

Removal of Co(II) and Cr(II) from Aqueous Solution Using *Ferronia elefantum* Fruit Shell Substrate

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Ferronia elefantum fruit shell substrate was found to have good sorption capacity for cobalt(II) and chromium(VI). Studies indicate that the sorption of Co^{2+} and Cr^{6+} increases with the increase in pH value and a contact time of 60 min was found to be optimum. The effect of concentration shows that fruit shell substrate can remove Co^{2+} and Cr^{6+} ions from water.

Key Words: Co(II), Cr(VI), *Ferronia elefantum*, Fruit shell substrate.

INTRODUCTION

The tremendous increase in the use of heavy metals over the past few decades^{1,2} has inevitably resulted in an increased flux of metallic substances in aquatic environment agricultural products and by products (such as peanut skin, rice straw, wheat flour, onion skin, mango cotyledon residue, garlic skin, etc.)³⁻⁵. Heavy metal cations from wastewater to below the discharge limits efficiently and economically have been reported⁶⁻⁸.

The present paper deals with the use of *Ferronia elefantum* fruit shell substrate for the removal and recovery of Co^{2+} and Cr^{6+} from water.

EXPERIMENTAL

All reagents used in the experiment were of analytical grade. All glassware used was leached with 10% nitric acid, washed with distilled water and dried in an oven. The initial stock Co(II) and Cr(VI) solution was prepared by dissolving requisite cobalt nitrate and potassium dichromate. A standard solution of Co(II) and Cr(VI) was prepared by taking different aliquots from stock solution with subsequent dilution with distilled water.

Dried fruit shells of the plant *Ferronia elefantum* were procured and crushed to small size in an electric grinder. 2 g of powder was added to a mixture of 20 mL of 0.2 N H_2SO_4 and 5 mL of 39% HCHO. It was kept in a water bath at 50°C for 6 h and occasionally stirred. The powder was washed with distilled water for several times to remove H_2SO_4 .

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RESULTS AND DISCUSSION

Effect of pH and temperature: The metal ions sorption increases with increase in pH of the solution from 3 to 6 and further decreases with increase in pH of the solution (Fig. 1), while it was found that the removal of metal ions from solution on the substrate decreases with increase in temperature (Fig. 2).

Effect of contact time and dosage: It was observed that Co^{2+} and Cr^{6+} ions removal from solution within 5 min was 85.05 and 64.87% showing that the metal ions sorption on substrate is relatively fast. In about 1 h the removal of Co^{2+} and Cr^{6+} ions from the solution recorded 98.57 and 94.4% and the adsorption remained constant even after a contact time of 24 h (Fig. 3). Moreover, as the dosages of the substrate are increased the sorption of metal ions also increases.

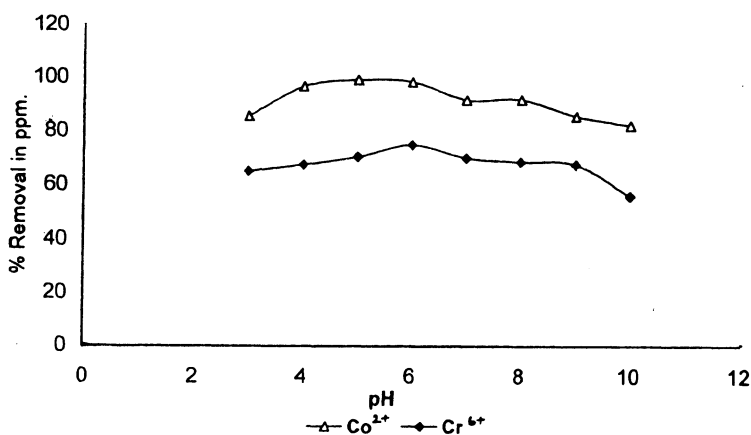


Fig. 1. Effect of pH on the adsorption of Co^{2+} and Cr^{6+} using *Ferronia elefantum* fruit shell substrate

