



A Green Approach for the Synthesis of Magnetic Reduced Graphene Oxide as a Promising Adsorbent for the Fast Removal of Pb²⁺ Ion from Wastewater

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Poster Theme: Clean Water
and Sanitation (SDG 6)

Introduction

Sources of Water Contamination

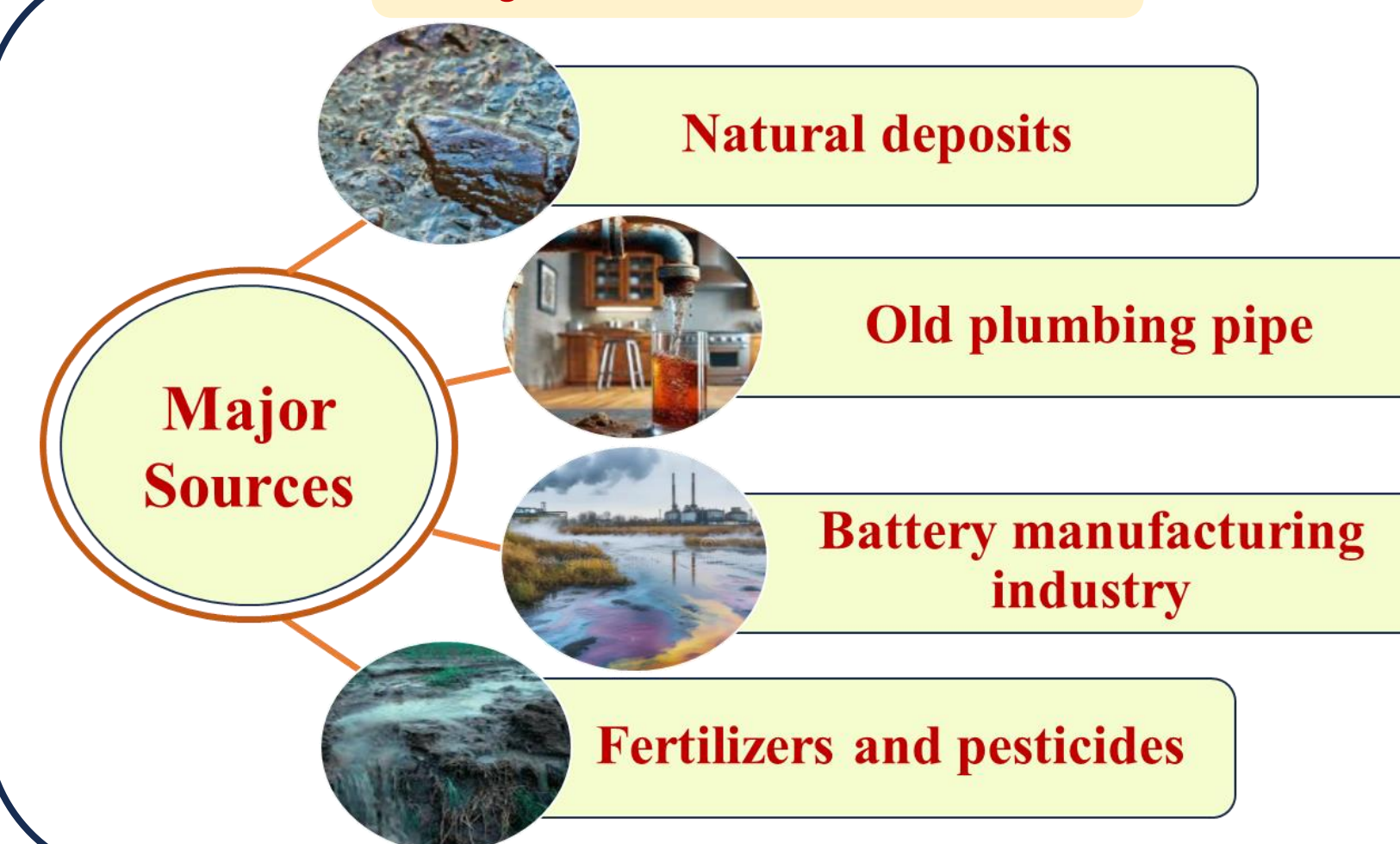
Biological	Physical	Radiological	Chemical
Major sources	Major sources	Major sources	Major sources
Bacteria (E. coli) & Viruses (hepatitis A)	Plastic bags, bottles, mining and construction activity	Leakage from nuclear plants or improper isotope disposal in water	Factories release heavy metals (Hg, Cr, Pb, Cd and As) & organic dyes

Lead poisoning in Bangladesh

- One of the most common and hazardous heavy metal contaminants in water.
- Nearly 70% intellectual disability caused by lead: UNICEF.
- The population has an average of 6.83 micrograms per deciliter of lead in their bloodstreams: UNICEF.
- Blood lead level high in 36M children.
- Productivity losses due to lead exposure cost 16 billion annually.
- More than 70 sites near the capital city have high to alarming levels of lead in the environment.

- Data by Pure Earth Bangladesh.

