REMOVAL OF CADMIUM(II) BY NATURAL ABSORBENTS

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Removal of cadmium cations from aqueous solution by natural absorbents like chitin, chitosan and bentonite has been investigated. The effect of different parameters like optimum absorbent dose, contact time of absorbent and cadmium (II) solution, and effect of different concentration of absorbent on cadmium solutions investigated. Various concentrations of cadmium solutions evaluated by atomic absorption. Redution of Cadmium (II) concentration after contacting with chitosan absorbent showed the efficiency of this absorbent in the extraction of cadmium even in the solution with cadmium concentration over than 200 ppm.

The pollution of water occurs due to the existence of toxic metals and organic compound and it causes serious problems for humans and environment, since, for example, chromium (VI) is known as a toxic material for bacteria, vegetation, animals and human beings. Most of the international drinking water standards are within 0.005-0.01 ppm cadmium and 5 for ppm zinc [1, 2]. Standards of using proper methods for removing toxic products from wastewaters are approved by severe rules, these methods are like: biological refinements of organic pollutants [3-4,], membrane method [5-6], advanced oxidation methods [7,8], chemical and electrochemical technique [9,10] and absorption method by different absorbents have been investigated widely. Among these methods, adsorption methods for removal of metals are used widely and investigated at presence of different adsorbents like carbon active [11], zeolites [12], clay [13], silica granules [14] and organic polymer materials [15]. Because of requires to low-cost adsorbents sources, increasing volume of trash and high-cost of irreversible synthetic resins, chitosan is one of the most effective materials in the refinement process of wastewaters and in this study chitosan was examined specifically.

EXPERIMENTAL SECTION

All experiments were done by using chitin, chitosan and bentonite as adsorbents but the study focused on chitosan more than others. Cadmium (II) solutions with certain concentration were prepared by cadmium powder, so alternation of cadmium solutions at different conditions were investigated thorough atomic absorption. HCl 1% solutions, which were prepared from HCl 37% (Merck), were utilized for preparing cadmium solutions. For making all solutions deionized water was used.

Basic adsorption experiments were conducted at a constant temperature room (23^0C) on a three-dimensional shaker. The solid-liquid system consisted of 20 ml cadmium solution, which contained 50 ppm amount of adsorbent which was located on shaker at certain pH and time. Then the mixture was filtered and cadmium ions concentration in filtrate measured by atomic absorption Perkin (analys 100 model). For drawing the standard calibration figure of the apparatus, cadmium solutions with 1, 20, 50 and 100 ppm were used. To obtain standard solution 100 ppm of cadmium ions, 5 ml of concentrated HCl was added to 0.1 grams of cadmium powder and the sample diluted by HCl 1% (v/v).

RESULTS AND DISCUSSIONS

To examine special methods of chitosan and compare it with other absorbents like chitin and bentonite, cadmium solution with 50 ppm concentration contacted with 0.25 grams of absorbents. Table 1 shows the effect of different absorbents on removal of cadmium. It is evident that chitosan is effective in removing cadmium from solution.

Effect of different absorbents on removal of cadmium

Absorbent	Chitosan	Chitin	Bentonite
Cadmium concentration (ppm)	18	35	30

Some conditions fixed like pH, contact time and room temperature, dependency of absorbent dose to remove cadmium ions from solution with 50 ppm concentration has been studied (Fig.1). Experiments show that increasing chitin and chitosan dose from 1 to 1.5 grams has no effect or has a little effect on removal of cadmium. Furthermore, using greater amounts of absorbents creates problems in the filtration processes of solution. Maximum absorbent sites in the certain amount of it were involved, that is why the value of absorbed cadmium on the surface of absorbent, after determining optimum dose of absorbent, remains constant, and so the ratio of free cadmium ions in the solution to absorbed ions remained invariable.

