Comparative Analysis of Locally Available Adsorbents for Purification of Water

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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 essential for all human beings on the earth, yet it has been observed that millions of people worldwide are still drinking water that is contaminated by bacteria, toxic chemicals and other pollutants. Hence there is a need for purification of water. In the present study a low cost water filter is designed for 7 litre capacity. The filter media consists of layers pebbles, sand, corncob, and adsorbents (sugarcane bagasse, rice husk, fly ash, activated carbon, and blended activated carbon & fly ash) 4cm each. The main focus in this project is the removal of fluoride from water by using adsorption technique. The water is also tested for various parameters like acidity, alkalinity, turbidity, total dissolved solids, Hardness and pH. From this study it can be concluded that Sugarcane Bagasse is an effective adsorbent. The removal efficiencies of Sugarcane Bagasse for Acidity, Alkalinity, Turbidity, and Fluoride are 40%, 2.5%, 94.84%, and 31.42% respectively. Rice Husk has removed hardness upto 18.18%.*

Keywords-Adsorbent, filter, fluoride, rural areas, treated water.

I. INTRODUCTION

Water is a clear, pellucid, transparent fluid which forms the streams, lakes, oceans and rain, is the major constituent of the fluids of living things chemical compound, and the most widely used of all solvents. Water is a liquid at standard, but it often co-exists on earth with its solid state, ice, gaseous state, and steam (water vapour).

Water covers 71% of the Earth's surface. It is vital for all known forms of life. On Earth, 96.5% of planet's water is found in seas and oceans, 1.7% in ground water, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies in the form of Rivers, lakes, and reservoirs.

1.1. SOURCES OF WATER POLLUTION

Water pollution occurs when undesirable effluents disperse in a water system and so water quality change. Water pollution has many sources like thermal and acid effluents from volcanic areas and are not common on the earth, domestic sources that are primarily sewage and laundry wastes and waste generated in houses, apartments, and other dwellings. In rural and some suburban areas, domestic wastes are handled at the individual residence and enter the environment through the soil either in partially treated or untreated fashion. In urban areas, domestic wastes are collected in sewage pipes and transmitted to control location either for treatment or discharge into a watercourse without treatment. Industrial wastes vary from industry to industry and from location to location. Some industries generate wastes high in organic matter, and these wastes can usually handled by methods similar to those used for domestic wastes, such industries include dairy and food-processing plants, meat-packing houses. Other industries, however, generate wastes that are low in organic matter but high in toxic chemicals such as metals, acids or alkalis. These include chemical plants, mining facilities, and textile mills. All these above sources contribute to water pollution to the greater extent.

Groundwater passes through fluoride rich rocks, it dissolves the fluoride and the water consequently can have more than an acceptable level of fluoride. Water used for drinking should not have fluoride in excess of 1.5 mg/l water having excess fluoride will lead to dental fluorosis and skeletal fluorosis. In all fluoride affected areas it is advised that rainwater harvesting is done to recharge the groundwater source that shows high fluoride levels.

1.2. NEED FOR PURIFICATION OF WATER

Purified water is essential for living a healthy life as such everyone should have access to it. Drinking water conditions have great impacts on people's everyday life, especially in the rural and remote areas where access to safe drinking water is very crucial. Unsafe drinking water may result in fatal diseases. Statistics shows that these diseases resulted in ninety percent of all deaths of children under five years old in developing countries, due to low immunization of children to infections.

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. 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.

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.

Filtration is a process which improves the water quality by the removal of suspended solids, colloidal matter and the reduction of number of bacteria, colour, odour etc. In the present study using locally available adsorbents, sand and gravel, a filter is designed which removes the physical and chemical impurities from water.

1.3. 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 technique". This water filtration system 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.

The objectives of the project.

In the present study an appropriate household filter is designed. The initial water quality is analysed, then Sugarcane Bagasse and Rice Husk are used as adsorbents in the filtration process. The filtered water quality is analysed and the effectiveness of each adsorbent is known and the efficiency of filtration is checked.

