**International Journal of Universal Science and Technology**
ISSN: **ISSN: 2454-7263** Copyright © Universal Print
Volume No. 03, Issue No. 01, Page No. 01-05 Published: Jan. 2018
Web: www.universalprint.org , Email: ijup@universalprint.org
Title Key: Study of Scavenging of Fe(II)…

# Study of Scavenging of Fe(II) on *Mangifera Indica* Bark Substrate

**A. B. Sahare[1] and S. G. Badne[2]**

[1]Department of Chemistry, S.S.E.S. Amravati's Science College, Pauni Dist. Bhandara-441910 (M.S.) India.

[2]Department of Chemistry, Shri Shivaji College of Arts, Commerce and Science, Akola (M.S.)

**e-mail: atulsahare28@gmail.com**

**Abstract**

The adsorption properties of *Mangifera indica* bark substrate was investigated for removal of Fe(II) from wastewater in a batch equilibrium system. The effect of various parameters like pH, contact time, initial metal ion concentration, doses of bark substrate, temperature and presence of extra elements was investigated. The adsorption isotherm data fitted with Freundlich model. It is found to have good adsorption capacity for Fe(II) which is found maximum at pH 4 for optimum contact time of 70 minutes. The adsorption decreases with increased temperature so all experiments were carried out at room temperature. The adsorption increases with doses of bark substrate and decreases by the presence of light metal ions in the medium. The bark substrate was found to eco-friendly and coast effect adsorbent material for scavenging of Fe(II).

**Keywords:** Mango bark, Iron removal, bark substrate, water treatment, adsorption.

## 1. Introduction

Water is an essential component for life. The water pollution is increasing mainly due to discharge of wastewater from various industrial processes. The water pollution has been reduced by treatment of wastewater using many methods [1]. Water pollution adversely affects living beings. The pollutants mainly heavy metals, acids, sediments, animal and human wastes, synthetic organic compounds etc. discharged into water resources and show toxic effects [2].

The heavy metals are non biodegradable pollutants and their high concentration can cause health hazards to human being and aquatic lives if exceed allowable limits [3]. Iron is the second most abundant element in the earth crust and it is present in natural waters in the form of oxides. It is an essential element for human being as it present in hemoglobin and used for storage of oxygen in the body[4]. Although Iron is an essential element to life in small concentration, but at high concentration it may have detrimental effect [5]. The excessive amount of Fe(II) in water supplies causes turbidity, unpleasant taste and odour. Therefore, removal of Fe(II) become an important issue for aquatic environment[6].

**International Journal of Universal Science and Technology**
ISSN: **ISSN: 2454-7263** Copyright © Universal Print
Volume No. 03, Issue No. 01, Page No. 01-05 Published: Jan. 2018
Web: www.universalprint.org , Email: ijup@universalprint.org
Title Key: Study of Scavenging of Fe(II)…

The removal of toxic heavy metals from wastewater is very important; therefore attention is given for recovery and reuse of wastewater [7]. There are many agricultural products, byproducts such as plant residue, fruit skin, straw etc. have tendency to remove the heavy metals economically and efficiently from wastewater by the process of adsorption [8]. The present work deals with scavenging of Fe(II) from wastewater using treated *Mangifera indica* bark substrate.

## 2.Methodology:

The study was performed in two phases: Preparation of adsorbent and Batch study.

**A] Preparation of Adsorbent (*Mangifera indica* bark substrate)**

The sundried *Mangifera indica* bark was powdered in electric grinder and sieved to small size. The bark powder was treated with a mixture of 100 ml 0.1 N HNO3 and 25 ml 39% HCHO. It was kept overnight in the mixture and occasionally stirred. Then, it was washed with distilled water several times to remove acid residue. Finally it was sundried and used for the study.

