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Preparation of activated carbon from sludge by 'double green activation' and adsorption capacity for Congo red dye

Jun Chen[a,b,c,*], Xiaowan Dong[a,b], Sisi Cao[a,b], Layun Zhu[a,b], Zihui Song[a,b], Jie Jin[a,d], Hongxing Yang[b]

[a]*School of Biology, Food and Environment, Hefei University, Hefei 230601, China, Tel. +86 551 62158405; Fax: +86 551 62158406; emails: chenjun@hfuu.edu.cn (J. Chen), 1823641450@qq.com (X. Dong), 1241715398@qq.com (S. Cao), 2966705708@qq.com (L. Zhu), 2966705708@qq.com (Z. Song), Tel. +86 551 62158409; Fax: +86 551 62158406; email: 2378859912@qq.com (J. Jin)*
[b]*Anhui Key Laboratory of Sewage Purification and Eco-restoration Materials, Hefei 230088, China, Tel. +86 551 65326105; Fax: +86 551 62158406; email: 331279963@qq.com (H. Yang)*
[c]*Anhui Guoke Testing Technology Co., Ltd., Hefei 230041, China*

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ABSTRACT

The sludge was transformed into activated carbon (SAC) by the green activation method. Citric acid ($C_6H_8O_7$) and potassium ferrate (K_2FeO_4) were used as different activators, and four kinds of SAC (SAC_N; SAC_{CA}; SAC_{PF}; $SAC_{CA\text{-}PF}$) were prepared by different activator combinations. The $SAC_{CA\text{-}PF}$ was produced with $C_6H_8O_7$ and K_2FeO_4 by the 'double green activation' method, it had the highest specific surface area (136 $m^2\ g^{-1}$) and abundant functional groups (C=O, Si–C) attached to it. The adsorption capacity of $SAC_{CA\text{-}PF}$ for Congo red (CR) was 98.61 mg g^{-1}, faster and more efficient than the other SAC. The adsorption process was well described by the Langmuir model and quasi-second-order kinetic model. The adsorption mechanism of $SAC_{CA\text{-}PF}$ (available on the CR surface) was attributed to various interactions, such as hydrogen bonding and electrostatic attraction. Moreover, $SAC_{CA\text{-}PF}$ could be regenerated by Fenton reaction, and the removal rate was still more than 80% after five cycles of used. The results indicated that the impregnation of $C_6H_8O_7$ and K_2FeO_4 can effectively improve the adsorption efficiency of SAC, prepared by the 'double green activation' method. This method can be applied for carbonized sludge and dye wastewater treatment in an environment-friendly way.

Keywords: SAC; Double green activation; Adsorption performance

* Corresponding author.