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Development and Characterization flow cost water purification equipment using different herbal (Tulsi leaves, Neem leaves, Rice husk, sugarcane bagasse)"

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ABSTRACT: Water purification is a process of removing undesirable physical, chemicals, biologically contaminants from water. Water purification system proposed in this project focus on providing a pure drinking water at low cost with high reliability to the rural families in remote area. There are various methods available for purification of water but they are not economically feasible for poor people. Proposed system consists of combination of natural substances (tulsi & neem). It is an effective method to remove flouride from water. This method can be made portable, cost effective, user complaint and energy efficient which will be self sufficient to meet the drinking water needs. Experimentation was carried out for testing of different water samples for removal of fluoride content. Water samples selected was Well water and Bore well water, all water analyzed and tested in laboratory. 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 bagasse and neem leaves powder mixed with calcium hydroxide (chuna) was prepared which also proved to be effective for removal of iron.

KEYWORDS*:* Water Purification, Tulsi Leaves, Neem Leaves, Rice Husk, Sugarcane Bagasse

I. INTRODUCTION

Water is basic necessity of man along with food and air. Natural water resources usually available are rivers, lakes and underground water reservoirs. About 71% planet is covered with water, yet of all of that 96.5% planets water is found in oceans, 1.7% in underground, 1.7% in glaciers and the ice caps and 0.001% in the air as fog and clouds. Only 2.5% earth's water is fresh water and 98.8% of that is in ice and underground .Less than 1% of all fresh water is in rivers, lakes and atmosphere. Unsafe drinking water may result in serious health problems and harmless diseases. According world health organization 1.1 billion people lake access to an improved drinking water supply, 88 % of the 4 billion cases of diarrhea disease are attributed to unsafe drinking water and 1.8 billion people die from diarrhea diseases each year (WHO, 2007). Statistics shows that these diseases resulted in 90% of all deaths of children under five years old in developing countries, due to low immunization of children to infections. Decreasing death from water borne diseases is a major goal of public health in developing country. Although of fulfillment 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 discard any undesired matters. In the past, various types of filters have been designed to be more useful for the rural areas of the countries, but the cost as well as the filter capacity is still not comfortable and further improvement is still required. Drinking water is being the biggest issue now days in India. Most of the people in the rural areas are not able to use water filters or buy mineral water bottles. To beaten this problem many efforts have been done due to which cleaning water may become an affordable commodity. Every household 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 conditions a number of contributions that has been made where the filter media varies from a layer of simple cotton cloth to composite nano materials.

On a global scale, the decreasing availability of conventional water sources has increased the demand for high quality freshwater. This forces everybody independently to think the alternative and sustainable solutions to manage this valuable resource. In India, about 25 billion liters of untreated wastewater discharged into the water bodies every day. The untreated wastewater will lead the environment as stake and well being /health of the people at risk by increase infectious disease. However, the sources of water problem keep rising, and among of them are called greywater. In the reality, the greywater discharge is a varied significantly with time of day and day of the week and affluence of the household. The major source of greywater is the laundry and it generates about 25% of a household daily water use. The laundry outlet is the one of the greywater pollutant that affected the soil in a ditch. The laundry water containing high salt and phosphorus concentrations can lead to salt accumulations in the soil and stunting of plants with low phosphorus tolerance . Furthermore, greywater is also a wastewater derived from the kitchen, bathroom (i.e., discharge from the hand basin, shower, and bath) and laundry water. However, greywater does not include wastewater that is discharge from the toilet use but hence considered as black water. Besides, greywater is generated in different quantities between households within one community and depend on different factor such as lifestyle and household activities.

The Earth's surface has around 71% water which is mostly saline. Water is also present in the ground, air and within living organisms (Glieck et al). To survive living being need water so water is very precious which everyone needs. Even though, 97 per cent of the earth is surrounded by water, only three per cent is fresh and reaming two thirds of this is frozen form and the remaining unfrozen is mostly also found as groundwater, and a small fraction present above the ground or in the air. (Ramappa1 et al). Water is prime life sustaining natural resource and it cannot be created like any other products or commodities. It is a nature's gift to all living beings on the earth. Water is life. Unfortunately planet is running low on water conservation and safe water so it is necessary to use it carefully and reuse it as much as possible. So it is important to use naturally available water carefully. Nearly three quarters of people in the world now use piped water supplies on premises to an increase from 2.3 billion to 4.2 billion over the same period. While the number of people without an improved source has declined substantially but 663 million people still used unimproved sources in 2015, and among these, 159 million relied on surface water (WHOCEF 2017).

