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Tea Waste as a Low cost Adsorbent for the Removal of Cadmium Ions from Synthetic Waste Water

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ABSTRACT

In 2015 India facing tremendous problem for removing Heavy metal from water and is becoming more important with the increasing of industrial activities. One of the most important environmental problems is water resources pollution by Heavy metals. Tea waste is good adsorbents for the removal of heavy metals from aqueous solutions. This study explores the adsorption potential of Cd (II) by Tea waste adsorbent in aqueous solution. The influences of several main parameters such as pH value, Dose, initial metal ion concentration, and contact time in batch experiments have been studied. The adsorption was depended on pH, adsorbent dosage, and contact time. Maximum removals of Cd (II) were obtained 92%.

The experimental data shows maximum removal of cadmium ions at 5 pH, 120min contact time and 0.5 grams adsorbent is 92% respectively.

Keywords---- Tea Waste, Heavy metals, Adsorption, Cadmium ions, Synthetic Wastewaters

I. INTRODUCTION

Cadmium is a chemical element with symbol Cd and atomic number 48. This soft, bluish-white metal is chemically similar to the two other stable metals in group 12, zinc and mercury. Like zinc, it prefers oxidation state +2 in most of its compounds and like mercury it shows a low melting point compared to transition metals. Cadmium and its congeners are not always considered transition metals, in that they do not have partly filled d or f electron shells in the elemental or common oxidation states. The average concentration of cadmium in the Earth's crust is between 0.1 and 0.5 parts per million (ppm). It was discovered in 1817 simultaneously by Stromeyer and Hermann, both in Germany, as an impurity in zinc carbonate.

Cadmium occurs as a minor component in most zinc ores and therefore is a byproduct of zinc production. It was used for a long time as a pigment and for corrosion resistant plating on steel while cadmium compounds were used to stabilize plastic. The use of cadmium is generally decreasing due to its toxicity (it is specifically listed in the European Restriction of Hazardous Substances) and the replacement of nickel-cadmium batteries with nickel-metal hydride and lithium-ion batteries. One of its few new uses is in cadmium telluride solar panels. Although cadmium has no known biological function in higher organisms, a cadmium-dependent carbonic anhydrate has been found in marine diatoms.

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II. MATERIAL AND METHODS

2.1. Preparation of the Tea Waste adsorbent

Tea waste collected from Gwalior railway station and washed with boiled water until the water was colourless. This process is repeated 15 washing cycle however washing cycle can be reduced by washing with NaOH solution and then it is dried in tray dryer at 108^0c for 12h.This dried material converted into powder and screened to size 100µm.Again this powder dried at 108^0c

for 5 hours and Then dried tea waste was chemically activated with 1.0M sulphuric acid and stored in sealed polythene bags. Now adsorbent is ready to use.

2.2. Preparation of synthetic wastewater

Synthetic Waste Water was made by dissolving analytical grade Cd $(No_3)_2.4H_2o$ in distilled water so that Cadmium Concentration of this solution was 1000 mg/l.

Instrument and Apparatus used

In the whole experiment some glassware (Conical flasks, Pipette, Measuring cylinders, Beakers, burette and Test tubes etc.) are used of borosil.

2.3. Analysis of Adsorbate

The residual concentration of Cadmium ions was determined spectrophotometrically at 382nm.

III. RESULT AND DISCUSSION

The percentage of removal efficiency of Cadmium ions can be determined

Metal ion removal (%) = $[(C_0 – C_e)/C_0] *100$

Where C_0 is the initial metal ion concentration of test solution, mg/l and C_e is the final equilibrium concentration of test solution, mg/l.

In this experiment following factor effecting adsorbent is

I. Effect of contact time

II. Effect of pH

III. Effect of adsorbent dose

1. Effect of contact time

The pictorial figure 3.1 shows the variation in the percentage removal of heavy metal with contact time using 0.5g of tea waste adsorbent at 5 pH for varying concentration 100ppm to 300ppm. The percentage removal of Cadmium is increases from 30 to 120 min and sharply decreases from 120 to 180 min. It is observed that for Cadmium ion the percentage removal is nearly 92% throughout the 120 min. contact times.

