Removal of Cr (VI) from Aqueous Solution by Subcritical Water-Treated Rice Husk

201221200 Xin MA

Cr (VI) is one of the most toxic and important heavy metals that lead to environmental pollution. Cr (VI) and its compounds are widely used in various industrial applications, such as electroplating, steel manufacturing, for military purposes and tanning leather and so on. But Cr (VI) causes some health problems like ulcers, respiratory problems, kidney and liver damage, lung cancer and death. Among the applied techniques, adsorption has been demonstrated to be the most promising, simple and economic method for the removal of heavy metals. In the present study, rice husk was chemically modified by subcritical water technology to obtain a new kind of adsorbent. Subcritical water-treated rice husk and pristine rice husk were evaluated and compared for their potential to remove Cr (VI) from aqueous solution. The final target was to simultaneously realize the recycling of rich husk and reduction of Cr (VI) pollution load from industrial effluents.

Batch adsorption experiments were carried out with the contact time, initial concentration and pH being taken into consideration. The morphology of pristine and treated rice husks surface was verified by scanning electron microscope (SEM) and characterized by fourier transform infrared spectroscopy (FTIR). Adsorption isotherms and kinetic model were used to evaluate the adsorption process.

Results showed that the process of Cr (VI) removal reached equilibrium in 24 h. After subcritical water treatment, at optimal initial pH of 2, the removal efficiency of treated rice husk could reach 100% at initial Cr (VI) concentration of 50 mg L^{-1}.

The equilibrium data was well fitted to Freundlich isotherm and well described by the pseudo second-order kinetic model. The maximum adsorption capacity was obtained at 31.13± 6.22 mg g^{-1} from Langmuir isotherm.

Subcritical water-treated rice husk was proved to be more effective than pristine rice husk for Cr (VI) removal. The Cr (VI) adsorption process was chemical multilayer adsorption. Adsorption mechanism studies showed that electrostatic adsorption played a dominant role in the whole process.

Keywords: Chromium; Rice husk; Subcritical water technology; Adsorption

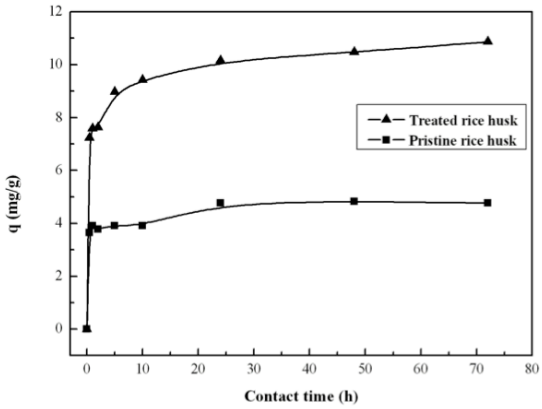

Fig. 1 Effect of contact time on Cr (VI) adsorption capacity onto pristine and treated rice husks.

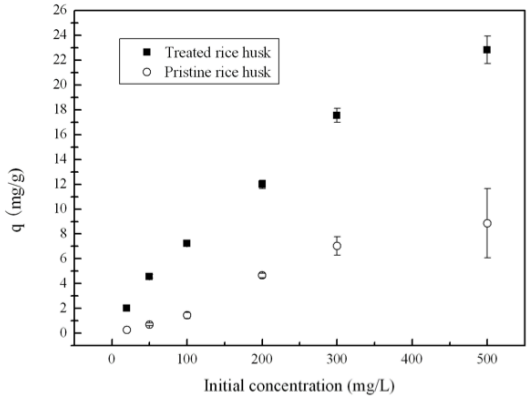

Fig. 2 Effect of initial concentration on Cr (VI) adsorption capacity onto pristine and treated rice husks.

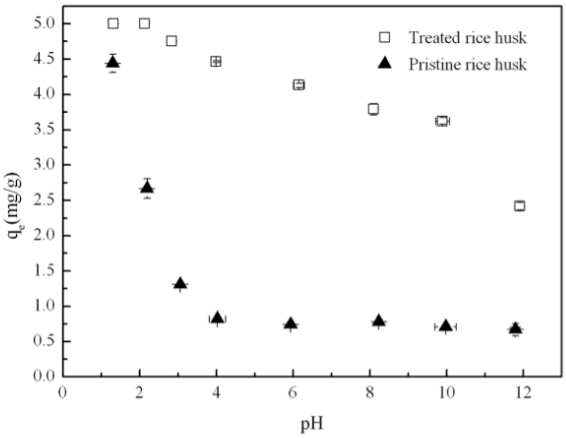

Fig. 3 Effect of pH on Cr (VI) adsorption capacity onto pristine and treated rice husks.

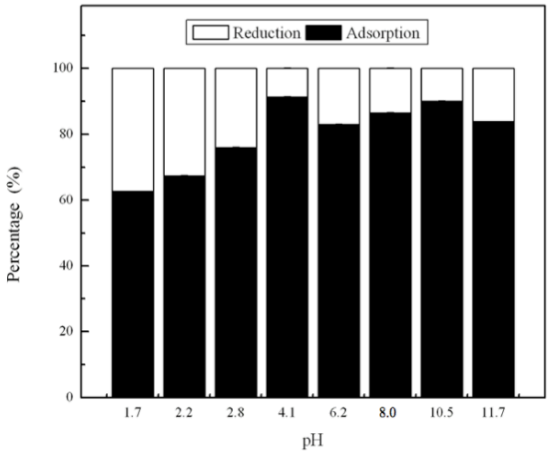

Fig. 4 Percentage of adsorption and reduction on removal of Cr (VI) (pristine rice husk).

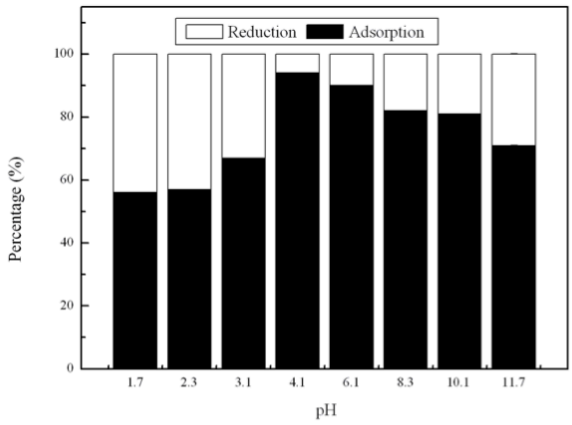

Fig. 5 Percentage of adsorption and reduction on removal of Cr (VI) (treated rice husk).