**B] Batch Study**

The batch study is carried out to fix optimum conditions for adsorption of Fe(II) on the bark substrate. The experiments were performed by using synthetically prepared wastewater. In this study 1 gm bark substrate was agitated with 100 ml Fe(II) solution. The concentration of Fe(II) was analysed using standard methods before and after adsorption [9]. The experimental parameters studied are:

1) Effect of pH
2) Effect of contact time
3) Effect of initial metal ion concentration
4) Effect of doses
5) Effect of temperature
6) Effect of extra elements

Adsorption Isotherm was plotted on the basis of batch study using *Freundlich* equation. It estimates the adsorption capacity of *Mangifera indica* bark substrate for Fe(II) ions.

## 3. Results And Discussion:

**Effect of pH**

The pH affects the solubility of metal ions in water [10, 11]. Therefore, pH is an important parameter for adsorption of metal ions. In this study pH of 56.87 ppm of Fe(II) solution was was fixed from 2 to 9 with the help of sulphuric acid and sodium hydroxide. 100 ml Fe(II) solution of definite pH agitated with 1 gm of bark substrate for 130 minutes. It was observed that the adsorption of Fe(II) varies with pH of solution with the maximum of 71.70% at pH 4. The results are given in fig.1. It was found that the final pH of solution was less than initial pH. Hence, for further experiments the optimum pH of solution was fixed to 4.

**Effect of Contact Time**

It requires some time to maintain the equilibrium of adsorbed ions between solid adsorbent and solution [12]. This time is generally referred as contact time. 100 ml Fe(II) solution of pH 4 was agitated with 1 gm of bark substrate for different intervals (from 5 to 120 minutes). The results are shown in fig.2. It was observed that the Fe(II) adsorption is very fast, about 57% adsorption takes place within 5 minutes. It maintains equilibrium after 60 minutes. Therefore, optimum contact time of 70 minutes was fixed for further study.

**Effect of initial metal ion concentration**

The process of adsorption can be affected by change in concentration of metal ion in the solution [13]. Therefore, effect of initial metal ion concentration is important in adsorption studies. In present work 100 ml Fe(II) solutions of pH 4 of concentrations ranging from 56.87 to 96.67 ppm were agitated with 1 gm bark substrate for 70 minutes. The results are given in fig.3. The study shows that removal of Fe(II) decreases with increasing initial concentration of Fe(II). It can be due to unavailability of adsorption sites.

**International Journal of Universal Science and Technology**
ISSN: **ISSN: 2454-7263** Copyright © Universal Print
Volume No. 03, Issue No. 01, Page No. 01-05 Published: Jan. 2018
Web: www.universalprint.org , Email: ijup@universalprint.org
Title Key: Study of Scavenging of Fe(II)…

### Effect of doses of bark substrate

The adsorption of Fe(II) was studied by taking different doses of bark substrate ranging from 0.5 to 4.0 gm in 100 ml Fe(II) solution while keeping initial concentration (56.87 ppm), temperature and pH (4) constant for 70 minutes. It is observed that the removal of Fe(II) increases with increasing doses of adsorbent. Results are shown in fig.4.

### Effect of temperature

Temperature is an important factor that highly affects the sorption equilibrium [14]. 100 ml Fe(II) solution of pH 4 was agitated with 1 gm of bark substrate at different temperatures ranging from 32° to 85°C. The results are mentioned in fig.5. The maximum adsorption of Fe(II) was observed at lower temperature of 32°C and it decreases with increasing temperature up to 85°C. This may be due to increase in kinetic energy of adsorbing ions at high temperature.

### Effect of extra element concentration

The adsorption of Fe(II) affected by presence of extra elements in adsorption medium in the form of cations [15]. In present study 100 ml Fe(II) solution of pH (4) containing different concentrations of $Na^{+}$, $Mg^{2+}$ and $Ca^{2+}$ in adsorption medium (varied from 12.15 to 36.45 ppm) agitated with 1 gm of bark substrate for 70 minutes. The results are given in fig.6. It has been observed that the adsorption of Fe(II) decreases with increasing concentration of these extra elements in the adsorption medium.

