Heavy metal removal of chromium from aqueous solutions by Amygdalus Scoparia shells

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Abstract

Environmental contaminated by heavy metals caused many attentions to discharge of sewage. In recent years,several methods of treatment have been developed for treating of wastewater, reducing the volume of produced sludge and improving water quality. The adsorption is an efficient treatment method due to easy operation and high efficiency. In this study, effectiveness of Amygdalus Scoparia shell has been investigated to remove heavy metal of chromium from real wastewater of electroplating process. The results were compared with commercial activated carbon. The experimental results showed for Amygdalus Scoparia shell, maximum adsorption occurs at pH=1 and the system has reached equilibrium in 3 hours. The pollutant concentration is between 5 to 150(mg/L). The maximum removal rate of 96.1 % occurs for a concentration of 5 (mg/L). The adsorbent dose was between 5 to 40 (g/L). These tests indicate positive effect of increasing adsorbent dose and adverse effect of increasing initial concentration in removal percentage. Removal of chromium decreased severely with increasing pH. Removal rate in optimal conditions was 96.1% which was much more effective than commercial activated carbon (92.5%).The results are adapted with Langmuir and Freundlich isotherms.

Keywords: Adsorption, Chromium, Amygdalus Scoparia shell, heavy metals

1. INTRODUCTION

CHROMIUM and its compounds are toxic metals introduced into natural water from a variety of industrial wastewater. The major sources are from Textile Dyeing, Leather Tanning, Electroplating and Metal Finishing industries which cause severe environmental and public health problems. The hexavalent form of chromium is considered to be a group "A'human carcinogen because of its mutagenic and carcinogenic properties [1]. It leads to liver damage, pulmonary congestion, oedema and causes skin irritation resulting in ulcer formation [2]. Its concentration in industrial wastewater ranges from 0.5 mg/l to 270000 mg/l [3]. The tolerance limit for the discharge of Cr (VI) into inland surface water is 0.1mg/l and in potable water is 0.05 mg/l [4]. A wide range of physical and chemical processes is available for the removal of Cr (VI) from wastewater such as electro-chemical precipitation, ultra filtration, ion exchange and reverse osmosis [5, 6]. The major drawbacks with these processes are high cost, toxic sludge generation or incomplete metal removal. The commercial activated carbon produced from coal can effectively remove chromium but these are also expensive as well as non-renewable resources. Many researchers have worked on production of activated carbon from renewable resources, using low cost methods and materials and also emphasis was also on to decontaminate water in an environmental friendly manner. Agricultural and industrial waste material is used as Activated carbons used by different researchers for the removal of chromium such as coconut husk and palm pressed fibers [7], coconut shell activated carbon [8], wood and dust coal activated carbons [9], saw dust and used rubber tyre carbon [10], cactus, olive stone/ cake, wool, charcoal and pine needles [11] rice husk carbon [12], Cequisetifolia leaf carbon [13], bagasse and fly ash [14], hazelnut shell [15], husk of Bengal gram [16], sugarcane bagasse [17], rice bran [18] and rice husk [19] have been reported in the literature. Almonds (amygdalus scoparia) are one of the important stone fruit grown in Iran-Esfahan. These