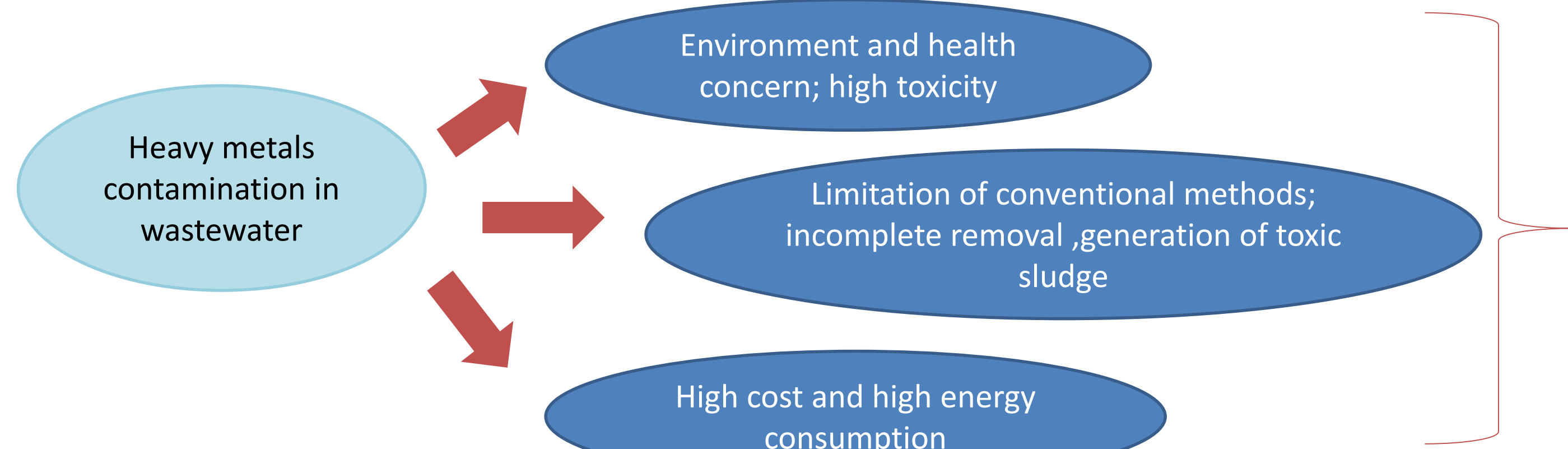
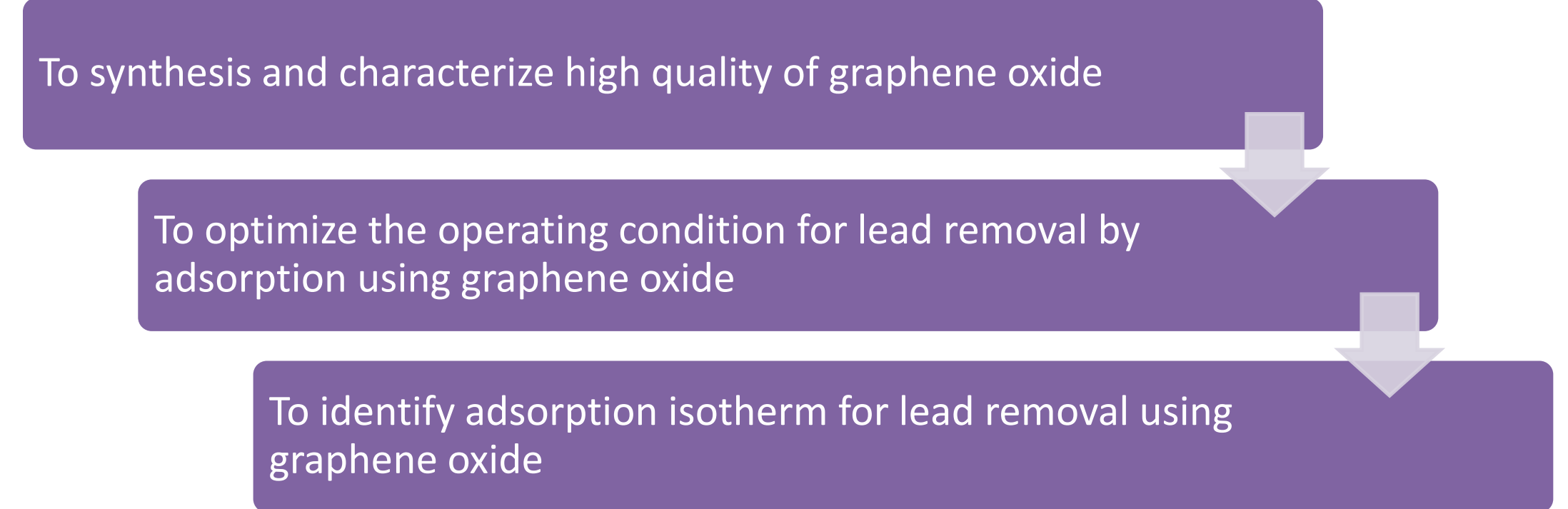