Water is the main constituent in our body. Human body composed mainly of water on average about 70%. Human being brain needs about 85% of water; liver requires about 90%, blood need 83% and even the bones need 35%. Therefore, consuming enough water in our daily life to stay hydrated and healthy is very important. According to the World Health Organization (WHO), over 1.34 billion people lack access to safe drinking water supplies. (Lakota et al). Water is one of the universal substances, which is used alike by all the living species to sustain life. To drink clean and pure water is necessity of human being. We rely on clean water but nowadays availability of clean water is reduced so clean water should be made available for living beings. The changes in climatic pattern has affected the river and other water bodies eventually it is affected the tap water so it is necessary to keep water bodies clean so to get potable water out of it and its use accordingly(Chandrakala et al).

Water shortage is huge problem in rural and urban areas. The huge cost is involved in water treatment process, thus result using untreated water for drinking purposes in many urban areas in India. The use of untreated or contaminated water for

drinking purpose results in causing water born-diseases like Diarrhea, Typhoid, etc and is seriously affecting the human health. The wastewater disposal from residential as well as industrial/commercial sources also is an important concern now a day. (Bibhabasu et al.).

1.1 AIM

The project aims at making a system that will provide safe water in adequate quantity effectively at low cost. This purifier will work according to the instructions given to the processor. The project will be capable of providing water in rural areas in large quantity according to requirement of drinking water of an individual houses or and community by using herbal Technique.

1.2 OBJECTIVE

- To design a Low cost water filtration using herbal technique.
- Development of low cost water purification equipment using different herbal (Tulsi leaves, Neem leaves, Rice husk, sugarcane bagasse, etc.)
- 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.
- Comparison of Result.

II. LITERATURE REVIEW

1. "Clean and Cost Effective Industrial Wastewater Treatment Technology for Developing Countries".
International Journal of Scientific and Research Publications, Volume 5, Issue 12, December 2015
Mr. TunTunNaing, KhinKhin Lay.
Author's paper deals with irradiative treatment of contaminated water with high dose of gamma rays . In this process of water purification they performed five steps. With the use of sulphuric acid they adjusted the pH value waste water of acidity adjustment. now hydrogen peroxide and ferrous sulphate are used to perform Fenton reaction which is a oxidation process. As initiator only trace amount was added. Then the gamma irradiation and sample irradiated was conducted in gamma chamber at room temperature. According to the mark the sample was filled into one litters bottle glass. Then the following doses were irradiated:0 kGy,1 kGy,2 kGy,3 kGy,…..18 kGy respectively. Now for alkaline sedimentation process the samples were carried out, after irradiation process. For next process, the pH value of sample was adjusted to value not less than 10 with calcium hydroxide for perform centrifuge method and sedimentation with gravity. For the purpose of color removal activated carbon filtration is used which is the final step of this experiment. As gamma radiation is helpful in purification of industrial waste water because they have lots of waste deposits as well as bacteria but for the normal use of water purification cannot be done with gamma radiation because it is harmful to health. But the gamma rays are harmful for human health as we are using it for drinking water.

2. "Low-cost solar water purifier for rural households".
Nimbkar Agricultural Research Institute (NARI) Phaltan, Maharashtra, India.
Mr. Anil K. Rajvanshi and AmolDalvi.
Author have discussed about technique of water purification with the help of solar energy. They used simple solar device to purify the water in their system. They started heating water using tubular solar collector.
All the harmful deposits were eliminated by heating water using solar technique but they have to heat the water until the next morning to a desired temperature. Then they have to collect it next morning. As in this process the water purification method takes a lot of time. This method is also no useful for the rainy seasons or the season where there is low

temperature . Therefore this time required is very much as if we want a purifier which has fast service. They also surveyed how many days there will be the temperature above 45 degree and analysis.

3. "Various method involved in water treatment to control water pollution". Department of chemistry , J.L Charturvedi College of Engineering, Nagpur, India.
S.S Turkar, D.B Bharti and G.S Gaikwad.
Author proposes various methods involved in waste water treatment to control water pollution. In this paper they have discussed about different characteristics of water that is physical, chemical, biological and radiological characteristics. They founded the physical characteristic as temperature, turbidity, and color. The another characteristic was chemical characteristics of water which includes pH levels hardness, and dissolves solids. Biological characteristics were having algae bacteria protozoan and viruses. They have also differentiates different parameter of natural water and waste water. What pollution was caused by the industries in water. There were also different methods available for treatment of hazardous wastes water treatment such as thermal and fixation method. They have also some a survey by year wise on the amount of water pollution by the states.