Major Sources of Lead



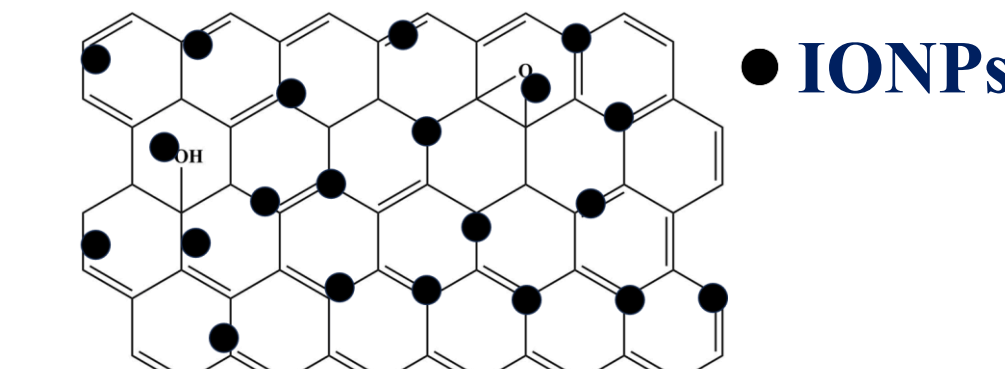
Traditional Adsorbents used in Adsorption



Though these materials are known for their abundant nature these material also posses some drawbacks-

- Clay can swell when wet, which reduces its adsorption quality.
- Activated carbon has limited adsorption capacity for heavy metals.
- Silica based adsorbents are chemically unstable in extreme pH.
- Zeolites has limited ion-exchange capacity for divalent/trivalent heavy metals.

Magnetic reduced graphene oxide

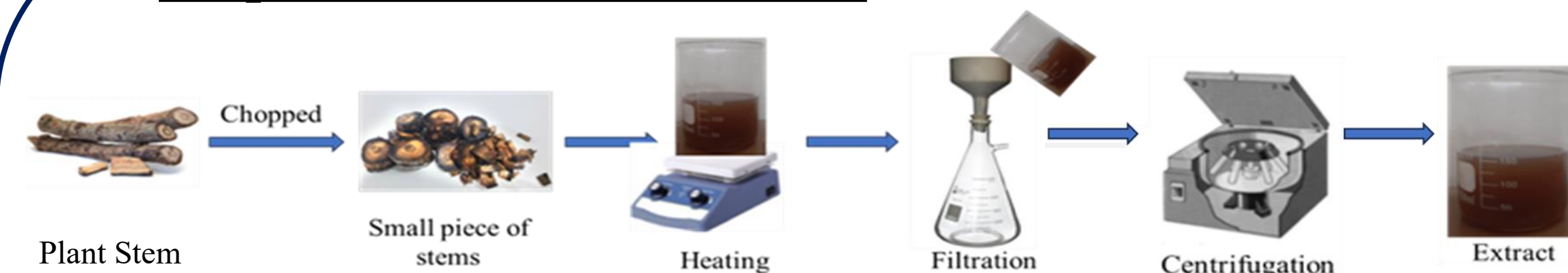


Magnetic reduced graphene oxide(rGO) is a promising adsorbent as compared to traditional ones-

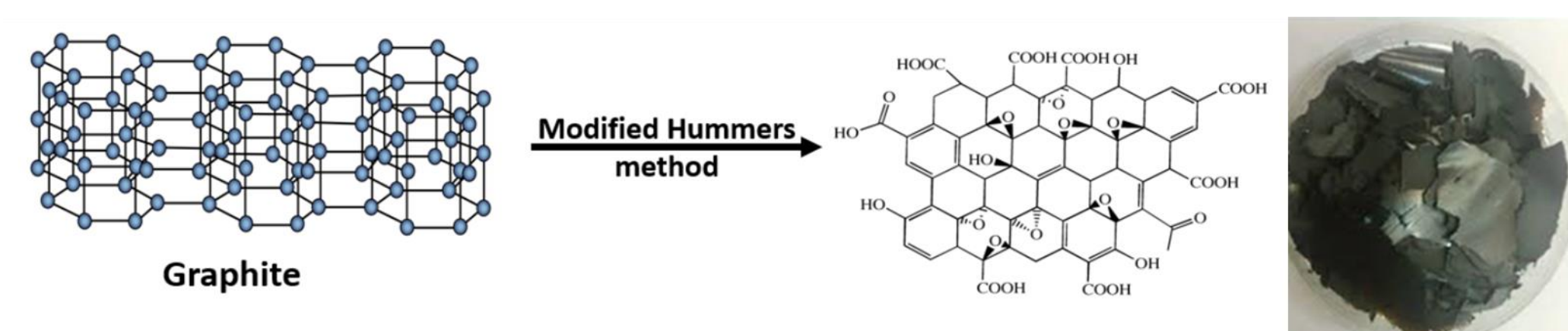
- High adsorption capacity, as rGO has an ultra-high surface area.
- Magnetic iron oxide nanoparticles allow magnetic separation; no filtration/centrifugation needed.
- Can be synthesized via green routes.

