

# COMPARATIVE STUDY OF MERCURY(II) REMOVAL ONTO NATURAL AND IRON-MODIFIED ZEOLITE

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## INTRODUCTION

The contamination of soil and water bodies with Hg(II) from the anthropogenic sources such as mining and industry activities causes negative effect for living organisms due to the process of bioaccumulation and biomagnification through the food chain. Therefore, the need for remediation of contaminated areas is extremely necessary, especially if it is effective by using low-cost sorbents. This paper compares the sorption abilities of natural and iron-modified zeolite towards mercury(II) ions from aqueous solutions. The influence of pH, solid/liquid ratio, initial concentration and contact time on the sorption efficiency onto both sorbent materials was investigated.

## MATERIALS AND METHODS

### 1. SAMPLE PREPARATION

From natural zeolite (NZ) is obtained iron-modified zeolite (FeZ) by sequentially treatment with 0.1 mol/L  $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  in an acetate buffer at  $\text{pH}=3.6$ , 1 mol/L NaOH and 4%  $\text{NaNO}_3$ .

### 2. BATCH SORPTION STUDIES

**Effect of pH:**  $\text{pH}_0=2-2.5$ ;  $\text{S/L}=10$  g/L;  $t=24$ h;  $T=25^\circ\text{C}$ ;  $c_0=4.00$  mM

**Effect of S/L:**  $\text{S/L}=2-80$  g/L;  $\text{pH}_0=2$ ;  $t=24$ h;  $T=25^\circ\text{C}$ ;  $c_0=4.06$  mM

**Effect of  $c_0$ :**  $c_0=0.46-12.26$  mM;  $\text{S/L}=10$  g/L;  $\text{pH}_0=2$ ;  $t=24$ h;  $T=25^\circ\text{C}$

**Effect of  $t$ :**  $t=0-1440$  min;  $c_0=3.94-9.93$  mM;  $\text{S/L}=10$  g/L;  $\text{pH}_0=2$ ;  $T=25^\circ\text{C}$

**Leaching standard test (DIN 38414):**  $\text{pH}_{\text{O}(\text{ultrapure water})}=2.00-12.05$ ;  $\text{S/L}=10$  g/L;  $t=24$ h;  $T=25^\circ\text{C}$ , saturated NZ and FeZ

