

Supporting Information

A resin containing pH-responsive chelating residues of aspartic and maleic acids for mitigation of toxic metal ions and methylene blue

Shaikh A. Ali*^{a,b}, Shuaib A. Mubarak^a, Ibrahim Y. Yaagoob^a, Zeeshan Arshad^a, and Mohammad A. J. Mazumder*^{a,b}

^a*Chemistry Department, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia.*

^b*Interdisciplinary Research Center for Advanced Materials, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia*

Table S1. Kinetics of the adsorption of Pb(II)^a on CPZA 7.

<i>Second-order</i>						
Temp (K)	$q_{e, \text{exp}}$ (mg g ⁻¹)	k_2 (h ⁻¹ g mg ⁻¹)	h^b (h ⁻¹ mg g ⁻¹)	$q_{e, \text{calc}}$ (mg g ⁻¹)	R^2	E_a (kJ mol ⁻¹)
298	79.49	1.812	11469	79.56	0.9999	40.7
313	79.72	4.184	26610	79.75	1.0000	
328	79.83	8.126	51814	79.85	0.9999	
<i>First-order</i>						
Temp (K)	$q_{e, \text{exp}}$ (mg g ⁻¹)	k_1 (h ⁻¹)		$q_{e, \text{calc}}$ (mg g ⁻¹)	R^2	
298	79.49	3.023		6.378	0.9928	
313	79.72	8.546		5.384	0.9980	
328	79.83	9.656		3.877	0.9654	
<i>Intraparticle diffusion</i>						
Temp (K)	k_p (mg g ⁻¹ h ^{-1/2})	x_i (mg g ⁻¹)		R_i	R^2	
298	9.090	72.01		0.0941	0.9955	
313	10.41	73.54		0.0775	0.9934	
328	11.64	74.50		0.0668	0.9973	

^aAdsorption of Pb(II) (200 ppm, 100 mL) by CPZA 7 (250 mg) (final pH: 6.0).

^bInitial adsorption rate $h = k_2 q_e^2$.

Table S2. Thermodynamic parameters for the adsorption Pb(II) by CPZA 7.

Temperature (K)	K_L^a (L mg ⁻¹)	$K_e^{o b}$ (unit less)	ΔG^o^c (kJ mol ⁻¹)	ΔH^o (kJ mol ⁻¹)	ΔS^o (J mol ⁻¹ K ⁻¹)	R^2
298	0.072	14918	(-) 23.8	(+) 27.8	(+)173	0.9909
313	0.1246	25817	(-) 26.4			
328	0.2012	41689	(-) 29.0			

^aFrom Langmuir nonlinear isotherms. ^busing Eq (10). ^c $\Delta G^o = - RT \text{Ln } K_e^o$

