Adsorption of Nickel Metal Ions from Aqueous Solutions on the Surface of Magnetic Iron Oxide: Kinetic and Isotherm Studies

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Outline

- **INTRODUCTION**
- **EXPERIMENTAL**
- **RESULTS & DISCUSSIONS**
- **CONCLUSION**

Introduction

- **Nickel Ni(II)** is mostly used in contemporary industry.
- Too much exposure of **Ni(II)** in humans can cause important influences such as increasing blood pressure, kidney and lung cancer.
- Currently the **Environmental Protection Agency (EPA)** standard for Ni(II) in drinking water is **0.04 mg L^{-1} .**
- ØSeveral pollutants sources of **Ni(II)** ions have been identified in water samples such as **electroplating, mining, machinery, and steel making industries**.
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- Several adsorbents have been reported for the removal of **Ni(II)** from aqueous solutions, including **chitosan, zeolite, functionalized polymers, activated carbon and multi-walled**
- Among these purification adsorbents, the adsorption of metal ions using **nanoparticles (NPs)** is preferred due to their **lower costs**, **high adsorption capacities**, **durability and high efficiency**, especially for **adsorption metal ions**.

Aims and Objectives

- Study the feasibility of Fe_3O_4 nanoparticles (NPs) as a novel nano-adsorbents for the efficient removal of Ni(II) from aqueous solution.

- The adsorption capacity of synthesized Fe_3O_4 nanoparticles (NPs) was determined by studying the equilibrium adsorption isotherms of Ni(II) in the batch experiments.

- The effect of mass dosage, pH, contact time, initial metal concentration and salt on removal efficiency of Ni(II) was investigated. The kinetic models related to the adsorption process in batch experiments were also studied.

