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Fabrication and evaluation of multistage water purifier by solar system

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Abstract
The fabrication is done to make a lite and easy machine which disinfect the water and make it for drinkable. The purpose of fabrication was done to develop a machine that makes unacceptable water to acceptable for drinking and household purposes as well for ruler area. By the using of such components and elements which have property to clean, stain and disinfect the water effectually and give maximum surety of drinking water as well as step by step filtering process. This machine provides up to 99.9 % clean, clear water and also remove odor from the untreated water. The fabrication was made by keeping in mind that it should be easy to use and maintain. Each candle can be cleaned easily and be reused. Which reduces the cost of maintains, and can use long as long for years. The use of solar panel provides enough energy that no other power supply needed. The capacity of battery storage enough to provide power for regular 60 hours, only when fully charged. The multistage purifier materials have their own property that makes purification effective. When the test was done it found that species were absent, and coliforms were totally nil. The turbidity of water was also controlled upto 95%. According to the data and results taken from various test parameters, it was found that the water purifier is given satisfied result and performance. After all experiments, it was found that machine has batter performance and durability.

Keywords: Water, Purifier, UV-C light, Coliform, SPC,

1. Introduction
Water covers 71% of the Earth's surface, and is vital for all known forms of life. On Earth, 96.5% of the planet's water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers. 0.001% in the air as vapor, clouds. Only 2.5% of the Earth's water is freshwater and only less than 0.03% in rivers and lakes **(Henniker *et al.* 1949)** [3]. In the water there are many types or unwanted undesirable chemicals, biological contaminants and suspended solids are present which is not fit for drinking purpose. It needs to be purified.

Water purification is the process of removing undesirable physical, chemicals, biological contaminants, suspended solids and gases from contaminated water. The goal is to produce water fit for a specific purpose. Most water is purified for human consumption (drinking water), but water purification may also be designed for a variety of other purposes, including meeting the requirements of medical, pharmacological, chemical and industrial applications. In general the methods used include physical processes such as filtration, sedimentation, and distillation, biological processes such as filters or biologically active carbon, chemical processes such as flocculation and chlorination and the use of electromagnetic radiation such as ultraviolet light. The purification process of water reduces concentration of particulate matter includes suspended particles, parasites, bacteria, algae, viruses, fungi etc. Simple techniques for treating water at home, such as chlorination, filters, and solar disinfection, and storing it in safe containers could save a huge number of lives each year.

It is a water filter which is made for ruler area daily use of drinking and cooking water where still no availability of clean water. It involves five steps to clean untreated water to treated water. Those are per/post sand filtration, pre/ post activated carbon filtration and ultraviolet treatment chamber which is operated by solar power. And water flow is commanded by a small electrical device called solenoid bulb. Where the research was done successful on water purification testes and low cost maintenances. Where sand controls the dirtiness of water due to presence of mud and dust. Where activated carbon controls the odor and taste of water due to the still water and presence of microorganisms and spoilage of waste materials. At the last ultra violet treatment chamber kills all the micro-organisms which are harmful to human. It kills E-coli and coliforms which and cause diarrhea vomiting or hazard etc.

The rapid sand filter or rapid gravity filter is a type of filter used in water purification and is commonly used in municipal drinking water facilities as part of a multiple-stage treatment system. [1] The first modern rapid sand filtration plant was designed and built by George W. Fuller in Little Falls, New Jersey. Fuller's filtration plant went into operation in 1902 and its success was responsible for the change in this technology in the U.S. Rapid sand filters were widely used in large municipal water systems by the 1920s, because they required smaller land areas compared to slow sand filters **(Fuller and George 1902**) [2]

Activated carbon, also called activated charcoal, activated coal, or carbon is a form of carbon processed to be riddled with small, low-volume pores that increase the surface area available for adsorption or chemical reactions. *Activated* is sometimes substituted with *active*. Due to its high degree of microporosity, just one gram of activated carbon has a surface area in excess of 500 m^2, as determined by adsorption isotherms of carbon dioxide gas at room or 0.0 °C temperature. An activation level sufficient for useful application may be attained solely from the high surface area; however, further chemical treatment often enhances adsorption properties (**Romanos *et al.* 2012)** [6]

