Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Material

Cadmium and Lead remediation using magnetic and non-magnetic sustainable biosorbents derived from *Bauhinia purpurea* pods

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Table SM1: Adsorption isotherm and kinetic models used in the study

Models name	Equation	Parameters	References
		(a) Kinetic models	
Psuedo First order	$q_t=q_e\ (1-e^{-k_1 t})$	$k_1(h^{-1})$ is the first order adsorption rate constant, q_e, is the Pb^{2+} amount adsorbed at equilibrium and q_t is the Pb^{2+} adsorbed at time "t".	1, 2
Psuedosecond order	$\frac{t}{q_t}=\frac{1}{k_2 q_e^{\ 2}}+\frac{t}{q_e}$	$k_2(g.mg^{-1}\ h^{-1})$ is the second order rate constant, q_e is the amount adsorbed at equilibrium, $q_t$is the amount adsorbed at time "t" and $k_2q_e^2$ represents the initial sorption rate.	3
		(b) Equilibrium models	
Freundlich	$q_e = K_F C_e^{\ 1/n}$	K_F-constant indicative of the relative adsorption capacity of adsorbent (mg/g), 1/n- a constant indicative of the intensity of the adsorption,q_e-adsorption capacity (mg/g), , C_e-equilibrium concentration of solute (mg/L),	4
Sips or Langmuir-Freundlich	$\mathbf{q_e = \frac{K_{LF} C_e^{\ n_{LF}}}{1+(a_{LF} C_e)^{n_{LF}}}}$	K_{LF}, a_{LF} and n_{LF} are the sips constants. q_e-solute amount adsorbed per unit weight (mg/g), C_e is equilibrium concentration (mg/L),	5
Redlich Peterson	$\mathbf{q_e = \frac{K_{RP} C_e}{(1+a_{RP} C_e^{\ \beta_{RP}})}}$	K_{RP}, a_{RP} and β_{RP} are Redlich-Peterson constants and the exponent, β, lies between 0 and 1. q_e - solute amount adsorbed per unit weight (mg/g) and C_e is equilibrium concentration (mg/L).	6
Koble–Corrigan	$\mathbf{q_e = \frac{A C_e^{\ n_{KC}}}{1+(b C_e)^{n_{KC}}}}$	A, b and n_{KC} are the ships constants. q_e- solute amount adsorbed per unit weight (mg/g) and C_e is equilibrium concentration (mg/L).	7
Radke and Prausnitz	$\mathbf{q_e = \frac{a\ b\ C_e^{\ \beta}}{a+b C_e^{\ \beta-1}}}$	a, b, and β are Radke and Prausnitz constants. q_e- solute amount adsorbed per unit weight (mg/g) and C_e is equilibrium concentration (mg/L)	8
Toth	$\mathbf{q_e = \frac{K_T C_e}{(1+B_T C_e^{\ \beta_T})^{\frac{1}{\beta}T}}}$	K_T, B_T, and β_T are Toth constants. q_e-adsorption capacity (mg/g), C_e-equilibrium concentration (mg/L)	9

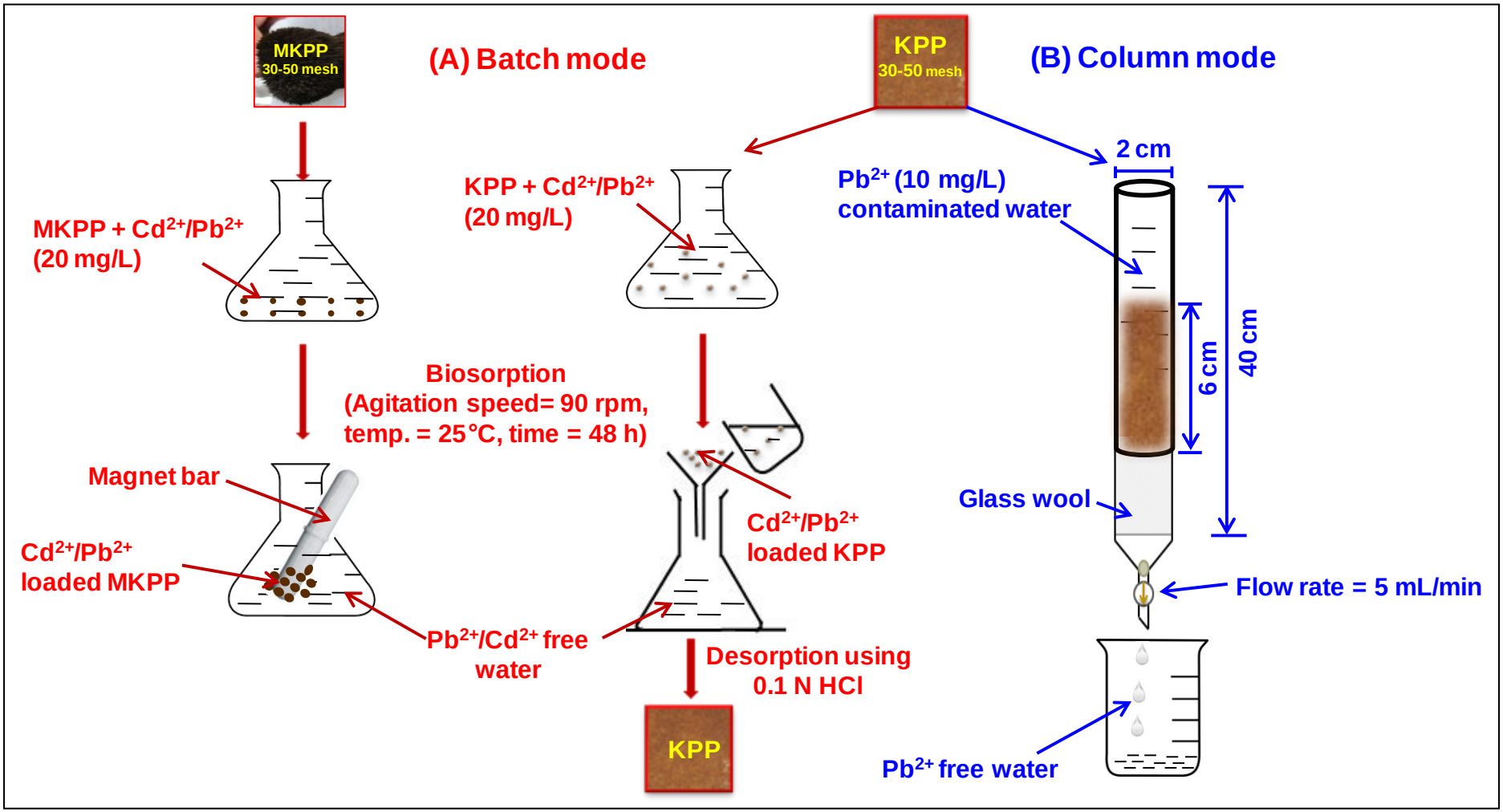


Figure SM1. Schematic diagram for Pb^{2+}/Cd^{2+} adsorption unto KPP/MKPP (A) batch mode and (B) continuous mode, and KPP recovery

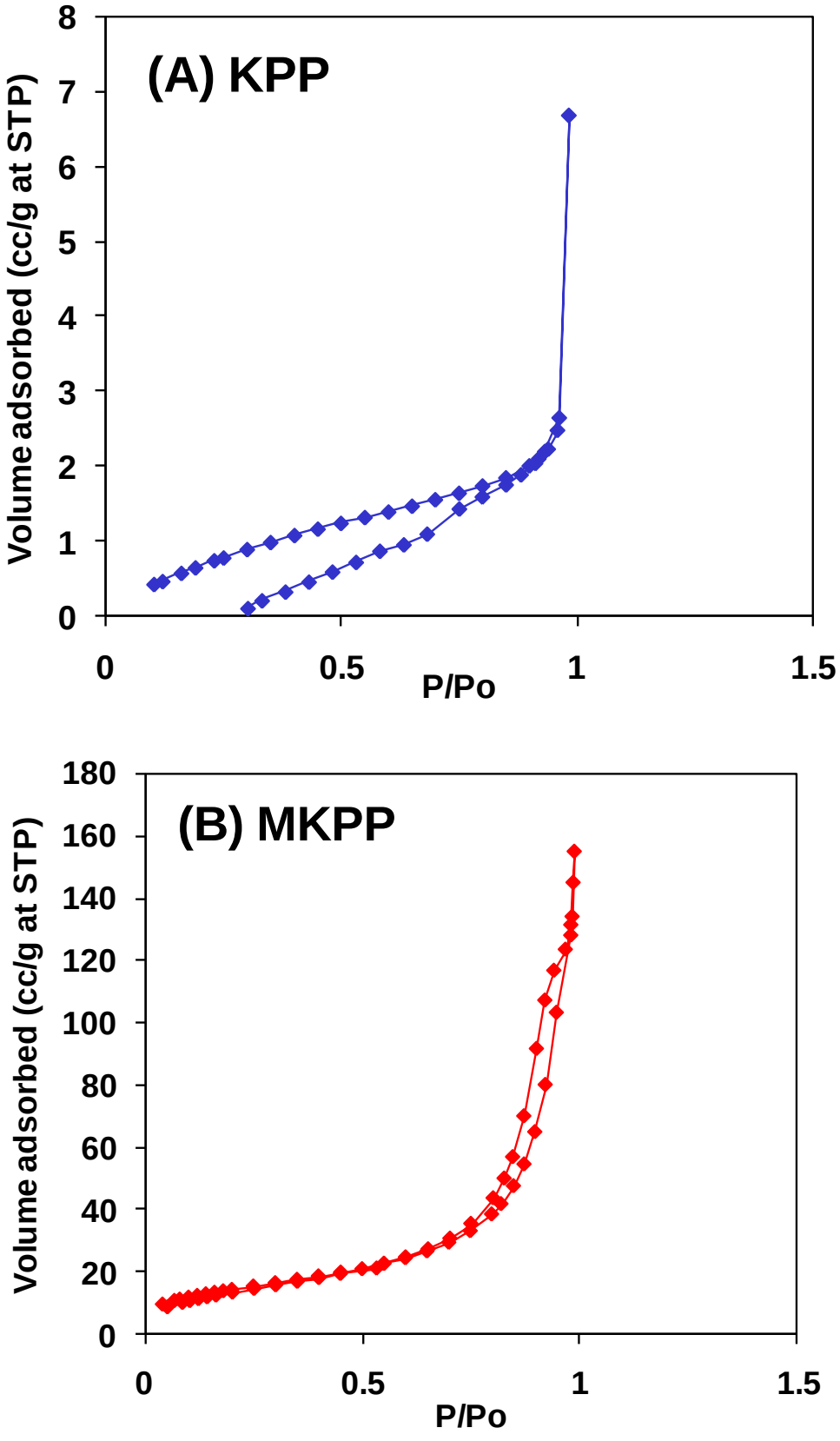
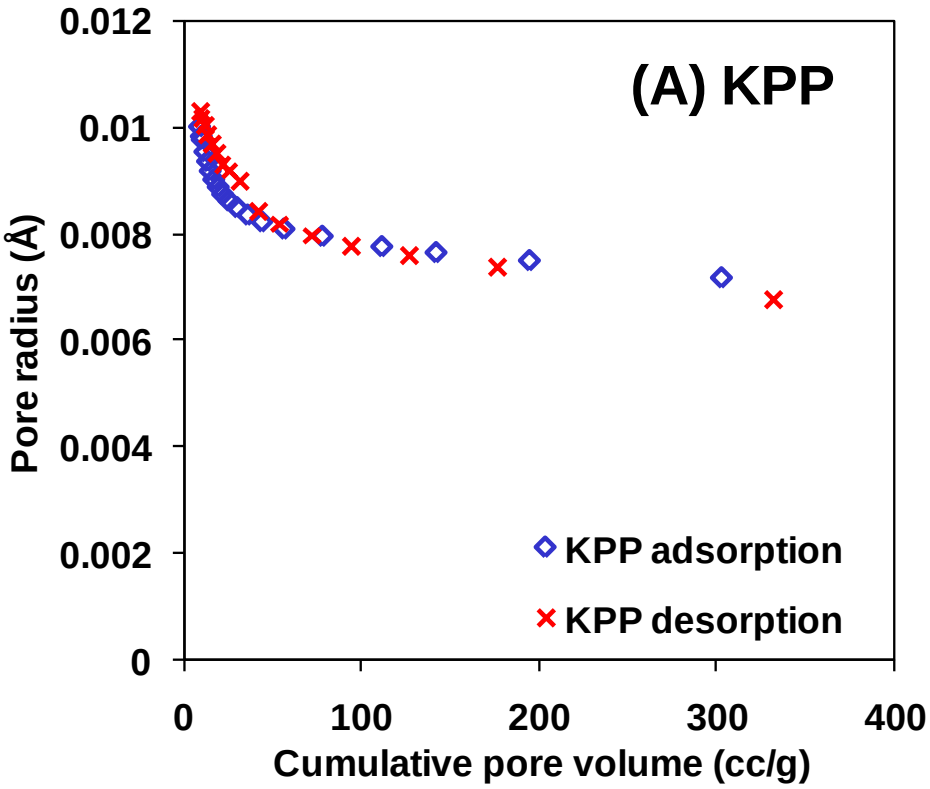


