Supplementary Data

Improving the adsorption efficiency of a low-cost natural adsorbent for the removal of an organic pollutant: Optimization and mechanism study

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Table S1. Main characteristics of CV dye**.**

Characteristic dye	Chemical formula	Nature	Wavelength (nm)	Molecular weight (g/mol)
CV	$C_{25}H_{30}ClN_3$	Cationic dye	598	407.98

Table S2. The linear, and nonlinear equations for pseudo-first order, pseudo-second order, Elovich, and intraparticle diffusion models.

	Nonlinear	Linear
PFO	$Q_t = Q_e(1 - exp(-K_1 * t)$ (1)	$ln(q_e - q_t) = \ln q_e - K_1 t$ (2)
PSO	$Q_t = \frac{Q_e^2 * K_2 * t}{1 + Q_e * K_2 * t}$ (3)	$\frac{t}{q_t} = \frac{1}{K_2 q_e^2} + \frac{1}{q_e} t$ (4)
Elovich	$Q_t = \frac{1}{\beta} * ln(1 + \alpha\beta)$ (5)	$q_t = \frac{1}{\beta \ln(\alpha\beta)} + \frac{1}{\beta} ln(t)$ (6)
IPD		$q_t = k_p t^{1/2} + C$ (7)

Where q_e and q_t (mg/g) are adsorbed amounts at the equilibrium and time t respectively, t is the time (min), α (mg/g.min) is the initial adsorption rate constant, β (g/mg) is the extent of surface coverage, and activation energy for chemisorption, K_p (mg/g.min$^{1/2}$) is the intraparticle rate constant and C (mg/g) is a constant that gives an idea about the thickness of the boundary layer.

Table S3. Non-linear, and linear equations for Langmuir, Freundlich, and Temkin isotherm models.

Isotherms	Non-linear	linear

Langmuir	$Q_e = \frac{Q_m * K_L * C_e}{1 + K_L * C_e}$ (8)	$\frac{C_e}{Q_e} = \frac{1}{K_L Q_m} + \frac{C_e}{Q_m}$ (9)
Freundlich	$Q_e = K_F * C_e^{1/n_F}$ (10)	$\ln Q_e = \ln K_F + \frac{1}{n} \ln C_e$ (11)
Temkin	$Q_e = BLn\,(K_T C_e)$ (12)	$\ln Q_e = B \ln C_e + B \ln K_T$ (13)

Where Q_e is the adsorbed amount at equilibrium (mg/g), Q_m is the maximum adsorption capacity (mg/g), K_L is Langmuir adsorption constant (L/mg), C_e is Equilibrium dye concentration (mg/L), K_F is the Freundlich adsorption constant ($mg^{(1-n)}$ L^n/g), n_F is the Adsorption intensity, K_T is Equilibrium constant of Temkin (L/mg), and B is the heat of adsorption (J/mol).

Table S4. EDS analysis of NC, AC, and AC-750°C

	EDS									
Elements	C	O	Na	Mg	Al	Si	K	Ca	Fe	Cl
NC	4.25	41.27	-	0.77	4.48	9.25	2.17	30.7	7.09	-
AC	2.97	41.02	0.25	1.41	9.37	28.30	4.34	4.28	6.06	-
AC-750°C	1.43	27.87	0.15	0.53	1.87	5.01	0.69	18.31	44.12	-

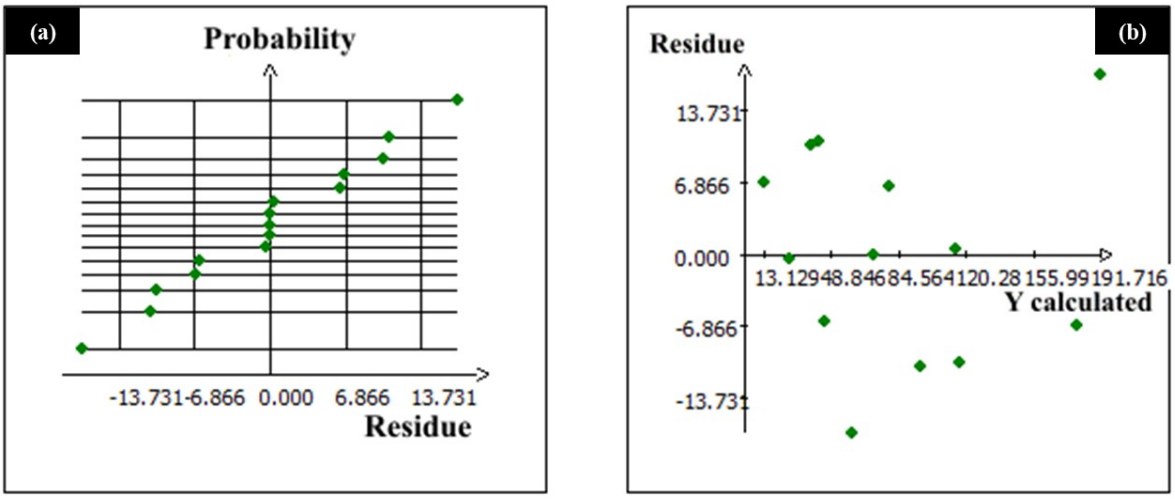

Fig.S1. Graphical study of residuals.