

Article

Removal of the Basic and Diazo Dyes from Aqueous Solution by the Frustules of *Halamphora* cf. *salinicola* (Bacillariophyta)

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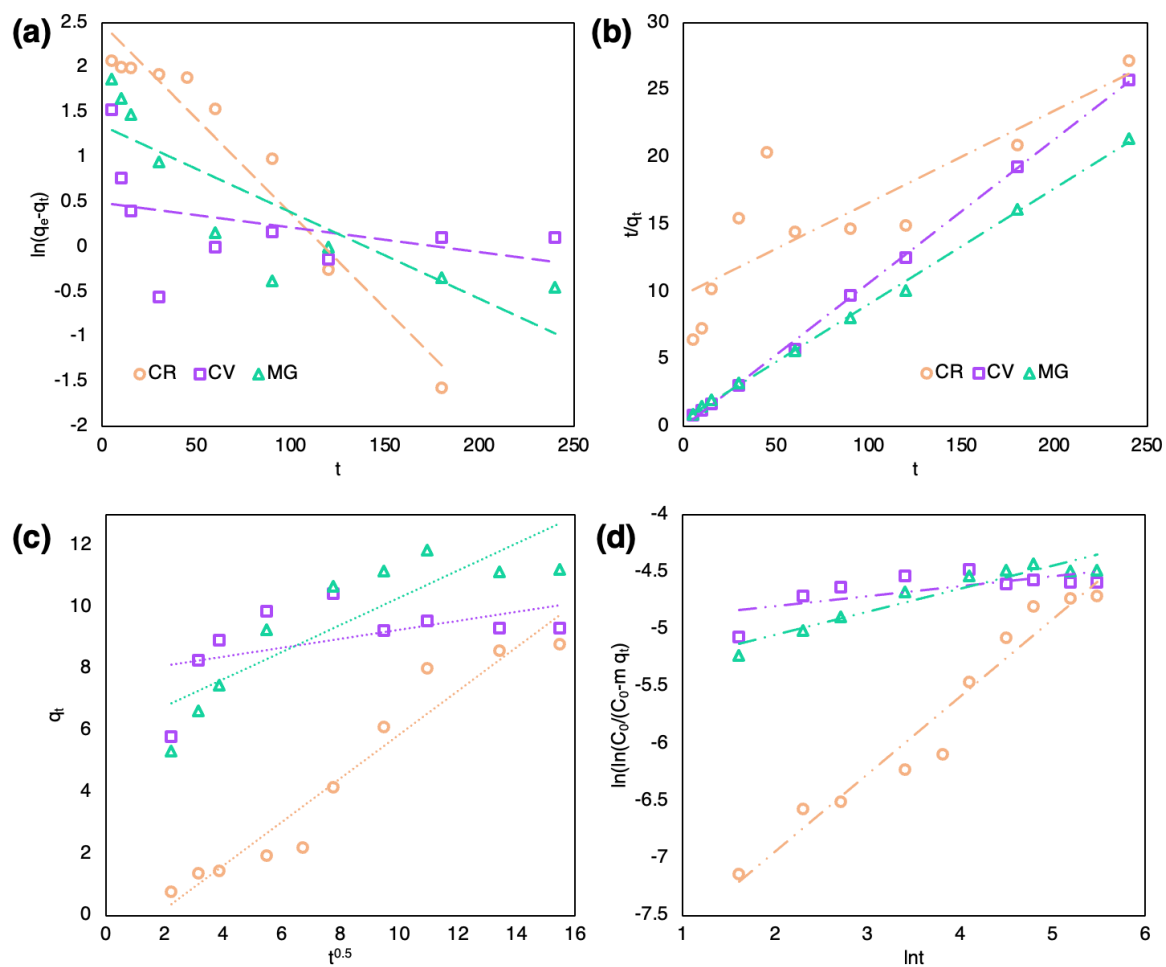


Figure S1. Adsorption kinetic and diffusion studies: (a) Pseudo-First Order; (b) Pseudo-Second Order; (c) Intra-particle diffusion; (d) Pore diffusion model (experimental data: orange circles – CR, violet squares – CV, green triangles – MG; calculated data: Pseudo-First Order – dashed line, Pseudo-Second Order – dash dotted line, Intra-particle diffusion – dotted line, Pore diffusion – double-dash dotted line).

