Mathematical Statistician and Engineering Applications
ISSN: 2094-0343
2326-9865

Removal of Iron from Real Waste-water Using Rice Husk Activated Charcoal

Anupam Sirothia [*1], Devendra Dohare [*2]

[*1]post graduation student, CE-AMD, Shri Govindram Seksaria Institute of technology and science , Indore, Madhya Pradesh, India

[*2]Assistant Professor, CE-AMD, Shri Govindram Seksaria Institute of technology and science , Indore, Madhya Pradesh, India

Article Info
Page Number: 10591 - 10599
Publication Issue:
Vol 71 No. 4 (2022)

Abstract

Heavy metals, when in abundance, can be very toxic to the medium in which it is dissolved. Adsorption has been used as a suitable water treatment process to remove heavy metals. Many studies have been conducted to remove these heavy metals by using different materials. Different materials have different chemical constitutes, hence, a material that is very effective in removing one heavy metal may prove to have a poor efficiency in adsorbing, or removing, another metal.For This research,Rice Husk Activated Charcoal was prepared From raw rice Husk and removal of iron was Done From the real waste-water from H.D. wire,Sanwer industry.rice Husk was grounded to fine size then treatment with acid was done and it was kept in hot air oven for one day then basic treatment was done with the help of sodium hydroxide and then it was kept in hot air oven for one day.then final rice husk activated charcoal was prepared. Then five waste-water sample were taken of different days and there various parameters were calculated such as pH,electrical conductiivty,turbidity,chemical oxygen demand and chloride content. Iron content of five sample were determined and after mixing with rice husk activated charcoal for two hours sample were filtered then with different dosing of rice husk activated charcoal were used to know the iron removal efficiency with the different dosing of rice husk activated charcoal and optimum dosage of rice husk activated charcoal was found.further investigations may need to be performed to obtain results on Different parameters,adsorbent particle size,contact time,agitation speed and temperature etc.

Article History
Article Received: *15 September 2022*
Revised: *25 October 2022*
Accepted: *14 November 2022*
Publication: *21 December 2022*

Keywords: Real Waste-water,adsoprtion,rice husk activated carbon,Iron removal

1. Introduction

1.1 GENERAL

Industrial activities lead to substantial release of toxic metals into the environment. In the recent years, heavy metal pollution has become one of the serious environmental problems. Many industries such as

electroplating, mining, steel industry are discharging wastewater containing heavy metals either partially treated or untreated directly into water bodies.

Since the number of health problem associated with environmental contamination continuous to rise, the removal of toxic pollutants such as phenol, ammonia and toxic metals from sewage and industrial waste water has received great attention (**Munaf E.&Zein R**.)

To reduce the environmental and health risks posed by wastewater, multiple technologies are used that are based on varying degrees of treatments, chemical reactions, and processes, such as membrane filtration, reverse osmosis, chemical precipitation, solvent extraction, oxidation, and adsorption (**Younas et al 2021**).

1.1.1 **Benefits of Using bioadsorption**

The application of the biosorption for removal of heavy metal is gaining momentum due to following reasons :

(A) chemical requirements for the whole treatment process is reduced
(B)low operating cost
(C)eco-friendly and cost-effective alternative of conventional techniques
(D)efficient at lower levels of contamination

2. LITERATURE REVIEW

Beer Singh et al(1995)

1.Based on this study, it was proposed that the active carbon 90CTC can be used for removal of contaminants like SM(sulphur mustard) and other toxins in water filtration systems.
2.It indicates that SM(sulphur mustard) and its hydrolysed products were retained by activated carbon as a result of physical adsorption.
3.Phenol cannot be used to simulate the adsorption of molecules like SM(sulphur mustard) on carbon in water.
4.The trend of SM(sulphur mustard) adsorption on carbon may be similar to OA(Oxygen analogue of Sulphur mustard) as the two molecules are structurally similar.