4. "Use of Pervious Concrete as Gravity Filter"
By:-Ninad Oke, Parth Choksi, Amey Naik, Nikita Mahapatra, ASABE Conference Paper, Publishing year :- Nov 2014.
In this study the usage of pervious concrete for filtration purpose is highlighted. It is well known that pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walkways, and however not much research has been done on its effectiveness to be used for filtration process. In the water purification process rapid sand filter is provided after sedimentation process. The turbidity of water entering the rapid sand filter is around 25-100 NTU depending on the season of the year. Conventionally, the filter media used is graded sand. This study was conducted to see the feasibility of using pervious concrete as a filtration media. The pervious concrete blocks used had sixteen different combinations in triplicate. The combinations used were having variability in type of cement, water cement ratio and thickness. A reduction of 69.8% turbidity for initial turbidity of 25 NTU and 66% reduction for initial turbidity of 100 NTU was observed. A 97 and 99 % MPN removal for 25 and 100 NTU of initial turbidity was observed.

5. "Design of Grey Water Treatment Units"
By:-M.Seenirajan, S.Sasikumar, Erlin Antony, International Research Journal of Engineering and Technology (IRJET). Publishing Year :- Volume:05 Issue:05 May 2018.
In this paper we have studied about composition and characteristics of grey water and using this information design of treatment units were easy. Treating wastewater will surely reduce the effects of its harm and thus increasing its usability. Once undergone through the procedure of proper treatment, you will no longer receive any bad odours. The water, thus obtained, is clean and safe for use. Grey water can replace drinking water for irrigating gardens or lawns especially during drought periods.

6. "Efficiency of Slow Sand Filter in Wastewater Treatment"
By- Teena Ann Thomas and K. Mophin Kani, International Journal of Scientific & Engineering Research. Publishing Year- Volume 7, Issue 4, April-2016.
Slow sand filtration is a technology that has been used for potable water filtration for hundreds of years. It is a process well-suited for small, rural communities since it does not require a high degree of operator skill or attention. As its name implies, slow sand filtration is used to filter water at very slow rates. The typical filtration rate is at least fifty times slower than for rapid rate filtration. It was observed that the reduction efficiency of turbidity is about 70% and the reduction in pH and electrical conductivity is also noticeable. Thus it can be concluded that the slow sand filter is efficient in treating wastewater from a particular source.

7. "A Review on Pervious Concrete"

By- Vr.Bharanidharan, K.Ashok Kumar, M. Samuel Thanaraj, International Research Journal of Engineering and Technology (IRJET). Publish year :-Volume-6, Issue-3, March 2019.

Pervious concrete is a cost-effective and environmental friendly solution to support sustainable construction. It's ability to capture storm water and recharge ground water while reducing storm water runoff enables pervious concrete play a significant role. Due to its potential to reduce the runoff, it is commonly used as pavement material. The smaller the size of coarse aggregate should be able to produce a higher compressive strength and at the same time produce a higher permeability rate. The mixtures with higher aggregate/cement ratio 8:1 and 10:1 are considered to be useful for a pavement that requires low compressive strength and high permeability rate. The ideal pervious concrete mix is expected to provide the maximum compressive strength, and the optimal infiltration rate. Pervious concrete is one of the leading materials used by the concrete industry as GREEN industry practices for providing pollution control, storm water management and sustainable design.

8. Politeknik sultan Idris Shah (2018), he worked on 'Water filter manufacturing the usage of coconut husk fiber, zeolite, charcoal and membrane for rainwater harvesting'.

Water great for the samples taken from five unique places is elevated after passing via the filters. There are a number of parameter which are regarded to be extended that pH, turbidity, color, organic oxygen demand, complete suspended solids, nitrate, zinc and sulfate. From this project, it is observed that rainwater consists a quantity of chemical compounds such as zinc, nitrate and sulfate. All samples had been harvested thru roof. There are many sources of impurities may want to be on the roof such as birds drop, materials of roof and leaves. Unclean reservoir may want to be the best location for micro organic growth. This should lead to excessive BOD reading.

9. Giridhar V S S Mittapalli (2016), he also study conducted on the " Use of Alum for Turbidity Removal in Synthetic Water".

