DEVELOPMENT OF LOW COST FILTER USING HERBAL TECHNIQUE

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

BY

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DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY

ROURKELA– 769008

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UNDER THE GUDANCE OF

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ROURKELA

CERTIFICATE

This is to certify that the project entitled **"DEVELOPMENT OF LOW COST FILTER USING HERBAL TECHNIQUE"** by ABHIJEET KUMAR [Roll no 110CE0503] in partial fulfilment of the requirements for the award of Bachelor of Technology degree in Civil Engineering at National Institute of Technology (Deemed University) in an authentication work carried out by her under my supervision and guidance.

To the best of my knowledge the matter embodied in the project has not been submitted to any other university/institute for the award of any degree or diploma.

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ROURKELA-769008

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My heart pulsates with the thrill for tendering gratitude to those persons who helped in completion for my project. The pleasant point of presenting a report is the opportunity to thank those who have contributed to build my knowledge. Unfortunately, the list of expressions of thank no matter how extensive is always incomplete and inadequate. Indeed this page of acknowledgement shall never be able to touch the horizon of generosity of those who tendered their help to me.

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Abstract

It is well known fact that clean water is absolutely essential for healthy living. Adequate supply of fresh and clean drinking water is a basic need for all human beings on the earth, yet it has been observed that millions of people world wise are deprived of this. Clean water use being a prime concern in many communities of developing countries. Contaminated water plays significant role in taking numerous lives in these localities, for which a number of efforts are being made for accessing safe purified drinking water. Fortunately, efficient and cheap water purification systems are being utilized and being tried to be accessed worldwide for easy access to clean water.

In the following project we had tried to develop a "Low Cost Water Purification Technique" using the basic ideas of bottle filter, some locally Herbal available filter material like Tulsi leaves powder, Neem leaves powder, Rice Husk, Sugarcane bagasse, fine graded sand and tries to improve the methodology using the UV Filter, RO Filter, and Activated Carbon Filter mechanism. Main focus was removal of iron from surface water by adsorption technique. Among all the herbal material used, the ash produce from rice husk was proved to give the best result in removal of iron and also available in local area having the cheapest material cost. Locally collected Sugarcane cane bagasse and neem leaves powder mixed with calcium hydroxide (chuna) was prepared which also proved to be effective for removal of iron.

CHAPTER 1

INTRODUCTION

1.1General:

During 17th century, Sir Francis Bacon made an attempt to desalination sea water by passing the flow through a sand filter. However the experiment was not succeed, but made the beginning of a new interest in this field. Pure water refers to all types of water from which chemicals are removed by different processes. The need of Purified water is absolutely essential for healthy life and it has great impacts on people's everyday life, especially in the rural and remote areas where access to safe drinking water is very crucial. Surface water often is the only source being used by human beings for domestic purpose mostly, thus water contaminations are difficult to avoid due to rigorous and reckless use of surface water.

Unsafe drinking water may result in serious health problems and fatal diseases. According world health organization 1.1 billion people lake access to an improved drinking water supply, 88 % of the 4 billion cases of diarrhoea disease are attributed to unsafe drinking water and 1.8 billion people die from diarrhoea diseases each year (WHO, 2007). Statistics shows that these diseases resulted in ninety per cent of all deaths of children under five years old in developing countries, due to low immunization of children to infections. Reducing death from water borne diseases is a major goal of public health in developing country. Despite of fulfilment of requirement of drinking water standards, the municipal water in used in developing countries is being improved and cost efficient water filtration techniques are being developed commonly used to improve taste or to eliminate any undesired matters.

In the past, various types of filters have been designed to be more suitable for the rural areas of the countries, but the cost as well as the filter effectiveness is still not satisfactory and further improvement is still required Hazeltine (1999)[17]. Drinking water is being the biggest issue nowadays in India. Most of the people in the rural areas are not able enough to use water filters or buy mineral water bottles. To overcome this problem many efforts have been done due to which cleaning water may become an affordable commodity. Every house hold should be able to develop its own drinking water purification system; this should be the aim of development of any low cost water purification technique. In this context a number of contributions that has been made where the filter media varies from a layer of simple cotton cloth to composite nano materials. Some of the typically used water filtration methods in India have been discussed here.

In some of the rural areas, women use cotton cloth layers for water filtration Ramachandran (2006)[16].. This method is very cheap, cost effective in removal of sediments or any suspended solids, but may be not completely suitable for drinking purpose. Some places people are using simple plastic bottles with open end, inside which a layer of bone char followed by a layer of sand and a layer of pebble on both sides of the bone char layer is being used through which water will be passed for filtration. This kind of filtration process is capable of removing sediment and microbes effectively from water.

Solar distillation and solar sterilization are the recent but convenient technologies developed as a low cost water filtration process LeMar et al (2010)[15]. In this process water filled clean plastic bottles are left in sun for several hours so that the UV radiation and the heat generated will be able to kill the microbes present in water causing many water borne diseases. Now these methods are improvised by using thermal indicators inside the bottle letting the users know when it will be safe to drink the water. But despite of being cheap and effective, this method is a function of availability of solar light. So maybe not abundantly used in water purification process. In comparison with solar sterilization, the solar distillation technique is even capable of purifying muddy water or salty water through the process of evaporation and condensation.

Recently Indian institute of technology Madras (IITM) has developed an effective low cost water filtration model specifically meant for rural areas which uses a cheap plastic mesh which is capable of removing 98 percent of impurities from water including pathogens pradeep, et al (2013)[18].The cost of the filter is somewhat Rs 700 to 800 and very easy for reuse. Another recent development of IIT M is development of composite nano material used as a filter media which capable of removing toxic metal ions as well as killing the pathogens. The filter is worth rupees Rs 500 excluding the cartridge. Another attractive feature of this filter media is that the cartridge can be reused by simply boiling in water or rubbing with lemon juice which is easily available in common households.

India's largest company Tata Group has developed a very cheap water filter known as "Swach", cost of which is less than Rs1000. It uses nano-technology for filtration and silver particles for eradicating bacterial contamination.

Ultimately the aim of development of any low cost water filtration model should be to operate with minimum energy, minimum maintenance, cost effective, environment friendly, implementable with ease and can be developed from local artisans. This will subsequently inspire the people to put hygiene in to habit and of course will help in the social and economic growth of the country.

1.2 Objectives

The scope of this project is to study the existing water filtration methods, and use the knowledge to design a **Low cost water filtration using herbal technique**. This water filtration system made by bottle, which will focus on cutting down the cost while maintaining filter effectiveness, by providing affordable water filters for the rural and remote areas, will greatly improve people's quality of living, and reduce the risk of any waterborne diseases therefore saving lives.

- Critical analysis of various herbal techniques used for identification of water purification.
- Most suitable method for removal of toxic element.
- Development of low cost water purification equipment using different herbal (Tulsi leaves, Neem leaves, Rice husk, sugarcane bagasse, etc.).
- Comparison of Result.

CHAPTER 2

Literature Review

Ajmal (2002) studied adsorption on rice husk: removal and recovery of Cd (II) from waste water. Here phosphate-treated rice husk (PRH) showed that adsorption of Ni (II) and Cd (II) was greater when PRH was used as an adsorbent. Sorption of Cd (II) was dependent on contact time, concentration, temperature, adsorbent doses and pH of the solution. The Langmuir constants and thermodynamic parameters have been calculated at different temperatures. It was found that recovery of Cd (II) from synthetic wastewater by column operation was better than a batch process.

Wong (2002) studied Removal of Cu and Pp by tartaric acid modified rice husk from aqueous solution. They studies on the modification of rice husk by various carboxylic acids. The results showed that tartaric acid modified rice husk (TARH) had the highest binding capacities for Cu and Pp. The carboxyl groups on the surface of the modified rice husk were primarily responsible for the sorption of metal ions. A series of batch experiments using TARH as the sorbent for the removal of Cu and Pp showed that the sorption process was pH dependent, rapid and exothermic. The sorption process conformed to the Langmuir isotherm with maximum sorption capacities of Cu and Pp. The uptake increased with agitation rate. Decrease in sorbent particle size led to an increase in the sorption of metal ions and this could be explained by an increase in surface area and hence binding sites. Metal uptake was reduced in the presence of competitive cations and chelators. The affinity of TARH for Pp is greater than Cu.

