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# EXPERIMENTAL INVESTIGATION ON REMEDITION OF POLLUTED UNDERGROUND WATER USING FILTER BED IN TAPS

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**Abstract - Quantity of drinking water have great importance, this thought inspired us to conduct this project. The study aimed to assess the suitability of the well waters around an industry for domestic purposes. The main physio-chemical water quality analysis of the parameters like turbidity, conductivity, pH, acidity, chlorides, dissolved oxygen, total solids, iron, COD, BOD etc., were conducted and the extent of the pollution of groundwater was analyzed.**

***Index Terms – Turbidity, Conductivity, Chlorofluorocarbons, Chlorides, Acidity, Chemical, Total Dissolved Solids, Filtration***

## INTRODUCTION

Water is one of the most valuable resources in our planet. The growth of industry, technology, population, and water use has increased the stress upon both our land and water resources. Locally, the quality of ground water has been degraded. Municipal and industrial wastes have entered the soil infiltrated some aquifers, and degraded the ground-water quality. Quality of ground water is decreasing considerably as industrial wastes are discharged into the surrounding area. Earth is the planet having about 70% of water but due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants which can cause various water borne diseases. Water quality is a term used to describe the chemical, physical and biological

characteristics of water usually in respect to its suitability for a particular purpose.

The study area we have selected is the industrial area near Kochuveli. The region is heavily polluted by the acidic effluents from the industries emitted directly to the coastal region. Due to this, the groundwater around the region is polluted and the people there cannot use this water for their daily uses. They depend on pipe water and some people are even depending on this polluted groundwater. Due to this, the people here are affected by various diseases such as skin and lung cancer, irritations in eyes and skin, allergic problems, asthma, tuberculosis etc. Due to emission of effluents 1 from industries to the sea, the aquatic life and animals near the coastal region are also affected.

So, we have decided to design a filter bed to purify the polluted ground water. The composite filter bed consists of gravel, activated carbon, geotextiles, fine sand and manganese dioxide. These materials are known to increase the quality of water and to make the water quality parameters within the permissible limits as per the IS standards. COD, iron, electrical conductivity, turbidity and total solids were reduced by using this filter media. The materials used in this filter media are easily available, economic and are environmental friendly.

## SAMPLING AND DATA COLLECTION

The samples were taken from 10 stations on 19 January 2021 in the North and South direction from effluent channel of Travancore Titanium Products Ltd. The collections were made during day time. Maximum care was taken for the collection of samples, their preservation and storage.

**Table 3.1: List of Sampling Stations**

| Sampling Stations | Latitude | Longitude | Distance from effluent channel |
|---|---|---|---|
| S1 | $9^0$63’ 34.6247"N | $82^0$32’ 35.21"E | 0.3S |
| S2 | 9 $^0$63’ 35.0245"N | $82^0$36’ 33.01"E | 0.6S |
| S3 | 9 $^0$63’ 35.5237"N | $82^0$42’ 21.11"E | 0.8S |
| S4 | 9 $^0$63’ 35.6127"N | $82^0$48’ 30.85"E | 1S |
| S5 | 9 $^0$63’ 36.0327"N | $82^0$54’ 22.12"E | 2S |
| S6 | 9 $^0$63’ 40.4327"N | $82^0$55’ 44.12"E | 0.3N |
| S7 | 9 $^0$63’ 7.5243"N | $82^0$44’ 32.12"E | 0.6N |
| S8 | 9 $^0$63’ 42.1342"N | $82^0$32’ 12.21"E | 0.8N |
| S9 | 9 $^0$63’ 54.0125"N | $82^0$45’ 25.45"E | 1N |
| S10 | 9 $^0$63’ 43.4217"N | $82^0$27’ 3.27"E | 2N |

### Analysis Of Water Quality Parameters:

Ground water quality was analysed for physical and chemical parameters such as Turbidity, Conductivity, pH, Acidity, Chlorides, DO, Total Solids, Iron, COD and BOD. The tests were conducted on the basis of IS standards.

### Design Of Filter Bed:

A suitable and economical filter bed was designed by the trial and error method using various materials like gravel, fine sand, geotextile, manganese dioxide and activated carbon. The increase in water quality parameters due to this filter media prototype was analyzed.

**Iron calibration solutions:**

| Concentration of Fe | Volume to pipet |
|---|---|
| 0.00mg Fe | 0.00ml |
| 0.05mg Fe | 4.00ml |
| 0.10mg Fe | 8.00ml |
| 0.15mg Fe | 12.0ml |
| 0.20mg Fe | 16.0ml |
| 0.25mg Fe | 20.0ml |

**Results Of Samples From South Direction:**

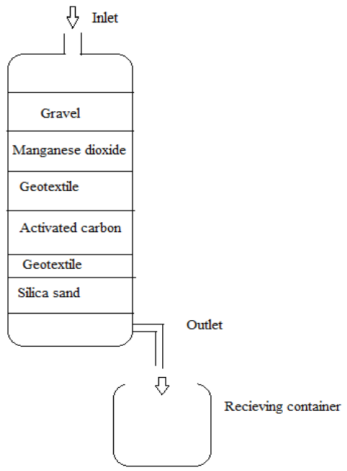
| Sl.no | Parameters | S1 | S2 | S3 | S4 | S5 |
|---|---|---|---|---|---|---|
| 1 | PH | 5.1 | 5.3 | 6.0 | 6.1 | 6.6 |
| 2 | CONDUCTIVITY (µs/cm) | 1760 | 1600 | 1112 | 632 | 543 |
| 3 | TURBIDITY(NTU) | 6.2 | 5.4 | 4.5 | 3.1 | 2.9 |
| 4 | IRON (mg/l) | 3.27 | 3.12 | 2.07 | 1.56 | 1.41 |
| 5 | CHLORIDE(mg/l) | 234.99 | 243.99 | 191.55 | 154.64 | 90.927 |
| 6 | BOD(mg/l) | 1.167 | 1.15 | 1.12 | 1.07 | 1.019 |
| 7 | DO(mg/l) | 2.1 | 3.49 | 4.32 | 5.64 | 6.01 |
| 8 | COD(mg/l) | 64 | 51 | 31 | 27 | 18 |
| 10 | ACIDITY(mg/l) | 32 | 25 | 26 | 20 | 19 |
| 11 | TOTAL DISSOLVED SOLIDS (mg/l) | 2400 | 2200 | 1300 | 1220 | 930 |

