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REMOVAL OF IRON FROM NATURAL GROUND WATER BY USING LOCALLY AVAILABLE MATERIAL

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Abstract— Adsorption, being a simple, practical and effortless procedure, is an effective procedure for the expulsion of toxins from wastewater. This study mainly deals with the removal of iron from ground water sources by using locally available low cost materials such as rice husk. The sample used for this filtration process was synthetically prepared iron solution using ferrous ammonium sulphate. In this examination rice husk have appeared to be successful and minimal effort adsorbent. Evacuation of iron from watery arrangements was contemplated utilizing bounteously accessible rice husk under different trial conditions. The most expulsion effectiveness of 96% was accomplished at rice husk of depth 2cm as filter medium for iron (II) removal at equilibrium conditions. Adsorption qualities showed that rice husk were acceptable for the purpose.

Keywords— Rice husk, Iron content, Absorbent

I. INTRODUCTION

Areas having a tropical climate have a high concentration of iron (Fe) in groundwater. In groundwater, Fe generally occurs in the oxidation state reduced soluble divalent ferrous iron (Fe^{2+}). When groundwater comes in contact with oxygen of the atmosphere, the Fe is oxidized to the ferric state and is precipitated as Fe-mineral. The subsurface reducing conditions have significant influence on the high Fe content of groundwater. Iron in rural groundwater supplies is a common problem, its concentration level ranges from 0 to 50 mg/l, while WHO recommended level is < 0.3 mg/l. When iron content exceed this permissible value then it can causes hemochromatosis, stomach problems, nausea, vomiting, wrinkles in skin. There are various methods of removal of dissolved iron from groundwater, some of them are Aeration or gas transfer, Adsorption, Ion exchange, Electro chemical, Desalination.

II. METHODOLOGY

Preparation of synthetic iron water

For the synthesis of synthetic iron water sample, Ferrous ammonium sulphate has been used in varying amounts in order to produce the required concentration for the tests.

Preparation of adsorbent

Rice Husk: The grounded rice husk is collected from locally available mill. It is prepared by washing it with tap water followed by distilled water. It is then allowed to dry for 3 days in the sun. The dried rice husk is then sieved to get size smaller than 300 micrometer. Then it was ready to use as an adsorbent.

Setting up of filter

Filter containing charcoal as adsorbent:

- The filter is of height 27 cm and diameter 22cm.
- In the first layer, coarse aggregates of sizes passing through IS sieve 40mm and retained on 20mm are used at thickness of 3cm.
- The second layer of coarse aggregates used are of sizes passing through IS sieve 10mm and retained on 4.75mm at thickness 2cm.
- The third layer is of coarse sand of size passing through IS sieve 4.75mm and retained on 2mm at thickness of 1cm.
- The fourth layer is of medium sand of size passing through IS sieve 2mm and retained on 600 micron at thickness 4cm.
- The fifth layer is of charcoal which is of granular type of approximate size between40mm and 4.75mm of thickness 5cm.
- The sixth layer is again of medium sand of thickness 4 cm.
- A layer of muslin cloth has been used above the charcoal layer to prevent it from mixing with sand.

Filter containing agricultural adsorbent:

- The filter is of height 33 cm and diameter 25cm. The layers of filter media are laid using sand, coarse aggregates and the appropriate adsorbent.
- In the first layer, coarse aggregates used are of sizes passing through IS sieve 40mm and retained on 20mm at thickness of 5cm.

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- The second layer of coarse aggregates used are of sizes passing through IS sieve 10mm and retained on 4.75mm at thickness 3cm.
- The third layer is of coarse sand of size passing through IS sieve 4.75mm and retained on 2mm at thickness of 4.5cm.
- The fourth layer is of medium sand of size passing through IS sieve 2mm and retained on 600 micron at thickness 8cm.
- The fifth layer is of the agricultural adsorbent, 1cm for rice husk.
- The sixth layer is of medium sand of above mentioned size of thickness 6 cm.
- A layer of muslin cloth is used once below the adsorbent layer and once above it to prevent the merging of the individual layers.

After allowing the water to pass through both the filter medium, ferrous iron, Fe (II) content in the water sample is estimated by titrating using potassium permanganate solution.