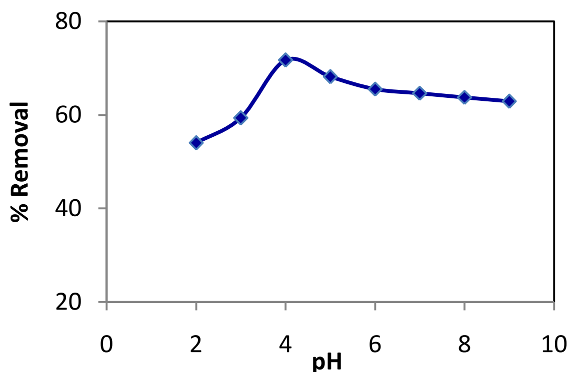


**Fig.1 Effect of pH on adsorption of Fe(II)**

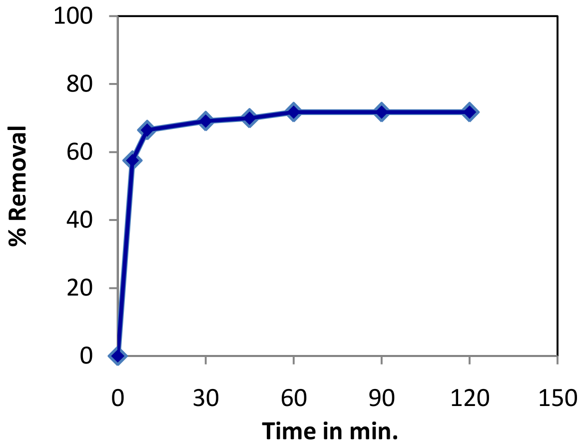


**Fig. 2 Effect of contact time on adsorption of Fe(II)**

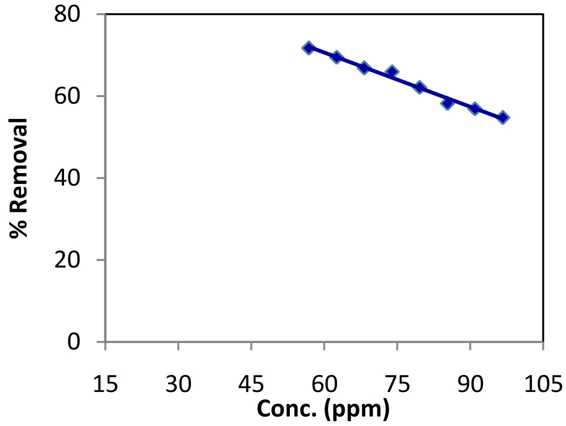


**Fig. 3 Effect of initial metal ion concentration**

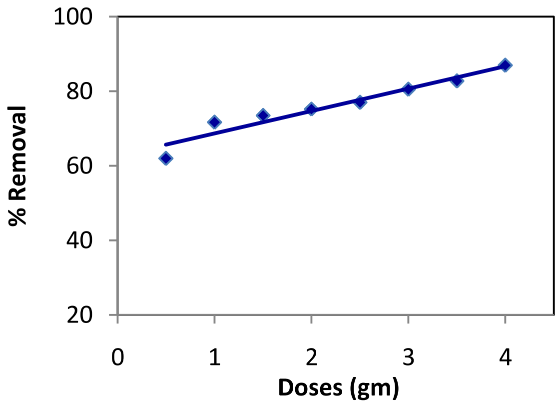


**Fig. 4 Effect of doses of bark substrate on adsorption of Fe(II)**

**International Journal of Universal Science and Technology**
ISSN: **ISSN: 2454-7263** Copyright © Universal Print
Volume No. 03, Issue No. 01, Page No. 01-05 Published: Jan. 2018
Web: www.universalprint.org , Email: ijup@universalprint.org
Title Key: Study of Scavenging of Fe(II)…

