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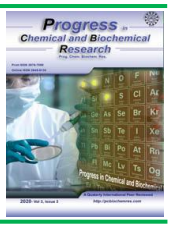

Original Research Article

Adsorption process for reducing heavy metals in Textile Industrial Effluent with low cost adsorbents

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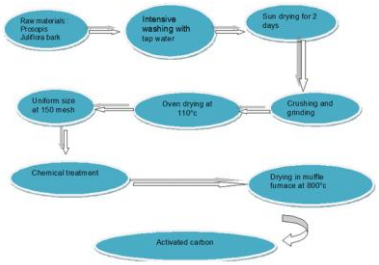
GRAPHICAL ABSTRACT



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ABSTRACT

Heavy metals such as Lead (Pb), Chromium (Cr), Cadmium (Cd) , Copper (Cu), Zinc(Zn), Arsenic(As),Iron (Fe), Mercury (Hg), Magnesium (Mg) and Sulphur (S) are widely used for production of colour pigments of textile dyes. The colossal increase in the use of heavy metals over past few decades is a no doubt a necessary consequence of increased flux of metals in aquatic environment. Removal of these metallic substances has become inevitable to maintain a balance in ecosystem. Many methods are being implemented to remove Heavy metals, among these use of activated carbon have become a very competent process. But heavy cost of the activated carbon has made Heavy metal removal as a great concern. Many researchers have been conducted to remove heavy metals using different materials. Various adsorbents have been used to remove different type of heavy metal ions from wastewater especially those are harmful to mankind. This project work has compared about the efficiency of removing heavy metals by using activated carbon from Prosopis Juliflora bark. Prosopis Juliflora tree is widely known for its extra ordinary character for absorbing water. Activated carbon was prepared from the barks of Prosopis Juliflora by thermal and chemical process. The Textile effluent was collected from Erode area where large stretch of textile industries is situated to conduct the specific experiments. Batch experiments were conducted to analyze Heavy metal elements from the effluent. The results show that this low cost and eco-friendly adsorbents can effectively used for the removal of heavy metals

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INTRODUCTION

Textile industry is one of the prime industries in the world which is the source of employment with least required special skills required. This contributes a vital part to the world economy. Textiles can be used in miscellaneous ways, like clothing, baskets, making containers, fabrication etc. At the same time textile industries are the great contributor for the pollution of environment in the world. Surveys of different part of world shows that 20 t0 30 % of fresh water is being polluted by textile industries. The water usage of textile industries is huge around a millions of gallons of water per day. This water loaded with lots of chemical is being discharged without any treatment has become a greatest threat to the environment.

Cellulose fibers, protein fibers and synthetic fibers are three basic types of fibers used in the manufacture of different textile products. Each type of fibers is dyed with different chemical dyes. Reactive dyes, direct dyes, naphtha dyes and indigo dyes are used for dying cellulose fibers. Acid dyes are used to dye protein fibers. Synthetic fibers are dyed using disperse dyes, basic dyes and direct dyes [1]. The main disadvantage of textile industries is that utilization of various chemicals and large amount of water during the production process. The water is mainly used for application of chemicals onto the fibers and final rinsing of products. The waste water produced during this process contains large amount of dyes and chemicals containing trace metals such as Cr, As, Cu and Zn which are highly capable of harming the environment and human health.

The textile waste water can cause different health hazards for human being like hemorrhage, ulcers, nausea, skin irritation and dermatitis. Heavy metals are naturally occurring metals in Earth's crust. Since our Earth's crust contain these metals, very minute amount of heavy metals leach inside the ground water. But the dominating industrialization in world has increased the heavy metals deposition in the water bodies to a greater extent is a great concern and threat for the environment. Metals such as Cadmium, Arsenic, Lead, Cadmium, Mercury, Chromium, Nickel are highly toxic even if at lower concentrations. The untreated effluent from textile industries is the great source of heavy metal deposition in soil and water, which in turn has an unimaginable adverse affect on the ecosystem. The major compartment of environment such as air, water and soil get highly contaminated with the heavy metals.

Numerous processes have been employed with varying degree of success in overcoming the dyes and heavy metals from textile effluent. Many expensive processes such as ion exchange, solvent extraction, thermal treatment, microbial reduction, and electro dialysis are done for successive removal of heavy metals and dyes from textile effluent. Adsorption is found to be efficient method in removing heavy metals from waste water [2]. Many natural adsorbents have been developed for the adsorption of heavy metals. Low cost adsorbents are derived from different agriculture waste such as coir pith [3], neem bark powder, tea waste, peanut shell etc for removing dyes from textile effluent [4, 5]. Activated carbon was prepared from prosopis Juliflora seeds with $ZnCl_2$ as the activation agent to remove acid blue 40 dyes [6].Direct brown MR dyes have been removed by using activated carbon of prosopis juliflora bark

[7]. Juliflora prosopis is abundantly found in coastal areas of Tamilnadu and can be used successfully for removing different Heavy metals from the textile effluent.

MATERIALS AND METHODS

Prosopis Juliflora Bark

In **Fig.2** Prosopis juliflora bark was collected from local area with help of local people in Chennai**.** The collected Prosopis Juliflora Bark materials were washed intensively in water to remove the peripheral dust and dirt present on them. After that they were sun dried for 2 days and then finely powdered with grinding machine in local mill. The powered materials were washed with distilled water for 4-5 times to remove all the dirt particles. The powdered Prosopis Juliflora bark was oven dried at 110°C for 10hrs to remove excess moisture. The powdered Prosopis Juliflora bark Carbon was sieved to get uniform particle size of 150 mesh. Then the powder was treated with zinc chloride for 24 hours in ratio of 5ml zinc chloride with 45 ml distilled water for 50g juliflora powder. The product was kept in a muffle furnace for about 1 hour in air tight container and the temperature was maintained at 800°C. The resulting powder was used for adsorption experiment. The process is known as pyrolysis. Pyrolysis is decomposition of product due to heat in absence of oxygen.