Methodology

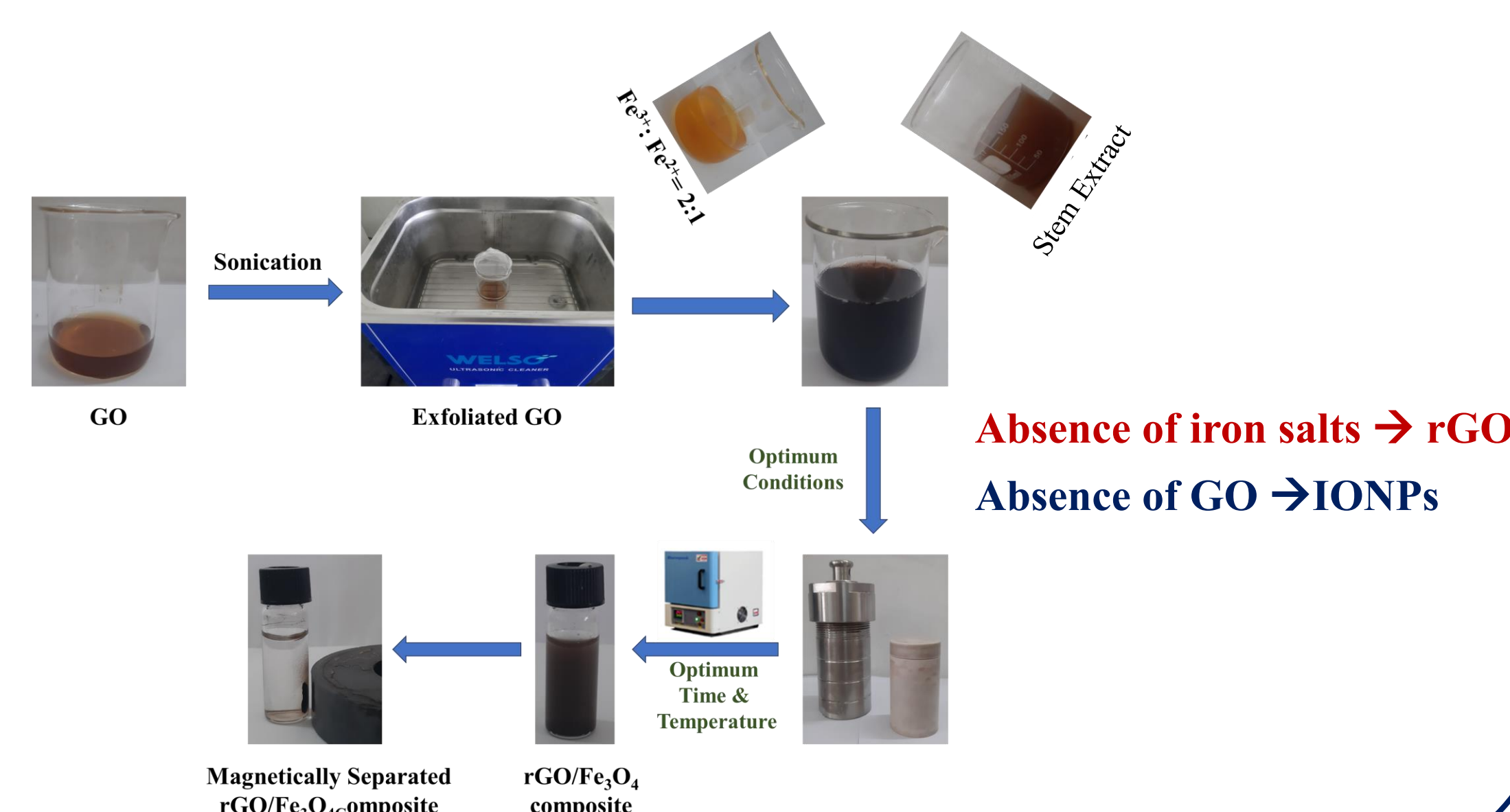
Preparation of Plant Extract



Synthesis of graphene oxide (GO)