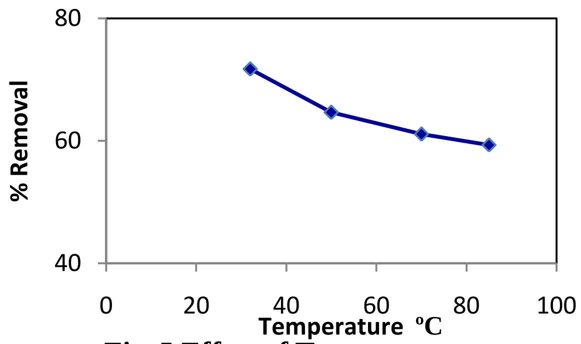


**Fig. 5 Effect of Temperature on adsorption of Fe(II)**

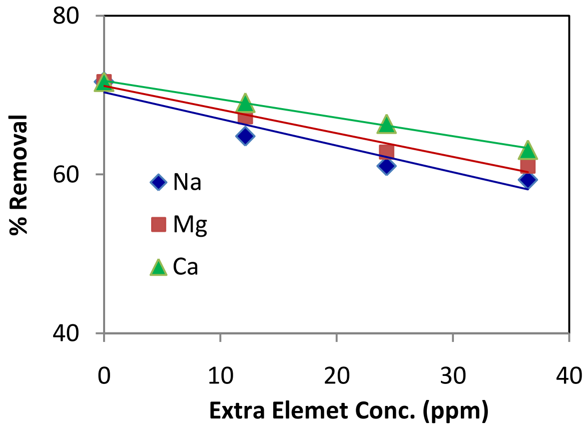


**Fig. 6 Effect of extra element concentration of adsorption of Fe(II)**

## Freundlich Adsorption Isotherm

The adsorption equilibrium data was further analyzed by well known Freundlich Adsorption Isotherm model. The Freundlich model indicates surface heterogeneity of the adsorbent *Mangifera indica* bark substrate for Fe(II). The Freundlich Isotherm equation can be written in linear form as:

$$log\frac{X}{M} = \log k + n\,log\,C_e$$

Where, *X/M* - the concentration of metal ion adsorbed per g of tree bark.
*Ce* - residual concentration of the metal ion.
*k* - the sorption capacity (in mg/l).
n - intensity respectively.

The Freundlich plot of *log X/M* against *log Ce* for adsorption of Fe(II) was drawn. The value of *n* obtained from slope and that of *k* is intercept of the graph.

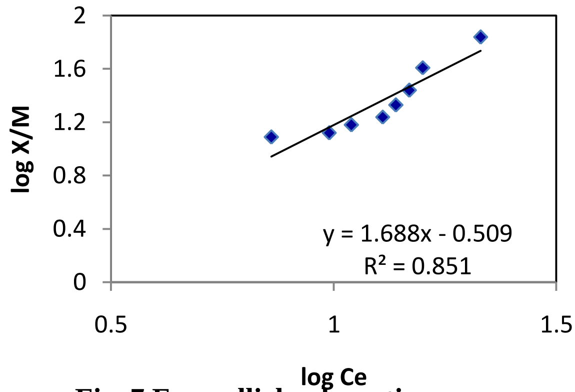


**Fig. 7 Freundlich adsorption isotherm for Fe(II)**

The adsorption isotherm is given in Fig 7. The straight line indicates that the adsorption of Fe(II) on bark substrate follow Freundlich equation. This model proves the higher adsorption of Fe(II) mainly due to greater tendency of this metal ion to be adsorbed on heterogeneous surface [16, 17]. The value of correlation regression $R^2$, for Fe(II) is found to be 0.851.

