RESEARCH PAPER

ASSESSMENT OF GROUNDWATER QUALITY AND REMEDIAL MEASURES OF CAUVERY RIVER BELT IN VEERANAM LAKE IN KATTUMANARKOIL AREA, TAMIL NADU, INDIA.

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Abstract

The Study of groundwater assessment can help to identify and improve predications of contaminant fate and transport in groundwater systems. The people of Kattumanarkoil area at Cuddalore district Tamilnadu mainly depend on the ground water for drinking and Agricultural purpose. The present study is undertaken to investigate extent of pollution to determine the groundwater quality in and around Kattumanarkoil area during Covid period at 2020-May month due to usage of fertilizers and make awareness among the people about the quality of ground water by taking water samples from 10 different locations and water quality assessment was carried out for the various Physico - Chemical and Heavy metals were analyzed and Reduction of physico - chemical parameters such as TDS,TH, HCO_3, BOD, Cl and Ca from the effluents and ground water samples was done by using specific adsorbents.

***Keywords*:**

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Introduction

Water plays an important role in human life. It is necessary for industry, agriculture and human existence. The healthy water ecosystem is depended on the physico-chemical and biological characteristics (Venkatesharaju.K *et al* 2010). Due to increase in industrialization, urbanization, agriculture activity and various human activities has increase the pollution of surface water and ground water (Bhalme.SP and Nagarnaik.PB 2012).Water is one of the most important of all natural resources known on earth. It is important to all living organisms, most ecological systems, human health, food production and economic development (Postel. S.L *et al* 1996).The water quality from the rivers has a considerable importance for the reason that these water resources are generally used for multiple matters (S.Venkatramanan *et al* 2014).The quality of potable water depends on water sources like river, well and lake etc (P.Mandal *et al* 2010) . The condition of drinking water may be polluted with pathogen, toxic metal, chemical compounds such as pesticides, herbicides and other industrial waste becomes waterborne outbreaks (Begum.A and Harikrishna 2008). Out of the total water consumed by human beings, more than 50 % of it is consumed for industrial activity and only a small proportion is used for drinking purposes (Jindal Kumar Manoj 2013). Good Quality of Drinking water is very necessary for improving the life of people and to prevent from diseases (Mohamed hanipha.M and Zahir Hussain.A 2013). Fresh water has become a scare commodity due to over exploitation and pollution (S.Gupta and D.N.Shukla 2006). Pollution of surface and ground water is great problem due to rapid urbanization and industrialization. Water pollution is defined as a change in the composition or conditions of the watercourse components, due to human activity, that makes water becoming less suitable for its natural

uses (I.A.Khatib *et al* 2008).Water must not contain microbiological contaminations that are pathogenic to humans (S.O.Nzunga 2019).Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life (Dahiya.S 2007). According to WHO organization, about 80% of all the diseases in human beings are caused by water (Igwenyi.I.O and Aja-Okorie 2014). Water is considered polluted if some substances or condition is present to such a degree that the water cannot be used for a specific purpose.

Study area

Cuddalore district:

Cuddalore district is one of the important districts of South Indian state Tamil Nadu. The District is located along the Eastern Coastal Region of the State. The district has an area of 3,564 km². It lies in the Agro Climatic zone II and the Geographic Coordinates of the district are: Latitude is $15^0\ 5^{11}$ /$11^0\ 11^{11}$ and $12^0\ 35^{11}$ N, Longitude is $78^0\ 38^{II}$ to $80^0\ 00^{11}$ and Altitude 4.6m MSL. Its coastal landforms include strandlines, raised beaches, sand dunes, mangrove swamps and tidal flats with predominantly sandy beaches on the northern side and mangrove swamps to the south.

The district of Cuddalore has some small deposits of lignite that helps the small factories that run in the area. The district is also one of the most robust fishing areas in the state of Tamil Nadu, and home to a large number of fisher population. According to 2011 census, Cuddalore district had a population of 2,605,914 with a sex-ratio of 987 females for every 1,000 males, much above the national average of 929. A total of 279,950 were under the age of six, constituting 147,644 males and 132,306 females.

Climate and rainfall

Cuddalore district is influenced by both the South West and North East monsoons, the latter is cyclonic in nature and attributable to a series of lows that develop in the Indian Ocean and Bay of Bengal and sweep across the peninsula. Normally this area receives about an annual rainfall of 1086.4 mm.

Temperature:

January to February is the comparatively cooler period. The temperature is low during the month of January with average mean daily temperature of (20.4 C) and high during the month of June with average mean daily temperature of (40.3 C).

Soil:

The soil of the district is classified as the black, red, ferruginous and arenacious. They are again subdivided into clays, loam and sands. Black soils are observed in the Chidambaram and Vrudhachalam Taluks. The sandy soils are seen along the coast in Cuddalore and Chidambaram Taluks. The younger alluvial soils are found as small patches along the stream and river courses in the district. The cashew is grown in red soils in the areas around Panruti, Vadalur, Neyveli and Virdhachalam and 60% of the state's production of cashews is accounted for by the District

Sample Collection:

Ground water samples were collected in and around Veeranam Lake in kattumanarkoil area in 10 representatives bore wells during for Covid period 2020 May month. The distance between one station to another station for ground water was maintained about 1 km. Samples were collected in bore wells after running it for 3 minutes. Samples were collected in a clean and 10 dry polythene bottles which were previously cleaned. Each bottle was rinsed with distilled water to avoid any possible contamination. The collected samples were analyzed for physico – chemical parameters and heavy metals contamination and the mean values are compared with standard values of WHO.

