

ORGANIC FILTERS: AN UPCOMING WATER TREATMENT METHODOLOGY

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Abstract- Water crisis pertaining to potable water's availability is not unknown. Today as the population has touched the 7.5 billion mark, the availability of existing potable water sources is more prone to extinction rather than satisfying the ever-increasing human needs. Increased industrialization has furthermore deteriorated the condition of existing sources, by inducing the leachate effect i.e. toxics percolating from solid industrial waste into ground water. Therefore, efforts towards developing effective, economical, and facile methods to filtrate water for drinking purpose is attracting researchers worldwide. This review centralizes on water filtration techniques, especially concerning rural areas of developing countries, which lack either the economic benefit or the availability of new, modernized and extravagant methods of filtration. It illustrates various small-scale organic filtration techniques that are efficient in separating suspended matter, chemicals, and pathogens as well as dissolved impurities found in drinking water to optimum or negligible limits.

Keywords: organic filters, rural areas, small-scale filtration techniques.

1. Introduction

The dearth of palatable water is one of the major concerns today. Wholesome water portrays treated water, which follows drinking standards; palatable water is pure water, fit for drinking while potable water is that which is having some natural chemicals dissolved leading to its sour taste and odor. Among the water pollutants, bio-origin pollutants are the deadliest, as infectious diseases caused by pathogens such as-bacteria (*Escherichia coli*), viruses (hepatitis, rotavirus), protozoa (*giardia*) are the most frequent. They lead to child mortality, malnutrition and stunted growth. The World Health Organization claims that around 1.6 million people die every year from waterborne diseases (Rohit Karnik, MIT). Predominantly these are children of age 5 years or below and belong to rural areas of developing countries. Contamination of available water sources is a major issue. Though ground water is comparatively safer than surface water and contains less pathogens (Hussam and Munir, 2007; Pandit and Kumar 2015), it may display high toxicity including inorganics (As, F) and radionuclides (U) (Hussam and Munir, 2007; Ndé-Tchoupe et al., 2015; Pandit and Kumar 2015). Metals like arsenic and fluoride are present in abundance in ground water in areas like Asia, the Rift Valley in East Africa and various countries in southern Africa (Smith and Smith, 2004; Chowdhury et al., 2016; Kut et al., 2016). Therefore, treatment at the origin is turning out to be a mandatory step. One such treatment is *Filtration*. Filtration involves separation of solids from fluids by providing a medium through which only the latter (filtrate) can

pass. Filtration can occur both naturally and in engineered systems as well; where biological, earthly, and industrial pollutants are to be separated, hence filters play a vital role here.

1.1 Need For Filters

Firstly, presence of lead, in natural streams makes it evident to filter it so as to avoid diseases caused by it. Experts claim that lead is the primary cause of learning disorder in children. Secondly, water turns foul within few days due to presence of various elements that tend to rot. Filtering separates those substances.

Thirdly, infants suffer from blue baby syndrome if nitrates content exceeds 45mg/l as unfiltered water directly affects human digestive system.

1.2 Related Work (Conventional/Inorganic Filter Techniques)

The necessity of pure water gave birth to various techniques which have been used since ages to filter impure water. They are:

Boiling: Bacteria present in water can be destroyed by boiling, this is trial and tested technique, but is limited to individual scale water boiling, as it consumes enormous fuel, energy and time. **Lime:** lime in excess amount (14 to 43 ppm) can kill bacteria up to 99.3%, but on the other hand, it compromises on the pH of water turning it alkaline thus requiring re-carbonation before supply. **Ozonolysis:** ozone gas is an excellent disinfectant. It is produced by passing a high-tension current through stream of air in closed chamber. Due to its instability, ozone breaks into oxygen and nascent oxygen, which is a powerful oxidizing agent, thus removing organic matter as well as bacteria. However, it is an expensive process.

Iodine and bromine: addition of iodine and bromine helps in killing pathogenic bacteria, limiting the quantity about 8 ppm and a contact period of 5 minutes. **UV- Disinfection:** invisible light rays having wavelength 1000-4000 micrometer are highly effective in killing all types of bacteria provided treated water has to be colorless and less turbid. **Activated-Carbon filters:** absorbs all impurities but is effective only when the water is already biologically safe. **Sand filters:** includes rapid sand filters and slow sand filters, they can remove pathogens but requires large area for establishment. **Chlorine treatment:** is effective on a large scale too, but becomes expensive for smaller towns also some waterborne pathogens are resistant to chlorine. **Reverse osmosis:**

involves a semi-permeable membrane that allows only liquid to pass through similar to screening but is expensive.

