

# Experimental Study on Heavy Metal Removal from Textile Industrial Wastewater using Banana Peel and Activated Carbon from Coconut Shell as an Adsorbent

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**Abstract**— The most important class of pollutants is the effluents (dyes) which are disposed directly to the river from the textile industries. This effluent contains several heavy metals like chromium and copper. Some of the heavy metals which are present in even smaller amount will cause a greater pollution. Disposal of the effluents into the water streams or precious water resource must be avoided. However there are various treatment methods before disposal, which will not be effective in the removal of heavy metals. Adsorption is recognized as an effective and economic method for low concentration heavy metal wastewater treatment. In the adsorption process numerous adsorbents are available. In this study, we used banana peel and activated carbon produced from coconut shell as a low cost adsorbent. A comparative study is done in order to make a comparison between the removal efficiency of chromium by these adsorbent. The dosage of adsorbents is about 10 grams, 15 grams, 20 grams which will create a situation of removing heavy metals. The adsorption process is done at the room temperature for about an hour for each adsorbent. The adsorption process is started with the initial concentration of 10 gram of each adsorbent and then gradually increased based on the removal percentage. At the end 25 gram of dosage is given beyond that which produces no change in the removal of heavy metals.

**Keywords**— Activated carbon, Adsorbent, Banana peel, Chromium, Heavy metal.

## I. INTRODUCTION

Wastewater from numerous industries such as paints and pigments, glass production, mining operations, metal plating, and battery manufacturing processes are known to contain contaminate such as heavy metal. Heavy metals such as Pb, Cd, Cr, Ni, Zn, Cu and Fe are present in industrial wastewater.

These heavy metals in wastewater are not biodegradable and their existence in receiving lakes and streams causes bioaccumulation in living organisms, which leads to several health problems in animals, plants and human beings such as

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cancer, kidney failure, metabolic acidosis, oral ulcer, renal failure and damage in for stomach of the rodent[1].

As a result of the degree of the problems caused by heavy metals pollution, removal of heavy metals from wastewater is important [2]. Investigation into new and cheap methods of metal ions removal has been on the increase lately. Recently efforts have been made to use cheap and available agricultural wastes such as coconut shell, orange peel, rice husk, peanut husk and sawdust as adsorbents [3-5] to remove heavy metals from wastewater. In this study, a comparative study is done in order to make a comparison between the removal efficiency of chromium by various adsorbent.

## II. MATERIALS

The materials which are used for adsorption process is the adsorbents. Following are the adsorbents used in this project.

- Banana peel
- Activated carbon from coconut shell.

### A. Preparation of banana peel adsorbent

Banana peels are collected and dried in the open area for 5 days. They are washed with distilled water thoroughly to remove dust particles in the surface of it. The peels are then dried in an oven at about 70°C. They are crushed into powder and are sieved in 320 micron sieve. The adsorbent prepared is thus stored in an air tight container for adsorption process. Figure 1 shows the prepared banana peel adsorbent.

### B. Preparation of activated carbon

Coconut shells are collected for making it activated carbon. They are crushed into smaller pieces. The smaller pieces of coconut shell is put into muffle furnace at 400°C Then it is made into crystals for the adsorption process.

## III. METHODS

Adsorption may be defined as the process of accumulation of any substance giving higher concentration of molecular species on the surface of another substance as compared to that in the bulk. When a solid surface is exposed to a gas or a liquid, molecules from the gas or the solution phase accumulate or concentrate at the surface. The phenomenon of concentration of molecules of a gas or liquid at a solid surface

is called adsorption. Adsorption is a well established and powerful technique for treating domestic and industrial effluents.

The basic principle of operation for carbon adsorption is the mass transfer and adsorption of a molecule from a liquid or gas into solid surface. Activated carbon is manufactured in such a way as to produce extremely porous carbon particles whose internal surface area is very large. This porous structure attracts and holds organic molecules as well as certain metal and inorganic molecules.



Fig. 1 Banana peel adsorbent

#### IV. EXPERIMENTAL SETUP

The effluent is passed through the layers of the column setup and sample is collected using the beaker at the bottom. The sample thus collected is tested for the chromium using atomic adsorption spectrometer.

#### V. RESULTS AND DISCUSSION

Initial concentration of chromium is 0.029mg/l. Table 1 shows that the usage of activated carbon adsorbent is proven to be more efficient in removing the chromium. The permissible limit of chromium prescribed by the IS codes is 0.005 mg/l and that is achieved by adding 20 grams of activated carbon.

The removal of chromium from the industrial effluent is comparatively studied by using various adsorbents separately in different dosages. The study proves that the use of the adsorbent, activated carbon is highly efficient for the removal of heavy metal chromium.

#### VI. CONCLUSION

The adsorption process summaries the comparative study on removal of heavy metal chromium from various industrial effluent using various adsorbents. There are numerous numbers of adsorbents namely rice husk, sludge, peel of citrus fruits, activated carbon, fly ash, etc., which have advantages in removing the heavy metals.

TABLE I  
FINAL CONCENTRATION

S.NO	Adsorbent Concentration (grams)	Activated carbon (mg/l)	Banana peel (mg/l)
1	10	0.022	0.012
2	15	0.015	0.009
3	20	0.010	0.003
4	25	0.010	0.003

We have selected two adsorbents for the comparative study which are Banana peel, and Activated carbon. These are the adsorbents which are available in huge quantities. Banana, coconuts are those which are abundant in Tamil Nadu.

In this study the activated carbon produced from coconut shell is highly effective in removal of heavy metal chromium. The other adsorbent banana peel can also be used in the removal of heavy metal which is also efficient. Further treatment like chemical action may improve the efficiency. Also the adsorption process is useful in treating the wastewater by achieving permissible range. The treated waste water can be thus used for gardening or can be mixed to the river.

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