

ADSORPTION OF CONGO RED FROM AQUEOUS SOLUTION USING RICE HUSK, CALCINED KAOLIN CLAY AND MICROWAVED RICE HUSK CLAY HYBRID

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INTRODUCTION

Dye is one of the most prevalent and significant harmful, mutagenic and carcinogenic pollutants having a devastating impact on the environment. Effluents, particularly from the textiles, paint, printing, photography, and pigment processing industries, are discharged into waterways, increasing the BOD, COD, TOC hence reducing the quality of water bodies. The adsorption approach has proven to be an effective and attractive process for removing non-biodegradable contaminants including dyes from wastewater due to its simplicity and availability of a wide range of adsorbents. The use of biosorbents has prompted a lot of interest in the scientific community for the production of sustainably friendly material for the treatment of wastewater.

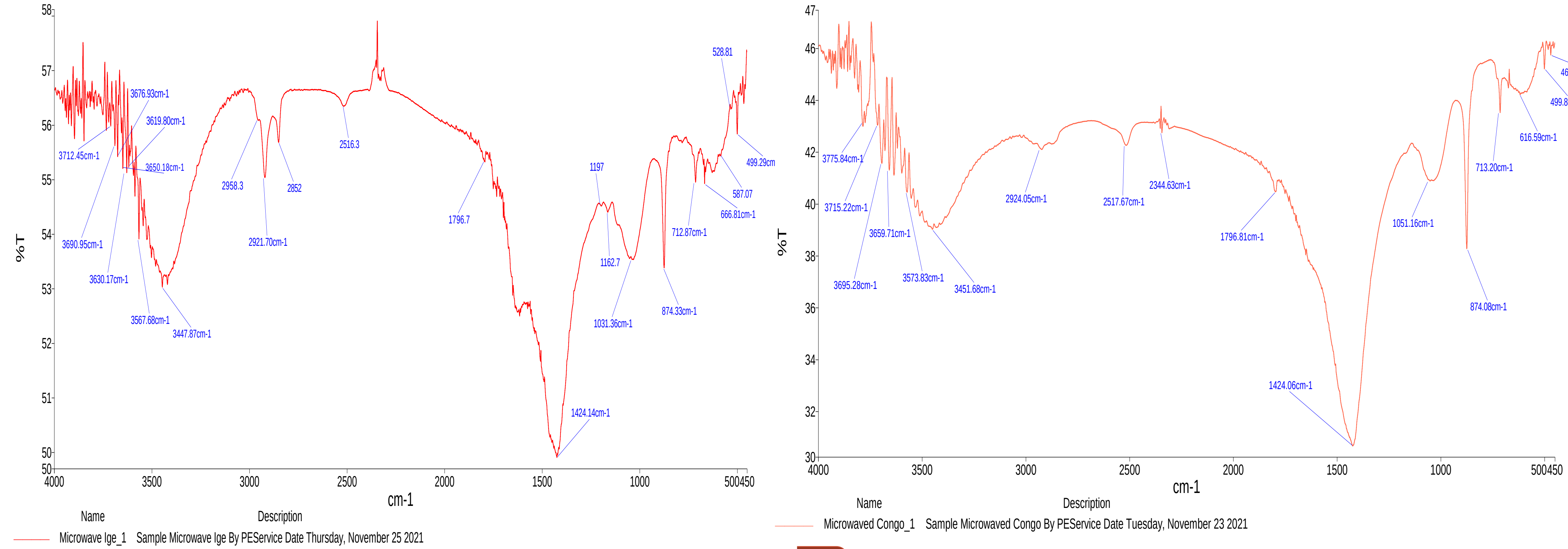
OBJECTIVE

The research was a comparative study of adsorption potential of CR on the Rice husk (RH), Calcined kaolin clay, (CKC) and Microwaved rice husk clay hybrid (MRHCH) by assessing the effect of operational variables such as time, concentration, temperature and adsorbent dosage.

