

# Removal of Iron from Aqueous Solution using Neem Leaf Powder as an Adsorbent

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**ABSTRACT:** A natural adsorbent made from Neem tree leaves (*Azadirachta Indica*) and used as a fine powder was found to be very effective to remove metal ions from water. In this work, removal of iron from water was studied by using neem leaf powder as an adsorbent with varying contact time and its concentration. The maximum removal of iron was noted 94.8364% when the sample was kept under contact of adsorbent of dose 200mg/l for 180 minutes.

**KEYWORDS:** Removal, Iron, Neem leaf powder

## I. INTRODUCTION

Iron is the second most abundant metal present on earth. The most common source of iron in groundwater is by decomposition of iron containing rocks. Industrial waste, rusting or corrosion of water supply pipes and reservoirs also causes contamination of water by iron. The permissible limit set by BIS (Bureau of Indian Standards) for iron in drinking water is 0.3mg/l, when exceeds this limit in public supplies it cause turbidity, inadequate taste and odor, staining of laundry and plumbing. In humans, if the iron is present in excess it causes stomach upset, ulcers, mental retardation, liver and brain damage. Therefore, it is necessary to remove iron from water and bring it down under its permissible limits.

Various methods are adopted to remove heavy metals from water including chemical, biological, physical treatments. However these methods are quite expensive and difficult. Hence there is need of easy and cost effective method to remove heavy metals including iron from water. Agricultural bi-products such as hazelnut hull (Ali Sheibani et al. 2012), duckweed (Jameel .M. Dhabab 2011), pomegranate peel carbon (Masoud Rohani et al. 2013), moringa oleifera i.e. *drum sticks* (Desai B. et al. 2013), rice husk ash (Sathy Chandrasekhar 2006), banana and orange peels (G. Annadurai et al. 2002) and coconut shell charcoal (K.S. Beenakumari 2009) were tested to remove heavy metals from aqueous solutions. The adsorption behavior of Chromium (Arunima Sharma 2004), Copper (Novie Febriana 2010), Zinc (Reena Malik 2012), and Nickel (L. Lisy 2016) from water on neem had been studied earlier. Arunima Sharma and Krishna G. Bhattacharyya used fine powder made from neem leaves to remove Chromium from aqueous solutions, a small amount of adsorbent i.e. 1.6 g/l of neem leaf powder removed 87% of Chromium in 300 minutes from the sample of concentration 14.1 mg/l. Novie Febriana, Sisca O. Lesmana, Felycia E. Soetaredjo, Jaka Sunarso and Suryadi Ismadji used neem leaf powder to remove copper ions from aqueous solutions and found the maximum adsorption capacity of neem leaf powder as 18.29 mg/g. Reena Malik, Suman lata and Sushila Singhal developed an adsorbent from neem leaf to remove Copper and Zinc from water. The study showed that the powdered form of neem leaves used as an adsorbent is very effective in removing Copper and Zinc from water. The maximum Copper removal was 76.8% and Zinc removal was 88.6%. L Lisy and L Subha compared the adsorption behavior of Nickel on neem bark charcoal and commercially activated carbon. The study showed that adsorption of Nickel on neem bark charcoal was 80% under optimum conditions.

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## II. MATERIALS AND METHODOLOGY

The stock iron solution was prepared by slowly adding 20 ml of concentrated  $H_2SO_4$  to 50ml water and dissolving 1.404 g  $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$ . A 0.02M Potassium permanganate was slowly added until a faint pink colour persists. Last few milliliters of the solution was added dropwise. Then the solution was diluted to 1000 ml with water and mixed properly. 1.00 ml of this stock iron solution was equal to 200  $\mu g$  Fe. This stock iron solution was further diluted to make standard iron solutions. A ready to use fine powder of neem leaves was directly purchased. After preparing the standards the water samples of known iron concentration were treated with neem leaf powder and then filtered using the Whatman filter paper 42. The filtered samples were then analyzed for iron concentration by using an Atomic Absorption Spectrophotometer (Shimadzu AA- 7000).

## III. RESULTS AND DISCUSSION

The effect of neem leaf powder when added to the water containing iron up to some extent was studied by varying the concentration of adsorbent and its contact time from 60 minutes to 180 minutes. At 60 and 120 minutes of contact time the removal was very low. Only at contact time of 180 minutes the removal of iron was considerable and was taken within the permissible limits. The figures shows the effect of contact time and concentration of adsorbent.

