Development of Low-Cost Filter using Herbal Techniques

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Abstract: We know well enough that clean drinking water is very necessary for living a healthy life. A sufficient supply of clean and fresh water is of a basic requirement for every living being on this planet and yet we see that millions of humans across the world do not get this. The use of clean water is actually a huge issue in lots so developing countries and their communities. The water that is contaminated can play a huge role in troubling human lives in localities and for this, a lot of effort has been made for access to pure drinking water. However, a pocket-friendly and efficient system of purification of water is being used and we are trying to offer it worldwide access to deliver clean water to people.
In this project, we initiated developing a Water Purification Technique at Low cost with the initial bottle filter idea, sone herb that is locally available like Neem powder or Tulsi Powder or rice husk o refine sand or sugarcane bagasse to get an improved method with the use of UV Filter, Activated Filter, and RO Filter methods. The major attraction was removing iron from the water surface with the adsorption process. And amidst all the herbs that are taken in the process, the ashes that we get from this rice husk are known to offer the most suitable outcomes in removing iron & this is normally available in local areas with an extremely cheap cost of the material. Sugarcane bagasse that is collected from the locals and powder of neem leaves coupled with calcium of hydroxide or chuna was made that proved of to be good enough in removing iron.

***Index Terms*—Filteration, Tulsi, Neem leaf, Rice Husk, Aluminum Hydroxide.**

I. INTRODUCTION

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). 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. 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.

II. LITERATURE REVIEW

Ajmal in 2002 did a study on the rice husk adsorption process that can be used to remove and recover Cd-2 from the wastewater. In this, rice husk treated with phosphate or PRH displayed that adsorbing the Ni-2 and Cd-2 was more when we use PRH as adsorbing product. Adsorbing of Cd-2 will depend on the time of contact, temperature, concentration, doses of adsorption and solution pH. Thermodynamic features and Langmuir contents were evaluated at distinct temperatures. We find that recovering the Cd-2 out of synthetic water with a column operation was far better than the batch process. Wong, in 2002, examined the exclusion of Pp and Cu with the use of rice husk modified with the use of tartaric acid with the help of an aqueous solution. The examination of alteration of rice husk with different carboxylic acids was done by them. The outcomes displayed that the rice husk altered with tartaric acid or TARH contained the most binding capacity against Pp and Cu. The group of carboxyl on the modified rice husk

surface was liable for adsorbing the metal ions. A variety of examinations were done using TARH as adsorbing material for removing Pp and Cu and they displayed that the adsorption was dependent on pH and was quick, apart from exothermic. This process made sure that Langmuir isotherm that has the most adsorption features was Pp and Cu. The process got increased with the rate of agitation. Lessening in the adsorbent size of particles could lead to an of enhancement in the adsorption of the metal of ions and it might be showed with an enhancement in the area of the surface apart from binding regions. The uptake in meta got lessened in the vicinity of chelator and cations that were competitive. The credibility of TARH is greater for Pp than Cu. Daifulla in 2002 examined the use of agro-residues or rice husks in low-capacity treatment plans of water. Rice husk could be turned into adsorbing products that can be used in the remediation of environment. The study featured and calculated a couple of adsorbents prepared out of rice husk. The efficacy of these adsorbents in removing complex matric that contained as many as 6 heavy metals was about 100 percent. The metal includes Iron, manganese, Zinc, Copper, Pp and Cadmium. And these can be found in drains that contain sewage and agricultural water present at El-Menofiya Governorate in Egypt. A couple of adsorbing products were made as per the designed schemes. A couple of adsorbing materials from teh husk of rice also had potency for adsorbing metals that are a menace to the environment. Sharma and Bhattacharya in 2004 studied the process of Chromium adsorption in powder of neem leaf. They developed a new adsorption method against a fine of powder that was of found to be extremely effective off in the removal of Chromium v1 of the aqueous resolution. Euras et al in 2006 examined the removal process of cadmium found in aqueous solution with the help of sugarcane bagasse. This paper dealt with the removal of cadmium from sugarcane bagasse in an aqueous solution. This process of removing cadmium was examined in batch experiments. The foremost preparation experiment for the synthesis of wastewater was the adsorption experiment. This process tends to be extremely quick and we achieved equilibrium in a very small period of time. The normal cadmium adsorption process was at a range of pH from 5 to 7. The kinetic method in adsorption of Cd on some sugarcane bagasse was examined with the application of pseudo-first-order and then the second-order followed by an intraparticle rate of a diffusion equation. The data in equilibrium satisfied the model of Langmuir isotherm and the mad determined adsorption capacity. Venkateswarlu et al in 2007 from the Department of Chemical Engineering in Andhra University in Vizag in India examined the exclusion of chromium out of an aqueous solution with the use of powder from neem lead an adsorbing material. He examined this and found that powder from neem lead could be used in adsorbing and removing Chromium in an Aqueous solution. Thomas et al in 2009 from the Department for Chemical Engineering in the University at the Benin in Nigeria also studied the bio adsorption of some heavy of metal ions of an aqueous solution with the use of a biomaterial. This process aimed to investigate the process of removing some unwholesome ions of heavy metals with the use of neem leaves from wastewater that was synthetic and to get this bio adsorbent in terms of a local replacement for remaining adsorbent materials in a commercial form. Ashoka and Inamdar in 2010 also examined the removal process of methyl red out of an aqueous solution with the help of treated sugarcane bagasse, a waste in the agro-industry. This process involved treatment of sugarcane bagasse with sulphuric acid and formaldehyde. The capacity of adsorption of both the treatments were studied under different pH of the initial concentration, contact time, dosage of adsorption and even the temperature to compare this bagasse with some powder of activated carbon. The action of this pH adsorbing dose in the initial dye concentration and the temperature when the dye was removed were seen for distinct periods. It was seen that the efficiency of adsorption of this bagasse treated with sulphuric acid was more than bagasse treated with formaldehyde. Dawande and Pandhare in 2010 examined the effect of powder from neem leas as an adsorbent that was low in cost and had certain other features. Adsorption was clearly in use in removing impurities from the affluents. He showed that the powder from neem leaf was activated with the use of chemical treatment as an adsorbent of low cost.

