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Impact of Sodium Ion Stress on the Mechanism of Lead Ion Migration in Electrochemical Treatment of Lead-Contaminated Soil

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INTRODUCTION & AIM

Treatment of lead-contaminated soil has become a prominent research concern, with electrochemical treatment (ECT) technology demonstrating significant potential in this regard. ECT not only overcomes the drawbacks of traditional technology of soil remediation, such as long remediation periods, low efficiency, and high costs, but also enables in situ remediation. However, the influence of varying concentrations of non-contaminant ions on the removal efficiency of heavy metal ions during electrochemical treatment remediation of different naturally polluted soils remains unclear. Therefore, investigating the impact of sodium ion stress on the migration of lead ions is essential.

Fig.4 Correlation parameters and repair efficiency comparison during electric repair process

	Upper soil layer					Lower soil layer						
Exp.	S1 (%)	S2 (%)	S3 (%)	S4 (%)	S5 (%)	S1 (%)	S2 (%)	S3 (%)	S4 (%)	S5 (%)	Average removal efficiency(%)	Energy consumption (kWh/m^3)
EK1	77.0	71.5	76.3	68.6	66.9	79.1	74.8	71.6	64.7	7.8	65.8	491.4
EK2	87.7	90.0	86.9	88.1	60.2	97.2	92.3	83.9	96.4	47.7	83.0	53.83
EK3	80.6	78.3	71.8	66.3	60.4	70.1	65.7	77.0	65.3	56.4	69.2	549.9
EK4	85.7	77.8	73.4	53.2	40.9	85.4	78.2	72.6	69.5	42.8	67.9	20.97

METHOD

This study applies a DC power supply connected to an experimental device. The device is made of plexiglass and consists of three compartments: one soil compartment and two electrolytic compartments. A multimeter is installed with a wire between the DC power and the soil reaction device for monitoring the current.

EXP.	Electrode material	Electrode treatment	Electrode position	Anolyte	Catholyte	Electric gradient (V/cm)	Treatment time (h)
EK1	graphite felt	drill	Electrolytic chamber	0.05mol/L sodium acetate	0.5mol/L acetic acid	2	204
EK2	graphite felt	drill	Electrolytic chamber	deionized water	0.5mol/L acetic acid	2	204
EK3	graphite felt	drill	Electrolytic chamber	0.05mol/L sodium acetate	0.5mol/L acetic acid	2	204
EK4	graphite felt	drill	Electrolytic chamber	deionized water	0.5mol/L acetic acid	2	204