## RESULTS AND DISCUSSION

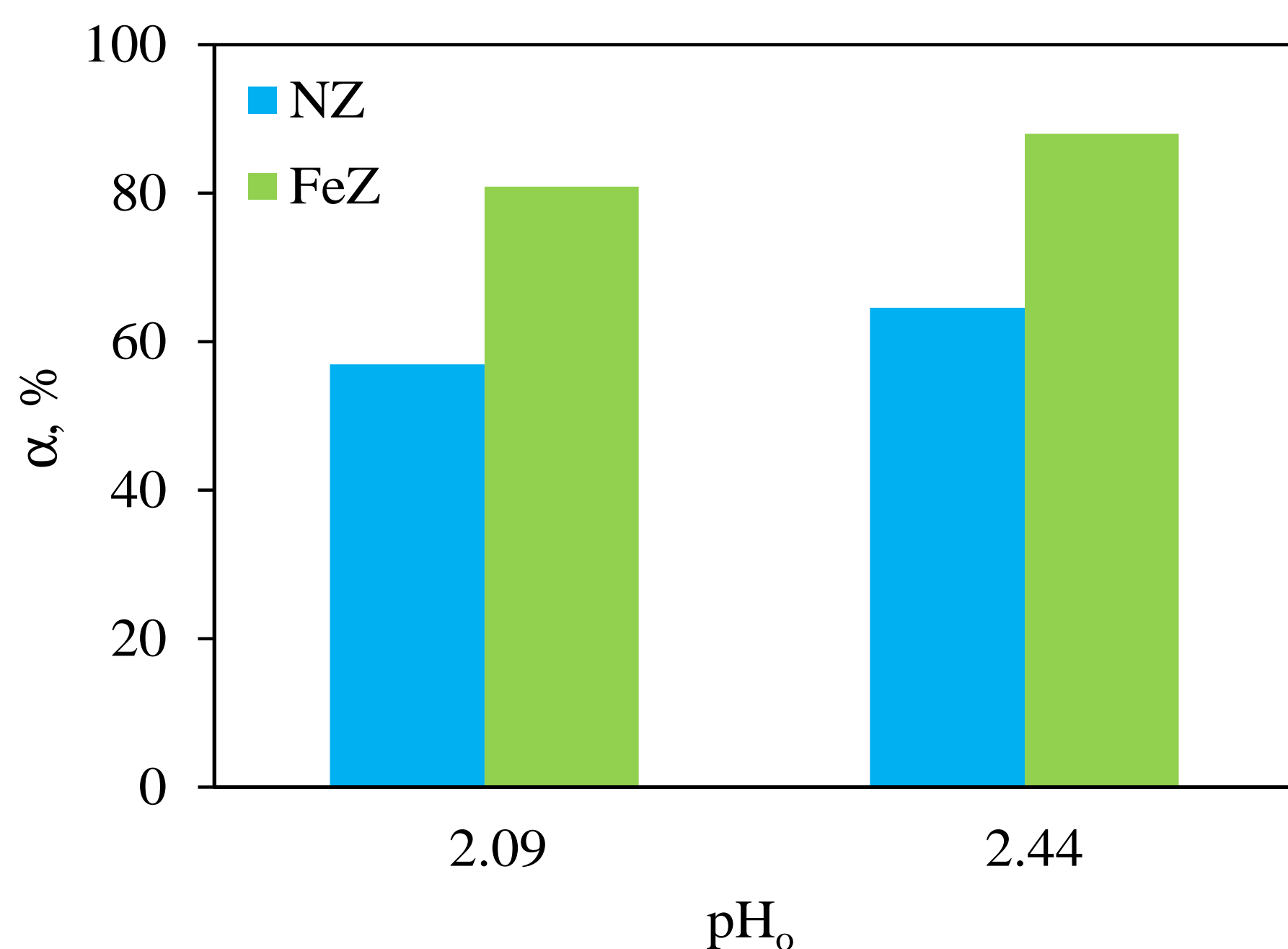


Fig. 1. Hg(II) removal efficiency onto NZ and FeZ depending on  $\text{pH}_0$ .

