Adsorption on properties and mechanisms of magnetic carbon-silicon composites in situ prepared from coal gasification fine slag

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Texts

Text S1. Characterization methods

The elemental composition of the original CGFS was analyzed by an inductively coupled plasma and optical emission spectrum (ICP-OES/MS, Agilent 5110 (OES), America) analyzed. The concentration of RhB was determined using a UV-visible spectrophotometer at 554 nm (UV-Vis DRS, UV-2550, Shimadzu, Kyushu, Japan). The crystal lattice structure and crystallinity of the material were analyzed by X-ray Diffraction (XRD, Rigaku smartlab SE, Japan). Radiation waves were Cu-Kα (λ=1.5418 A) at 40 kV, 40 mA, deflection angle 2θ=5-80°. The surface morphology of the samples was observed by scanning electron microscopy (SEM, Phenom pure plus, Netherlands/TESCAN MIRA LMS, Czech), while the elemental composition of the samples was analyzed by EDS. The pore structure of the samples was characterized by the N_2 adsorption-desorption test using a rapid specific surface area and porosity analyzer (BET, Quantachrome Autosorb-iQ, America) at 77K, to obtain their specific surface area and pore size distribution. Surface chemical compositions were analyzed by X-ray photoelectron spectroscopy (XPS, Thermo Scientific ESCALAB Xi+, America). Thermal gravimetric analysis (TGA, Rigaku TG-DTA8122, Japan) for analyzing material composition, thermal stability, decomposition processes of substances, etc. The vibrating sample magnetometer (VSM, LakeShore 7404, America) was used to test the hysteresis lines on the samples at 25°C.

Tables

Table S1. Levels of factors used for Box-Behnken experimental design.

Coded	Factors	Levels		
		-1	0	+1
A	Temperature (℃)	20	40	60
B	Fe^{3+}: Fe^{2+}	0.5	1	1.5
C	pH	9.0	10.0	11.0

Noted: The three levels of factor B, namely 0.5, 1, and 1.5, correspond to the molar ratio of Fe^{3+}: Fe^{2+} as 2:1, 1:1, and 1:2 respectively.

Table S2. Actual and predict RhB Removal efficiency from the experimental design matrix with Fe-HH-CGFS

Run	Coded			Removal Efficiency (%)	
	A	B	C	Actual value	Predicted value
1	0	-1	-1	94.58	94.70
2	-1	0	-1	93.89	93.95
3	-1	1	0	78.07	78.60
4	1	-1	0	91.76	91.23
5	1	1	0	78.93	79.10
6	-1	-1	0	92.32	92.15
7	0	1	-1	80.21	79.63
8	0	0	0	97.47	96.65
9	-1	0	1	93.11	92.70
10	0	0	0	96.46	96.65
11	0	0	0	98.11	96.65
12	0	1	1	81.64	81.52
13	0	0	0	96.15	96.65
14	1	0	1	93.47	93.41
15	0	0	0	95.05	96.65
16	0	-1	1	91.55	92.13
17	1	0	-1	92.42	92.83

Table S3. ANOVA results for the response surface quadratic model on the RhB removal.

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	710.91	9	78.99	75.58	< 0.0001	significant
A-Temperature	0.082	1	0.082	0.0785	0.7875	
B-Fe^{3+}:Fe^{2+}	329.73	1	329.73	315.5	< 0.0001	
C-pH	0.2211	1	0.2211	0.2116	0.6595	
AB	0.5041	1	0.5041	0.4823	0.5097	
AC	0.8372	1	0.8372	0.8011	0.4005	
BC	4.97	1	4.97	4.76	0.0655	
A^2	27.92	1	27.92	26.72	0.0013	
B^2	326.27	1	326.27	312.19	< 0.0001	
C^2	3.041	1	3.04	2.91	0.1317	
Residual	7.32	7	1.05			
Lack of Fit	1.67	3	0.5552	0.3931	0.7655	not significant
Pure Error	5.65	4	1.41			
Cor Total	718.22	16				
Std. Dev.	1.02		R^2	0.9898		
Mean	90.89		Adjusted R^2	0.9767		
C.V. %	1.12		Adeq Precision	23.0231		