Somnath Mukherjee et al (2006)

1.The use of WC(Wood charcoal) and BA(bagasse ash) as two inexpensive carbonaceous adsorbents for the removal of phenol from water environment has been found to be comparable to commercial grade AC(Activated charcoal).
2.Removal efficiency of phenol slightly increased when the pH of adsorption system decreased.

V.K. Gupta et al(2009)

1.Low-cost alternative adsorbents may be classified in two ways, either on basis of their availability (i.e., natural materials such as wood, peat, coal, lignite, etc.;
industrial/agricultural/domestic wastes or byproducts such as slag, sludge, fly ash, bagasse flyash, red mud Chitin and chitosan.
2.Both chitin and chitosan are being used as an attractive source of adsorbents, especially for metal removal. In a study of removal and recovery of Cu (II), Cr (III), and Ni (II) from solutions

3.Jha et al.157 studied chitosan for Cd (II) removal and reported an adsorption capacity of 5.93 mgg^{-1} at a pH range of 4.0–8.3

Munaf &Zein(2010)

1.The percentage of chromium,zinc,copper and cadmium ions removal from real waste water sample were 65,55,50 and 60% since real waste water sample contain other ions, the reason is may be due to possibility of competition for adsorption site.

2.In the Optimum range from 4.5 to 6.5 pH maximum uptake of chromium,zinc,copper and cadmium ions by rice husk were 75,70,79 and 80% respectively.

3.The adsorption capacity of rice husk much depends on the surface activity,namely specific surface area available for solute-surface interaction this means that the sorption material having larger surface area or in other words has small particle size could adsorb metal ion stronger than the smaller one

Hegazi(2013)

1.Batch studies using tartaric acid modified rice husk as adsorbent have been carried out for the removal of lead and copper and have reported the effects of various parameters such as pH, initial concentration of adsorbate, particle size, temperature etc. It was reported that modified rice husk is a potentially useful material for the removal of Cu and Pb from aqueous solutions

2.The results of using real wastewater showed that rice husk was effective in the simultaneous removal of Fe, Pb and Ni, whereas fly ash was effective in the removal of Cd and Cu.

Bisht et al.(2016)

1.Graphene

2.Adsorbed chromium onto the surface of graphene oxide and the maximum adsorption capacity found was around 92.65 mg/g at an optimum pH of 5

3.S.Gopalakrishnan et al. (2015) have also oxidised graphene for the addition of COOH, C¼O and OH functional groups onto the surface using a modified Hummer's method . The novelty of their work is that only 70 mg of graphene oxide has been utilized for 100% removal of chromium from wastewater effectively at an optimum pH of 8

Mittal et al(2016)

1.The graft copolymers of guar gum have good adsorption capacities for the removal of different toxic metal cations, such as Pb^{2+}, Cu^{2+} and methylene blue from aqueous solutions. A graft copolymer of guar gum with PAAM was used for the removal of Cr^{6+} ions from wastewater with a significantly high adsorption capacity of 588.24 mgg^{-1}.

2.The graft copolymers of guar gum have also shown their potential as adsorbents for the adsorption of various cationic and anionic impurities from wastewater

Dinesha et al(2017)

1.On a mass basis,nanoadsorbent have much larger surface areas compared to macro particles. They can also be enhanced with various reactor groups to increase their chemical affinity towards target compounds.

2.Peng et al., (2005) have developed a novel sorbent with high surface area (189 m^2 /g) consisting of cerium oxide supported on carbon nanotubes (CeO_2-CNTs).