Figure SM2. BET surface area plot for (A) KPP and (B) MKPP



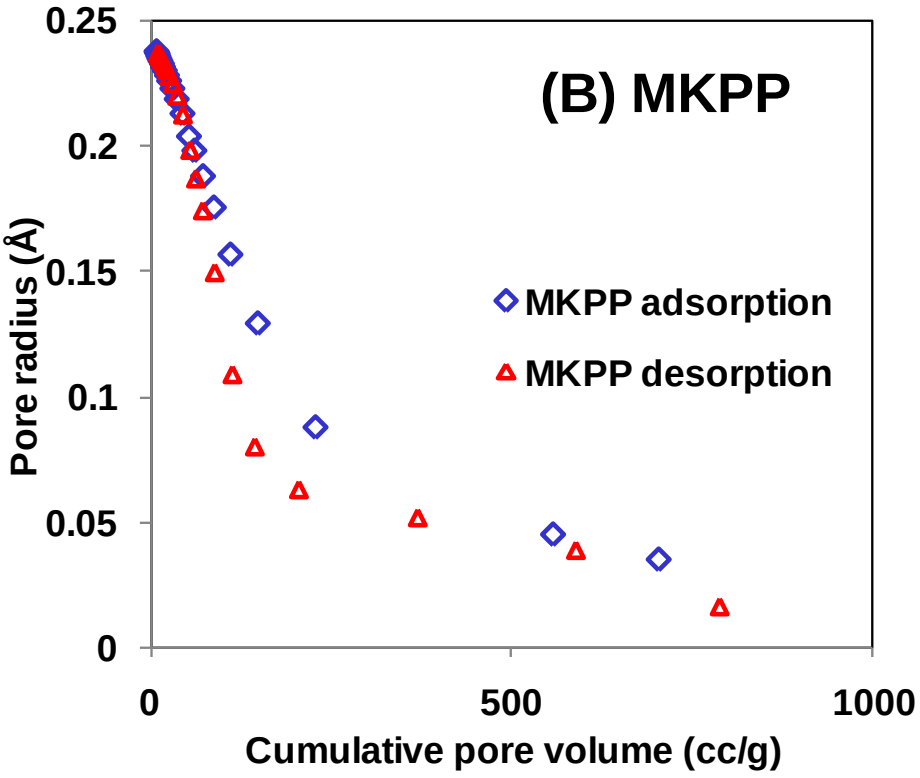


Figure SM3. Pore size distribution plots for (A) KPP and (B) MKPP.

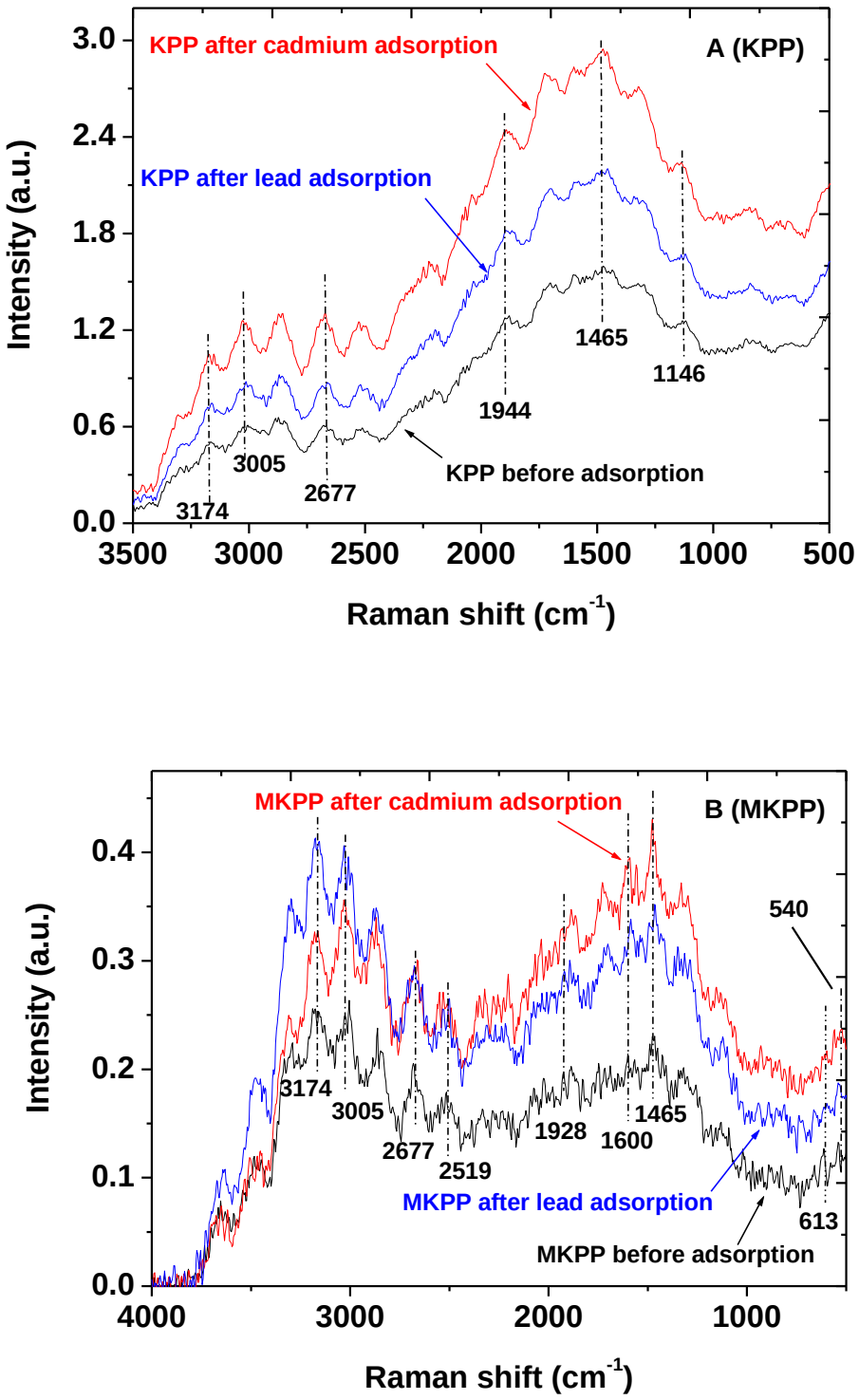
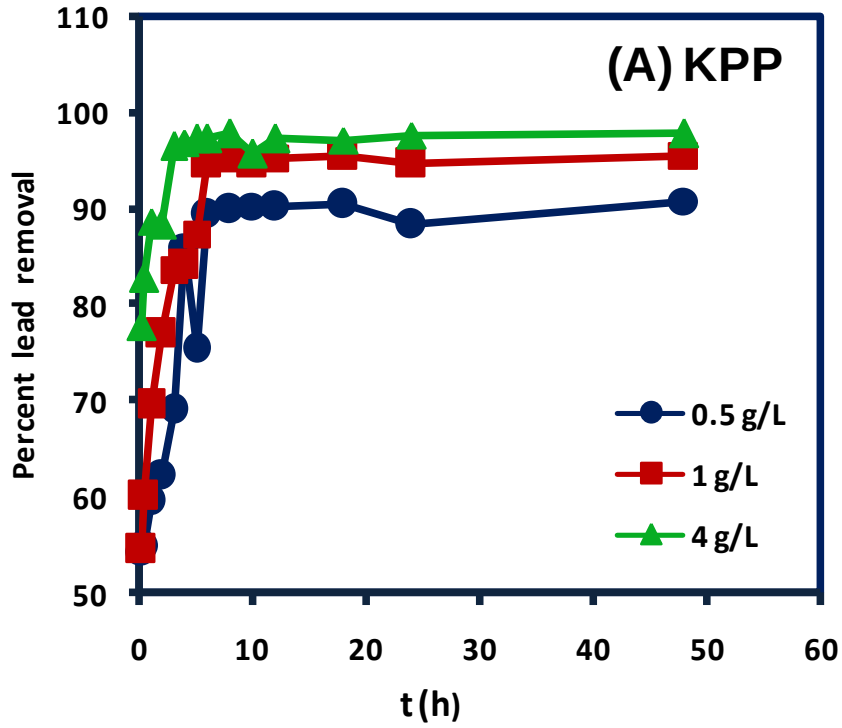