The ultraviolet absorption spectrum of liquid water. The absorption of carefully purified water has been measured at 1 nm intervals in the wavelength range 196 to 320 nm. The measured absorptive fell monotonically from a value of (1.26±0.03) m−1 at 196 nm, to a value of (0.0100±0.0006) m−1 at 320 nm. The water was purified by ion–exchange, followed by four subsequent distillations, the first being carried out under mild oxidizing conditions, and the last being performed in all-silica apparatus, the water vapor being heated to a temperature of 870 K in the presence of oxygen to remove residual organic impurities. The absorptivities were measured using a differential path length method and a correction for the effect of double reflections in the absorption cells was derived and applied to the data. The measured absorptivities were much lower than all previously reported values in the 200–300 nm region, but gave considerably better agreement with theory and aligned well with the edge of a set of recent vacuum UV measurements in high purity water. It appears that previously reported absorptivities of liquid water in the 200–300 nm region is too large by up to two orders of magnitude, due to the presence of oxygen and of persistent absorbing impurities. The small absorption peak reported around 275 nm by **(Verma and Saksena 1965)** [9] and which has often been cited to corroborate electron impact evidence for the existence of a low-lying 3 B 1 state of the water molecule, was not observed, despite adequate sensitivity and stability. The broad and unstructured absorption observed across the 200–300 nm region was only slightly in excess of that attributable to the aggregate of Rayleigh scattering (**Quickenden and Irvin 1980)** [5].

2. Materials and Methods

The machine was a rectangle shape in design and all the contact part were used as plastic and metals with the help of electronic devices. The machine was designed in such a way that untreated water or contaminated water was successfully treated, filtered and removed contamination and purified the water.

Water testing methods collect from **APHA, AWWA and WPCF (1985)** [1]**, Indian Standard (1999)** [4]**, USEPA (1987)** [8]**, USEPA (2000)** [7].

2.1 Machine design

The following design criteria were used:

- Local availability and cost of materials.
- Mechanical properties, which includes strength, rigidity, toughness and ductility.
- Machinability or formability.

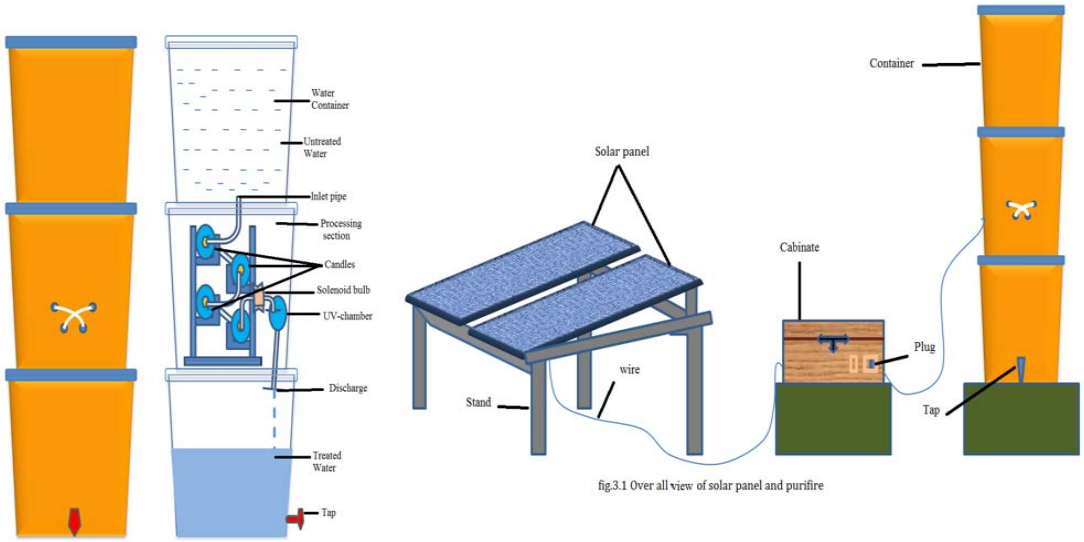

Fig 1: water purifier with a solar system.