3.Deliyanni et al., (2003) have also synthesized and characterized a novel As (V) sorbent consisting of akaganeite nanocrystals

Wolowiec et al(2019)

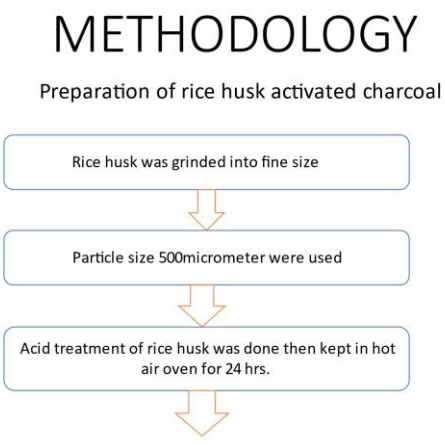
The pollution of surface and groundwater with heavy metals is a major issue worldwide, and the development of suitable technology to remove heavy metals from the aqueous solutions is necessary. WTRs(Water Treatments Residuals) have a surprisingly good sorption capacity for different compounds, especially heavy metals and metalloids. However, in most studies, the sorption efficiency was dependent on the pH of the solution, reaction time, temperature, and initial metal concentration in the solution. Decrease in particles size enhanced sorption properties due to increases in the specific surface area.

Qasem &Lawal(2021)

1.Carbon-based adsorbents-

2.Carbon-based nanoporous adsorbents, especially activated carbons (ACs), carbon nanotubes (CNTs), and graphene (GN), are extensively used in the applications of heavy metal removal owing to their tremendous surface area (500–1500 m^2/g) the current surface modification techniques demand high heat/pressure, strong acid/base, or intensive oxidation/reduction

3.1 METHODOLOGY



Base treatment was done with Naoh and was kept in hot air oven for 24 hrs

Sample collection -

Five sample were collected from wire industry sanwer indore.

