



## Use of polyethyleneimine-modified wheat straw for adsorption of Congo red from solution in batch mode

Yu Shang<sup>a</sup>, Jinghua Zhang<sup>b</sup>, Xia Wang<sup>a</sup>, Randi Zhang<sup>a</sup>, Wei Xiao<sup>a</sup>, Shusheng Zhang<sup>a</sup>, Runping Han<sup>a,\*</sup>

<sup>a</sup>School of Chemistry and Molecular Engineering, Zhengzhou University, No 100 of Kexue Road, Zhengzhou 450001, P.R. China, Tel. +86 371 67781757; Fax: +86 371 67781556; emails: [shangmagic2012@126.com](mailto:shangmagic2012@126.com) (Y. Shang), [hanrunping12@163.com](mailto:hanrunping12@163.com) (X. Wang), [1309549748@qq.com](mailto:1309549748@qq.com) (R. Zhang), [951725772@qq.com](mailto:951725772@qq.com) (W. Xiao), [zsszz@126.com](mailto:zsszz@126.com) (S. Zhang), [rphan67@zzu.edu.cn](mailto:rphan67@zzu.edu.cn) (R. Han)

<sup>b</sup>Department of Chemistry and Chemical Engineering, Huanghuai University, No 599 of Wenhua Road, Zhumadian 463000, P.R. China, Tel. +86 371 67781757; Fax: +86 371 67781556; email: [hollyli@126.com](mailto:hollyli@126.com)

Received 20 November 2014; Accepted 26 February 2015

---

### ABSTRACT

It is essential and important to remove dyes from solution and adsorption is considered as a promising technology for removal of dyes from solution. In this study, wheat straw was modified with polyethyleneimine to enhance adsorption capacity for anionic dye, Congo red (CR). The presence of the amine group on modified wheat straw (MWS) was confirmed by FTIR and elemental analysis. The CR adsorption onto the surface of MWS was performed in batch mode. The effects of pH, salt concentration, initial CR concentration, contact time, and solution temperature on adsorption quantity were performed. The results showed that the maximum adsorption capacity was reached at pH 5.0 and inorganic salt had little effect on CR adsorption. Isotherm and kinetic analysis showed that Langmuir and intraparticle model described the adsorption behavior very well, suggesting a monolayer adsorption and the rate-controlling step of intraparticle diffusion, respectively. The adsorption quantity was  $89.7 \text{ mg g}^{-1}$  at 303 K from Langmuir model. MWS can be efficiently regenerated with  $0.1 \text{ mol L}^{-1}$  sodium hydroxide solution and reused for CR adsorption. It was concluded that MWS might be a promising agent to adsorb anionic dye from solution.

*Keywords:* Adsorption; Congo red; FTIR; PEI-modified wheat straw; Regeneration

---

\*Corresponding author.