INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACY AND CHEMISTRY

Available online at www.ijrpc.com

Research Article

REMOVAL OF COPPER (II) ION FROM AQUEOUS SOLUTION USING EIHHORNEA CRASSIPIES: CHARACTERISTIC AND MORPHOLOGY STUDY

C. Pragathiswaran[1*], S. Sibi[2] and P. Sivanesan[3]

[1]Department of Chemistry, Periyar. E.V.R.College, Trichy-23, Tamil Nadu, India.
[2]Department of Chemistry, Adhiyamann College of Engineering, Hosur-635 109, Tamil Nadu, India.
[3]Tamilnadu newsprint and papers limited, Kagithapuram, Karur-639 136, Tamil Nadu, India.

ABSTRACT

In this research, adsorption of Copper (II) ions on Eihhornea Crassipies leaf has been studied through using batch adsorption techniques. The main objectives of this study are to 1) investigate the Copper adsorption from aqueous solution by Eihhornea Crassipies leaf, and 2) determine the appropriate adsorption isotherm of Copper (II) on Eihhornea Crassipies leaf. The obtained results showed that the adsorption of Copper (II) by Eihhornea Crassipies leaf follows Langmuir isotherm equation with a correlation coefficient equal to 0.996. The results indicate that Eihhornea Crassipies leaf can be employed as a low cost alternative to commercial adsorbents in the removal of Copper (II) from water and waste water.

INTRODUCTION

The presence of toxic heavy metals in industrial effluents has become a matter of environmental concern.Mining, tannery, jewelry, chemical, metallurgical, electrical and electronics large scale industries in industrial nations, and also arts crafts in developing industries are the main source for metal containing waste pollution. Heavy metals removal from aqueous solution has been commonly carried out by several process, chemical precipitation, solvent extraction, ion exchange, reverse osmosis for adsorption. There is growing attention to the health risks on humans and animals due to existence of heavy metals in the environment. In contrast, the adsorption technique is one of the preferred methods for removal of heavy metals because of its efficiency and low cost[1].The adsorption, with the selection of suitable adsorbents, can be an effective technique for the removal of heavy metals from waste water[2].Some of the suggested adsorbents are moss peat[3], fly ash[4,5],activated carbon[6-8],zeolite.

MATERIAL AND METHODS

Preparation of adsorbent

The Eihhornea Crassipies leaf was ground and particle sizes between 75 and 300 microns were obtained by passing the milled material through standard steel sieves. Then, they used for experiments without washing or any other physical or chemical treatments.

Batch sorption experiments

The sorption studies were carried out at 30 ±1°C. Solution pH was adjusted with H_2SO_4 or NaOH. A known amount of adsorbent was added to samples and was agitated by jar test at 250 rpm agitation speed, allowing sufficient time for adsorption equilibrium. Then, the mixtures were filtered through filter paper, and the Copper (II) ions concentrations were determined in the filtrate using DR/4000U spectrophotometer. The Copper removal (%) at any instant of time was determined by the following equation

$$\text{Copper removal (‰)} = C_o - C_t / Co \times 100$$

Where, Co and Ct are the concentration of Copper at initial condition and at any instant of time, respectively.

Adsorption isotherms

The Langmuir adsorption model is based on the assumption that maximum adsorption corresponds to saturated monolayer of solute molecules on the adsorbent surface .The linear form of the Langmuir equation can be described by

C_e/q_e = ($1/Q_o b$) + (1/Qo) C_e where C_e (mg/L) is the equilibrium concentration of the adsorbate, qe (mg/g) is the amount of adsorbate per unit mass of adsorbent, Q_O and b are Langmuir constants related to adsorption capacity and rate of adsorption respectively. The

linear plot of specific adsorption (C_e/q_e) against the equilibrium concentration (C_e). (Fig 1) shows that the adsorption obeys the Langmuir model. The Langmuir constants Q_o and b were determined from the slope and intercept of the plot are presented in table.1 The R^2 values (0.987) suggest that the Langmuir isotherm provides a good fit to the isotherm data.

