شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

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تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

HANAA ALY

Modern Techniques and Methods for the Removal and Assessment of Some Environmental and Industrial Pollutants

Submitted by

Awaad Hussein Awaad Aboterikea
(M.Sc., 2006)

A Thesis Submitted for the Ph.D. Degree

InChemistry

Chemistry Department,
Faculty of Science,
Ain Sham University

2021

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M.Sc. (Chemistry)1994

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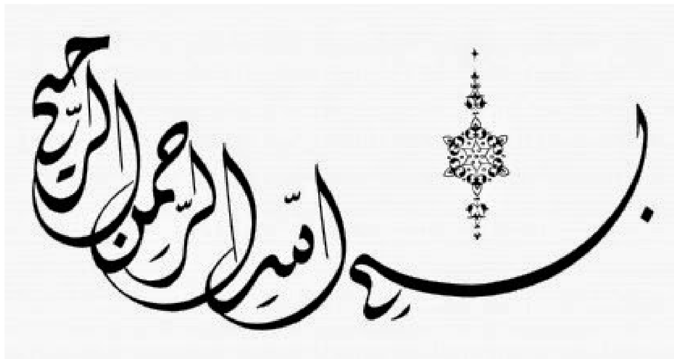
2021



رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ
وَعَلَىٰ وَالِدَيَّ وَأَنْ أَعْمَلَ صَالِحًا تَرْضَاهُ وَأَدْخِلْنِي
بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ

صدق الله العظيم

النمل الاية ١٩

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Removal of barium and strontium from wastewater and radioactive wastes using a green bioadsorbent, *Salvadora persica* (Miswak)

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ABSTRACT

The adsorption ability of *Salvadora persica* (Miswak) root powder was tested as a green biosorbent for the removal of barium and strontium from wastewater and radioactive wastes. The structure of the powder SP(M) and its chemical properties were characterized and evaluated by Fourier transform infrared spectrometry and scanning electron microscope morphology. The adsorption efficiency has been investigated as a function of pH, contact time, adsorbent dose, and initial metal ions concentration. The experimental data were analyzed using equilibrium isotherm, and kinetic models. The isotherm data agreed fairly well with Langmuir and Freundlich isotherm models. According to the Langmuir isotherm model, the maximum adsorption capacity was sufficiently high compared with many of the previously reported adsorbents and found to be 34.97 and 41.49 mg/g for Ba(II) and Sr(II), respectively. Miswak proved to be suitable and efficient biosorbent, environmentally friendly, cost effective, and obtained from naturally and widely grown trees in many parts of the world.

Keywords: Removal of barium and strontium; Adsorption; *Salvadora persica* (Miswak); Radioactive waste; Wastewater

1. Introduction

Radioactive waste resulting from many applications of radionuclides in industry, agriculture, medicine, research, and nuclear reactors has a negative impact on human health and the environment [1]. Barium and strontium ions are the most toxic radionuclides present in relatively large amounts in radioactive liquid wastes arising from the reprocessing plants [2]. Both ions are bone-seeking elements and have carcinogenic effects. Barium compounds dissolve easily in water, thus they have a great potential to spread over long distances. The aquatic organisms tend to accumulate barium compounds in their bodies over time, which can cause undesired effects [3]. Strontium is absorbed by the human body and tends to accumulate in the liver, lungs, and kidneys. Excessive amounts may cause oxygen shortage, anemia, and in the worst case, cancer, because of the damage to the genetic material in body cells [4]. Strontium-90 (^{90}Sr) has been considered as one of the highly-concerned radioactive hazards since the Fukushima nuclear event in 2011 [5–7]. Due to its chemical similarity to calcium

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ADSORBENT FOR EFFICIENT REMOVAL OF MERCURY(II) FROM AQUEOUS SOLUTION

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Keywords: Removal, mercury, zinc oxide, sulfur, wastewater.

Decontamination of mercury from aqueous media remains a serious task for health and ecosystem protection. Removal of Hg(II) from the aqueous solution by ZnO:S has been investigated and elucidated. The effect of various parameters such as solution pH, adsorbent dose, contact time, initial adsorbate concentration has been studied and optimized. The optimized parameters for metal ion are pH value of 2.4, the equilibrium time was attained after 30 min, and the maximum removal percentage was achieved at an adsorbent loading weight of 0.08 g. It was found that the adsorption capacity of ZnO:S increased with increase in the initial mercury concentration. The equilibrium and kinetic data were found to be in good agreement with Freundlich isotherm model.

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INTRODUCTION

Mercury with unusual chemical and physical properties is universal pollutant. Even at very low concentration, mercury causes potential hazards due to its accumulation in food chain. A special characteristic of mercury is its strong absorption into biological tissues and slow elimination from them.[1] The major effects of mercury poisoning manifest as neurological and renal disturbances as it can easily pass the blood-brain barrier and affect the fetal brain. High concentrations of Hg(II) cause impairment of pulmonary function and kidney, chest pain and dyspnousea.[2,3] Numerous cases of mercury poisoning, or Minamata disease are reported in different countries around the world which resulted due to the consumption of fish and shellfish by human.[4]

Because of the above reasons, mercury must be removed to very low levels from wastewater generated in industries such as metal smelting and caustic-chlorine production in mercury cells, metal processing, plating and metal finishing.[5] Numerous physical and chemical separation processes, such as solvent extraction, ion-exchange, precipitation, membrane separation, reverse osmosis, coagulation and photoreduction,[6-9] have been applied for effective reduction of mercury concentrations from various aqueous solutions.

Among various technologies developed over the years for mercury removal, adsorption holds great promise due to the simplicity and relatively low-cost of adsorption technology as well as the effectiveness of adsorption method to purify water.[10]

Low-cost adsorbents already reported for the removal of Hg(II) include fly ash,[11] coal,[12-13-14] tree bark,[15] human hair,[16] fertilizer waste,[17] used tea leaves,[18] waste rubber,[19] rice-husk ash,[20] flax shive,[21] oil shale,[22] camel bone charcoal[23] and iron ore slime.[24]

The aim of this work is to assess the ability of ZnO:S to adsorb Hg(II) from aqueous solution. Effect of various parameters e.g. solution pH, contact time, initial Hg(II) concentration and solid/liquid ratio was studied for the optimization of removal process. Furthermore, Hg(II) adsorption isotherm and mechanism were measured and discussed.

EXPERIMENTAL

Materials

A stock Hg(II) nitrate (1000 mg L^{-1}) standard solution was supplied by Merck. A solution (10 mg L^{-1}) was prepared by dilution with deionized distilled water and used as adsorbate.

Adsorbent, i.e. ZnO nanoparticles was prepared by co-precipitation method. The starting materials were zinc acetate ($Zn(OAc)_2 \cdot 2H_2O$), thiourea and sodium hydroxide. To prepare sulphur doped zinc oxide (S:ZnO) with small percentage of sulphur, a 1 molar solution of zinc acetate was prepared in deionized water (Solution A). Similarly, 1 molar solution of thiourea was prepared in deionized water (Solution of B).

Then 50 mL of solution A and B are left on the magnetic stirrer/hotplate for 1 h at 60 °C and stirred at 800 rpm and then these solutions were mixed. Sodium hydroxide solution (4 mol) was added gradually to this mixture to increase the pH up to 10, this resulted in the formation of white-yellow precipitate. The precipitate was left on the magnetic stirrer/hotplate on the same condition for another 1 h, filtered and washed several times to remove any unwanted elements such as sodium and further organic materials by

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