Removal of Heavy Metals from Industrial Effluents by Natural Adsorption on Azadirachta Indica Activated Carbon

N. Yuvaraja[1]
[1] Department of Civil Engineering,
M.A.M. College of Engineering,
Assistant Professor Tiruchirappalli- 621 105, India.

T. Sathya[2]
[2] Department of Civil Engineering,
M.A.M. College of engineering, P.G Student,
Tiruchirappalli- 621 105, India.

***Abstract*:- With the beginning of industrialization, humanity has seen different ecological issues in the general public. Effluents from an extensive number of ventures viz., electroplating, cowhide, tannery and so forth. They contain a huge measure of substantial metals in their wastewater. The customary treatment of overwhelming metal tainting incorporates concoction precipitation, compound oxidation, particle trade, a film division and so forth. These techniques are expensive, vitality concentrated and regularly connected with an age of lethal results. In the present examination different ease adsorbent has been audited as a reduction of substantial metal contamination from wastewater. This adsorbent incorporates materials of a regular cause like zeolites, mud, peat greenery and chitin are observed to be a compelling operator for the expulsion of dangerous overwhelming metals like Pb, Cd, Zn, Cu, Ni, Hg, Cr and so forth. Aside from these different rural squanders like rice husk, neem bark, dark gram, squander tea; Turkish espresso, walnut shell and so forth were additionally settled as an intense adsorbent for overwhelming metal expulsion. Effects like fly fiery remains, impact heater slime, squander slurry, lignin, iron hydroxide, and red mud, husks, tea manufacturing plant squander, sugar beet mash, battery industry squander, ocean knob buildup and grape stalk squanders have been investigated for their specialized attainability to expel lethal overwhelming metals from sullied water.**

Keywords:* *Agricultural waste; Heavy metal; Low-cost adsorbent; Wastewater; Toxicity

1. INTRODUCTION

Modern utilized water is one of the significant wellsprings of sea-going contamination. Among the oceanic contaminations, substantial metals have picked up generally more hugeness in perspective on their determination, biomagnification, and toxicity. Overwhelming metal defilement exists in watery squanders of numerous businesses, for example, metal plating, mining tasks, tanneries, radiator producing, purifying, composite ventures and capacity batteries fabricate (Kadirvelu, 1998). Treatment forms for metal expulsion from wastewaters incorporate precipitation, layer Filtration, particle trade, adsorption and precipitation/adsorption. Practical elective advancements or adsorbents for the treatment of metal-containing wastewaters are required. Common materials that are accessible in substantial amounts, or certain waste items from agrarian activities, may have potential as economical adsorbents. Because of their minimal effort, after these materials have been used, they can be discarded without recovery. For the most part, adsorbents can be accepted as ease on the off chance that they require small handling, are plentiful in nature, or are a result or waste material from another industry (Bailey et al., 1998). Reports have shown up on the readiness of actuated carbons got from rice husk (Srinivasan et al., 1988), coconut shell carbon (Arulanantham et al., 1989) coconut tree sawdust carbon (Kadirvelu et al., 2000) and a few sorts of enacted carbon from farming side-effects (Marshall et al., 1993). As a banana strip, orange strip and fish scales were appeared to expel substantial metals from manufactured arrangements the point of this examination was to research the possibility of utilizing Azadirachta indica carbon for the expulsion of overwhelming metals from mechanical effluents by fluctuating parameters of adsorbent measurement and carbon focus.

This paper reports the potential of banana and orange peels as adsorbents for the removal of Cu, Zn, Co, Ni, and Pb from the water. The buildups of banana and orange strips can be handled and changed over to be adsorbents since they have huge surface territories, high swelling limits, superb mechanical qualities, and are advantageous to utilize and have incredible potential to adsorb harmful contaminants.

2. MATERIALS AND METHODS

2.1 SAMPLING TECHNIQUES

The wastewater samples were collected from near SIPCOT industrial complex. Samples were collected in 1 L polyethylene bottles which were previously cleaned. Each bottle was rinsed with distilled water to avoid any possible contamination. The procedures were followed by standard books and manuals.

The water samples were centrifuged and refrigerated at 4° C until used for analysis. Finally, the sample wastewater to be tested and measure the level contaminants.

Physical parameter	Sample Test
Total dissolved solids (mg/l)	1210
BOD (mg/l)	520
COD (mg/l)	685
Chloride (mg/l)	353
Sulphate (mg/l)	712
Nitrate (mg/l)	150
Fluoride (mg/l)	15.16
Zinc (mg/l)	95
Copper (mg/l)	41
Iron (mg/l)	25
Cobalt (mg/l)	20
Manganese (mg/l)	50
Chromium (mg/l)	154
Lead (mg/l)	42
Cadmium (mg/l)	54
Mercury (mg/l)	26

2.2 NATURAL ADSORBENTS

There are many natural adsorbents used which are easily available and do not cause any harmful effects to the environment. Some of them are clay, orange peels, fish scales, waste tea, grapes, walnut shell, peanut hell pellets, rice husk etc., Banana and orange peels are abundantly available in India. They are very cheap. And even it can be easily combined with each other and their combination has best results when compared to individual performance as adsorbents.

