Supplementary Information

Lignin-based Magnesium Hydroxide Nanocomposite. Synthesis and Application for the Removal of Potentially Toxic Metals from Aqueous Solution

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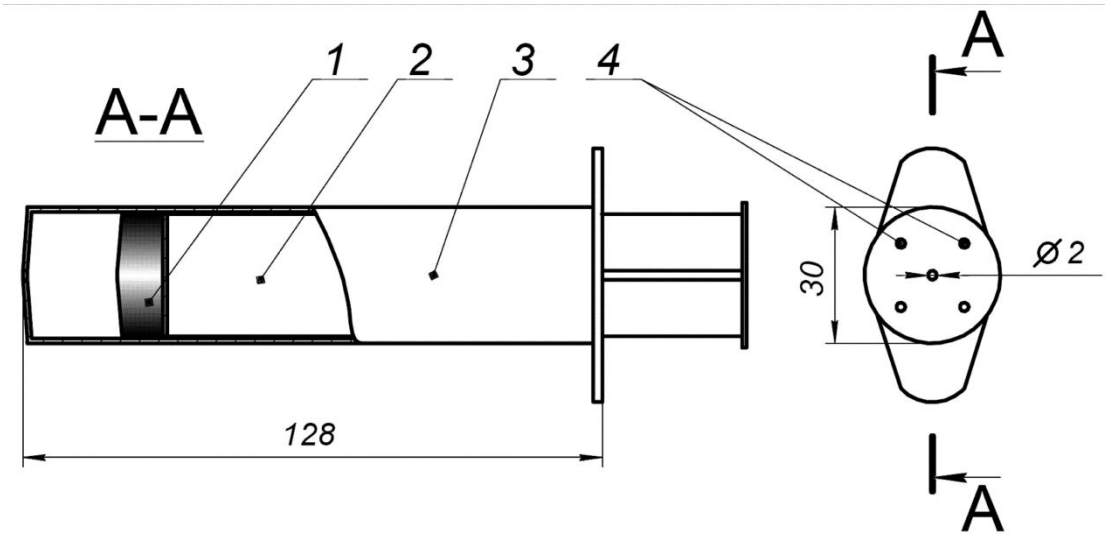

Figure S1. Extruder for making granules of lignin-based nanocomposite: 1 – seal; 2 – piston; 3 –housing; 4 – orifices (5 pcs).

Figure S2. Granules of lignin-based nanocomposite.

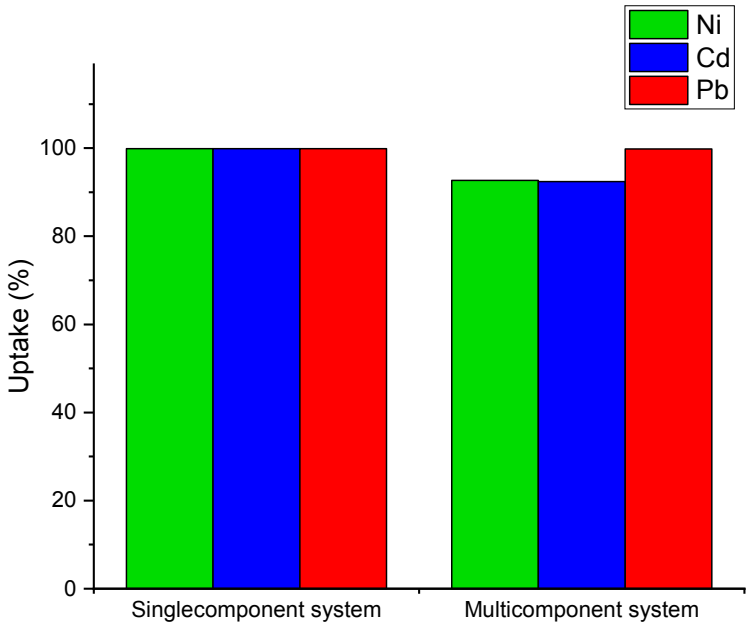

Figure S3. Uptake of cations in singlecomponent system and multicomponent system with competing ions: Na^{+}, K^{+}, Mg^{2+} and Ca^{2+}.

