ISSN 2348-0831

Removal of copper from aqueous solution using Syzygium Cumini L

K.R.Ghadge
Assistant Professor, Department of Civil Engineering, Sanmati College of Engineering, Washim, Maharashtra

1. INTRODUCTION

Copper is a toxic metal. It causes a disease named Wilson's disease. It causes harmful biochemical effects, toxicity and hazards in flora, fauna and human beings. Intake of copper through air, water, and food beyond its permissible limits causes disease. Copper toxicity leads to serve mucosal irritation, corrosion, widespread capillary damage hepatic and renal damage, central nervous system irritation followed by depression. Over the last few decades, several methods have been devised for the treatment and removal of heavy metals. The commonly used procedures for removing metal ions from aqueous streams include chemical precipitation, Chemical reduction, Xanthate process, Cementation, Solvent Extraction, Electro deposition, Reverse osmosis, Electro dialysis, Ion exchange, Donna dialysis may require working with corrosive chemicals, increase the volume of waste sludge, used a trial and error approach, high cost of electrodes has inspired researchers to investigate effective treatment process called Adsorption and to find suitable low cost adsorbents. The objective of this study to evaluate the feasibility of using the Syzygium Cumini L seed powder for the removal of copper, optimize of the different operating parameters such as pH, adsorbent dose, contact time and initial copper concentration , to find the equilibrium values, in order to get maximum removal efficiency study the comparison of Adsorption capacity of locally available adsorbent.

2. LITERATURE REVIEW

Y. Zhang , Alka Shukla , Shyam S. Shukla , Bin Yu Kenneth L. Dorris have studied the locally available sawdust, a byproduct of the world industry found to be a low cost and promising adsorbent for the removal of copper(II) from wastewater. In this work, adsorption of copper on sawdust has been studied by using batch techniques. The equilibrium adsorption level was determined to be a function of the solution pH, contact time, and sorbate concentration. The equilibrium adsorption capacity of sawdust for copper was obtained by using linear Freundlich and Langmuir isotherms.

A.Aklil, M.Moutlin, S.Sebti, have examined calcined phosphate as a new product for the removal of heavy metals from aqueous solution. Removal of lead, copper, zinc on the calcined phosphate was investigated in batch experiments. The kinetic of lead on calcined phosphate adsorption efficiency and adsorption process were evaluated and analyzed using the theories of Langmuir and freundlich. The influence of pH was studied. The adsorption capacity obtained at pH 5 was 85.6, 29.8, and 20.6mg/g for the formation of solid solution type fluoropaptiite for copper.

Ackmez Mudhoo, Vinod Garg, Shoabin Wang have examined that bio-sorption as a novel and green bioremediation technique for heavy metal pollutants from contaminated natural waters and wastewaters.

3.0 METHODOLOGY

3.1 Preparation of adsorbent

Syzygium Cumini L is an evergreen tropical tree in the flowering plant family Myrtacae, native to India and Indonesia. Seeds were locally collected from Syzygium Cumini L tree located in Nasik. Flesh of the fruit was removed .The seeds were separated from the Syzygium Cumini L fruits by eating and seed was washed with the distilled water. The seeds were dried in shade and stored at 25^0C. The dried seed was ground and screened to uniform powder by using 150 microns sieve. Thus Syzygium Cumini L seed powder is stored in an air tight container for further

3.2 Data modeling

The efficiency and copper adsorption capacity from the residual copper concentration was calculated

by the following equations.

The percent removal efficiency of the copper was calculated as follow,

$$\% \text{ Removal} = \quad x100 \qquad (1)$$

Where, Ci is the initial copper concentration (mg.L-1), Ce is the equilibrium concentration of copper solution (mg.L- 1)
usage.

$$\text{Adsorption capacity (qe)} = F^{(13)} \qquad (2)$$

3.3 Reagents andequipment's

Prepare a series of standard metal solutions in the optimum concentration range by appropriate dilution of the following stock metal solutions with water containing 1.5ml conc. (HNO3)/l. Thoroughly, dry reagents before use. In general use reagents of the highest purity.

Copper Dissolve 1.00g copper metal in 15ml of 1+1 HNO3 and dilute to 1000ml with water;

1.00ml = 1.000mg Cu.

Air, cleaned and dried through a suitable filter to remove oil, water and other foreign substances ,use metal free water for preparing all reagents and calibration standards and as dilution water. Acetylene standard commercial grade acetone.

3.4 Batch Adsorptionstudy

The batch study was performed to determine the optimum condition and to study the effect of pH, adsorbent dose, contact time and initial copper concentration on the test solution.

Where, Ci is the initial copper concentration (mg.L-1), Ce is the equilibrium concentration of copper solution (mg.L- 1), V is the volume of solution used in the batch (lit.), m is mass of adsorbent (g), qe is adsorption capacity (mg of copper removed/ g of adsorbent).

4.0 RESULTS AND DISCUSSIONS

4.1 Effect of Adsorbent dose on percentage copper removal.

One of the important parameter, because it determines the capacity of an adsorbent for a given initial concentration of the adsorbate. More specifically, the increase rate of this parameter was high for higher adsorbent doses, due to the greater availability of active sites on the surface of the materials, and low for lower adsorbent doses, due to the progressive saturation of these active sites. In addition, it could also be noticed that the majority of the tested materials, steady state was reached for an adsorbent dose value 0.1g/l Therefore, the optimum adsorbent dose of 0.1 g/L was selected in all the subsequent experiment.