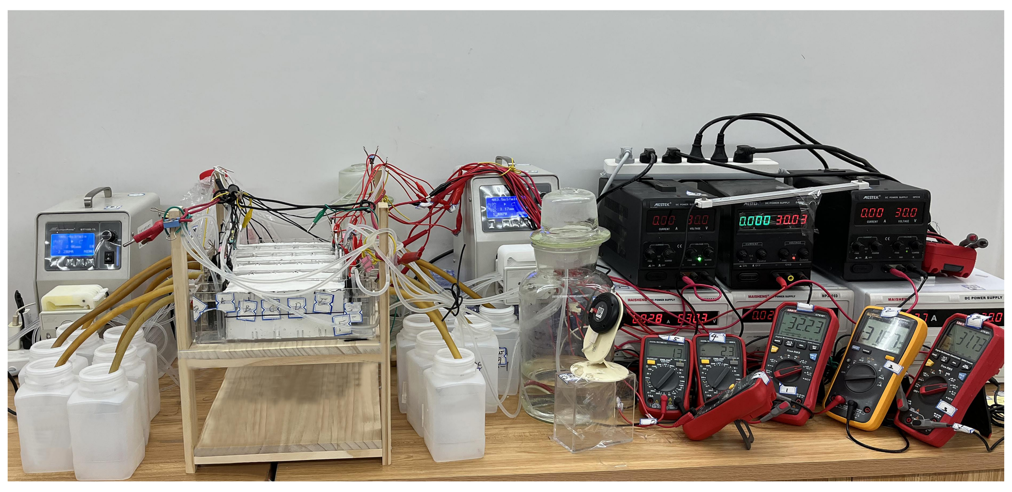


Fig.1 Experimental setup for Pb-contaminated soil treatment

Fig.2 Electrode material

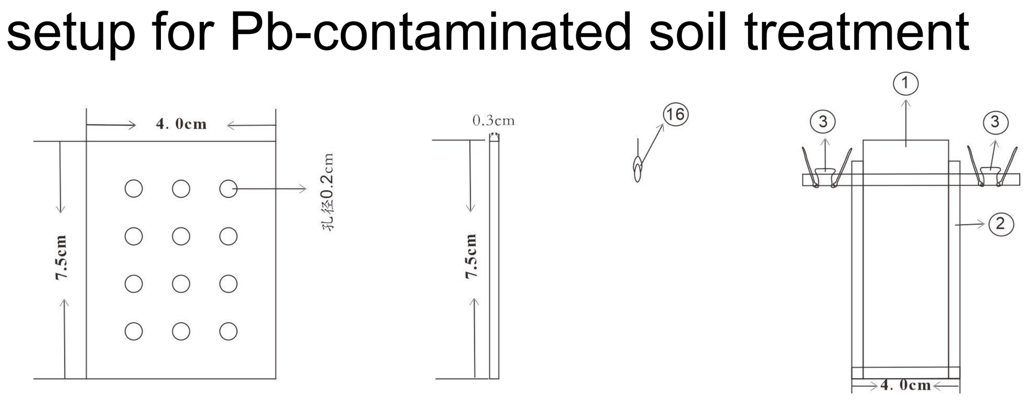
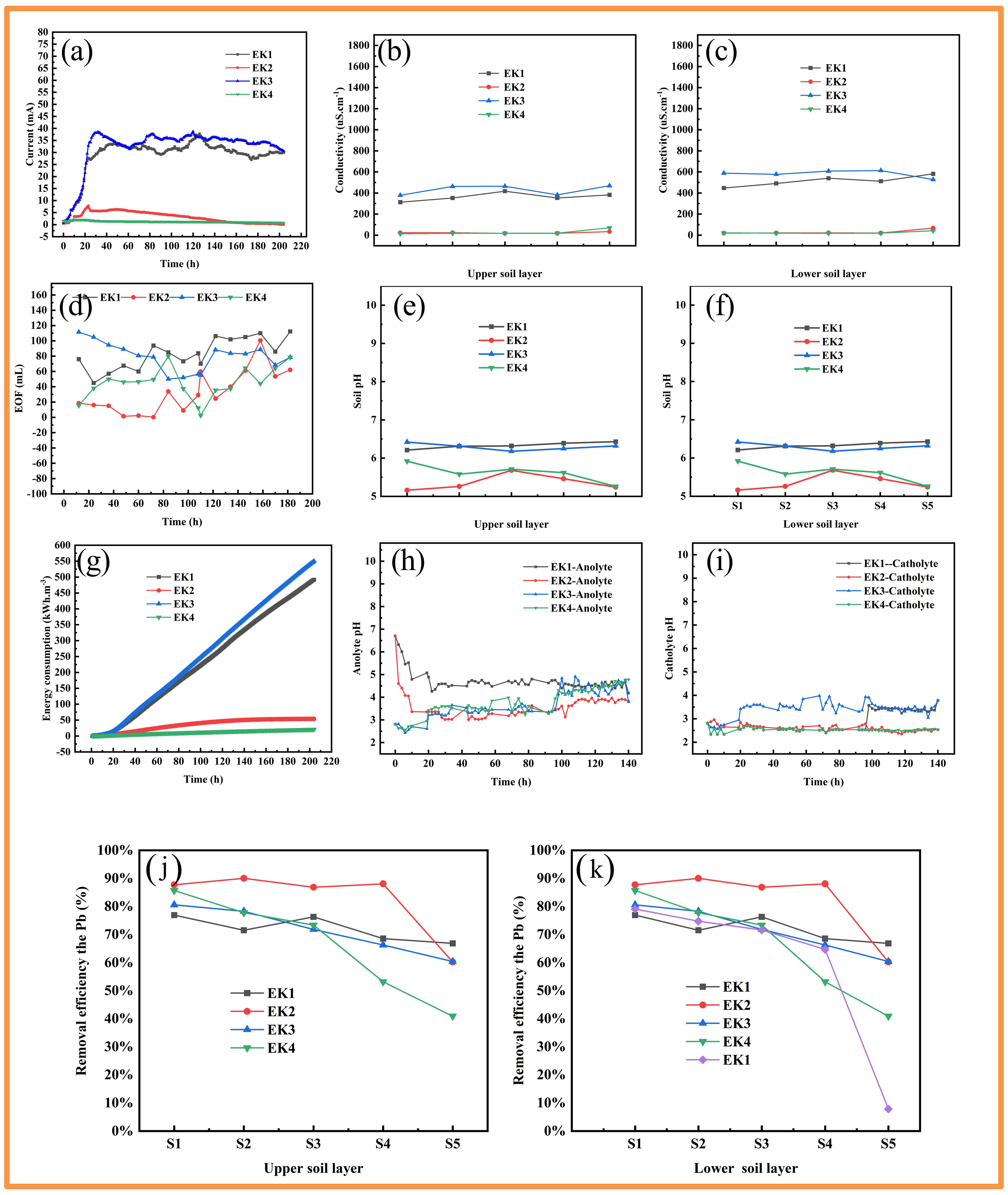


Fig.3 Electrode treatment and placement method

RESULTS & DISCUSSION

This study indicates a significant influence of the presence of sodium ions on the migration of lead ions during ECT. A high concentration of sodium ions induces ion competition in the soil, hindering the migration of lead ions and causing a decrease in their migration rate. Additionally, the competitive interaction between sodium ions and lead ions has a pronounced effect on the efficiency of ECT, leading to a reduction in the removal efficiency of lead ions.



CONCLUSION

These results emphasize the importance of considering sodium ion stress in the electrochemical remediation of lead-contaminated soil and provide valuable insights for optimizing electrochemical remediation strategies.

FUTURE WORK / REFERENCES

Due to the coercive effect of sodium acetate on lead ions, it is foreseeable that the simultaneous presence of sodium ions and lead ions will reduce the remediation effect of electrokinetic technology on lead contaminated soil. In the future, the application of electrokinetic technology in soil remediation where salt ions and lead pollution coexist may require the use of enhanced methods to achieve efficient removal of pollutants.