO compared to its initial concentration in solution. Figure 1 shows that GO has very high adsorption efficiency for Pb-210 and moderate of Ra-226 in a multicomponent system and even with as high as 1M of NaCl, the pH of all samples is between 2 and 3. Low efficiency is observed for Co-60, Sr-85 and Cs-137. Figure 2 shows extremely high adsorption efficiency for all metals tested. The pH of samples containing GO and F1, F2, F3 and F4 were 7.3, 7.0, 7.9 and 7.7, respectively. The difference between Figure 1 and 2, may suggest that there are several mechanisms affecting the adsorption process, such as protonation of the surface of GO at low pH, competition between cations and concentration factors.

*Flocculants F1, F2, F3, F4 patent pending.

References

[1] Anna Yu. Romanchuk, A. S. (2013). Graphene oxide for effective radionuclide removal. *Physical Chemistry Chemical Physics*, 2321-2327.

[2] Xiangxue Wang, S. Y. (2016). Application of graphene oxides and graphene oxide-based nanomaterials in radionuclide removal from aqueous solutions. *Science Bulletin* , 1583-1593.

Figures

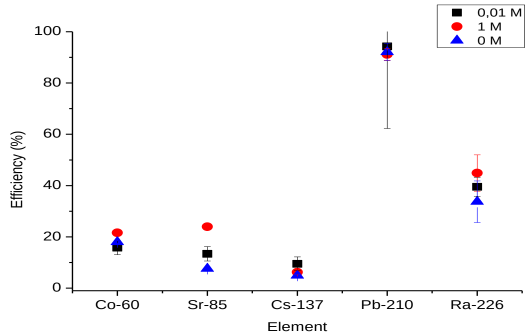

Figure 1: Adsorption efficiency (%) for Co-60, Sr-85, Cs-137, Pb-210 and Ra-226 on GO. Three concentrations of NaCl 0M, 0.01 M and 1M are shown. Total activity of RN is 100 Bq and concentration of GO 0.3 g/L

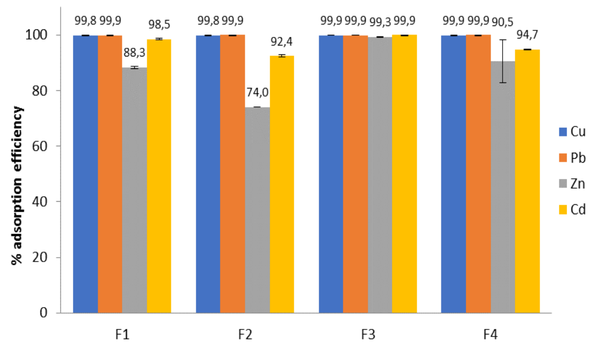

Figure 2: Adsorption efficiency (%) for Cu, Pb, Zn and Cd on GO together with F1, F2, F3, F4. Error bars represent two times the standard deviation from the three parallels. Concentration of metals 5 ppm, GO concentration 0.6 g/L and concentration of flocculants 0.6 g/L.