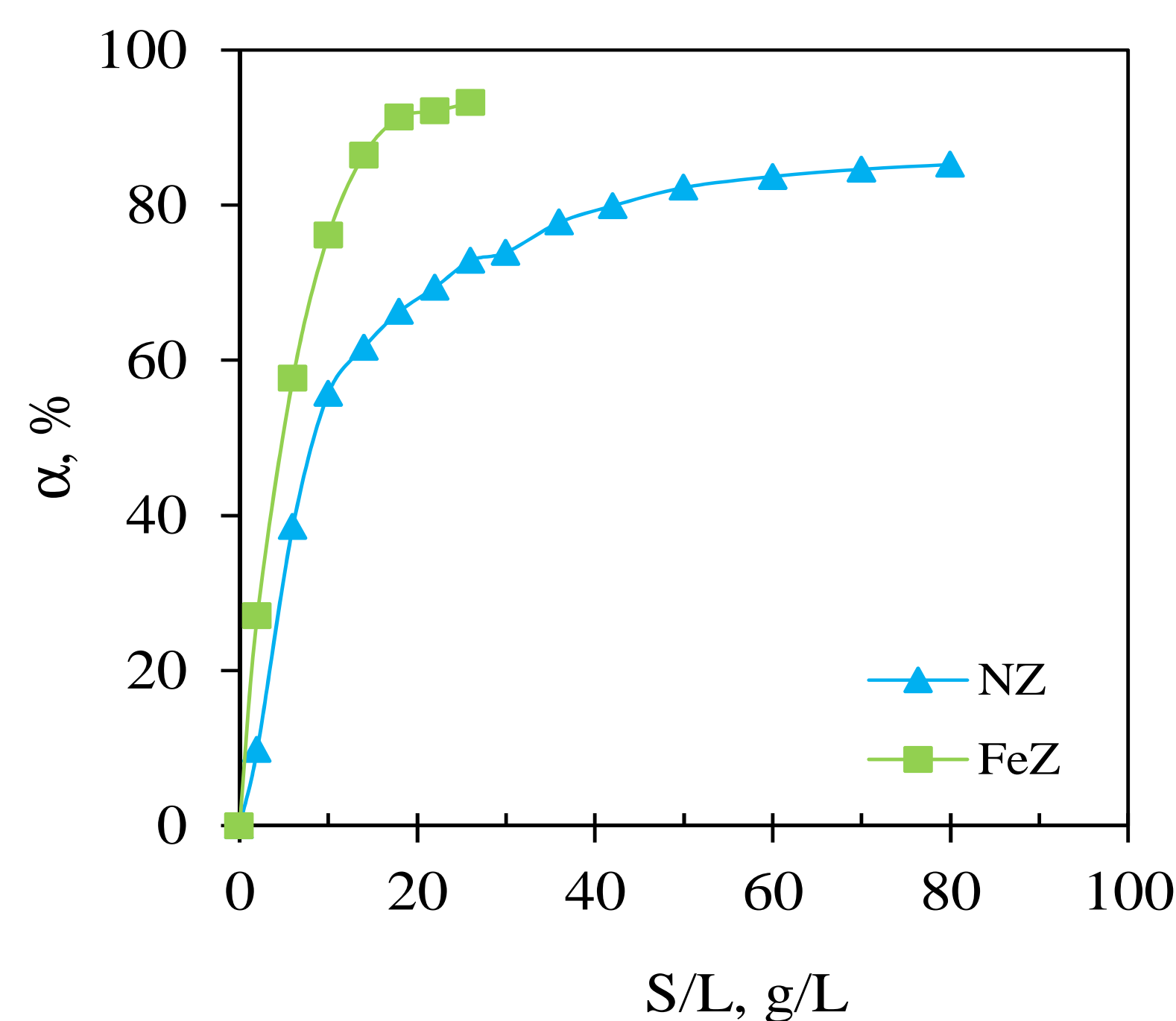


Fig. 2. Hg(II) removal efficiency onto NZ and FeZ depending on solid/liquid ratio.