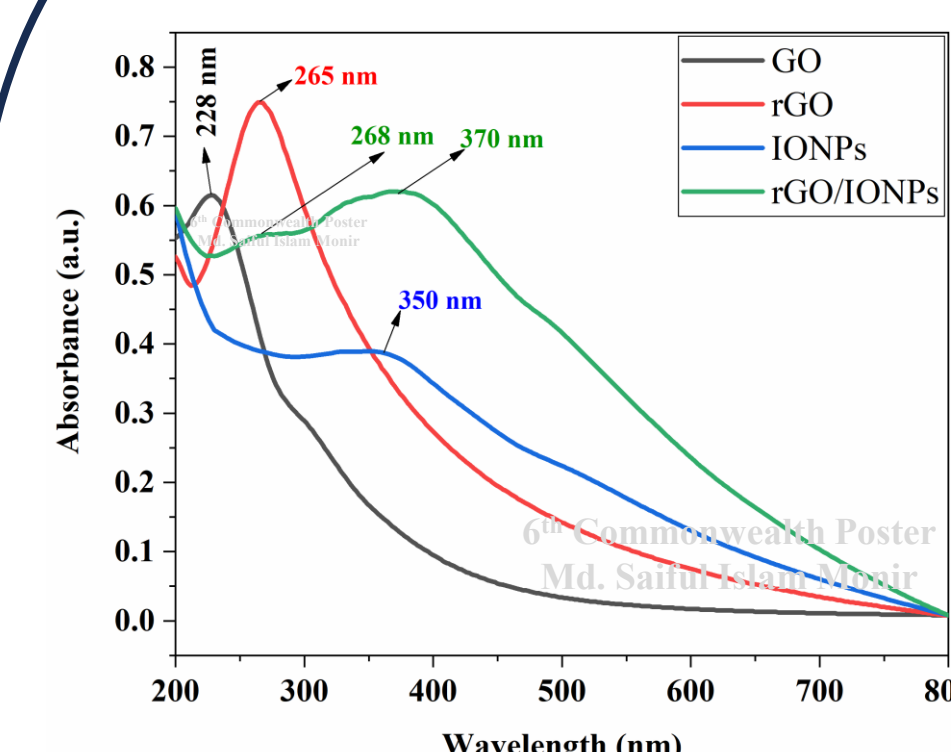


Preparation of rGO/IONPs nanocomposite



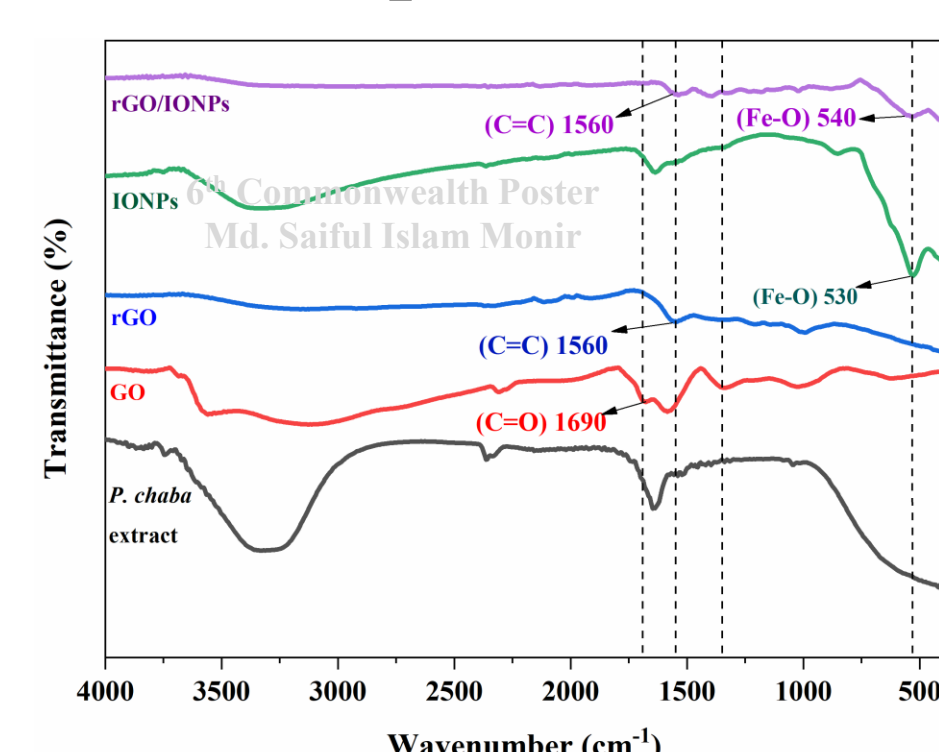
Results and Discussion

UV-Vis Spectra



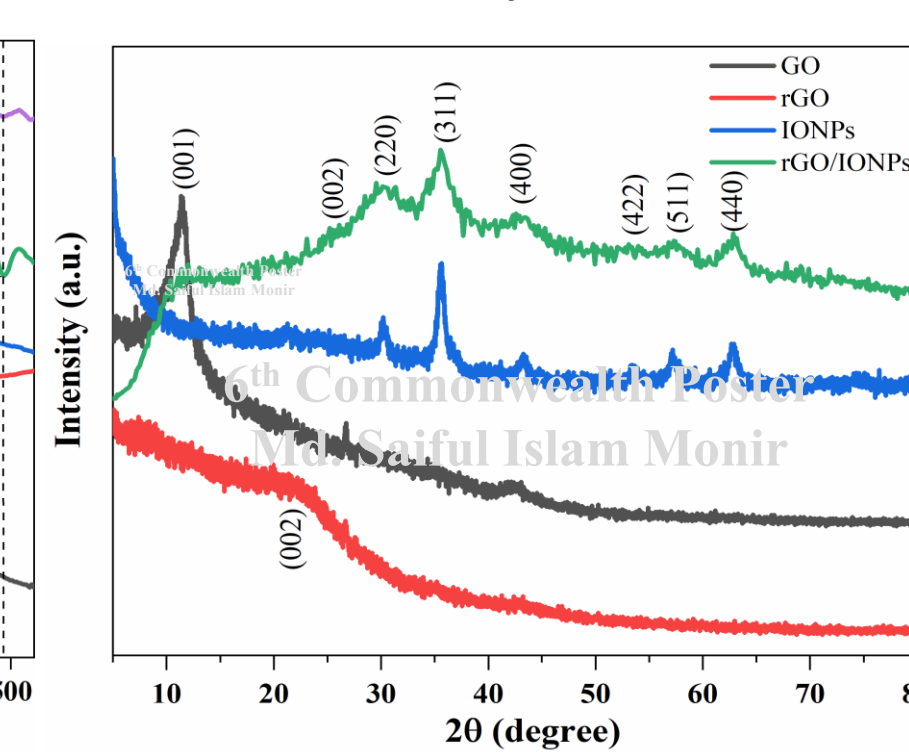
- rGO/IONPs is a combination of rGO and IONPs

