

Supplementary Material

**Robust and Recyclable Sodium Carboxymethyl Cellulose -
Ammonium Phosphomolybdate Composites for Cesium
Removal from Wastewater**

Ningluo Zhang, Shangqing Chen, Jiayin Hu*, Jian Shi, Yafei Guo and Tianlong Deng*

¹ Tianjin Key Laboratory of Marine Resources and Chemistry, College of Marine and
Environmental Science, Tianjin University of Science and Technology, Tianjin, 300457, China

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1. Modeling parameters

1.1 Thermodynamic parameters

Table S1. Thermodynamic parameters of CMC-AMP for Cs⁺ adsorption.

Absorbents	<i>T</i> (K)	ΔG^0 (kJ·mol ⁻¹)	ΔH^0 (kJ·mol ⁻¹)	ΔS^0 (J·mol ⁻¹ ·K ⁻¹)
CMC-AMP	293.15	-14.193	24.247	131.128
	303.15	-15.505		
	313.15	-16.816		
	323.15	-18.127		

1.2 Kinetics parameters

1.2.1 Lagergren pseudo-first-order rate parameters

Table S2. Lagergren pseudo-first-order rate parameters for Cs⁺ adsorption.

Initial Cs ⁺ concentration (mg/L)	<i>q</i> _e , exp (mg/g)	<i>q</i> _e , cal (mg/g)	<i>k</i> ₁ (min ⁻¹)	<i>R</i> ²
100	61.2060	85.8241	0.00074	0.9715

1.2.2 Lagergren pseudo-second-order rate parameters

Table S3. Lagergren pseudo-second-order rate parameters for Cs⁺ adsorption.

Initial Cs ⁺ concentration (mg/L)	<i>q</i> _e , exp (mg/g)	<i>q</i> _e , cal (mg/g)	<i>k</i> ₂ (x10 ⁻³ g·mg ⁻¹ ·min ⁻¹)	<i>R</i> ²
100	61.2060	87.3362	0.004738	0.9859

1.2.3 Intra-particle diffusion model parameters

Table S4. Intra-particle diffusion model parameters for Cs⁺ adsorption.

Initial Cs concentration (mg/L)	Phase I			Phase II		
	<i>k</i> _{dif1} (mg·(g·min ^{1/2}) ⁻¹)	<i>C</i> ₁	<i>R</i> ₁ ²	<i>k</i> _{dif2} (mg·(g·min ^{1/2}) ⁻¹)	<i>C</i> ₂	<i>R</i> ₂ ²
100	1.0457	-8.3133	0.9857	0.024526	41.8983	0.9243

1.3 Adsorption isotherm

1.3.1 Langmuir and Freundlich isotherm constants

Table S5. Langmuir and Freundlich isotherm constants for Cs⁺ removal.

Absorbent	T (K)	Langmuir			Freundlich		
		$q_{\max}$ (mg/g)	b (L/mg)	R^2	K_F (mg/g)(L/mg) ^{1/n}	n	R^2
CMC-AMP	293.15	39.68	0.02518	0.9522	6.740	3.286	0.9433
	303.15	45.21	0.02596	0.9861	6.309	2.863	0.9712
	313.15	70.22	0.02465	0.9688	9.085	2.766	0.9865
	323.15	72.89	0.03417	0.9587	13.069	3.228	0.9698

2. EDX analysis

Table S6. EDX analysis of the various elements of CMC-AMP and CMC-AMP-Cs

Component	Mass fraction (%)	
	CMC-AMP	CMC-AMP-Cs
C	20.25	20.17
N	2.54	0.61
O	37.88	36.33
Na	0.08	0.01
Fe	2.75	2.26
P	1.07	1.2
Mo	35.44	36.21
Cs	0	3.21

3. Characterization of CMC-AMP after adsorption

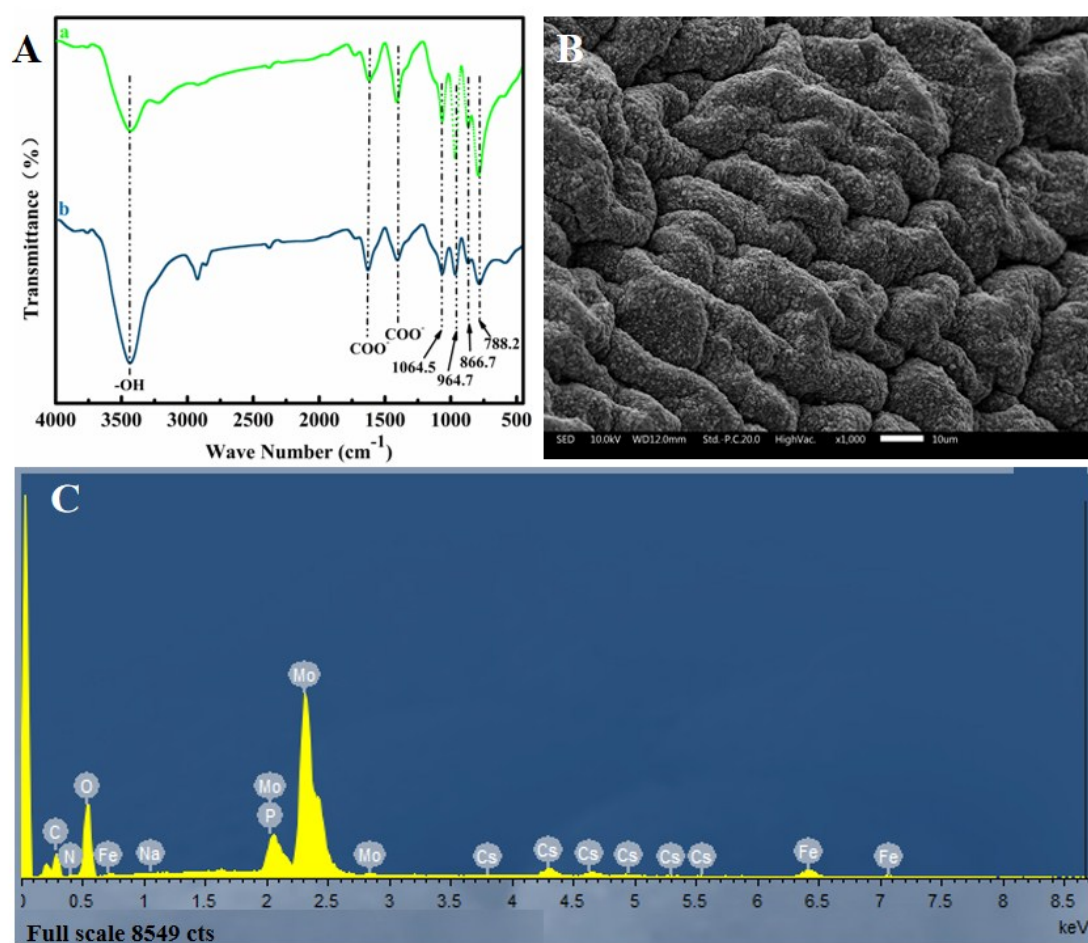


Fig. S1 Characterization of CMC-AMP after adsorption: the FT-IR spectrum (A), SEM image (B) and EDX spectrum (C).

4. Cs⁺ adsorption in ground water

Table S7. Concentrations of main metal cations in ground water and adsorption performance ^a

	main metal cations				
	Cs ⁺	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺
Concentration (mg/L)	17.58	682.01	137.90	211.05	-
<i>E</i> (%)	89.5	5.4	13.3	6.8	-

^a Adsorption conditions: adsorbent dosage 1.5 g/L, pH=8, *T*=298.15 K.