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STAINLESS STEEL SLAG FOR Cr^{3+} REMOTION

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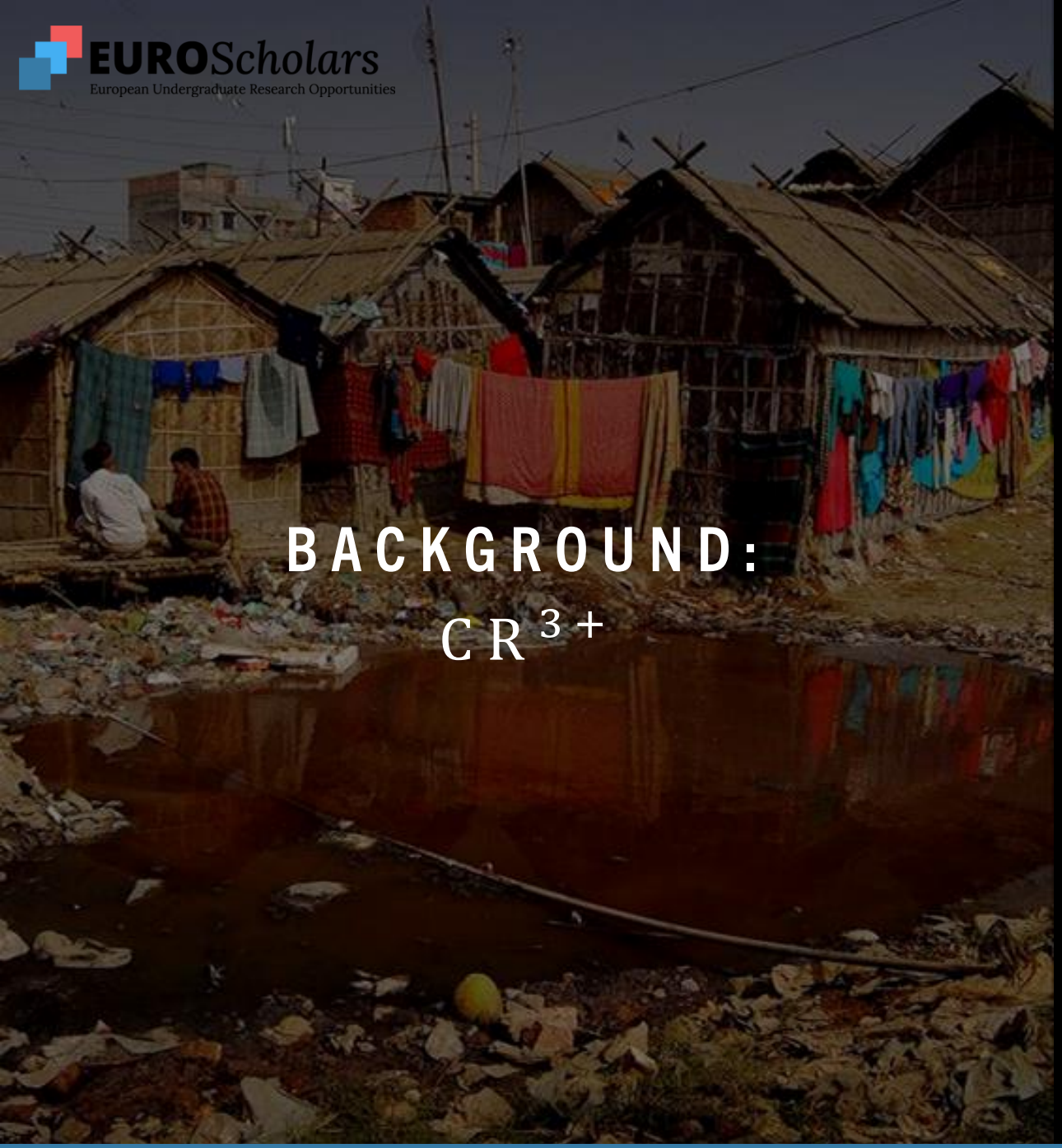
PRESENTATION SUMMARY