II. FILTRATION MODEL DEVELOPMENT

In the proposed study a simple square shaped filter is designed and fabricated by using "Acrylic Sheet" of thickness 6mm as shown in figure 2(a) with the following dimension.

Length= 66cm
Filter Dimension Overall= 25 x 25cm (square)
Filter media thickness= 25cm wide, 16cm height
Water collection chamber= 25cm wide, 25cm height

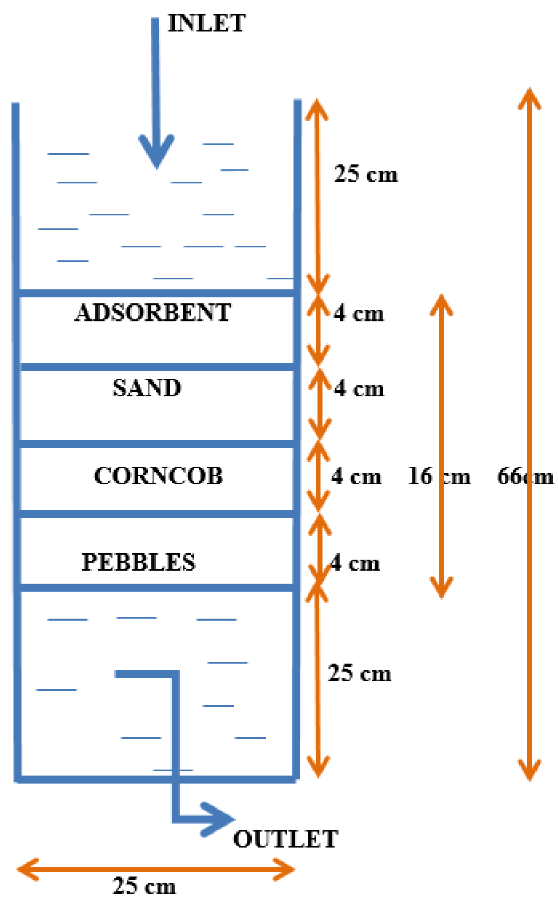

Fig 2(a): Line Diagram of Filter

- The filter media is supported on a 6mm thick acrylic sheet having the holes of 5mm diameter.
- Water collected in the bottom chamber is collected out from the tap which is located at 2cm above from the bottom.

In the proposed design of the model, synthetic water of known fluoride concentration was passed through the inlet pipe of diameter 2mm at the top. Inside the filter, different adsorption media of 16cm, (4cm each) thickness were placed. Then after filtration, the filtered water was collected at the bottom of the filter through tap in a beaker and the filtered water is checked for the various parameters like Acidity, Alkalinity, Turbidity, Total dissolved solids, pH, Hardness, and Fluoride.

2.1 Materials Used and Preparation of Adsorption

Different adsorption media used are listed below which are locally collected at a very cheap cost.

2.11. Pebbles

Fig 2.11: Pebbles

Pebbles are collected from the Tungabhadra river bank which is located in harihara city. Then the pebbles required for 4 cm layer are washed with the distilled water for about 2 to 3 times, and are dried in the sunlight about 15mins. For experimentation the pebbles passing through 40mm and retained on 20mm IS sieve were used in this study.

2.12. River Sand

Fig 2.12: River Sand.

Sand is also collected from the Tungabhadra river bank which is located in harihara city. The sand required for 4cm layer is washed with the distilled water and dried to sunlight for about 15mins. For experimentation the sand passing through 4.75mm and retained on 600µ IS sieve were used.

2.14. Sugarcane Bagasse

Fig 2.14: Sugarcane Bagasse

Sugarcane bagasse is taken from the sugar industry located in the Kukkuwada village near Davanagere. It is washed by using distilled water, and dried in sunlight.

2.15. Rice Husk

Fig 2.15: Rice Husk

Rice Husk is taken from the rice mill which is located at the PB road Davanagere. The powder form of the rice husk is removed by washing it in distilled water for about 3-4 times.