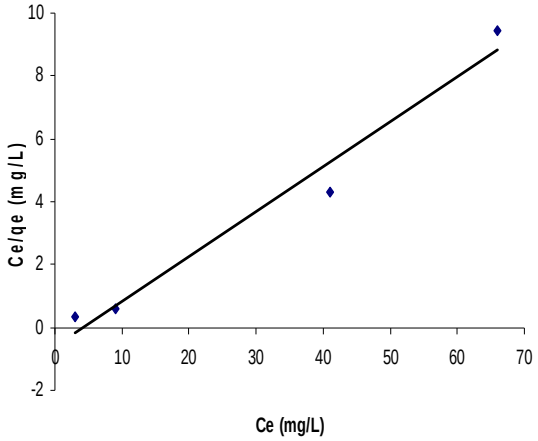

Fig. 1: Langmuir isotherm for Copper (II) sorption onto Eihhornea Crassipies

Table 1

Langmuir isotherm constants and correlation coefficients for adsorption of chromium (VI) on to Eihhornea Crassipies adsorbent

Langmuir isotherm

Qb = 0.10

b = -0.80

R^2 = 0.996

The essential characteristics of the Langmuir isotherm can be expressed in terms of a dimensionless constant separation factor L = 1/ $1+bC_o$ where C_O (mg/L) is the highest initial concentration of adsorbent and b (L/mg) is Langmuir constant. The parameter R_{L+} indicates the nature of shape of the isotherm accordingly

$R_L > 1$ unfavourable adsorption

$0<R_L< 1$ Favourable adsorption

$R_{L=0}$ Irreversible adsorption

$R_L = 1$ linear adsorption

The value of R_L in the present investigation has been found to be 0.9477 at 30 ^{o} C showing that the adsorption of Copper (II) on Eihhornea Crassipies is favourable at temperature studied. From Table 1 it was observed that the equilibrium sorption data were very best represented by the Langmuir isotherm. The best fit isotherm expression confirm the monolayer coverage process of Copper (II) onto Eihhornea Crassipies.

SEM/EDX analysis

In order to confirm the adsorption of metal ions on Eihhornea Crassipies and gain more information concerning the alteration of the surface morphology after adsorption of Cu (II), a microscopic SEM/EDX technique was applied. The SEM micrographs of original and Cu –adsorpebed Eihhornea Crassipies were shown in Figs 2(a,b,). As seen in fig 2(a), the surface of the adsorbent shows a continuous and compact structure. Coverage of the surface of the adsorbent due to adsorption of metal ions, presumably leading to formation of a monolayer of the metal ion over the adsorbent surface is evident from the formation of layer. The EDX data of the Eihhornea Crassipies (Figs 2c and d) confirmed the presence of metal adsorption on the Eihhornea Crassipies mass, giving a direction of metals on adsorbent .