In this context, new techniques that can improve or add upon current methodologies which are urgently sought after. Especially keeping rural,remotes areas in mind,which faces inavailability of modern facilities,are economically deficient and covering small area. If we look into mother earth for inspiration, we find that many potential solutions exist. This is where organic filters comes into play. They are substantially made of natural fibres and prove to be an effective filter material, which is inexpensive, easy to make and use, and are individual-suiting techniques.

2. Proposed System/Methodology

Since ages, communities have been using various plant-based water treatment methods—for example creating drinking stalks from plant stems. Similar to it are methods given below.

2.1 Water filtration using fruit peelings

This method consists rubbing alcohol with apple and tomato peelings and after drying them out, we get fruit water filter that when made to place in impure water for several hours, would absorb pesticides, heavy metals like lead, arsenic, and colored dye. After peel removal, water can be used for drinking purpose (Ramakrishna Mallampati, National University of Singapore), as shown in figure-1 and 2.



Fig 1: Fruit peeling

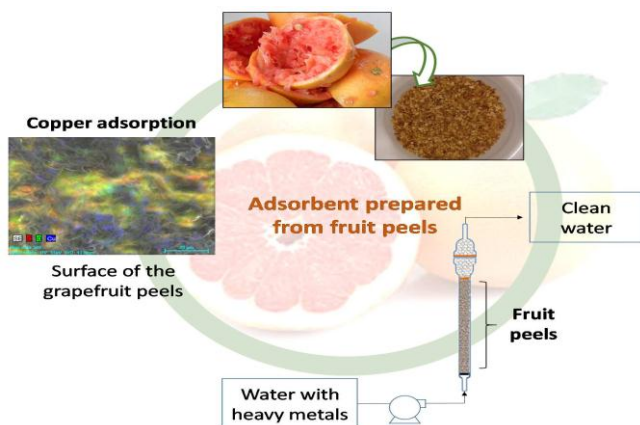


Fig 2: Flow Chart Depiction of the method.

2.2 Two-step filtration with coconuts and rice

Shredded coconut fibers such as its husks can be used to filter suspended solids such as metal and silt from the water, which when made to pass through burnt husks of rice remove remaining impurities too. On repetition of these steps increased lucid water can be obtained which palatable i.e. colorless, without any odor and free of infectants, as shown in figure-3.



Fig-3: Coconut husk and rise

2.3 Plant xylem

Plant xylem has turned out to be lifesaver and can be converted into a commercial plant filter by mere use of sapwood branch. Researchers from MIT conducted successful experiments with white pine xylem; they peeled of the branch, attached a plastic tube on its top and fastened it to a water tap source. Water would drive through the permeable xylem and would sieve suspended matter, dye, and even E-coli bacteria from provided impure water. With further research into types of plant xylem tissues, separation of viruses does not seem to be an impossible goal, as shown in figure-4.

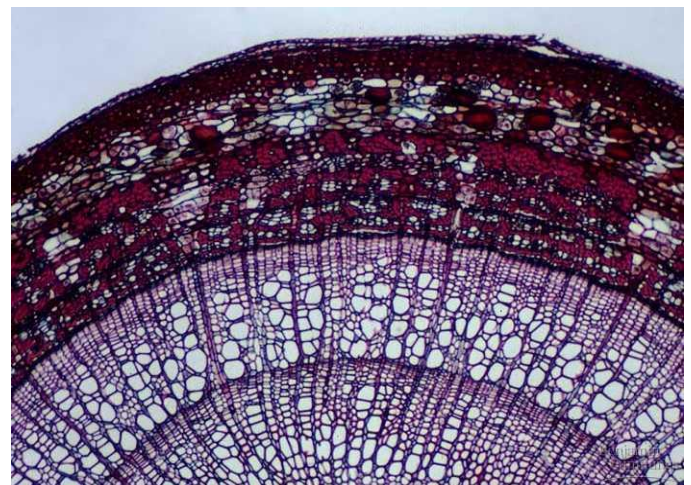


Fig 4: Cross-section of plant xylem

2.4 Banana peels

Banana peels can be effective even after eleven times of mincing. It is an easy, durable, inexpensive and individually suiting method of filtering turbid water, as shown in figure-5.



Fig 5: Banana peel

2.5 Sun and Citrus method

Solar disinfection is a trial and tested method, but with addition of any citrus fruit slices, when left in the sun can result bacteria-free water as filtrate. This method has shown greater results by elimination of E-coli bacteria, as shown in figure-6.



Fig 6: Slices of lemon in impure water in the presence of sunlight

2.6 Cilantro Tea Bags

Recently, researchers have also discovered a way to filter water by use of crushed cilantro, by grinding it and passing water through it, or by making tea bags that will absorb much sought after impurities such as heavy metals. It is just as effective as a charcoal filter, as shown in figure-7.