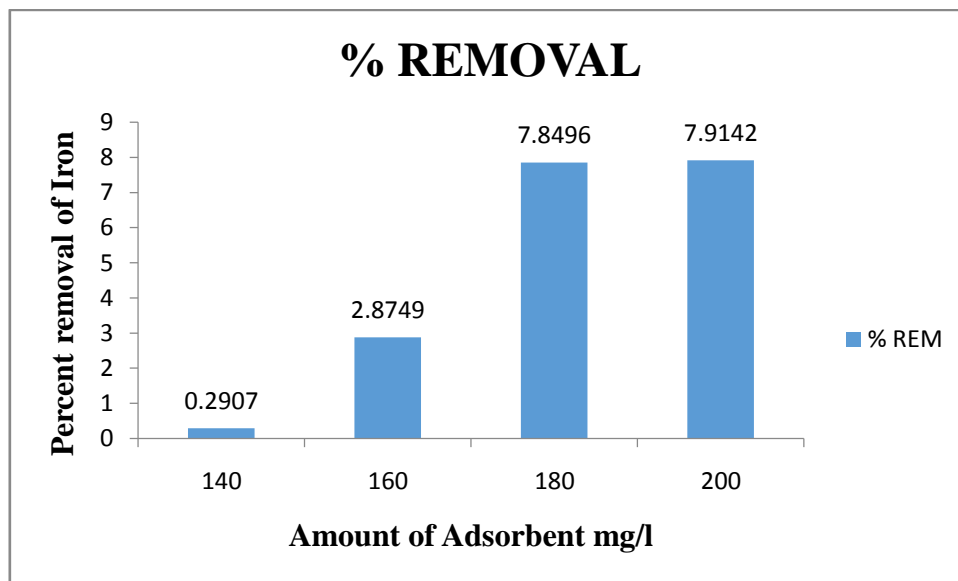


Figure 1. Effect of adsorbent dose on the removal of iron with contact time 60 minutes

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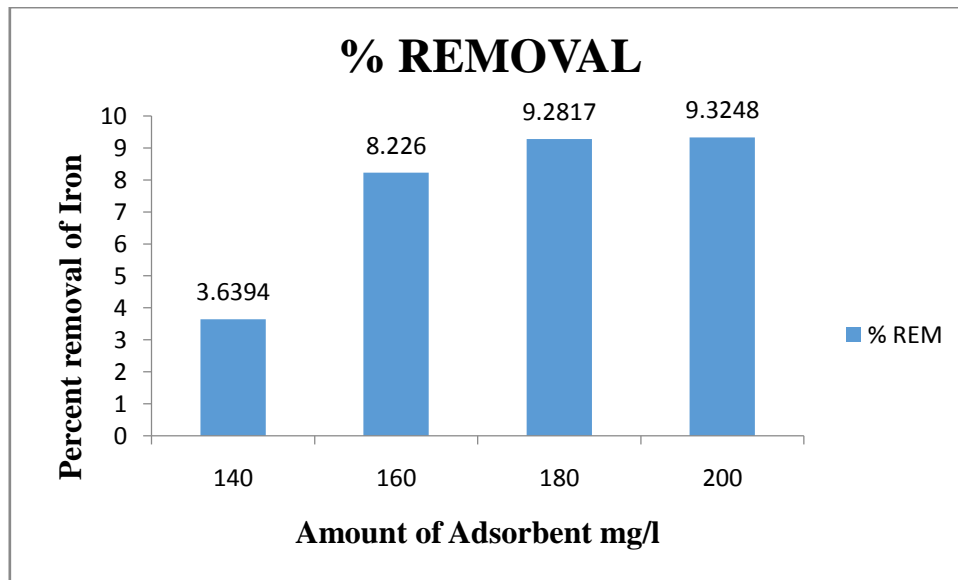


Figure 2. Effect of adsorbent dose on the removal of iron with contact time 120 minutes