- Personal introduction
- Background
  - -Cr 3+
  - -Existing technologies
  - -Circular economy
- Ladle slag properties
- Methodology
- Data analysis
- Conclusions
- Future work

PERSONAL INTRODUCTION

- Interdisciplinary studies at the University of Alabama
- Previous research: antibacterial properties of MOFs
- Sustainability efforts and goals

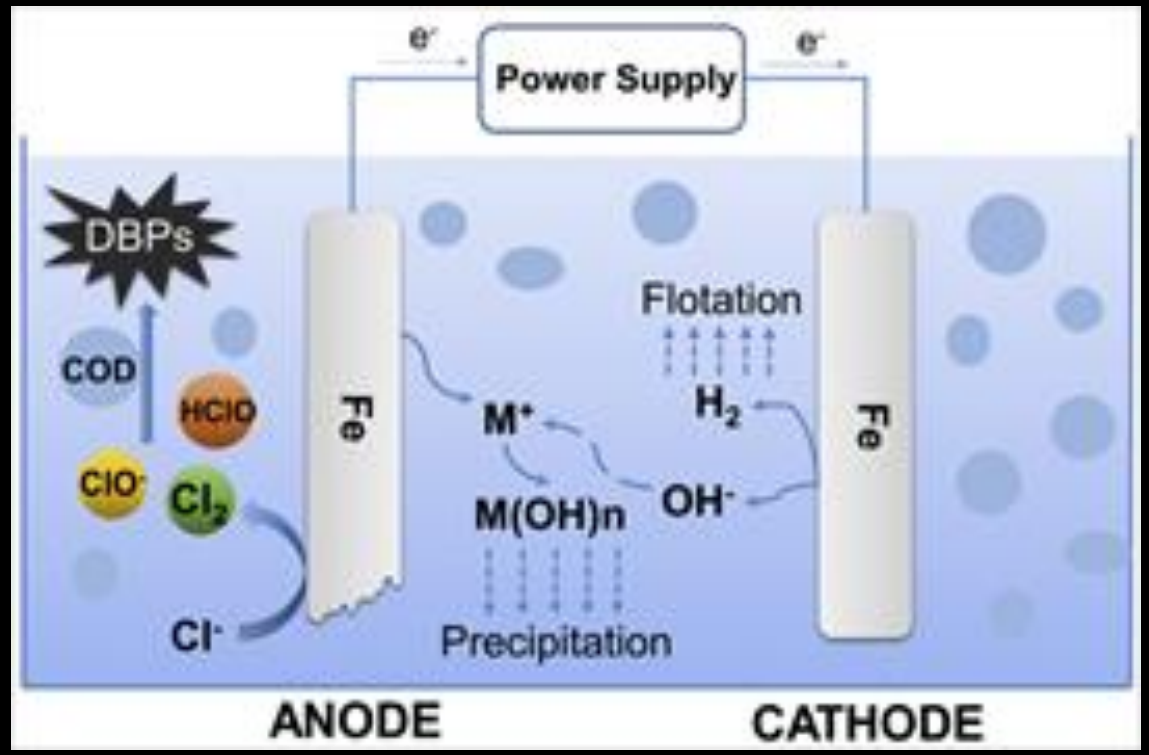


BACKGROUND:

Cr^{3+}

- Pollution sources: industrial waste from manufacturing glass, ceramics, and photographic products; processes such as textile dying and leather tanning
- Indirectly from hexavalent Cr
- Water and soil contamination
- Harmful to plants, wildlife, and human health

BACKGROUND: EXISTING TECHNOLOGIES



Electrocoagulation - complex with high operating costs

Membrane filtration – slow, short lifespan, high operating costs

Adsorption- most common

BACKGROUND: CIRCULAR ECONOMY

"In such an economy, all forms of waste… are returned to the economy or used more efficiently" (UNTAD)

"Excess steel slag…(raker, ladle, clean out, or pit slag) is usually sent to landfills for disposal" (US FHWA)

Circular economy. UNCTAD. (2022, November 10). Retrieved November 13, 2022, from https://unctad.org/topic/trade-and-environment/circular-economy

User guidelines for waste and byproduct materials in pavement construction. FHWA. (n.d.). Retrieved November 13, 2022, from https://www.fhwa.dot.gov/publications/research/infrastructure/structures/97148/ssa1.cfm#:~:text=While%20most%20of%20the%20furnace,sent%20to%20landfills%20for%20disposal.

