Purification of Water Using Low Cost Adsorbents-Fly Ash and Activated Carbon

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Abstract- *As we know that, surface water and ground water are polluted because of anthropogenic activity. 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 (Fly ash, activated carbon,) 4cm each. The objective of this project is to remove the 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 the fly ash is an effective adsorbent. Since it maintains pH, Acidity, Alkalinity, and removes Turbidity, Fluoride Effectively with removal efficiencies of 4.95%, 42.85%, 21.22%, 97.24%,20.78% respectively.*

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

I. INTRODUCTION

Water is one of the universal substances, which is used alike by all the living species to sustain life. Clean and plentiful water provides the foundation for prosperous life and communities. We rely on clean water to survive, but now we are heading towards a water crisis. The changes in climatic patterns are threatening lakes and rivers, and also the key sources that we tap for drinking water, which are being overdrawn or tainted with pollution. Moreover, Industrialization activities for the development of nation contribute to global environmental deterioration as these activities caused depletion, degradation and deterioration of natural resources and biodiversity. Additionally, these industrial activities indirectly overload water body with thousands of water pollutant and subsequently polluting the environment.

1.1 Overview of the problems related to ground water

Basic domestic water quantity needs can be divided into categories including water for drinking, cooking, hygiene, and other domestic purposes, including productive uses. Drinking water comes from surface and ground waters. Large-scale water supply systems rely on surface water resources, and smaller water systems use ground water. Drinking water needs can vary according to the water content of food consumed, manual labour performed and climatic conditions. In addition, men, children and women have varying needs. The ground water supplies have become highly contaminated by the addition of undesirable substances that have rendered it unfit and toxic for various purposes, especially for drinking. The quality of groundwater is generally slower to change, especially when it comes from deeper aquifers. The groundwater is not directly exposed to wastewater discharge, air pollution, or contamination from run-off (if the well is properly constructed).Natural filtration can remove some contaminants as the water percolates through the soils and rock thus protecting the quality of ground water.

Safe drinking water is essential for living; lack of access has resulted in many waterrelated diseases. There are an estimated 4 billion cases of diarrhoea annually. Despite being largely preventable and treatable, every year 1.8 million people die from diarrhoeal diseases. Eighty-eight percent (88%) of these deaths are attributed to unsafe water supply, inadequate sanitation and poor hygiene.

In general, greater part of the India, ground water is used for agricultural, drinking or industrial purpose. The ground water in shallow aquifers is generally suitable for use for different purposes and is mainly containing calcium carbonates and bicarbonates. The quality in deeper aquifers also varies from place to place and is generally found suitable for common uses. The main ground water quality problems in India are salinity, arsenic, nitrates, fluorides, etc.

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.

Objectives of the project.

In this present study an appropriate household filter is designed. The initial quality of the water is analysed, then Fly ash and activated carbon are used as adsorbents in the filtration process. The quality of water after filtration 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

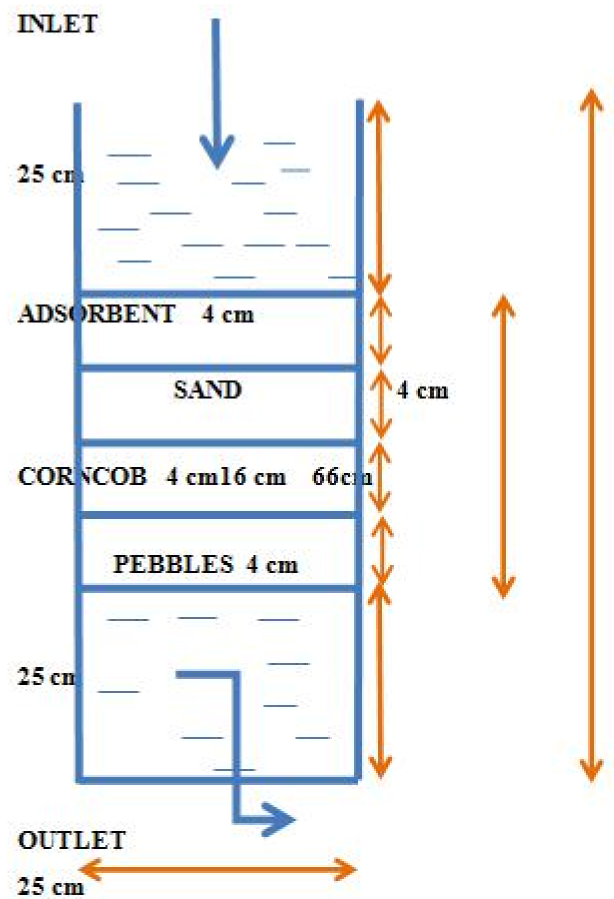

Fig 2(a): Line Diagram of Filter

- 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. Fly ash

Fig 2.14: Fly ash

The fly ash is collected from the sugar industry which is located in Kukkuwada village near Davanagere. For the experimentation the fly ash passing through 2.36mm retained on 1mm is taken, it is washed with the distilled water and dried to the sunlight.