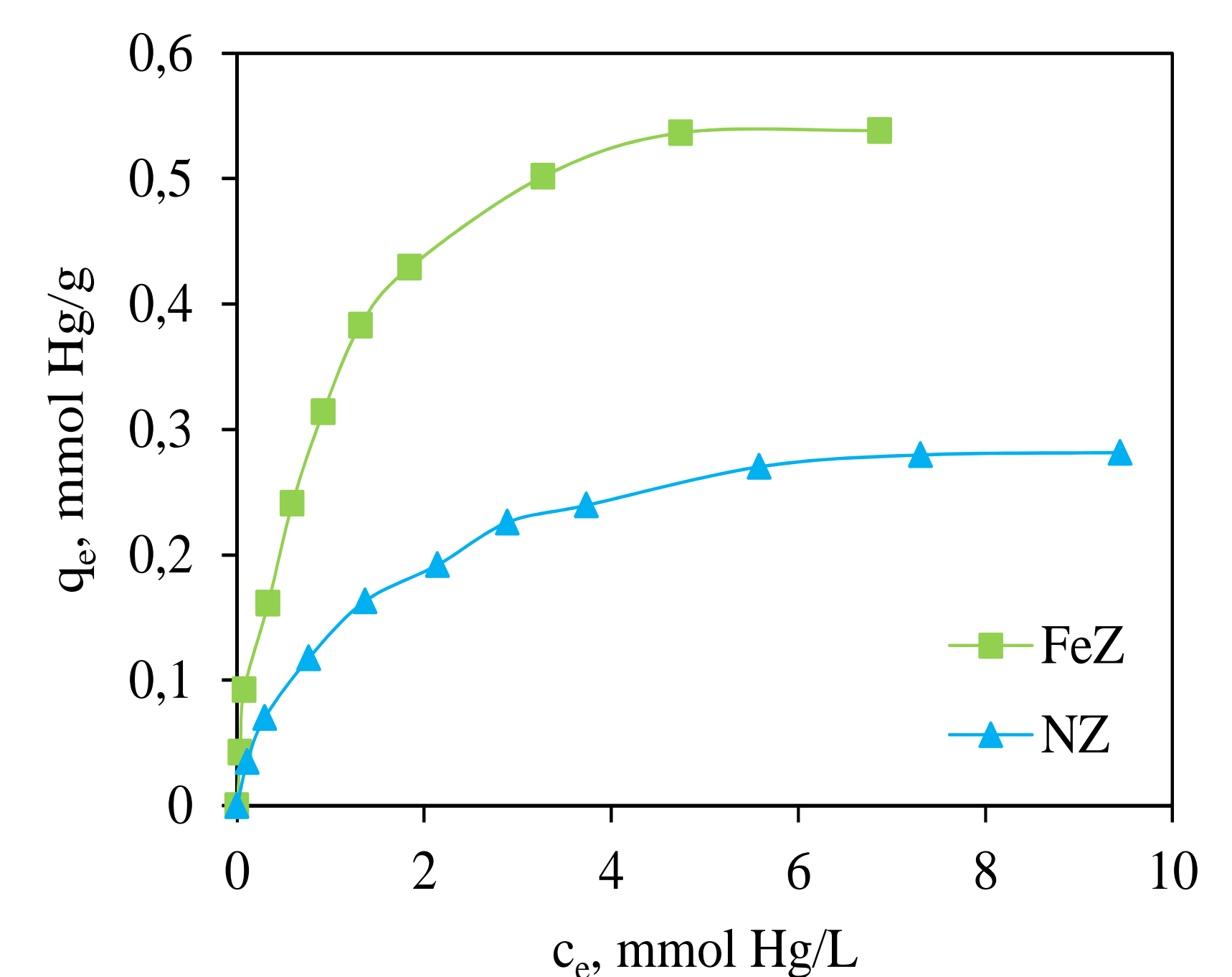


Fig. 3. Hg(II) sorption isotherms for the NZ and FeZ.

