J Radioanal Nucl Chem (2012) 294:81–86
DOI 10.1007/s10967-011-1539-3

Biosorption of radiotoxic ^{90}Sr by green adsorbent: dry cow dung powder

Nisha Suresh Barot · Hemlata Kapil Bagla

Received: 29 October 2011 / Published online: 20 November 2011

Abstract The present investigation entails the biosorption studies of radiotoxic Strontium (^{90}Sr), from aqueous medium employing dry cow dung powder (DCP) as an indigenous, inexpensive and, eco-friendly material without any pre or post treatments. The Batch experiments were conducted employing ^{90}Sr(II) as a tracer and the effect of various process parameters such as optimum pH, temperature, amount of resin, time of equilibration, agitation speed and concentration of metal ions have been studied. The kinetic studies were carried out employing various models but the best fitting model was Lagergren pseudo-second order model with high correlation coefficient R^2 value of 0.999 and cation exchange capacity of DCP was found to be 9.00 mg/g. The thermodynamic parameters for biosorption were evaluated as $\Delta G^\circ = -5.560$ kJ/mol, $\Delta H^\circ = -6.396$ kJ/mol and $\Delta S^\circ = 22.889$ J/mol K, which indicated spontaneous and exothermic process with high affinity of Sr(II) for DCP.

Keywords Biosorption · Radiotoxic strontium · Dry cow dung powder · Green adsorbent

Introduction

In the domain of toxic radionuclide persisting in our environment, ^{90}Sr is considered as one of the most hazardous fission product due to its long physical half-life of 29 years [1] and its inevitable presence in the water, soil and food chain. The anthropogenic activities such as nuclear weapon testing, reprocessing of liquid spent fuel, etc. are major source of ^{90}Sr in our environment. Strontium is referred as a bone seeker as it imitates the calcium in the human body and increases the risk of bone cancer, leukemia, etc. [2]. On the contrary, if managed scientifically, it has also been proved to be aiding to mankind. ^{90}Sr has been used as a power source for radioisotope thermoelectric generators (RTGs), as well as used in cancer therapy and in forensic sciences [3]. Hence, there is a great necessity to adapt a methodology which can be employed for the eco-friendly removal of ^{90}Sr from the aqueous system with a view of reprocessing the same and to reap out its aforementioned benefits.

In the field of radionuclide research, some of the well established processes such as chemical precipitation, membrane process, liquid extraction, and ion exchange [4, 5] have been applied as a tool for the removal of this metal ion. These all methods are not considered to be greener due to some of their shortcomings such as incomplete metal ion removal, high requirement of energy and reagents, generation of toxic sludge or other waste materials which in turn require treatments for their cautious disposal. Eventually, it adds on to the cost, time and feasibility of the entire procedure.

The greener and cleaner approach of biosorption is a sure solution to this situation. Biosorption phenomenon is acquiring strong footage due to its mechanism based on non-directed physico-chemical interactions that occur between metal species and dead biomass. Biosorption deals with both living biomass as well as non-living aggregates of biomaterial. But biosorption by dead biomass is often faster [6], since only passive cell wall based binding transport, into the cell takes place.

N. S. Barot · H. K. Bagla (✉)
Department of Nuclear & Radiochemistry, Kishinchand Chellaram College, 124 D. W. Road, Churchgate, Mumbai, Maharashtra, India
e-mail: hemabagla@gmail.com

N. S. Barot
e-mail: barot_nisha@hotmail.com