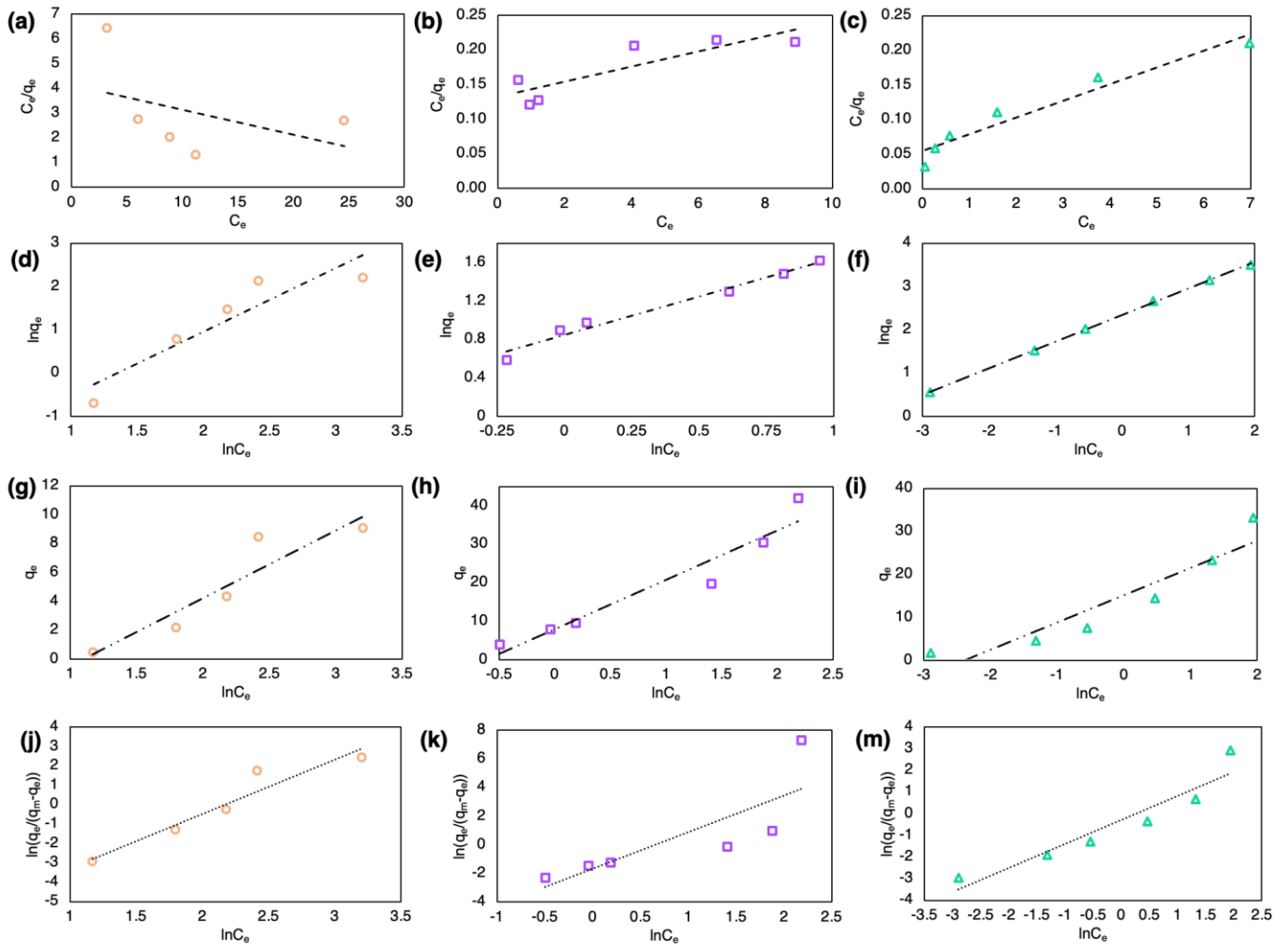


Figure S2. Adsorption equilibrium study: Langmuir model for (a) CR, (b) CV, (c) MG; Freundlich model for (d) CR, (e) CV, (f) MG; Temkin model for (g) CR, (h) CV, (i) MG; and Sips model for (j) CR, (k) CV, (m) MG (experimental data: orange circles – CR, violet squares – CV, green triangles – MG; calculated data: Langmuir – dashed line, Freundlich – dash dotted line, Temkin – double dash dotted line, Sips – dotted line)