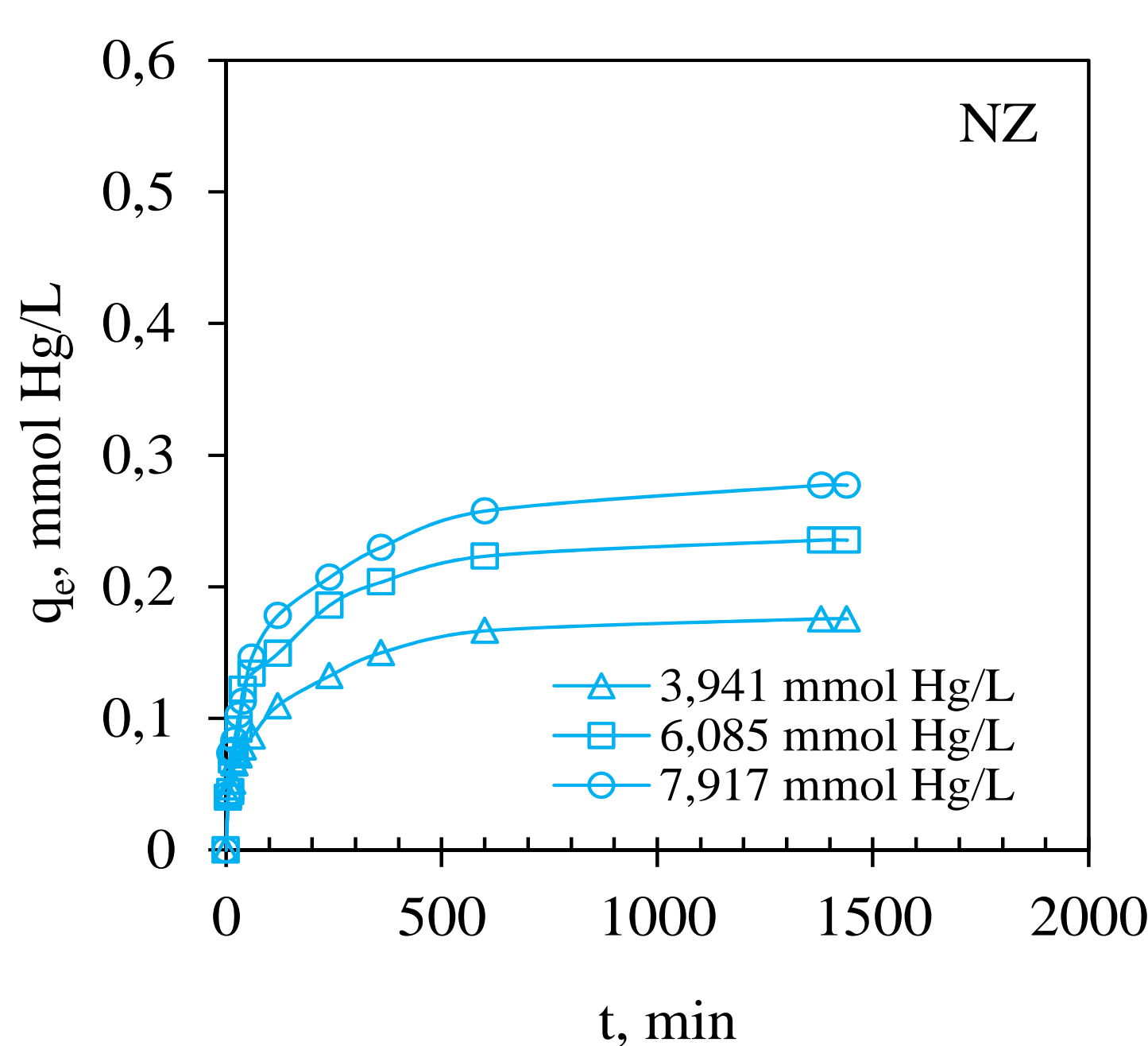


Fig. 4. The amount of Hg(II) sorbed per gram of NZ in relation of time.

