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SURFACE ASSIMILATION OF COPPER (CU^{2+}) FROM WASTE WATER USING MANGO PEEL POWDER (MPP)

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Abstract: Copper is a heavy metal and a pollutant from industries such as fungicides, pesticides, electrical appliances manufacturing industries and products containing copper. These industries discharge pollutants through water which contains copper metal. This has adverse effect on many creatures which damages kidneys, nervous system and liver. The main aim is to study the removal of copper as it is a heavy metal and a pollutant from industries. Experimentation on the adsorption of Cu^{2+} from waste water using Mango Peel Powder (MPP) was conducted to study different parameters such as contact time (20, 40, 60 minutes), concentration (0.05,0.1,0.15,0.2 ppm) and altering adsorbent (MPP) weight (1, 2 gm). Adsorption studies were made on changing three parameters contact time, concentration and weight of adsorbent. Refractive Index method is used to calculate the percentage recovery of copper for a fixed time of contact and changing concentration by maintaining equal weight of adsorbent. The same procedure was repeated changing time of contact and weight of adsorbent (Mango Peel Powder).
Keywords: adsorption, Copper (Cu^{2+}), mango peel powder, refractive index

INTRODUCTION

The heavy metal ions such as Pb(II), Cu(II), Zn(II), Hg(II), Cr(VI) and As(V) primarily come from industrial effluents in the aqueous environment. These metal ions present in water causes numerous poisonous effects on the human health and environment. The extended half-life of heavy metal ions and their non-biodegradability causes a buildup of metal ions in the living organisms, causing various diseases such as nervous system damage, poisoning, and cancer. Presence of heavy metals in the water causes various health issues such as damaging of kidneys, nervous system and liver. The elimination of heavy metals from wastewater and water is essential for environment protection and public health. The pollutants are released into water bodies through different ways. They can be released from wastewater treatment facilities, industrial effluents, refineries etc. So, it is very important to remove the excess heavy metals from water to safeguard public health and environment [1-3]. The important toxic metals i.e. Copper, Nickel, Zinc and Lead find their way to the water bodies through the waste waters. Heavy metals can accumulate in the environment elements such as food chain, and thus may pose a significant threat to human beings. Copper, in small amounts, plays a vital role as a cofactor in a variety of essential enzymes required for homeostasis, growth and development in humans. The natural concentration of Cu is about 50 ppm in soil, 4-10 μg/L in water (usually bound to organic materials) and 18-45 μg/g in the human liver (dry weight), but excessively high doses of Cu, introduced by the ingestion of food or water with excessive Cu content, may result in a variety of symptoms and illnesses [4-6]. While these primarily affect the liver, in the form of cirrhosis, they may also result in general weakness, lethargy and anorexia. Copper enters the environment primarily through chemical-related industries such as metal plating and cleaning. Consequently, it is necessary to clean wastewater by eliminating its heavy metal content by using proficient methods. There are a variety of methods existing for the elimination toxic metals from the water such as Reverse osmosis, Ion-exchange, Membrane separation and Precipitation etc. Apart from these, other cheap adsorbents have been studied, mainly by using bio-adsorbents, such as chitosan and algae. Still the experiments performed in fixed-bed offered incomplete results. Bentonite clays are extensively used as barriers to evade underground and subsoil landfill water pollution by leaching of heavy metals. Considering the easy operational conditions and simplicity, adsorption and the retention of copper ions from aqueous solutions by Mango Peel Powder (MPP) is studied in this work [7-9].

MATERIALS AND METHODS

— Preparation of Adsorbent (Mango Peel Powder)

The peels of different types of mangoes were collected and they were dried under sunlight for nearly three weeks at a temperature of 27-32°C. After drying, the adsorbent was crumbled into fine particles and finally the size of the particles obtained as 0.074 mm diameter using the sieve of 200 mesh.

— Preparation of CuSO4.5H2O Stock solution

Solutions of copper ions of different concentrations (0.05, 0.1, 0.15, 0.2 mg/lt) were prepared from a stock solution of CuSO4.5H2O.The pH was adjusted with 0.1 NaOH or H2SO4.