In this the effectiveness of alum used to be evaluated at room temperature with initial pH (6-7.4) For 2 coagulant doses 10 mg/l and 20 mg/l in 250 ml synthetic high turbid water by means of adopting guide agitation at very low settling Results confirmed that coagulation technique ought to cast off turbidity effectively the use of highly low stages of Alum. Studies expose that turbidity elimination relies upon on pH, coagulant dose, also as initial turbidity of water. The absolute best turbidity removal effectivity was 46.15 p.c. over the utilized vary of turbidity. The outcomes of the cutting-edge learn about can be used as a baseline information for drinking water cure facilities which uses Alum as a coagulant.

10. Maxim Tyulenev (2016), he also conducted a study on 'Coal producers waste water purification'.

The analysis of dependence provided in graphics has showed that the change of oil products concentration C from filtering path L with high accuracy (R2 is not lower than 0.91) is approximated by expression:- $C = C0 \cdot e\text{-}0.016$lwhere, C0 - initial concentration of oil products in the waste waters discharged for purification, L - filtering path.

11. Shilpa S. Ratnoji (2014), conducted a study on 'a study of coconut shell-activated carbon for filtration and it's comparison with sand filtration'.

For conducting the pilot scale study of filtration different grades of CS-AC VIZ WT D816, WTE830 and WTE124 depending upon their sizes were produced from Indo German Carbons Limited, Kerala. These CSAC were of size 8*16 US mesh size (I, coarser), 8*30 US mesh size (II, medium), and 12*40 US mesh size (III, finer).CS-Ac were maintained at a depth of 4cm in the column. Reduction in BOD and COD is illustrated is not that pronounced and reduction in Cod and BOD proves that the organic compounds can be effectively removed by coconut shell activated carbon .coconut shell activated carbon can be looked upon for future treatment of water in removing suspended solids, iron and total organic carbon instead of sand filtration in the treatment plants and this technique is highly advantages, inexpensive and cost-effective as well as turn there will be utilization of a waste which would be otherwise simply dumped. Thus, this improvisation can be effected as a novel method as drinking water treatment taking environment into worry.

12. Karmen Margeta (2013), yet as he additionally conducted a study on 'Natural Zeolites in water treatment - however effective is their Use'

he work represented was partly supported by the Ministry of Science, Education and Sports of the Republic of Republic Croatia through the bilateral project. The distinctive natural process and surface assimilation properties, high consistence and glorious thermal stability of Zeolites create then terribly appropriate for several applications, additionally in water treatment processes. Many different studies have incontestable their effectiveness in reducing the concentrations of contaminants (metals, anions and organic matter) in water. The complexness of aquatic systems demands special attention within the choice and preparation of materials for water purification. The chemical behavior of natural zeolites in several binary compound environments, that was additionally a topic of recent geochemical and technological studies, to boot proven their pertinency, though watching of ph and it's changes, remains vital for his or her use of real environments. Further research should be focused on the optimization of the surface modification procedures to boost their efficiency and to reinforce the potential of regeneration. Moreover, detailed characterization of natural and altered zeolites is needed to lifted to understand the structure- property relationship.

III. PROPOSED METHODOLOGY

3.1 MATERIALS USED

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 analyzing filter effectiveness.

Here we have manufactured a simple cylindrical filtration bottle with the Following dimension

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

1. Plain Sand
2. Tulsi Leaves Powder
3. Neem Leaves Powder
4. Rice Husk
5. Sugarcane Bagasse

3.2 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.