Daifulla (2002) studied Utilization of agro-residues (rice husk) in small waste water treatment plans. Rice husk can be made into sorbent materials which are used in environmental remediation. This study characterized and evaluated two types of sorbents made from rice husk. The efficiency of both sorbents in the removal of the complex matrix containing six heavy metals was c100%. These metals are Fe, Mn, Zn, Cu, Cd and Pp., which are found in the drain containing the agriculture and sewage wastewater at El-Menofiya Governorate, Egypt. The two sorbent materials were prepared according to the scheme presented. The two sorbents made from the rice husk have considerable potential for adsorption of metals of environmental concern.

Sharma and Bhattacharyya (2004) studied Absorb Adsorption of Chromium (VI) on Neem Leaf Powder. He was developed a developed a novel adsorbent from mature leaves of the Neem tree for removing metal ions from water. The adsorbent, in the form of fine powder, was found to very effective in removing chromium (v1) from aqueous solution.

Euras, et al. (2006) studied Removal of cadmium from aqueous solution by adsorption on to sugarcane bagasse. In this paper, cadmium removed by sugarcane bagasse from aqueous solution. Process for removal cd, investigated through batch experiments. First experiment of preparation of synthesis waste water and adsorbent and adsorption experiment. The adsorption processes was relatively fast and equilibrium was achieved after some duration. The optimum adsorption of cd occurred at ph. range 5-7. The kinetic process of cd adsorption on to sugarcane bagasse was tested by applying pseudo first order, second order and intraprtide diffusion rate equation. The equilibrium data fitted the Langmuir isotherm model & maximum adsorption capacity determined.

Venkateswarlu et al. (2007) Department of Chemical engineering; Andhra University, Visakhpathanam (India) studied Removal of chromium from an aqueous solution using Neem leaf powder as an adsorbent. He was investigated; Neem leaf powder is used as an adsorbent for the removal of chromium from aqueous solution.

Thomas et al. (2009) Department of Chemical Engineering, University of Benin, Benin City, Nigeria in studied Bio sorption of Heavy Metal Ions from Aqueous Solutions Using a Biomaterial. The aim of this work is to study the removal of toxic heavy metal ions by Neem leaves from synthetic waste water and to offer this bio sorbent as local replacement for existing commercial adsorbent materials.

Ashoka and Inamdar (2010) studied Adsorption removed of methyl red from aqueous solution with treated sugarcane bagasse and activated carbon. Paper reported that methyl red dye removed by sugarcane bagasse, an angro industry waste from the waste water. In this process, sugarcane bagasse treated with formaldehyde and sulphuric acid. The adsorption capacities of both treated bagasse were examined at varying ph. initial dye concentration, adsorbent dosage, contact time and temperature and compare the treated bagasse with commercially available powdered activated carbon. The effect of ph. adsorbent dosage, initial dye conc.., and temperature on removal of dye was examined for different times. It was observed that adsorption efficiency of sulphuric acid treated bagasse was higher than formaldehyde treated bagasse.

Pandhare and Dawande (2010) studied Neem leaves powder as low –cost adsorbent and its characteristics. Adsorption has been used successfully in the removal of impurities from effluents. He was developed the Neem leaves powder activated using chemical treatment as low-cost adsorbent.

Ganvir, et al. (2011) studied the removal of fluoride from groundwater by aluminium hydroxide coated Rice husk ash [12, 13]. Activated aluminum hydroxide has been used for activating the RHA surface which forms a complex with fluoride ion in water and accelerates the process of removal.RHA was obtained by controlled burning of dry and crushed rice husk and treating with hydrochloric acid before activation.

Bhattacharjee (January 2013), studied Disinfection of Drinking Water in Rural Area Using Natural Herbs. Here tulsi leaf and neem leaf used for purify of water and check coliform reduction in water samples by Aqueous leaf extract, Alcoholic leaf extract and Fresh leaf juice

CHAPTER 3

Filtration Model Development And Materials Used

3.1 Filtration Model Development:

Here we have manufactured a simple cylindrical filtration bottle as shown in Figure 3.1(a) with the Following dimension:

- Length=15 cm.
- Internal diameter = 7.3 cm.
- Base and top is covered with a sponge of 2 cm thickness as per fig 3.1(b).
- From the base, outlet pipe is extended to collect water with a tap as shown in fig 3.1(a) to regulate filtered water.
- Top of the cylinder filter bottle was covered with a cap of 0.5mm thickness as shown in figure 3.1(a).
- A hole of 12mm diameter was made to connect with the inlet pipe.

In the proposed design of the model, the prefabricated water of known iron concentration was passed through the inlet pipe above. Inside the bottle cylinder, different adsorption media of specified thickness were placed with proper gravel support. Then after filtration, the filtered water was collected through the outlet part in a beaker and the final concentration was measured in the Atomic Absorption Spectrometer (AAS).The rate of filtration was noted and for each adsorption media, three or four samples were tested and average concentration was considered for analysing filter effectiveness.

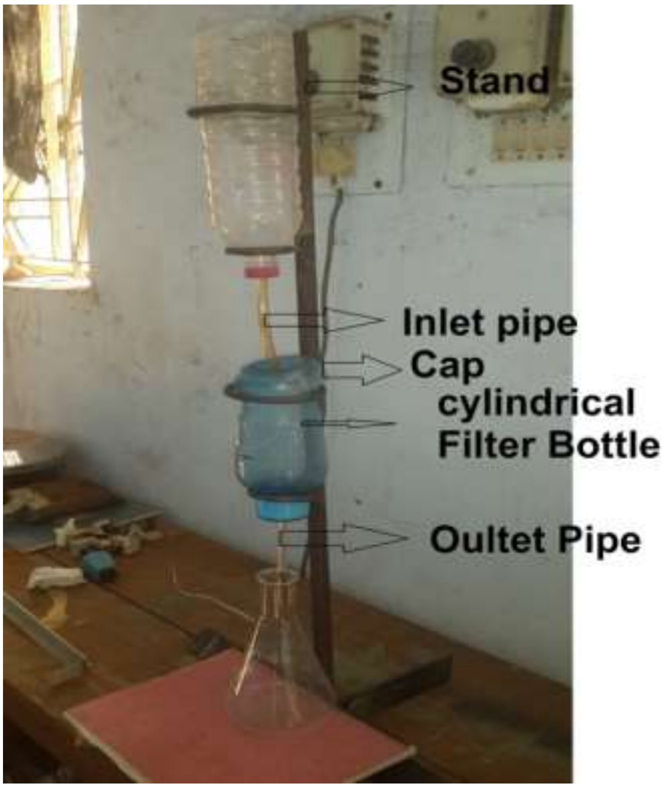

Fig 3.1(a) Filtration model **Fig3.1 (b) Sponge**

3.2 Materials used and Preparation of Adsorption Media:

Large number of scientist and environmentalist has investigated the possibility and efficiency of utilization of the herbal as an adsorbent for heavy metal adsorption in polluted water. Following materials were used in removal of iron from water, discussed below.

3.2.1 Plane Sand:

Fine sand and gravel are naturally occurring glacial deposits high in silica content and low in soluble calcium, magnesium and iron compounds are very useful in sedimentation removal. But here the media is used for iron removal from drinking water. Here for the experimentation plane sand passing through 600 Micron IS sieve were used.

3.2.2 Tulsi Leaves Powder:

The scientific name of Tulsi is Ocimum Tenuiflorum, Holy basil or Ocimum Sanctum Linn. Leaves are dropped in drinking water for purification and for medication. In all Hindu temples, water mixed with Tulsi leaves are offered to devotees every day since the herbal plant is an excellent medicinal plant found all over India and is considered sacred. The leaves, seeds and root of this plant have been used in ayurvedic medicine. Chemical composition is highly complex, containing many nutrients and other biological active compounds. It can remove fluoride levels in drinking water. Recently it's used have been found in fighting fluorosis. They are mainly two types of Tulsi. First is Shyam Tulsi having dark coloured stems and leaves and second Rama Tulsi have whitish stem and green leaves.

Here Tulsi leaves powder was used for removal of iron from water. Tulsi leaf powder was purchased from the local market of Rourkela.

