ELECTROKINETIC ANALYSIS OF ZN^{2+} FATE AND TRANSPORT IN POROUS MEDIA

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Abstract: Electrokinetic analysis enables efficient heavy metal removal in low-permeability soils using electric fields. This study investigates the fate and transport of Zn^{2+} ions in porous media using electrokinetic techniques. The experiment was conducted by applying a constant voltage of 32 V across two reactors filled with a porous medium and submerged in an electrolyte solution with a controlled salt concentration of 6.7 g/L. Zn^{2+} was injected into the porous media, and their migration was tracked at multiple sampling points over a period of time. The results revealed that Zn^{2+} migration followed zero-order kinetics, indicating that the rate of reaction was independent of Zn^{2+} concentration. The zero-order rate constants for different sampling points varied, with the highest rate constant observed at the cathode side, indicating the dominance of electromigration. For example, the zero-order rate constant at 5 cm from the injection point to the cathode side was found to be 344.20 mg/L·h, significantly higher than in the duplicate (same position), which had a rate constant of 126.49 mg/L·h. Furthermore, the sand used in the porous media showed a 20 % adsorption of heavy metals over the 24-hour experimental period. This suggests that in addition to electromigration, adsorption, and diffusion played secondary roles in the Zn^{2+} transport process. These findings demonstrate the effectiveness of electrokinetic methods for remediating Zn^{2+} contamination in porous media, particularly where traditional techniques may be less effective.

Keywords: Electrokinetic remediation; Zinc migration; Zero-order kinetics; Heavy metal diffusion; Porous media transport