CONTEXT & OBJECTIVE



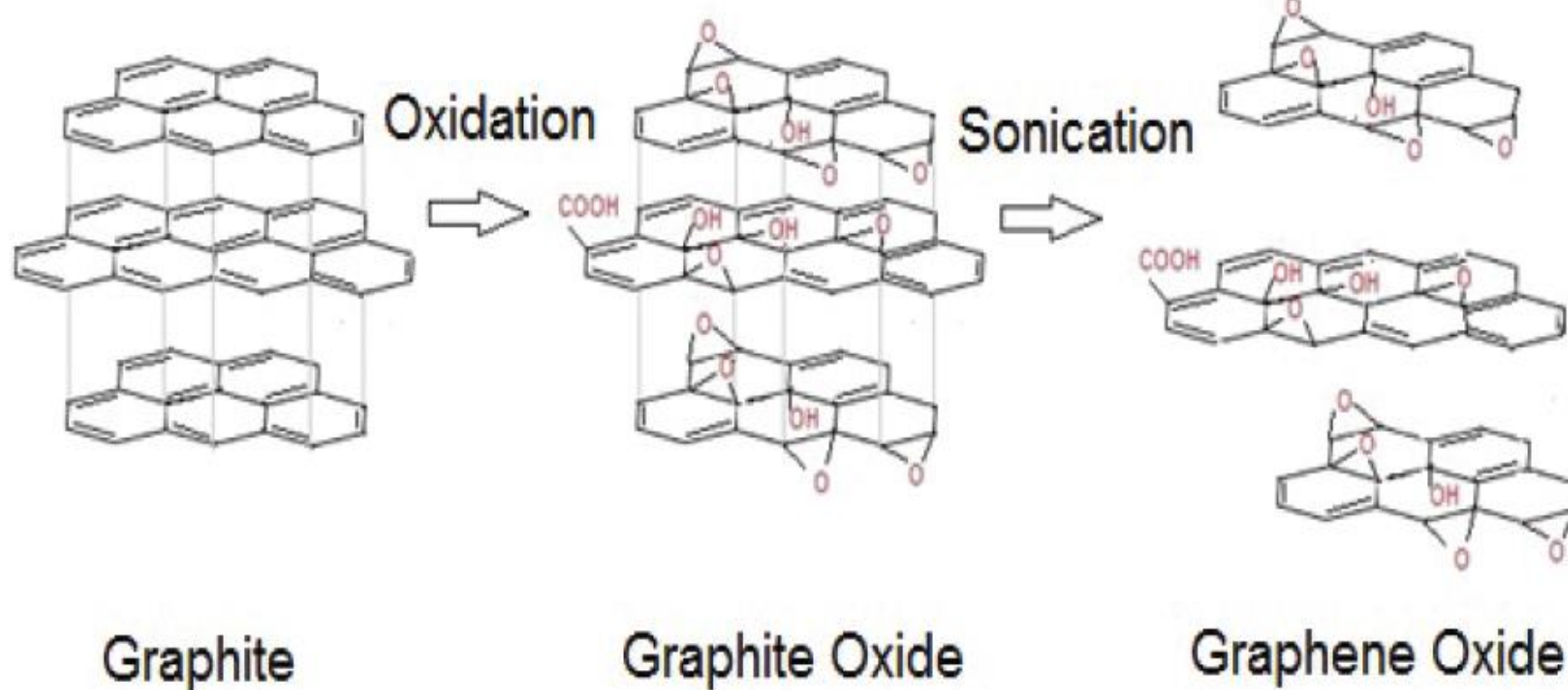
This study aims to remove lead from wastewater effluent by adsorption process using graphene oxide