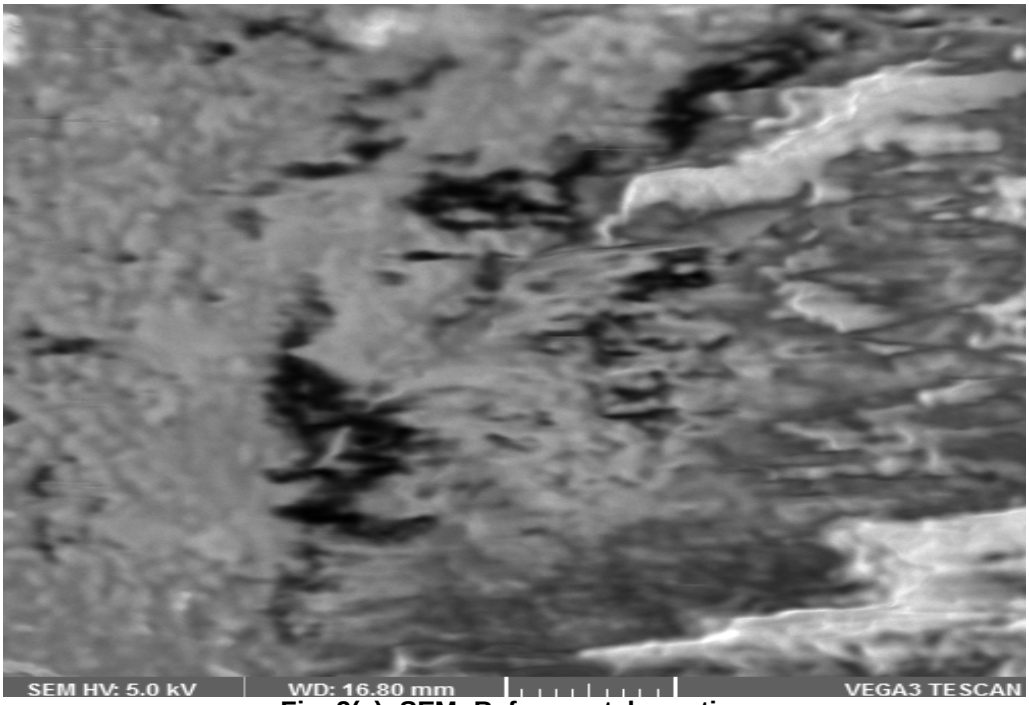

Fig. 2(a): SEM- Before metal sorption

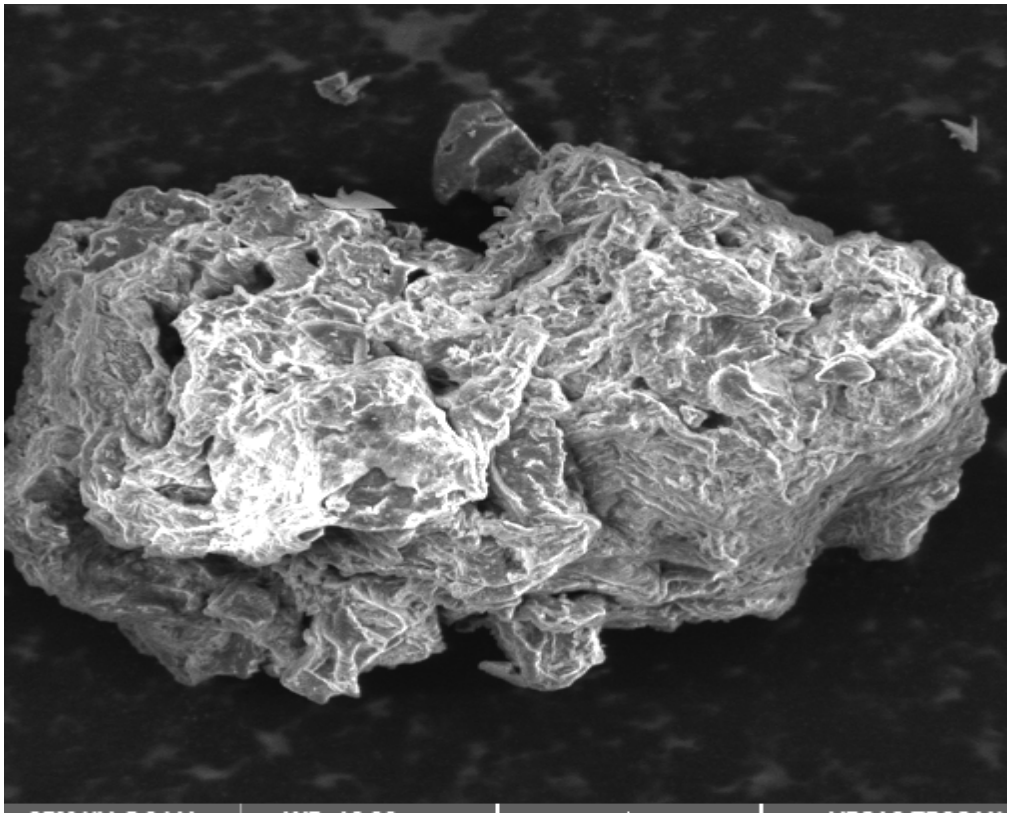

Fig. 2 (b): SEM- after Cu (II) ion adsorbed

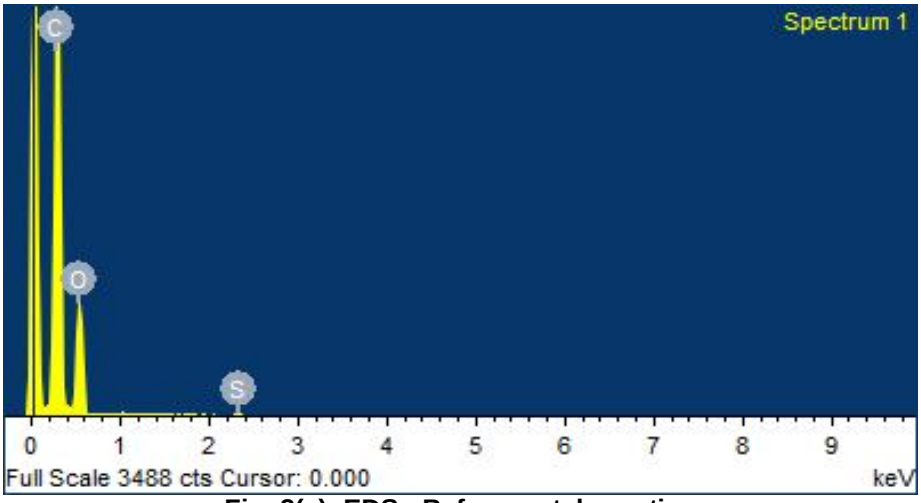

Fig. 2(c): EDS - Before metal sorption

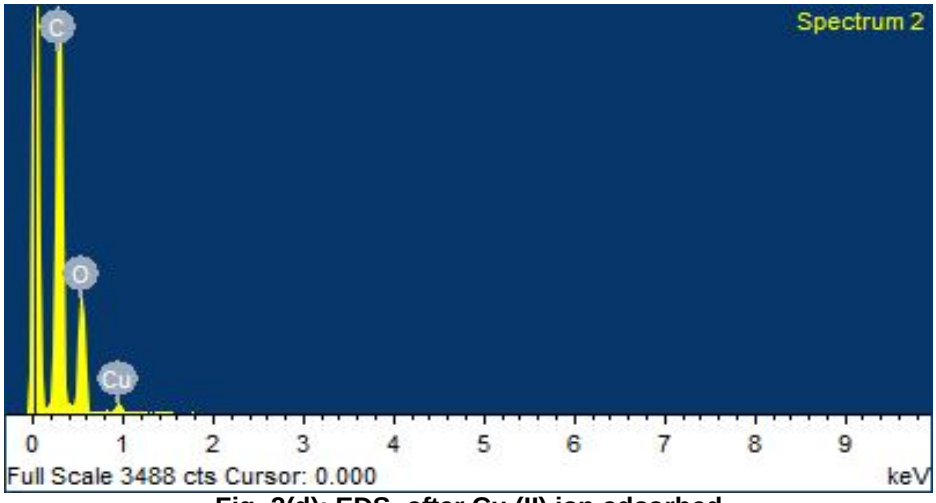

Fig. 2(d): EDS- after Cu (II) ion adsorbed

CONCLUSION

The result s revealed the potential of Eihhornea Crassipies leaf an agricultural waste material is low cost adsorbent for removing metal ion solutions. Equilibrium data well with Langmuir isotherm model with monolayer adsorption and the value of the separation factor R_L indicated the Cr (VI) Eihhornea Crassipies system was favorable adsorption.

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