2.15. Activated Carbon

Fig 2.15: Activated Carbon

III. METHODOLOGY

In the present studythe 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

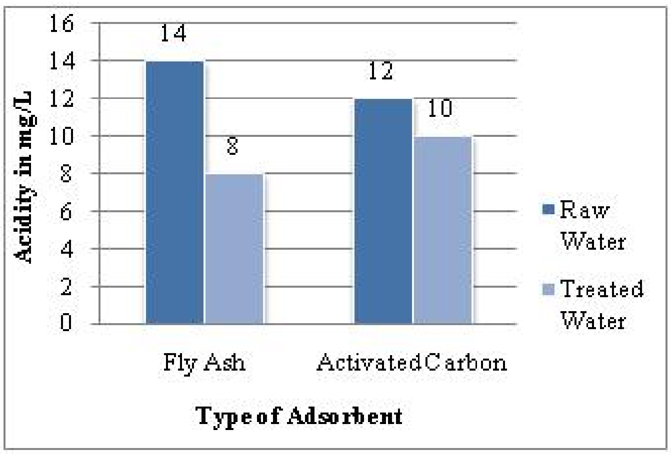

Chart 1: Comparative graph for acidity test.
Fly ash is effective in removing the Acidity up to 42.85% when compared activated carbon.

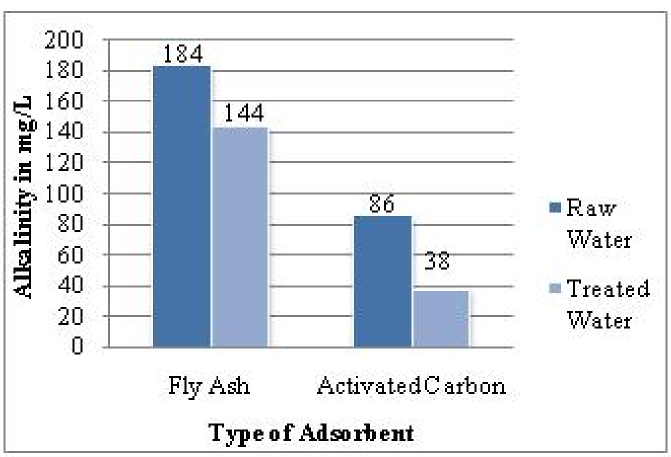

Chart 2: Comparative graph for Alkalinity test.
Activated Carbon is effective in removing Alkalinity up to 55.81% when compared to fly ash.

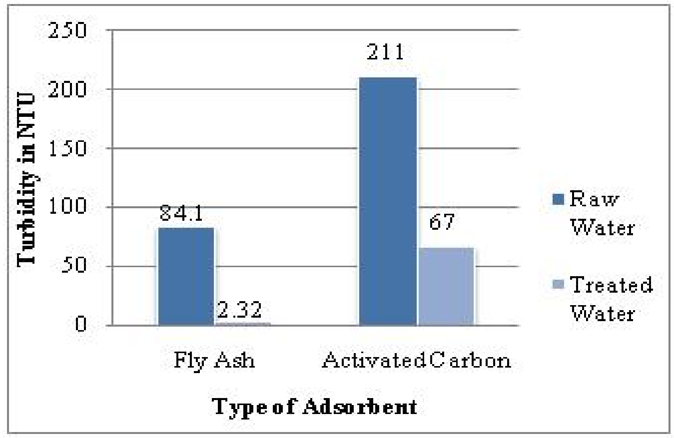

Chart 3: Comparative graph for Turbidity.
Fly ash removes Turbidity upto 97.24% compared to Activated carbon.

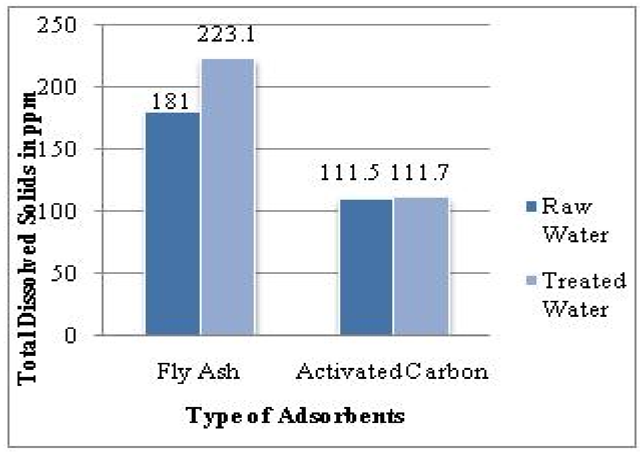

Chart 4: Comparative graph for Total dissolved solids.

In both the adsorbents total dissolved solids are increased due to the minute particles present in them, but in Activated Carbon the increase in total dissolved solids is less when compared to Fly Ash.