Fig 3.2 Tulsi leaves powder

3.2.3 Neem Leaves Powder:

The scientific name of neem is Azadirachta indica. Neem leaf powder was purchased from the local markets of Rourkela. Neem leaves powder was taken for removal of toxic element from water. Here, two methods were adopted. First method was only neem powder used but second method was mixed thoroughly with calcium hydroxide (chuna) 1:10 ratio. Chemical formula of calcium hydroxide is Ca(OH)2. It is springily soluble in water and forms a solution called lime water.

Fig 3.3 Neem leaf powder

3.2.4 Rice husk:

Rice husk are the hard protecting covering of grains of rice. Around 20% of the paddy weight is Husk. Scientific name for rice is oryza sativa. The chemical composition of Rise husk is similar to that of many common organic fibres and it contains of cellulose 40-50%, lignin 25-30%, ash 15-20% and moisture 8-15 %(by Hwang and Chandra 1997). After burning, most evaporable components are slowly lost and the silicates are left. Low value agricultural by rice husk can be made purification of water. Rice husk was collected from a local mill in jehanabad, Bihar. The rice husk was sieved in the mesh in the range of 600 micron in order to increase its surface area. This was used as and adsorbent along with sand as a base material.

Fig 3.4 Rice Husk

3.2.5 Aluminum hydroxide coated Rise husk Ash:

Rice husk ash (RHA) is generated by burning rice husk. Cellulose and lignin are removed by burning and leaving behind silica ash. Rice hush ash was produced by controlled temperature and environment of burning process in muffle furnace at a temperature of 500 degree Celsius for 3 hours. The RHA was first soaked with 0.01 N HCl. Dry RHA of 100 gm, 0.6 M of aluminum salt (Aluminum Sulphate salt) solution and 3M sodium hydroxide was added and stirred for one hour and then the filtered rice husk ash was kept in oven for 3 hours at 373 K [12, 13].This was used as an adsorbent along with sand as a base material.

Fig. RHA coated with Al $(OH)_3$

Fig. Rice Husk Ash

Fig 3.5(c) Muffle furnace

From, fig 3.5 (c) **Muffle furnace** is a device used for heating and converts sample to ash. It is oven type equipment. Muffle furnace are most often utilized in laboratories as a compact means of creating extremely high temperature atmosphere. They have coarse and fine turn. Coarse turn used for large interval temperature but fine turn to hold very accurate and stable temperature with very little variance. They are used to test the characteristics of materials at these extremely high and accurate temperatures.

3.2.6 Sugarcane Bagasse:

Bagasse is sugarcane fiber waste left after juice extraction. Bagasse contains mainly cellulose, hemi cellulose, pentosans, lignin, sugars, wax and minerals. Sugarcane bagasse was collected from Makhdumpur in Jehanabad, Bihar. It was first washed thoroughly with tap water and again washed with distilled water to remove dirt and metallic impurities and after which it was dried in the oven at about 105 degree Celsius for 3 hours and 24 hours dried in sun light. The dried bagasse was grounded and made like fine particles to increase its surface area and 0.1M HCL was added in 100gram bagasse. This was used as an adsorbent along with sand as a base material.

Fig 3.6 Sugarcane bagasse

CHAPTER 4

METHODOLOGY

For removal of iron broadly four herbal materials had been used in the experiments i.e. Tulsi leaves powder, neem leaves powder, rice husk and sugarcane bagasse has been adopted. The following adsorption media had been experimented here for removal of iron from drinking water.

Procedure for preparation of Standard Solution:

- Standard solution of the toxic element will be prepared by mixing toxic element with the water.
- Filter model will prepared consisting sponge, sand and different herbals.
- Then standard solution will pass through the filter model and final solution obtained is the purified solution.
- Finally the content of toxic element remaining will be calculated.
- Toxic element used was iron.
- First made the iron 1000ppm standard solution.
- 3.5713 g of ferric sulphate (Fe2 (So4)3) was dissolved in 1 L of water to make 1000ppm of iron solution as 1000 ppm = (1000 mg / L Fe) * (1 g Fe / 1000 mg Fe)* (398.88 g Fe/2*55.845g Fe) *X* 1 L = 3.5713 grams. For 10ppm of iron mixed with 500ml of water, 5ml of 1000ppm solution because 1000*x=10*500 => x=5ml.

4.1 Tulsi leaves Powder:

Tulsi powder and 600 micron sand was taken. Top and bottom layer of sand having different thickness and in between a layer of tulsi leaves powder of different amount. Known concentration of 500ml of iron solution was passed through the sand and tulsi powder and filtrate was collected in a beaker then it is filtered through a Whatman filter paper. The rate of filtration was calculated and final iron concentration was measured with AAS (Atomic Absorption Spectrometer).

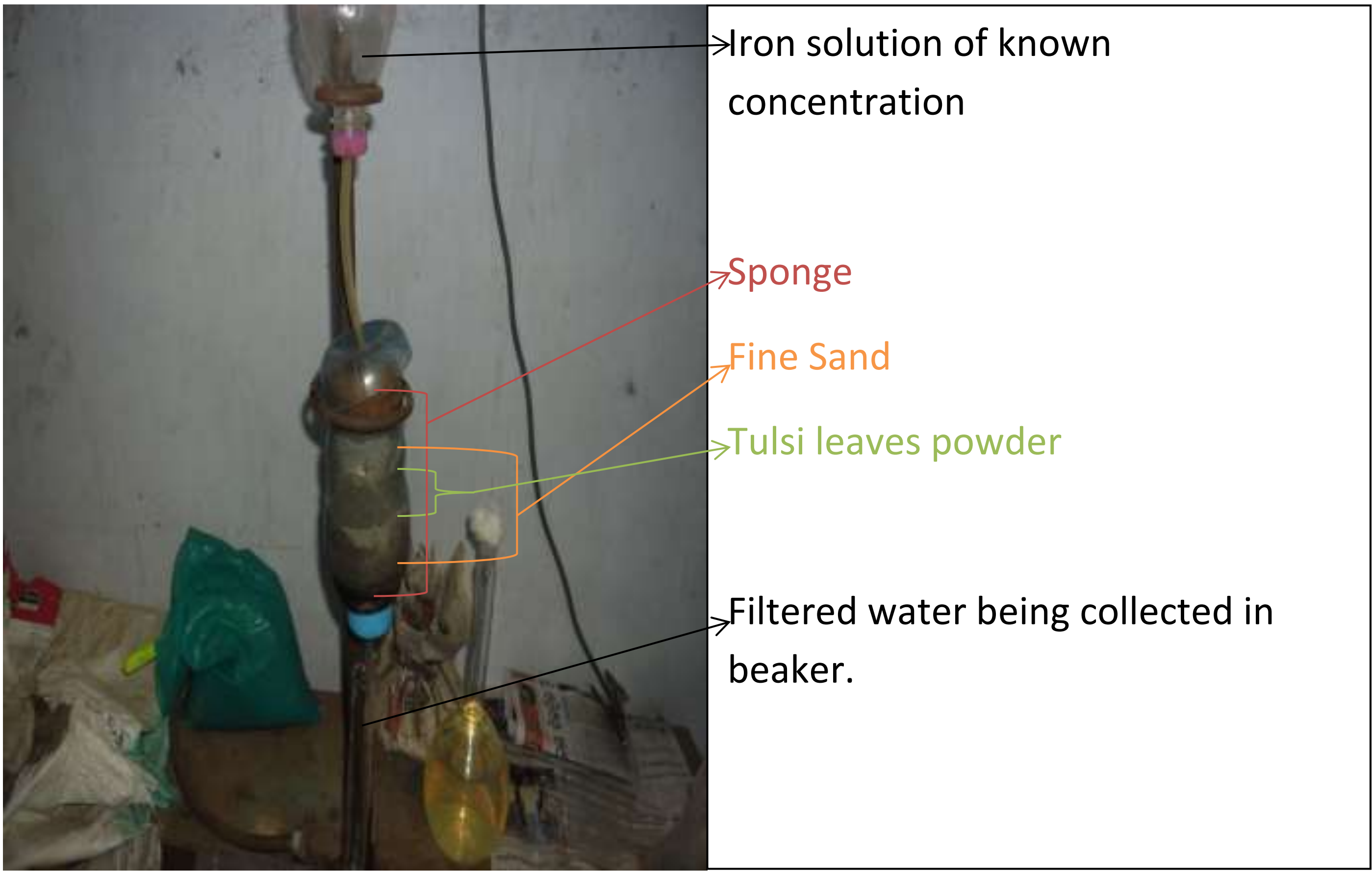

Fig4.1 Filtration with Tulsi leaf powder

4.2Neem leaves powder:

4.2.1 Method - 1

When Neem powder and 600 micron sand was taken. Top and bottom layer of sand having different thickness and in between a layer of neem leaves powder of different amount. Known concentration of 500ml of iron solution was passed through the sand and neem powder and filtrate was collected in a beaker then it is filtered through a Whatman filter paper. The rate of filtration was calculated and final iron concentration was measured with AAS (Atomic Absorption Spectrometer).