3. Results and Discussions

The present investigation of fabrication on water purifier was successful in prevent to microbiological and chemical hazard and provide the treated water. The water collected from Yamuna River and household tap water tested in Mahewa, Allahabad. The Results showed that (Table A) standard plate count in treated water was excellent in comparison to untreated water. Coliform test was done and founded that coliform was counted nil in both treated sample tests. The pH test found that treated water was better than compared to untreated water. TDS test was better in treated water compared to untreated water in both samples. Turbidity test was excellent resulted in both sample tests of treated water

Table A: Testing of river water (Yamuna) and household tap water disinfection sample

Type of water	Test									
	SPC		Coliform		pH		TDS		Turbidity	
	Yamuna	Tap	Yamuna	Tap	Yamuna	Tap	Yamuna	Tap	Yamuna	Tap
Untreated	25	5	10	1	8.9	6.5	353	425	40	5
Treated	0	0	0	0	8.5	6.7	335	390	3	2

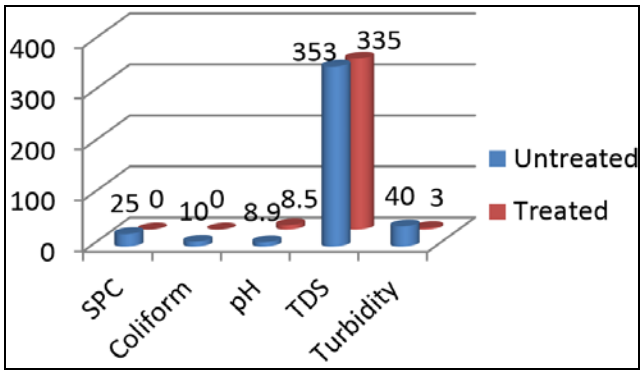

Fig 2: River sample water (Yamuna)

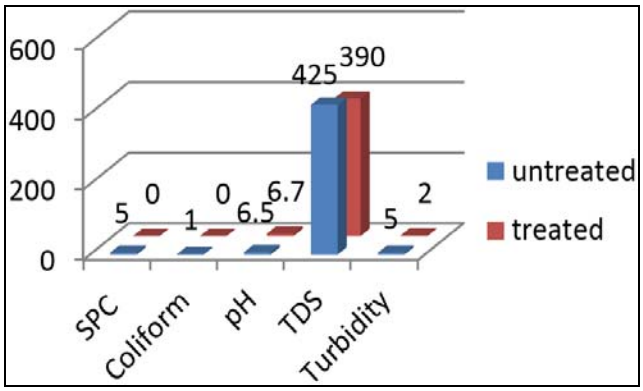

Fig 2: Household tap sample water

3.1 Performance evaluation

The following parameters to be undertaken:

- Maximum container capacity= 20 liter
- Resulted in purified water as per treatment by multi stage per performance was found 100% disinfection.
- The discharge rate of treated water through the entire process is 6min/l.
- As power consumption used by UV-bulb is less than 6 mAh.
- Power consumption used by solenoid bulb is 1 mAh.
- Therefore the capacity of battery storage enough to provide power for regular 60 hours. Only then, when fully charged.
- Purifier can filter water +7000 liter water.
- The solar panel can provide power for run other lite accessories like 12v fan, 18v led light on bulbs.

Care and Precaution:

- Candles must be clean in between 2-3 month for effective purification.
- Electric wires and plug handled carefully.
- Battery must be charged by solar light
- The solar panel should be facing front toward the sunlight.
- Solar panel provides 1 ampere power in normal day sunlight. But more effective 1.3 – 1.4 ampere given in 11pm to 4pm.

3.2 The results are all presented herein as follows

- The purification performance was given 100%.
- The discharge rate of treated water through the entire process is 6min/l.
- The capacity of the purifier was up to 20liter when full.

4. Conclusion

In this chapter, a well summarized conclusion of the entire project is given citing all the objectives under which the above project was executed; the justification as shown above in the overall project is summarized. A water filter was designed using engineering design software like power point and Pro-engineering into a theoretically synchronized machine prototype on paper, basing on the engineering design the machine prototype was fabricated into a solar system at the Workshop of Estate Division of SHIATS and its performance evaluation carried out at the Department of Food Process Engineering, Vaugh School of Agricultural Engineering and Technology. During the performance evaluation, various parameters were analyzed and proved worthy, parameters like performance, Cost effectiveness and evaluation energy consumption etc were determined, the cost effectiveness of the dryer was proved through monetary expenditures and expenses.

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