FTIR Spectra



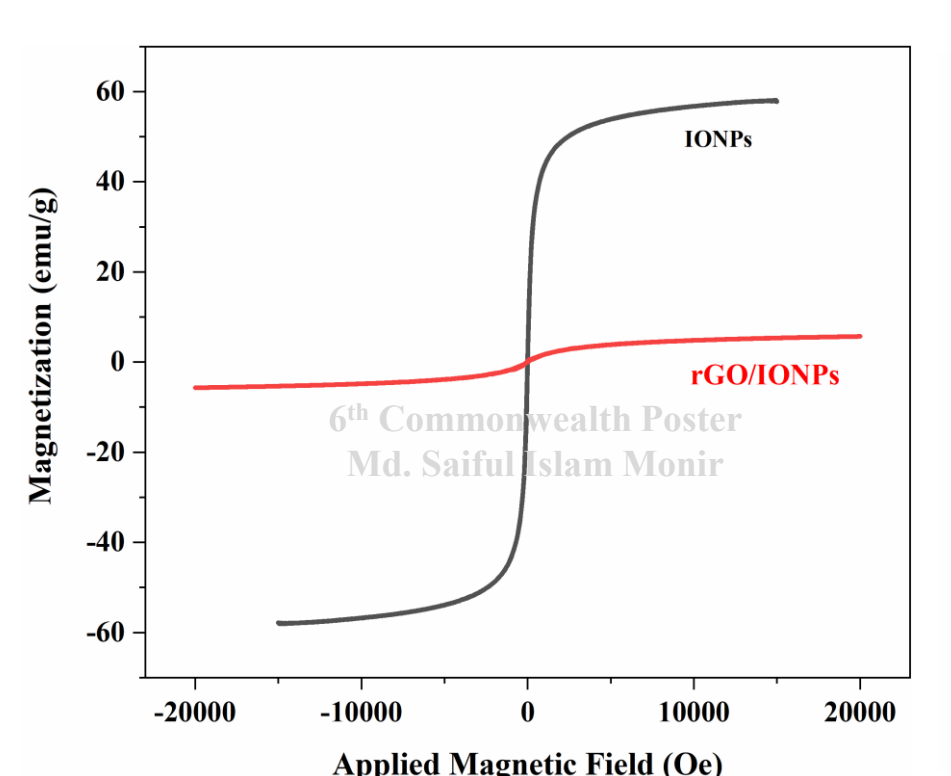
- rGO/IONPs is a coexistence of rGO and IONPs.

XRD Analysis



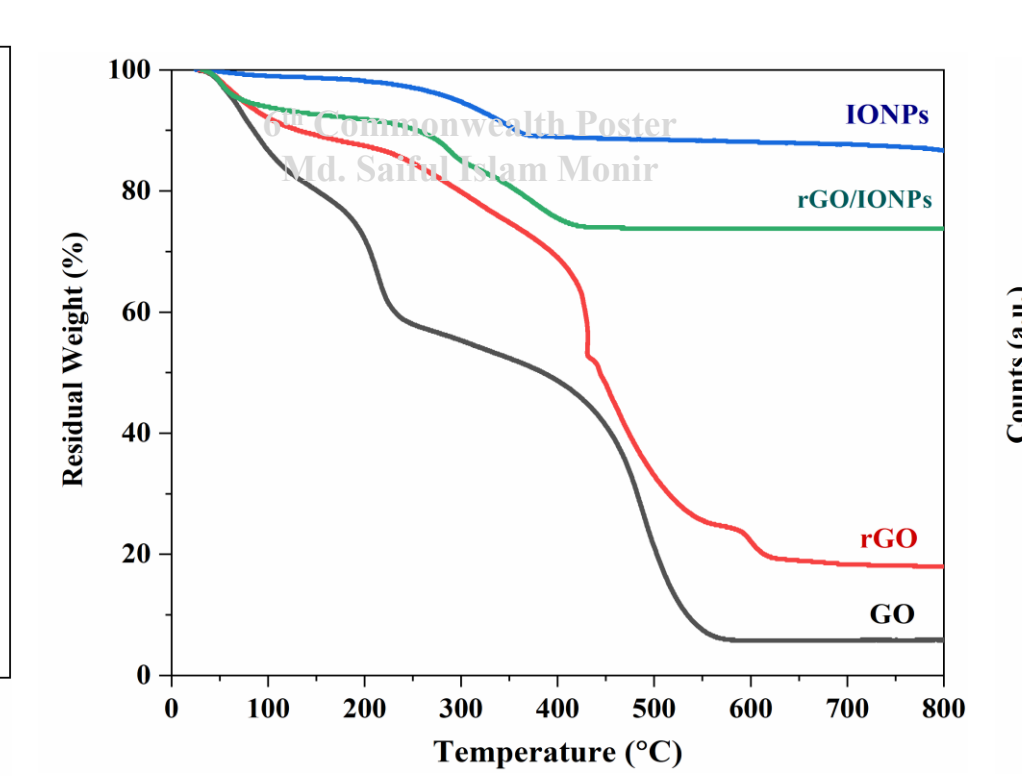
- rGO/IONPs is a coexistence of rGO and IONPs.