Experimental

- **Batch experiments**
- **Adsorption experiments**

1. **Adsorption Isotherm Study**
2. **Adsorption Kinetics Study**

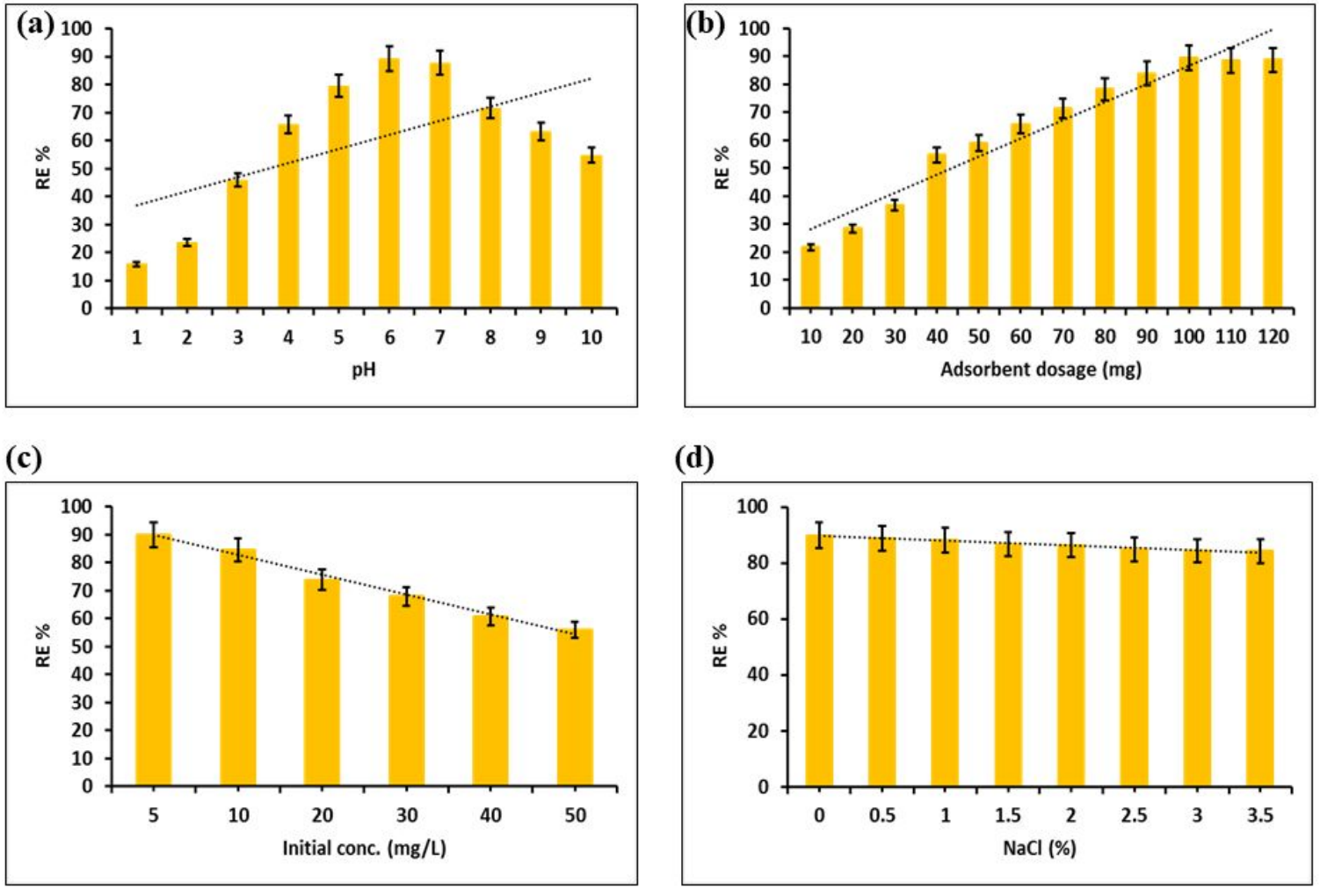

Figure 3: The influences of (a) pH, (b) adsorbent dosage, (c) Initial concentration, (d) salinity on Ni(II) metal ions adsorption by using Fe_3O_4 nano-adsorbent

3 . Adsorption Isotherms Studies

The adsorption capacity of the Fe_3O_4 nano-adsorbent was examined at pH 6, with 100 mg of the Fe_3O_4 nano-adsorbent and varied 100 mL solutions of Ni(II) metal ions concentrations from 5–50 mg/L at a temperature 298 K (Figure 4).