Fish scales which are generated as waste can be used effectively by using it as a bio adsorbent. It has the ability to adsorb heavy metal ions such as chromium, copper, zinc etc., a fish scale can also be combined with other natural adsorbents effectively. All the natural adsorbents used here are biodegradable in nature.

2.3 MATERIALS COLLECTION

The various adsorbent materials collected from the local market. These waste fruit peels are available near fruit shop and fish scales are collected from the fish market. Banana and orange peels were cut into little pieces, dried, squashed, and washed completely with two-fold refined water to evacuate the following earth. They were at last dried in an air broiler at 100°C for 24 hr. After drying, the adsorbents were sieved. The particle sizes were 1 to 5 mm. Banana and orange peels were soaked into it. They were separated and flushed with refined water until the filtrate was close impartial. The fish waste can be collected and cleaned, finally, separate out fish scales be a knife. The Azadirachta indica bark collected from the neem tree and remove the waste part. It may use for making activated carbon.

2.4 PREPARATION OF ADSORBENTS

Banana peel and orange peel were collected from local fruit fields in the northern part of Pakistan and were washed in distilled water and it is then filtered and dried in shade for sunlight. The material is then heated in an oven at 800C for 24 hours. Finally, we prepared natural adsorbent as brown in color. Fish wastes were collected and then it was washed and cleaned gets fish scales and dried in sunlight and heated in an oven at 700C till the scales become crispy.

2.5 PREPARATION OF ACTIVATED CARBON

The neem tree, outer portion used for activated carbon by carbonization. The neem bark should be kept sunlight 2days. Thoroughly, dried and waste things to be removed. Then is standing by burning under 600-800 C for 1-2 hrs.

Later, a few hours it may separate the carbon portion and be sieved in 5-10 mm pore size. The differ layer to be laid over the activated carbon and proper setup to be down.

2.6 TREATMENT METHOD

The treatment of wastewater by aeration, adsorption technique and filter activated carbon. First, the wastewater should be passed through screening, oil removal by the aeration process for 1 hr. The aerated water was transferred into an adsorption technique. The banana peel, orange peel, and fish scales were to be measured for equal proportion and weighted. The adsorbent was thoroughly mixed to adsorbate for 2 hrs. After some time the treated water to be kept remains constant for 1/2 hr. Finally, the treated wastewater flow into granular activated carbon setup as it for normal filtration technique and it may remove 82-86% of contaminants.

3. RESULT

3.1 CHARACTERISTICS OF THE ADSORBENT

The carbon percentages of the banana and the orange peels were 39.33, 35.21 and hydrogen percentage of fish scale are 40.63, respectively. A generally bigger level of hydrogen in contrast with nitrogen mixes shows that carbon-hydrogen gatherings may be accessible for adsorption. The relatively high percentage of carbon shows that a very high percentage of protein might be present in the peels. This is worthwhile over protein-rich adsorbents since proteinous materials are probably going to fester under sodden conditions.

3.2.1 EFFECT OF pH

The amount of metal adsorption increases with pH which is typical of metal adsorption by banana and orange peels. Metal adsorption depends on the nature of the adsorbent surface and species solution. At lower pH, H+ contends with metals for the trade locales in the framework along these lines in part discharging the last mentioned. The substantial metals are totally discharged under conditions of outrageous acidic conditions. The measure of adsorption is a base at pH 2 and increments as pH increments. The most extreme adsorption happens at pH 6–8 for banana, fish scales, and orange peels But adsorption decreases when pH increases further. The base adsorption at low pH (< 2) might be because of the higher fixation and high versatility of H+. The H+ particles are specially adsorbed over metal particles. Arrangement pH would influence both fluid science and surface restricting locales of the banana and orange strips. The measure of adsorption increments with expanding pH up to the point (> 8) where the metals hasten.

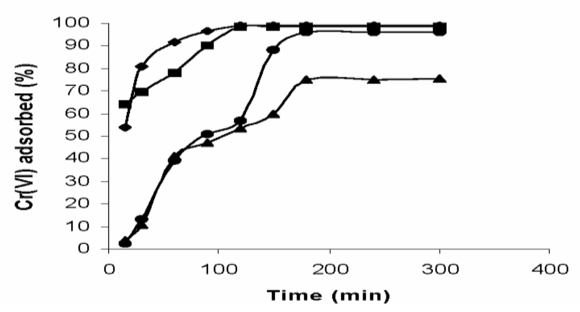
3.2.2 EFFECT OF AGITATION TIME AND INITIAL CONCENTRATION

The effect of agitation time on various concentrations of solutions (0.5 to 1.25 mg/l) is presented. The removal rate was rapid during the first 10 min of agitation. Then the rate slowed down gradually until it attained an equilibrium beyond which there was no significant increase in the rate of removal. Adsorption equilibrium was obtained at 45, 50, 40, 45 and 45 min for the metals concentrations of 25, 50, 75, 100 and 125 mg/l respectively. Data indicated that the maximum percentage adsorption was 85.61%, 83.35%, 71.97%, 64.13% and 54.32% respectively, for the initial metal concentrations of 0.95, 0.40, 0.94, 0.54 and 0.34 mg/l. Effect of agitation time and initial concentration (10 mg/l; 20 ppm; 50 mg/l; 100 mg/l) on removal (adsorbent dose: 1 g/100 ml; pH 2.0).