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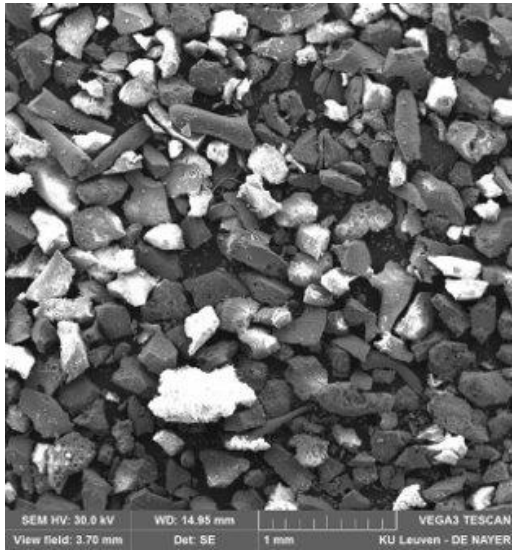
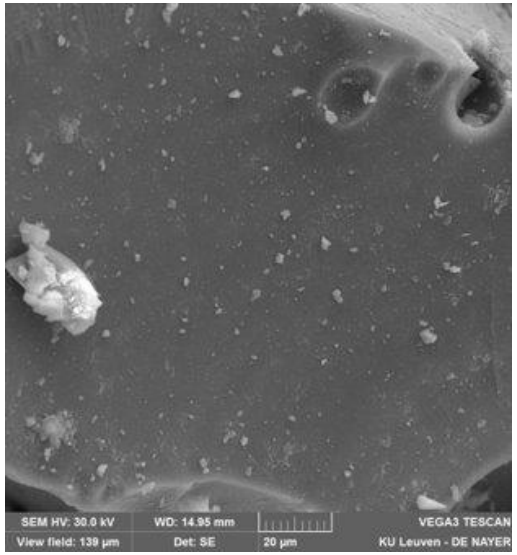
LADLE SLAG PROPERTIES





