

Design, Analysis and Fabrication of a Contaminated Water Filtration System

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Abstract - The earth is covered by 70% of water in which only 1% accounts to fresh water which is largely polluted due to rapid urbanization and irresponsible waste management. The freshwater bodies are Lakes, Rivers, Underground water table etc, all these water bodies have underground water channels connecting each other allowing transfer of effluents. Modern filtration methods mainly consist of chemical filtration (chlorination and ozonation) which have proven to be hazardous to the human life, in an attempt improve existing filtration methods we have employed the use of bio-adsorbents to treat industrial wastewater in an eco-friendly and economical way. Understanding of deterioration in quality of the lake water due to the excessive presence of microbial activity. Understanding the application and use of Ultra-Violet Radiation (UV) in the reduction and prevention of growth of the microbes present in water. Along with the utilization of existing UV technology and Thermal energy storage methods to reduce microbial reactivation and other polluting factors. Review the various methods and techniques that can be used for the integrated application of the fruit peels, plant coagulants and UV in the purification process of the polluted water and analysing the uses and benefits of various fruit peels in their forms (original and alternate) in the removal of metallic and non-metallic wastes and impurities from polluted/waste water. Utilization of renewable and sustainable energy sources for the purification process of the polluted water. Evaluation and selection of suitable ingredients and processes based on the factor of availability and economical expenses.

lake which comprised of the following effluents and their level.

Constituents	level
Ph level	6.8-8.4
Total Bacteria count(cells/mg)	10 ⁴ -10 ⁷
BOD(mg/l)	25-180
COD(mg/l)	44-330
Cadmiun(mg/l)	0.03-0.76
Lead(mg/l)	0.01-1.77
Chromium	0.02-0.67
Nickel(mg/l)	0.002-0.41
Copper(mg/l)	0.01-0.461
Dissolved Oxygen(mg/l)	0-3

As seen above the major constituents are heavy metals and micro-organisms, therefore the bio-adsorbent technology along with UV and Thermal energy storage of rocks has been incorporated. In the apparatus first comes the TES rocks which absorb the thermal energy from sunlight and transfer it to the water, thereby increasing the temperature. Next it goes to a UV treatment chamber where the micro-organism growth is eliminated by breaking its DNA bond, but the carbon based body remains therefore the bio-adsorbent treatment is incorporated such that all the sediments can be removed during flocculation leaving clean water coming outside the tank.

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)...

1. INTRODUCTION

Water is the most essential element on earth for the survival of living beings, the earth is covered by 70% of water but only about 1% is fresh water which is largely polluted due to rapid urbanization and irresponsible waste management. If things go on like this there will be a huge water crisis, therefore measures have to be taken in order to prevent any sort of crises. Already several methods exist in the process of filtration which incorporate chemical use like chlorination and ozonation but these also in the long run cause problems to the environment and human health. Other sustainable methods exist but they cost more and are not utilized under one system. The objective behind our filtration is to reduce the levels of effluents from a limnological study on Bellandur

The Sedimentation tank is where the bio-adsorbent is being done, here we are incorporating a French press technique which use Dc servo motors from linear motion in the z axis, basically the bio-adsorbent powder is put in the tank and allowed to settle for 30 minutes after which a mesh is French pressing through the water down taking all the sediments down, then allowing the clean water to pass out .

The mechanism used in French press technique is powered using a solar panel setup and an closed loop control system in incorporated in order to manage the movement of the mechanism along with the data from the sensors which will display the values of ph, hardness etc.

The movement of the mechanical arms is time based, which will move every 30 minutes and hold the sediments down and flow the clean water out by opening the outlets at the same time.

FOLLOWING ARE THE IMAGES DEPICTING THE POLLUTED WATER OF THE BELLANDUR LAKE:



Fig 1.1



Fig 1.2: Collected Sample water

2. Design and Analysis

2.1 Objective of the Proposed Research

The Objective of the proposed research is to design and fabricate a contaminated water filtration system that will

clean the water efficiently using only renewable energy to power its parts, the system should be cost efficient and user friendly so that it can be used by anyone.

