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Removal of Iron from Ground Water Using Natural Adsorbents

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Abstract: ***Water is the very essential material to all living things for their survival. Good health condition depends on purity of water. Water may exposed to various activities such as industrial, agricultural, domestic etc which leads to the deterioration of water quality. Water quality problem typically associated with high concentration of iron content. Payyoli is a municipality town on the Malabar Coast of Kozhikode. People of Payyoli are facing serious drinking water issues due to the presence of high level of iron content. This study tries to introduce low-cost adsorbents sugarcane bagasse (SCB), coconut coir (COC) and neem leaves (NL) for the removal iron from water. Effect of parameters like contact time, pH and adsorbent dosage on iron removal were determined using each of these adsorbents.***

Keywords: Sugarcane bagasse, Coconut coir, Neem leaves, Iron

1. Introduction

Water is very essential material for all living things for their survival. Out of all water on Earth, saline water in ocean, seas and saline ground water make up about 97% of it. Remaining 2.5-2.75% contribute fresh water. Less than 0.01% of it as surface water in lakes, swamps, rivers etc. water may occur in solid form or liquid form or gaseous form. All these three forms are useful to human beings. The different human activities such as industrial activities, domestic activities and agricultural activities will leads to water pollution. Water quality problem typically associated with high level concentration of iron. Iron removal from groundwater is therefore, a major concern for most scientific researchers [19]. People of Payyoli in Calicut facing serious drinking water problems due the presence of iron in well water. The excessive iron content in drinking water will leads to unusable. This study is trying to introduce some natural adsorbents such as sugarcane bagasse (SCB), coconut coir (COC) and neem leaves (NL) for the removal of iron from drinking water. The water samples are collected from Payyoli in Calicut District.

2. Objectives

- Preparation of adsorbents using sugarcane bagasse (SCB), coconut coir (COC) and neem leaves (NL).
- Iron removal using prepared natural adsorbents.
- Determination of effect of various experimental parameters on iron removal.

3. Adsorption

Adsorption is a highly effective physicochemical process for removing heavy metals from wastewater, especially at low initial metal concentrations. Agricultural by-products such as rice husk, coconut husk, grounded coconut shells, saw dust, neem leaves and barks, sugarcane baggase, as well as waste materials such as sludge fly ash and bottom ash have been reported in this special issue for the removal of metals from wastewater [7].

Adsorption is a surface phenomenon, in which molecules of adsorbate are attracted and held to the surface of an adsorbent until equilibrium is reached between adsorbed molecules and those still freely distributed in the carrying gas or liquid [4].

4. Materials and Methodologies

4.1 Raw materials

Sugarcane bagasse (SCB), coconut coir (COC) and neem leaves (NL) are the important materials used for this project.

4.2 Chemicals Used

Concentrated Hydrochloric acid, Hydroxylamine Hydrochloride,1,10 Phenonthroline, Ammonium Acetate, Ferrous Ammonium Sulphate are the chemicals used for the study

4.3 Instruments

Instruments used are UV-VIS spectrophotometer, pH meter, Magnetic stirrer and Turbidity meter.

4.4 Preparation of adsorbents

SCB and Coconut coir were first washed thoroughly with distilled water to remove the dust particles, then soaked overnight in0.1 N NaOH solutions and again washed well with DDW. Then they were soaked in 0.1 N CH_3COOH for a period of 2–3 h to remove the traces of NaOH. It was thoroughly washed again with DDW till the wash water became colourless and then filtered, well dried, powdered and sieved before use [16].

Neem leaves are washed several times with distilled water to remove dust and other impurities. Then drying, it was ground using domestic mixer. The samples were washed with distilled water to remove colour and dried in an oven at 80 ^{0}C for 24 hours. The dried sample was stored in airtight bottles

for further use without any chemical or physical treatment [9].

4.5 Preparation of aqueous solution of iron

Stock solution of iron (1000mg/l) was prepared by dissolving calculated amount of ferrous ammonium salts in distilled water and also add sulphuric acid.

4.6 Collection of Samples

Payyoli is a municipality town on the malabar coast of Kozhikode district in south Indian state of Kerala. Three samples were collected from Payyoli of Kozhikode district.

Figure 1: Sample 1

Figure 2: Sample 2

Figure 3: Sample 3

4.7 Batch Adsorption studies

Batch adsorption study is done by adding dried adsorbent in to the samples. The sample is continuously stirred for one hour. After that filtered and analyzed using spectrophotometer[9].