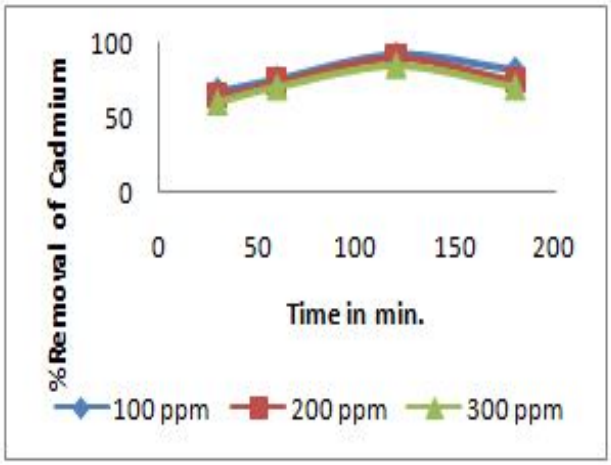

Figure 3.1: Effect of contact time of % removal of Cadmium ion by tea waste adsorbent.

2. Effect of pH

The pictorial figure 3.2 shows the variation in the percentage removal of heavy metal with pH using 0.5g of tea waste adsorbent at 120min for varying concentration 100ppm to 300ppm.The % removal of Cadmium is increases 2 to 6 pH and sharply decreases from 6 to 7 pH.It is observed that for Cadmium the percentage removal is nearly 92% at 5 pH.

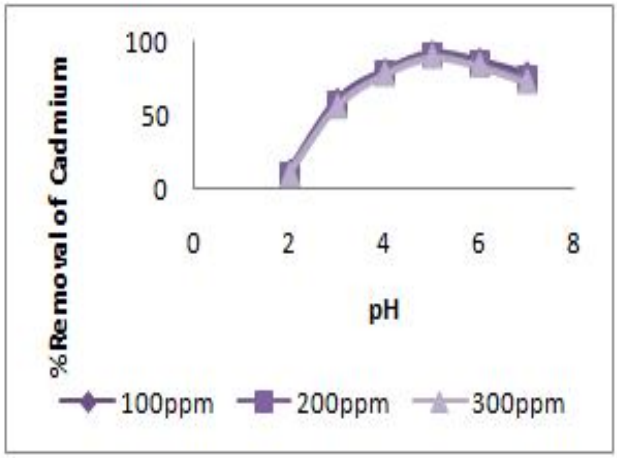

Figure 3.2: Effect of pH on % removal of Cadmium ion by tea waste adsorbent.

3. Effect of Dose:

The pictorial figure 3.3 shows the variation in the percentage removal of heavy metal with adsorbent dosage using 120min contact time at 5 pH for varying concentration 100ppm to 300ppm.the % Removal of Cadmium ions is increases from (0.2 to 0.8) gram and decreases from (0.8 to 1.0) gram. It is observed that for Cadmium the percentage removal is nearly 92% at 0.5 gram adsorbent dose.

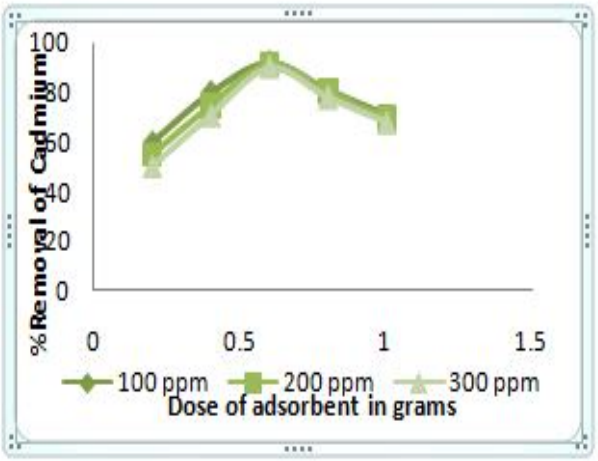

Figure 3.3: Effect of Dose on % removal of Cadmium ion by tea waste adsorbent.

IV. CONCLUSION

Experiment results showed that maximum removal of Cadmium ion by tea waste is 92%.

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