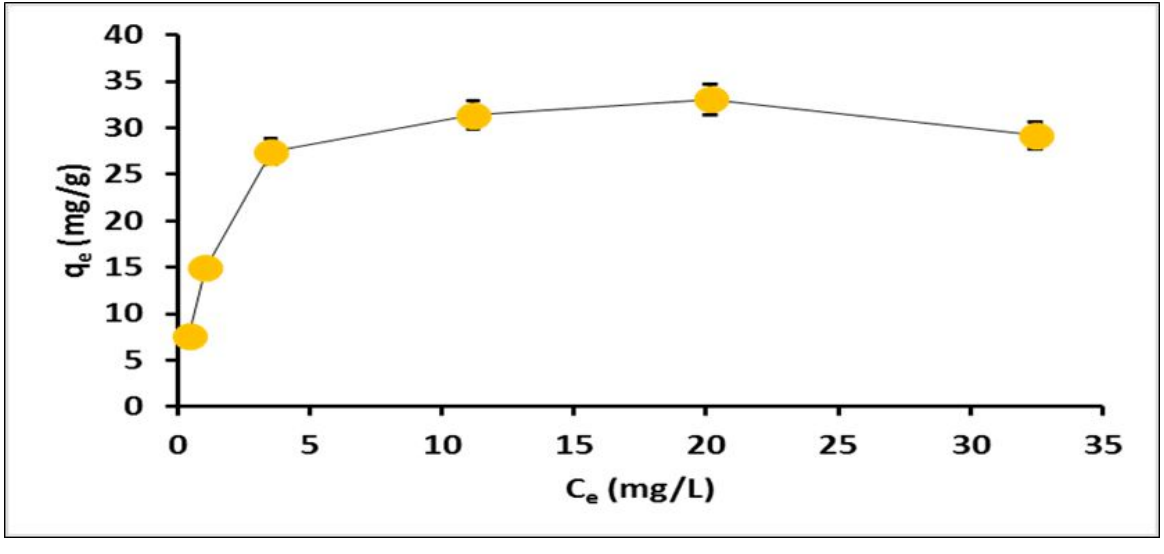

Figure 4: Adsorption isotherms data of Ni(II) metal ions onto Fe_3O_4 nano-adsorbent at 298 K

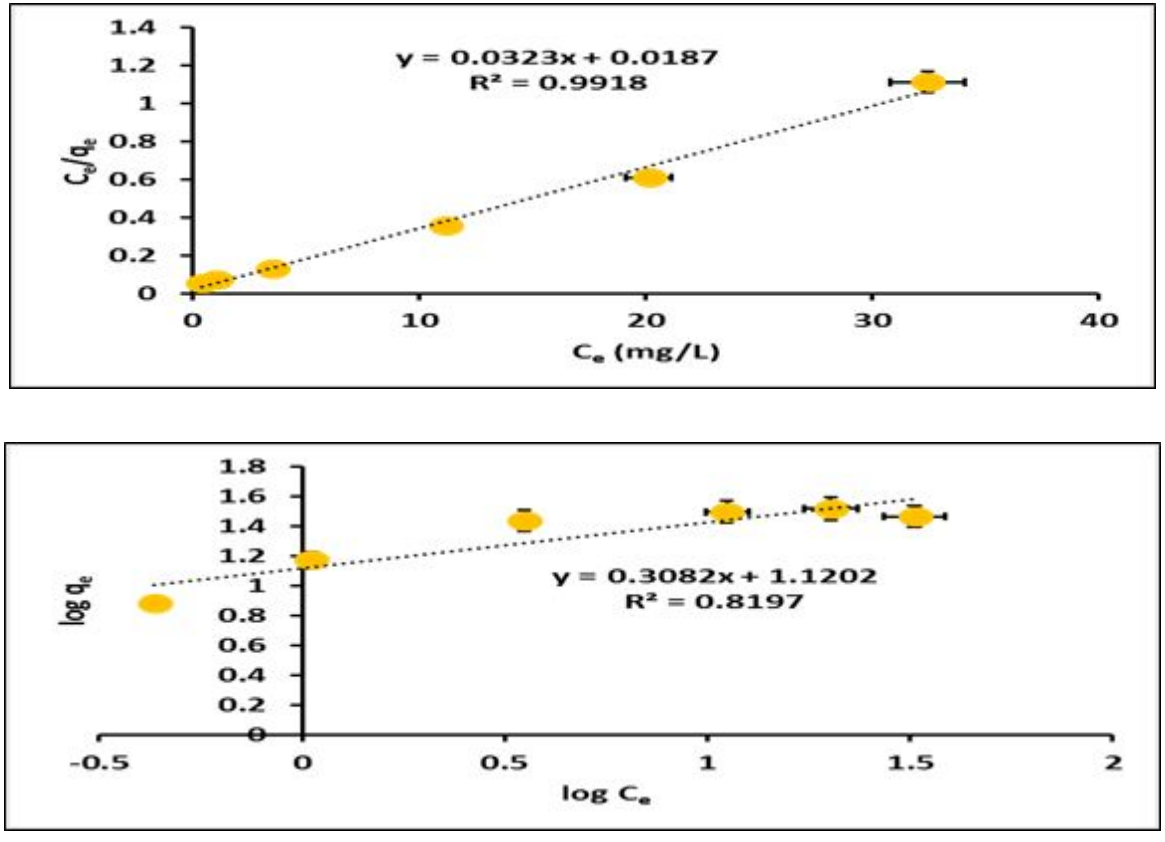

Figure 5: (a) Langmuir, (b) Freundlich isotherm model for adsorption Ni(II) and metal ions by Fe_3O_4 nano-adsorbent at 298 K

4. Adsorption Kinetics Studies

Adsorption kinetics studies are significant for describing the solute uptake rate. Kinetics tests were achieved by adding 100 mg of the Fe_3O_4 nano-adsorbent to 100 mL solutions containing 5 and 40 mg/L of Ni(II) metal ions initial concentrations, respectively.