5. Results

5.1 Characteristics of Samples

Parameters	Sample 1(S_1)	Sample 2(S_2)	Sample 3(S_3)
Turbidity(NTU)	215	27	53
pH	6.95	6.95	6.85
Conductivity(ms/ppt)	3.037	3.570	4.303
TDS(ms/ppt)	1.609	2.30	2.91
DO(mg/l)	8.1	9.1	9
TSS(g)	0.0088	0.0011	0.0034
Hardness(mg/l)	155	175	125
Chloride(mg/l)	8.86	35.45	26.59
Iron(mg/l)	1.86	0.84	0.95

5.2 Effect of adsorbent dosage on sample 1

The sample 1 contains 1.86mg/l iron. Contact time is kept as 60 minutes and pH 5.

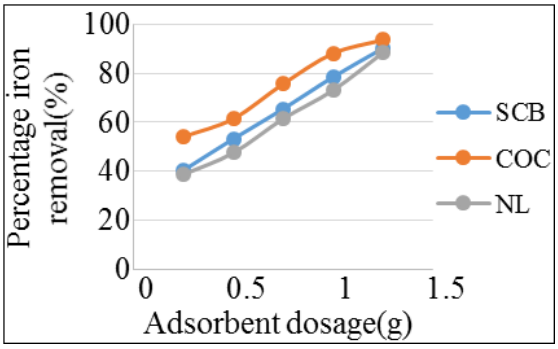

Figure 4: Percentage iron removal vs adsorbent dosage (S1)

5.3 Effect of adsorbent dosage on sample 2

The sample 2 contains 0.84mg/l iron. Agitation time is 60 minutes and pH 5.

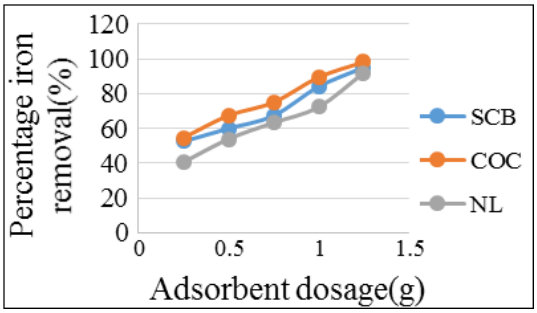

Figure 5: Percentage iron removal vs adsorbent dosage (S2)

5.4 Effect of adsorbent dosage on sample 3

The sample 3 contains 0.95mg/l iron. Contact time is 60 minutes and pH is 5.

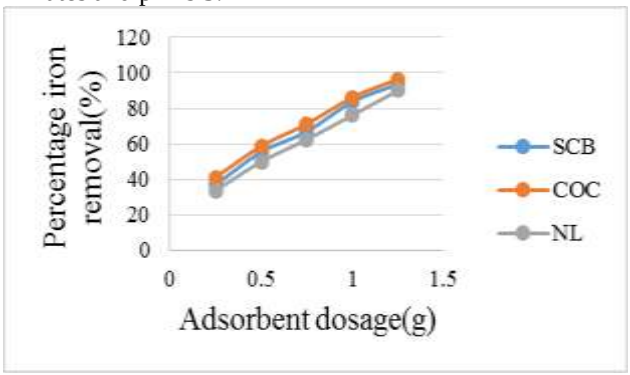

Figure 6: Percentage iron removal vs adsorbent dosage (S3)

Result shows that on increasing the adsorbent dosage the iron removal efficiency also increases. At higher adsorbent dosage more binding sites are available [16].

5.5 Effect of contact time on sample 1

The sample 1 contains 1.86mg/l iron. Adsorbent dosage is 1.25g and pH is 5.

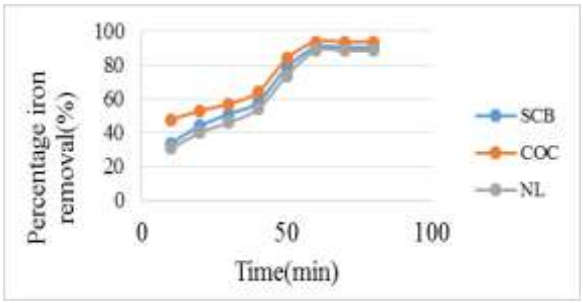

Figure 7: Percentage iron removal vs time (S1)

5.6 Effect of contact time on sample 2

The sample 2 contains 0.84mg/l iron. Adsorbent dosage is 1.25g and pH is 5.

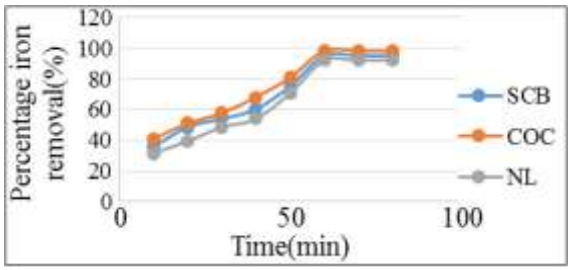

Figure 8: Percentage iron removal vs time (S2)

5.7 Effect of contact time on sample 3

The sample 3 contains 0.95mg/l iron. Adsorbent dosage is 1.25g and pH is 5.