EXPERIMENTAL SECTION

A) SYNTHESIS OF GRAPHENE OXIDE

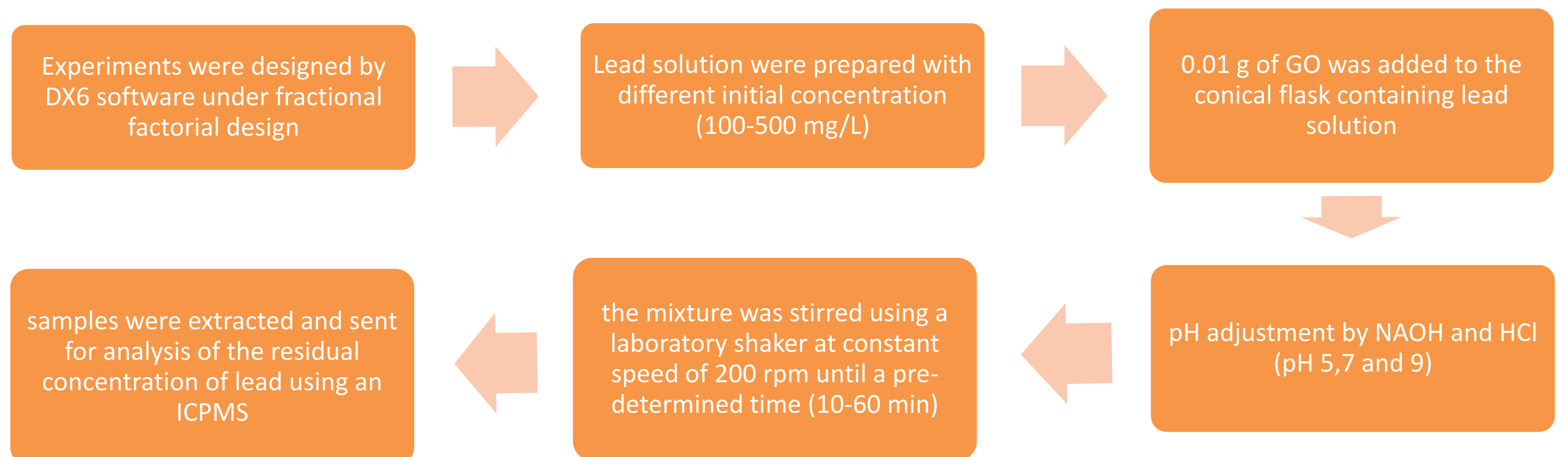
The synthesis of GO involves oxidation of graphite into graphite oxide and exfoliation of graphite oxide into graphene oxide (Wahab et al. 2016).