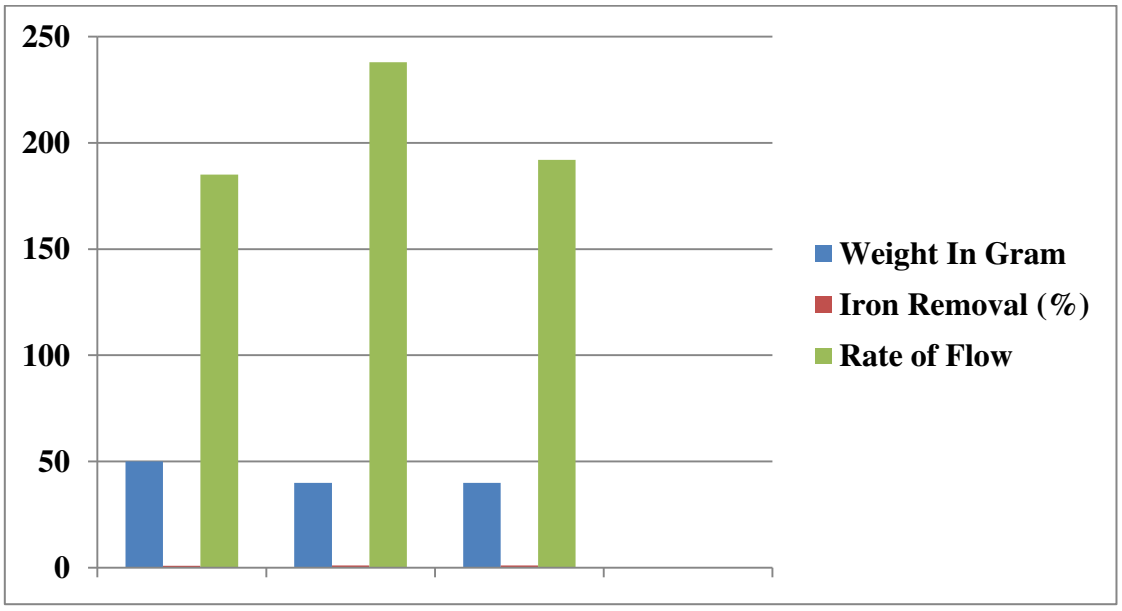
IV. RESULTS AND DISCUSSION

5.1 RESULTS OF FILTRATION IN TULSI LEAVES POWDER

The results are obtained in removal of iron by using Tulsi powder as mentioned in methodology. 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	50 gm	1.053	0.974	185
2	Top layer and Bottom=2cm	40 gm	1.053	0.998	238
3	Top layer and bottom=3cm	40 gm	1.053	0.983	192



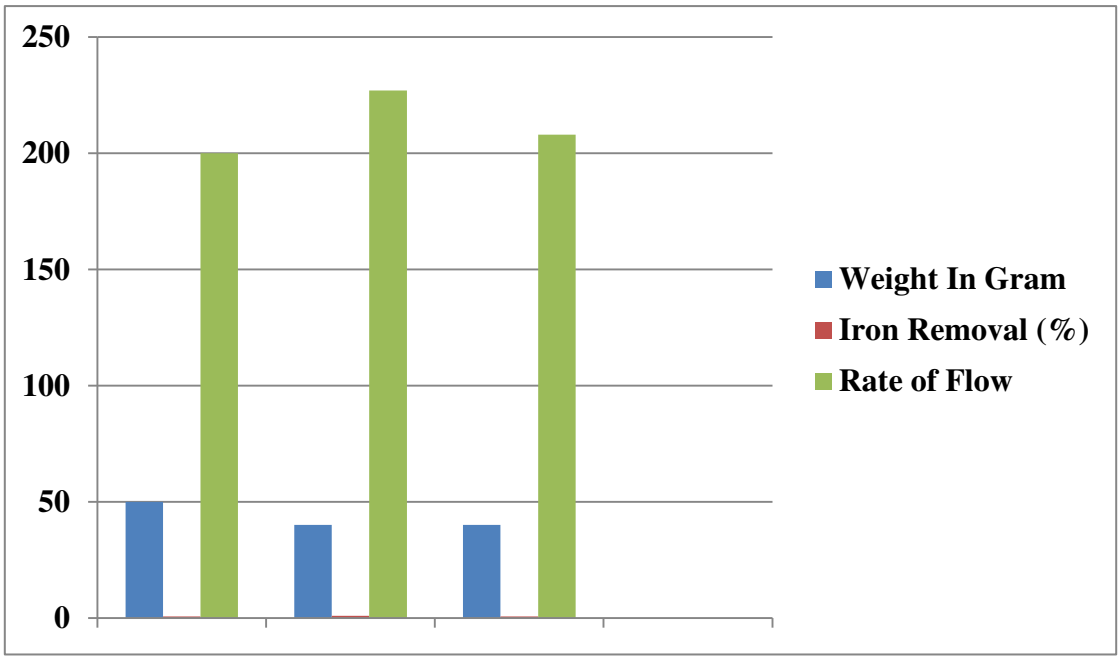
[Fig.5.1: Iron removal in Tulsi leaves]

5.2 RESULTS OF FILTRATION IN NEEM LEAVES POWDER

5.2.1 The results are obtained in removal of iron by using neem powder as mentioned in methodology. 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 (in cm)	Amount of Neem Leaf powder (gram)	Initial iron content (ppm)	Final iron content (ppm)	Rate of filtration (ml/min)
1	Top layer=2cm Bottom=3cm	50 gm	1.317	0.710	200
2	Top layer and Bottom=2cm	40 gm	1.317	0.890	227
3	Top layer and bottom=3cm	40 gm	1.317	0.698	208