The system is fitted with latest sensors and actuator to control the flow of water through the system, the utilization of UV lamp is incorporated to kill microorganism and inhibit their growth by breaking their DNA bonds. The solar preheater is used to kill light sensitive microorganisms and heat the water to activate the process. The pulverized form of bio-wastes and plant coagulants is dumped in a tank where it can rest for 30 minutes, after which a French press technique is incorporated to separate the sediments.

Based on the research we have understood that the incorporation of different segments in such a manner will give improved output as when compared to individual result.

2.2 Methodology of the Proposed Project

Coagulant powder making

1. Sun Drying Method

Fruit peels are to be sun dried for 2 days until moisture is lost and snaps crisply upon breaking Mince the dried peels in ball mill (FRITSCH Pulverisette 6) for 20 min at 500 rpm. This produces a particle thickness of 35-45 μm .

2. Microwave Oven Method

Fruit peels are to be dried in microwave oven in short intervals of 2 mins until peels is completely dry. (Different Peels require different number of iterations.) Fruit peels are to be dried in an electric oven for 48 hrs at 100 C. Mince the dried peels in ball mill (FRITSCH Pulverisette 6) for 20 min at 500 rpm. This produces a particle thickness of 35-45 μm .

3. Carbonization Method

Fruit peels are to be dried by anyone of the above-mentioned methods.

To carbonize the dried peel, place them in a furnace for 3hrs at 200 C.

Pulverize after carbonization.

Merits of Different Peels and Organic Matter

1. Banana Peel

Banana peel helps in absorption of **Lead & Copper**. It is due to the presence of acid groups such as carboxylic and phenolic groups. These groups enable the peel to have a natural affinity to lead and copper.

2. Orange Peel

Orange peel helps in the reduction of COD. It is due to the increased presence of **hydroxyl radicals**. It also consists of

cellulose pectin, hemi-cellulose, lignin and limestone. This enables orange peel to be an effective bio-adsorbent for removing metals, and organic pollutants from polluted water. The different dyes which it absorbs are Golden yellow, Black B and Red 6BL.

3. Moringa Oliefera Seed (Drumstick) & Alum

Moringa seeds in addition with alum have a very positive impact in water purification, they aid in the conversion of acidic water to basic water.

They also reduce the turbidity of polluted water.

This is owed to the presence of water soluble cationic proteins in seeds.

2.3 Calculations

For Prototype:

Height of the tank, $h = 170 \text{ mm.} = 0.17 \text{ m.}$

Volume of the tank, $V = 5.3407 \times 10^{-3} \text{ m}^3$.

Diameter of the pipe, $d = 1 \text{ inch} = 0.0254 \text{ m.}$

Area of cross section of the pipe, $A = 5.067 \times 10^{-4} \text{ m}^2$

Velocity of the flowing water, $v = 0.5 \text{ m/s.}$

Discharge through the pipe, $Q = A \cdot v = 2.5335 \times 10^{-4} \text{ m}^3/\text{s.}$

Diameter of the tank, $D = 200 \text{ mm.} = 0.2 \text{ m.}$

Time taken to fill the tank, $t = 21.08 \text{ secs}$

Similarly,

For $d = 2 \text{ inches}$, $\text{Area} = 2.0268 \times 10^{-3}$, $Q = 1.0134 \times 10^{-3} \text{ m}^3/\text{s}$,
 $t = 5.27 \text{ sec.}$

For $d = 3 \text{ inches}$, $\text{Area} = 4.5603 \times 10^{-3}$, $Q = 2.2801 \times 10^{-3} \text{ m}^3/\text{s}$,
 $t = 2.34 \text{ sec.}$

2.4 Components and assembly

1. Solar preheater

In the solar preheater we are using a long slab of black limestone and placing it in a tank which is covered with a glass sheet and placing an insulator under it. As seen in the diagram are places inside a casing or collector box.

