BMC Chemistry

RESEARCH ARTICLE

Open Access

Synthesis of molecularly imprinted polymer for removal of Congo red

Syed Rizwan Shafqat[1], Showkat Ahmad Bhawani[1*], Salma Bakhtiar[1] and Mohamad Nasir Mohamad Ibrahim[2]

Abstract

Congo red (CR) is an anionic azo dye widely used in many industries including pharmaceutical, textile, food and paint industries. The disposal of huge amount of CR into the various streams of water has posed a great threat to both human and aquatic life. Therefore, it has become an important aspect of industries to remove CR from different water sources. Molecular imprinting technology is a very slective method to remove various target pollutant from environment. In this study a precipitation polymerization was employed for the effective and selective removal of CR from contaminated aqueous media. A series of congo red molecularly imprinted polymers (CR-MIPs) of uniform size and shape was developed by changing the mole ratio of the components. The optimum ratio (0.1:4: 20, template, functional monomer and cross-linking monomer respectively) for CR1-MIP from synthesized polymers was able to rebind about 99.63% of CR at the optimum conditions of adsorption parameters (contact time 210 min, polymer dosage 0.5 g, concentration 20 ppm and pH 7). The synthesized polymers were characterized by various techniques such as Fourier Infra-red spectroscopy (FTIR), scanning electron microscopy (SEM), Thermogravimetric analysis (TGA), energy-dispersive X-ray spectroscopy (EDX), and Brumauer–Emmett–Teller (BET). The polymer particles have successfully removed CR from different aqueous media with an efficiency of about ~ 90%.

Keywords: Congo red, Synthesis, Molecularly imprinted polymer, Removal, River water

Introduction

Dyes are important ingredients in many industries such as textile, paints, cosmetics, pharmaceuticals, papers and printing [1]. They are capable of causing various harmful effects (toxicity, carcinogenic and mutagenic) on both human and aquatic life [2]. The colored effluent can reduce the oxygen levels in water and can affect photosynthetic processes of aquatic plants that resulted in the damage of aquatic flora and fauna [3, 4]. Congo red (CR) is an anionic dye and is widely being used in many industries. The elimination of CR from polluted water is important because it can be metabolized to carcinogenic agents (benzidine derivatives) if persisted. Therefore, different physical and chemical methods have been used for the removal of dyes from effluents such as chemical precipitation [5], chemical oxidation [6], adsorption [7], microbial or enzymatic treatment [8], and photo catalysis [9], mineral composites [10], natural sorbent materials [11, 12].

The need of more specific method for the removal of Congo red from different sources of water is essential. Therefore, molecularly imprinted polymers are the right choice for the removal of various pollutants from water effluents because of selectivity and specificity of method. MIPs are synthetic highly cross-linked materials with high ability to recognize and bind target molecules with specificity and affinity comparable to those of natural receptors [13–15]. Because of many advantages of MIPs such as specific recognition, chemical stability, and comparatively cheap and easy preparation [16] they have been widely employed for a variety of applications such as separation [17] solid-phase extraction (SPE) [18] sensors [19].

*Correspondence: sabhawani@gmail.com; bshowkat@unimas.my
[1] Faculty of Resource Science and Technology, Universiti Malaysia Sarawak (UNIMAS), 94300 Kota Samarahan, Sarawak, Malaysia
Full list of author information is available at the end of the article