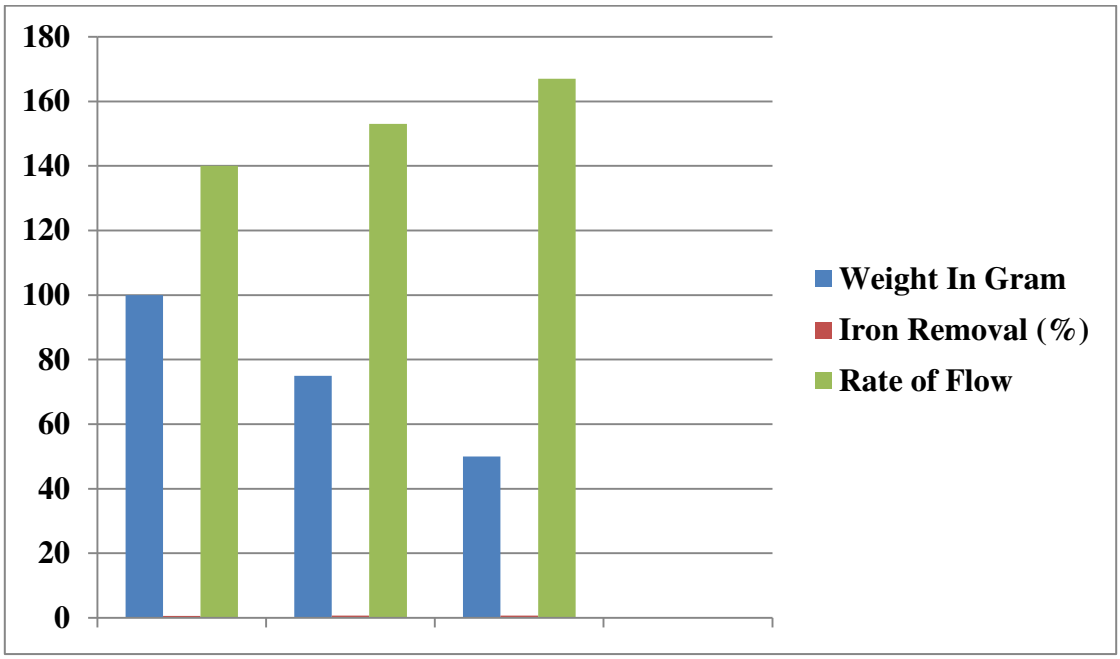


[Fig.5.2.1: Iron removal in Neem leaves]

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 methodology. 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 (in cm)	Amount of Tulsi Leaf powder (gram)	Initial iron content (ppm)	Final iron content (ppm)	Rate of filtration (ml/min)
1	Bottom layer =2cm	100 gm	1.317	0.579	140
2	Bottom layer =2cm	75 gm	1.317	0.632	153
3	Bottom layer =2cm	50 gm	1.317	0.676	167



[Fig.5.2.2: Iron removal with Chuna mixed neem powder]

5.3 RESULTS OF FILTRATION IN RICE HUSK

The results are obtained in removal of iron by using rice husk as mentioned in methodology. 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.

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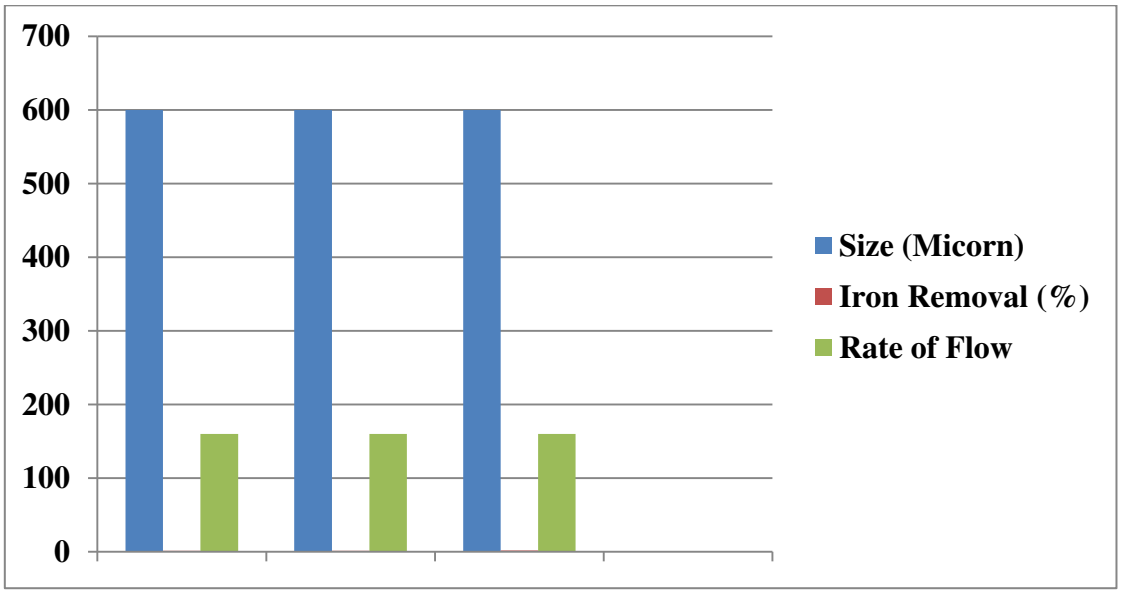
Table 5.3 Results of filtration in unmodified rice husk