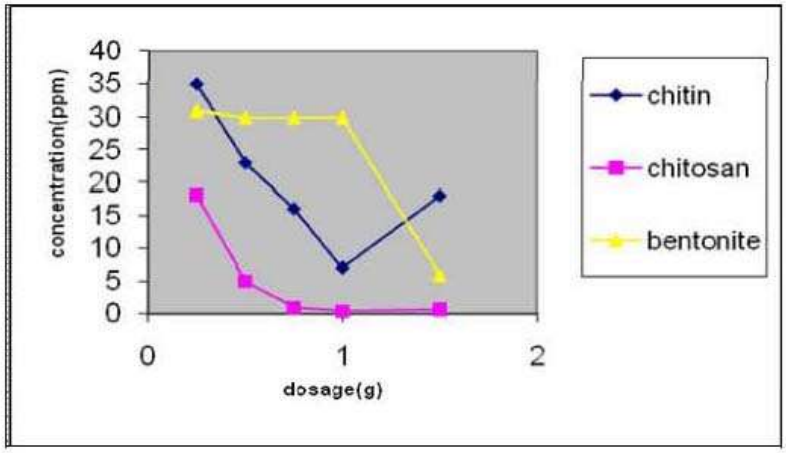

Figure 1. Effect of absorbent dose used for removal of cadmium cations

Increase of contact time between absorbent and cadmium (II) solution, before they reach equilibrium state, led to the increase of absorbed ions. This result was obtained in consideration that some parameters like: pH, amount of absorbent dose and room temperature are constant. Results show that the optimum adsorption time for chitin occurs at 150 min, but optimum adsorption time for chitosan is 30 min and for bentonite increasing contact time has no effect on removal of cadmium from solution (Fig 2). After reaching the equilibrium state, because the maximum accessible sites of the absorbent are occupied by cadmium cations, the ratio of cadmium ions in the solution to the absorbed cadmium ions on chitosan remains invariable.

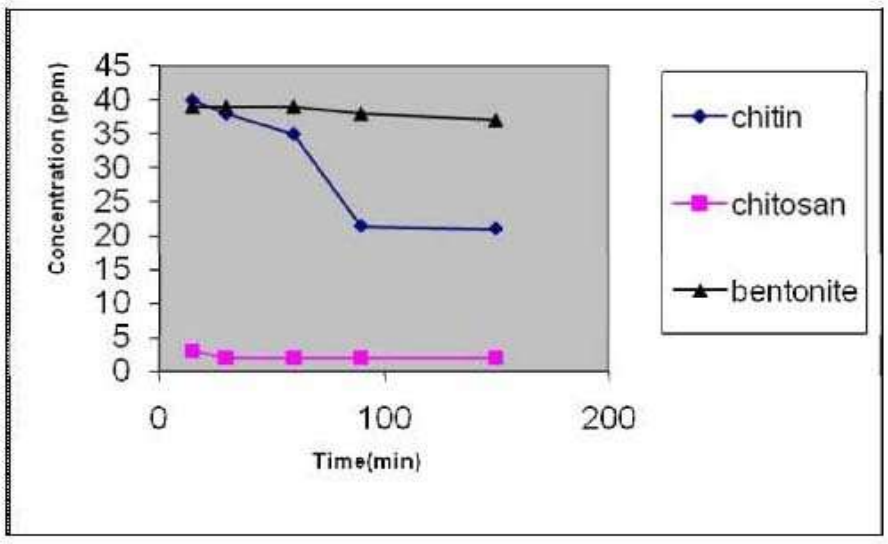

Figure 2. Effect of contact time on removal of cadmium (II) by different absorbents

According to the optimum conditions which were obtained in the previous sections for chitosan, 0.5 grams of chitosan was shacked with 20 ml of cadmium (II) solution with different concentration of 5, 10, 50, 100, 500 ppm for 30 minutes. Then mixtures were filtered and cadmium concentrations in filtrates were measured by atomic absorption. At concentrations lower than 50 ppm removing action was successfully done according to the international standards and cadmium concentration gain to determination limit of ppm.

CONCLUSION

Removal of cadmium (II) from solution can be done by chitosan more effectively. Optimum pH for these experiments was 2 and optimum absorbent dose was 1 gram in 20 ml of solution. Optimum contact time between absorbent and cadmium (II) solution for chitosan was 30 minutes. In the solutions with 50 ppm concentrations, removing action at optimum conditions of experiments was done successfully and cadmium concentration reached required limit of ppm.

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TƏBİİ ABSORBENTLƏRLƏ KADMİUM(II) İONLARININ AYRILMASI

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Kadmium(II) ionlarının sulu məhluldan təbii absorbentlər olan xitin, xitozan və bentonitlə sorbsiyası tədqiq olunmuşdur. Sorbsiya prosesinə absorbentin miqdarının, cadmium ionlarının qatılığının, sorbsiya müddətinin təsiri öyrənilmişdir. Kadmium ionlarının qatılığı atom absorbsiya metodu ilə təyin edilmişdir. Kadmium ionlarının qatılığı hətta 200 mq/l-dən cox olan məhlullardan onun ayrılmasında xitozan daha yüksək effektivlik göstərir.

ИЗВЛЕЧЕНИЕ ИОНОВ КАДМИЯ(II) ПРИРОДНЫМИ АБСОРБЕНТАМИ

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Исследовано извлечение ионов кадмия(II) из водных растворов с помощью природных абсорбентов - хитина, хитозана и бентонита. Изучено влияние количества абсорбента, концентрации ионов кадмия и времени на процесс сорбции. Концентрация ионов кадмия определена методом атомной абсорбции. Наибольшую эффективность в извлечении кадмия из растворов проявляет хитозан, он эффективен даже при концентрации ионов кадмия в растворах более чем 200 мг/л.