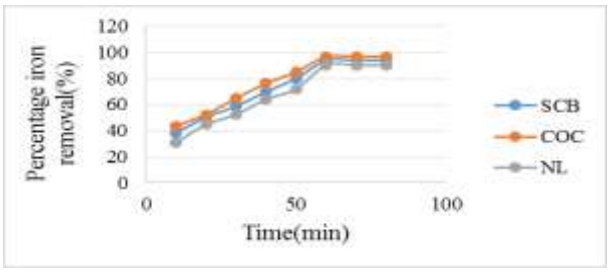

Figure 9: Percentage iron removal vs time (S3)

On increasing the contact time the iron removal efficiency also increases. After 60 minutes of shaking the adsorbenst get saturated. All binding sites were filled with adsorbate [16].

5.8 Effect of pH on sample 1

The sample 1 contains 1.86mg/l iron. Adsorbent dosage is 1.25g and contact time is 60 minutes.

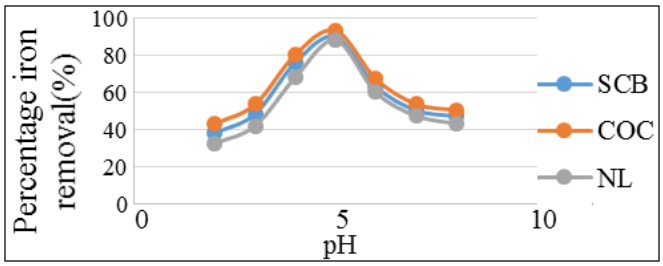

Figure 10: Percentage iron removal vs pH (S1)

5.9 Effect of pH on sample 2

The sample 2 contains 0.84mg/l iron. Adsorbent dosage is 1.25g and contact time is 60 minutes.

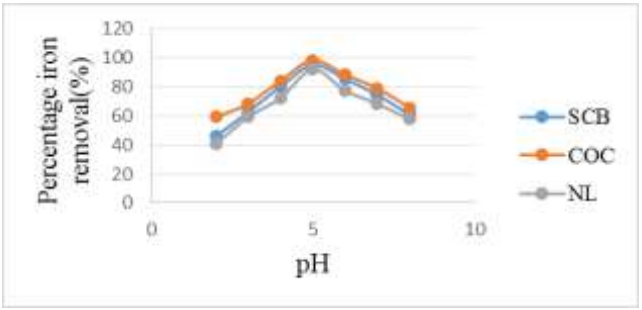

Figure 11: Percentage iron removal vs pH (S2)

5.10 Effect of pH on sample 3

The sample 2 contains 0.95mg/l iron. Adsorbent dosage is 1.25g and contact time is 60 minutes.

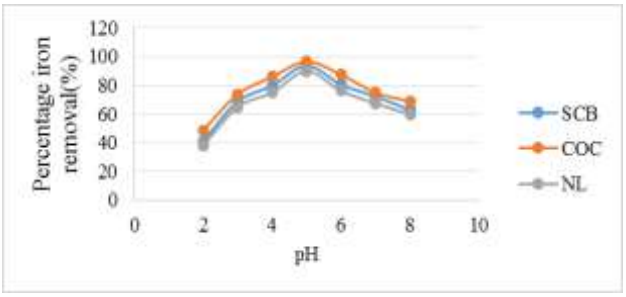

Figure 12: Percentage iron removal vs pH (S3)

On increasing the pH removal efficiency also increases upto certain limit and then efficiency decreases. Optimum pH is obtained as 5 for three adsorbents.

6. Discussions

The physicochemical analysis of the samples shows that it contains high level of iron content and turbidity values. According to WHO allowable limit of iron in water is 0.3mg/l. As per IS 10500: 2004 drinking water standards desirable limit of turbidity is 5 NTU. Here both turbidity and iron exceed the limit. On the basis of the results it is clear that the three adsorbents SCB, COC and NL have significant effect on iron removal. Contact time, pH, and adsorbent dosage have significant effect on iron removal. On increasing the adsorbent dosage0.25-1.25g of different adsorbents the iron removal efficiency also increases. At higher adsorbent dosage more binding sites are available hence the efficiency is increases. The contact time is also varied 10-60 minutes. Maximum efficiency obtained 60 minutes of shaking. After 60 minutes the adsorbent is saturated. Initial concentration is also affect the removal efficiency. COC adsorbent has better iron removal efficiency than SCB and NL adsorbent. The pH is varied 2-8. When pH of the sample increased the removal efficiency also increases then decreases.

7. Conclusions

- This study shows that the three adsorbents have significant effect on iron removal.
- On comparing the three adsorbents the iron removal for coconut coir is higher than that of neem leaves and sugarcane bagasse.
- Since sugarcane bagasse, neem leaves, coconut coir are easily available and ecofriendly it can be used for the removal of iron from water.

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