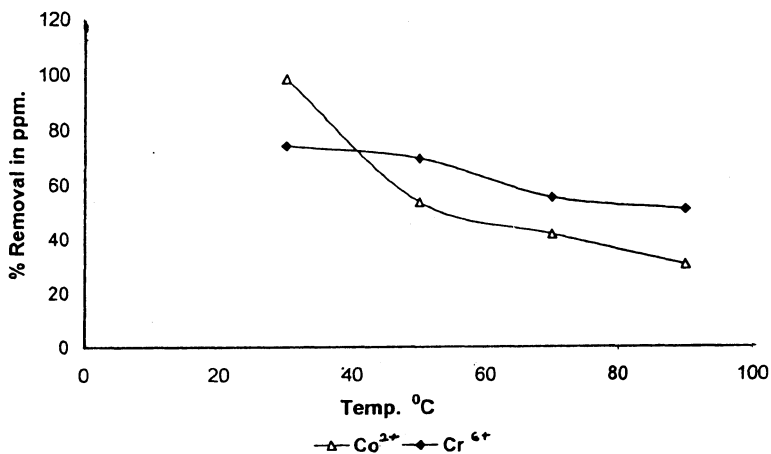


Fig. 2. Effect of temperature on the adsorption of Co^{2+} and Cr^{6+} using *Ferronia elefantum* fruit shell substrate

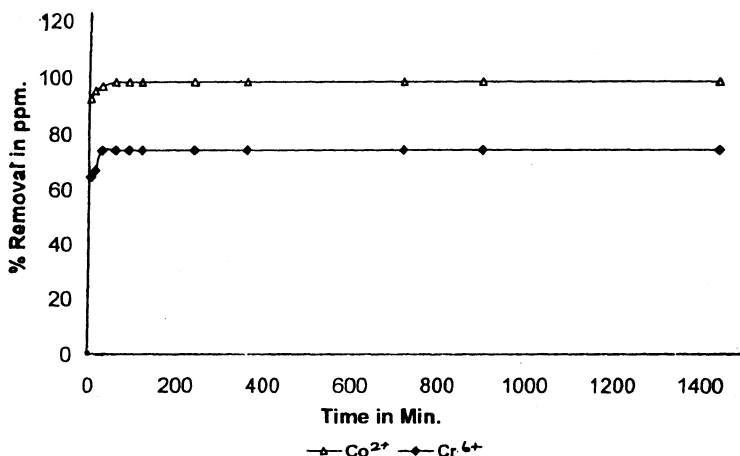


Fig. 3. Effect of contact time on the adsorption of Co²⁺ and Cr⁶⁺ using *Ferronia elefantum* fruit shell substrate

Effect of light metal ions: Light metal ions such as Na⁺, Mg²⁺ and Ca²⁺ have considerable effect on the sorption of Co²⁺ and Cr⁶⁺ by the substrate and it was found that the sorption of the metal ions by the substrate gradually decreases in the presence of these light metal ions.

Effect of initial metal ion concentration: The removal of Co²⁺ and Cr⁶⁺ metal ions from the solution was observed. The initial metal ions concentration increases, although the sorption of metal ions naturally decreases (Fig. 4).

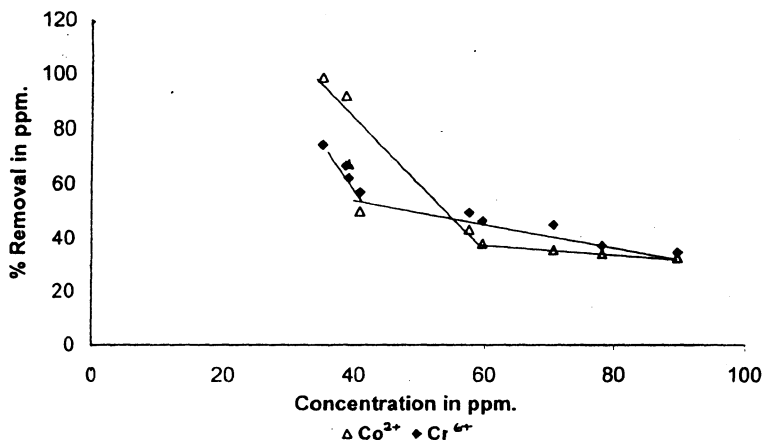


Fig. 4. Effect of initial metal ion concentration on the adsorption of Co²⁺ and Cr⁶⁺ using *Ferronia elefantum*, fruit shell substrate

Conclusions

The *Ferronia elefantum* fruit shell substrate seems to be very efficient and economical for removing toxic heavy metal ions, such as Co²⁺ and Cr⁶⁺ from industrial wastewater. For the preparation of the substrate raw materials employed

are widely available and inexpensive. Its metals ions binding capacity is appreciably high. Thus, it can be concluded that *Ferronia elefantum* substrate seems to offer a very cheap and useful product for the effective removal and recovery of toxic heavy metal ions from industrial wastewater by using such substrate.

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