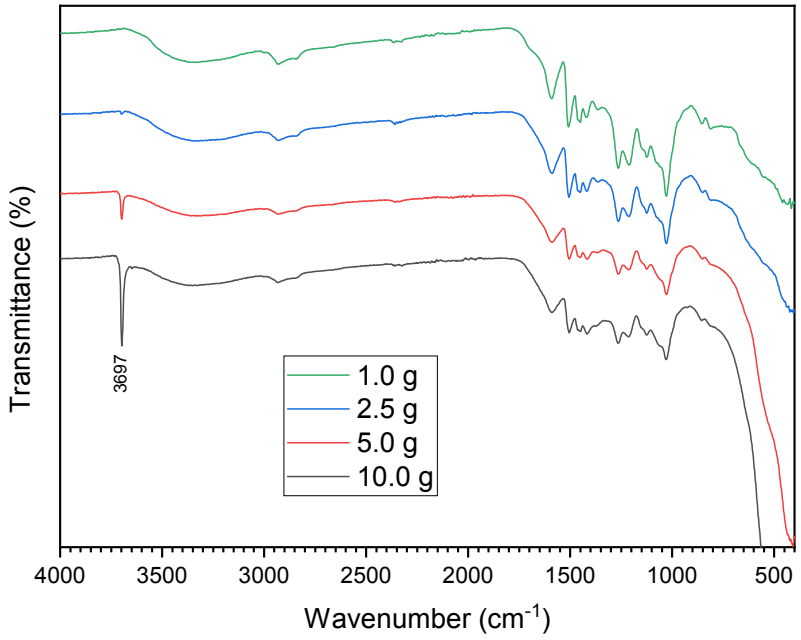

Figure S4. The FTIR spectra of lignin-based nanocomposite with various added $MgCl_2$ amount (g).

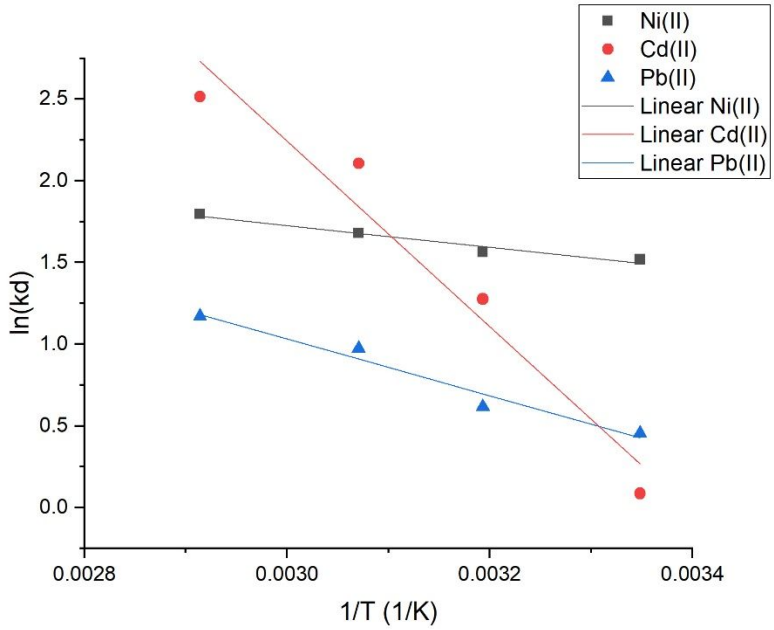

Figure S5. The van't Hoff plot.