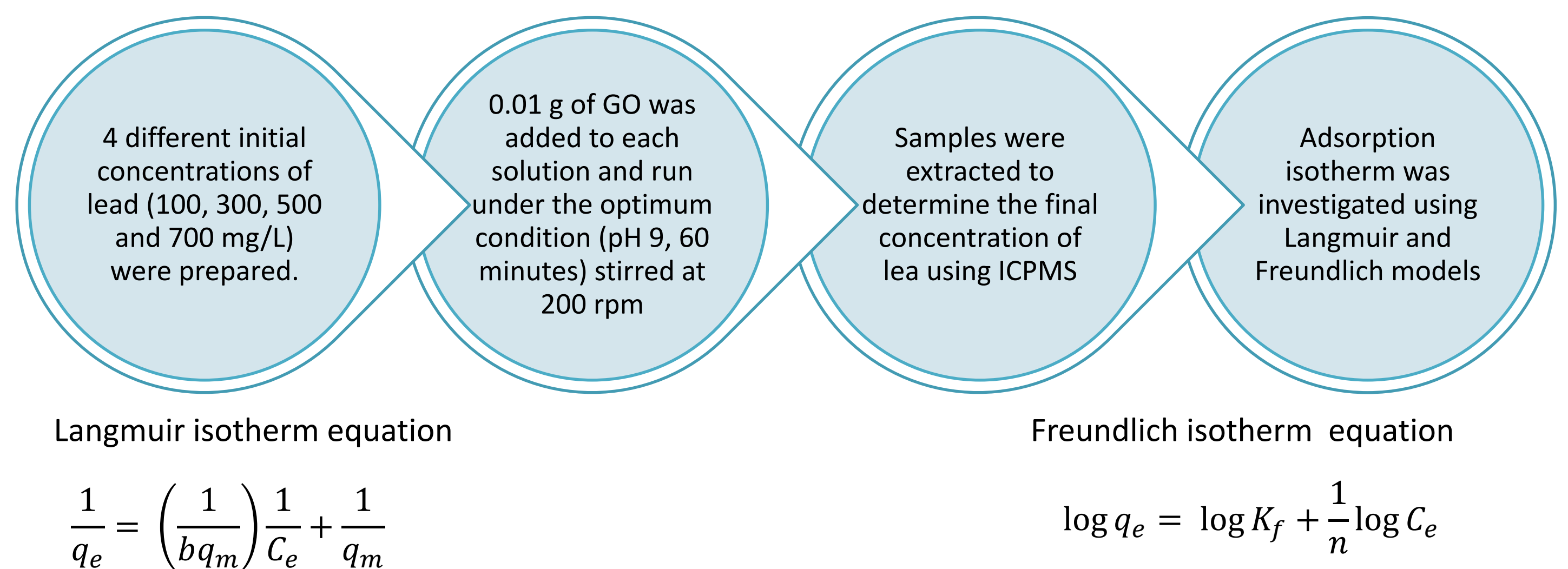
B) CHARACTERIZATION OF GO

FTIR	to identify the chemical compound and organic molecules presence in GO using FTIR spectrometer (V70, Bruker Corp., Massachusetts, US).
SEM	GO powder sample was sprinkled on the sample holder using a double-sided tape, then coated using sputter coater device (Q-SC7620, QuorumTech Ltd., London). The morphology of GO was evaluated with a SEM (JSM-IT 100, Jeol, Japan)

C) BATCH ADSORPTION EXPERIMENT



D) ADSORPTION ISOTHERM



Langmuir isotherm equation

$$\frac{1}{q_e} = \left(\frac{1}{bq_m}\right)\frac{1}{C_e} + \frac{1}{q_m}$$

Freundlich isotherm equation

$$\log q_e = \log K_f + \frac{1}{n} \log C_e$$

RESULTS AND DISCUSSION

A) GRAPHENE OXIDE

The SEM micrographs of GO powder displayed a randomly aggregated and crumpled structure, showed some wrinkle and fold area on the surface of GO and its confirmed that the graphite was well exfoliated during the oxidation process (Yusoff, Samad, Loh & Lee 2018).

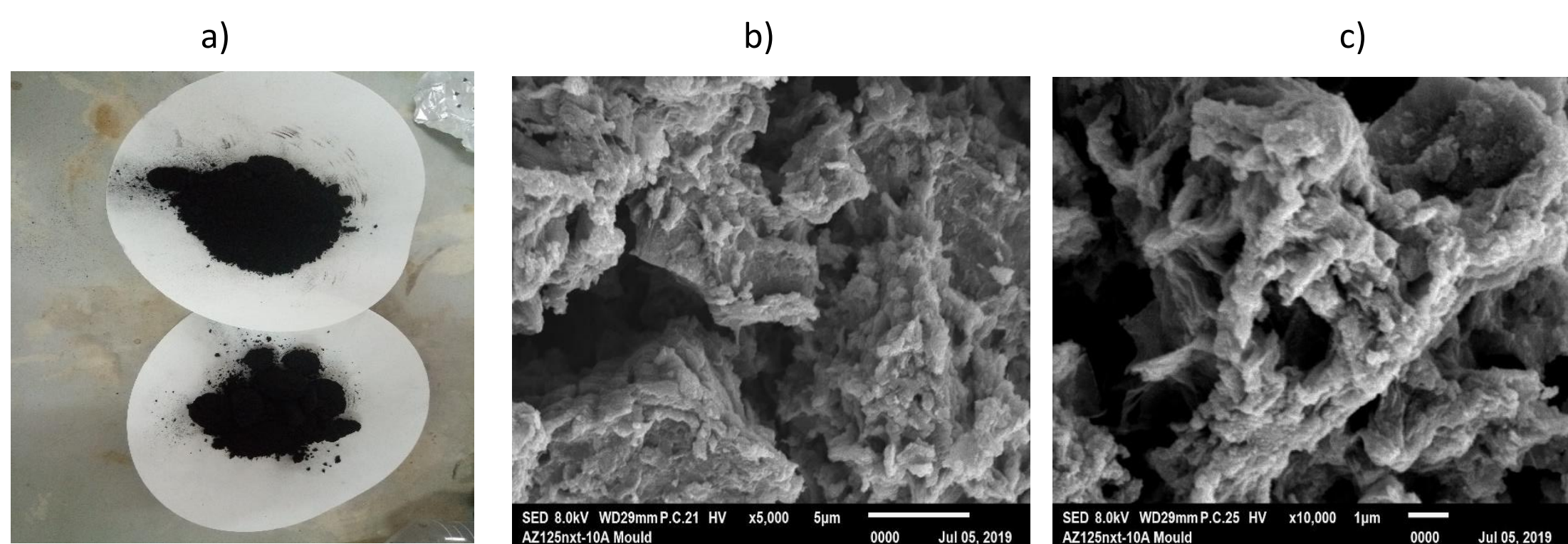


Fig 1: a) powder form of produced GO after freeze-dry and SEM images on the magnificant of b) 5k X and c) 10k X