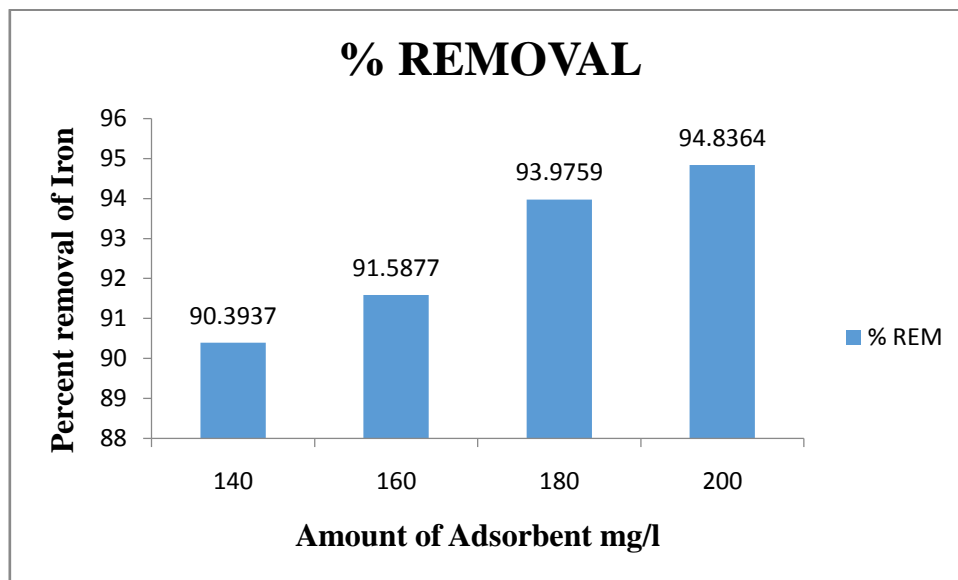


Figure 3. Effect of adsorbent dose on the removal of iron with contact time 180 minutes

As shown in above figures, for the contact time of 60, 120 minutes the adsorbent did not make much difference. But, for 180 minutes it removed iron from the aqueous solution to maximum quantity. The iron concentration was brought down from 0.9296mg/l to 0.0480mg/l. The sample volume taken for the experimentation was kept constant to 50ml.

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## IV. CONCLUSION

This study shows that under optimum conditions neem leaf powder was suitable in removing iron from aqueous solutions due to its high adsorption capacity, low cost, availability. The removal of iron was dependent upon amount of adsorbent and also contact time. The maximum iron removed was 94.8364% at contact time of 180 minutes and 200mg/l amount of adsorbent.

## REFERENCES

- [1] Ali Sheibani, Masoud Reza Shishehbor and Hamed Alaei, "Removal of Fe(III) ions from aqueous solution by hazelnut hull as an adsorbent", International journal of industrial chemistry(2012),vol. 3(4), 1-4
- [2] Arunima Sharma and Krishna G. Bhattacharyya (2004), "Adsorption of Chromium (VI) on Azadirachta Indica (Neem) Leaf Powder", Adsorption(2004), vol.10, 327-338
- [3] Haloi Nabanita, Sarma H.P., "Removal of iron from ground water by using heart wood charcoal of Areca catechu", Journal of Environmental research and development (2012), vol.7(2), 688-693
- [4] IK Erabee, A Ahsana, Bipin Jose, M Imteaz, S Idrus, NN Nik Daud, "Adsorptive treatment of landfill leachate using activated carbon modified with three different methods", KSCE Journal of Civil Engineering (2016), 1-25
- [5] Ashutosh Tripathi and Manju Rawat Ranjan, "Heavy Metal Removal from Wastewater Using Low Cost Adsorbents", Journal of bioremediation & biodegradation (2015), vol.6(6), 1-5
- [6] M. Razia, V. Karthiga, C. Thamaraiselvi, S.H.Saira Banu, L. Paul Evangelin Shavisha, W. Bernala, "Vetiveria Zizaniodes and Terminalia Chebula as alternative natural adsorbent for drinking water treatment", International journal of research and development in pharmacy and life sciences(2014), vol.3(3), 978-982
- [7] Ghanshyam Pandhare, S.D.Dawande, "Neem Leaves Powder as a Low cost Adsorbent and Its Characteristics", International journal of advanced engineering technology(2013), vol.4(2), 61-62
- [8] Desai B, Desai H, "Potential of Moringa Oleifera (Drum Sticks) Seeds and Its Application as Natural Adsorbent in Removal of Heavy Metal Ions", International Journal of Environment, Ecology, Family and Urban Studies (2013), vol.3(4) 9-22
- [9] Muhammad B. Ibrahim, Muhammad S. Sulaiman and Sadiq Sani, "Assessment of Adsorption Properties of Neem Leaves Wastes for the Removal of Congo Red and Methyl Orange", 3rd International Conference on Biological, Chemical & Environmental Sciences(2015), 21-22
- [10] Reena Malik, Suman lata and Sushila Singhal, "Neem Leaf Utilization for Copper and Zinc Ions Removal from Aqueous Solution", International journal of science and research(2014), vol.3(5) 695-705
- [11] Sathy Chandrasekhar and P. N. Pramada, "Rice husk ash as an adsorbent for methylene blue-effect of ashing temperature", Adsorption(2006), vol.12, 27-43
- [12] Prabha R.T., Dr. Udayashankara T.H, "Removal of heavy metal from synthetic wastewater using Rice husk and Groundnut shell as adsorbents", IOSR Journal of Environmental Science(2014), vol.8(7), 26-34
- [13] Omar E. Abdel Salam, Neama A. Reiad and Maha M. ElShafei, "A study of the removal characteristics of heavy metals from wastewater by low-cost adsorbents", Journal of Advanced Research (2011), vol.2, 297-303
- [14] G. Annadurai, R.S. Juang and D. J. Lee, "Adsorption of heavy metals from water using banana and orange peels", Water Science and Technology(2002), vol.47(1), 185-190
- [15] Jameel .M. Dhabab, "Removal of some heavy metal ions from their aqueous solutions by duckweed", Journal of Toxicology and Environmental Health Sciences(2011), Vol. 3(6), 164-170
- [16] Babak Kakavandi, Roshanak Rezaei Kalantary, Mahdi Farzadkia, Amir Hossein Mahvi, Ali Esrafil, Ali Azari, Ahmad Reza Yari and Allah Bakhsh Javid, "Enhanced chromium (VI) removal using activated carbon modified by zero valent iron and silver bimetallic nanoparticles", Journal of Environmental Health Science & Engineering(2014), vol.12(115), 1-10
- [17] Norhene Mahfoudhi, Sami Boufi, "Nanocellulose as a novel nanostructured adsorbent for environmental remediation: a review", Cellulose (2017), vol.24, 1171-1197
- [18] L Lisy, L Subha, "Adsorption isotherm and kinetic studies of Nickel (II) ions removal using Neem bark charcoal and commercially activated Carbon: A comparative study", International Journal of Advanced Science and Research(2016), vol.1(12), 16-20
- [19] M. A. Hossain, H. Hao Ngo, W. S. Guo and T. V. Nguyen, "Removal of Copper from Water by Adsorption onto Banana Peel as Bioadsorbent", International Journal of GEOMATE(2012), Vol. 2(2), 227-234
- [20] R. Sabreen Alfarrar, N. Eman Ali and Mashita Mohd Yusoff, "Removal of heavy metals by natural adsorbent: review", International Journal of Biosciences(2014), vol.4(7), 130-139
- [21] Rafie Rushdy Mohammed, "Removal of Heavy Metals from Waste Water Using Black Teawaste", Arab Journal for Science and Engineering(2012), vol.37, 1505-1520
- [22] Sureshkumar Halnor and Milind Ubale, "Removal of Fe(II) from aqueous solution and waste water by Prosopis Juliflora Leaf Powder by adsorption", Chemical science review and letters (2013), vol.1(4), 239-244
- [23] Masoud Rohani Moghadam, Navid Nasirizadeh, Zienab Dashti and Esmail Babanezhad, "Removal of Fe (II) from aqueous solution using pomegranate peel carbon: equilibrium and kinetic studies", International Journal of Industrial Chemistry (2013), vol.4(19), 1-6
- [24] Hala Ahmed Hegazi, "Removal of heavy metals from wastewater using agricultural and industrial wastes as adsorbents", Housing and Building National Research Center (HBRC) Journal (2013), vol.9(1), 276-282