III. METHODOLOGY

In the present study the stock solution is prepared containing 2 mg/l fluoride concentration. To this synthetic sample, artificially turbidity is induced by adding turbid matter and colouring matter. The total influent water volume is 7 litres.

After preparing synthetic water, containing fluoride, it is fed to the filter. During the study period both influent and effluent is tested for significant water quality parameters such as Acidity, Alkalinity, Turbidity, Total dissolved solids, pH, Total hardness, Calcium hardness, Magnesium hardness, and Fluoride.along with the rate of filtration. Removal efficiencies of adsorbents sugarcane bagasse and risk husk are compared. All the parameters are tested according to standard Methods for the Examination of water and Wastewater by APHA(2001).

The prepared inlet synthetic water is fed to the filter media having the different layers of 4cm each such as pebbles, Corn cob, Sand, and the top most layer is the adsorbent such as Sugarcane Bagasse, Rice Husk which is changed and compared for the different parameters.

Then the filtered water is collected from the tap, which is located at 2cm above from the bottom and the outlet water is tested for the above mentioned parameters.

After conducting all the tests the results and removal efficiencies are compared for different two adsorbents.

IV. RESULTS AND DISCUSSIONS

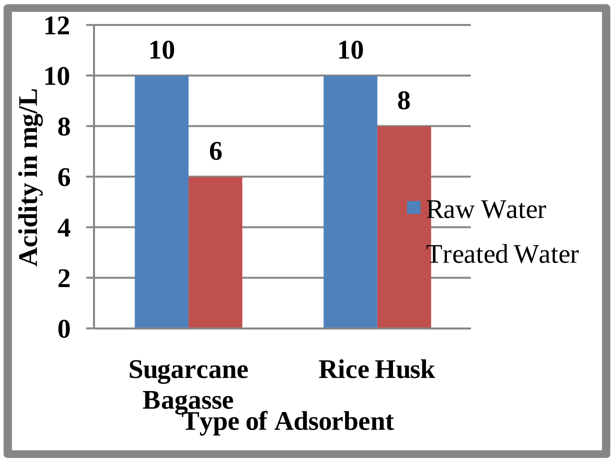

Chart 1: Comparative graph for acidity test.

Sugarcane Bagasse removes acidity upto 40% compared to Rice Husk.

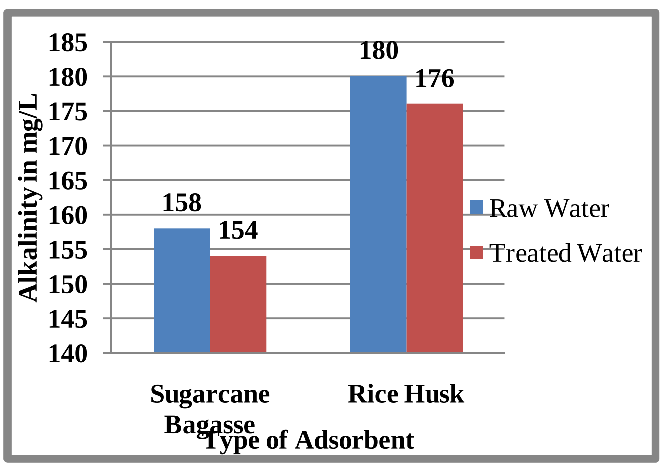

Chart 2: Comparative graph for Alkalinity test.

Sugarcane Bagasse removes alkalinity upto 2.5% compared to Rice husk.

