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Enhanced adsorptive removal of oxidation intermediate 1,4-benzoquinone using thermally treated activated carbon fibres

Fazhan Li[a], Guoting Li[a,*], Bingtao Liu[a], Xiwang Zhang[b]

[a]*Department of Environmental and Municipal Engineering, North China University of Water Resources and Electric Power, Zhengzhou 450011, China*
Tel. +86 371 69127436; Fax: +86 371 65790239; email: liguoting@ncwu.edu.cn
[b]*Department of Chemical Engineering, Monash University, Clayton, Vic 3800, Australia*

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ABSTRACT

As an oxidation intermediate generated in advanced oxidation processes, 1,4-benzoquinone, a toxic intermediate has drawn increasing attentions due to its high toxicity. Activated carbon fibre (ACF) was calcined and employed for the efficient removal of 1,4-benzoquinone by adsorption. Although no noticeable change was observed on the surface morphologies of the ACF after calcination at 300°C, the results showed that the adsorptive removal efficiency of the thermally treated ACF was enhanced by 25.1% compared to the raw ACF. Energy dispersive X-ray analysis indicated that the oxygen content of the thermally treated ACF increased significantly, which might contributed to its higher adsorption capacity. Langmuir isotherm and pseudo-second-order model well fitted the experimental data. Maximal adsorption capacity of 315.2 mg/g was achieved at neutral pH and 25°C. Both neutral and acidic conditions were favorable for the 1,4-benzoquinone adsorption on the calcined ACF. The ionic strength effect experiment showed that 1,4-benzoquinone formed inner-sphere surface complexes and coexisting anions had a minor influence on the adsorption. The enthalpy and entropy of adsorption were found to be −43.62 kJ mol^{-1} and −102.51 J mol^{-1} k^{-1}, respectively, which indicates the adsorption process, was exothermic. Easy regeneration and repeated use suggest that the thermally treated ACF could be an alternative sorbent for 1,4-benzoquinone removal.

Keywords: Adsorption; Activated carbon fibre; 1,4-benzoquinone; Calcination

*Corresponding author.