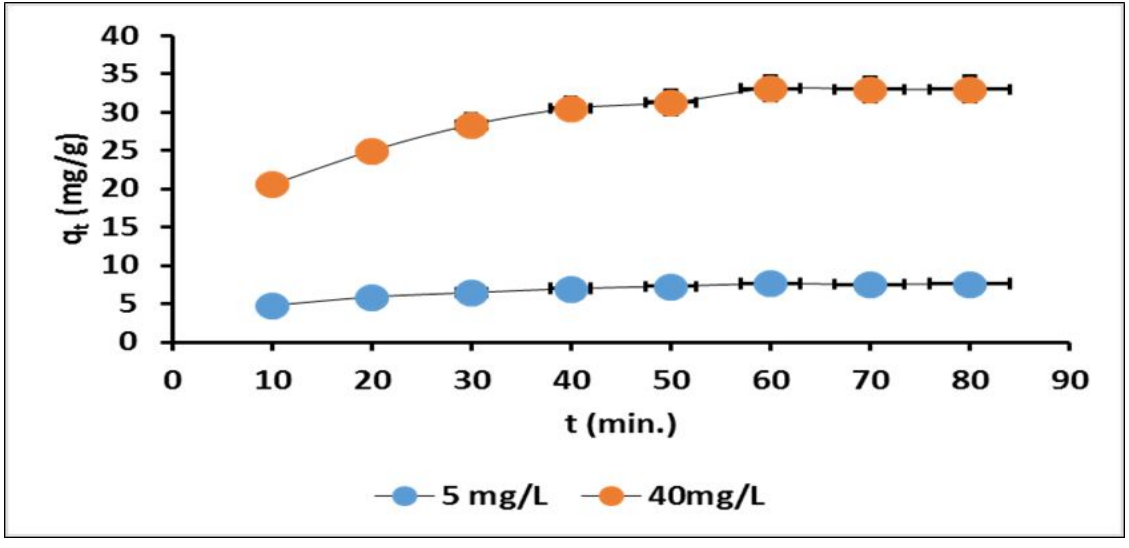

Figure 6: Adsorption kinetics studies for 5 and 40 mg/L of Ni(II) metal ions initial concentrations using Fe_3O_4 nano-adsorbent

