Polyvinyl Alcohol/Polysaccharide Hydrogel Graft Materials for Arsenic and Heavy Metal Removal

Md. Najmul Kabir Chowdhury,[a] Ahmad Fauzi Ismail,[a] Mohammad Dalour Hossen Beg,[b] Gurumurthy Hegde[c] and Rasool Jamshidi Gohari[a]

[a]Advanced Membrane Technology Research Center (AMTEC), Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia

[b]Faculty of Chemical and Natural Resources Engineering, Uiversiti Malaysia Pahang, Gambang, Malaysia

[c]BMS R and D Centre, BMS College of Engineering, Basavanagudi, India

ABSTRACT

Water pollution from arsenic and some other heavy metals has been reported all over the world. The goal of this investigation is to develop different polysaccharides–polyvinyl alcohol (PVA) hydrogel graft materials for the removal of toxic and carcinogenic arsenic (As) species as well as a series of heavy metals (Mn^{2+}, Cr^{2+}, Fe^{3+}, Ni^{2+}, Cu^{2+} and Pb^{2+}) from contaminated water. Hydrogels were developed with PVA and PVA/polysaccharide (as blended materials) using a γ-ray irradiation technique and then characterized by Fourier transform infrared (FTIR) and gravimetric methods. The absorbed dose of γ-radiation was optimized to obtain good gelation, and some important physical parameters such as gel fraction, degree of swelling and water absorption kinetics of the synthesized hydrogels were also investigated. The optimum absorbed dose of 30 kGy gave a gel fraction of about 98% in the PVA/corn starch (CS) hydrogel. The developed hydrogels have the capability to make chelates, which are utilized for the removal of arsenic and heavy metals. The absorption of arsenic and heavy-metal ions from the respective aqueous solution by the chelating functionalized gels has been assessed by atomic absorption spectrophotometry (AAS). The calculated maximum amount of iron and arsenic removal capacities of 37 075 and 22 112 mg kg^{-1}, respectively, were found for the PVA/CS hydrogel. We also found that polysaccharide (PS) analogues showed affinities toward the metal ions to a considerable extent in the following order: $Fe^{3+} > Mn^{2+} > Cu^{2+} >$. The results obtained from this study indicate that the functionalized hydrogels show a good chelating tendency and are suitable for water treatment.

KEYWORDS: Water pollution; Hydrogel

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