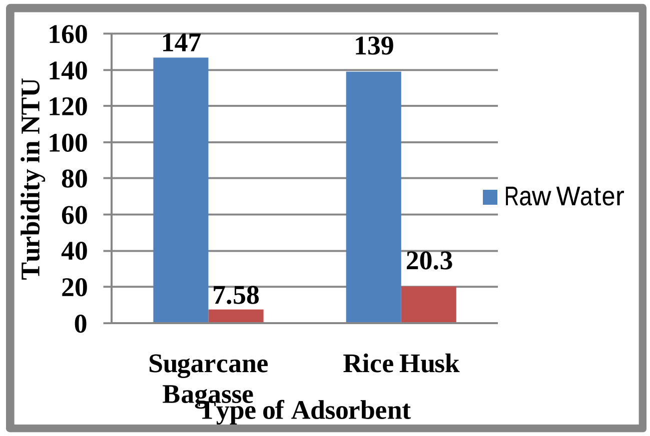

Chart 3: Comparative graph for Turbidity.

Sugarcane Bagasse removes Turbidity upto 94.84% compared to Rice Husk.

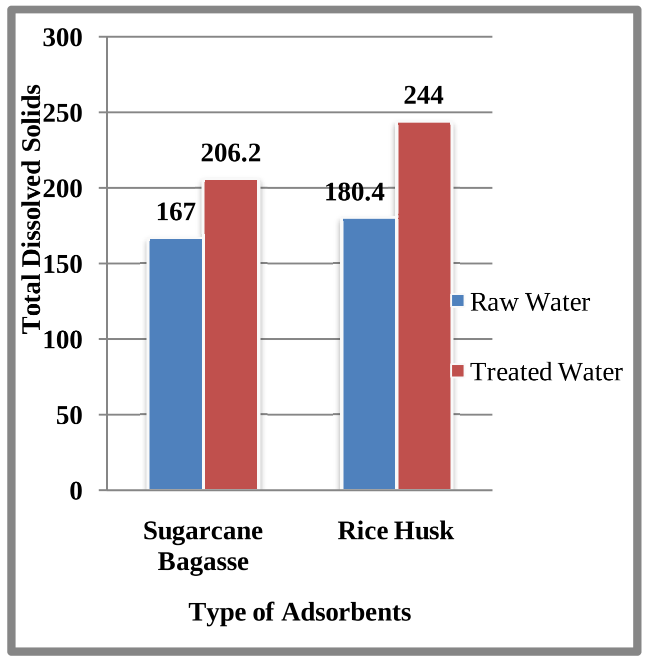

Chart 4: Comparative graph for Total dissolved solids.

In both the adsorbents total dissolved solids are increased due to the minute particles present in them, but in Sugarcane Bagasse increase in total dissolved solids is less when compared to Rice Husk.

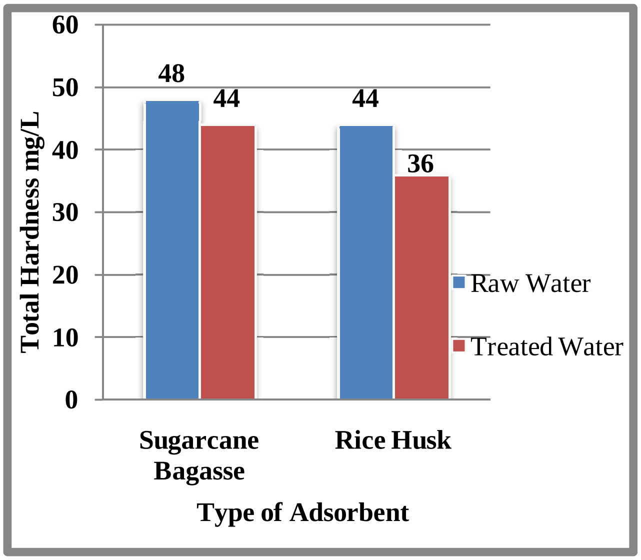

Chart 5: Comparative graph for Total hardness.

Rice Husk removes Hardness upto 18.18% compared to Sugarcane Bagasse.