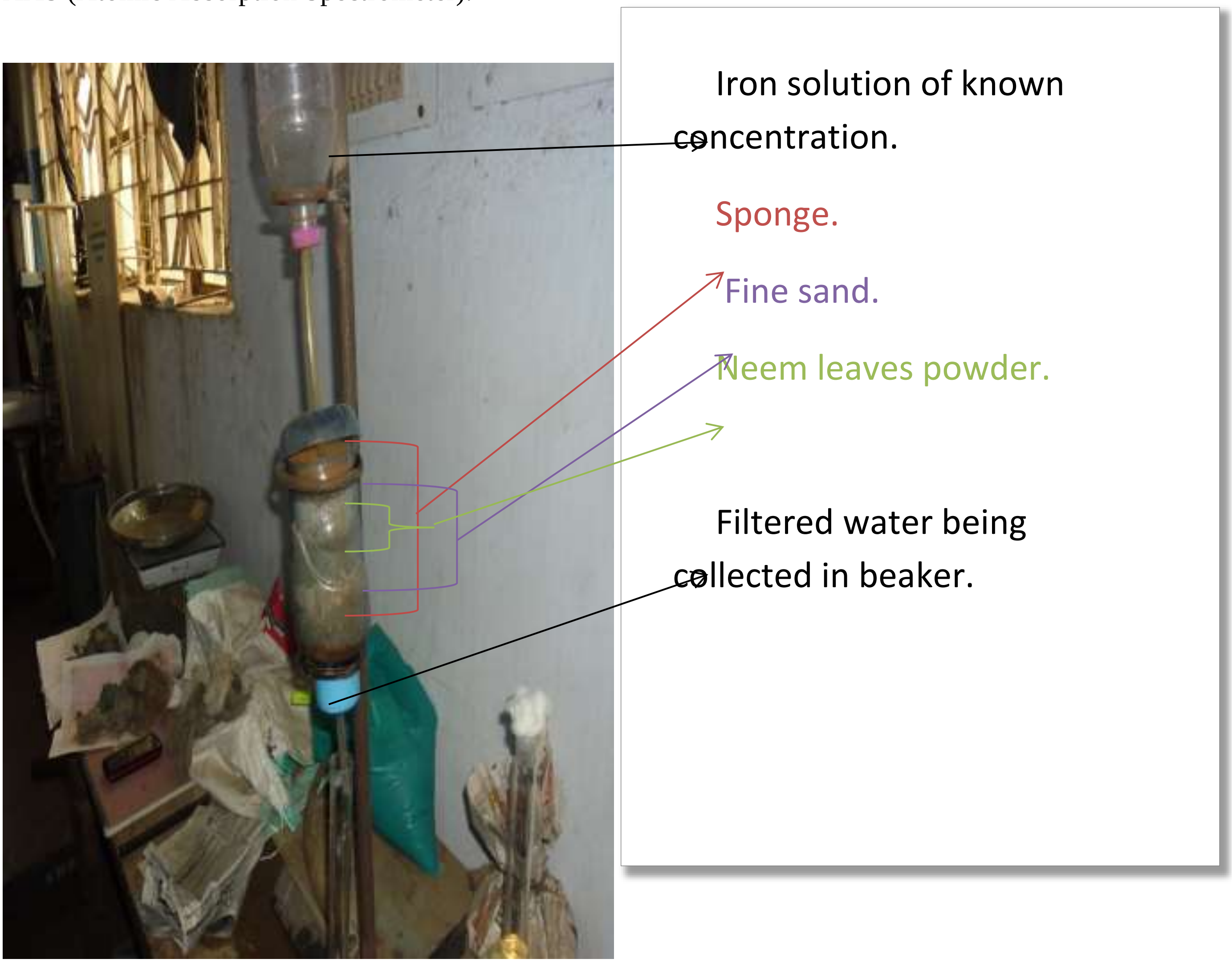

Fig4.2.1 Filtration with neem leaf powder

4.2.2 Method - 2

When neem powder treated with calcium hydroxide (chuna) and 600micron sand was taken. Here, bottom layer of sand having 2cm thickness and top layer chuna mixed neem powder of different amount. Known concentration of 500ml of iron solution was passed through the sand and neem powder and filtrate was collected in a beaker then it is filtered through a Whatman filter paper. The rate of filtration was calculated and final iron concentration was measured with AAS (Atomic Absorption Spectrometer).

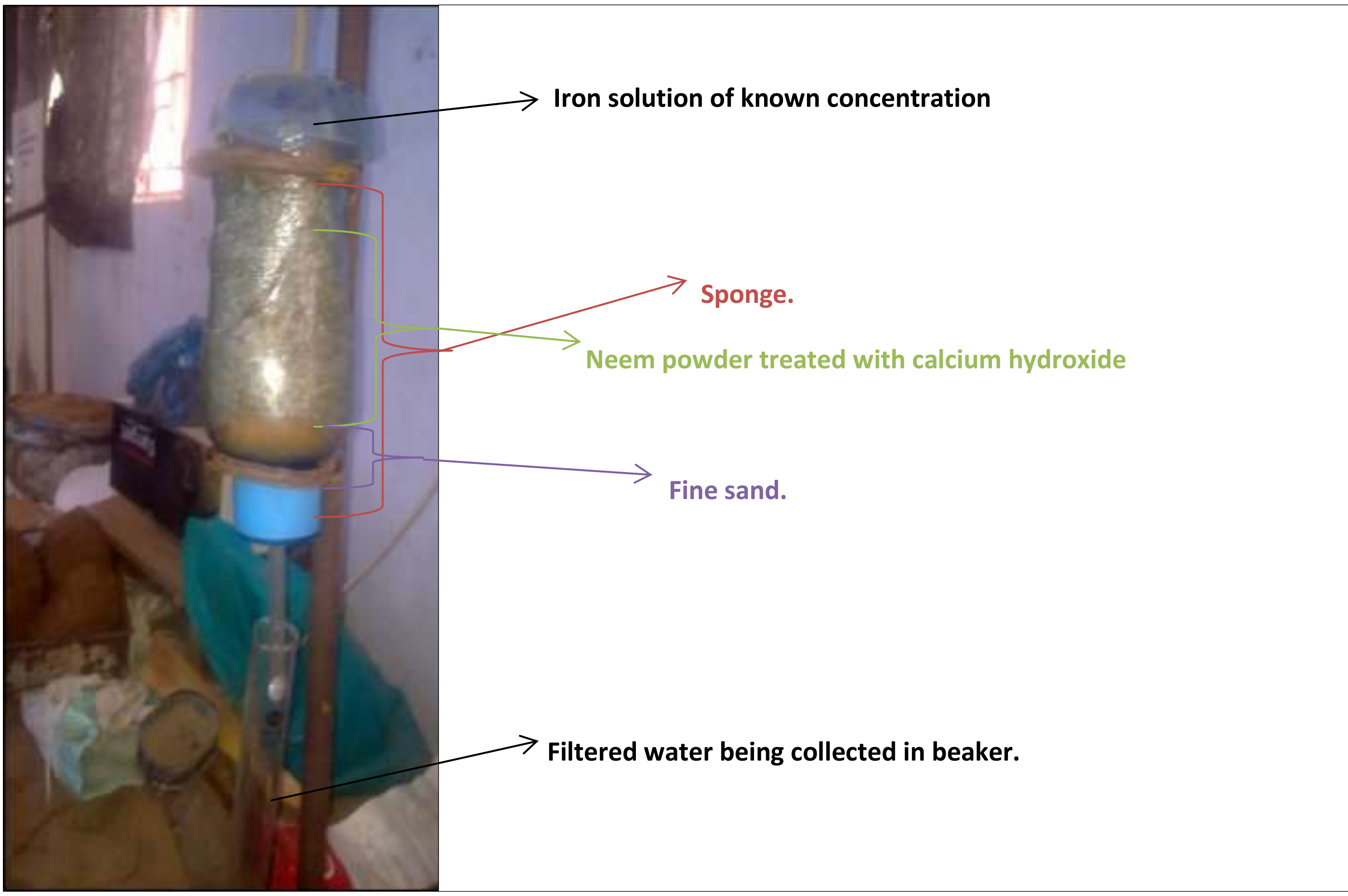

Fig4.2.2 Filtration with neem leaf powder treated with calcium hydroxide

4.3 Rice husk:

Rice husk and 425micron sand was taken. Top and bottom layer of sand having 2cm thickness and in between a layer of rice husk of 100gram. Known concentration of 500ml of iron solution was passed through the sand and rice husk and filtrate was collected in a beaker then it is filtered through a Whatman filter paper. The rate of filtration was calculated and final iron concentration was measured with AAS (Atomic Absorption Spectrometer).