## 4. Conclusion:

The adsorption capacity of Fe(II) on *Mangifera indica* bark substrate was examined in the present study and adsorption equilibrium was investigated. The amount of Fe(II) adsorbed was found very significantly with various parameters like pH, contact time, initial metal ion concentration, doses, presence of light metal ions and temperature. The adsorption of Fe(II) on bark substrate shows typical trend like any adsorbent. The

**International Journal of Universal Science and Technology**
ISSN: **ISSN: 2454-7263** Copyright © Universal Print
Volume No. 03, Issue No. 01, Page No. 01-05 Published: Jan. 2018
Web: www.universalprint.org , Email: ijup@universalprint.org
Title Key: Study of Scavenging of Fe(II)…

adsorption isotherm was well fitted by Freundlich equation for heterogeneous adsorption. The bark substrate was found to be efficient media for Fe(II) removal from wastewater and could be an eco-friendly and cheap adsorbent material for other metal ion removal from wastewater.

## 5. References


1. G Thilagam et al., Adsorption behavior of Fe(II) ion from aqueous solution onto nano carbon, *Int. J. Chem. Studies*, 2016; 4(1): 96-102.
2. Khitoliya R. K., Environmental Pollution, S. Chand Limited, 2004, pp .1-309.
3. Sohil Ayub et. al., Efficiency evaluation of Neem bark in treatment of industrial waste water, *Env. Poll. Con. J.*, 2001, 4(4): 34-38.
4. Jun Dai et al., Adsorption Behavior of Fe(II) and Fe(III) Ions on Thiourea Cross-Linked Chitosan with Fe(III) as Template, *Molecules*, 2012, 17: 4388-4399.
5. Katerina Atkovska et al., Adsorption of Fe(ii) and Zn(ii) ions from landfill leachate by natural bentonite, *Journal of Chemical Technology and Metallurgy*, 2016, 51(2): 215-222.
6. S. S. Al-Shahrani, Treatment of Wastewater Contaminated with Fe(II) by Adsorption onto Saudi Activated Bentonite, *IJET-IJENS*, 2013, 13(06): 58-68.
7. Gopi Krishna et. al., Preconcentrative separation of Chroium (IV) species from Chromium (III) by coprecipitation of its ethyl xanthate complex onto Napthalene, *Talenta*, 2004, 63: 41-46.
8. Rao, M.M. et al., Removal of mercury from aqueous solutions using activated carbon prepared from agricultural by-product/waste, *J. Environ. Manage.*, 2009, 90( 1): 634-643.
9. APHA (1995) Standard Methods for Estimation of water and Wastewater. American Public Health Association, American Water Works Association, *Water Pollution Control Federation*, New York.
10. Qiu Y. et al., Surface characteristics of crop-residue-derived black carbon and lead(II) adsorption, *Water Res.*, 2008, 42: 567-574.
11. Bhatti, H.N. et al., Removal of zinc ions from aqueous solution using Moringa oleifera Lam. (horseradish tree) biomass, *Process Biochem.*, 2007, 42: 547-553.
12. Malik, R. et al., Adsorption of malachite green on groundnut shell waste based powdered activated carbon. *Waste Manage.*, 2007, 27: 1129-1138.
13. Pechyen, C. et al., Investigation of pyrolyzed chars from physic nut waste for the preparation of activated carbon, *J. Solid Mechanics Material Eng.*, 2007, 1(4): 498-507.
14. Tikomolora K. et al., Adsorption on quartz of Co(II) and Ni(II) in the form of hydroxide nanoparticles or metal ionic species from solution with pH close to that onset of hydroxide formation, *Russian J. Gen. Chem.*, 2002, 72(7): 989-996.
15. Chipin Huang and Huang C.P., Aspergilus oryzae and Rhizopus oryzae for Cu(II) removal, *Water Res. Oxford*, 1996, 30(9): 1985-1990.
16. Upendra Kumar and Manas Bandyopadhyay, Fixed Bed Column Study for the Removal of Ni(II) from Aqueous Waste by NCRH, *Res. J. of Chem. and Environ.*, 2005, 9(4): 81-86.