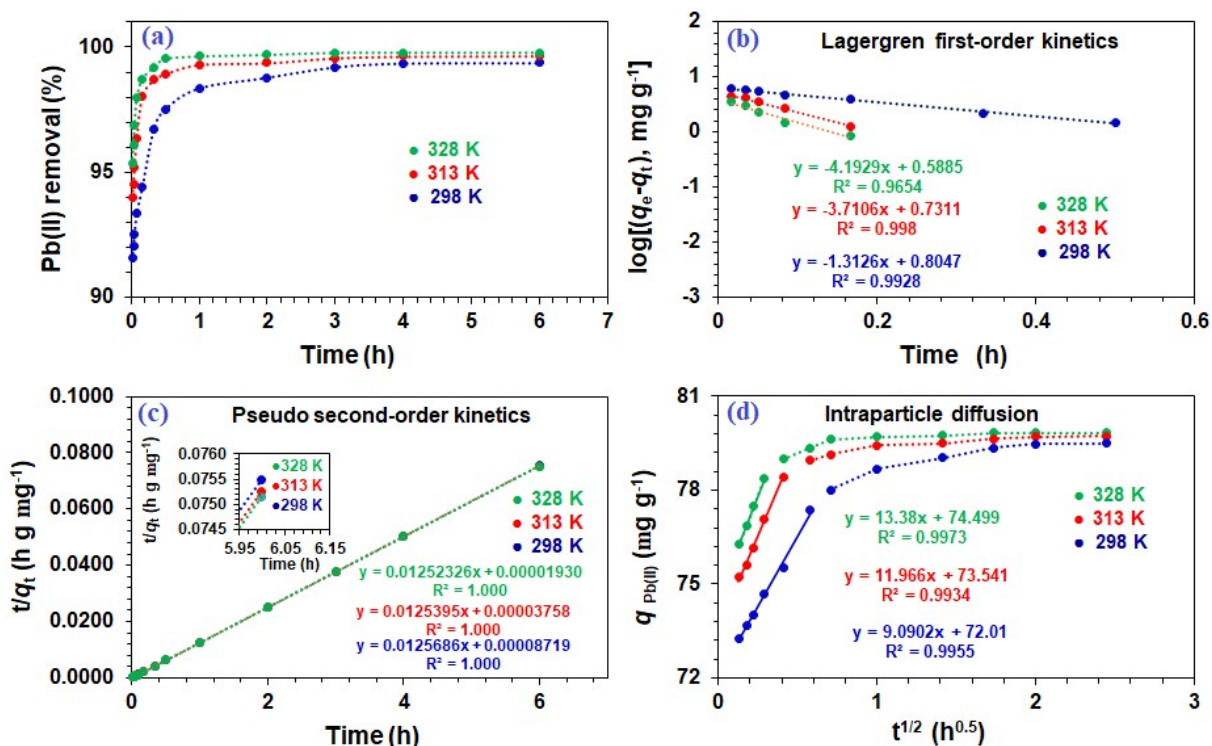


Figure S1. Kinetics of removal of Pb(II) by CPZA 7 at ●298, ●313, and ●328 K: Kinetic plots of (a) percent Pb(II) uptake by CPZA 7; (b) First-order, (c) Second-order, and (d) Intraparticle diffusion. [Experimental conditions: CPZA 7 (250 mg), 200 ppm MB (100 mL), pH 6.0]

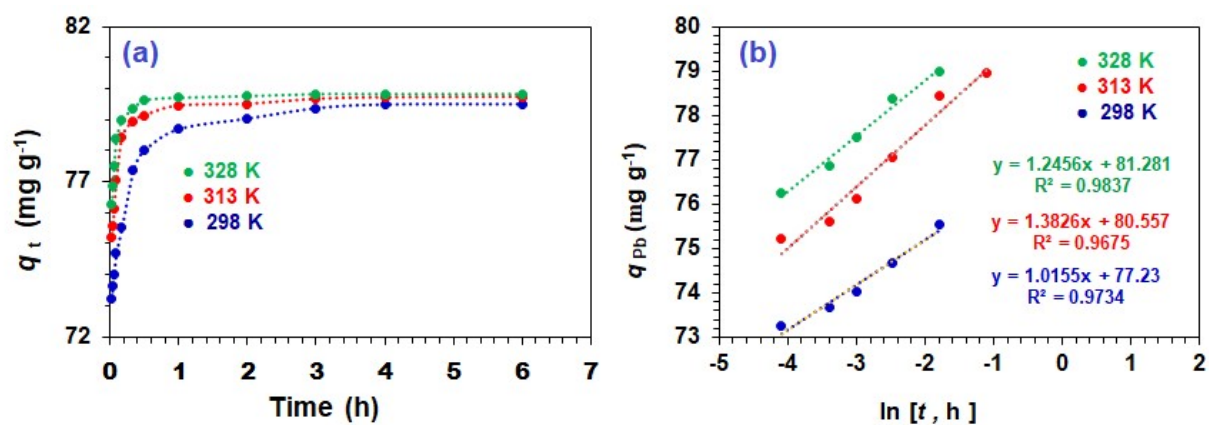


Figure S2. (a) Changes of adsorption capacity, q_t of Pb(II) over time; (b) Plot of Elovich kinetic model. [Experimental conditions: 250 mg CPZA 7, 100 mL 200 ppm Pb(II), pH 6.0];