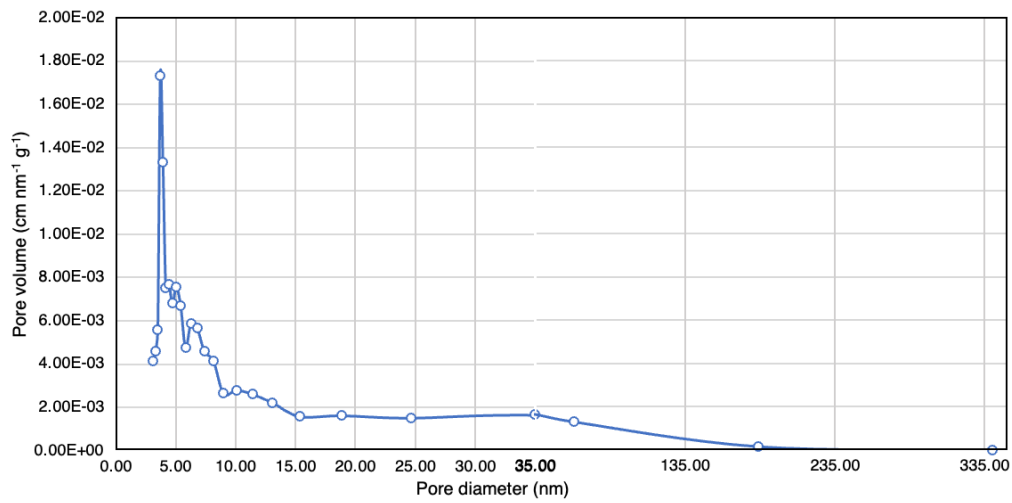


Figure S3. Pore size distribution of the diatom frustules of SZCZM1454 *H. cf. salinicola*

Table S1. Linearized forms of the kinetic and isotherm models' equations and parameters

Models	Equation		Description of parameters	Ref.
Kinetic study				
<i>Pseudo-first order</i>	$\ln(q_1 - q_t) = \ln q_1 - k_1 t$	(1)	q_t (mg g ⁻¹) – amount adsorbed at given time (t, min) q_1 (mg g ⁻¹) – adsorbent capacity at equilibrium k_1 (min ⁻¹) – Pseudo-first order constant rate	[133]
<i>Pseudo-second order</i>	$\frac{t}{q_t} = \frac{1}{k_2 q_2^2} + \frac{1}{q_2}$	(2)	q_2 (mg g ⁻¹) – adsorbent capacity at equilibrium k_2 (g (mg min) ⁻¹) – Pseudo-second order constant rate α (mg (g min) ⁻¹) – initial adsorption rate β (mg g ⁻¹) – desorption constant	[134]
Diffusion study				
<i>Boyd's</i>	$B_t = -0.4977 - \ln(1 - \frac{q_t}{q_e})$	(3)	q_e (mg g ⁻¹) – amount adsorbed at equilibrium B_t – mathematical function of F F – the fraction of metal ion adsorbed at any time (t)	[135]
<i>Intra particle diffusion</i>	$q_t = k_{wm} t^{0.5} + B$	(4)	q_t (mg g ⁻¹) – amount adsorbed at given time (t, min) K_{wm} (mg (g min ^{0.5}) ⁻¹) – Intra-particle diffusion rate constant	[136]
<i>Pore diffusion</i>	$\log \log \left(\frac{C_0}{C_0 - m q_t} \right) = \log \left(\frac{m K_\beta}{2.303 V} \right) + \Delta \beta \log t$	(5)	B (mg g ⁻¹) – intercept C_0 (mg L ⁻¹) – initial concentration of MB m (g) – mass of adsorbent g $\Delta \beta$ and K_β – Bangham constants V (mL) – volume of solution	[137]
Equilibrium study (isotherms)				
<i>Langmuir</i>	$\frac{C_e}{q_e} = \frac{1}{K_L Q_{max}} + \frac{C_e}{Q_{max}}$	(6)	q_e (mg g ⁻¹) – adsorption capacity at equilibrium C_e (mg L ⁻¹) – concentration of MB dye at equilibrium	[138]
<i>Freundlich</i>	$\ln q_e = \ln K_F + \frac{1}{n} \ln C_e$	(7)	q_{max} (mg g ⁻¹) – maximum monolayer adsorption capacity of Langmuir	[139]
<i>Temkin</i>	$q_e = \frac{RT}{b} \ln C_e + \frac{RT}{b} \ln K_m$	(8)	K_L (L mg ⁻¹) – Langmuir constant	[140]
<i>Sips</i>	$\ln \left(\frac{q_e}{q_m - q_e} \right) = \frac{1}{n} \ln C_e + \ln K_s^{\frac{1}{n}}$	(9)	K_F [(mg g ⁻¹) (mg L ⁻¹) ⁻ⁿ] – Freundlich constant n – dimensionless Freundlich intensity parameter R (J [mol K] ⁻¹) – universal gas constant T (K) – temperature b (J mol ⁻¹) – Temkin constant related to sorption heat K_m (L g ⁻¹) – Temkin isotherm constant q_m (mg g ⁻¹) – the Sips maximum adsorption capacity K_s [(mg L ⁻¹) ^{-1/n}] – the Sips equilibrium constant n – the exponent of Sips where 0<1/n≤1	[141]