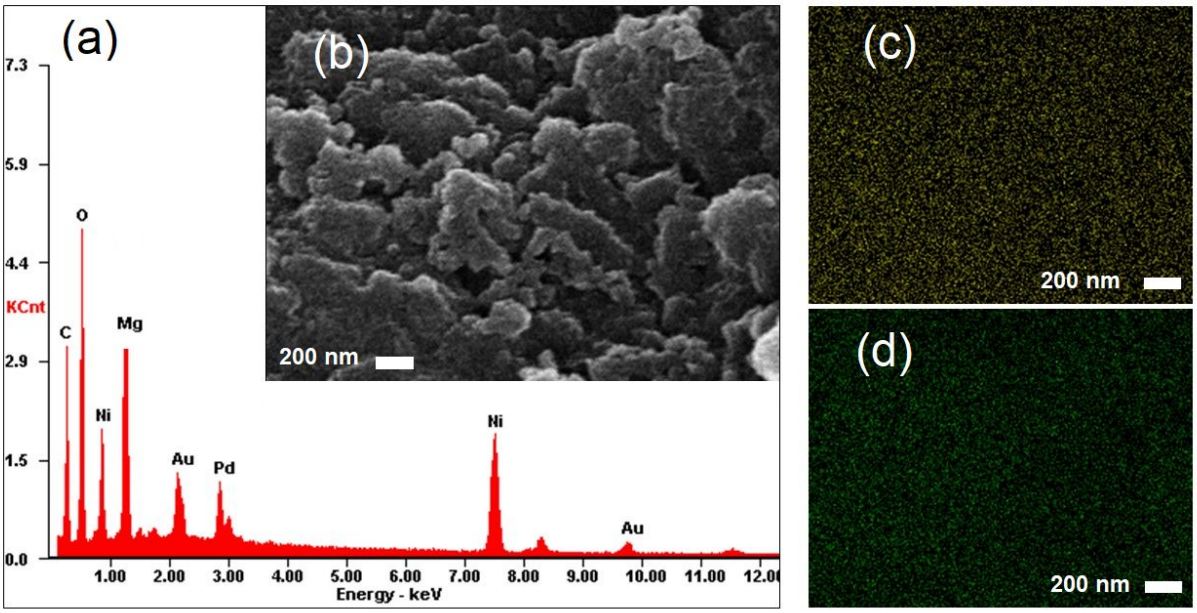

Figure S6. (a) EDS spectrum and elemental mapping of the LH-MH after adsorption of Ni^{2+}: (b) SEM image; (c) Ni; (d) O.

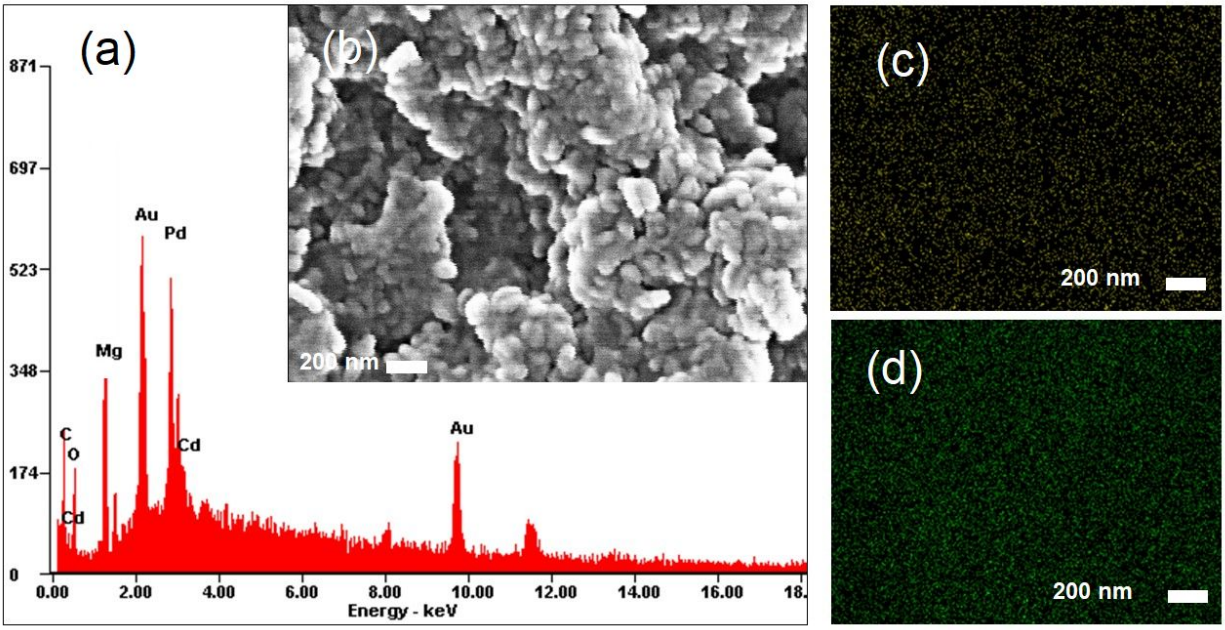

Figure S7. (a) EDS spectrum and elemental mapping of the LH-MH after adsorption of Cd^{2+}: (b) SEM image; (c) Cd; (d) O.