Procedure:

- Approximately 0.8g of $KMnO_4$ is weighed and transferred to 250ml water taken in a 500ml beaker and dissolved. The solution is boiled gently for about 20 minutes and then cooled to room temperature. The solution is filtered and stored in a clean dark brown coloured bottle.
- About 0.63g of oxalic acid is weighed out accurately and transferred into a 10ml volumetric flask and dissolved in water. Make up the volume to 100ml mark.
- 10ml of 0.1N oxalic acid is pipetted out into a 250ml conical flask. 10ml of 4N H_2SO_4 is added and mixed well. The solution is heated on wire gauze till the flask is unbearable to touch (-60^{o}C). Now it is titrated with $KMnO_4$ giving swirling motion to the flask. The end point will be a faint pinkish colour. The process is repeated for concordant readings.

III. RESULTS AND DISCUSSIONS

Observations by titration for the analysis of iron in water (not suitable for low concentration solutions)

Let, Strength of Oxalic acid solution = N1
Volume of Oxalic acid solution, V1=10ml
Strength of potassium permanganate solution ($KMnO_4$)= N2
Volume of potassium permanganate solution ($KMnO_4$) = V2
Burette readings:

Table 1: Standardisation of $KMnO_4$ solution

Sl no.	Initial reading (ml)	Final reading (ml)	Volume of $KMnO_4$ V2 (ml)	Concordant Reading for V2 (ml)
1	0	8.9	8.9	
2	8.9	18.9	10	9.6
3	18.9	29	10.1	

Calculation:

10ml of 0.1N oxalic acid solution= Xml of $KMnO_4$ solution
We have,

$V1*N1= V2*N2$
$N2=(V1*N1)/V2$
$=(10*0.1)/9.6$
$=0.1041$ N

Table 2: Burette readings: (For iron sample before passing through charcoal filter)

Sl no.	Initial readings (ml)	Final readings (ml)	Volume of $KMnO_4$ (ml)	Concordant reading for V3 (ml)
1	0	15.8	15.8	12.63
2	15.8	26.9	11.3	
3	26.9	37.9	11	

Table 3: Burette readings (For iron sample after passing through charcoal filter)

Sl no.	Initial readings (ml)	Final readings (ml)	Volume of $KMnO_4$ (ml)	Concordant reading for V4 (ml)
1	0	2.3	2.3	2.13
2	2.3	4.3	2	
3	4.3	6.4	2.1	

Calculations (for charcoal filter):

1ml of 0.1N $KMnO_4$ = 0.005585g, Fe
V3 ml of N2 $KMnO_4$ = (0.005585*V3*N2)/0.1
= 0.0734g, Fe
10ml of Fe2+ solution contains = 0.0734g, Fe
Amount of Fe per litre of the given solution = 0.0734*100g
= 7.34g
Similarly V4 ml of N2 KmnO4 = 0.01238g, Fe
Amount of Fe per litre of the given solution = 1.23g

Table 4: Burette readings (For iron sample before passing through rice husk filter)

Sl. No.	Initial readings (ml)	Final Readings (ml)	Volume of $KMnO_4$ (ml)	Concordant reading for V3 (ml)
1.	0	15	15	12.3
2	15	26.3	11.3	
3	26.3	36.9	10.6	

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Table 5: Burette readings (For iron sample after passing through rice husk of 1cm depth filter)

Sl. No.	Initial readings (ml)	Final Readings (ml)	Volume of $KMnO_4$ (ml)	Concordant reading for V4 (ml)
1.	0	1.2	1.2	1.16
2	1.2	2.4	1.2	
3	2.4	3.5	1.1	

Table 6: Burette readings (For iron sample before passing through rice husk filter)

Sl. No.	Initial readings (ml)	Final Readings (ml)	Volume of $KMnO_4$ (ml)	Concordant reading for V5 (ml)
1.	0	15.1	15.1	12.63
2	15.1	26.7	11.6	
3	26.7	37.9	11.2	

Table 7: Burette readings (For iron sample after passing through rice husk of 2cm depth filter)

Sl. No.	Initial readings (ml)	Final Readings (ml)	Volume of $KMnO_4$ (ml)	Concordant reading for V6 (ml)
1.	0	0.5	0.5	0.4
2	0.5	1.1	0.6	
3	1.1	1.3	0.2	

Calculations (for filter containing rice husk):