VSM Analysis



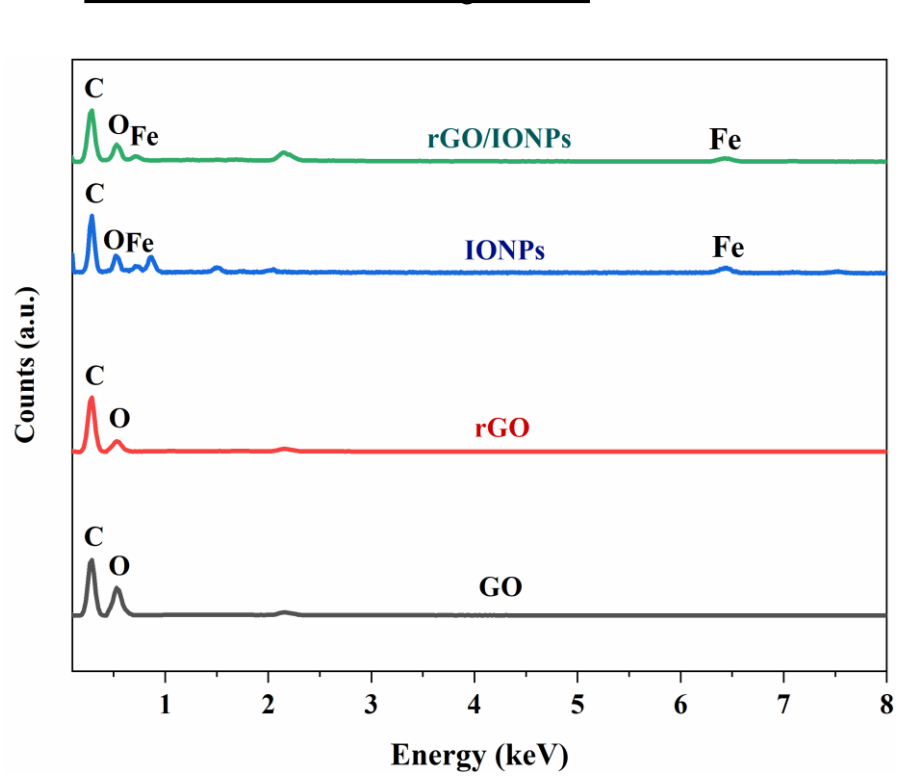
- M_s(IONPs)= 58 emu/g
- M_s(IONPs/rGO)= 6 emu/g

Thermogravimetric Analysis



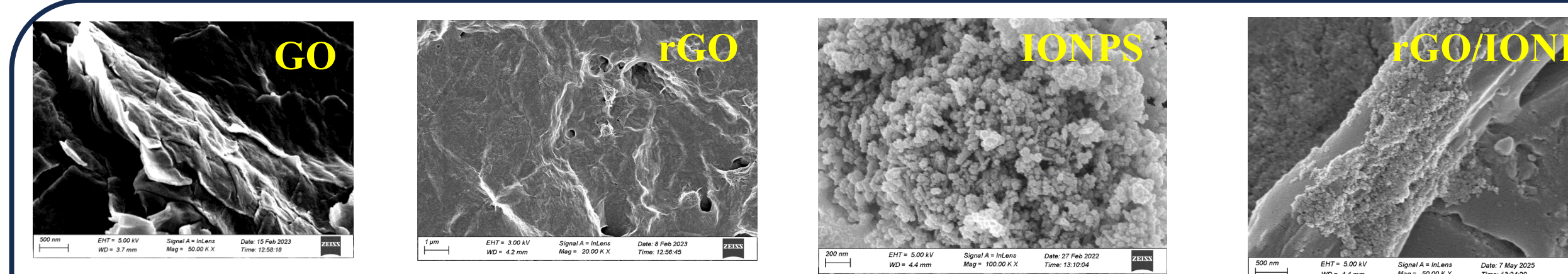
- Weight loss: IONPs < rGO/IONPs < rGO < GO

EDX Analysis



- rGO/IONPs is a coexistence of rGO and IONPs.

