Adsorption of chromium (VI) on chemically activated saw dust

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SUMMARY

Bioremediation of heavy metal pollution remains a major challenge in environmental biotechnology. The ability of chemically activated sawdust to remove chromium from aqueous solution was investigated. Experiments were carried out as a function of adsorbent dosage, initial concentration of chromium and contact time. The mechanism of metal sorption by chemically activated sawdust gave good fits for Langmuir, Freundlich and Lagergren models. The bioadsorption efficiency of chromium to the sawdust was decreased as the initial concentration of metal ions increased. The percentage removal was increased (79% to 97%) with an increase in contact time (20 to 100 min) at an initial Cr (VI) concentration of 20 mg/L. According to Langmuir isotherm, the monolayer saturation capacity (*Qo*) was 33.55mg/g. The study showed that chemically activated sawdust was more favourable for the adsorption of chromium (VI) from the aqueous solutions.

Key words : Sawdust, Kinetics, Adsorption, Hexavalent chromium, Low cost adsorbents

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Due to various human activities like ore mining and industrial processes, the natural biogeochemical cycles is disrupted causing increased deposition of heavy metals in terrestrial and aquatic environment. Heavy metals can be extremely toxic as they damage nerves, liver, kidney and bones and also block functional groups of vital enzymes. Release of these pollutants without proper treatment poses a significant threat to both environment and public health, as they are non biodegradable and persistent in nature. Through a process of biomagnifications, they further accumulate in food chains. (Martins *et al*., 2006). Hexavalent chromium compounds are toxic, several can even cause lung cancer. Chromium and its compounds are widely used in electroplating, leather tanning, cement, dyeing, metal processing, wood preservatives, paint and pigments, textile, steel fabrication and canning industries. These industries produce large quantities of toxic wastewater effluents (Raji and Anirudhan, 1997). The maximum concentration limit for Cr (VI) for discharge into inland surface waters is 0.1 mg/l and in potable water is 0.05mg/l. Procedures for the removal of toxic metals from contaminated environments have been developed and most of them are based on ion exchange and/or precipitation. Physico-chemical methods have several disadvantages such as unpredictable metal ion removal, high reagent requirements and formation of sludge and its disposal, in addition to high installation and operational costs (Deepa *et al*., 2006). Natural materials that are available in large quantities or certain waste from agricultural operations may have potential to be used as low cost adsorbents, as they represent unused resources, widely available and are environmentally friendly (Deans and Dixon, 1992). In the present study, saw dust, which is a milling agro-waste available in plenty in a tropical country like India, is used for the removal of Cr (VI) ions from aqueous solutions.

MATERIALS AND METHODS

Preparation of adsorbent:

Saw dust was procured from local market and was chemically activated by 50% sulphuric acid. It was washed with distilled water to remove the residual acid. Then that was dried in hot air oven and sieved.

Preparation of stock and adsorbate solution:

A stock solution of chromium (VI) was prepared by dissolving 2.8287 g of potassium dichromate (K2Cr2O7) in 1000 ml of distilled water. This solution was diluted as required to obtain standard solutions containing 5, 10, 15, 20, and 25 mg/L of chromium (VI).

Batch mode adsorption studies:

Contact time:

1g of chemically activated sawdust was added in a 50ml of various adsorbate solutions at a constant pH of 2.0 and was agitated in a horizontal bench shaker at room temperature (27±2°C). The flasks were withdrawn at