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(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

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- [25] Magda A. Akl, AbdElFatah M. Yousef and Sameh AbdElnasser, "Removal of Iron and Manganese in Water Samples Using Activated Carbon Derived from Local Agro-Residues", *Journal of Chemical Engineering and Process Technology* (2013), vol.4(4), 1-10
- [26] Rashmi R. Devi, Iohborlang M. Umlong, Bodhaditya Das, Kusum Borah, Ashim J. Thakur, Prasanta K. Raul, Saumen Banerjee and Lokendra Singh, "Removal of iron and arsenic (III) from drinking water using iron oxide-coated sand and limestone", *Applied Water Science* (2014) vol.4(1), 175–182
- [27] Danka Barloková and Ján Ilavský, "Removal of Iron and Manganese from Water Using Filtration by Natural Materials", *Polish Journal of Environmental Studies*(2010), vol.19(6), 1117-1122
- [28] R. Balaji, S. Sasikala and G. Muthuraman, "Removal of Iron from drinking / ground water by using agricultural Waste as Natural adsorbents", *International Journal of Engineering and Innovative Technology (IJEIT)*(2014), vol.3(12), 43-46
- [29] Dongcheng Yang, Lili Yu, Hou Chen, Yanbo Yu, Yuanyuan Xu, Jinming Sun and Yating Wang, "Use of apple seeds as new source for synthesis of polyacrylonitrile-based adsorbent to remove Pb(II)", *Polymer Bulletin* (2017)
- [30] Angelica Marquetotti Salcedo Vieira, Marcelo F. Vieira, Gabriel F. Silva, Álvaro A. Araújo, Márcia R. Fagundes-Klen, Márcia T. Veit and Rosângela Bergamasco, "Use of Moringa oleifera Seed as a Natural Adsorbent for Wastewater Treatment", *Water Air Soil Pollution*(2010), vol.206(1), 273–281