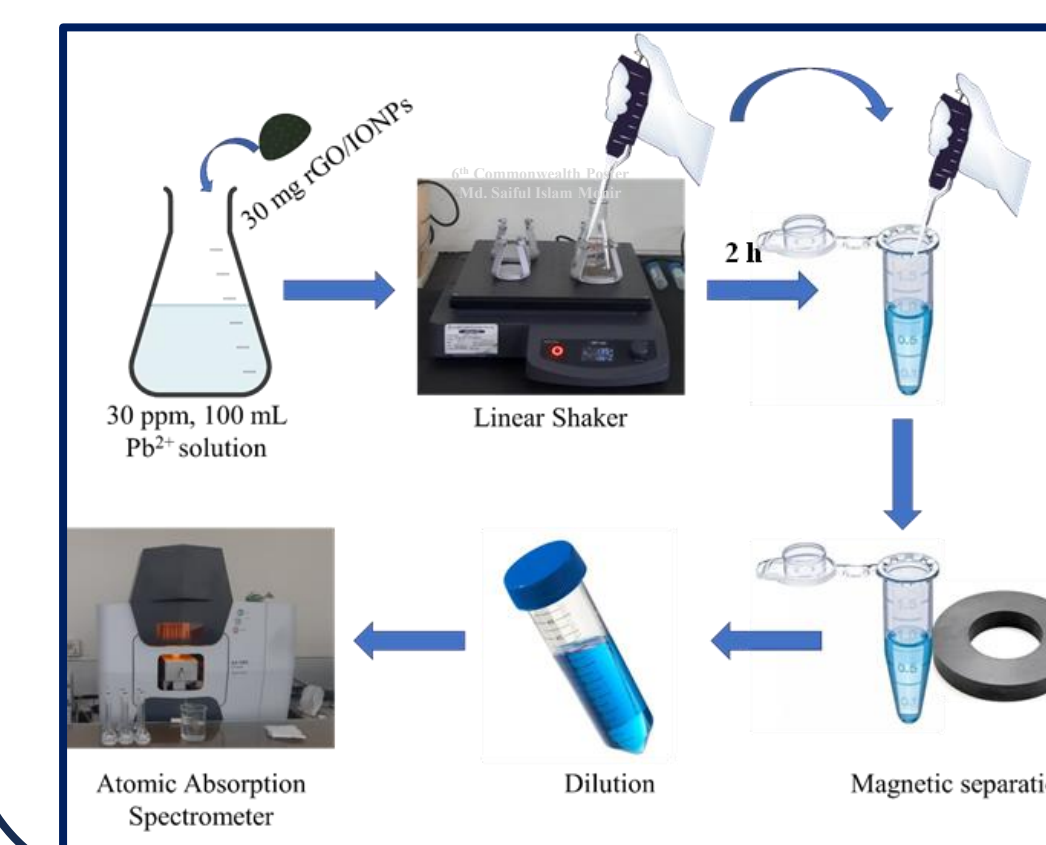
Morphological Analysis



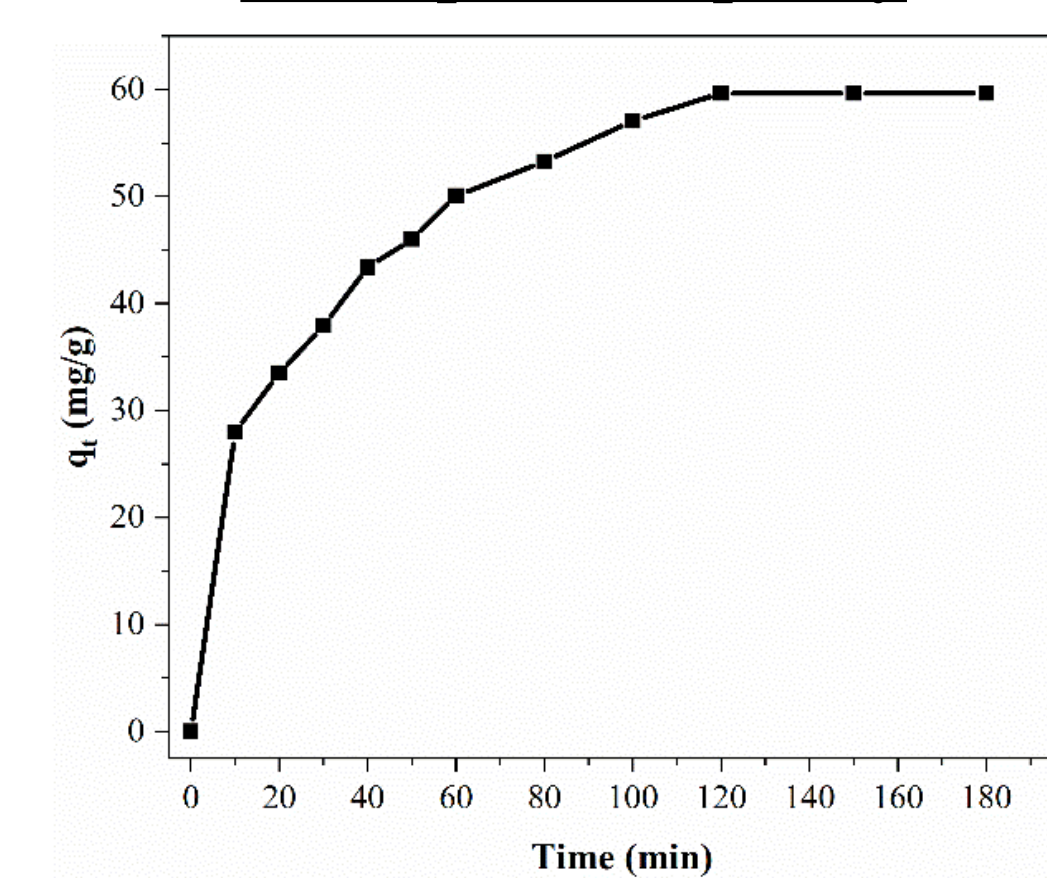
- Presence of IONPs in rGO sheet confirms the successful synthesis of rGO/IONPs.