Figure SM4. FT-Raman spectra of (A) KPP and (B) MKPP before and after Pb^{2+} -and Cd^{2+} adsorption



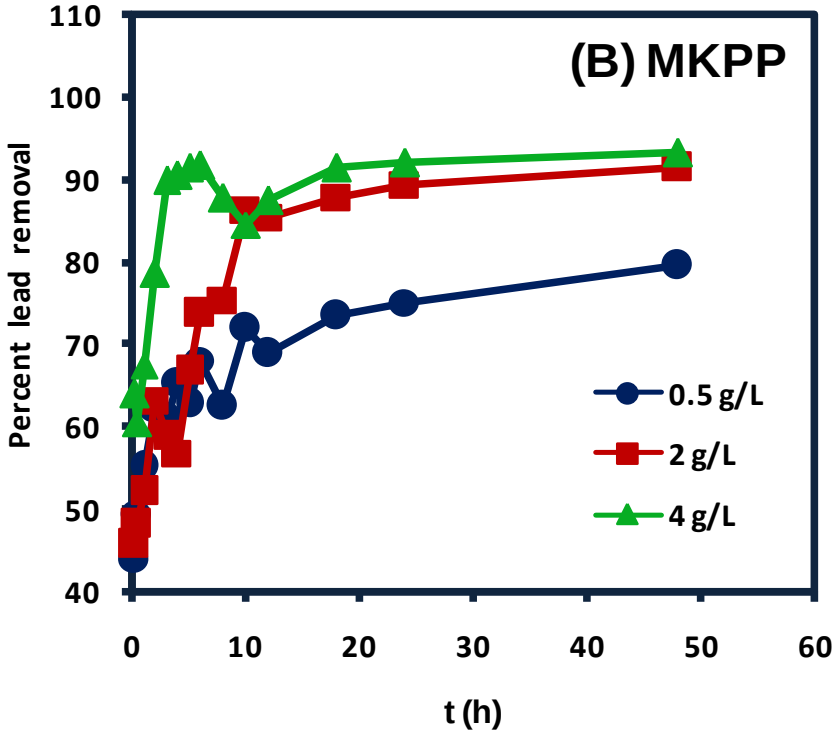
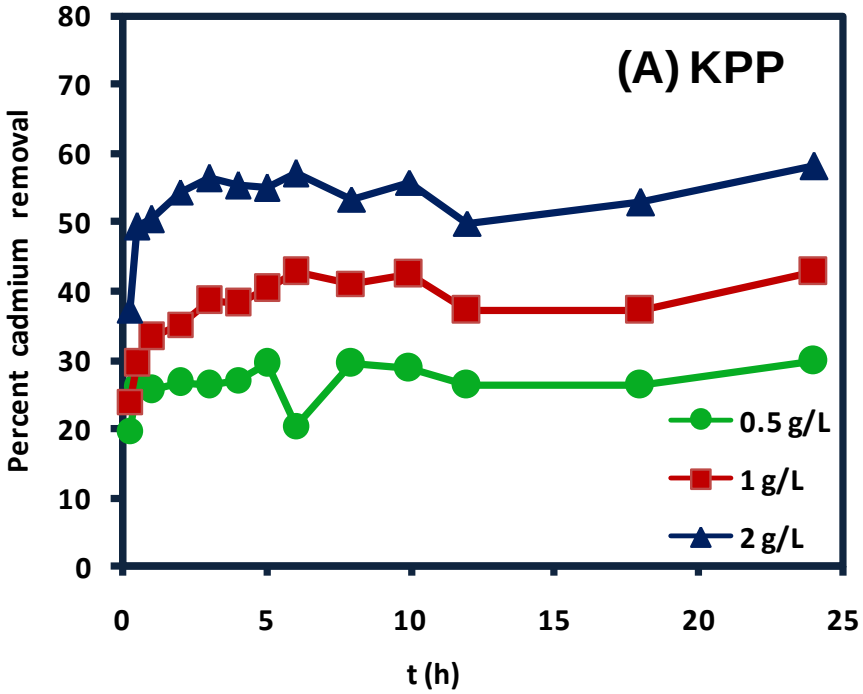


Figure SM5. Effect of adsorbent dose on Pb^{2+} adsorption by (A) KPP and (B) MKPP [pH 4.5; initial Pb^{2+} and Cd^{2+} concentration = 10 mg/L; particle size = 30-50 B.S.S mesh and T = 25 °C]



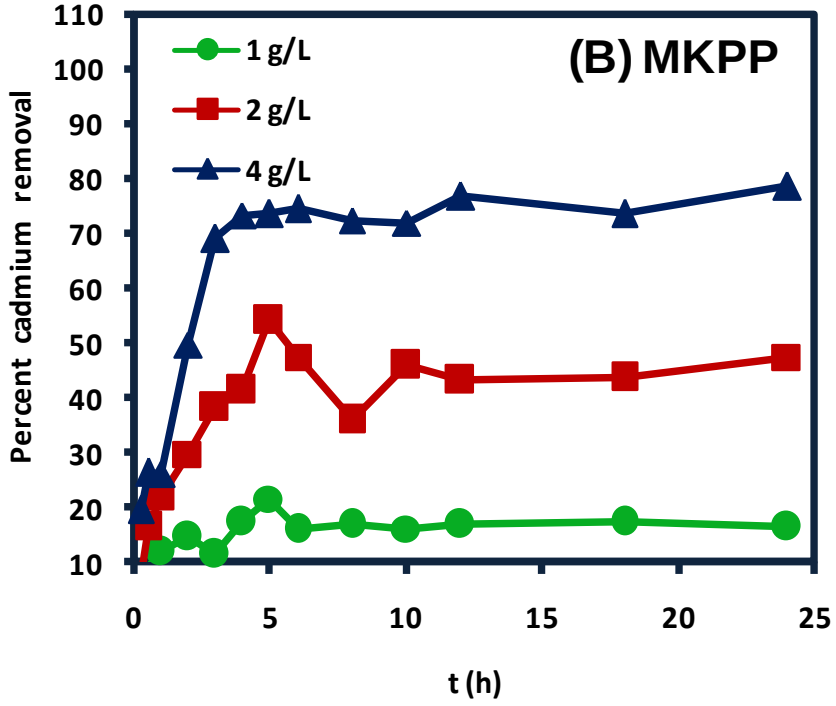


Figure SM6. Effect of adsorbent dose on Cd^{2+} adsorption by (A) KPP and (B) MKPP [pH 5.0; initial Cd^{2+} concentration = 20 mg/L; particle size = 30-50 B.S.S mesh and T = 25 °C]

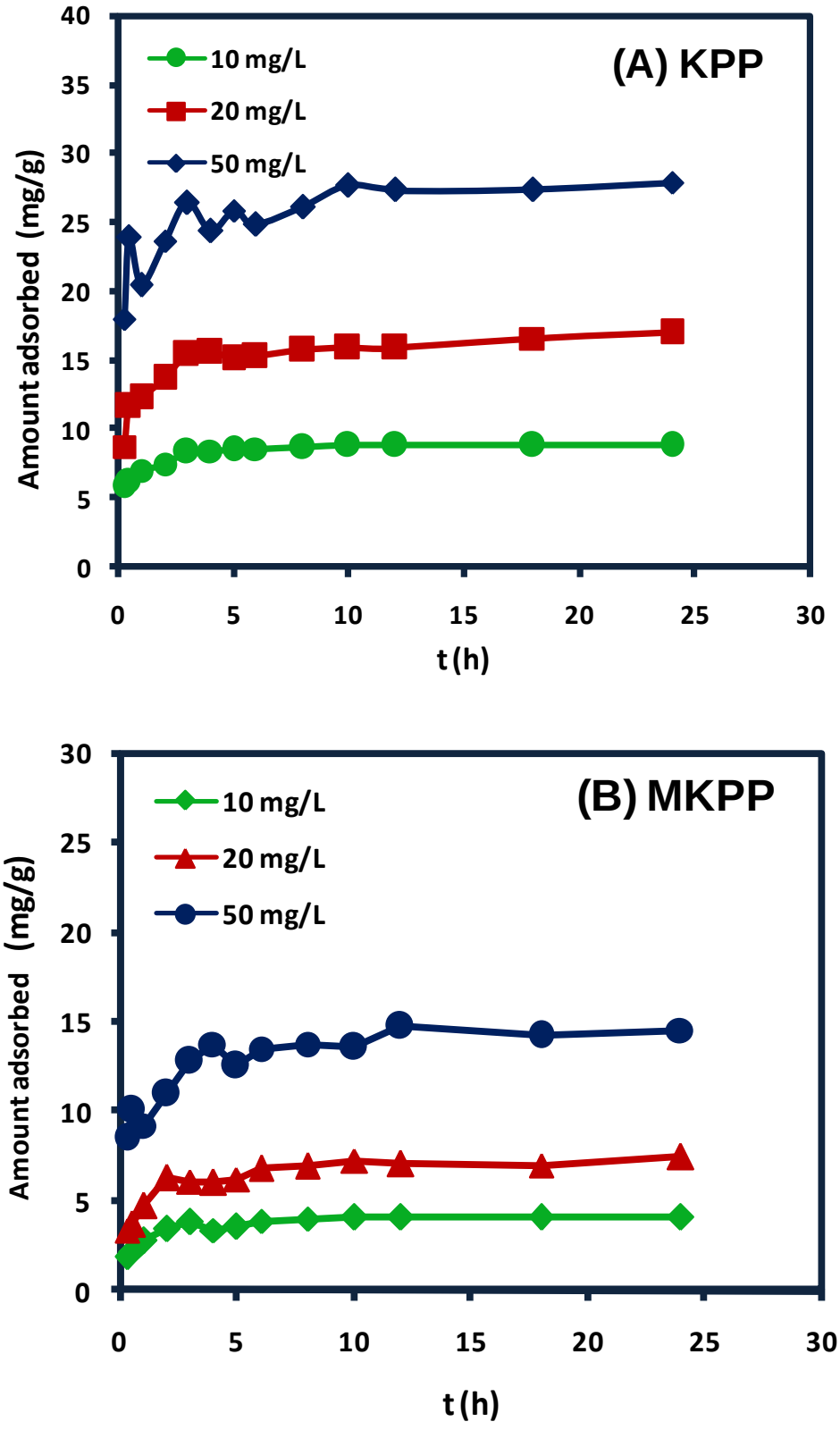


Figure SM7. Effect of adsorbate concentrations on Pb^{2+} adsorption by (A) KPP and (B) MKPP [pH 4.5; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S mesh and T = 25 °C]