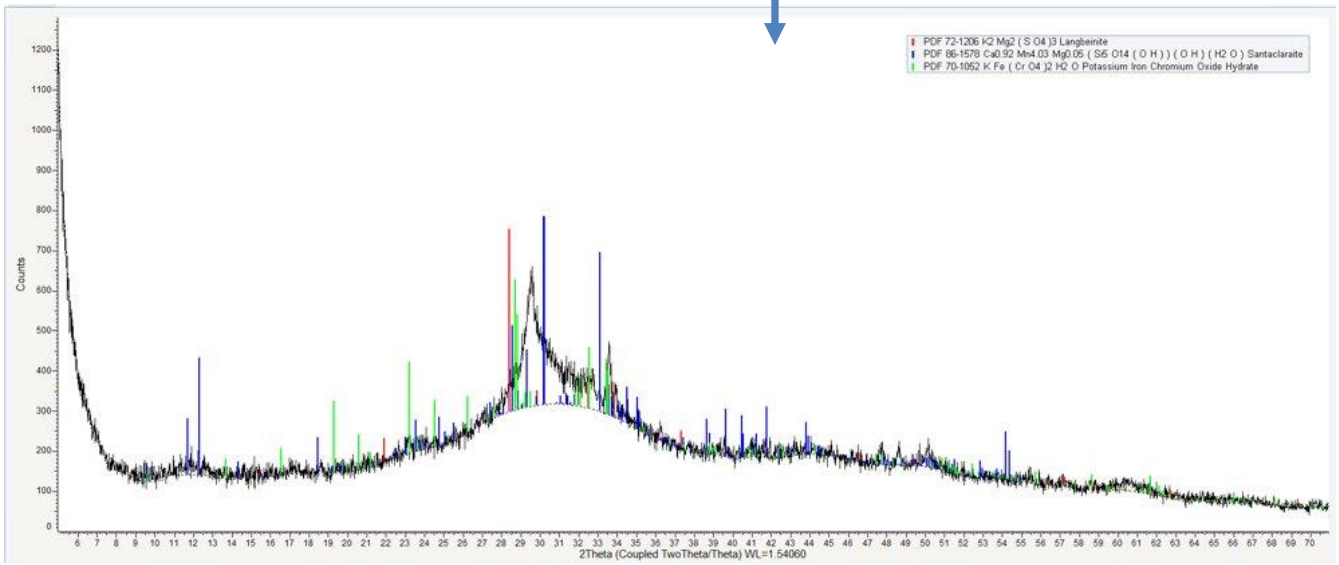
SEM images reveal mesoporous structure

Ca, Mg, Mn, C, Al, Fe, Cr, Ni and Zn

EDX measurements are expressed in atomic %

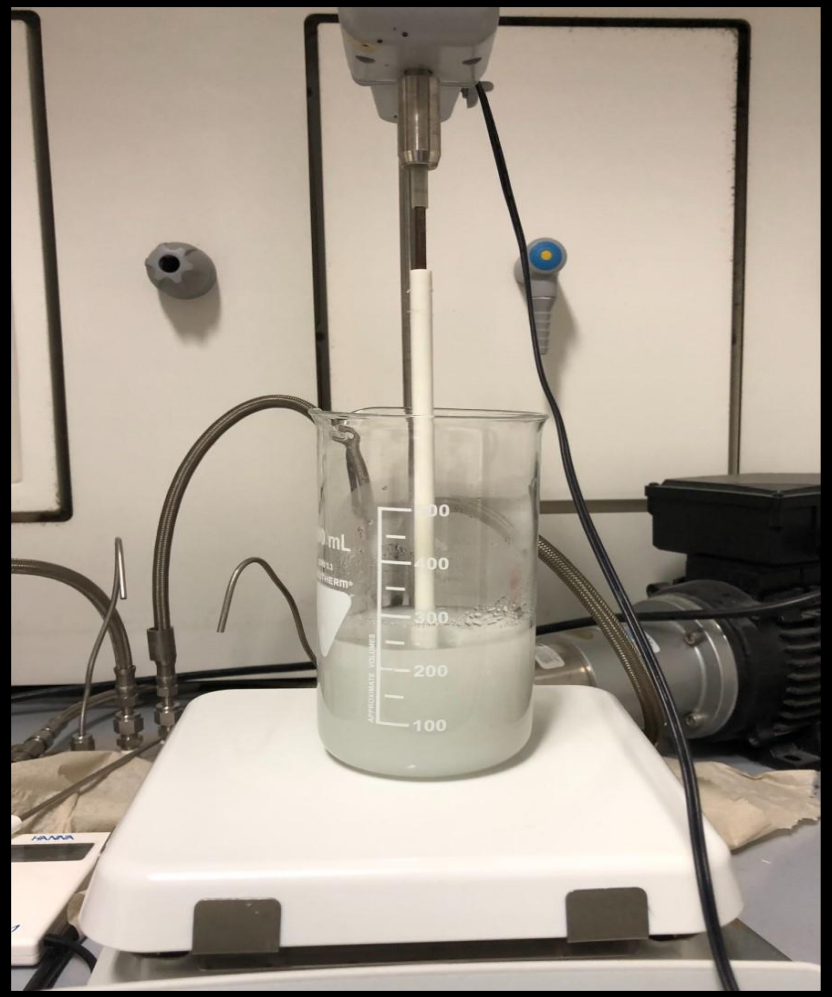
Ca	Mg	Mn	C	Al	Fe	Cr	Ni	Zn
80.4	8.4	0	0	10.47	0.28	0.44	0	0