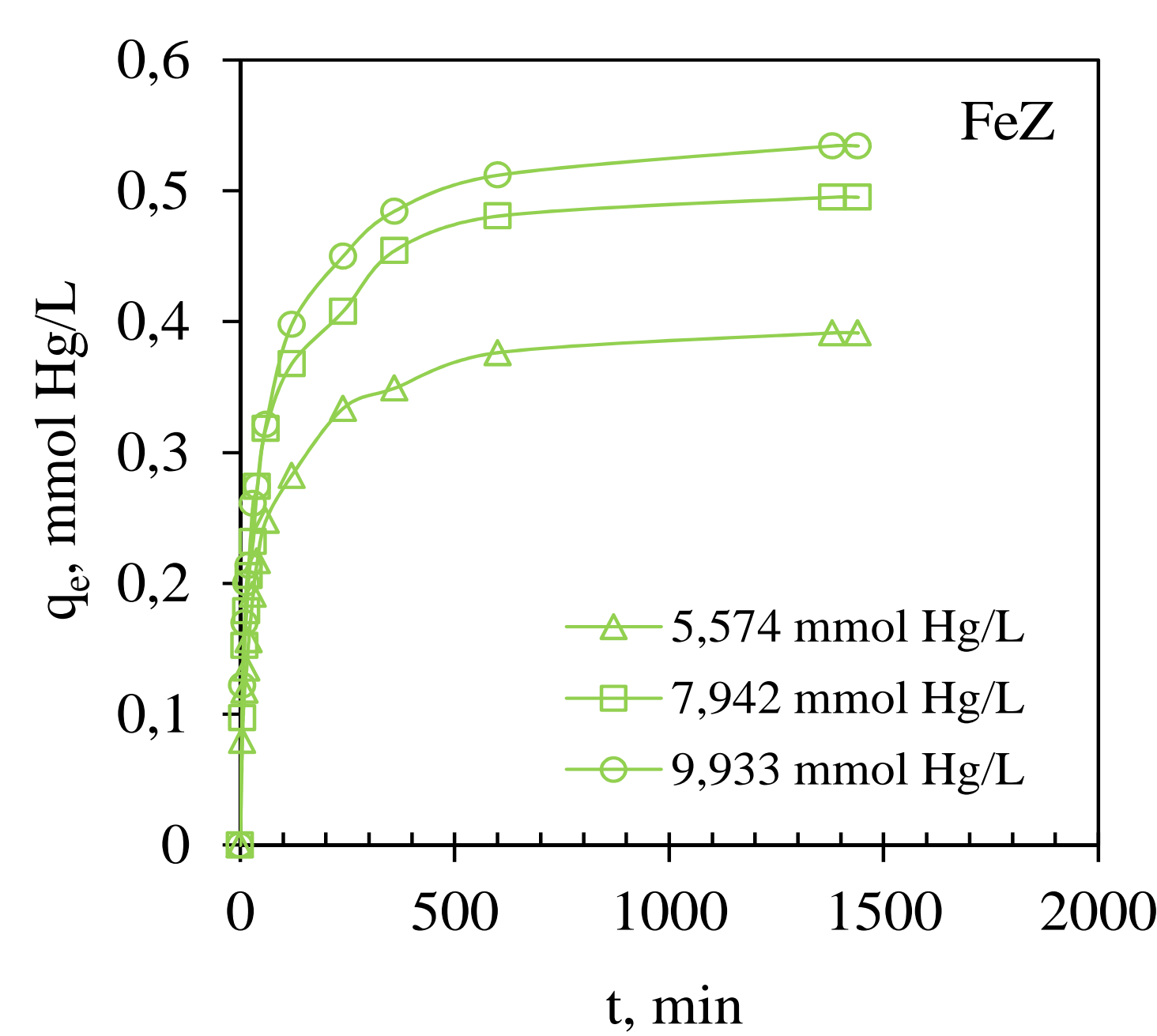


Fig. 5. The amount of Hg(II) sorbed per gram of FeZ in relation of time.

