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Design of Dual Media Water Filter Purifier Using Clay Pot

Patil Prashant Shivajirao[1,*], Thakare Abhijit M.[2], Manoj R. Avhad[3], Patil Sachin Sopan[4]

Abstract

Numerous organisations make low-cost water treatment devices for rural homes, for instance filters, RO and UV-based water purifiers. However, these devices have problems like filter clogging, the need to replace filters frequently water contamination (in the case of RO), and the truth that electricity is not always available in rural areas, which makes them costly to use. Because of this, RO and UV purifiers are too expensive for people who live in rural areas. The goal of our project is to improve existing filter designs and fix the problems with current filtration models in a cost-effective way. The study focusses on water purification utilising naturally sourced materials, employing copper mesh as a disinfectant to develop an effective and cost-efficient water purifier for rural areas. People use earthen pots to clean water that is made from different amounts of clay and sawdust (50:50, 60:40, 70:30). People in rural areas usually use lake and well water in the specific way. Multiple assessments of drinking water done on samples before and after the treatment showed that the filters were able to clean the water to the standards for drinking water. The first model (50:50) removed the most turbidity and TDS, with lake water losing 89% and 72.35% of its turbidity and TDS, and well water losing 78% and 67.47% of its turbidity and TDS. Because copper was used as a disinfectant, there was no E. coli in the water that was treated for any of the three models. The findings indicated that the Pot Filter (50:50 model) can be effectively utilised as an economical filtration device in rural locations.

Keywords: Clay pot, ecosystem, safety and hygiene, natural resource, agricultural

INTRODUCTION

One of the primary challenges that society struggles with currently is making certainly everyone has access to clean drinking water. The forecasts say the circumstances will get worse in the future because there will be less fresh water and individuals.

Onwards to primitive age, when the intellectual man had started thinking and studying about agriculture and the environment; he realized and developed new concepts, 'The Science'! By the time, 'The man growing social' became aware of his Safety and Hygiene [1, 2]. He started using hygiene practices primly in the food and water culture. He found that the Physical, chemical and biological properties of water may vary region to region; from time to time and the water in its available form is not always potable. It may contain impurities other than required nutrients to human body [3]. He understood the importance of purification of water.

Formerly, they used some basic ways for purification. Later, rising agricultural and industrial development across the globe lead man to treat

***Author for Correspondence**
Patil Prashant Shivajirao
E-mail: prashantbhamrepatil29@gmail.com

[1–4]Assistant Professor, Department of Civil Engineering, MET's Institute of Engineering, Nashik, Maharashtra, India.

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water as the Precious Natural Resource in this ecosystem, where water is used for many purposes in various ways [4-7]. Besides only for drinking, washing etc. water has found numerous applications and uses in industry today. Also increase in water pollution or contamination with waste result in adverse changes in its properties, making it hazardous for drinking directly. It may cause diseases [8]. Now -a-day‟s water is thus tested for necessary parameters before any application and is then treated to match the requirements.

Today, innovations in environmental science are contributing to the growth of various methods for water purifying. To accomplish this, a special "water treatment plant" is built down to the water supply infrastructure [9]. It has different steps designed to render water safe for individuals to utilise and even drink. Treatment units are basically coagulation, flocculation, sedimentation, and filtration units. Our project addressed “"Modification in RSF with coconut shells as capping layer" talks about how filter design has modified recently to get rid of problems with older models. The water crisis affects millions of people worldwide the world, and it is likely to get worse in the coming years and decades. In 2010, it was thought that 1.8 billion people drank water that was "unsafe," and 783 million people regularly used water sources that were not protected from contamination [7]. Children are the most affected by drinking dirty water: 15% of deaths in children under five years old have been connected to the nearly 2.5 billion cases of diarrhoea reported each year. This means that every year, 3.4 million kids die from diarrhea and other diseases caused by microbes in water. This contributes to it the second most widespread cause of death in kids, especially in low- and middle-income countries.

Statement of the Problem

The filtration units in the treatment facilities fail to function as well as they deserve to. The organization are having major problems like high head loss, frequent clogging, a lower filtration rate, and more waste of filtered water during backwashing since it requires to be refreshed more often. This means that the standard of the filtration is not as good as could possibly be.

Objectives

The purpose of this project is to develop an efficient working model that is feasible to utilize instead of RO and UV purifiers in rural areas at a low cost. This model will provide safe drinking water that fulfils the necessary standards and will be far more efficient and affordable over RO and UV purifiers.