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



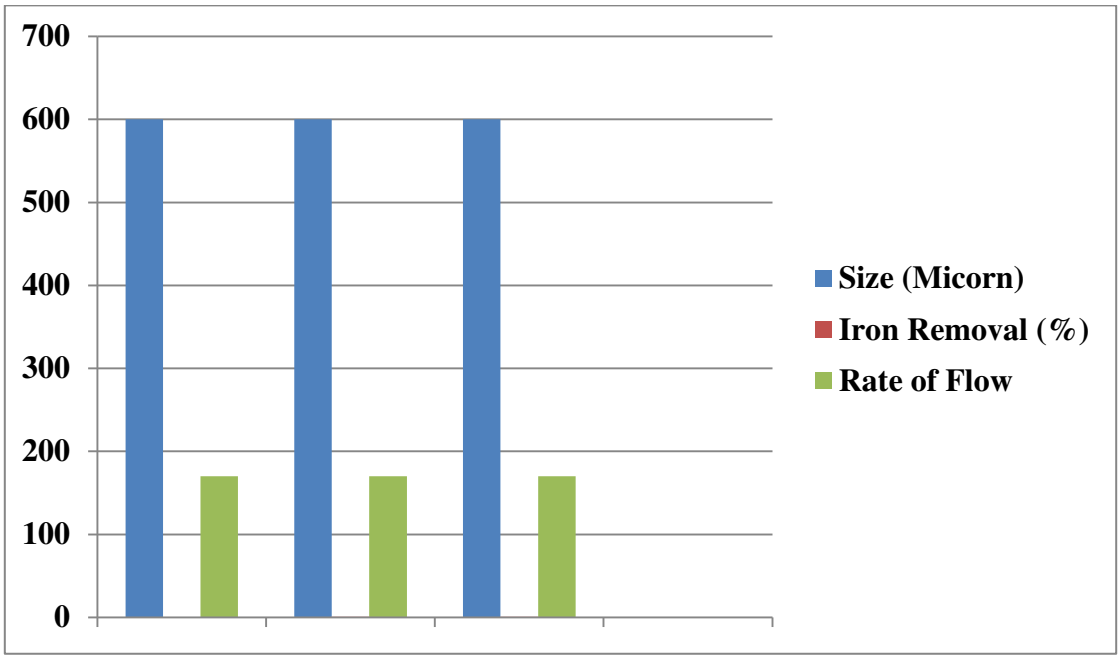
[Fig.5.3: Iron removal in Rice husk]

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 methodology. 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.

