Author's personal copy

J Radioanal Nucl Chem
DOI 10.1007/s10967-014-3334-4

Biosorptive profile of synthetic and natural humiresin for the remediation of metallic water pollutants

Nisha S. Barot · Roshan P. Khilnani · Hemlata K. Bagla

Received: 25 June 2014
© Akadémiai Kiadó, Budapest, Hungary 2014

Abstract To evaluate the bioremediation efficiency of natural humic substances, over it's synthetic counterpart, a comparative batch equilibration biosorption assay have been carried out employing radiotracers on different humiresins. The biosorptive profile of various humiresins as devised hereby, attempts to justify an innovative and concrete role of dry cow dung powder (DCP), in 'as it is form', for the bioremediation of metal pollutants such as Cr(III), Cr(VI), Cd(II), Hg(II) and Sr(II). Our comparative results conclude that, with all other optimized parameters as obtained 100 mg of DCP removes Cr(III) at pH 6, Cd(II) at pH 3 and Hg(II) at pH 3 to 70–75 and 80–85 % respectively. Also, at pH 1 with 250 mg of DCP 70–75 % Cr(VI) is removed. Similarly, 90–95 % of Sr(II) is sequestered at pH 6, with 350 mg of DCP. The study on thermodynamic, kinetic and isotherm modelling of DCP indicates feasible, eco-friendly and efficient process.

Keywords Metal toxicity · Humic substances · Bioremediation · Dry cow dung powder · Humiresin

Introduction

The metal toxicity in hydrosphere has upsurged the need to explore the methods for combating against hydro-hazards. In the field of remediation of heavy metal pollutants as well radionuclides, some of the well-established processes such as chemical precipitation, membrane process, liquid extraction and ion exchange [1] have been applied. All these 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 effective recycling of the metals by biological system initiated the field of Biohydrometallurgy. It is a technical area that is based on specific interactions between biomatrix and minerals or metals to be extracted from raw materials [2]. There are three principal advantages of biological technologies for the removal of pollutants; firstly, biological process can be carried out in situ at the contaminated site, second, bioprocess technologies are all usually benign to environment, and lastly, they are cost effective. One such important and widely studied field is biosorption, where certain types of dead biomass are able to bind and concentrate metals from even very dilute aqueous solutions. It can be defined as a process, metabolism-independent, passive, physico-chemical binding of metal ions involving non-living biomass [3].

Humic substances (HSs) are ubiquitous in all the system and are foremost compound of each non-living natural organic matter. It is a heterogeneous mixture of morphologically changed degradation products of biomolecules which on humification give rise to a family of amorphous, polyelectrolytic, polydisperse and colloidal compounds [4]. Humification is highly sensitive to pH, temperature and climatic conditions. They possess a unique conjugated chelate (keto–enol) moiety that changes the structure of humic acids depending on their environment [5]. HSs have a large number of hydrophilic functional groups: carboxyl (–COOH), phenolic and/or hydroxyl (–OH), carbonyl

N. S. Barot · R. P. Khilnani · H. K. Bagla (✉)
Department of Nuclear and Radiochemistry, Kishinchand Chellaram College, D.W. Road, Mumbai 400 020, Maharashtra, India
e-mail: hemabagla@gmail.com

Published online: 27 July 2014