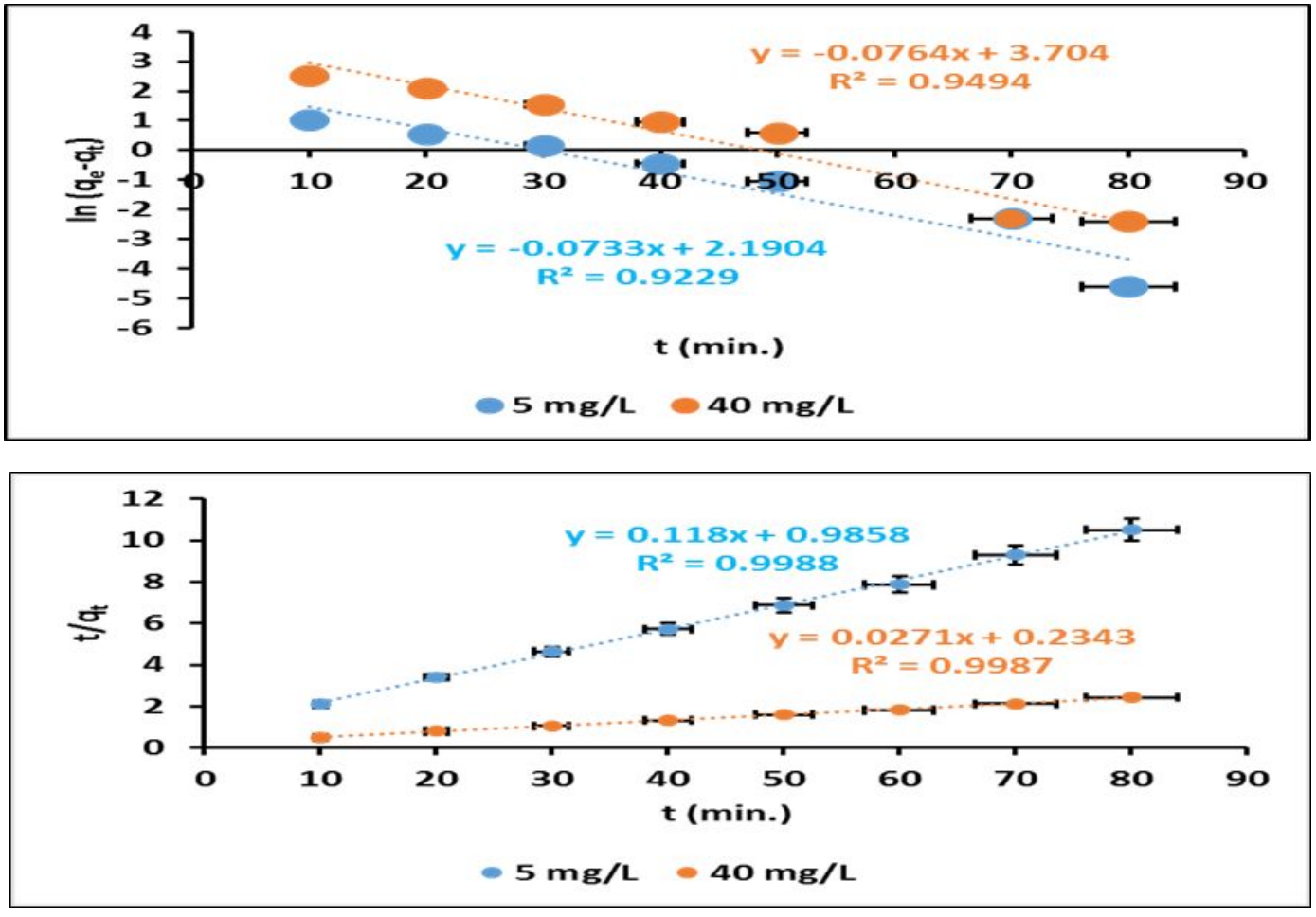

Figure 7: (a) Pseudo-first order, (b) Pseudo-second order kinetic model for adsorption Ni(II) metal ions by Fe_3O_4 nano-adsorbent at different initial concentrations (5 and 40) mg/L

Conclusions

- The present work focus on adsorption of Ni(II) ions from aqueous solution by the Fe_3O_4 magnetic material as an efficient novel adsorbent. Adsorption of Ni(II) ions was recognized to be effective in the pH 6.
- The fast adsorption of the Fe_3O_4 magnetic nano-adsorbent for Ni(II) ions make these materials appropriate for water treatment methods.
- Equilibrium isotherm results were fitted using two models. Among these models, Langmuir model was in good agreement with the experimental results with high R^2 values.
- Kinetic study showed that the pseudo-second order model is suitable to explain the adsorption method.
- The mechanism of adsorption take in chiefly ionic interactions (chemical interactions) between Ni(II) metal cations and Fe_3O_4 magnetic nano-adsorbent.


Obrigado
감사합니다
Gracias
Merci
شكرا لك
Thank you
Danke
ありがとう
Ευχαριστ