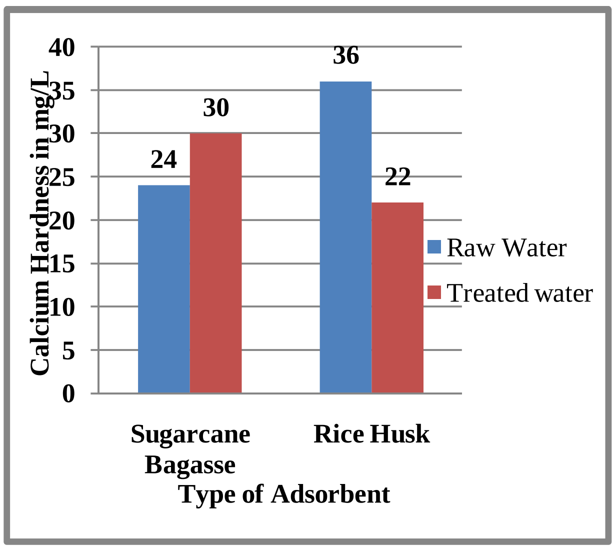

Chart 6: Comparative graph for calcium hardness.

In Sugarcane Bagasse the calcium hardness increases, but in Rice husk calcium hardness decreases upto38.88%.

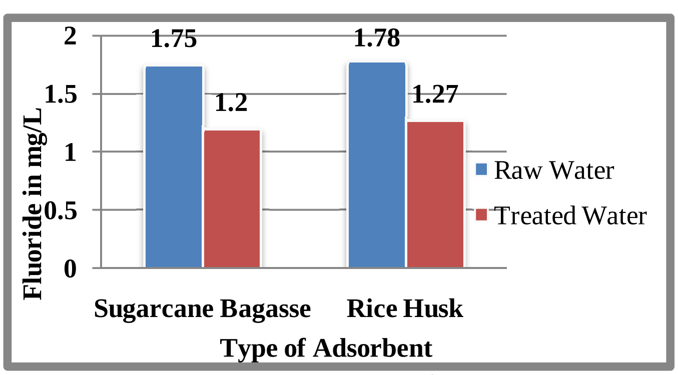

Chart 7: Comparative graph for Fluoride.

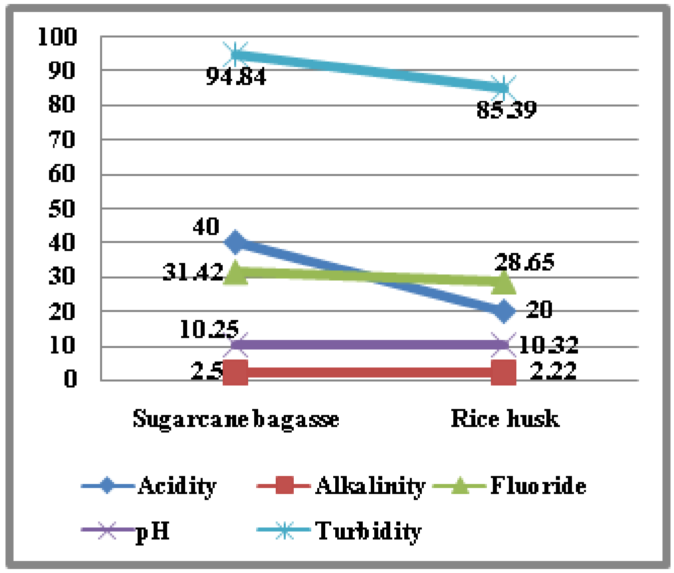

Chart 8: Comparison Graph.

Sugarcane Bagasse removes Fluoride upto 31.42% compared to Rice Husk.

V. CONCLUSIONS

Sugarcane bagasse is effective in removing Acidity, Alkalinity, Turbidity, and fluoride. Rice husk is effective in maintaining the pH and effective in removal of hardness. From this study it can be concluded that Sugarcane Bagasse removes all the parameters as compared to Rice Husk, so Sugarcane Bagasse is the good Adsorbent. The filtration capacity of the filter can be improved by adding 0.0001µ filter paper.

It can also be concluded that the filter designed is effective in removing many water quality parameters without consuming any power and wasting water unlike in reverse osmosis technologies.

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