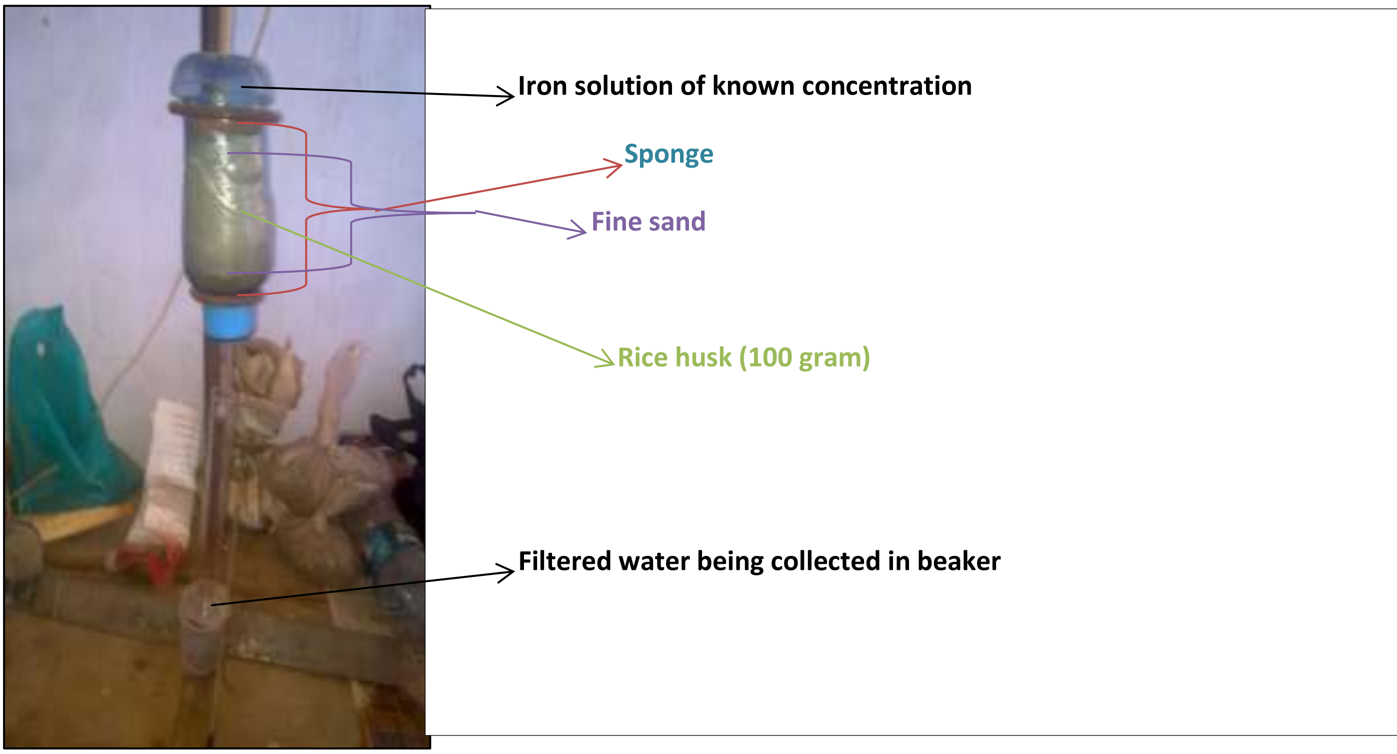

Fig4.3 Filtration with rice husk

4.4 Aluminum hydroxide coated Rice husk ash:

$Al(OH)_3$ coated rice husk and 425micron sand was taken. Top and bottom layer of sand having 3.5cm thickness and in between a layer of RHA of 6cm. Known concentration of 500ml of iron solution was passed through the sand and RHA and filtrate was collected in a beaker then it is filtered through a Whatman filter paper. The rate of filtration was calculated and final iron concentration was measured with AAS (Atomic Absorption Spectrometer).

Fig4.4 Filtration with Al(OH)3 coated rice husk

4.5 sugarcane bagasse:

Sugarcane bagasse and sand was taken. Top and bottom layer of sand having 3.5cm thickness and in between a layer of bagasse of 6cm. Known concentration of 500ml of iron solution was passed through the sand and bagasse and filtrate was collected in a beaker then it is filtered through a Whatman filter paper. The rate of filtration was calculated and final iron concentration was measured with AAS (Atomic Absorption Spectrometer).

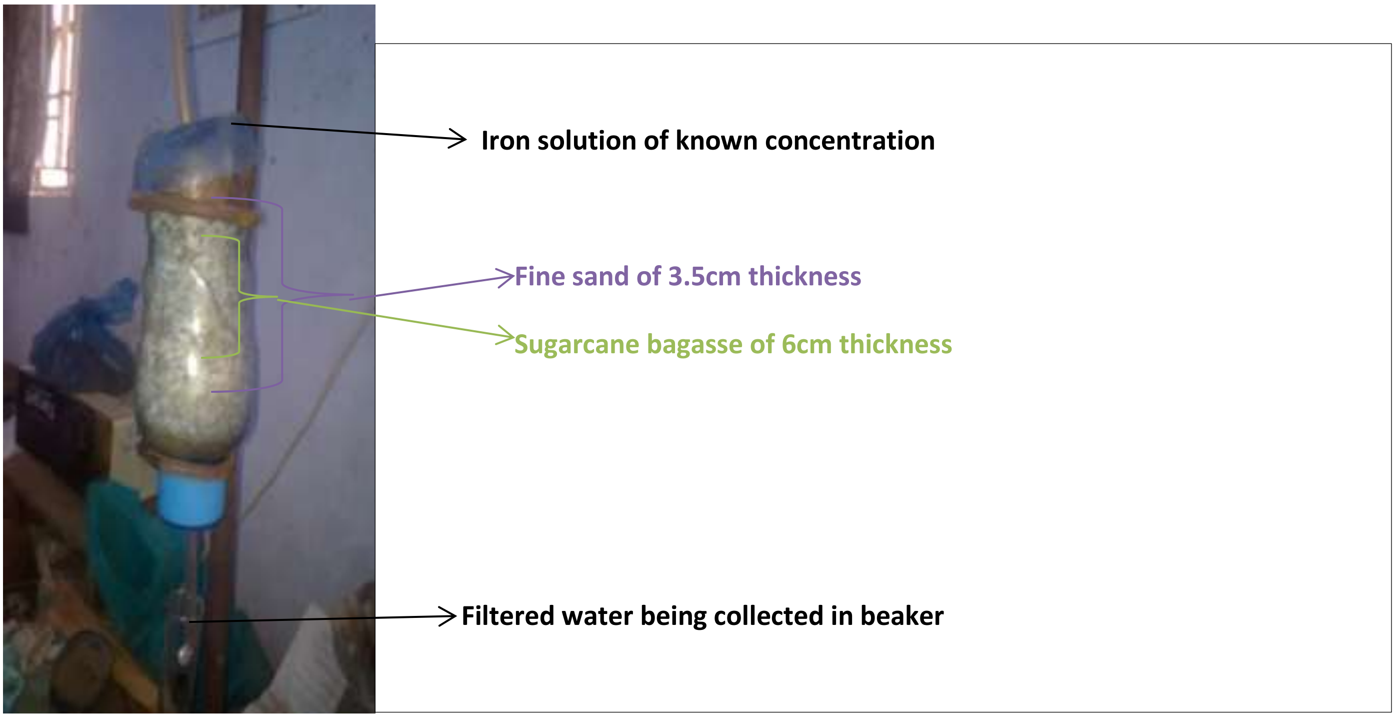

Fig4.5 Filtration with sugarcane bagasse

CHAPTER 5

Result and Discussion

5.1 Tulsi leaves powder:

The results are obtained in removal of iron by using Tulsi powder as mentioned in 4.1. The rate of filtration and the effectiveness in removing iron are tabled here. The initial iron concentration was 1.053ppm and better removal iron (in %) in sample 1 but rate of filtration in this case was lesser. The results are shown in Table 5.1 and Figure 5.1.