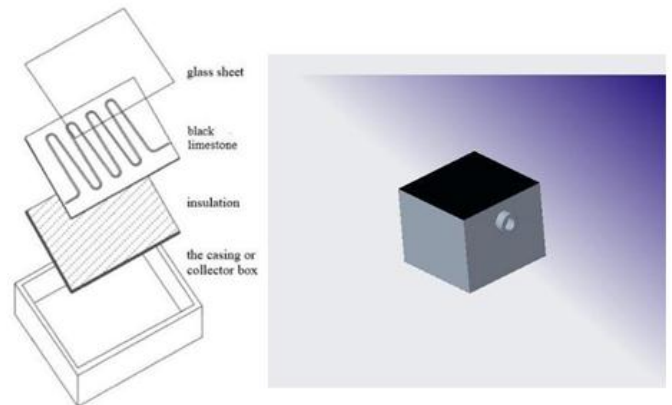


Fig 2.1



Fig 2.2

2. UV Lamp tube

The UV lamp is covered with a quartz glass sleeve and placed in a tube which has a reflective wall on the inside and helps in dispersion of light. Here the water stays for a period of 5 minutes.

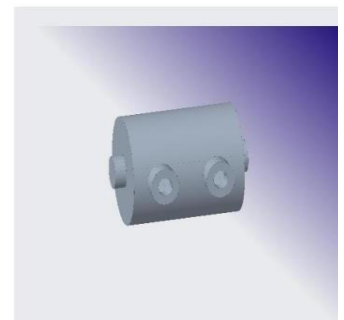
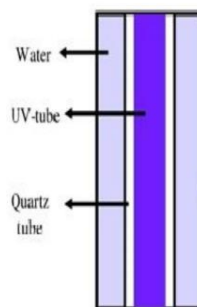


Fig 2.3



Fig 2.4

3. Adsorbtion tank



Fig 2.5

As seen in the above show figure, the adsorption tank comes in the last where the bio- adsorbents are dumped in the tank and is allowed to sit for 30 minutes after which a mechanism performs a French press so that the it pushes the sediments down and the outlet is opened for the water to flow out.

The entire system was originally designed to be controlled using dc servomotor, sensors and control unit powered by a solar panel and battery system.

4. Filtration mesh



Fig 2.6

The previously shown image is that of the filtration mesh, with the help of which the coagulants are going to be. While designing the tank the idea of moving a mesh up and down was to be done with the help of a motor.

5. Sensors, Control System and solar energy generation system

In order to make the system more automated, sensors are being used to check the levels of certain characteristics before and after filtration. To control the sensor function and to manage and time the movement of the French press mechanism a feedback loop control system has to be incorporated. All these systems are powered using a solar panel which stores the energy in the battery by absorbing energy from the sun. This electrical energy is used for UV lamp and other electrical components

System Assembly

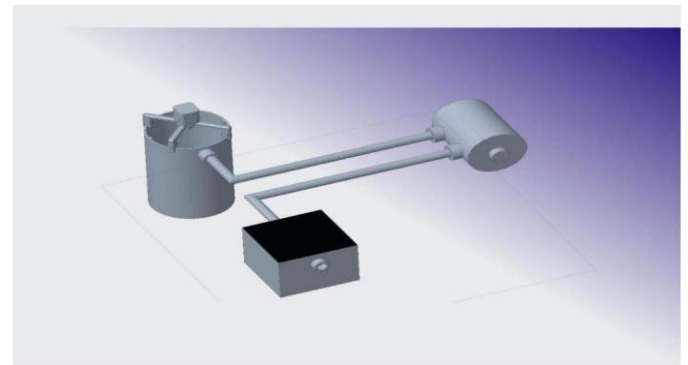


Fig 2.7



Fig 2.8

An assembly of the proposed system is shown above, where the flow of water will occur with the help of gravity.

2.5 Outcomes of proposed project

- Understanding and evaluating the condition, composition and the pollution (organic and inorganic) present in Bellandur Lake.
- Application and utilization of naturally occurring pebbles and stones for the process of pre-heating the polluted water.