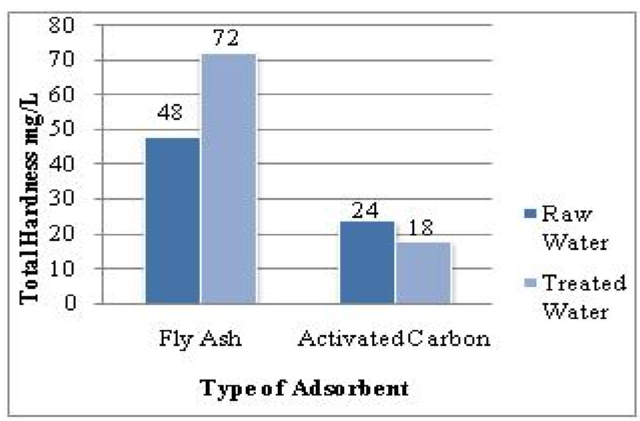

Chart 5: Comparative graph for Total hardness.
Activated Carbon is effective in removing total hardness up to 25% compared to Fly Ash. Presence of Fly Ash increases the total hardness.

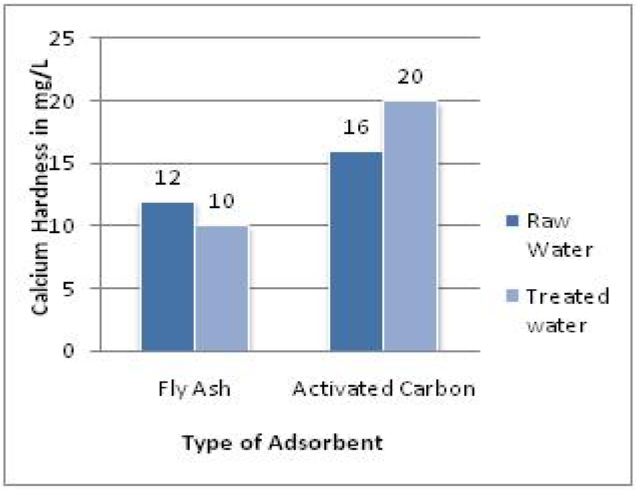

Chart 6: Comparative graph for calcium hardness.
In Activated Carbon the calcium hardness increases,but in FlyAsh calcium hardness decreases upto 16.66%.

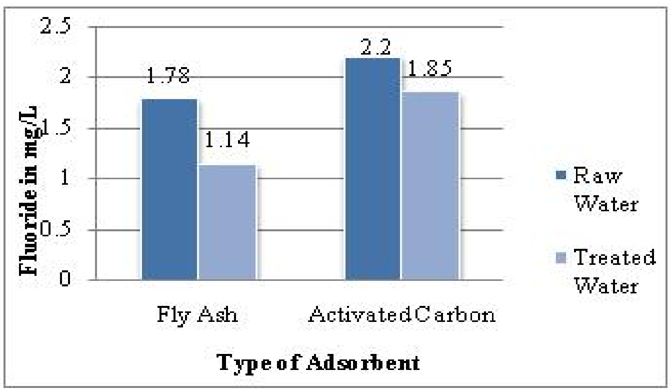

Chart 7: Comparative graph for Fluoride.
Fly Ash removes Fluoride upto 20.78% compared to Activated Carbon.

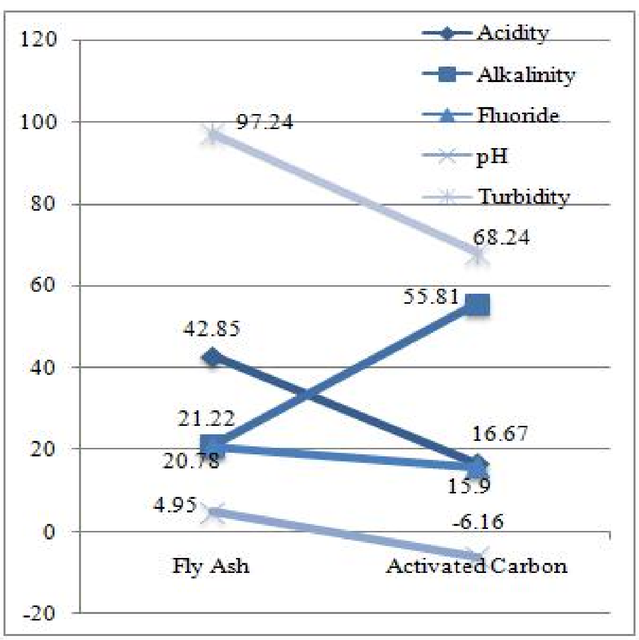

Chart 8: Comparison Graph for removal efficiencies.

V. CONCLUSION

Fly Ash is effective in maintaining the Acidity, Alkalinity, and removes the Turbidity, and fluoride. Activated Carbon removes the total hardness compared to Fly Ash. From this study it can be concluded that Fly Ash removes all the parameters except hardness as compared to Activated Carbon, hence Fly Ash 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.

VI. ACKNOWLEDGEMENT

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