Table 5.1 Results of filtration in tulsi leaves powder

Sample No	**Thickness of Sand Layer (in cm)**	**Amount of Tulsi Leaf powder (gram)**	**Initial iron content (ppm)**	**Final iron content (ppm)**	**Rate of filtration (ml/min)**
1.	Top layer=2cm Bottom=3cm	50gram	1.053	0.974	185
2.	Top layer and Bottom=2cm	40gram	1.053	0.998	238
3.	Top layer and bottom=3cm	40gram	1.053	0.983	192

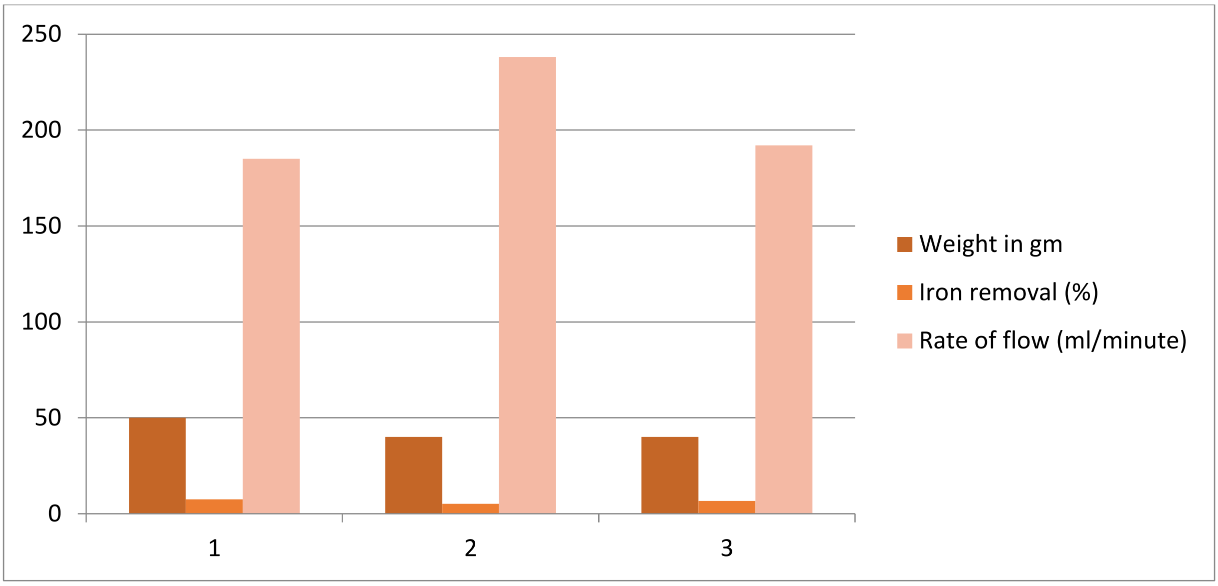

Fig 5.1 Iron removal in Tulsi leaves

5.2 Neem leaf powder:

5.2.1 The results are obtained in removal of iron by using neem powder as mentioned in 4.2.1. The rate of filtration and the effectiveness in removing iron are tabled here. The initial iron concentration was 1.317ppm and better removal iron (%) obtained in sample 3 but rate of filtration in this case was lesser. Neem leaf powder has given the better result compared to the Tulsi leaf powder. The results are shown in Table 5.2.1 and Figure 5.2.1.

Table 5.2.1 Results of filtration in Neem leaves powder

Sample no:	Thickness of sand layer(cm)	Amount of Tulsi Leaf powder	Initial iron content (ppm)	Final iron content (ppm)	Rate of filtration (ml/min)
1.	Top layer=2cm Bottom=3cm	50gram	1.317	0.710	200
2.	Top layer and Bottom=2cm	40gram	1.317	0.890	227
3.	Top layer and bottom=3cm	40gram	1.317	0.698	208

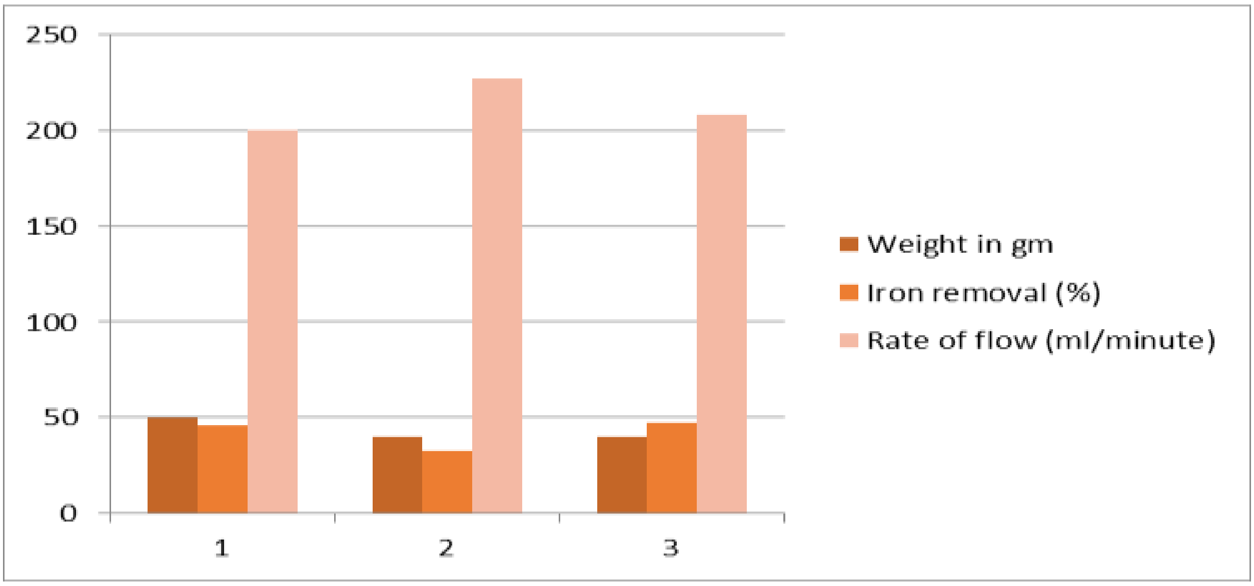

Fig 5.2.1 Iron removal in Neem leaves powder

5.2.2 The results are obtained in removal of iron by using neem leaf powder mixed with chuna (Ca (OH) 2) as mentioned in 4.2.2. The rate of filtration and the effectiveness in removing iron are tabled here. The initial iron concentration was 1.317ppm and better removal iron % in sample 1 but rate of filtration in case was lesser. It gives better result compare to the neem leaf powder. The results are shown in Table 5.2.2 and Figure 5.2.2.