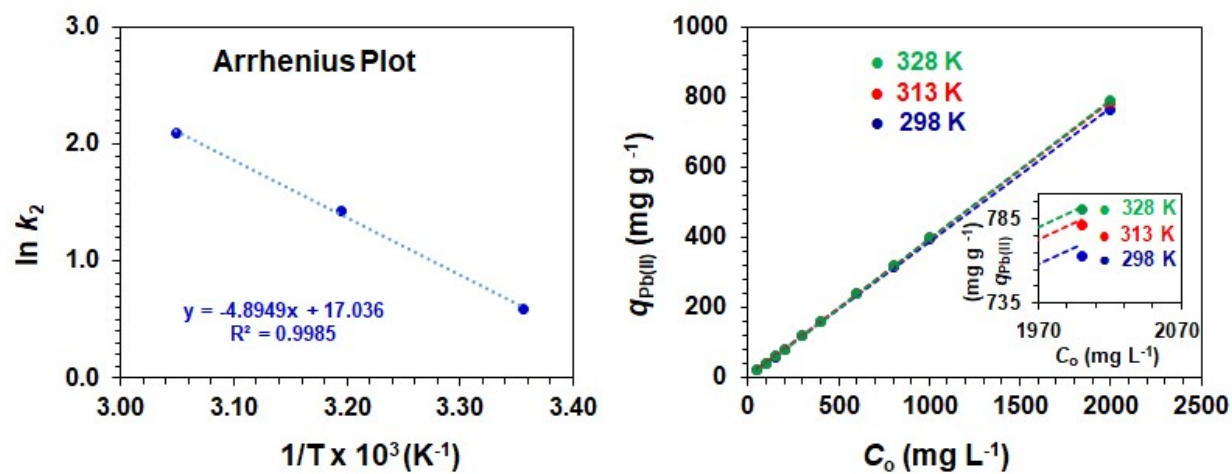


Figure S3. a) Arrhenius plot and (b) dependency of q_e of CPZA 7 on the initial Pb(II) concentrations (C_o) at 298, 313, and 328 K