**Results Of Samples From North Direction:**

| Sl.no | Parameters | S1 | S2 | S3 | S4 | S5 |
|---|---|---|---|---|---|---|
| 1 | PH | 5.4 | 5.3 | 5.5 | 5.6 | 5.9 |
| 2 | CONDUCTIVITY (µs/cm) | 1700 | 1688 | 1402 | 520.4 | 530.7 |
| 3 | TURBIDITY(NTU) | 7.2 | 6.9 | 6.2 | 4.8 | 3.2 |
| 4 | IRON (mg/l) | 2.9 | 1.592 | 1.55 | 1.3 | 0.39 |
| 5 | CHLORIDE(mg/l) | 242.321 | 223 | 173.24 | 66.81 | 58.21 |
| 6 | BOD(mg/l) | 1.17 | 1.15 | 0.817 | 0.718 | 0.72 |
| 7 | DO(mg/l) | 2.53 | 3.21 | 4.242 | 5.63 | 5.3 |
| 8 | COD(mg/l) | 69 | 50 | 29 | 24 | 15 |
| 10 | ACIDITY(mg/l) | 32 | 29 | 25 | 23 | 20 |
| 11 | TOTAL DISSOLVED SOLIDS (mg/l) | 2100 | 1910 | 1520 | 970 | 810 |

**Treatment Method:**

Schematic diagram of composite media filter:




**Comparison of samples S1 and S2 before and after filtration:**

| Parameters | S1 Before filtration | S1 After filtration | Removal Efficiency (%) | S2 before filtration | S2 After filtration | Removal Efficiency (%) |
|---|---|---|---|---|---|---|
| Total Dissolved Solids(mg/l) | 2400 | 570 | 73.25 | 2200 | 600 | 72.72 |
| Iron(mg/l) | 3.27 | 1.2 | 63.30 | 3.12 | 0.9 | 71.15 |
| Conductivity (µs/cm) | 1760 | 790 | 55.11 | 1600 | 732 | 54.25 |
| Turbidity(NTU) | 6.2 | 2.55 | 58.87 | 5.4 | 1.32 | 75.56 |
| COD(mg/l) | 64 | 3.9 | 93.90 | 51 | 2.9 | 94.31 |

**Comparison of samples S4 and S5 before and after filtration:**

| Parameters | S4 Before filtration | S4 After filtration | Removal Efficiency (%) | S5 before filtration | S5 After filtration | Removal Efficiency (%) |
|---|---|---|---|---|---|---|
| Total Dissolved Solids(mg/l) | 2100 | 620 | 70.47 | 1910 | 400 | 79.05 |
| Iron(mg/l) | 2.9 | 0.85 | 70.68 | 1.592 | 0.321 | 79.83 |
| Conductivity (µs/cm) | 1700 | 799 | 53 | 1688 | 750 | 55.56 |
| Turbidity(NTU) | 7.2 | 2.56 | 64.44 | 6.9 | 2 | 71.01 |
| COD(mg/l) | 69 | 3.2 | 95.36 | 50 | 2.4 | 95.2 |

**Installation Of Filtermedia:**

A portion of water from the water tank is directed to the kitchen taps. Kitchen taps can be connected to this filter media after controlling its flowrate using a flow controlling valve. Flow rate for our filtermedia prototype is 9 Litre/ hour. It is better to use this water for cooking and drinking purposes. Flow rate can be increased by accurate design of filtermedia and increasing the depth, width etc.. of the filter materials.

## CONCLUSION

**i)** We concluded that the water quality parameters of the groundwater was not within the permissible limits as per the IS standards.

**ii)** On the basis of the tests conducted on the water samples, we concluded that those at a distance of 0.3 and 0.6 km in North and South direction of the effluent channel of the industry directed to the sea are severely affected.

**iii)** Thus the filter media prototype have an average removal efficiency of 74.87% of total dissolved solids, 70.31% of iron, 51.55% of electrical conductivity, 67.55% of turbidity and 95.42% of COD

## SCOPE FOR FUTURE STUDY

**i)** The project can be continued by studying all the physical, chemical and biological characteristics of water, also taking into account the poisonous heavy metals contained in water as the effluents from industries may contain heavy metals.

**ii)** In that case an additional layer of animal born charcoal can be added for removing the heavy metals from the polluted samples. Suitable plant biomass like Parthenium sp. can be used as a sorbent for removal for chloride from water. So this can be added with the filter media for removal of chloride content.

**iii)** The filtration using composite media can be studied in detail by making adsorption isotherms analyzing it. This can be done by designing a slow sand filter with composite media, provision for reducing periodic maintenance and making a prototype of it and testing the filtered water.

**iv)** The study can be further continued by making the prototype for different filtration rate and adjusting the depth of each layer for obtaining the best results.

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