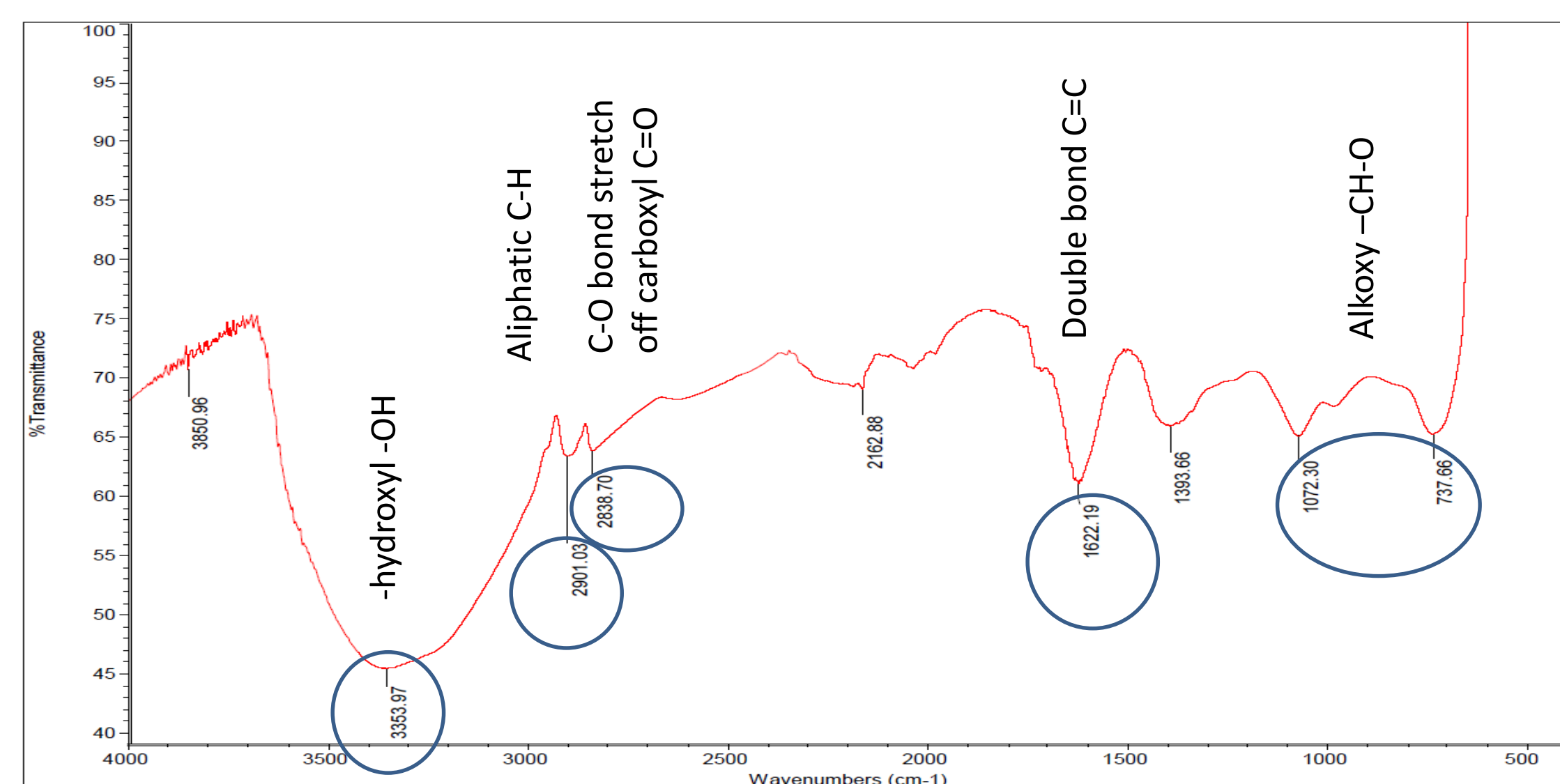


Fig 2: FTIR analysis of GO

B) BATCH ADSORPTION AND ISOTHERM

Table 1: Batch adsorption experiment of GO for lead removal

Run	A:Contact time (min)	B:pH	C:Initial concentration of lead, C ₀ (mg/L)	Final concentration of lead, C _e (mg/L)	Percentage removal(%)
1	35	7	324.31	13.430	94.30
2	10	9	539.61	22.060	95.90
3	60	9	107.21	0.024	99.98
4	10	5	107.21	47.880	55.30
5	60	5	539.61	54.900	89.80
6	60	9	539.61	20.750	96.10
7	10	5	539.61	52.100	90.30
8	10	9	107.21	0.101	99.90
9	60	5	107.21	71.720	33.10
10	35	7	324.31	18.510	94.30

$$\% \text{ Removal} = \frac{C_0 - C_e}{C_0} \times 100$$

Optimum conditions for adsorption of lead by GO were at pH 9, contact time 60 minutes with 100 mg/L of initial concentration.