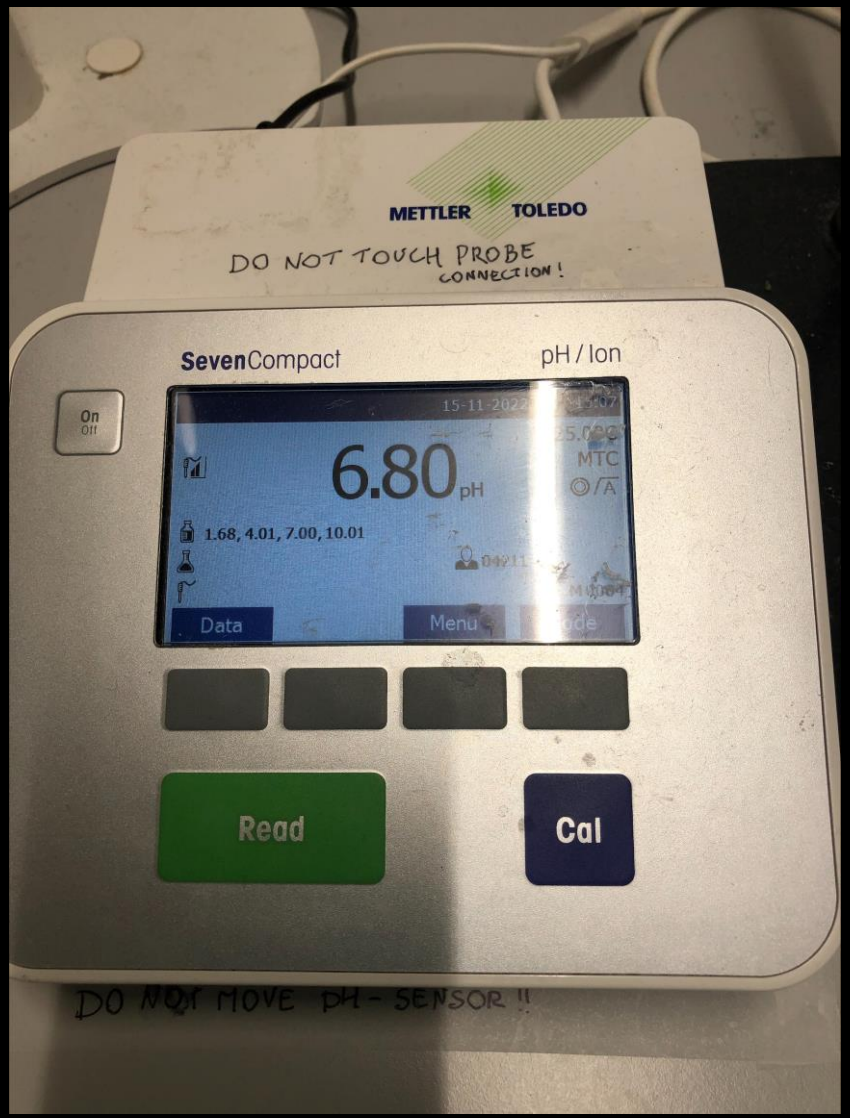
EDX and XRD spectroscopies indicate high calcium content



METHODOLOGY

- Cr solutions were prepared in concentrations of 10, 30, and 60
- Samples of each of these solutions were prepared at pH 4, 7, and 10
- Each solution was added to a beaker and stirred at 200 rpm
- Ladle slag was added to the beaker at a concentration of 8 g/L
- Samples were taken every 10 minutes, then after 2 hours and 3 hours