METHODOLOGY

The Area of Study

The district of Dhule previously existed as West Khandesh and currently serves as the district headquarters since 1960. The westernmost district in the Northern border area of Maharashtra State is situated between 20°38' and 22°3' North latitude and 73°47' and 75°11' East of longitude [10].

Materials Used

Clay, sawdust, copper mesh as a disinfectant, fine sand and gravel, coconut shell, activated carbon, cotton, corn starch and maize waste.

Casting Procedure of Model

- For casting the filter, the appropriate quantity of clay and sawdust will be used: Model I 50:50, Model II 60:40, Model III 70:30.
- During the period, you ought to listen out for hard things in the mixture, like small stones.
- A fine mixture is made so that it can be shaped into earthen vessels.
- After the mixture is made, three pots (matkas) that look like hollow spindles are shaped with the same dimensions: 10 inches in diameter, 1 foot in height, and 0.59 inches in wall thickness. It will be kept in a kiln and burned [11].

Information about Model

Total number of models used for this project 3 Nos. The models each for same material (Figures 1&2). Name of models A, B, and C For making of each pair different quantity is used. Material used for each two model is different as following:-

- Model A – 50% Clay & 50% saw dust
- Model B – 40% Clay & 60% saw dust
- Model C – 30% Clay & 70% saw dust.

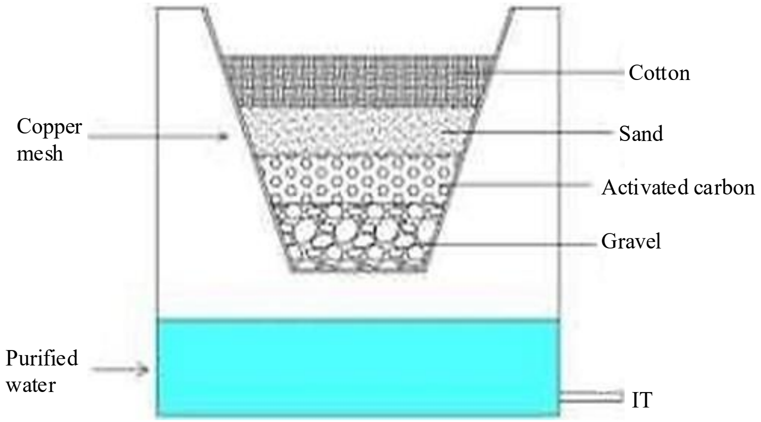

Figure 1. Schematic diagram of a clay pot water filter
Source: *Diagram prepare by own*

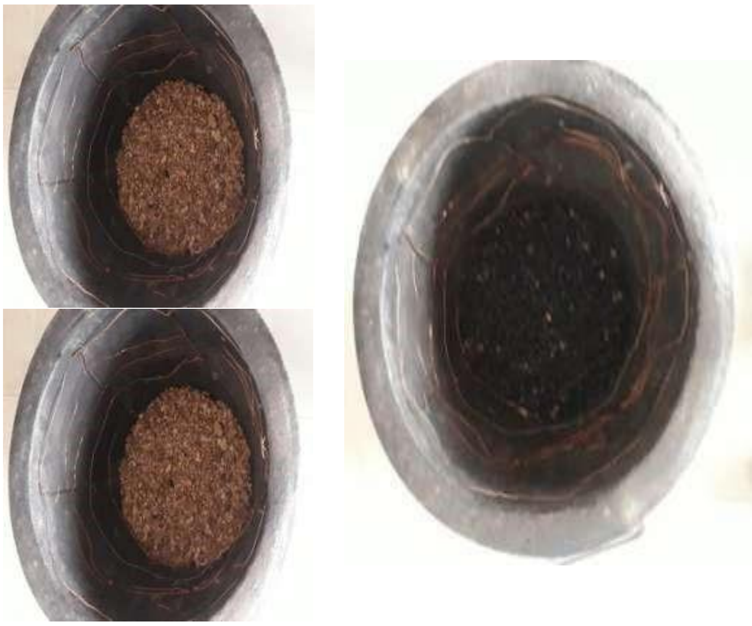

Figure 2. Diagram of Water Filter
Source: *Images captured of our own model*

READINGS OF LAKE WATER SOURCE

The given Table provides a comparative analysis of various water quality parameters across five different samples: untreated lake water, three treated samples (A1, B1, C1), and purified RO/UV water [12]. The pH level of the lake water is slightly alkaline at 8.6, while the treated samples show values closer to neutral, ranging from 7.61 to 7.94, with RO/UV water having a balanced pH of 7. The turbidity of lake water is notably high at 34 NTU, indicating the presence of suspended particles. This value significantly decreases in the treated samples, with the lowest turbidity of 1 NTU recorded in RO/UV water (Table 1). showed that the filters were capable of clean water to the standards for drinking water.