III. Material and Method

a) Material

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.

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.

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 colored 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 Barilley.

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.

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.

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. This was used as an adsorbent along with sand as a base material.

b) Methodology

- Sampling of Herbal Material.
- Sampling of Drinking Water
- Preparation of Sample for Testing
- Filter Model Preparation.
- Preparation of Absorption Media
- Testing of Layers
- Filtration Test
- Result
- Conclusion

Method of Preparing Standard of Solution:

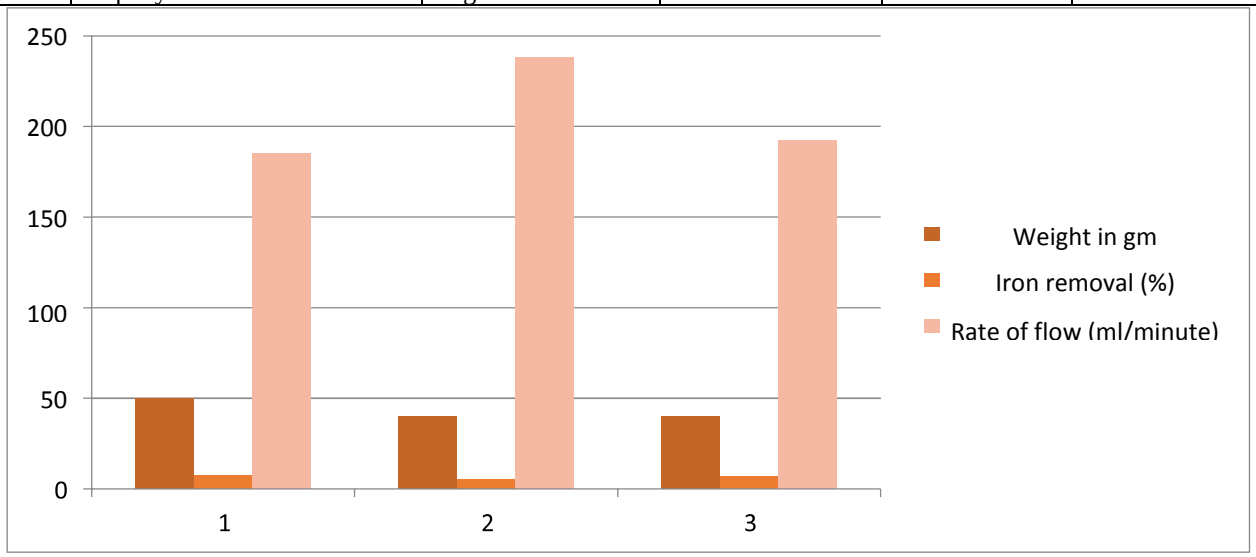
- The standard of a solution containing of the toxic elements will be made with a mix of toxic elements of water.
- We prepare a filter model that contains sponge, some sand and distinct herbs.
- The standard solution gets passed from the filter mode and what we obtain finally is purified solution
- Next we calculate the amount of toxic elements remaining
- Iron was used as a toxic element.