Table 5.2.2 Results of filtration in neem leaf powder mixed with chuna

Sample no:	Thickness of sand layer(cm)	Amount of Tulsi Leaf powder	Initial iron content (ppm)	Final iron content (ppm)	Rate of filtration (ml/min)
1.	Bottom layer=2cm	100gram	1.317	0.579	140
2.	Bottom layer=2cm	75gram	1.317	0.632	153
3.	Bottom layer=2cm	50gram	1.317	0.676	167

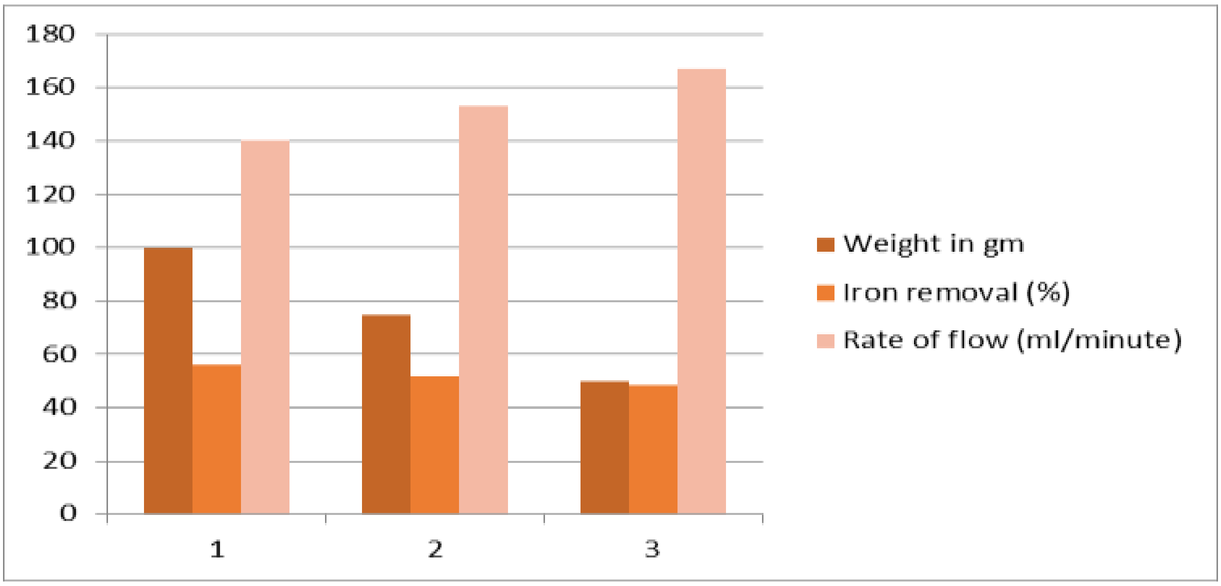

Fig 5.2.2 Iron removal with Chuna mixed neem powder

5.3 Rice husk:

The results are obtained in removal of iron by using rice husk as mentioned in 4.3. The rate of filtration and the effectiveness in removing iron are tabled here. The initial iron concentration was 2.378ppm and removal from 1.611 ppm by averaging the concentration of three samples. The results are shown in Table 5.3 and Figure 5.3.

Table5.3 Results of filtration in unmodified rice husk

Sample no.	**Size of RH (micron)**	**Initial Iron content (PPM)**	**Final Iron Content (PPM)**	**Rate of filtration (ml/min)**
1	600	2.378	1.593	160
2	600	2.378	1.569	160
3	600	2.378	1.671	160

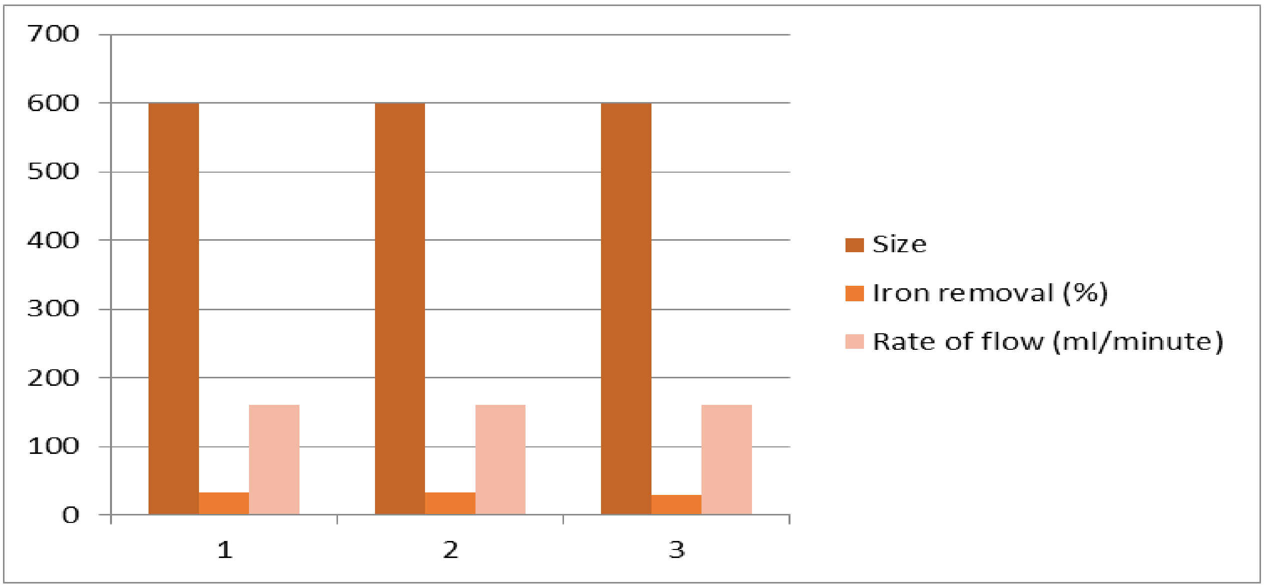

Fig 5.3 Iron removal in Rice husk

5.4 Al (OH) 3 coated Rice husk ash:

The results are obtained in removal of iron by using Al (OH) 3 coated Rice husk ash as mentioned in 4.4. The rate of filtration and the effectiveness in removing iron are tabled here. It gave satisfactory result in removal of iron compare to unmodified rice husk. The initial iron concentration was 2.378ppm and removal from 0.562ppm by averaging the concentration of three samples. The results are shown in Table 5.4 and Figure 5.4.

Table5.4 Results of filtration in modified rice husk

Sample No.	Size of RH (micron)	Initial Iron content (PPM)	Final Iron Content (PPM)	Rate of filtration (ml/min)
1	600	2.378	0.469	170
2	600	2.378	0.563	170
3	600	2.378	0.656	170

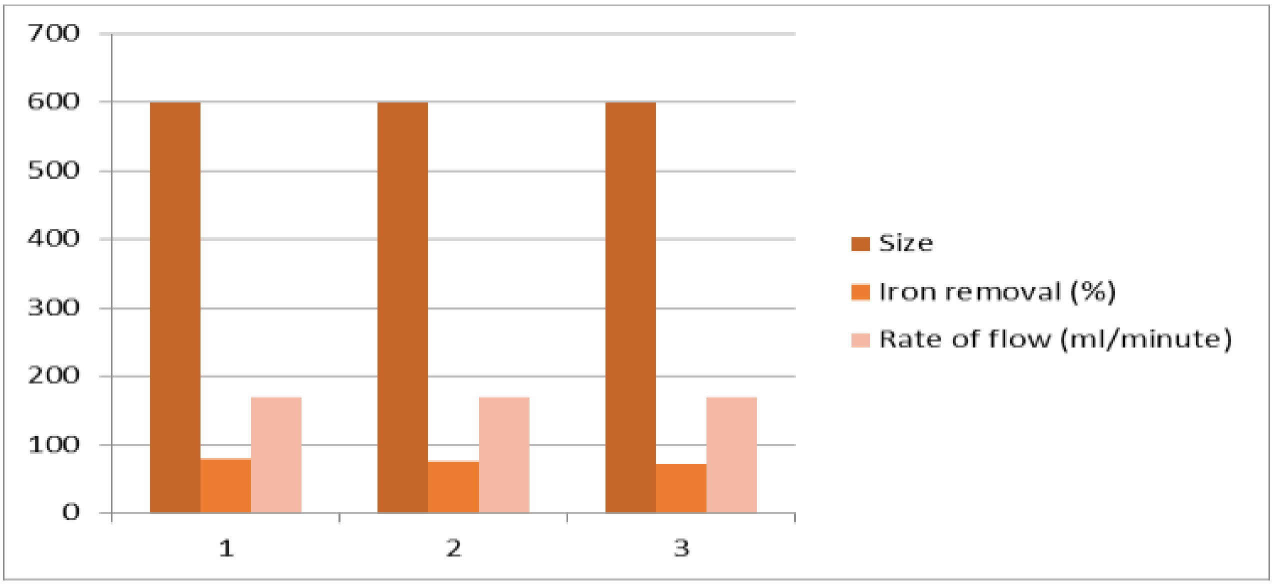

Fig 5.4 Iron removal in $Al(OH)_3$ coated rice husk

5.5 Sugarcane bagasse (SB):

The results are obtained in removal of iron by using Sugarcane bagasse (SB) as mentioned in 4.5. The rate of filtration and the effectiveness in removing iron are tabled here. The initial iron concentration was 2.378ppm and removal from 1.394ppm by averaging the concentration of three samples. The results are shown in Table 5.5 and Figure 5.5.