— Preparation of Calibration Chart

Take 4 conical flasks and wash them clean using distilled water. Add 100ml distilled water to each of the conical flask. Add 5,10,15,20 grams of $CuSO_4.5H_2O$ to each of the flask. Swirl the solutions in flasks until the solutions gets uniformity. Using Refractive Index (RI) meter find RI for each solution present in flasks. Plot graph for Weight of copper in $CuSO_4.5H_2O$ vs. RI [10-11]. This plot is considered as Calibration chart (Table 1 & Figure 1).

Table 1: Calibration chart

Vol. of water added (ml)	Wt.of CuSO4.5H2O (gm)	Wt. of Cu (gm)	R.I
100	1	0.254505	1.3651
100	2	0.509011	1.3702
100	3	0.763516	1.3785
100	4	1.018022	1.3858
100	5	1.272527	1.3898
100	10	2.5448	1.3923
100	15	3.8173	1.3989
100	20	5.0897	1.4026

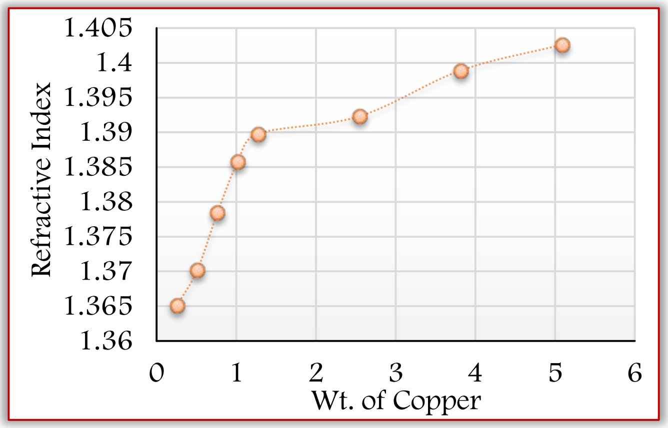

Figure 1: Calibration chart

Table 1 and Figure 1 shows the relation between Weight of copper and Refractive Index.

From Figure 1, it is clear that if concentration of copper solution increases Refractive index also increases.

— Experimental procedure

Take 4 conical flasks and add 100 ml water to each of the flask respectively. Label them as 1,2,3,4. Add 5,10,15,20 grams of $CuSO_4.5H_2O$ into each flask respectively. When the solution becomes uniform, measure the Refractive Index of solution in each flask using the Refractometer. Now add 1gm of adsorbent (Mango Peel Powder) to each of the flask and keep it in shaker for 20 minutes. After 20 minutes take out the samples and filter the solution using Whitman Filter paper (Grade 1-Particle retention 120μm). Collect the filtrate and measure Refractive Index. Repeat the same procedure for contact time 40 minutes and 60 minutes by varying adsorbent (MPP) weight i.e, 1gm and 2 gm. The experiments of copper adsorption were performed batch wise [12-13].

RESULTS AND DISCUSSIONS

— Effect of Concentration of copper sulphate solution on % Removal for 1 gram MPP

Table 2 and Figure 2 describes the variation in the percentage removal of copper (II) for 1 gram of adsorbent, MPP with various concentrations. For the contact time of 20 minutes, maximum percentage removal is obtained at 0.15 ppm (63.62%) and minimum removal at 0.2 ppm (18.91%). For 40 minutes contact time, maximum percentage removal is obtained at 0.15 ppm (65.33%) and minimum removal at 0.2 ppm (30.3%).

For 60 minutes contact time, maximum percentage removal is obtained at 0.1ppm (76.89%) and minimum removal at 0.05 ppm (61.65%). Therefore for an adsorbent dosage of 1 gram, maximum removal of copper can be obtained at 60 minutes, which shows that more the contact time; more will be the adsorption capacity.