Textile effluent sample was tested for the initial concentration of the heavy metals present. The analysis was made using PERKIN ELMER OPTIMA 5300 DV ICP-OES to find out the concentration of Arsenic (As), Cadmium (Cd), Chromium (Cr), Coppe(Cu), Iron (Fe), Mercury(Hg), Magnesium (Mg), Lead (Pb), Sulphur (S) and Zinc (Zn) present in the effluent samples.

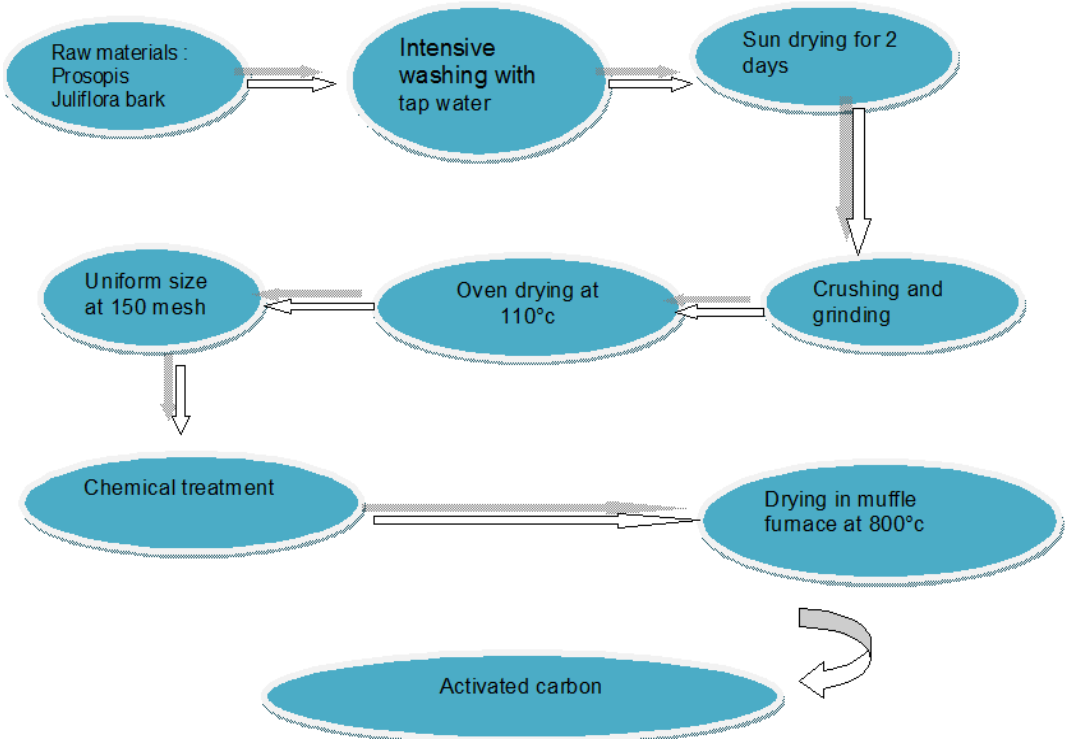

Fig. 1. Flow diagram of juliflora bark

(a)

(b)

Fig. 2. Juliflora bark before process (a) and Juliflora bark activated carbon after the process (b)

RESULT AND DISCUSSION

The effluent sample was treated with adsorbent (activated carbon) obtained from prosopis juliflora bark for 180 minutes. The adsorbent dosage that is activated carbon of Prosopis juliflora bark is mixed with the effluent sample at a ratio of 1:2 for adsorption. By scrutinizing the result, we can see that heavy metals were reduced when compare to that untreatment process of effluent. So the Arsenic (As), Chromium (Cr), Copper (Cu), Iron (Fe), Mercury (Hg), Lead (Pb), and Zinc (Zn) are reduced significantly. The obtained values are present in **Table 1**.

Table 1. Julifora activated carbon powder before and after treatment process of heavy metal residue

Heavy Metals	Before julifora activated carbon	After Julifora activate carbon
Arsenic (As)	0.020 mg/L	0.003 mg/L
Cadmium (Cd)	0.002 mg/L	0.002 mg/L
Chromium (Cr)	0.090 mg/L	0.001 mg/L
Copper (Cr)	0.078 mg/L	0.004 mg/L
Iron (Fe)	1.122 mg/L	0.032 mg/L
Mercury (Hg)	3.382 mg/L	0.415 mg/L
Manganese (Mg)	25.96 mg/L	13.46 mg/L
Lead (Pb)	0.018 mg/L	0.005 mg/L
Sulphur (S)	97.13 mg/L	64.92 mg/L
Zinc (Zn)	1.868 mg/L	0.107 mg/L

CONCLUSION

The present investigation has been carried out to study the suitability of eco-friendly indigenous adsorbent of Prosopis Juliflora bark for the removal of heavy metal such as arsenic, Cadmium, Copper, Mercury, Lead and Zinc from Textile Effluent wastewater. Among the adsorbents as Prosopis Juliflora bark carbon powder was found out showed a significant adsorption of Heavy metals and agricultural by-products are easily available and using them to treat the textile effluent, cut short the expenses of industry to treat the effluents.

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