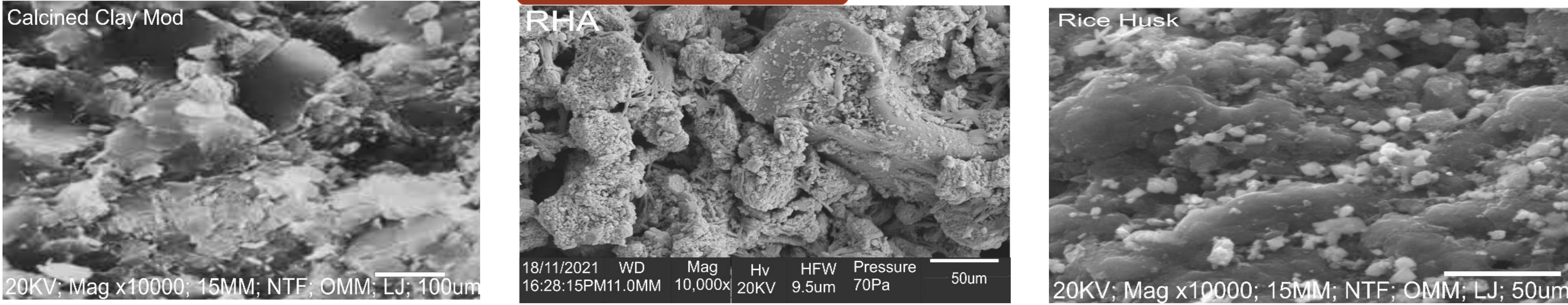
METHODOLOGY

- Collection of various materials required for the analysis.
- Preparation of adsorbents: RH modification using IM 10l NaOH for 24 hours, CKC calcination at 650°C for 2 hours, Microwaved combination of RH and CKC at a ratio of 1:1, medium temperature for 15min.
- Characterization of adsorbents using SEM and FTIR instruments.
- Preparation of stock solution of the adsorbate CR and dilution to obtain the working solutions of 50, 100 and 150ppm.
- Analysis such as effect of time, adsorbent dosage, combined effect of time, concentration and temperature were conducted.