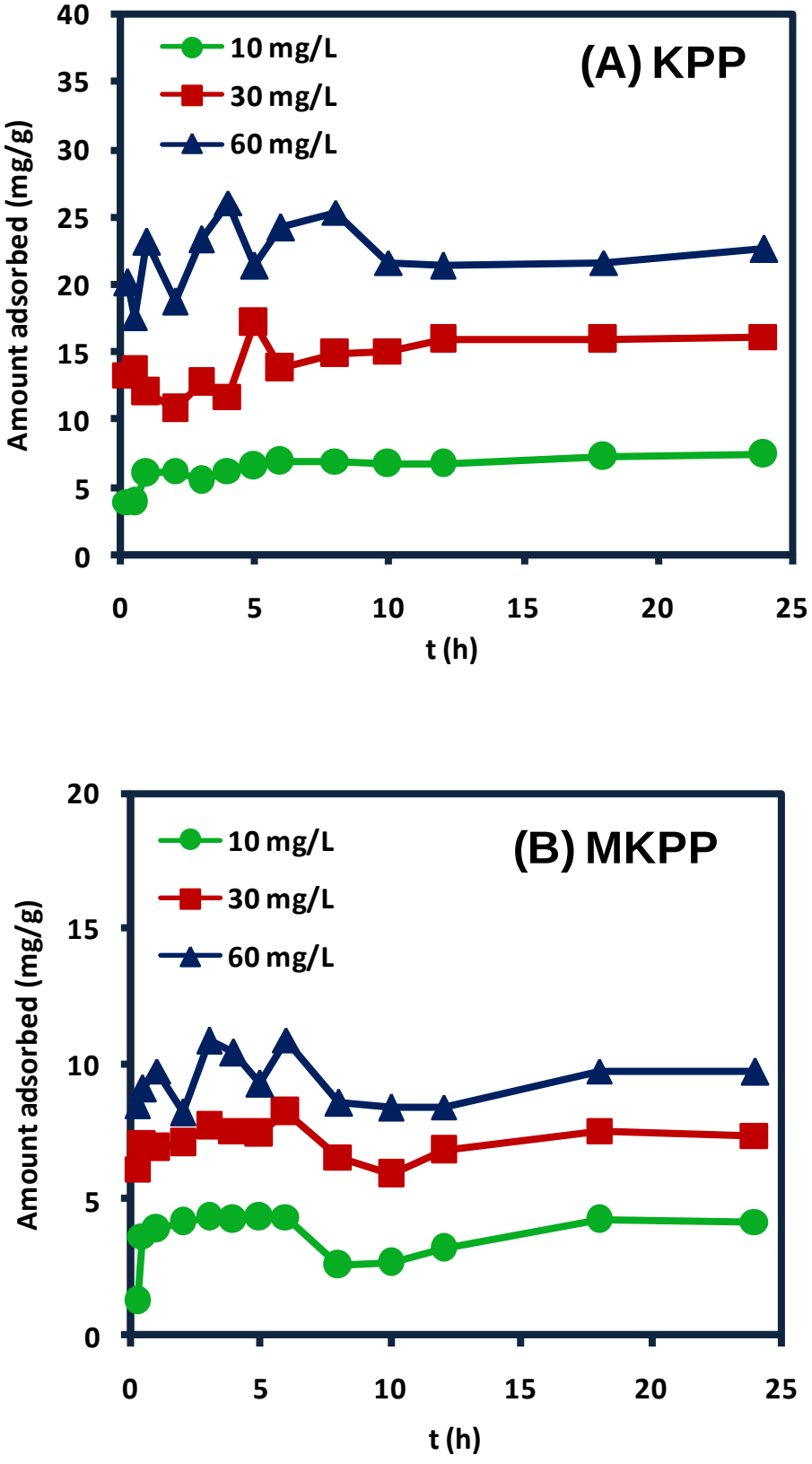


Figure SM8. Effect of adsorbate concentrations on Cd^{2+} adsorption by (A) KPP and (B) MKPP [pH 5.0; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S mesh and T= 25 °C]

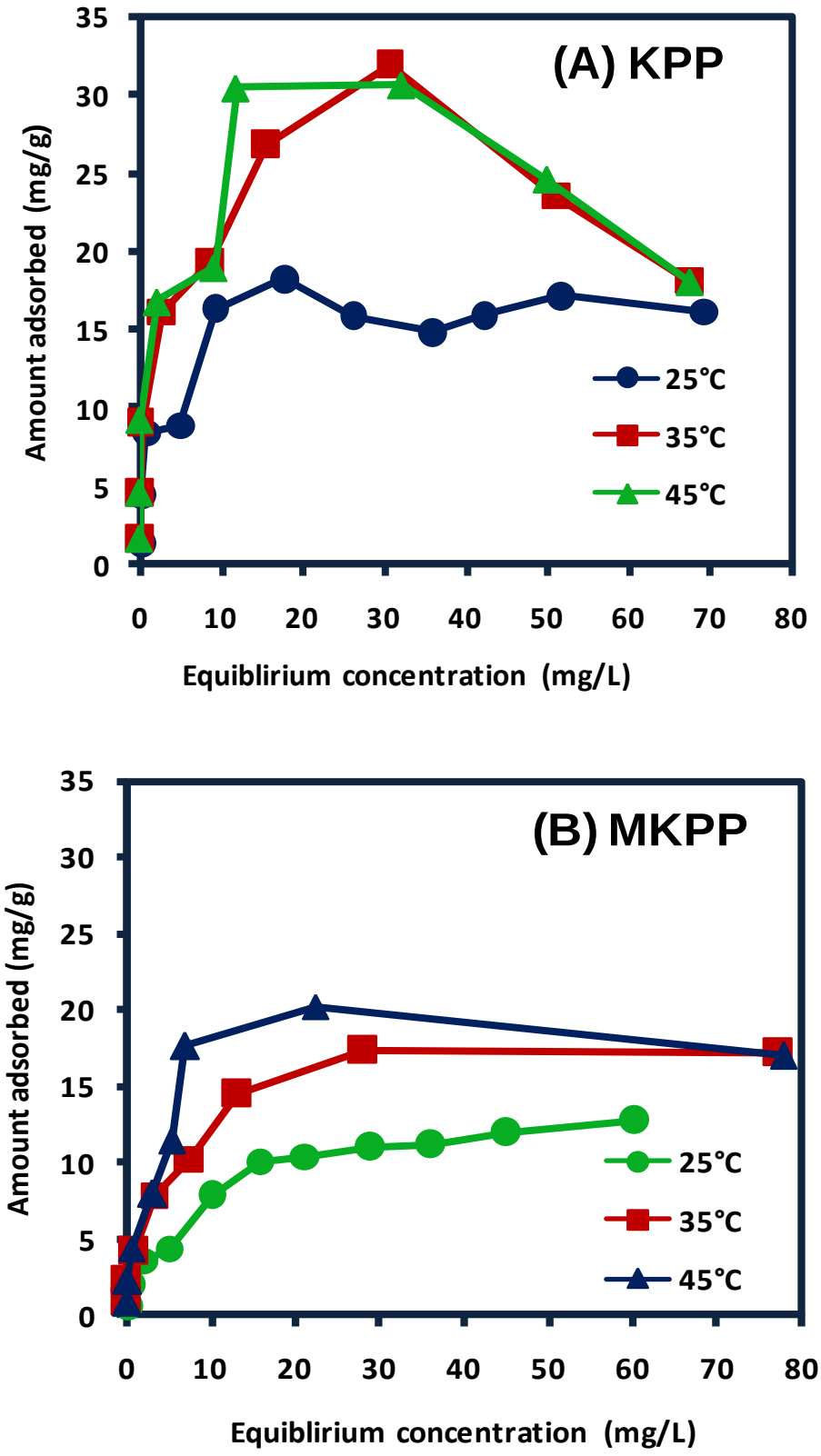


Figure SM9. Effect of temperature on Pb^{2+} by (A) KPP and (B) MKPP [pH 4.5; lead concentration= 5-100 mg/L; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S mesh]