Table 2: Equilibrium data for Langmuir and Freundlich isotherms

Equilibrium C _e (mg/L)	Langmuir Q _e (mg/g)	Langmuir		Freundlich	
		1/C _e	1/q _e	log C _e	log q _e
2.57	1046.4	0.3891	0.000956	0.4099	3.0197
15.92	3083.9	0.0628	0.000324	1.2019	3.4891
42.1	4975.1	0.0237	0.000201	1.6243	3.6968
276.6	4818.1	0.0036	0.000208	2.4419	3.6829

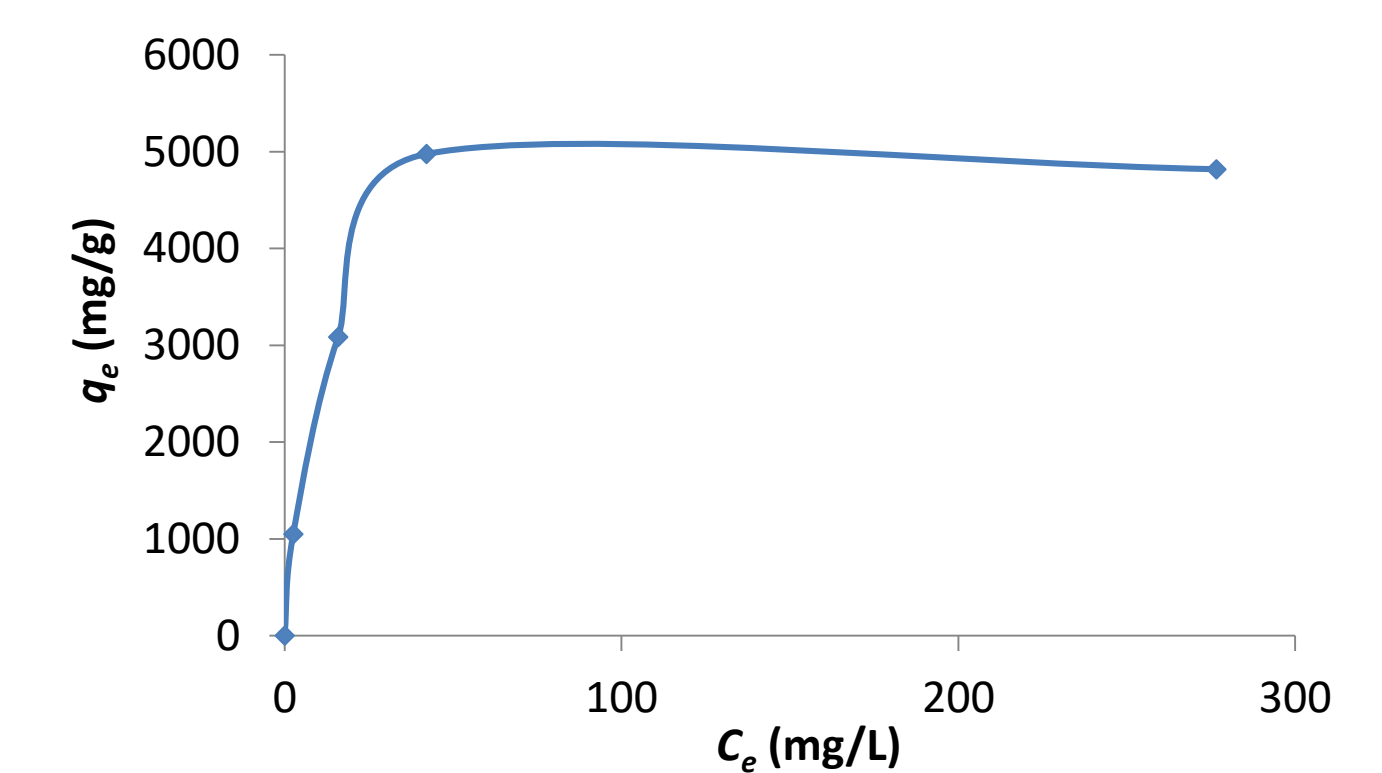


Fig 3: Graph of equilibrium concentration of lead on GO surface, q_e, versus the concentration of the lead in the solution, C_e