METHODOLOGY

The final pH of each sample was measured with a pH meter

The final Cr concentration was analyzed with ICP spectroscopy

Procedure was repeated with each concentration at each pH

Procedure was repeated with each solution heated to 45°C

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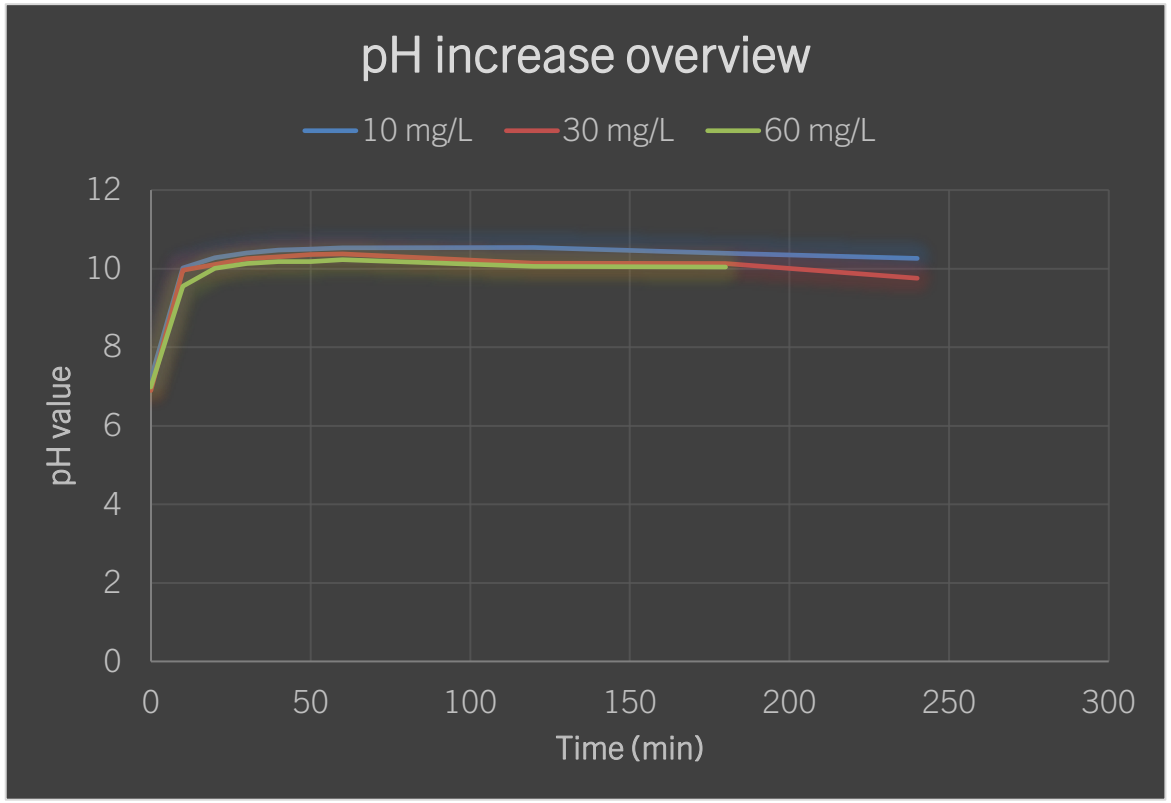
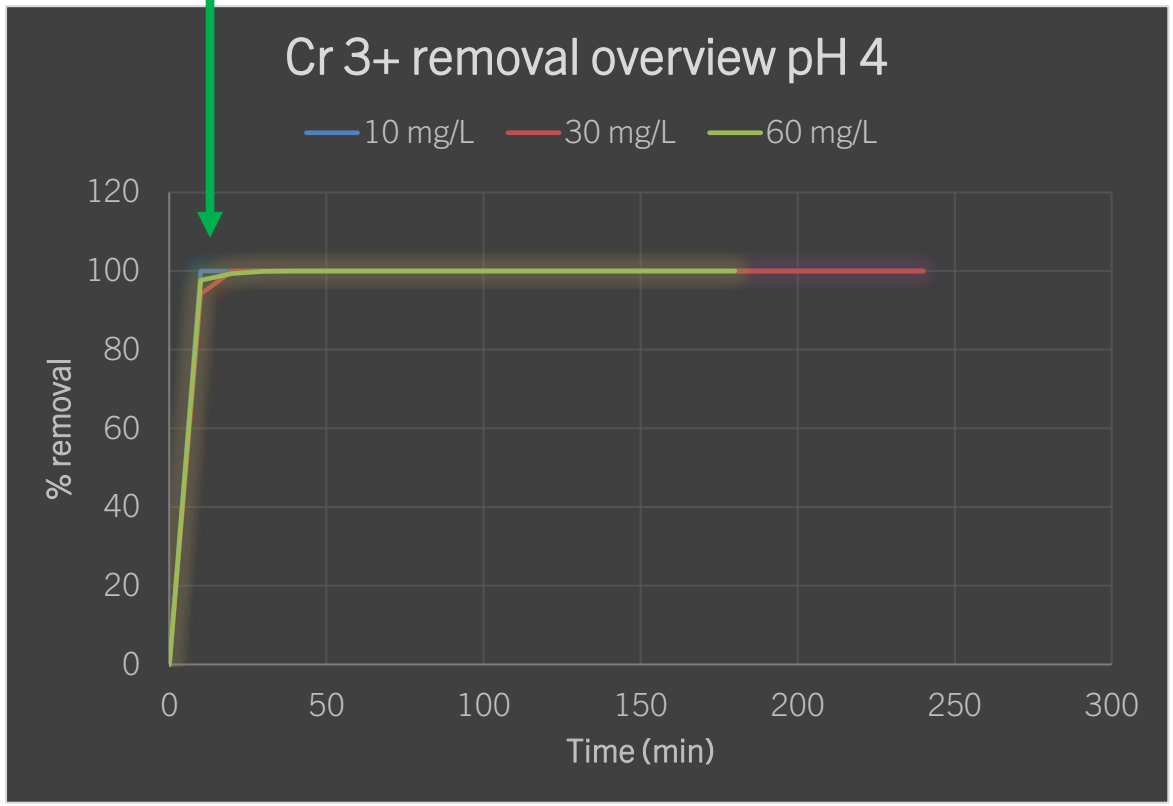
DATA ANALYSIS