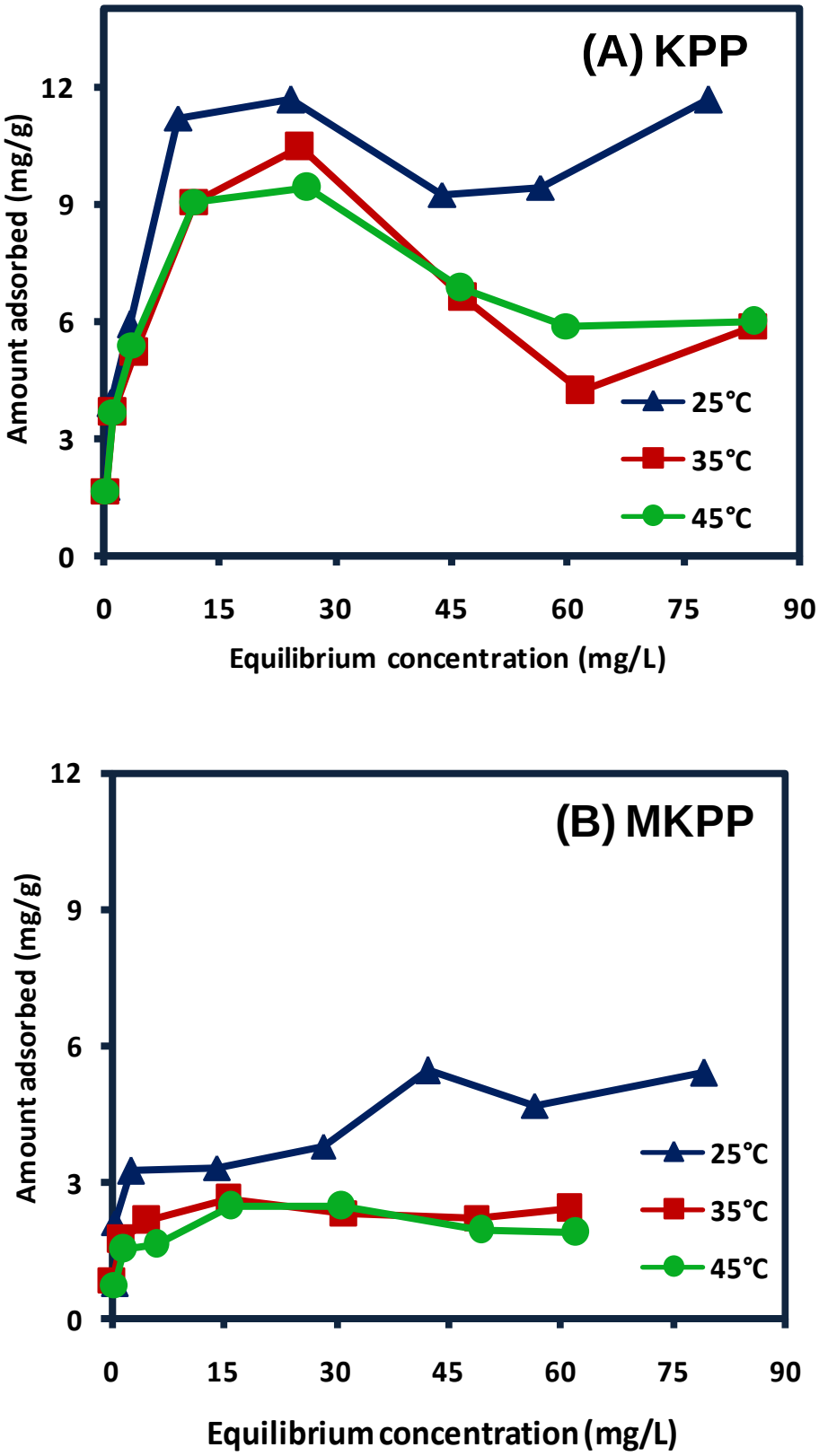


Figure SM10. Effect of temperature on Cd^{2+} by (A) KPP and (B) MKPP [pH 5.0; cadmium concentration= 2-100–mg/L; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S mesh]

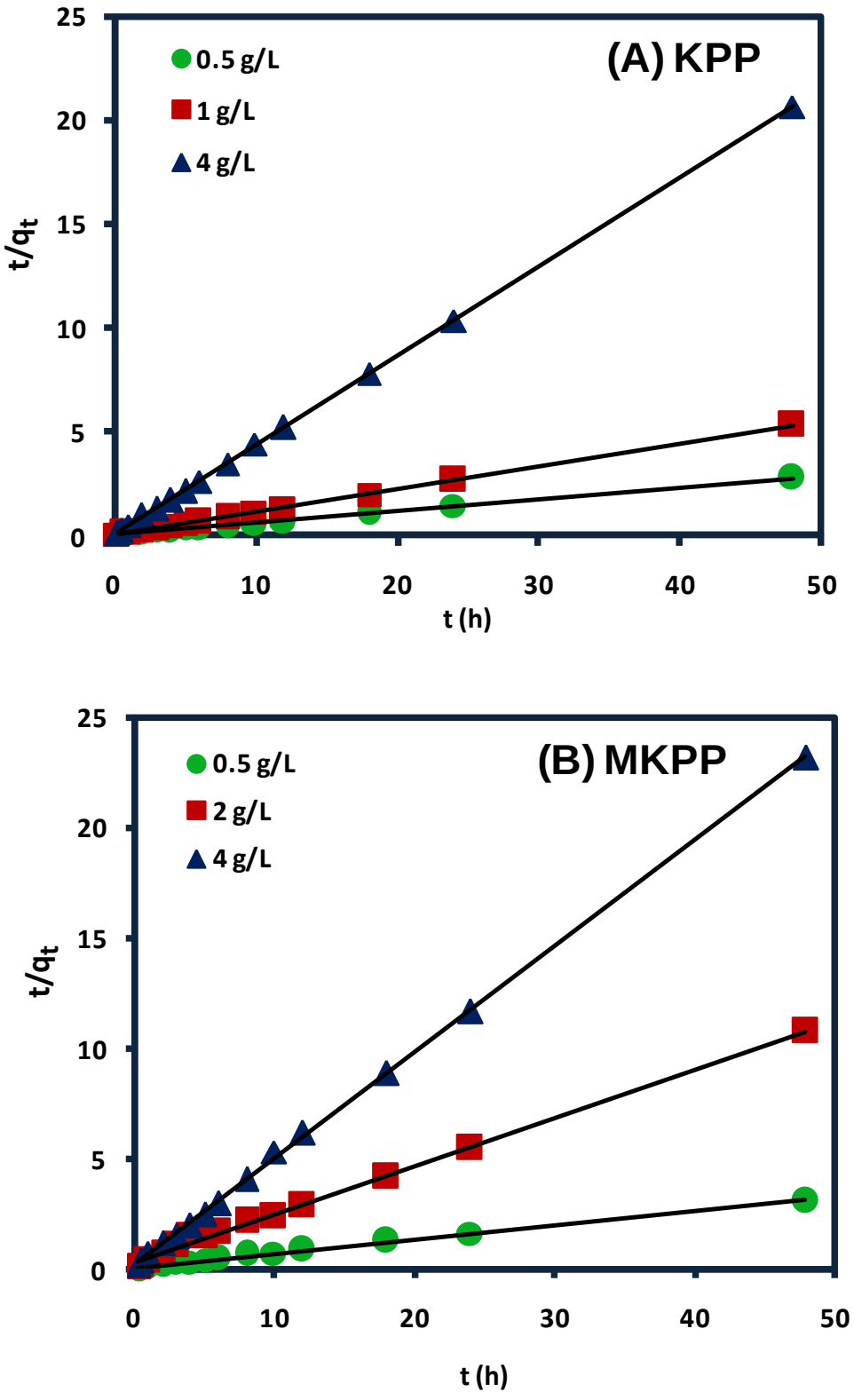


Figure SM11. Pseudo-second order kinetic plots for Pb^{2+} removal by (A) KPP and (B) MKPP at different doses [initial lead concentration = 10 mg/L; pH = 4.5, particle size = 30-50 B.S.S. mesh]

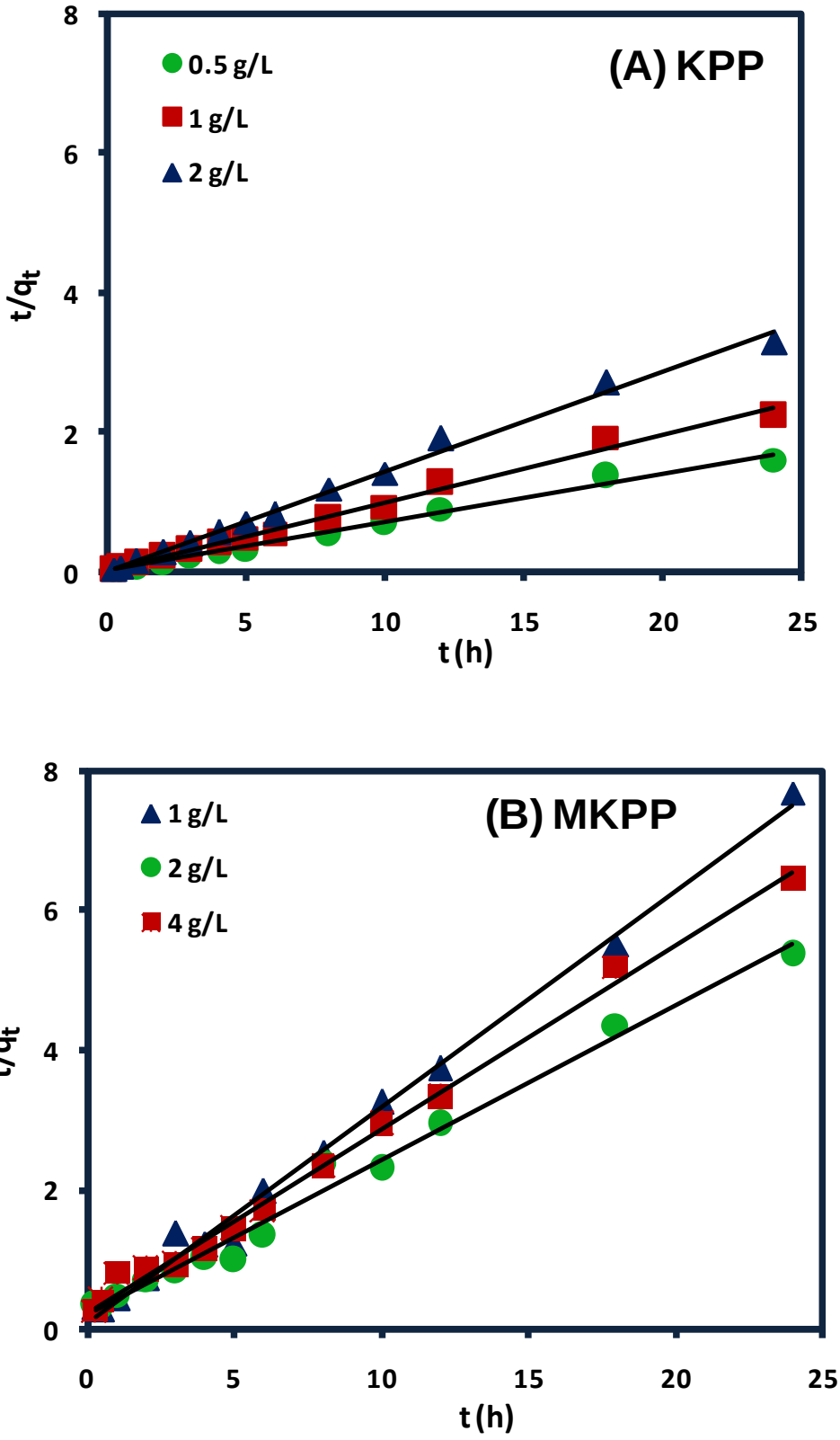


Figure SM12. Pseudo-second-order kinetic plots for Cd^{2+} removal by (A) KPP and (B) MKPP at different doses (initial cadmium concentration = 20 mg/L; pH = 5.0, particle size = 30-50 B.S.S. mesh)