Table 5.4 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



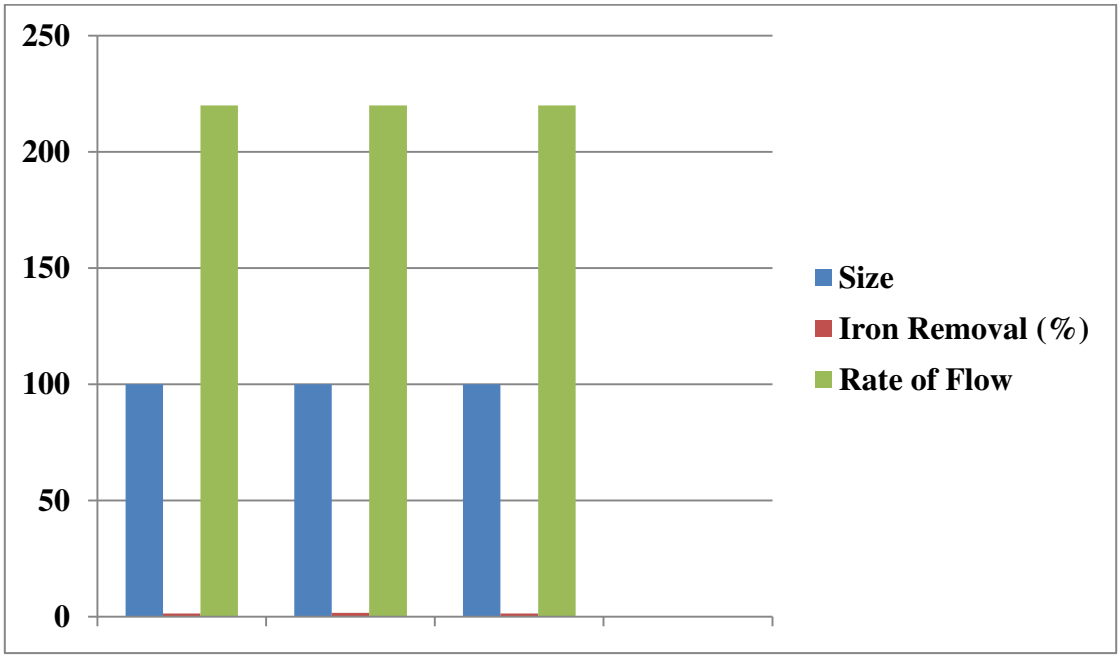
[Fig.5.4: Iron removal in Al(OH)3 coated rice husk]

5.5 RESULTS OF FILTRATION IN SUGARCANE BAGASSE

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

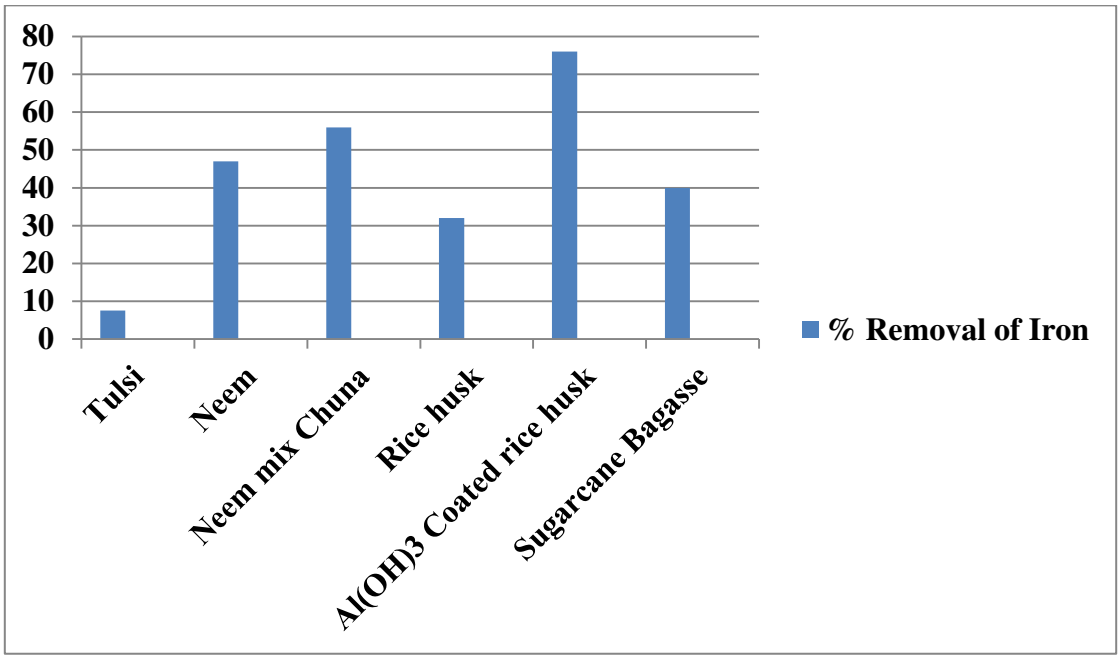
Table 5.5 Results of filtration in Sugarcane bagasse

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 RESULTS



[Fig.5.6: Variation of % removal of irons with different herbal used]

- In Tulsi leaves powder, better result obtained in sample1 which removed the iron concentration was 7.502%.
- In Neem leaves powder, better result obtained in sample3 which removed the iron concentration was 47.00%.
- In neem leaf powder mixed with chuna, better result obtained in sample1 which remove the iron concentration was 56%.

- In unmodified rice husk remove the iron concentration was 32% 5 modified (Al (OH) 3 coated) Rice husk was 76 %.
- 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
Total Cost			137.50/-

VI.CONCLUSION

- 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.

VII.FUTURE SCOPE

- 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.

- 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).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.

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