

## Review and Performance of Chitosan and the Resulting Compounds as Adsorbents

Sepehr Azizkhani<sup>1</sup>, Nader Mokhtarian<sup>2\*</sup>, Sepanta Dokhani<sup>3</sup>, Mohammad Javad Akbarzadeh<sup>4</sup>

<sup>1</sup> Departments of Chemical Engineering, Shahreza Branch, Islamic Azad University, Shahreza, Iran

<sup>2</sup> Department of Chemical Engineering, Islamic Azad University, Shahreza Branch, Esfahan, Iran

<sup>3</sup> Young Researchers Club, Shahreza branch, Islamic Azad University, Shahreza, Iran

<sup>4</sup> Departments of Chemical Engineering, Shahreza Branch, Islamic Azad University, Shahreza, Iran

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### ABSTRACT

Chitosan is a good absorber for removing cationic and anionic dyes as well as the removal of heavy metals ions. Chitosan and bio polymers is used for water purification and sterilization in recently years, for removal some materials that are harmful for human body even at low concentrations.

Chitin is one of the most materials in the earth extract from crustacean shell such as prawns, crabs, shrimp, fungi and other crustaceans chitosan has a certain reputation for many reason like :absorption properties, no toxicity, ability to decomposition, stabilize of enzymes.

The use of chitosan have a high speed and is an economically and efficiently. chitosans are for separation of materials such as copper, zinc ,chrome ,iron nickel ,cadmium ,mercury that is debated mechanism to coordinate the metal ions with an amino group. Each of the ions separate in special conditions that related to elements like: ion adsorption on the surface ,chemical absorption ,PH, rate mix ,temperature ,concentration.

**KEYWORDS :** Chitosan , adsorption heavy ion, separation , effect of PH in separation

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### 1. INTRODUCTION

Heavy metals in water has created many environmental problems that some of this ions have irreversible damage to human health as injury to the nervous system and kidney. Remove heavy metals are very important that there are many ways that chitosan is one of the best way.<sup>1</sup>

Chitosans are derived from glucan with repeating chitin units that was found with boil chitin in KOH solution by roget in 1895.chitin is a mucopoly saccharides that be found wide in exoskeletons of crustaceans such as lobster ,shrimp ,crab and in yeasts too.<sup>2</sup>

To improve chitosans performance specially adsorbent ,referrals such as epichlorohydrin and glutaraldehyde have been used cross-linking agent stabilize chitosan in acid solution and also enhance its mechanical properties.

#### Chitosan properties

Because chitosan has a special structure ,special properties that are used in various industries.

##### 1-LipoPHilic properties

Cellules, chitosan has a structure similar to that of a free amino group is available cellulose is a plant fiber that has a hydro PHilic property ,but because chitosan has amino group it has low lipid friendship for properties of chitosan.it use in various industries including the construction of anti fat and anti cholesterol.

##### 2-Ability to retun th the environment

Chitosan is a natural structure that can be hydrolyzed by the enzyme chitosanaz .if it gets in to the environment and hydrolyzed by the enzyme is converted to units of mono saccharides.

##### 3-Environmenta sustainability

Chitosan is a natural biopolymer bio compatibility that if entrance to the environment do not contaminate it

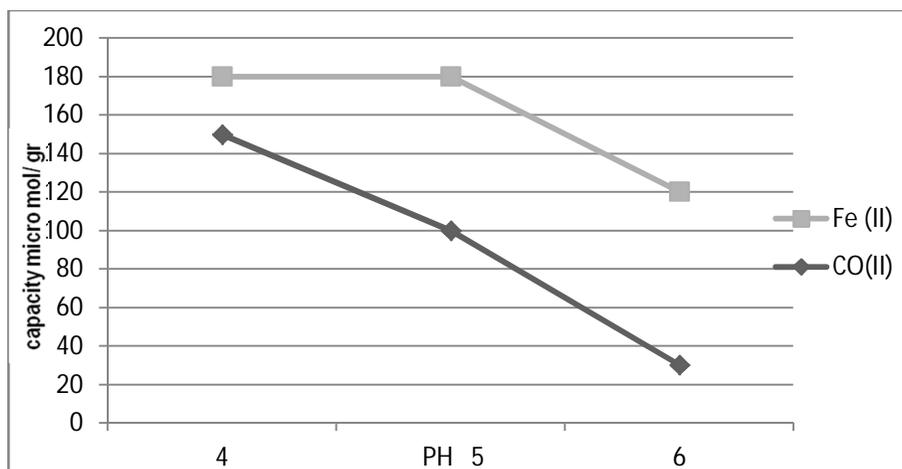
#### Effect of PH

Chitosan is very sensitive to PH and it can separate with the two models: as the gel and as the solution.

