Supporting information

**Preparation of *Quercus mongolica* leaf-derived porous carbon with a large specific surface area for highly effective removal of dye and antibiotic from water**

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**S1. Mechanism of chemical activation**

When the biochar is heated under N2 atmosphere with the presence of NaOH, the possible chemical reaction steps are listed as following:

(S1)

(S2)

(S3)

Through the reaction of biochar and NaOH, a large number of micro- and mesopores occur in the surface of biochar, and the specific surface area of biochar may largely increased (Norouzi et al., 2018).

Fig. S1

**Fig. S1** The relationship between the RhB adsorption capacities of porous carbon products and the activation conditions including (a) temperature, (b) the ratio of NaOH to carbon, and (c) activation time using NaOH as the activator.

Fig. S2

**Fig. S2** The (a) C1s and (b) O1s XPS spectra of PCQL.

**Fig. S3**

**Fig. S3** (a) the initial pH and finial pH of NaCl aqueous solutions after PCQL samples were added; (b) Effect of pH on the adsorption capacities of PCQL toward RhB.

**Table S1** Parameters of adsorption kinetic models for RhB adsorption on PCQL.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Models | Equation |  | *C*o (mg L-1) | | | |
| 100 | 200 | 300 | 400 |
| Pseudo-first-order |  | *k*1 (min-1) | 0.15 | 0.14 | 0.15 | 0.19 |
| *qe* (mg g-1) | 867.0 | 1108.7 | 1195.3 | 1259.9 |
| *R*2 | 0.9925 | 0.9897 | 0.9895 | 0.9947 |
| *SSE* | 508.48 | 1143.68 | 1354.07 | 755.13 |
| Pseudo-second-order |  | *k*2 (g mg-1 min-1) | 3.6×10-4 | 2.4×10-4 | 2.5×10-4 | 3.8×10-4 |
| *qe* (mg g-1) | 907.3 | 1168.1 | 1254.2 | 1302.6 |
| *R*2 | 0.9998 | 0.9999 | 0.9999 | 0.9999 |
| *SSE* | 10.24 | 7.53 | 12.61 | 5.26 |
| Intra-particle diffusion |  | *ki*,1 (L g-1) | 183.92 | 230.40 | 252.33 | 278.23 |
| *C* | 25.05 | 28.91 | 35.38 | 45.89 |
| *R*2 | 0.9371 | 0.9464 | 0.9335 | 0.9092 |
| *SSE* | 11601.31 | 15448.38 | 23139.13 | 38921.74 |
| *ki*,2 (L g-1) | 17.31 | 22.68 | 33.22 | 17.84 |
| *C* | 733.86 | 926.31 | 941.44 | 1125.19 |
| *R*2 | 0.9895 | 0.9366 | 0.9299 | 0.9299 |
| *SSE* | 6.03 | 64.85 | 408.04 | 44.57 |
| *ki*,3 (L g-1) | 1.86 | 5.33 | 5.80 | 3.45 |
| *C* | 862.83 | 1071.89 | 1155.18 | 1240.22 |
| *R*2 | 0.7516 | 0.9412 | 0.9535 | 0.9641 |
| *SSE* | 14.54 | 24.51 | 22.71 | 6.17 |

**Table** **S2** Parameters of adsorption kinetic models for TC adsorption on PCQL.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Models | Equation |  | *C*o (mg L-1) | | | |
| 100 | 200 | 300 | 400 |
| Pseudo-first-order |  | *k*1 (min-1) | 0.20 | 0.20 | 0.17 | 0.17 |
| *qe* (mg g-1) | 1254.4 | 1228.7 | 1162.5 | 897.4 |
| *R*2 | 0.9964 | 0.9968 | 0.9940 | 0.9925 |
| *SSE* | 496.08 | 421.73 | 723.78 | 537.67 |
| Pseudo-second-order |  | *k*2 (g mg-1 min-1) | 4.4×10-4 | 3.6×10-4 | 5.0×10-4 | 4.5×10-4 |
| *qe* (mg g-1) | 932.8 | 1206.5 | 1262.1 | 1290.7 |
| R2 | 0.9999 | 0.9999 | 0.9998 | 0.9998 |
| *SSE* | 3.6 | 6.66 | 16.26 | 20.73 |
| Intra-particle diffusion |  | *ki*,1 (L g-1) | 194.86 | 254.87 | 277.99 | 281.50 |
| *C* | 31.01 | 38.61 | 46.54 | 47.17 |
| *R*2 | 0.9151 | 0.9228 | 0.9065 | 0.9064 |
| *SSE* | 17776.59 | 27557.90 | 40030.64 | 41129.54 |
| *ki*,2 (L g-1) | 14.43 | 17.28 | 12.19 | 10.71 |
| *C* | 785.94 | 1027.19 | 1133.68 | 1170.07 |
| *R*2 | 0.9443 | 0.9559 | 0.9923 | 0.8115 |
| *SSE* | 22.96 | 25.85 | 2.17 | 47.12 |
| *ki*,3 (L g-1) | 2.06 | 2.11 | 2.52 | 3.99 |
| *C* | 891.89 | 1160.89 | 1216.66 | 1224.52 |
| *R*2 | 0.9515 | 0.8997 | 0.7253 | 0.9182 |
| *SSE* | 3.01 | 6.77 | 30.10 | 19.45 |

**References**

Norouzi, S., Heidari, M., Alipour, V., Rahmanian, O., Fazlzadeh, M., Mohammadi-Moghadam, F., Nourmoradi, H., Goudarzi, B., Dindarloo, K., 2018. Preparation, characterization and Cr(VI) adsorption evaluation of NaOH-activated carbon produced from Date Press Cake; an agro-industrial waste. Bioresource Technol. 258, 48–56. https://doi.org/10.1016/j.biortech.2018.02.106.