- 1ml of 0.1N KMnO4 = 0.005585g, Fe
- V3 ml of N2 KMnO4 = (0.005585*V3*N2)/0.1
  = 0.0715g, Fe
- 10ml of Fe2+ solution contains = 0.0715g, Fe
- Amount of Fe per litre of the given solution = 0.0715*100g = 7.15g
- Similarly V4 ml of N2 KmnO4 = 0.00674g, Fe
- Amount of Fe per litre of the given solution = 0.68g
- Similarly V5 ml of N2 KmnO4 = 0.0734g, Fe
- Amount of Fe per litre of the given solution = 7.35g
- Similarly V6 ml of N2 KmnO4 = 0.0023g, Fe
- Amount of Fe per litre of the given solution = 0.23g

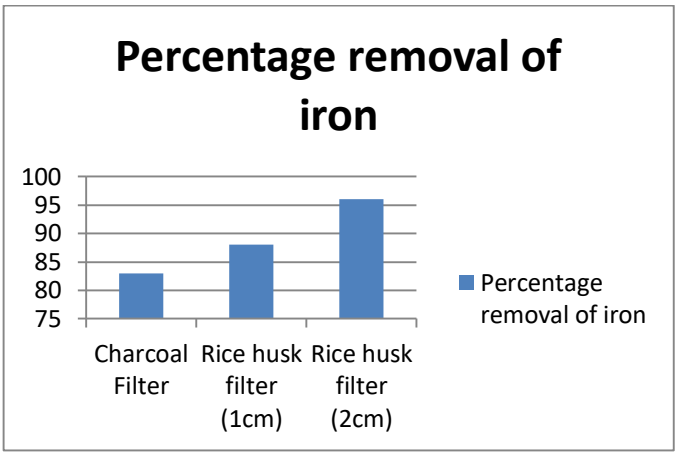

Fig 1: Comparison between the charcoal filter and rice husk filter

IV. CONCLUSION

From the study it was found that removal of iron was found to be 83% for charcoal filter and 88% and 96% in case of rice husk used filter of depth 1cm and 2cm respectively. Therefore with increase in the adsorbent dosage leads to increase in the removal of iron content from the sample.

Again Rice husk has been found to be in reasonable priced and an effective adsorbent for the elimination of Fe (II) ions from aqueous solution without requiring any pre-treatment. The test outcome has proven to remove iron to a maximum limit.

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VI. REFERENCE

Ajmal M,Khan Rao R.A,Anwar S,Ahmad J,Ahmad R (2003), "Adsorption studies on rice husk: removal

and recovery of Cd(II) from wastewater",Bioresource Technology 86:147–149.

Akiladevi A.R (2017), "Removal of iron from synthetic waste water using sawdust and ricehusk" (IJES),vol. 8, no. 6.

Balaji R (2014) et al., "Removal of iron from drinking/ground water using agricultural waste as natural adsorbent" (IJES).

Chakrabarty S (2017) "Removal of iron (II) ion from aqueous solution using tea leaves" (IJES), vol. 6, no. 12.

Dadhich A, Thatavarthy S (2015) "An assessment of efficiency of non-conventional adsorbents in removal of iron(II)", Research in Journal of Pharmaceutical, Biological and chemical sciences.

Das B, Hazarika P, Saikia G, Kalita H, Goswami D.C, Das H.B, Dube S.N and Dutta R.K (2007), Journal of Hazardous materials, 141, pp. 834-841.

Guidelines for Drinking water Quality (1984).,Recommendations, W.H.O., Vol .1, Geneva,Switzerland 79.

Kasman Monik,Ibrahim Shaliza, Salmariza (2012) "Removal of iron from aqueous solution of rice husk :Isotherm and kinetic study",Journal Litbang Industry, Vol.2 No.2.

Navratil J.D, and Tsair M.T.S (2002), Magnetic separation of iron and heavy metals from water, Water science and Technology, 47, 29-32.

Punmia B C and Jain Ashok (1995), Water Supply Engineering, Firewall Media.

Ralph A.P (1993),Apparatus for removal of iron from drinking water, US Patent No. 5,180,491.

Senthamilkumar S(2014) et al "Cost economics of iron removal plants" (IJES), Volume-3, Issue-11, • ISSN No 2277 – 8160.

Yeddou, and Bensmaili A (2007) "Equilibrium and kinetic modeling of iron adsorption by eggshells in a batch system: effect of temperature", Desalination 206: 127–134.