

# Adsorption of Hexavalent Chromium from Wastewater using Magnetic Biochar Derived from Peanut Hulls

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## SUPPLEMENTARY MATERIAL

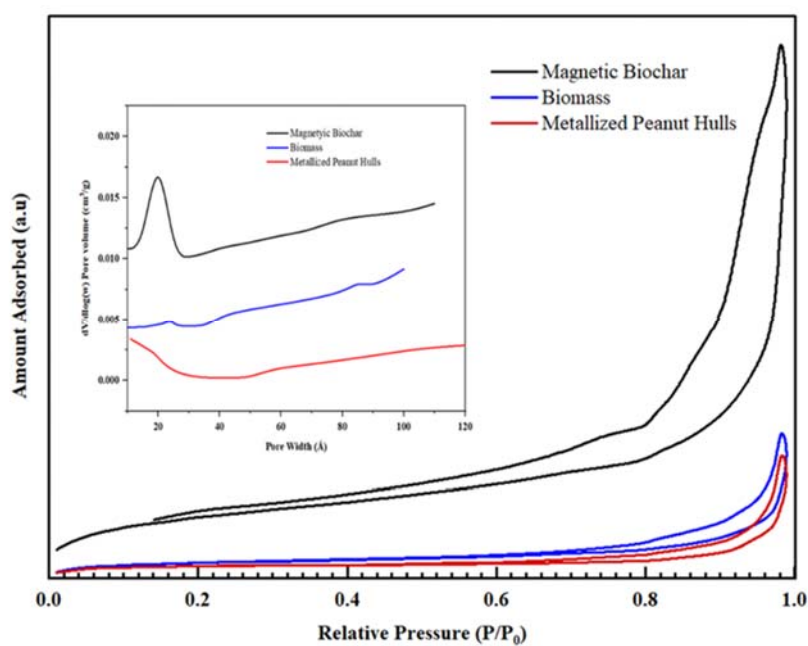


Figure S1: BET surface area analysis for pristine peanut hulls biomass, metallized peanut hulls and magnetic biochar

Table S1: Numerical optimization results for biochar synthesis

Number	Pyrolysis Temperature (°C)	Ratio of metal salts to biomass	Pyrolysis time (h)	Flow of nitrogen	Yield (%)	Cr(VI) removal efficiency (%)	Desirability
<b>1</b>	<b>300.58</b>	<b>0.53</b>	<b>1.00</b>	<b>Yes</b>	<b>62.97</b>	<b>100.46</b>	<b>0.85</b>
2	242.93	0.86	2.86	yes	65.88	96.52	0.84
3	243.31	0.89	6.00	No	65.58	96.32	0.84
4	242.86	0.86	6.00	No	65.97	96.60	0.84
5	242.87	0.78	6.00	No	66.46	97.55	0.84
6	266.62	0.53	1.00	Yes	64.80	96.51	0.84
7	267.05	0.53	1.00	Yes	64.80	96.51	0.84
8	265.80	0.54	1.00	Yes	64.80	96.5	0.84
9	264.60	0.55	1.00	Yes	64.78	96.52	0.84
10	269.35	0.50	1.00	Yes	64.77	96.52	0.84
11	270.80	0.50	1.00	Yes	64.73	96.50	0.84
12	266.41	0.54	1.00	Yes	64.73	96.52	0.84
13	261.48	0.57	1.00	Yes	64.69	96.48	0.84
14	270.16	0.57	1.00	Yes	64.36	95.48	0.84
15	249.69	0.84	5.88	No	63.56	96.18	0.83
16	243.31	0.75	1.00	Yes	62.04	97.04	0.82
17	285.41	0.45	1.14	Yes	61.71	96.01	0.82
18	231.64	0.44	1.00	No	60.36	96.42	0.80
19	232.72	0.44	1.00	No	60.42	96.46	0.80
20	229.15	0.46	1.00	No	60.22	96.32	0.80
21	230.24	0.45	1.00	No	60.27	96.45	0.80
22	234.60	0.43	1.00	No	60.50	96.55	0.80
23	227.38	0.46	1.00	No	60.11	96.25	0.80
24	241.40	0.41	1.00	No	60.7	96.91	0.80
25	300.58	0.67	6.00	Yes	61.07	97.41	0.80