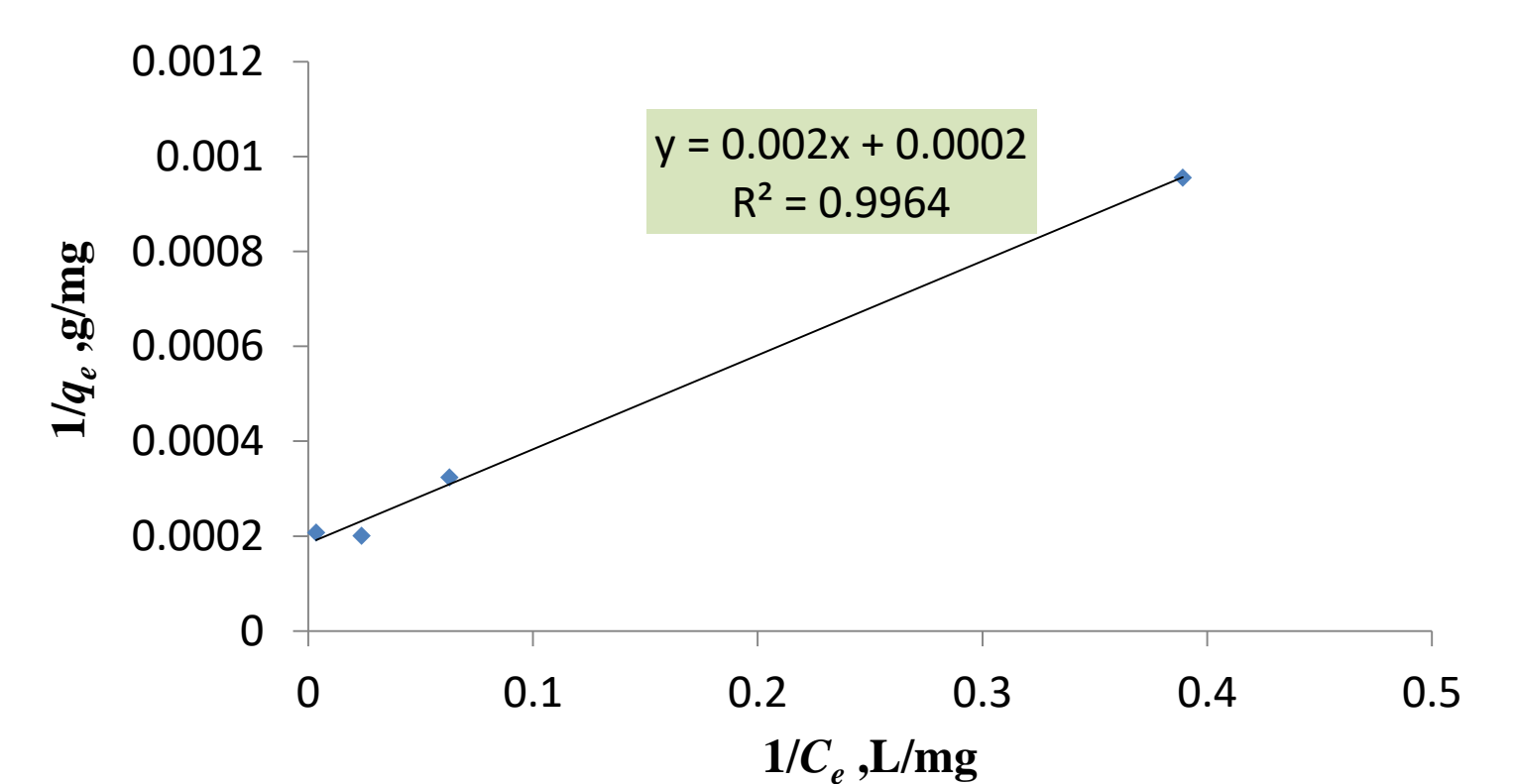


Fig 4: Graph of Langmuir isotherm; 1/q_e versus 1/C_e

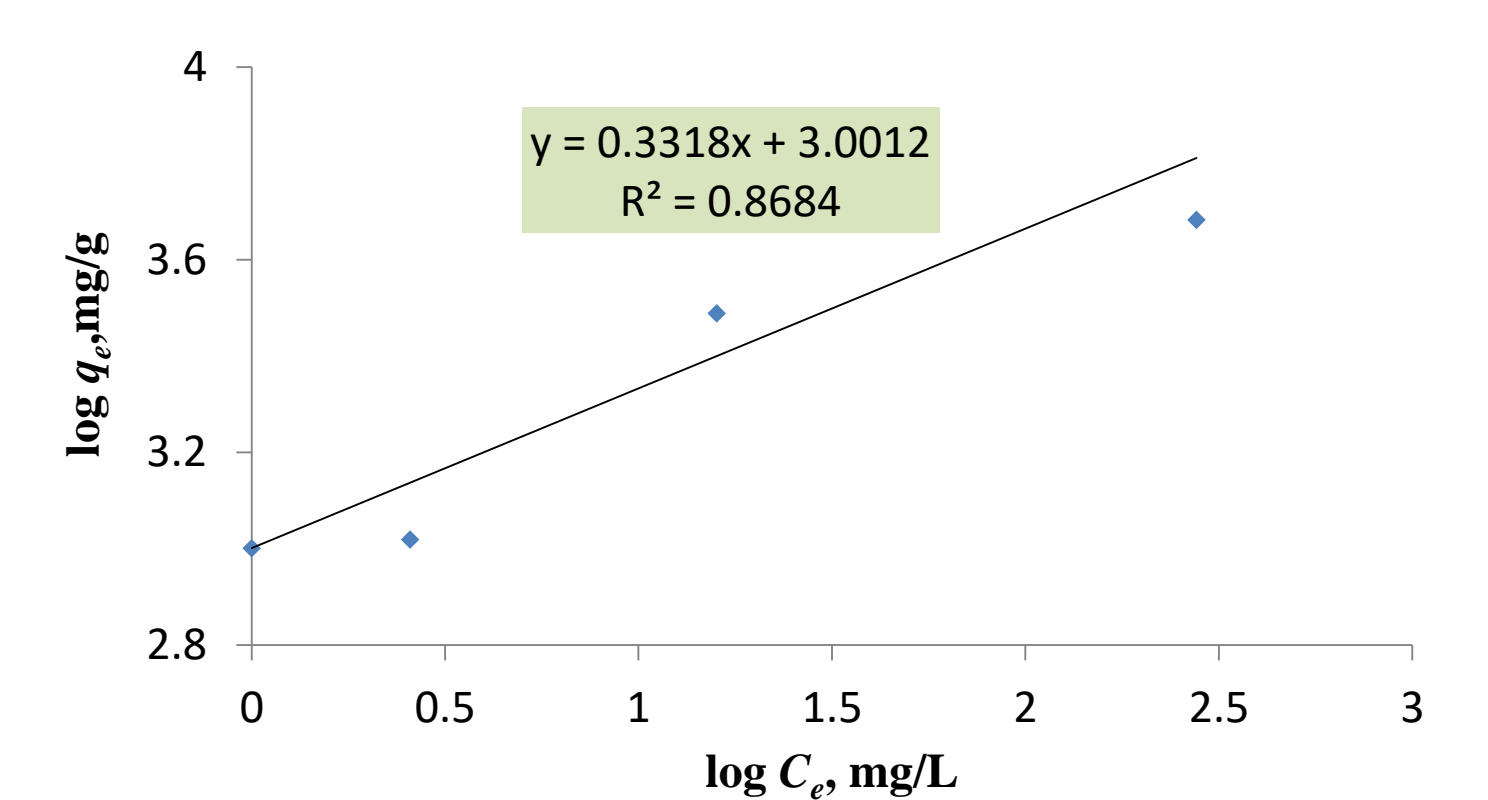


Fig 5: Graph of Freundlich isotherm; 1/q_e versus 1/C_e

CONCLUSION

In conclusion, the operating conditions of adsorption by graphene oxide were optimized by fractional factorial design. The highest percentage removal with 99.9 % of lead removal was identified at pH 9, contact time 60 minutes with 100 mg/L of lead initial concentration. The adsorption study fitted well in Langmuir isotherm (R²= 0.9964) and the maximum adsorption capacity of lead onto graphene oxide was 500 mg/g. It is therefore believed that utilization of GO is an excellent alternative to enhance adsorption performance towards efficient wastewater treatment. This work become a promising research direction for graphene-based membrane fabrication for heavy metals removal in current and future membrane applications.

REFERENCES

- Mahmoudi, E. et al. (2019) Distinguishing characteristics and usability of graphene oxide based on different sources of graphite feedstock, *Journal of Colloid and Interface Science*, 542, 1-33, DOI: 10.1016/j.jcis.2019.02.023
- Yusoff, Samad, Loh & Lee (2018). Structural and Morphological Study of Sulfonated Graphene Oxide Prepared with Different Precursors. *Jurnal Kejuruteraan SI* 1(2), 65-71, DOI: 10.17576/jkum-2018-si1(2)-08
- Wahab, I. F. et al. (2016). Electrospun Graphene Oxide-Based Nanofibres, *Advances in Carbon Nanostructures*, Adrian M.T. Silva and Sonia A.C. Carabineiro, IntechOpen, DOI: 10.5772/64055.