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Adsorption of Cd^{2+} Ions by Modified Chitosan with 3, 4-Dihydroxy Benzoyl Groups

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In recent years, much attention has been focused on the contamination of aquatic media by heavy metals; because heavy metals are highly toxic even at low concentrations and can accumulate in living organisms, causing various disorders and diseases [1]. Several methods have been attempted to remove heavy metals from waste water such as chemical precipitation, filtration, membrane separation, electrochemical treatment, ion exchange, and adsorption [2–4]. Chitosan (CS) is well known as an excellent natural biosorbent of heavy metal ions, dyes and proteins because its amino and hydroxyl groups may serve as coordination sites to form complexes with various heavy metal ions such as Cu(II), Ni(II), Pb(II), Cr(IV) [5,6]. Considering the interaction of chitosan with metals the reaction may be described by:

$$\text{Chitosan} + M^{n+} \rightarrow (\text{Complex})^{n+}$$

The amino and hydroxyl groups of chitosan can act as a reactive site for chemical modification. In order to increase the adsorption capacity of chitosan, and to improve the adsorption selectivity of metal ions, several chemicals with certain functional groups have been loaded on chitosan such as isatin, diacetylmonoxime, thiourea and maleic anhydride [7-9]. previously, N-di and trihydroxy benzoyl chitosan nanoparticles were prepared and studied theirs capability in the removal of Cu^{2+}, Zn^{2+}, Pb^{2+} and Ca^{2+} ions from aqueous solution [10].

Cadmium is one of the heavy metals, which is highly toxic to humans, plant and animals. The metal is of special concern because it is non-degradable and therefore persistent. It was found that the adsorption capacity of Cd^{2+} from aqueous solutions on N-Dihydroxy Benzoyl chitosan (CS-DHBA) nanoparticles are higher than that on CS at different initial Cd^{2+} concentrations.

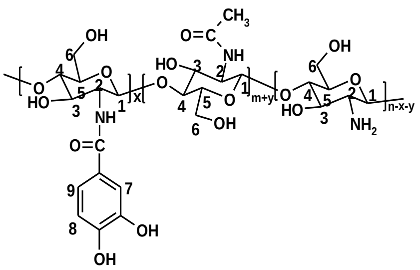

Figure 1: CS-DHBA

Adsorption equilibrium experiments were carried out as a function of contact time, ratio, pH, temperature and coexisting ions. The equilibrium time of Cd^{2+} adsorption was found to be 60 min. The maximum adsorption capacity was found within each optimal pH range and maximum adsorption capacity of Cd^{2+} took place at the pH 5.8. The percentage removal of Cd^{2+} decreased with the rise in temperature from 288 to 328 K which identified its exothermic nature and Cd^{2+} binding strength increased as the temperature decreased. The maximum adsorption capacity of Cd^{2+} was 42.64 mg/g at 288 K. The adsorption of Cd^{2+} was found to be fitted the Langmuir isotherm model, which suggests monolayer coverage of adsorbent surface [11]. Kinetic study obeyed pseudo-second order model, which indicates chemisorptions as the rate limiting step in adsorption process. This study showed that N-Dihydroxy Benzoyl chitosan (CS-DHBA) could be used as good adsorbent material for Cd^{2+} removal from aqueous solution.

References

1. Zhou L, Wang Y, Liu Z, Huang Q. Characteristics of equilibrium, kinetics studies for adsorption of Hg(II), Cu(II), and Ni(II) ions by thiourea-modified magnetic chitosan microspheres. J Hazard Mater. 2009; 161: 995-1002.
2. Naim MM, Abdel Razek HEM. Chelation and permeation of heavy metals using affinity membranes from cellulose acetate–chitosan blends. Desalin Water Treat. 2013; 51: 644–657.
3. Kavak D. Removal of lead from aqueous solutions by precipitation: Statistical analysis and modeling, Desalin. Water Treat. 2013; 51: 1720–1726.
4. Shafaei A, Ashtiani FZ, Kaghazchi T. Equilibrium studies of the sorption of Hg (II) ions onto chitosan. Chem Eng J. 2007; 133: 311–316.
5. Chen AH, Liu SC, Chen CY, Chen CY. Comparative adsorption of Cu(II), Zn(II), and Pb(II) ions in aqueous solution on the cross linked chitosan with epichlorohydrin. J Hazard Mater. 2008; 154: 184-191.
6. Ngah WS, Fatinathan S. Pb(II) biosorption using chitosan and chitosan derivatives beads: equilibrium, ion exchange and mechanism studies. J Environ Sci (China). 2010; 22: 338-346.
7. Monier M, Ayad DM, Wei Y, Sarhan AA. Adsorption of Cu(II), Co(II), and Ni(II) ions by modified magnetic chitosan chelating resin. J Hazard Mater. 2010; 177: 962-970.
8. Zhou L, Wang Y, Liu Z, Huang Q. Characteristics of equilibrium, kinetics studies for adsorption of Hg(II), Cu(II), and Ni(II) ions by thiourea-modified magnetic chitosan microspheres. J Hazard Mater. 2009; 161: 995-1002.
9. Guo TY, Xia YQ, Hao GJ, Zhang BH, Fu GQ, Yuan Z, et al. Chemically modified chitosan beads as matrices for adsorptive separation of proteins by molecularly imprinted polymer. Carbohydr Polym. 2005; 62: 214–221.
10. Taghizadeh MT, Bahadori A. Preparation, characterization and adhesive properties of di- and tri-hydroxy benzoyl chitosan nanoparticles. Chinese Journal of Polymer Science. 2013; 31: 649-659.
11. Ibrahim SC, Hanafiah MAKM, Yahya MZA. Removal of Cadmium from aqueous solutions by adsorption onto sugarcane bagasse. American-Eurasian J Agric & Environ Sci. 2006; 1: 179-184.

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