Table S2: Numerical optimization results for Cr (VI) adsorption

Number	pH	Adsorbent Loading (g/L)	Pollutant Concentration (mg/L)	Cr(VI) Adsorption Efficiency (%)	Desirability
<b>1</b>	<b>3.00</b>	<b>5.00</b>	<b>20.00</b>	<b>97.85</b>	<b>1.00</b>
2	4.40	2.82	18.33	85.07	0.95
3	5.46	15.00	5.00	85.42	0.94
4	7.00	1.00	15.00	59.35	0.94
5	4.10	14.31	5.42	86.61	0.93
6	11.40	1.93	6.00	28.32	0.93
7	3.00	1.00	5.00	77.86	0.93
8	8.02	5.18	5.31	77.89	0.92
9	11.71	9.95	19.72	87.54	0.92
10	9.00	5.00	10.00	81.47	0.91
11	4.17	14.83	5.12	82.88	0.91
12	11.23	8.10	16.17	88.93	0.91
13	8.80	7.20	18.00	89.94	0.91
14	11.40	1.93	19.00	22.20	0.91
15	6.67	3.44	10.11	83.87	0.91
16	6.53	2.11	14.06	74.30	0.91
17	7.23	5.98	6.24	88.78	0.90
18	11.45	4.47	15.05	59.90	0.90
19	6.02	1.67	8.16	71.61	0.90
20	7.45	2.75	6.32	66.79	0.89
21	4.30	14.56	5.43	86.01	0.89
22	6.10	4.71	5.34	84.48	0.87
23	5.13	1.75	14.58	80.36	0.86
24	7.12	2.85	10.33	76.74	0.85
25	7.57	1.70	11.92	64.15	0.85

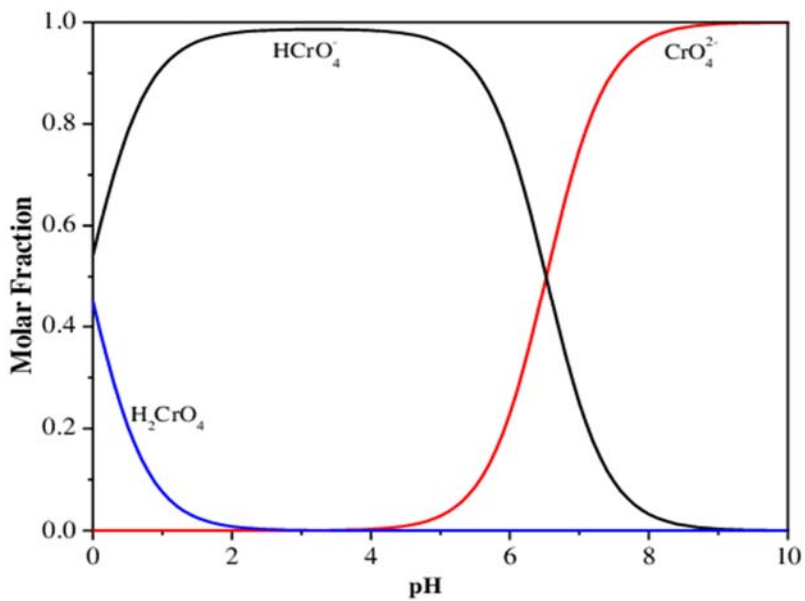


Figure S2: Distribution of Cr (VI) species as a function of the solution pH (Marinho *et al.*, 2017)

