R. Kumar, P. Malodia, M. Kachwaha, S. Verma*

Water Quality Management Group, Desert Environmental Science and Technology Division,
Defence Laboratory, Ratanada Palace Jodhpur, India

ADSORPTIVE AND KINETIC STUDIES OF RESIN FOR REMOVAL OF Cs^+ AND Sr^{2+} FROM AQUEOUS SOLUTION

Mixed bed resin was prepared using T-46 (H^+) and A-33 (OH^-) through mixing their ratio 1:1.6 and characterized by Fourier transform infrared scanning electron microscopy and energy dispersive X-Ray spectroscopy. The mixed bed resin was evaluated for the removal of cesium and strontium from contaminated water. The aim of our study was to find the suitable condition for removal of Cs and Sr ions from water under different conditions viz. initial concentration of Cs and Sr ions, contact time, dose of resin and pH. Cs and Sr ions, adsorption data are fitted well with Freundlich and Langmuir isotherm models. The adsorption capacity was 7.53 and 9.58 mg/g for Cs and Sr ions, respectively as obtained at initial concentration 10 mg/L by Langmuir isotherm. Adsorption kinetics was followed by pseudo-second order reaction. The rate constants of pseudo-second order reaction were calculated and quite high correlation coefficients R^2 98 – 99.5 were obtained. The resin also used for removal of Cs and Sr ions from tap water (TDS – 200 mg/L) and saline water (TDS – 2000 mg/L), and showed 90% (Cs) and 95% (Sr) removal at 10 mg/L of each ion concentration.

Keywords: adsorption isotherm, adsorption kinetics, cesium, strontium, mixed bed resin.

INTRODUCTION

The presence of toxic metal ions in the environment is a severe problem because of their acute and long term toxicity. These ions are present in water due to industrial applications such as the manufacture of pesticides, batteries, alloys, electroplated metal parts, mining, refining and production of textiles, paints and dyes [1, 2]. Nowadays, the major problem is that water may get contaminated with long-lived isotopes such as Cs, Sr and others. The sources of these radionuclides are operation of nuclear power plants, research facilities and the use of radioisotopes in industry and diagnostic medicine produce a wide variety of radioactive wastes [3 – 6]. Drinking water, if contaminated, will be a severe threat to military as well as to civilian population. Therefore the removal of radionuclides from water is a necessary requirement, as became evident from the events which have occurred in Ukraine (Chornobyl, 1986) and Japan (Fukushima, 2011) due to the industrial accident and eartquake, respectively.

Several methods have been developed and used to remove radionucleides from contaminated

* Для листування: rnunia@rediffmail.com

лям изотерм Фрейндлиха и Ленгмюра. Адсорбционная емкость составляла 7,53 и 9,58 мг/г соответственно для ионов Cs и Sr; данные получены при их начальной концентрации 10 мг/дм^3 по изотерме Ленгмюра. Кинетика адсорбции соответствовала реакции псевдовторого порядка. Рассчитаны константы скорости реакции псевдопервого порядка и получены достаточно высокие коэффициенты корреляции R^2 (98 – 99,5). Смола, использованная для удаления ионов Cs и Sr из водопроводной воды (минерализация – 200 мг/дм^3) и соленой воды (минерализация – 2000 мг/дм^3), обеспечила удаление 90% Cs и 95% Sr при концентрации 10 мг/дм^3 каждого иона.

Ключевые слова: изотерма адсорбции, кинетика адсорбции, цезий, стронций, смола со смешанным слоем.