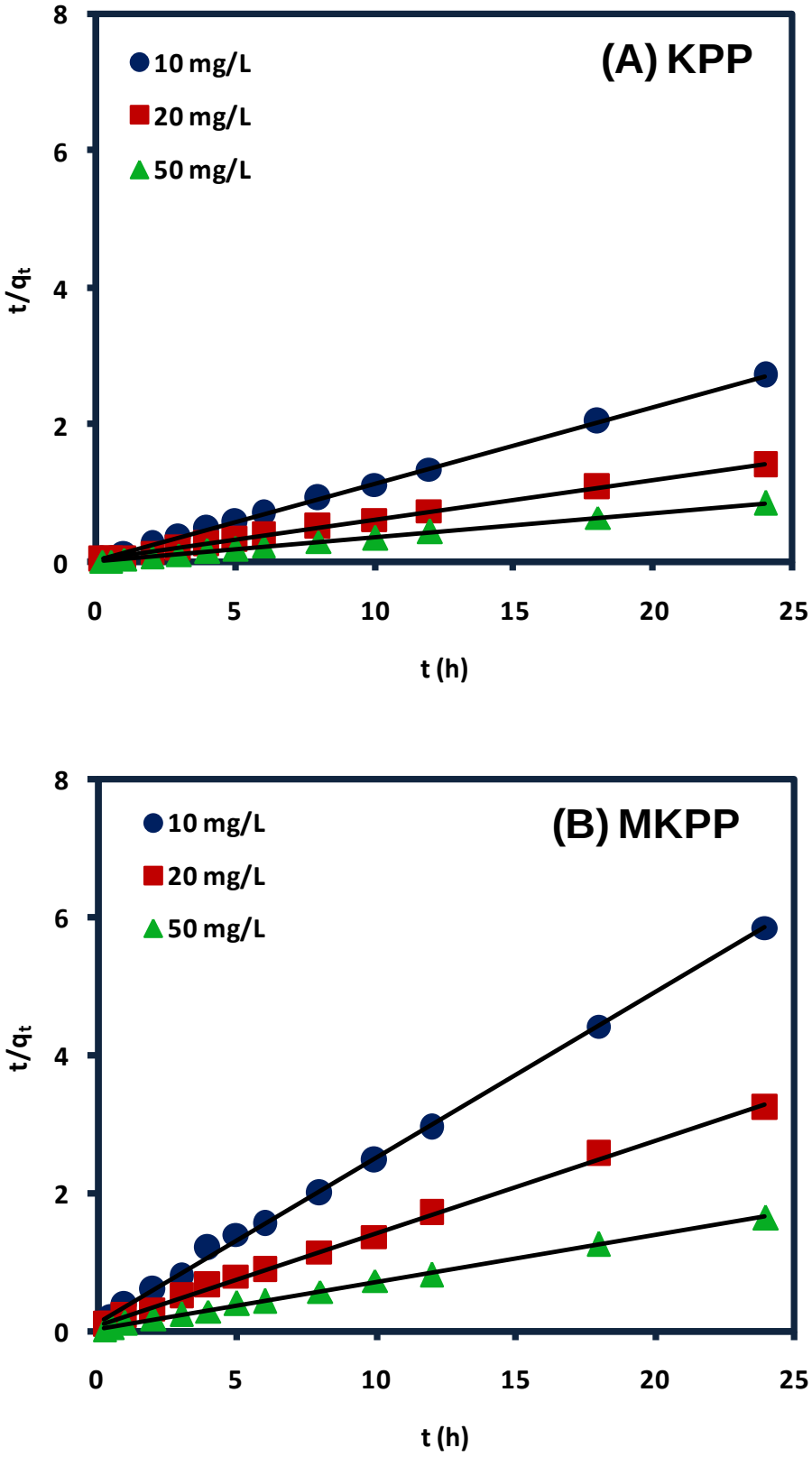


Figure SM13. Pseudo-second-order kinetic plots for Pb^{2+} removal by (A) KPP and (B) MKPP at different concentration [pH = 4.5, adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP), particle size = 30-50 B.S.S. mesh]

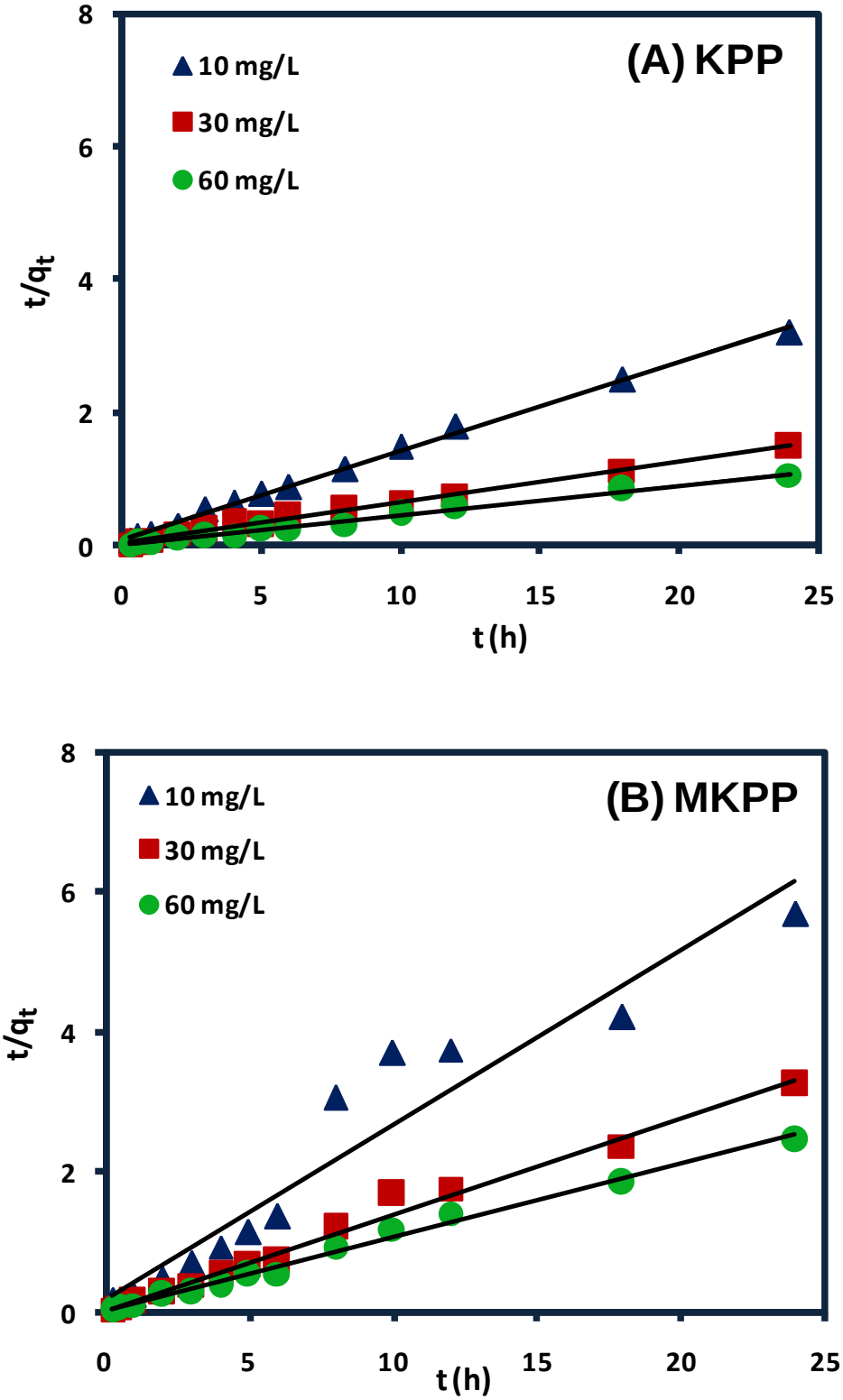


Figure SM14. Pseudo-second-order kinetic plots for Cd^{2+} removal by (A) KPP and (B) MKPP at different concentrations [pH = 5.0, adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size = 30-50 B.S.S. mesh]