- Understanding of deterioration in quality of the lake water due to the excessive presence of microbial activity.
- Understanding the application and use of Ultra-Violet Radiation (UV) in the reduction and prevention of growth of the microbes present in water.
- Learning about the adverse changes in the ecological cycle of the lake and also learning of methods and techniques to revert those changes.
- Learning and analysing the uses and benefits of various fruit peels in their forms (original and alternate) in the removal of metallic and non-metallic wastes and impurities from polluted/waste water.
- Learning and contemplating the application and benefits of different plant coagulants that can be used in their forms (original and alternate) in the removal of solid wastes (organic and inorganic) and also in the reduction/prevention of microbial activity in the polluted water.
- Understanding and reviewing the various methods and techniques that can be used for the integrated application of the fruit peels, plant coagulants and UV in the purification process of the polluted water.
- Formulation and utilization of renewable and sustainable energy sources for the purification process of the polluted water.
- Evaluation and selection of suitable ingredients and processes based on the factor of availability and economical expenses. Water testing was conducted according IS 3025 Standard Protocols.

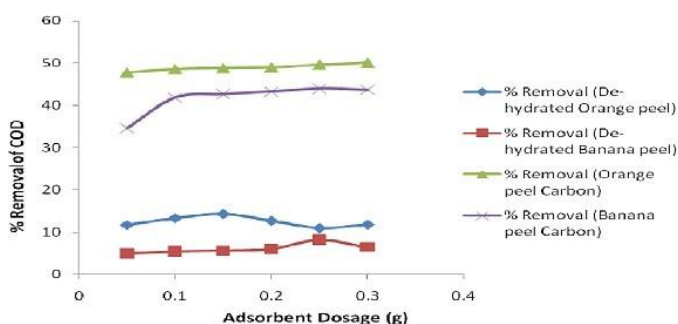


Fig 2.9

Parameters	Pre-treatment	Post Treatment
pH	6.8	6.5
BOD(mg/l)	19.8	5
COD(mg/l)	120	--
Dissolved oxygen(mg/l)	<1.0	7
Total bacteria count(cells/ml)	10 ⁴ -10 ⁷	10 ⁷
Copper(mg/l)	0.01-0.461	0.33
Lead(mg/l)	0.01-1.77	0.2

Table 2.1

2.6 Relevance of present work

It is inevitable that our surroundings and environment are degrading every day and have caused our lives to be in great danger. In an attempt to save the most valuable resource, water, on our planet we have designed this study. It is in every way relevant and important to the sustainable existence of the future generation that we responsibly manage our water resources.

We have through our proposed project and area of study have made an attempt to design and analyse a system for the purification of the contaminated water in Bellandur Lake. The lake water is predominantly polluted with the discharge of untreated sewage from housing blocks and residential areas in addition to the chemical discharge of industries.

As Bellandur Lake is part of our city we feel that it is our responsibility that we make a valid effort to rectify our errors and be more responsible towards nature. We are proposing the use of bio adsorbents as an economical and eco-friendly method to tackle this issue.

The mismanagement and negligent attitude towards the lake has led to the degradation of all-natural life forms that existed in the lake. The continuous discharge of untreated sewage and industrial waste has led to the intoxication of the ground water table in and around the area. This has further caused increased levels of nitrides and phosphorous in bore well water that was retrieved from the surrounding areas of the lake.

Furthermore, the residents who live near the lake face many health issues such as lung diseases and dengue fever, the contamination of water has led to the depletion of aquatic life and the fertile wetlands where once farming used to happen.

Bellandur Lake is connected to Varthur Lake, hence the flow of water from Bellandur has also caused the contamination of water in Varthur Lake. Furthermore, the presence of household oils and other organic effluents has caused the frothing of water and sometimes this has also led to fires.

Owing to all these issues we feel that it is relevant and our responsibility that an effort is made to conserve and rejuvenate our water bodies.

3. CONCLUSIONS

- This can be a start to changing our mode of filtering from chemical basis to natural materials.
- This method shows us how we can utilize wastes in order to filter water, basically performing dual functions.
- The project has a lot of prospects and provides great scope for developments.

•The initial model focusses upon the Bellandur lake but utilizing these techniques the technology can be incorporated for any lake.

•This technology can be utilized for rivers and other water bodies as well.

•This technology currently focusses on making the water suitable for the environment and prevents further degradation, but in future this technology can be used to filter it to drinking water level of purity.

ACKNOWLEDGEMENT

The authors can acknowledge any person/authorities in this section. This is not mandatory.

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