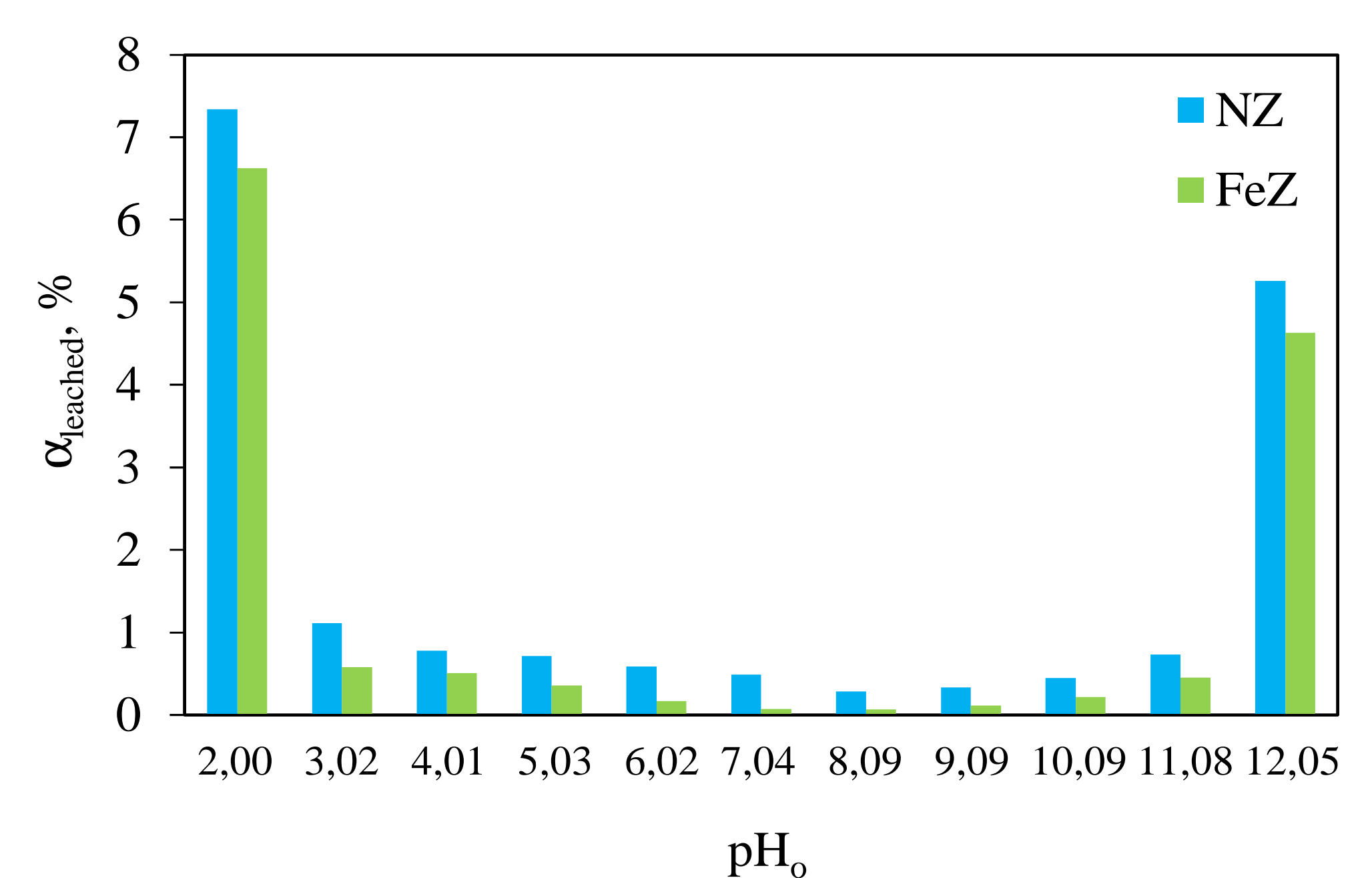


Fig. 6. Percentage of leached Hg(II) from saturated NZ and FeZ in ultrapure water at different  $\text{pH}_0$ .

1. The optimal pH for the removal of Hg(II) is  $\text{pH}<2.5$ , since at  $\text{pH}>2.5$  Hg(II) starts to precipitate (Fig. 1).
2. To achieve the same sorption efficiency, the twice solid/liquid ratio of NZ than that of FeZ is needed, indicating that FeZ has a better sorption ability (Fig. 2).
3. At the optimal  $\text{pH}=2$ , the maximum amount of sorbed mercury(II) is 0.28 mmol/g of NZ and 0.54 mmol/g of FeZ (Fig 3).
4. A minimum contact time of 600 minutes is required to achieve the maximum sorption capacity for both sorbents independently of  $c_0$  (Figs. 4 and 5).
5. The leaching of Hg(II) from saturated sorbents in a wide pH range,  $4.01<\text{pH}<9.09$ , was observed in the amount of only 0.28%–0.78% from NZ and 0.07%–0.51% from FeZ. At extreme pH conditions,  $\text{pH}<3$  and  $\text{pH}>11$ , leaching of Hg(II) in an amount of 4–7% occurred on both sorbents (Fig. 6).

## CONCLUSION

Both sorbent materials could be used for *in situ* remediation of soil or groundwater contaminated with Hg(II) and the results suggest that the modification significantly improves the sorption properties of NZ.

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