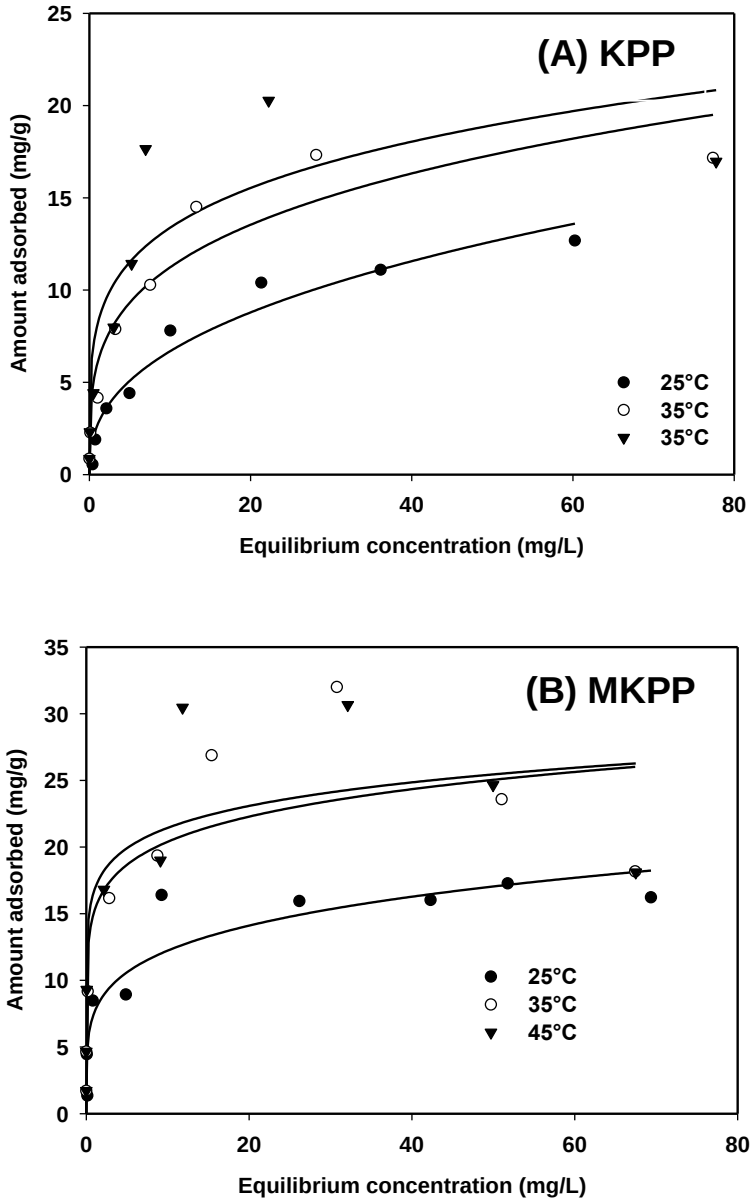
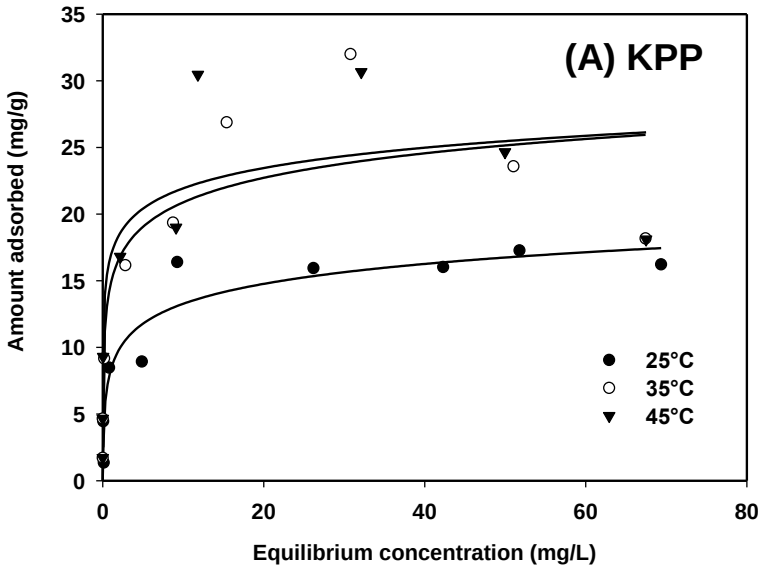


Figure SM15. Freundlich adsorption isotherm of Pb^{2+} by (A) KPP and (B) MKPP at different temperatures [pH= 4.5; initial lead concentration range= 2-100 mg/L; T = 25 °C; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S. mesh]



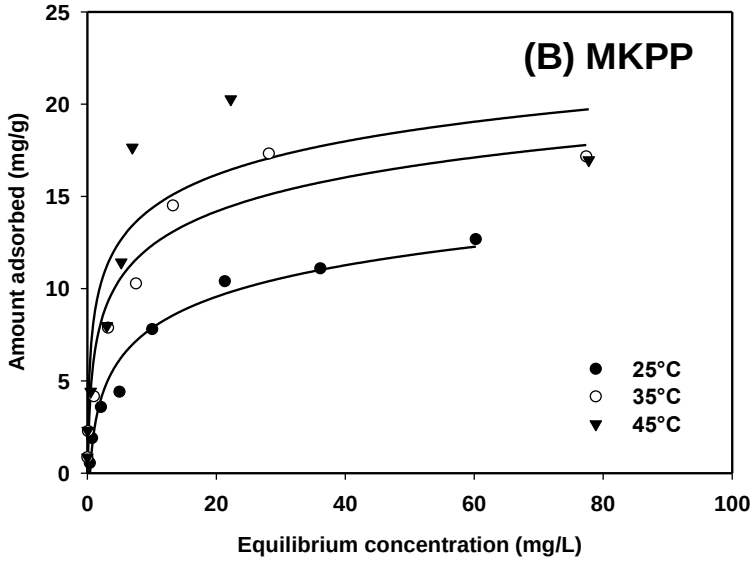


Figure SM16.Temkin adsorption isotherm of Pb^{2+} by (A) KPP and (B) MKPP at different temperatures [pH= 4.5; initial lead concentration range= 2-100 mg/L; T = 25 °C; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S. mesh]

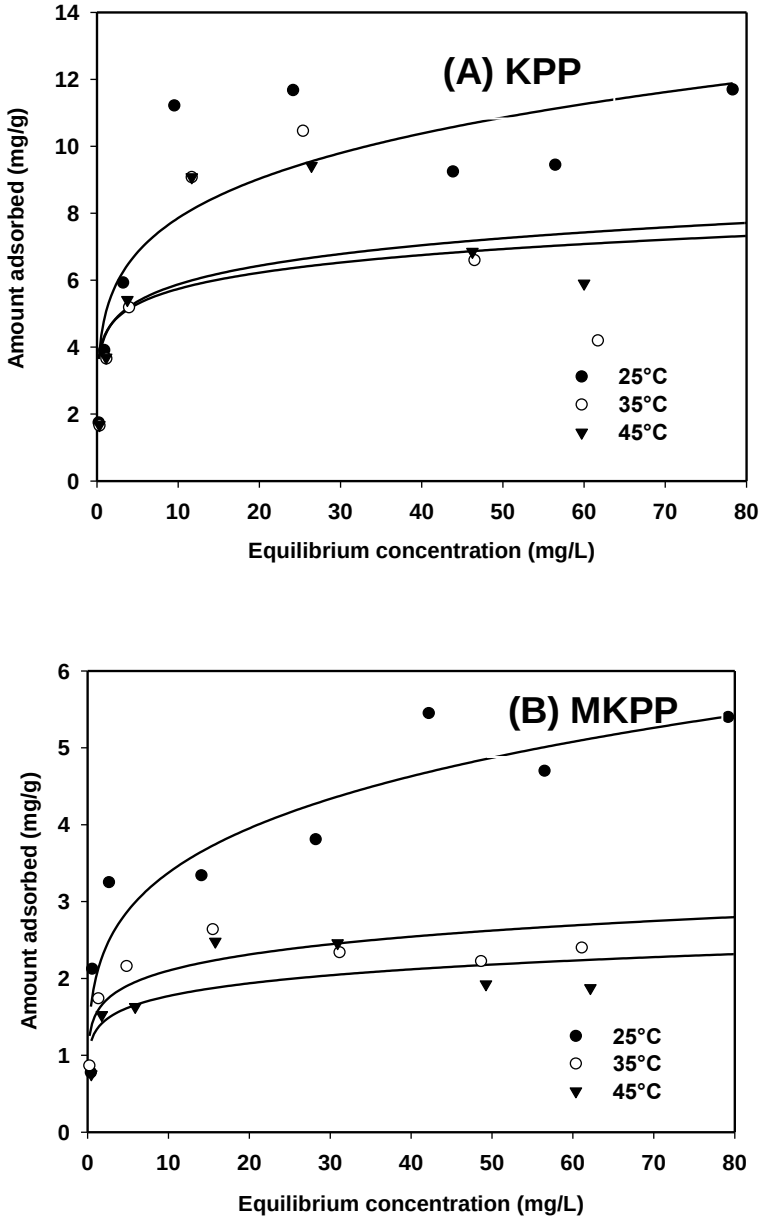


Figure SM17. Freundlich adsorption isotherm of Cd^{2+} by (A) KPP and (B) MKPP at different temperatures [pH= 5.0; initial cadmium concentration range= 2-100 mg/L; T = 25 °C; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S. mesh]

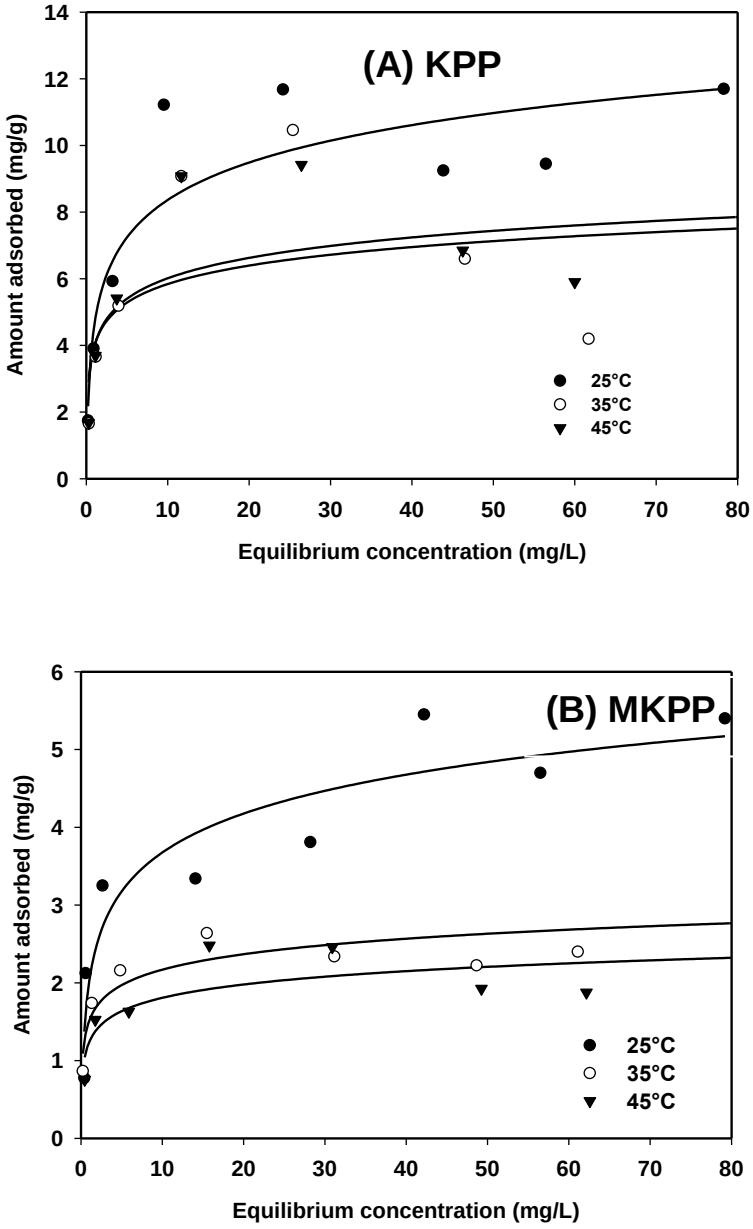


Figure SM18.Temkin adsorption isotherm of Cd^{2+} by (A) KPP and (B) MKPP at different temperatures [pH= 5.0; initial cadmium concentration range= 2-100 mg/L; T = 25 °C; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S. mesh]