Following test were performed

1. Ph of sample
2. Electrical conductivity
3. Turbidity




4.Total solids, Total dissolved solids and Total suspended solids

5. Chloride content

6.Chemical oxygen demand

Steps for determining COD of sample -

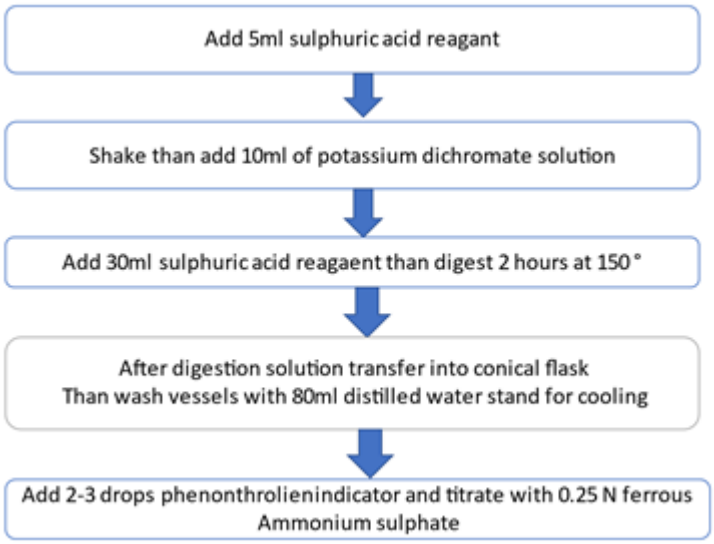
Method- open reflux method

Take 20ml of sample & blank in reaction vessel

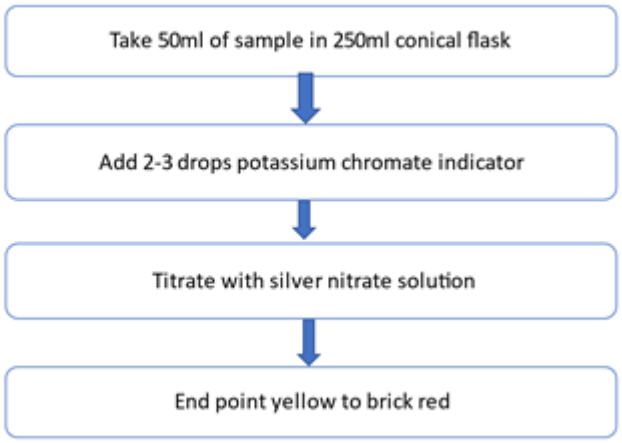
↓

Add 1 spatula mercuric sulphate

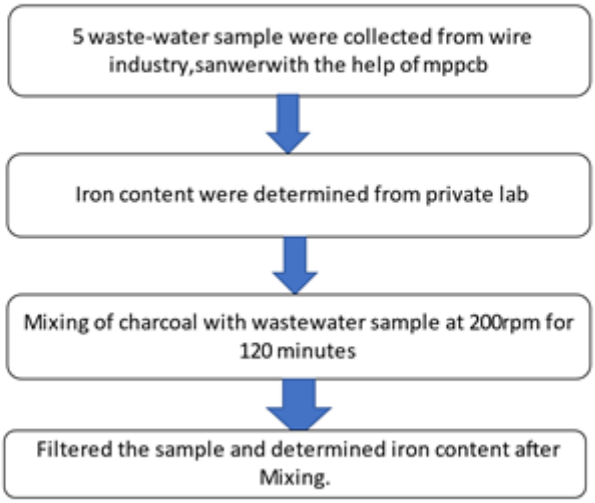
↓



Steps for determining chloride -



Removal of iron from wastewater

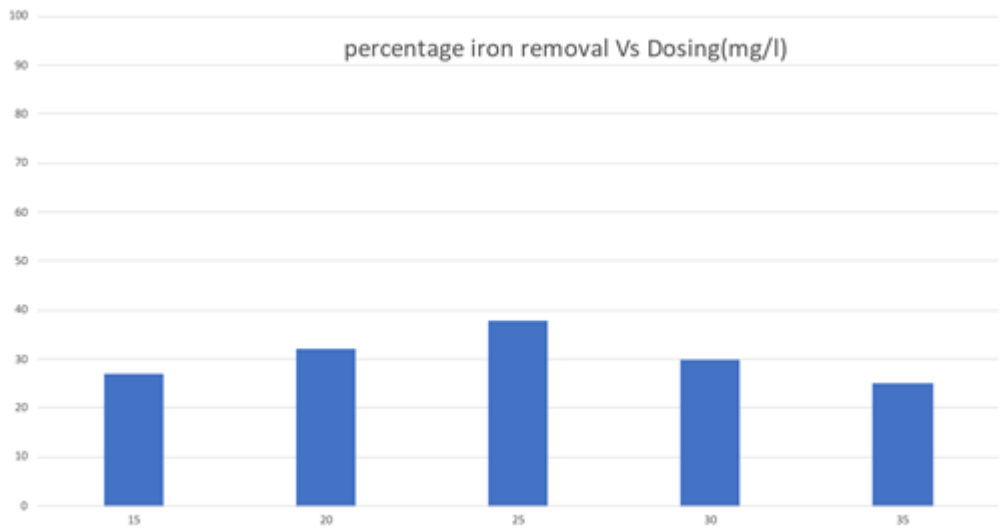


4.RESULTS

parameters	Total solids	chloride	c.o.d	pH	conductivity	turbidity
1	9.3946	83.3784	11,800	1.56	143.40	44.7
2	8.4645	97.4731	10,584	2.47	284.40	38.4
3	9.8729	76.4925	11,342	1.45	226.74	48.4
4	7.1743	72.5298	12,426	1.98	325.45	40.6
5	7.9845	79.5297	10,364	2.34	174.46	43.7

For different dosing iron removal efficiency

S.No	Dosing(mg/l)	Initial(mg/l)	Final(mg/l)	Efficiency(%)
1	15	6170	4504	27
2	20	6170	4195	32
3	25	6170	3808	28
4	30	6170	4319	30
5	35	6170	4627	25



Discussion

- This study shows that rice husk activated charocal prepared by chemical activation can be used for the removal of iron from real Waste-water.
- Rice Husk activated Charcoal Can be used in the place of Normal charcoal
- Using Rice husk activated Charcoal Can be seen as a conventional way to Use husk and convert them in Charcoal

5. CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

1.Practically Rice Husk activated Charcoal Cannot Be Used Because Final Values are not in the desired limits.
2.Maximum efficiency observed was of 32%.
3.Optimum dosage of rice husk activated charcoal was 30mg/l.
4.Rice husk activated charcoal can be used for removing iron from real waste-water.

