Efficient Removal of Uranium from Seawater by Gamma Radiation Induced Carboxymethyl Cellulose/ Sodium Styrene Sulfonate Hydrogel

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Introduction

Over the years, nuclear fuel made with uranium extracted from seawater is found one of alternatives to uranium ore mining in planning for the future of nuclear energy. However, the amounts present are very low, just only around three parts per billion [1]. Therefore, methods for extraction of uranium from seawater which do not have to be time-consuming and expensive are of great importance. There is currently a considerable amount of research being done on extracting uranium from seawater such as pumping or filtering systems but they have no interest and no future. And attention has therefore turned to using adsorbents from polymeric material with abundant adsorption sites that can collect the uranium in a promising way. Previous work shows that some functional groups such as cyano groups [2, 3, 4] were grafted onto polymer chain to converted to hydrogel containing amidoxime groups to increase not only the mechanical strength but also capacity of uranium adsorption. In the present work, a series of gamma radiation induced CMC/SSS hydrogels were prepared used as adsorbents for uranium adsorption from aqueous solution. CMC/SSS hydrogels were characterized. The parameters influencing the adsorption capacity of grafted gels such as SSS content, pH, contact time, and initial concentration were investigated

Experimental

A series of hydrogels were prepared by the following procedure. An aqueous solution of 20wt% CMC/SSS in paste-like state with w/w ratios of CMC/SSS were into PE tubes, that were irradiated in 20-100 kGy. The irradiated gels were extracted, washed with distilled water to remove un-reacted ingredients. The particles size fraction 5mm^3(~ 0.200 g) were chosen for all experiments. The obtained hydrogels were characterized by gel fraction, swelling ratio and IR spectroscopy and applied against the multi-element ion solution (Fluka, Sigma-Aldrich) and seawater with initial concentration of Uranium as shown in Table 1.

Table 1: Concentration of some metal ions in stock solution and seawater

Metal ion	Concentration (ppb)	
	Stock solution	Seawater [1]
Pb	10	0.03
Cd	3	0.1
Fe	300	2
U	**2**	**3.2**

Results and Discussion

CMC/SSS hydrogels were successfully prepared using gamma irradiation. FT/IR spectra of grafted gels have characteristic bands at 1034 and 1010 cm^{-1} (-SO_3Na group) while the bands detected at 1216 and 1160 cm^{-1} were due to S=O stretching vibration to confirm the presence of function groups responsible for the adsorption of uranium

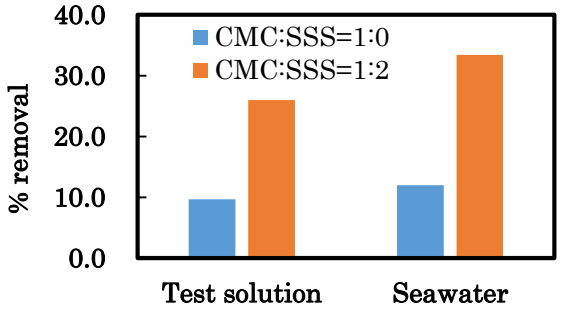

Fig. 1. Percentage removal of uranium

Fig. 1 shows the uranium removal of grafted CMC/SSS adsorbents. As can be seen, the CMC/SSS gels showed high percentage of uranium removal at equilibrium because there was the electrostatic interaction between the sulfonic group and uranium metal.

References.

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