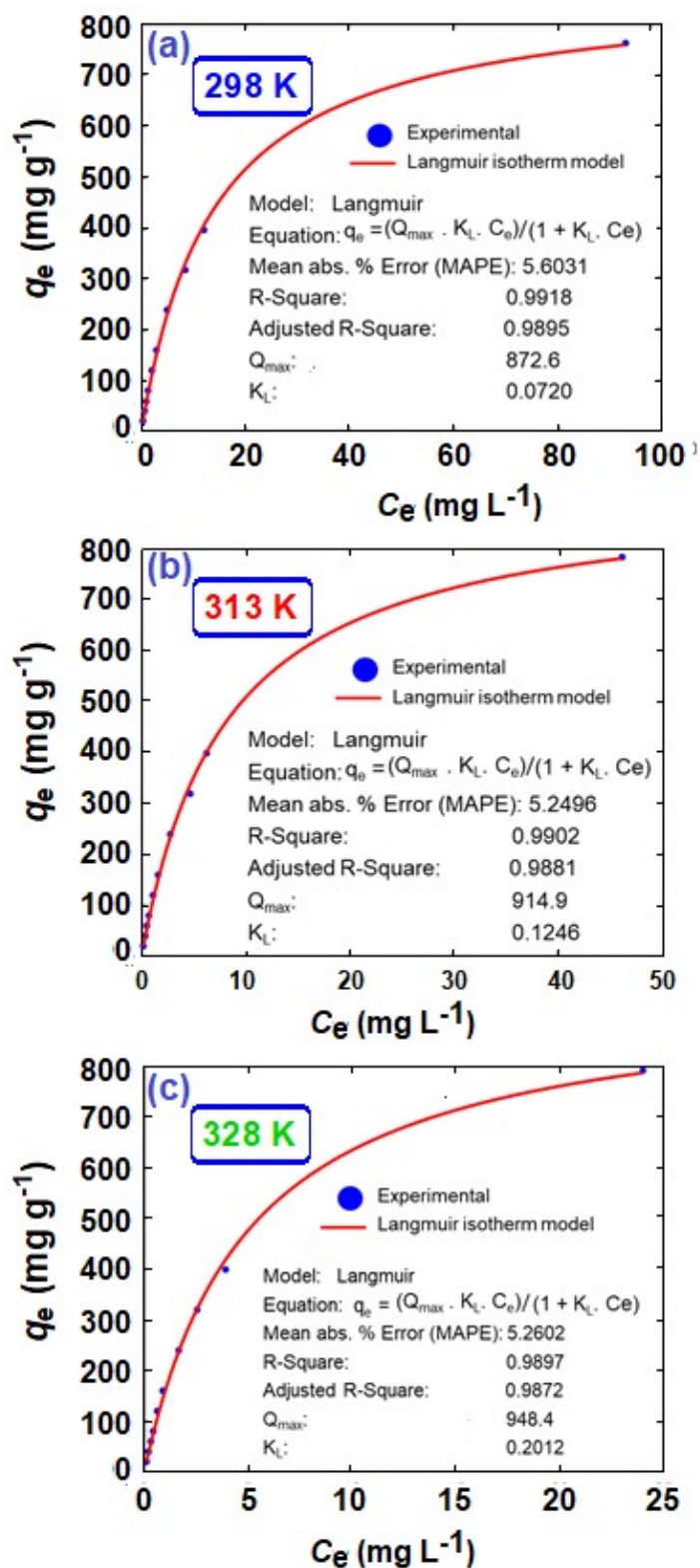


Figure S4. The removal of Pb(II) by CPZA 7: Nonlinear Langmuir Isotherms at (a) 298 K, (b) 313 K and (c) 328 K. [Resin (50 mg), 20 mL Pb(II) having C_0 50, 100, 150, 200, 300, 400, 600, 800, 1000, and 2000 ppm, final pH: 6.0].

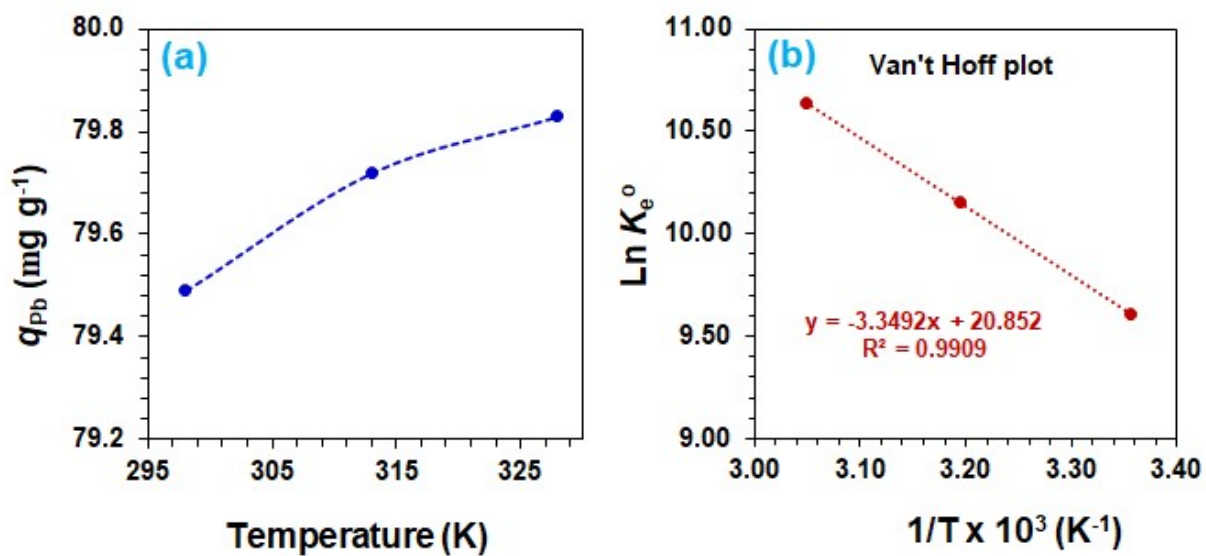


Figure S5. (a) Dependency of Pb(II) adsorption capacity, q_e on temperature [50 mg CPZA 7, 20 mL 200 ppm Pb(II) (C_o), pH 6.0] and (b) Van't Hoff plot.