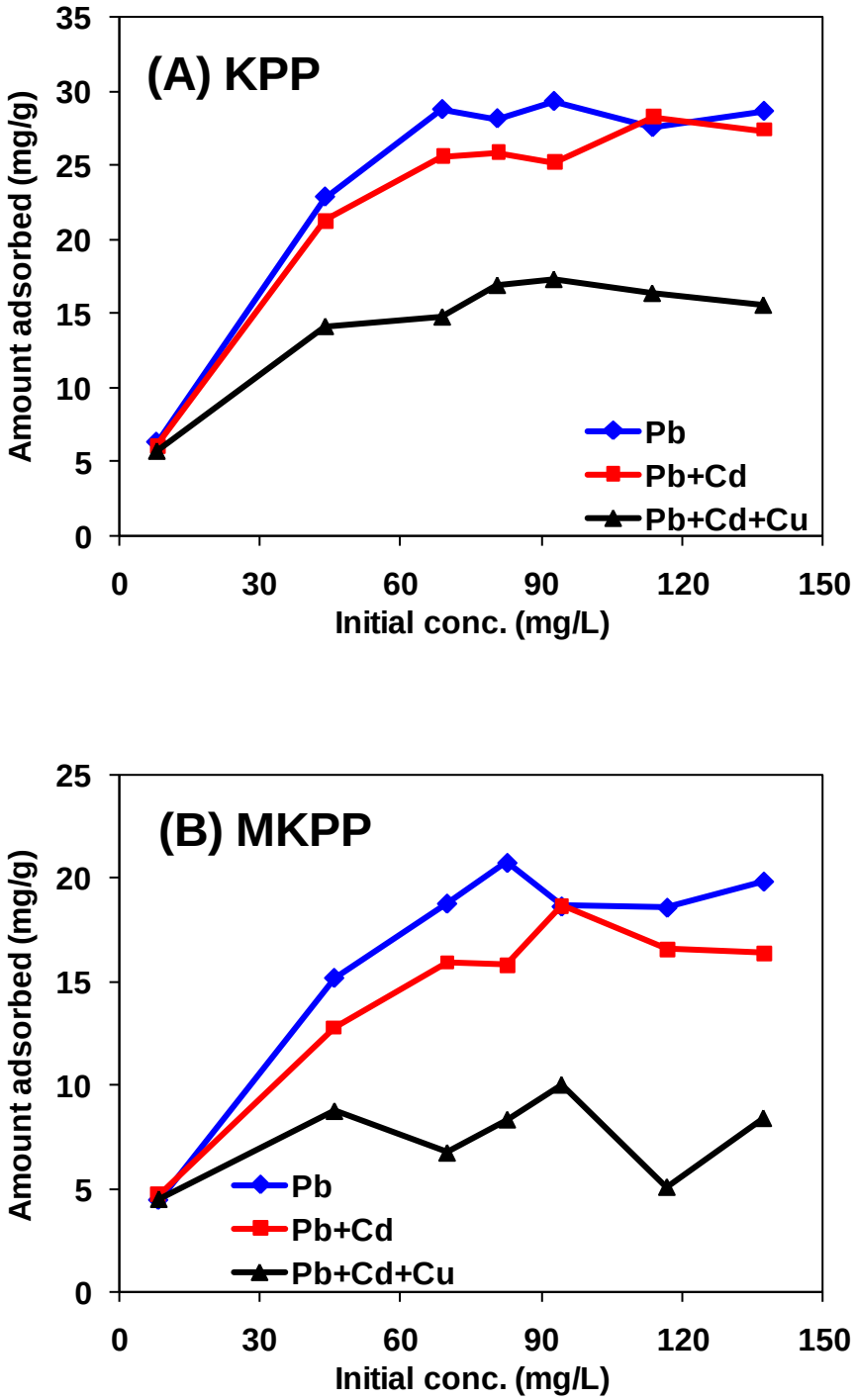
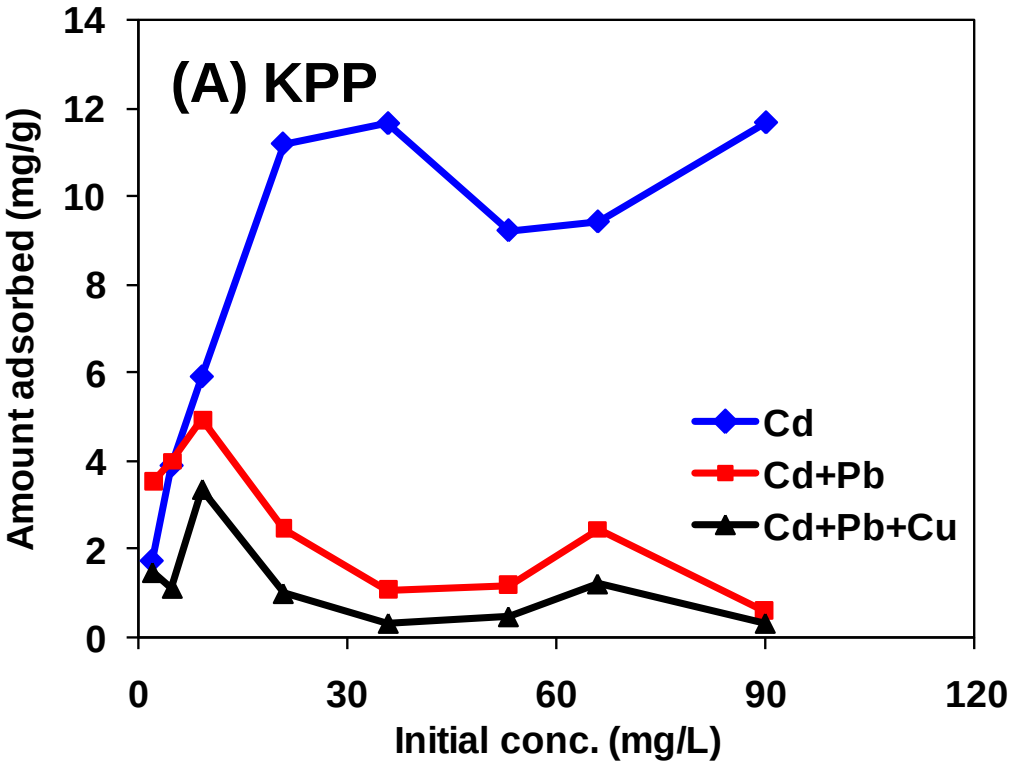


Figure SM19. Adsorption isotherms of Pb^{2+} on (A) KPP and (B) MKPP in the absence and presence of Cd^{2+} and Cu^{2+}. The sample with interfering Cd^{2+} and Cu^{2+} was in 1:1:1 molar ratio [pH= 4.5; adsorbent concentration= 4.0 g/L; particle size= 30-60 B.S.S. mesh].



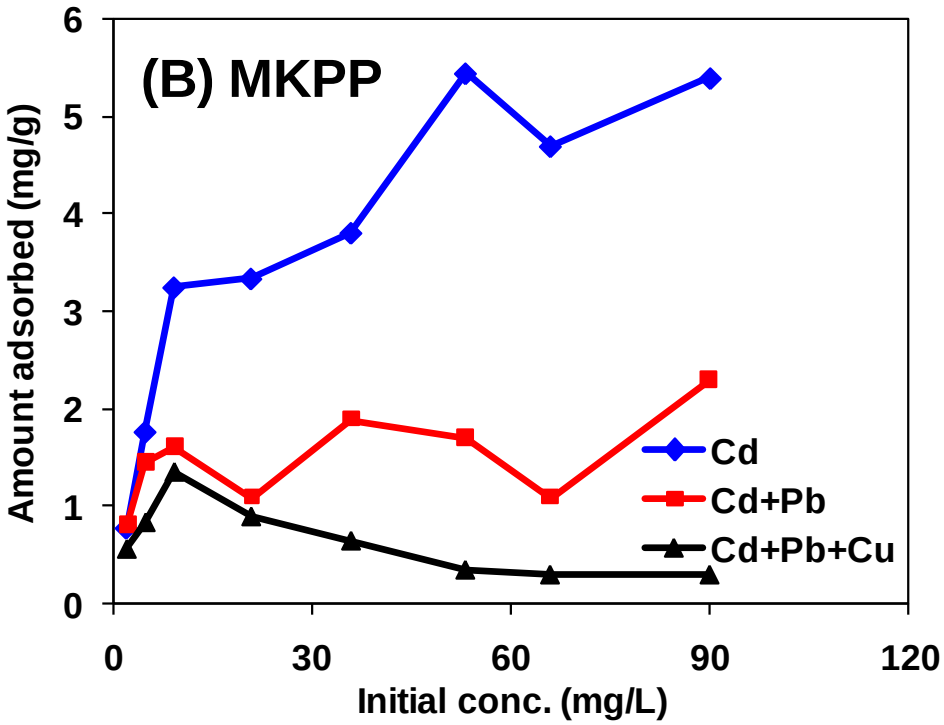


Figure SM20. Cd^{2+} removal on [A] KPP and [B] MKPP in Cd^{2+}-Cu^{2+}-Pb^{2+}system. [Initial pH= 5.0; adsorbent dose= 1 g/L (KPP) and 2 g/L (MKPP); particle size= 30-50 B.S.S mesh; Cd^{2+}, Cu^{2+} and Pb^{2+}molar ratio= -1:1:1]

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