Table5.5 Results of filtration in Sugarcane bagasse

Sample no	**Amount of SB (gram)**	**Initial Iron content (PPM)**	**Final Iron Content (PPM)**	**Rate of filtration (ml/min)**
1.	100	2.378	1.396	220
2.	100	2.378	1.589	220
3.	100	2.378	1.297	220

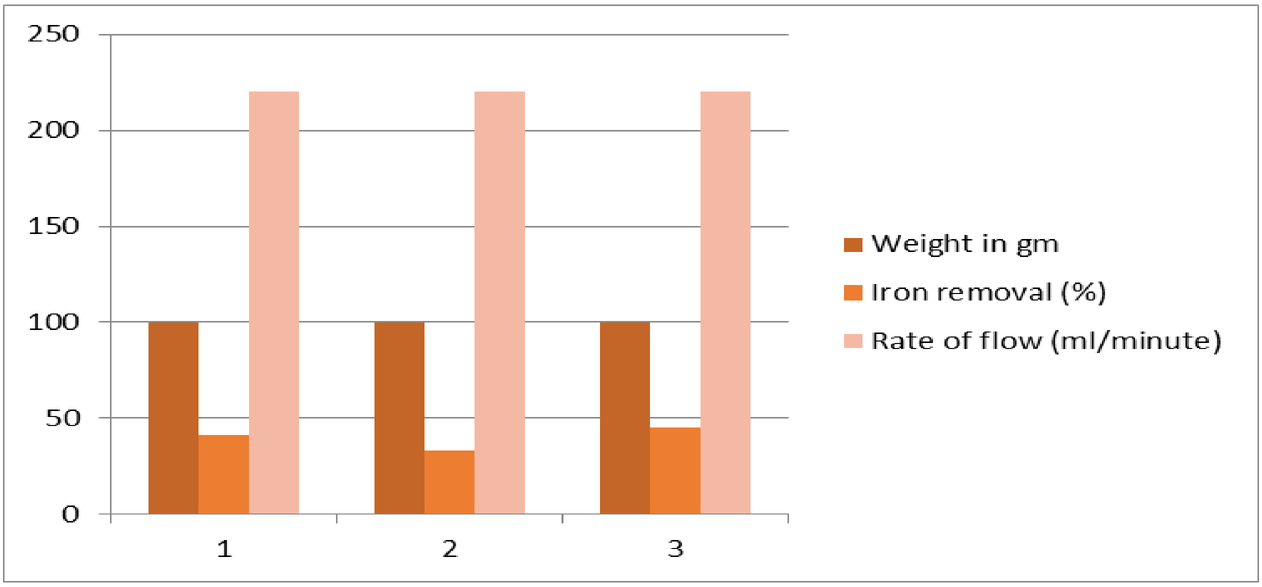

Fig 5.5 Iron removal in Sugarcane Bagasse

5.6 Comparison of result:

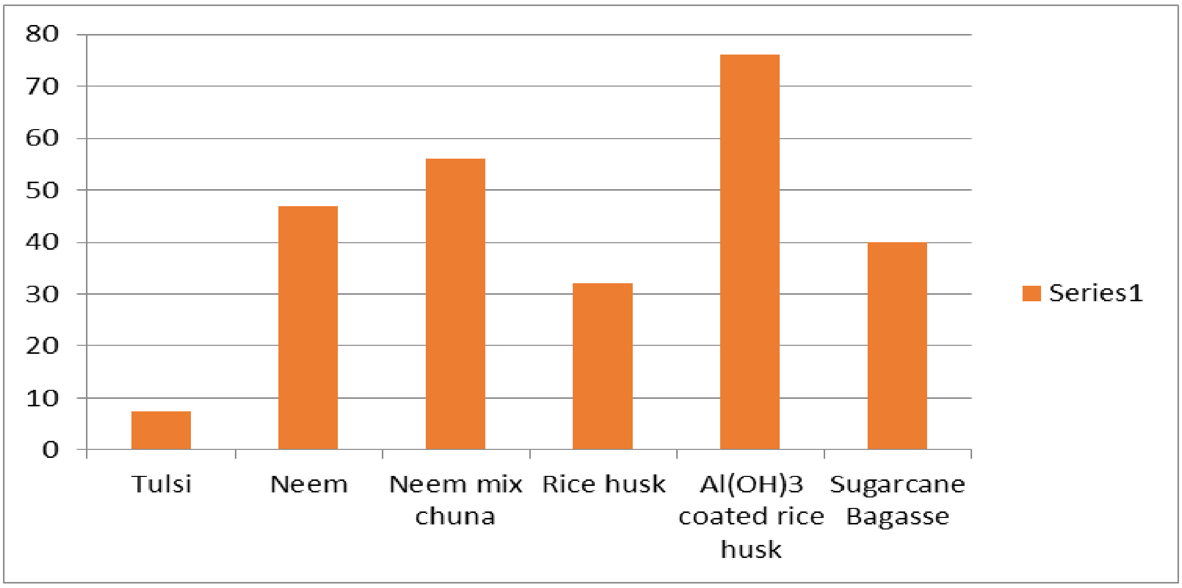

Fig5.6 Variation of % removal of irons with different herbal used

Figure 5.6, in x-axis indicated:

1 In Tulsi leaves powder, better result obtained in sample1 which removed the iron concentration was 7.502%.

2 In Neem leaves powder, better result obtained in sample3 which removed the iron concentration was 47.00%.

3 In neem leaf powder mixed with chuna, better result obtained in sample1 which remove the iron concentration was 56%.

4 In unmodified rice husk remove the iron concentration was 32%

5 modified (Al (OH) 3 coated) Rice husk was 76 %.

6 Sugarcane bagasse remove the iron concentration was 40% by averaging the concentration of three samples.

5.7 Cost of the filter

Here we have provided a chart for the cost of all the adsorbent media we have used for experimentation excluding the labour cost, maintenance cost and energy cost. Here the material cost of each adsorption media per kg used for experimentation is given in the table and the total cost as per the amount of material used is also mentioned.

Table 5.6 Material cost of different adsorbent media used in experimentation

Material	**Amount used for experiment (kg)**	**Rate per kg In rupees**	**Total cost In rupees**
Sand	0.9	15	13.5
Tulsi leaf powder	0.2	300	60
Neem leaf powder	0.3	150	45
Rice husk	0.6	20	12
Aluminum sulphate	0.05	20	1
Sugarcane bagasse	0.2	20	4
Bottle	---	- --	2

CHAPTER 6

CONCLUSIONS

- Adsorption being the simplest and cheapest technique for iron removal, it has several advantages, like longer filtration runs, shorter ripening time, better filtrate quality. But the only limitation is back wash water requirement is essential for the filter media to run effectively.
- Sand being the cheapest adsorbing surface is very effective in removal of dissolved iron from drinking water and the rate of filtration is also very high. The only demerit is subsequent development of bacterial layer due to rigorous use. Again back washing is needed time to time.
- Tulsi leaves powder is not improve to be a good adsorbent in removal of iron.
- Neem leaf powder mixed with chuna (Ca (OH) 2) proved to be good result in removal of iron compare to untreated neem leaves powder. Because modified neem powder decreased the rate of filtration.
- Aluminum hydroxide coated RHA also proved to be a good adsorbent in removal of iron. Previously Ganvir, et al. in 2011 has been experimented that it forms complexes with fluoride ion for its removal. Here in case of iron, there is no proof of formation of any complex. So the removal may be credited to roughening of RHA surface due to modification by aluminium hydroxide.

- Sugarcane bagasse, the removal is not so significant. This may be due to lager particle size of material being used. Smaller the size of particle larger will be the specific surface and better will be the removal.

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