IV. RESULTS

Results of filtration in tulsi leaves powder

Iron removal in Tulsi leaves

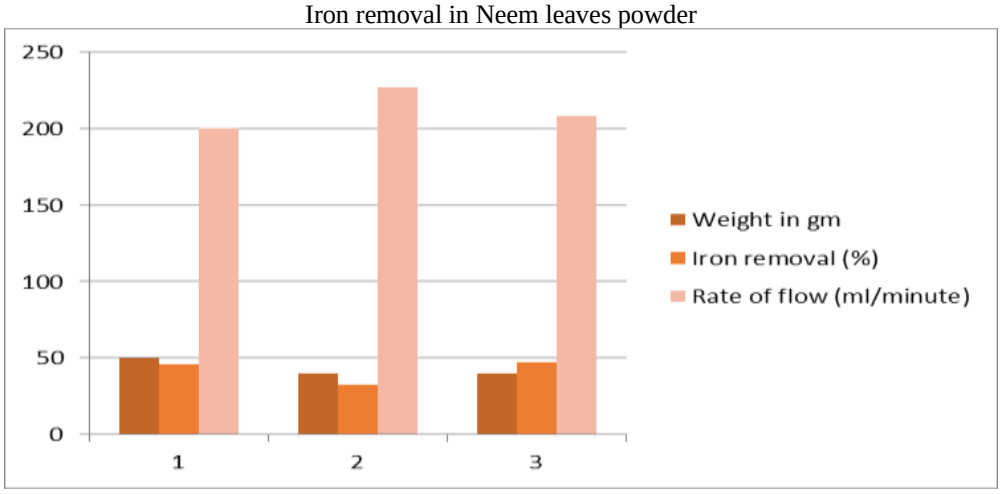
S. No	Thickness of Sand Layer (cm)	Amount of Tulsi Leaf powder (g)	Initial iron content (ppm)	Final iron content (ppm)	Rate of filtration (ml/min)
1.	Top layer=2cm Bottom=3cm	50gram	1.053	0.974	185
2.	Top layer and Bottom=2cm	40gram	1.053	0.998	238
3.	Top layer and bottom=3cm	40gram	1.053	0.983	192



Results of filtration in Neem leaves powder

S. 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

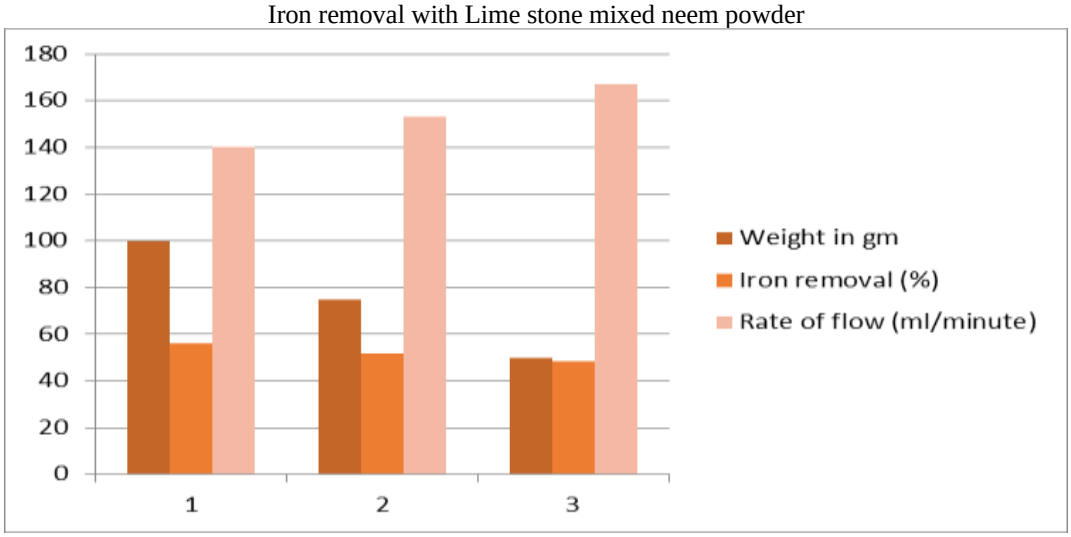
Iron removal in Neem leaves powder



Results of filtration in neem leaf powder mixed with lime stone

S. 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

Iron removal with Lime stone mixed neem powder



V. 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 Lime Stone (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 aluminum 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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