Application of response surface methodology for optimization of cadmium (II) in aqueous solution by chitosan/MCM-41

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Abstract
In this study, removal of cadmium from aqueous solution was conducted by chitosan and MCM-41 nano composite. Response surface methodology (RSM) was used for modeling and optimizing the process, and to gain a better understanding of the process performance. Centered Composite Design (CCD) was used as the experimental design .Parameters effects such as temperature, pH, contact time, initial Cd(II) concentration and adsorbent dose on the adsorption process were studied. The numerical optimization revealed that the optimum removal (87.15%) obtained at ct/mcm-41 dosage of 0.1g, initial Cd (II) concentration of 20 mgL^{-1}, contact time of 30 min, temperature 30^0c and pH of 6.

Key words: Aqueous solution, Cd (II) removal, Response surface methodology

1. Introduction

Heavy metals represent a group of dangerous environmental pollutants that due to their toxic effects on human health in concentrations above the permissible limits cause widespread concerns [1]. Cadmium (II), as an example of toxic metals, is of significant environmental concern due to high mobility [2].

According to the guidelines of the World Health Organization, the allowable limit of cadmium in water is 0.003 mg/L. This stringent limit of cadmium in potable water is due to cadmium's severe toxicity and effect on the health of humans, animals and plants. Moreover, cadmium has been found to accumulate primarily in the kidneys and has a relatively long biological half-life of 10 to 35 years in humans. It is believed that the kidneys are the target organs for cadmium toxicity [3].

A potential source of cadmium contamination in drinking water is industrial wastewater. Industrial sources include the waste from the manufacturing processes of smelting, pesticides, fertilizers, dyes, pigments, refining, textile operations, etc [4].

Several technologies, such as electro coagulation process, ion exchange, emulsion liquid membrane, reverse osmosis processes and adsorption have been tested for heavy metal removal from the industrial wastewater to decrease their impact on the environment. Nevertheless, the adsorption seems to be the most suitable method for the removal of metals in the case of low concentration due to low cost and high efficiency.Many adsorbents such as activated carbon, clays, metal oxides, silica , zeolite and chitosan have been used for the metals removal [5-7].

Chitosan (CS) is a cationic biopolymer obtained from deacetylation of chitin which is the second most abundant biopolymer in nature [8,9]. Chitosan has received considerable attention