5.2 Future Scope

1.Different bioadsorbent can be used such as guarbeans,bagasse ash(fibrous residue),wood charcoal and fly-ash can be used in the place of rice husk activated charcoal
2.Artificial waste-water can be used instead of real waste-water and different parameter can be studied varying phand varying temperature
3.Comparison of two bio-adsorbent can be done to choose the best suitable
4.Different metals removal studies can be done which can be removed using bio-adsorbent.

REFRENCES

[1] Agarwal M.,Bisht R. (2016) “Heavy metal removal from wastewater using various adsorbents”: a review November 2016 Journal of Water Reuse and Desalination 7(4)

[2] Ahmed H.(2013) “Removal of heavy metals from wastewater using agricultural and industrial wastes as adsorbents”. *HBRC Journal Volume 9*, Issue 3, December 2013, Pages 276-282

[3] Gupta V.K.,Carrott P.J.M,Carrot M.,Suhas(2009) **“**Low-Cost Adsorbents: Growing Approach to Wastewater Treatment” Critical Reviews in Environmental Science and Technology Volume 39, 2009 Issue 10

[4] Kennedy K.,Maseka K.,Mbulo M.(2018) “Selected Adsorbents for Removal of Contaminants from Wastewater: Towards Engineering Clay Minerals”, *Open Journal of Applied Sciences*.Vol.8 No.8, August 2018

[5] Mittal H.,Ray S.,Okamoto M.(2016) “Recent Progress on the Design and Applications of Polysaccharide-Based Graft Copolymer Hydrogels as Adsorbents for Wastewater” Purification Macromolecular Materials and Engineering/Volume 301, Issue 5/ p. 496-522

[6] Mukherjee S.,Kumar S.,Mishra A. Fan M.(2006) “Removal of phenols from water environment by activated carbon, bagasse ash and wood charcoal”.*chemical Engineering Journal*, 129(2007) 133-142

[7] Mukherjee S.,Mukhopadhyaya S.,Zafri M.,Zhan X.,Hashim M.,Gupta B. (2018) "Application of guar gum for the removal of dissolved lead from wastewater"November 2016 Journal of Water Reuse and Desalination 7(4) Vol 111

[8] Munaf E. & Zein R.(2010)**"**the use of rice husk for removal of toxic metals from waste water". Environmental Technology : http://dx.doi.org/10.1080/09593331808616549

[9] Pruss A.,Komorowska M.,Wolowiec M.,Bajda T.Rzepa G**.,(**2019) Removal of Heavy Metals and Metalloids from Water Using Drinking Water Treatment Residuals as Adsorbents: A Review. MDPI journal,Mineral,Volume 9/Issue 8.

[10] Qasem N.,Mohammed R.,Lawal D**.** (2021) "Removal of heavy metal ions from wastewater: a comprehensive and critical review. *Nature partner journals*". npj Clean Water Article number: 36 (2021)

[11] Singh B., Madhusudhanan S., Dubey V., Nath R., Rao N.S.B.N (1995) " Active Carbon for Toxic chemicals from contaminated water". Carbon Vol. 34, No. 3, pp. 327-330,1996 Copyright 0 1996 Elsevier Science Ltd.

[12] Tripathi A. & Rawat M.(2015) "Heavy metal removal from wastewater using low cost adsorbents", Journal of Bioremediation & Biodegradation 06(06) January 2015