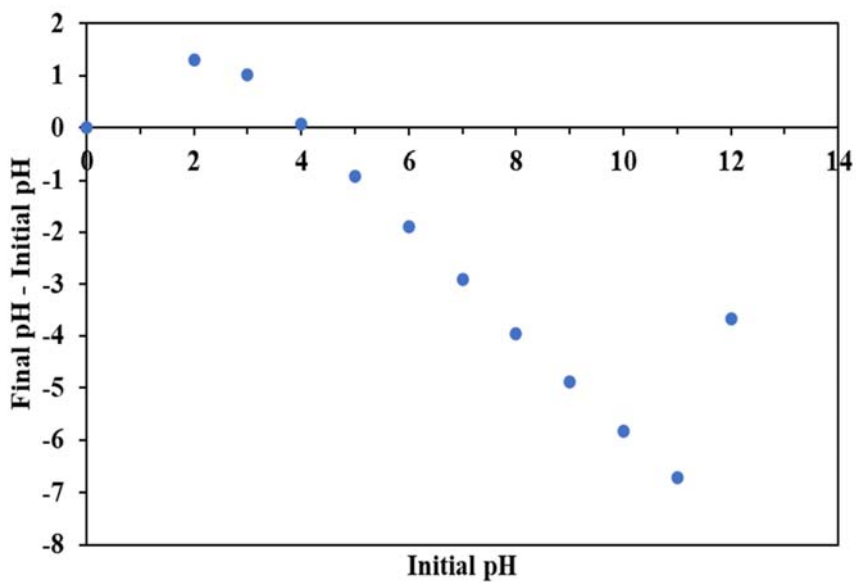


Figure S3: Point of zero charge for magnetic biochar

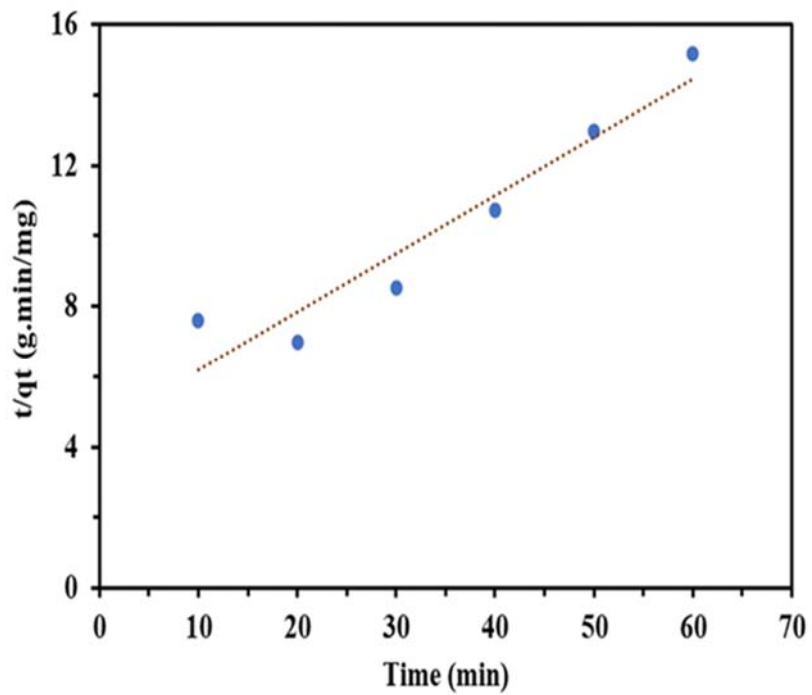


Figure S4: Pseudo second order kinetic data fits using (pH 3, 20 mg/L and 5 g/L loading)



Figure S5: Cr(VI) solutions before and after interactions with magnetic biochar

Table S3: Matrix for Magna Chute Magnetism Testing

Test No.	Intial sample weight (g)	Filter paper weight (g)	Magnetic fraction (g)	Non-magnetic fraction (g)	Total mass collected (g)	Mass balance (%)	Magnetic fraction (%)
1	10.02	3.06	5.8	4.14	9.94	99.2	58.3
2	10.05	3.06	6.00	4.00	10.00	99.5	60
3	9.98	3.06	5.85	4.07	9.92	99.4	58.8

## REFERENCE

Marinho, B.A., Cristóvão, R.O., Djellabi, R., Loureiro, J.M., Boaventura, R.A. and Vilar, V.J., 2017. Photocatalytic reduction of Cr (VI) over TiO<sub>2</sub>-coated cellulose acetate monolithic structures using solar light. *Appl. Catal. B: Environ.* 203, pp.18-30.