Fig-7: cilantro leaves in water

2.7 Sustainable filtration with the help of aquatic plants

Growing plants that filter water in your vicinity or in your nearest water source paves way for an add-on filtration as in Fig. no 3. The cost of plant being low, and with the plan that will give you a persistent fresh water supply, these do negligibly less harm than benefit. Plants such as yellow irises or water lilies suits the purpose as they remove optimum carbon dioxide from the water, turning it less acidic and hence is suited for consumption. They also moderate chemical levels in the water such as excess of nitrogen and phosphorus which otherwise are good in small amounts, but damage digestive system when in excess, as shown in figure-8.



Fig 8: Aquatic Plants

2.8 Marsh plant filtration

Plants such as bulrushes and reeds that grow in wetlands are helpful in cleaning laundry wastewater. These plants are easily available and hence have low impact on pockets, as shown in figure-9 (a&b).

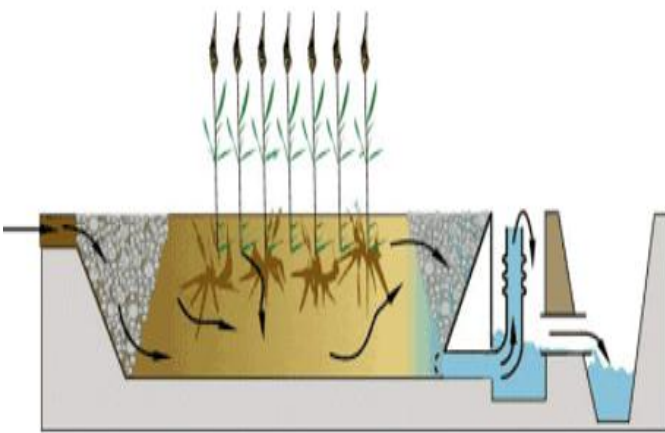


(a)



(b)

Fig 10: (a) Moringa seed, (b) Results of three different treatments.



(b)

Fig 9: (a) Marsh plant, (b) Constructed Wetland using Marsh Plants for water purification

2.9 Moringa seed purification

Moringa plant's seeds when crushed and added to impure water, the seed particles attach themselves with dirt and other foreign matter present in the water and settles down at the bottom. These seeds are also helpful in lowering bacterial levels, as shown in figure-10 (a & b)



(a)

2.10 Jackfruit seed filtration

Jackfruit seeds have huge benefits for the individual immune system and are full of nutrients. Even more, they can be grounded and used to purify wastewater, as shown in figure-11.



Fig-11: Jackfruit seed

2.11 Java plum seed filtration

This is a traditional method from Sudan, which makes use of grounded mature Java plum seeds. The grounded bulk is combined with potable water for further disinfection. It also filters pathogens such as stomach worms from water, as shown in figure-12.



Fig-12: Java plum seed

2.12 Euglena Bio Filtration System

Euglena being an aquatic organism absorbs water pollutants from impure water. This characteristic of euglena has been used to develop a filtration system to treat wastewater (Noble purification). They made use of algae in a controlled state to prosper in wastewater, which then absorbed toxins from the water, as shown in figure-13 (a&b).



(a)

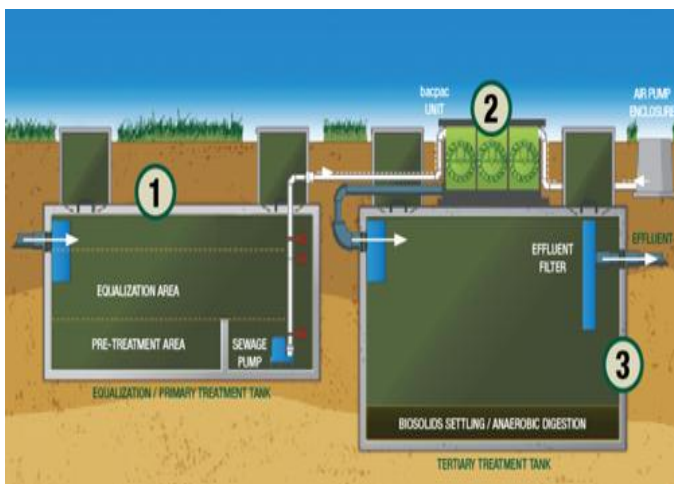


Fig 13: (a) Euglena, (b) Bio filtration system

3. Conclusion

In this paper we discussed that organic filters are a much better alternative for the treatment of impure water as they are healthy as well as economical method especially for rural areas. Many of the above discussed methods can be practiced without any prior training or with minimum knowledge, thus are ideal for remote places and areas where people are not educated enough about the conventional methods of water filtration.

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