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WATER TREATMENT USING COIR YARN TO REMOVE EXCESS IRON AND COLLOIDAL IMPURITIES

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Abstract

Surface water can be usable but sometimes it can be toxic due to the contamination from various sources. Industrial and commercial activities are a significant cause of water pollution, as are runoff from agricultural areas, urban runoff, and discharge of treated and untreated sewage. Many of the groundwater in India and Kerala are badly affected by excessive iron content. Iron in water will destroy property and food. It can also cause health issues like hereditary hemochromatosis, increasing the risk of arthritis, cancer, liver problems, diabetes, and heart failure. It is difficult to remove excess iron by conventional methods of aeration and filtration. The most popular method adopted is the expensive "ion exchange" process which is not affordable for the poor rural population. So, it is required to use some efficient method which is very easy and economical. Adsorption is one such basic method that proves to be cost-effective. Studies have shown that coconut husk yarn (coir yarn) and pith have excellent adsorption capacity to remove heavy metals. The objective of this study is to find a low-cost water treatment method using coir yarn to remove excess iron and colloidal impurities. Here the details of an experimental filter model and a proposed design of a domestic filter is presented.

A miniature water filter model is developed using (i) Three Plastic Bottle (1-litre capacity, 26cm depth, 9cm diameter at the cross-section), (ii) Coir Yarn (Deeply cleaned to get rid of impurities and soaked for 2 days), (iii) Filter Sand- silica sand .6-2 mm size (Washed) 10 cm thick, (iv) Coarse sand - M sand 2.5-4mm size (washed) 5cm thick, and (v) Gravel- broken stones (baby metal) 6 mm - 2 cm thick. The three bottles are placed vertically, the first bottle contains Coir, the second one M sand and baby metals and the third bottle is to receive the treated water. Raw water passes slowly through the first bottle through the coir yarn at an even flow rate. As the water passes down under gravity, the coir yarn adsorbs the iron content in it. The flow rate was approximately 2 litres per hour. Coir treated water enters the second bottle containing the sand bed, where the physical processes of filtration to remove colloidal and suspended matter take place. Fine particles and microorganisms are filtered out of the sand. This treated water is collected at the end in the third bottle. Fig. 1 shows the schematic of the experimental filter model and Fig. 2 shows the experimental filter model.

With the available information from the working filter visited by us and the performance of the miniature filter model prepared and tried by us, it is concluded that the coir yarn can be effectively used for the removal of excess iron and turbidity from water. Two types of filters are proposed for use in rural households. Filters working for 12 hours and 24 hours to treat 500 litres of water required for a Rural Kerala household. The daily household water consumption for a small family was assumed to be 500 Litres per day. The dimensions of the water filtration tank

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were found for two different tanks. Table 1 show the design parameter of the proposed filters for domestic use. The approximate cost of the filter is Rs 500-600, which can effectively treat and produce 500 litres of iron-free water. Further detailed research and investigations are to be conducted to modify the design and structure of the domestic filter to enhance the filter's treatment efficiency and operation.

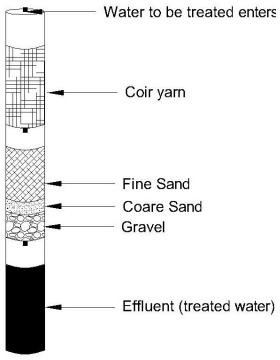

Fig. 1 Filter model sketch

Fig. 2 Experimental Filter model

Table 1 Proposed filters for domestic use

Twelve-hour working filter	**Twenty-four-hour working filter**
Design rate of flow of water - 0.7 litres/minute (500 litres per day in 12 hrs)	Design rate of flow of water - 0.035 litres/minute (500 litres in 24 hrs)
Area of the filter - 0.921 m^2	Area of the filter - 0.462 m^2
Diameter of filter - 0.34 m	Diameter of filter - 0.22 m
Height of the filter - 0.80 m	Height of the filter - 0.80m

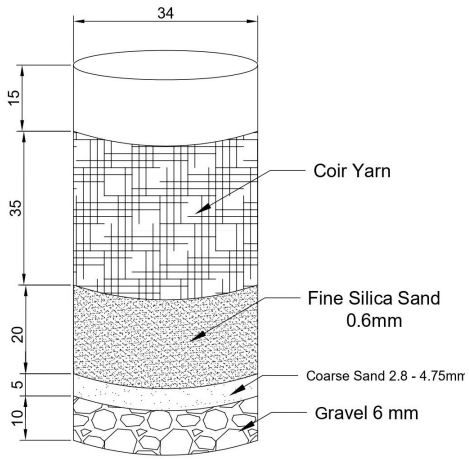

Fig. 3 Twelve-hour working filter

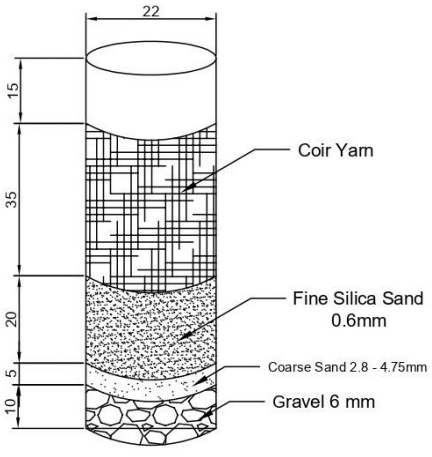

Fig. Twenty-four hour working filter

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The coconut coir yarn is a suitable adsorbent of dissolved iron from water. Coir yarn showed removal of dissolved iron content from all samples tested. The removal efficiency found was varying from 9.8% to 87.5%. There is a notable improvement in removing iron content from highly contaminated raw waters with the increase in contact time. Suitable reactors with appropriate contact times are to be designed to remove iron content to bring down the concentration to the permissible limits. All the samples showed variation in pH, which must be studied in detail. We could find visual differences in the water which is been passed through the filter. The working filter which we visited, is found to remove iron content to bring down the concentration to the permissible limits. The performance of the developed filter model noticed visually indicates that the iron and turbidity removal capacity is excellent. However, this must be ensured by conducting quality tests of the treated water. The Domestic Filter unit designed has a high potential for treating the contaminated groundwater of the rural households with low investment and very cheap maintenance cost. This technology can be effectively scaled up for use in small community water supplies in rural India.

Keywords: Coir Yarn, Adsorption, Iron Content

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