**Enhanced phenanthrene removal in aqueous solution using modified biochar supported nano zero-valent iron**

Hongwei Wu\*1,2, Qiyan Feng\*2,3, Hong Yang3, Ping Lu3, Bo Gao3, Amir Alansari4

*1. College of Chemistry Chemical Engineering and Material Science, Zaozhuang University, Zaozhuang, PR China*

*2. Low Carbon Energy Institute, China University of Mining and Technology, Xuzhou, PR China*

*3. School of Environmental Science and Spatial Informatics,* *China University of Mining and Technology, Xuzhou, PR China*

*4. Department of Civil and Environmental Engineering, University of North Carolina at Charlotte, Charlotte, NC 28223, USA*

Table S1 Basic properties of PHE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Compounds | Molar mass | Ring number | Solubility | log Kow |
| PHE | 178.2 | 3 | 1.18 mg/L | 4.46 |

Table S2. Elemental composition and general characteristics of the biochar samples.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Samples | C  (%) | H  (%) | N  (%) | O  (%) | H/C | (O+N)/C | BET Surface area  (m2/g) | Pore Size  (Å) | Pore volume  (cm3/g) |
| BC | 87.35 | 2.17 | 0.78 | 9.52 | 0.0248 | 0.1179 | 94.4251 | 50.5664 | 0.1194 |
| MB | 91.48 | 1.23 | 0.74 | 6.36 | 0.0134 | 0.0776 | 313.8487 | 48.1540 | 0.3778 |
| nZVI/MB | - | - | - | - | - | - | 325.2783 | 43.5281 | 0.3967 |

Table S3. Kinetics parameters of PHE removal by BC, MB, nZVI and nZVI/MB

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| samples | | parameters | | BC | MB | | nZVI | | nZVI/MB |
| pseudo-first-order | | *k*1×102 (1/min) | | 0.08 | 0.30 | | | 0.05 | 0.41 |
|  | | *R*2 | | 0.8109 | | 0.8113 | | 0.7357 | 0.8423 |
| pseudo-second-order | | *k*2 ×102 (g/mg/min) | | 2.67 | 3.25 | | | 1.43 | 3.48 |
|  | *h*(mg/g/min) | | | 0.31 | 0.89 | | | 0.23 | 1.09 |
|  | | *R*2 | 0.9979 | | 0.9819 | | | 0.9891 | 0.9898 |

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Fig. S1 The pseudo-second-order kinetic model at different temperatures. Adsorbent dosage=1.0 g/L, initial PHE concentration=0.8 mg/L, pH=6.5.

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Fig. S2 C1s XPS spectra of BC (a), MB (b) and Fe 2p XPS spectra of used nZVI/MB (c).