100% of Cr removed after 10 mins

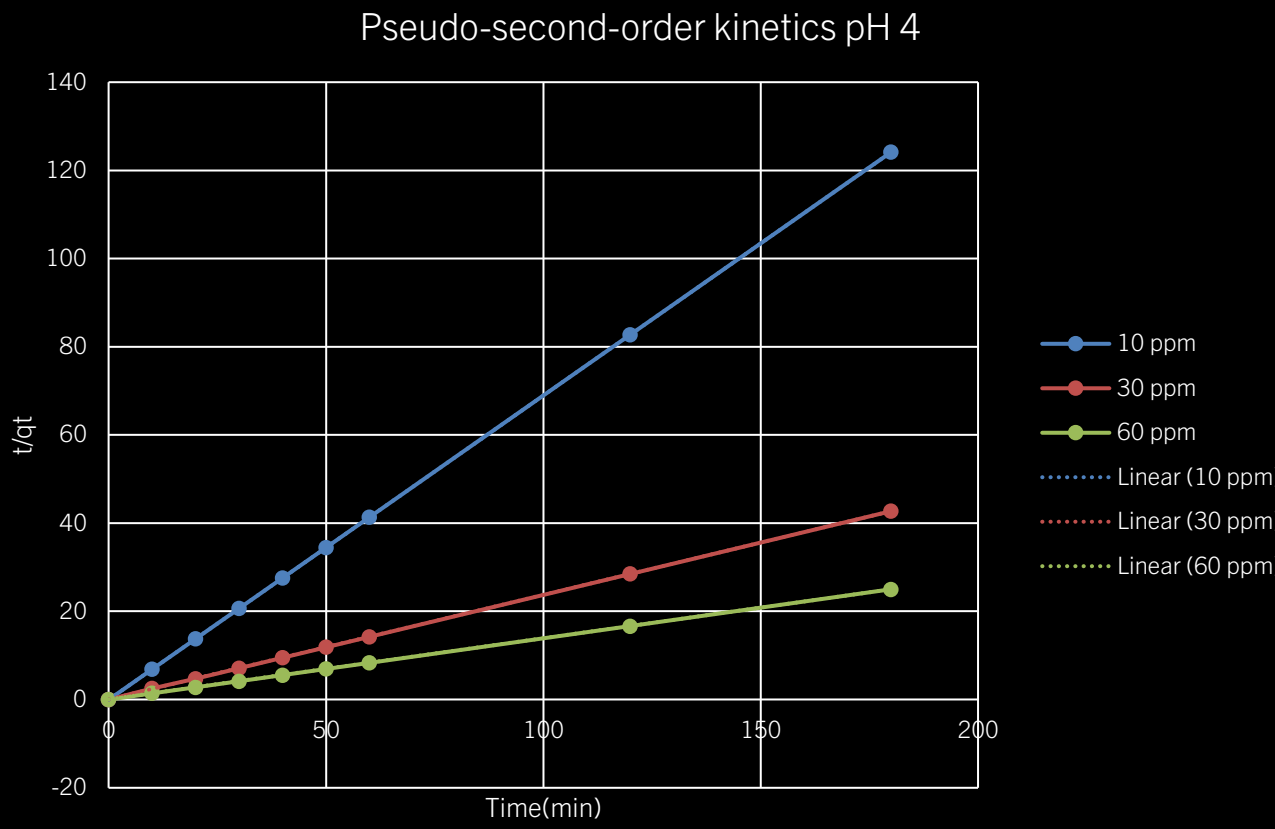


pH increase reflects the precipitation of Cr due to the presence of calcium

ANALYSIS: KINETICS

$R^2 = 0.1338$, $R^2 = 0.3111$, $R^2 = 0.4695$

Low R^2 indicates that the properties of this adsorption process do not fit with the PFO kinetic model

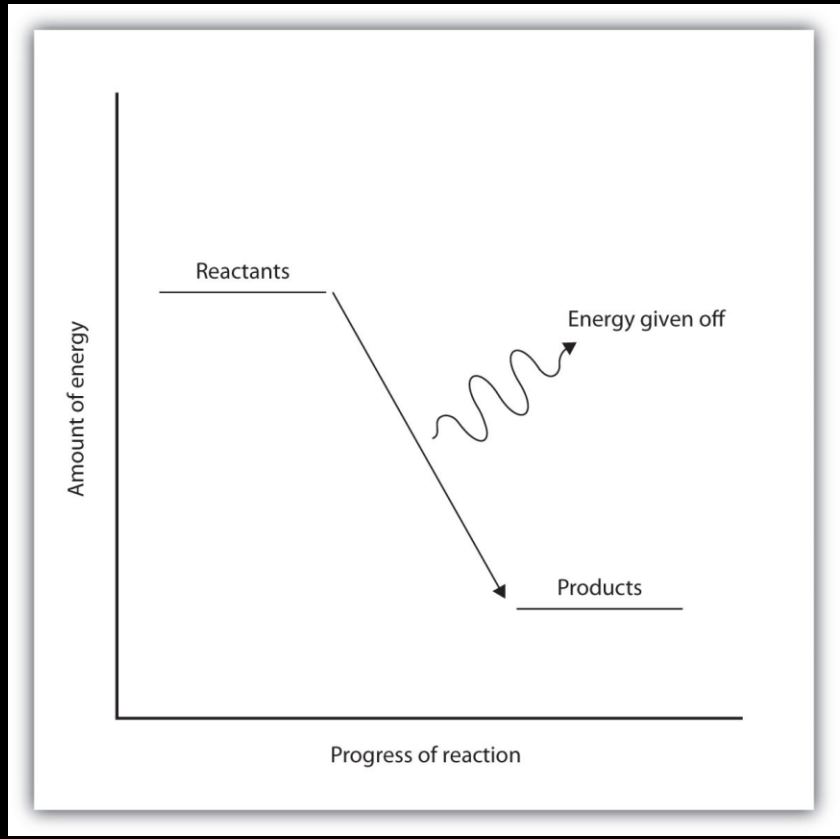


$R^2 = 1$, $R^2 = 1$, $R^2 = 1$

High R^2 indicates that the properties of this adsorption process fit well with the PSO kinetic model

CONCLUSIONS

- The pseudo-second-order kinetic model implies chemisorption in the adsorptions process
- Adsorbent achieved 100% removal efficiency at various concentrations
- Ladle slag can be used in place of commercial materials



FUTURE WORK

- Test for fluoride removal
- Analyze the mechanism of removal
- Evaluate simultaneous removal of fluoride and Cr
- Evaluate capacity for metal recovery