Low –acid solution PH is reason to increase the capacity of environmental adsorption and with stand the acidic environment

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\*Corresponding Author: Nader Mokhtarian, Department of Chemical Engineering, Islamic Azad University, Shahreza Branch, Esfahan, Iran



**Fig 1. Adsorption capacity by chitosan**

Chitosan is hydrophilic and cationic and in suitable range of pH has an optimum adsorption that is different for each ion generally with increase of pH protein decrease and cross linker help to improve adsorption capacity.

Improper methods for control of metal ions in wastewater may increase the risk for humans in the long term, toxic heavy metal ions that discharged from chemical industries include chromium, cadmium and mercury<sup>3</sup>.

### Combinations of chitosan

#### 1. Chitosan compounds of alumina ceramics

Chitosan alumina ceramics remove an ionic and cationic heavy ions such as: AS(III), AS(V), Cr(VI), NI(II). Oxalic acid is used in this process act as a bridge between alumina and chitosan, while others use the amine link.<sup>4</sup>

#### 2. Chitosan compounds cotton fiber composites.

Cotton is a natural cellulosic fiber that has some useful properties such as soft, comfort, absorbency and good strength. In this compound hydroxyl group in cellulose allow hydrogen create between two polymer links.<sup>5</sup>

#### 3. Magnetite composite chitosan

Magnetite adsorption capacity for the adsorb of some radio nuclides. magnetite iron oxide such as  $\text{Fe}_3\text{O}_4$ ,  $\text{Fe}_2\text{O}_3$  can be renovated to have a better magnetic properties, with low toxicity and low price, that with cross linking such as epichlorohydrin has a more adsorption capacity.<sup>6</sup>

4-Polyvinyl alcohol (PVA) composite with chitosan

PVA is a highly hydrophilic, non toxic and pH stability according to the highly polar nature of the PVA has a minimize sediment. Because hydrophobic balance, which is include natural compounds, force non-polar surfaces to absorb pollutants<sup>7</sup>.

5- Polyvinyl chlorid (PVC) with chitosan

PVC has high surface and good physical and chemical stabilities. Additionally the surface of pvc is a good area for adsorb metal ions efficiently.<sup>8</sup> We can cover this surface with sodium dodecyl for separate of nickel and copper.

### Conclusion

This paper indicates that the adsorption using chitosan composite are becoming alternative formula adsorption in removal dyes and heavy metal ions.

Modified chitosan's ability to adsorb heavy metals from aqueous solutions was offered by Langmuir.

Totally, cross linking or alternatives of chitosan led to a notification decrease in adsorption ability that should use hydroxyl or carboxyl and amino group for effective adsorption.

### REFERENCES

- [1] Kumar, M. N. V. R. (2000). A review of chitin and chitosan applications. *Reactive & Functional Polymers*, 46, 1–27
- [2] On chitosan dowex A-1 and zerolit 225. *Journal of Applied Polymer Science*, 67, 1067–1070.
- [3] Wan Ngah, W. S., Ariff, N. F. M., Hashim, A., & Hanafiah, M. A. K. M. (2010). Malachite Green adsorption onto chitosan coated bentonite beads: Isotherms, kinetics and mechanism. *Clean—Soil, Air, Water*, 38, 394–400.

- [4] Veera, M. B., Krishnaiah, A., Ann, J. R., & Edgar, D. S. (2008). Removal of copper(II) and nickel (II) ions from aqueous solutions by a composite chitosan biosorbent. *Separation Science and Technology*, 43, 1365–1381.
- [5] Qu, R. J., Sun, C. M., Wang, M. H., Ji, C. N., Xu, Q., Zhang, Y., et al. (2009). Adsorption of Au(III) from aqueous solution using cotton fiber/chitosan composite adsorbents. *Hydrometallurgy*, 100, 65–71.
- [6] Huang, G. L., Zhang, H. Y., Jeffrey, X. S., & Tim, A. G. L. (2009). Adsorption of chromium(VI) from aqueous solutions using cross-linked magnetic chitosan beads. *Industrial & Engineering Chemistry Research*, 48, 2646–2651.
- [7] Carroll, T., Booker, N. A., & Meier-Haack, J. (2002). Polyelectrolyte-grafted microfiltration membranes to control fouling by natural organic matter in drinking water. *Journal of Membrane Science*, 203, 3–13.
- [8] Srinivasa, R. P., Vijaya, Y., Veera, M. B., & Krishnaiah, A. (2009). Adsorptive removal of copper and nickel ions from water using chitosan coated PVC beads. *Bioresource Technology*, 100, 194–199.