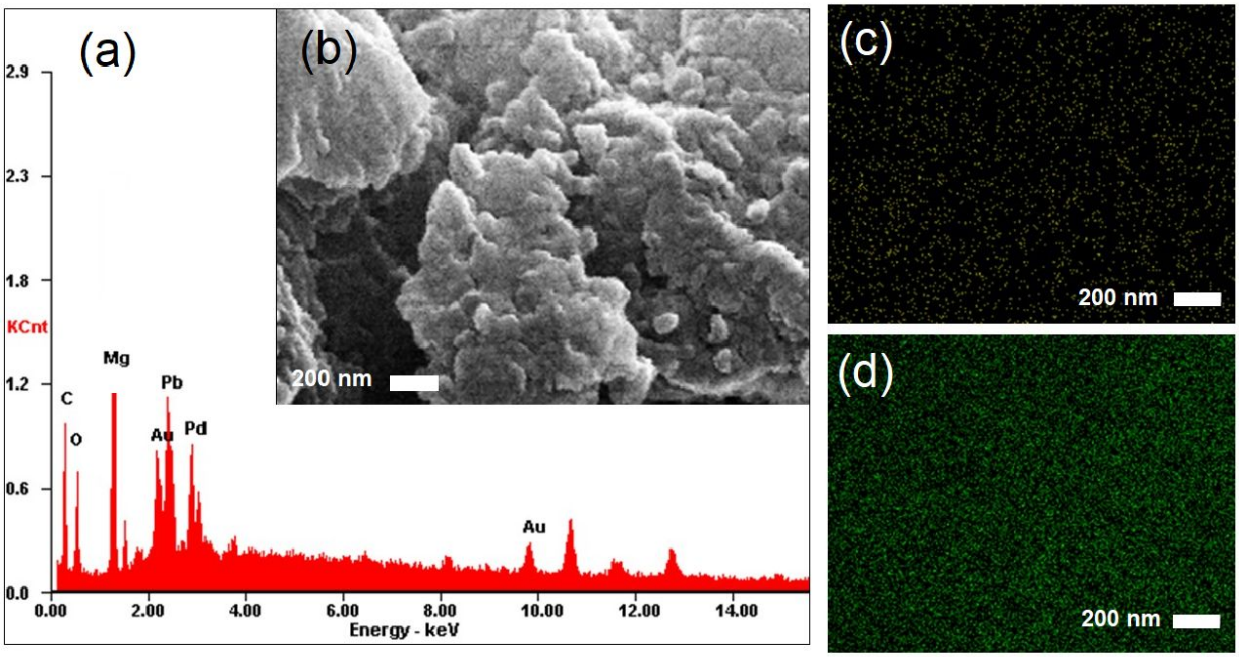

Figure S8. (a) EDS spectrum and elemental mapping of the LH-MH after adsorption of Pb^{2+}: (b) SEM image; (c) Pb; (d) O.