4.2 Effect of Initial metal concentration on percentage copper removal.

The mechanism of metal adsorption from an aqueous solution is particularly dependent on the initial metal concentration in the solution. According to the results increasing the initial Cu(II) concentration caused an increase in the amount of Cu(II) adsorbed per adsorbent mass unit. This was due to the increase in the driving force for mass transfer, which is the concentration gradient. These findings agree with previous studies (Aydin et al., 2008; El-Ashtoukhy et al., 2008; Zheng et al., 2008).

5.0 EFFECT OF PH ON PERCENTAGE COPPER REMOVAL

The pH of an aqueous solution is one of the most important controlling parameters in the heavy metal adsorption process. It affects the surface charge of the adsorbent and the degree of ionization and speciation of the heavy metal in the solution. This study was carried out in a pH range 2-11 since copper starts to precipitate above pH 7. The optimum Cu (II) uptake of 97.16%, by Syzygium Cumini L respectively, was observed at pH 7.

6.0 EFFECT OF CONTACT TIME ON PERCENTAGE COPPER REMOVAL

By increasing contact time, an increase in both the amount of Cu(II)adsorbed per adsorbent mass unit and the Cu(II) removal was obtained. In most cases, the quick initial rate of adsorption during the first few

minutes of contact was followed by a slower one, until equilibrium state was reached.

This was due to the existence of abundant vacant active Syzygium Cumini L sites, whereas as adsorption continued a progressive saturation of these active sites with time occurred. In addition, the required time to reach equilibrium was about 6 h, since an increase of contact time to 24h did not have any significant effects.

5.0 CONCLUSIONS

In this paper the operational parameters such as pH, adsorbent dose, contact time and initial copper concentration were found to have predominant effect on the adsorption efficiency of Syzygium Cumini L seed powder. The uptake of copper ions is possible between pH of 2.0 and 10; however pH of 7.0 gives maximum copper removal for Syzygium Cumini L seed powder.

The removal efficiency at pH=7 is about 97.16% whereas at pH=6 it is 78.36%. Which are also encouraging and might be improved by optimizing the operating parameters at the pH=7.

The percentage of copper removal was found to be a function of adsorbent dose and contact time at a given initial solute concentration In case of effect of adsorbent dose, equilibrium dosage of 0.1g was found for Syzygium Cumini L seed powder after that there is no any significant change on copper removal efficiency with increase in dose. While the maximum efficiency was found to be 99.84%.

The increase in copper concentration from 5 to 30mg/L the percentage of copper removal was decreased from 99.54- 90.14% and curve gradually attains equilibrium after 720 min for Syzygium Cumini L seed powder. As there was no significant increase in percentage of copper removal after 360 min so equilibrium time of 360 min was chosen for Syzygium Cumini L seed powder.

7.0 REFERENCES

[01] M.Sarioglu, U.Attay, Y.Cebeci ―Removal of copper from aqueous solutions by phosphate rock‖ Desalination 181(2005) 303-311.

[02] El-Ashtoukhya, N.K. Amina, O. Abdelwahab ―Removal of lead (II) and copper (II) from aqueous solution using pomegranate peel as a new adsorbent‖ Desalination 223 (2008) 162–173.

[03] Hayrunnisa Nadaroglu , Ekrem Kalkan , Nazan Demir ― Removal of copper from aqueous solution using red mud‖ Desalination 251 (2010) 90–95.

[04] Ping Xin Sheng, Yen-Peng Ting, J. Paul Chen, and Liang Hong ―Sorption of lead, copper, cadmium, zinc, and nickel by marine algal biomass: characterization of biosorptive capacity and investigation of mechanisms‖ Journal of Colloid and Interface Science 275 (2004) 131– 141.

[05] Xue-song Wang , Yong Qin ―Equilibrium sorption isotherms for of Cu2+ on rice bran‖ Process Biochemistry 40 (2005) 677–680.

[06] Frantseska-Maria Pellera , Apostolos Giannis, Dimitrios Kalderis , Kalliopi Anastasiadou Rainer Stegmann , Jing- Yuan Wang , Evangelos Gidarakos ―Adsorption of Cu(II) ions from aqueous solutions on biochars prepared from agricultural by-products‖ Journal of Environmental Management 96 (2012) 35-42.

[07] SM Lee, Allen P. Davis ―Removal Cu(II) and Cd(II) From Aqueous Solution by seafood Processing waste sludge‖ Water Resources 35(2) 2001 534-540.

[08] Nathalie Chiron, Richard Guilet, Eric Deydier ―Adsorption of Cu(II) and Pb(II) onto a grafted silica: isotherms and kinetic models‖ Water Research 37 (2003) 3079–3086.

[09] Moon-Sun Kim, Kyo-Min Hong, Jaygwan G. Chung ―Removal of Cu(II) from aqueous solutions by adsorption process with anatase-type titanium dioxide Water Research 37 (2003) 3524–3529.

[10] Frantseska-Maria Pellera , Apostolos Giannis, Dimitrios Kalderis , Kalliopi Anastasiadou Rainer Stegmann , Jing- Yuan Wang , Evangelos Gidarakos ―Adsorption of Cu(II) ions from aqueous solutions on biochars prepared from agricultural by-products‖Journal of Environmental Management 96 (2012) 35-42.

[11] Bin Yu , Y. Zhang , Alka Shukla , Shyam S. Shukla , Kenneth L. Dorris ―The removal of heavy metal from aqueous solutions by sawdust adsorption—Removal of copper‖ Journal of Hazardous Materials B80 (2000) 33– 42.