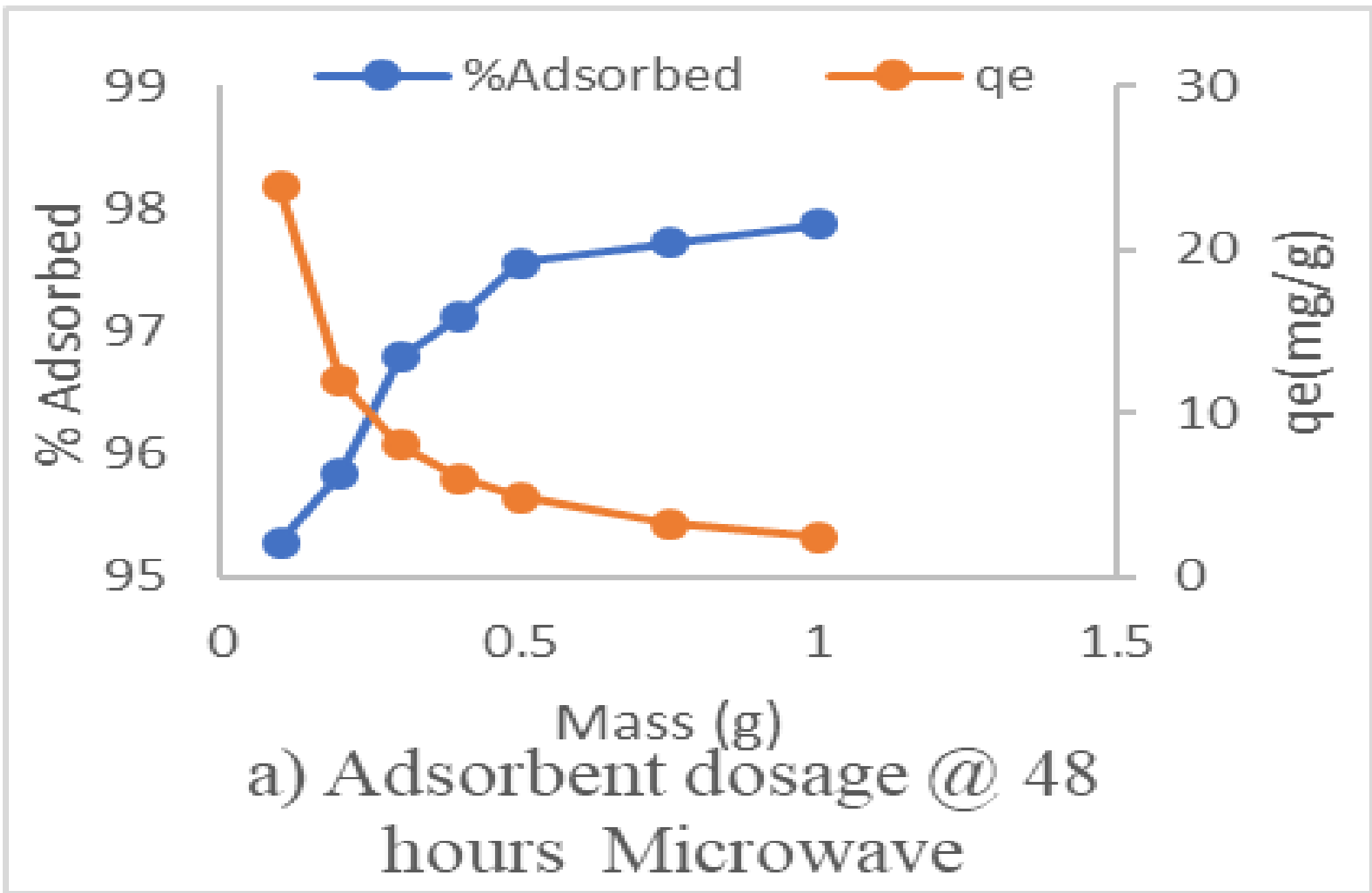
FTIR ANALYSIS



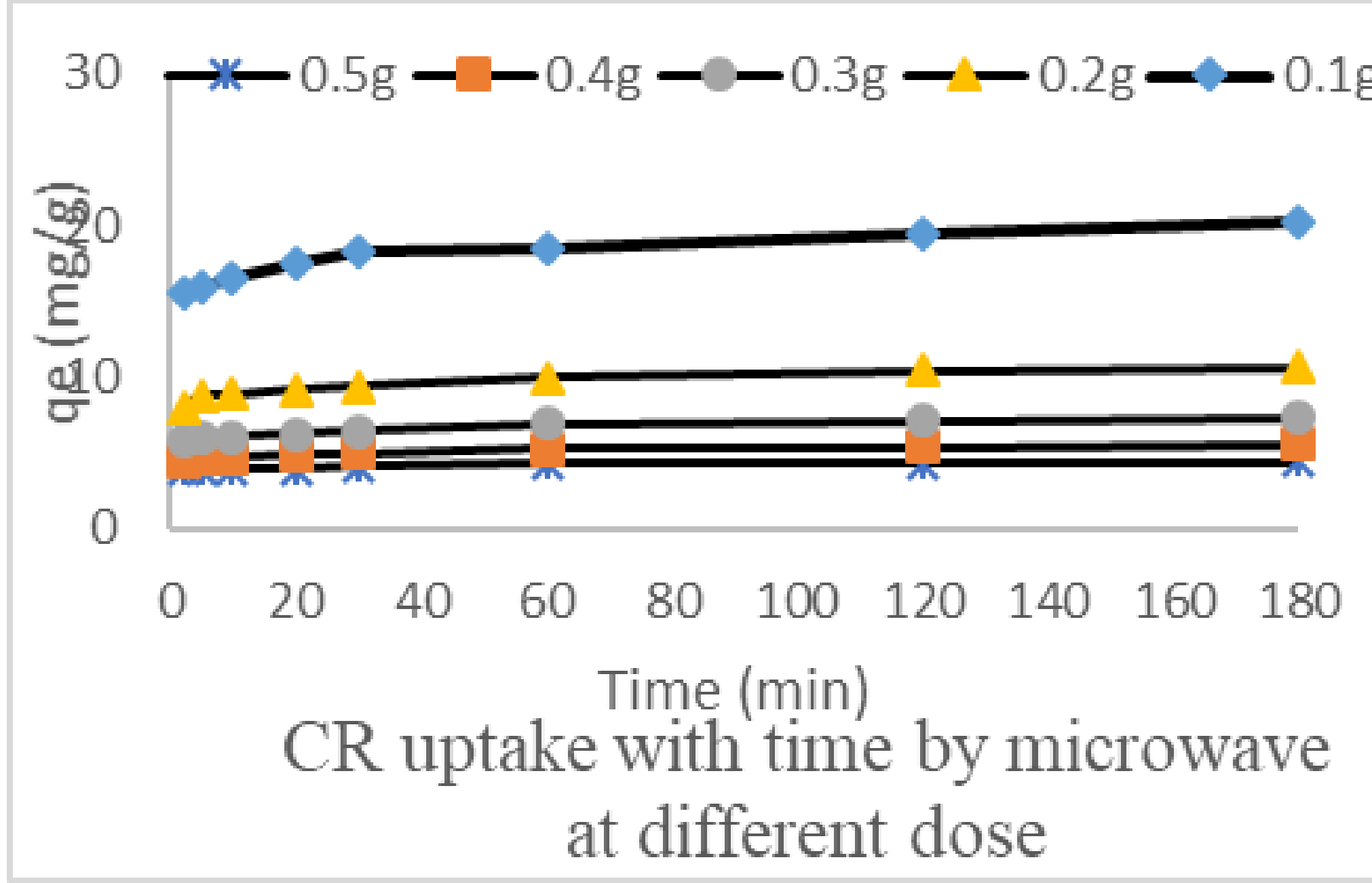
SEM ANALYSIS



EFFECT OF ADSORBENT DOSAGE



EFFECT OF TIME



RESULT AND DISCUSSION

Equilibrium isotherm data for the adsorption of CR onto MRHC, CC and RH.

Dye	Adsorbent	Langmuir			Freundlich		
		qm	b	R ²	n	K _f	R ²
CR	MRHC	4.008	0.311	0.9318	4.340	9.836	0.9825
	CC	2.194	3.974	0.9732	1.462	46.355	0.9932
	RH	0.883	0.027	0.900	0.619	1790.61	0.9745

Pseudo- second order parameters for the adsorption of CR onto MRHC, CC and RH.

	qe	qe	K ₂	h	R ²
(CR) sorbent	Experimental (mgg ⁻¹)	Calculated (mgg ⁻¹)	(gmg ⁻¹ min ⁻¹)	(mgg ⁻¹ min ⁻¹)	
MRHC	5.534	5.562	0.5022	15.536	0.9997
CC	4.130	4.15	0.5773	9.943	0.9998
RH	3.180	3.247	0.1485	1.5656	0.9972

In the spectrum of MRHCH, the percentage transmittance reduces from the range of (50-58%) to (30-47%) after treatment. The SEM results of MRHCH also showed clear large pores while the disrupted surface and porous texture can provide a suitable ground for the molecules to get adsorbed. It was observed that the MRHCH reached saturation in few minutes and remain constant as times increases. There was a rapid rate of adsorption for CKC and RH in the 2-40minutes of adsorption which then became constant. The rate of adsorption increase as the dosage increase while it decrease as the concentration increase.

CONCLUSION

The adsorption potentials of MRHCH, CKC and RH for removal of CR was 98%, 95% and 89% respectively. The isotherm is best fitted into Freundlich model while the kinetics study obeyed the pseudo-second order kinetics. The combined effects of temperature, time and concentration showed that the removal of CR by CKC and RH increased as temperature increases while the MRHCH decreased. At higher concentration, the adsorption became lesser which indicate that the removal efficiency of the adsorbents are dependent on the initial concentration. The removal efficiency increases with increase in contact time.