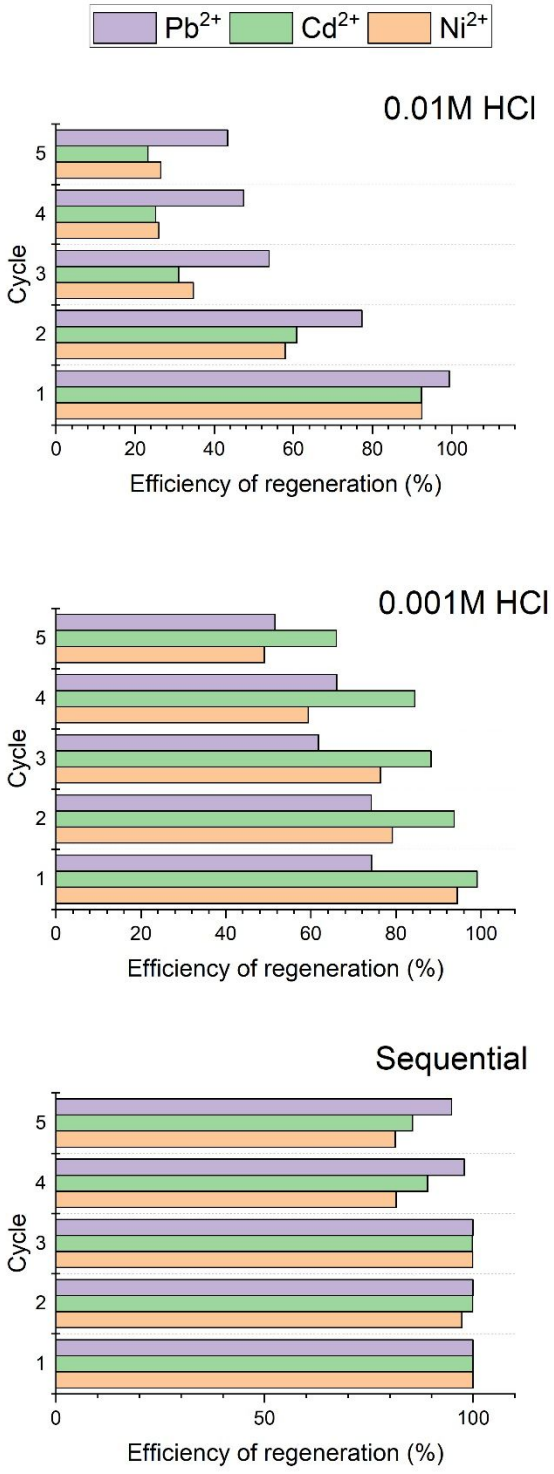

Figure S9. Regeneration of lignin-based nanocomposite after adsorption of Ni^{2+}, Cd^{2+} and Pb^{2+} using 0.01 mol/L HCl, 0.001 mol/L HCl and sequential regeneration: 0.01 mol/L HCl – 1 M $MgCl_2$ – 0.05 mol/L NaOH.

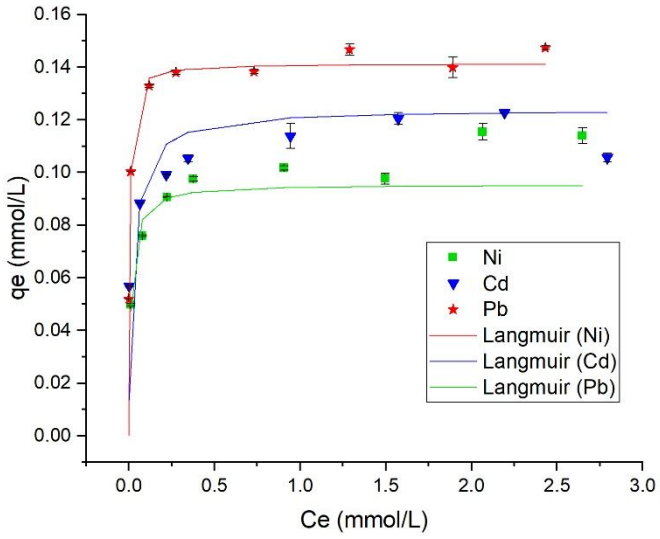

Figure S10. Adsorption isotherms of Ni^{2+}, Cd^{2+} and Pb^{2+} using lignin.

Table S1. The uptake of cations using lignin-based nanocomposites with various added amount of $MgCl_2$.

Added $MgCl_2$ amount (g) to the lignin suspension	**Uptake (%)**		
	Ni^{2+}	**Cd^{2+}**	**Pb^{2+}**
1.0	79.89	84.83	86.55
2.5	84.06	91.98	97.79
5.0	98.95	99.57	99.60
10.0	99.69	99.87	99.60

Table S2. Compared adsorption capacities (mmol/g) of lignin based-nanocomposite and some other adsorbents (recalculated values from mg/g to mmol/L using corresponding molar masses).

	Ni	**Cd**	**Pb**
Lignin (this study)	0.11	0.12	0.15
Lignin-based nanocomposite (this study)	1.05	0.92	1.08
lignin grafted carbon nanotubes [1]			1.13
Si/lignin hybrid [1]	1.31	0.75	
As-received ACF/Oxidized ACF [2]	0.034/0.170	-	-
GAC-HD 400 [3]	-	-	0.14
GAC-Filtrasorb 400 [4]	-	0.07	-

References

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