Table 1. Readings of lake water

S.N.	Parameter	Reading	Lake Water				Unit
		Initial Reading	***A1***	***B1***	***C1***	***RO/UV***	
1	Ph	8.6	7.61	7.9	7.94	7	
2	Turbidity	34	4	6	19	1	NTU
3	TDS	434	120	300	219	200	Mg/l
4	Total Hardness	247	129	180	160	0	Mg/l
5	Chloride	165	52	130	70	0	Mg/l
6	Fluoride	1	0.1	0.2	0.2	0	Mg/l
7	MPN	3	0	0	0	0	
8	Copper	1.2	0.4	0.7	0.8	0	Mg/l
9	Temperature	22	20	20	20	20	C

Total Dissolved Solids (TDS) and total hardness are also considerably reduced post-treatment. Lake water shows a TDS of 434 mg/L, which drops to 200 mg/L in the RO/UV sample. Similarly, hardness decreases from 247 mg/L to 0 mg/L. Chloride and fluoride concentrations follow a similar trend, with both being eliminated in RO/UV water. Microbial contamination, measured through MPN, is present in lake water but absent in all treated samples. The temperature remains constant at around 20–22°C across all samples. Overall, the data demonstrates a marked improvement in water quality after treatment, especially through RO/UV purification.

STUDY OF EXPERIMENTS

Existing pores in earthen pots. subsequently pour water into the pot, a certain amount it is going to escape out through these holes and evaporate from the pot's surface, making the pot cooler than it was before. Clay is another beneficial feature about clay water pots. The alkaline clay reacts with the acidic water to make the right pH balance. This water is excellent for people experiencing a cough or a cold.

- Maximum turbidity and TDS was removed.
- In 1st model (50:50) up to 89% and 72.35% respectively for lake water and by 2nd model up to 78% and 67.47% respectively for well water.
- As copper was used as a disinfectant, no trace of E-coli was found in the treated water for all three models.
- The results showed that a pot filter (50:50) can be an effective technique to filter purify water in rural areas to obtain a low cost.
- Other models is less efficient than model A1.
- This filter is economical than other filters.

The Table 2 compares water quality parameters of untreated well water, three treated samples (A1, B1, C1), and RO/UV purified water. The pH of well water (8.2) is slightly alkaline but is adjusted closer to neutral after treatment, with RO/UV showing an ideal value of 7. Turbidity increases slightly in A1–C1 but is lowest in RO/UV water (1 NTU), indicating effective filtration. TDS, hardness, and chloride are reduced in all treated samples, with RO/UV achieving the most significant removal. Fluoride, copper, and MPN values also drop to safe levels post-treatment. Notably, MPN is eliminated in all treated samples, showing successful disinfection. Temperature remains constant (20–22°C). Overall, the results confirm that water quality improves with treatment, especially using RO/UV systems.

Table 2. The varioations reading with the model well

S.N.	Parameter	Initial Reading	Well Water				Unit
			A1	***B1***	***C1***	***RO/UV***	

1	Ph	8.2	7.89	7.89	7.94	7	
2	Turbidity	9	13	13	19	1	NTU
3	TDS	206	135	135	219	200	Mg/l
4	Total Hardness	239	144	144	160	0	Mg/l
5	Chloride	130	42	42	70	0	Mg/l
6	Fluoride	0.6	0.1	0.1	0.2	0	Mg/l
7	MPN	4	0	0	0	0	
8	Copper	1.2	0	1.1	0.8	0	Mg/l
9	Temperature	22	20	20	20	20	C

CONCLUSION

Based on the findings of the study, Model A1 (50:50 pot filter) proved to be the most efficient among all tested setups in improving water quality to meet acceptable drinking standards. Detailed analysis was conducted on samples collected from different water sources—lake, well, and river—both before and after filtration. For lake water, the A1 model achieved a significant reduction in turbidity by 89% and TDS by 72.35%, indicating a strong performance in removing suspended particles and dissolved solids. In the case of well water, the second model was also effective, reducing turbidity by 78% and TDS by 67.47%. Similarly, for river water, reductions of 80% in turbidity and 78% in TDS were observed. An important aspect of the filter design was the use of copper, which served as a natural disinfectant. As a result, no traces of E. coli bacteria were detected in any of the treated samples, confirming the filter's microbiological effectiveness. Overall, the results indicate that the 50:50 pot filter model is a reliable, affordable, and practical solution, especially suitable for use in rural areas where access to clean water and advanced treatment systems is limited.

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