3.2.3 EFFECT OF ADSORBENT DOSAGE

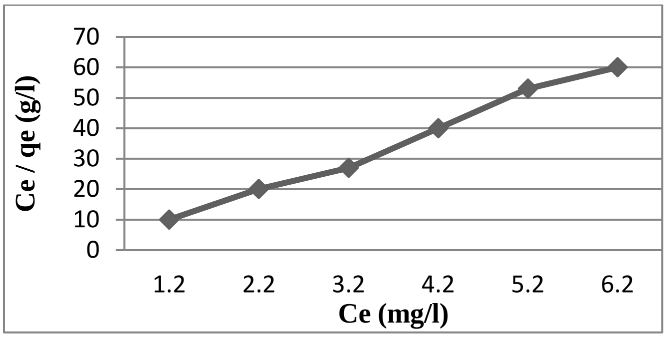
Increasing adsorbent concentration increased the percent removal. For the complete removal of Cr from 0.94 mg/l, a dosage of 350 mg was required. The availability of more surface functional groups and surface area at increasing dosage is directly proportional to Cr adsorption (Kadirvelu et al., 2000). Kinetic study In order to find out the potential rate-controlling steps involved in the process of adsorption of Cr onto CTD, both pseudo-first-order and pseudo-second-order kinetic models were used to fit the experimental data at various concentrations. The pseudo-first-order rate expression of the Logarithm model is generally expressed as follows Eq (1).

dq /dt = k1, ad (qeq – q) ------------>1



However, the experimental data, the value of qeq (equilibrium adsorption density). The rate constants k1 ad and theoretical values of qeq calculated from the slope and intercept of the linear plots along with the corresponding correlation coefficients. The pseudo-second-order kinetic rate equation is expressed as Eq (2).

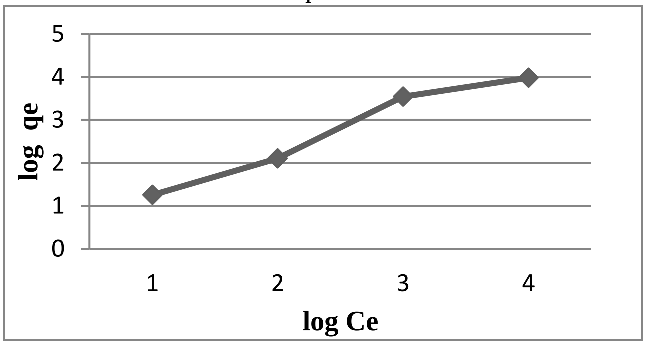
dq /dt = k2, ad (qeq – q)------------->2



3.3 ADSORPTION ISOTHERMS

A liquid phase adsorption isotherm is the plot of the amount of adsorbate adsorbed per unit weight of carbon against the concentration of adsorbate remaining in solution. It shows the distribution of adsorbate between the adsorbed phase and the solution phase at equilibrium. Generally, straight line plots are obtained by making use of the Freundlich empirical equation, which relates the amount of adsorbate in the solution phase to that in the adsorbed phase by the expression

X/M = K Ceq1/n------------>3



The Freundlich equation is used to calculate the amount of activated carbon required to reduce any initial concentration (Co) to a predetermined final concentration (Ceq). Substituting these values in the place of X in the equation (3). The Freundlich isotherm was applied to the present study to estimate the adsorption capacity of variable adsorbents. It is valid for monolayer adsorption onto a surface containing a finite number of identical sites. The linear plots of Ceq/q vs Ceq for Cr show that adsorption follows the adsorption model. log Ce and log qe were determined from the slope and the intercept of the plot to be 44.95 mg/g and 0.01 l/mg, respectively.

4. CONCLUSION

This work examined the adsorption of metals (Cr, Zn, Co, Ni, Cu) from synthetic solutions using water-treated banana and orange peels. The adsorption capacity was found to be 7.97 (Cr), 6.88 (Ni), 5.80 (Zn), 4.75 (Cu), and 2.55 mg/g (Co) using banana peel; and was 7.75 (Cr), 6.01 (Ni), 5.25 (Zn), 3.65 (Cu), and 1.82 mg/g (Co) using orange peel and fish scales. Favorable adsorption was achieved at high pH, with its maximum level of Cr reaching about 7.97 (banana) and 7.75 mg/g (orange and fish scale). The banana, fish scale, and orange peels appeared to be useful in the removal of trace metals from synthetic solutions.

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