Applications

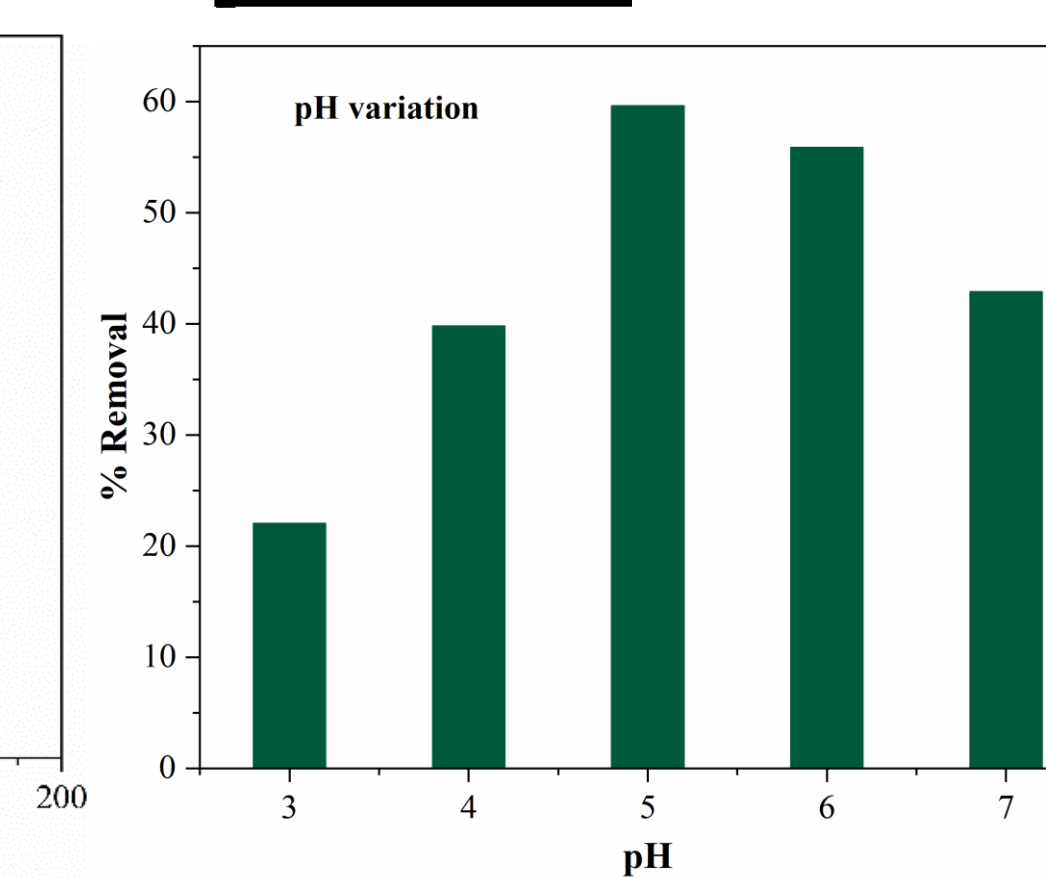
Adsorption Procedure (Batch Adsorption)



Adsorption Capacity



pH Variation



Models and Equations		
Kinetics Parameters		
Pseudo-first order	K ₁ (1/min)	R ²
$\ln(q_e - q_t) = \ln q_e - k_1 t$	0.02811	0.977
Pseudo-second order	K ₂ (×10 ⁻⁴ g/(mg·min))	R ²
$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e}$	7.55	0.9965

Conclusion

- Successful synthesis of rGO/IONPs using *Piper chaba* stem extract.
- Obtained rGO/IONPs shows good adsorption capacity towards Pb²⁺ ion.
- The product could be used as a good adsorbent for other heavy metal removal as well.

Reference

Osman, A. I. *et al.* (2023). *Environmental Chemistry Letters*, 21(4), 2337-2398
Prasad, C. *et al.* (2017). *Journal of Environmental Chemical Engineering*, 5(5), 4374-4380
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