Table 2: Concentration vs. % Removal for 1 gram MPP

S.No	Concentration	% Removal at 20 mins	% Removal at 40 mins	% Removal at 60 mins
1	0.05	38.1	58.1	61.65
2	0.1	60.2	63.1	77
3	0.15	63.62	65.33	76.89
4	0.2	18.91	30.3	75

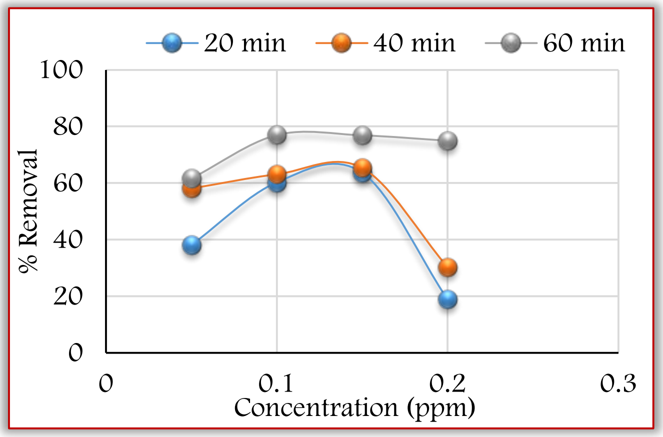

Figure 2: Concentration vs % removal plot for 1 gm MPP

— Effect of Concentration of copper sulphate solution on % Removal for 2 gram MPP.

Table 3 and Figure 3 describes the variation in the percentage removal of copper (II) for 2 gm of adsorbent, MPP with various concentrations. For 20 minutes contact time, maximum percentage removal is obtained at 0.1 ppm (50.99%) and minimum removal at 0.05 ppm (24.27 %).

For 40 minutes contact time, maximum percentage removal is obtained at 0.15 ppm (74.42%) and minimum removal at 0.2 ppm (58.65 %). For 60 minutes contact time, maximum percentage removal is obtained at 0.05 ppm (78.87%) and minimum removal at 0.2 ppm (71 %). Therefore for an adsorbent dosage of 2 gram, maximum removal of copper can be obtained at 40 minutes.

Table 3: Concentration vs. % Removal for 2 gram MPP

S.No	Concentration	% Removal at 20 mins	% Removal at 40 mins	% Removal at 60 mins
1	0.05	24.27	58.65	78.87
2	0.1	50.99	68	70
3	0.15	28	74.42	75
4	0.2	31	46	71

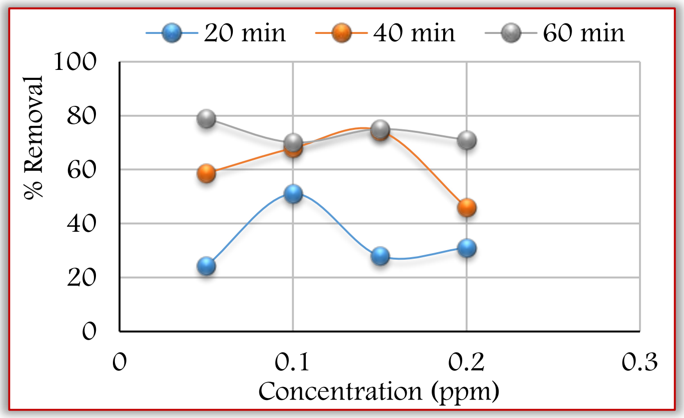

Figure3: Concentration vs % removal plot for 2 gm MPP

CONCLUSIONS

The study shows that adsorption can be used as an efficient method for removal of pollutants from water and thus decontaminating it. However, this process is restricted due to the high cost of the traditional adsorbents like activated carbon.

This study concludes that the removal of heavy metals from water is very important to safeguard society and environment from dangers. This study explored the potential of low cost adsorbent for its ability to adsorb Copper (II). Removal of copper (II) has been studied using surface assimilation process with Mango Peel Powder.

Study can be concluded based on two important factors those are based upon availability of adsorbent (MPP) and time available. If time is considered then the best result can be obtained at a contact time of 40 minutes and concentration of 0.15 ppm for 2 gm of MPP whereas when the availability of adsorbent is considered then the best result can be obtained at contact time of 60 minutes for 1 gm of MPP at concentration of 0.1ppm.

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