TABLE-1: Water Sampling Stations and Sample Numbers

S. No	Sampling Stations	Sample Number
1	Vattathur	A1
2	Mazhavarayanallur	A2
3	Kumarakudi	A3
4	Allur	A4
5	Paripooranatham	A5
6	Vazhaikollai	A6
7	Vadakku Viruthangan	A7
8	Kandha Kumaran	A8
9	Kollumedu	A9
10	Lalpettai	A10

RESULTS AND DISCUSSION

Table 2: Physico-chemical and parameter of ground water samples collected around in Veeranam lake near Kattumanarkoil area.

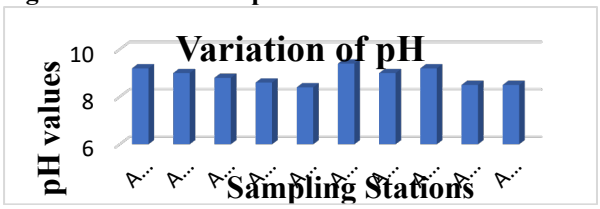
Sample name	pH	EC	TDS	TH	Ca	Mg	CO_3	HCO_3	Cl	DO	BOD	COD	Cu	Ni	Pb
A_1	9.2	35	13	595	330	218	210	220	585	7	19	22	0.	0.	0.

		87	91									.5	01	11	23
A2	9.0	3478	1510	910	243	159	261	381	223	7.6	37	24	0.05	0.15	0.27
A3	8.8	2790	1215	551	351	182	52.5	445	609	8.3	27	38.5	0.07	0.19	0.15
A4	8.6	3294	1370	670	211	121	144	470	1062	4.8	20	27.5	0.09	0.05	0.19
A5	8.4	2780	1730	316	189	130	1500.5	261	533	7.7	19	29.5	0.10	0.05	0.13
A6	9.4	1783	1730	445	195	177	142	162	321	5.7	19	24	0.18	0.09	0.15
A7	9.0	2059	1220	805	280	326	622.5	190	300	3.3	13.5	26	0.14	0.03	0.18
A8	9.2	2376	1435	420	234	111	319	123	392	9.5	15.5	19	0.19	0.02	0.14
A9	8.5	1679	1655	537	207	149	522.5	149	440	6.0	11.5	36	0.05	0.06	0.08
A10	8.5	17	17	621	327	265	114	180	158	6.9	90	30	0.	0.	0.
													02	03	11
		49	45												

pH

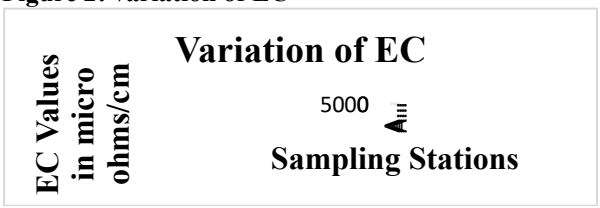
pH is considered as an important biochemical and ecological factor and provides an important information in many types of geochemical equilibrium, solubility and concentration calculations. It is an important parameter in water body since most of the aquatic life are adapted to an average pH and do not withstand drastic changes (Devi S and Premkumar R 2018). The pH of the samples varied between (8.4 - 9.4) which were found to be above the limit prescribed by WHO (6.5-8.5). The higher range of pH indicates higher productivity of the water.

Figure1: Variation of pH



Electrical conductivity Electrical conductivity (EC) which is a measure of water's ability to conduct an electric current is related to the amount of dissolved minerals in water (Gebrekidan Mebrahtu and Samuel Zerabruk 2011) EC values were in the range of 1749-3587 micro ohms/cm, in the present study the EC values were found to be above the permissible limit set by WHO (600 micro ohms/cm). This may due to the present of high amount of dissolved inorganic substance in ionized from water. Higher the value of electrical conductivity, higher will be the concentration of salts in the water.

Figure 2: variation of EC

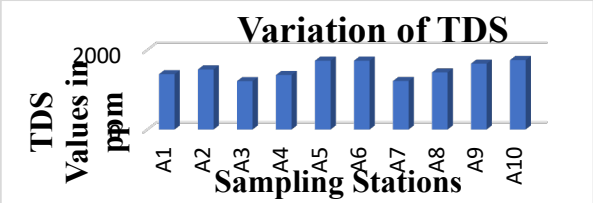


Total dissolved solids

TDS indicates the quality of dissolved solids available in water. The high values of TDS indicate the percolation of external solid substances in to the water bed during the rainy season. High value of TDS resulted in high electrical conductivity (Padmavathy S and Suriyakala K 2014).The permissible limit of WHO is (300-500) ppm. The total dissolved solids in the samples were found to be (1215-1745) ppm which is above than the limit prescribed by the WHO value. High level of TDS may aesthetically be unsatisfactory for bathing and washing. High values of TDS in ground water are generally not harmful to human beings but high concentration of these may affect persons, who are

suffering from kidney and heart diseases.

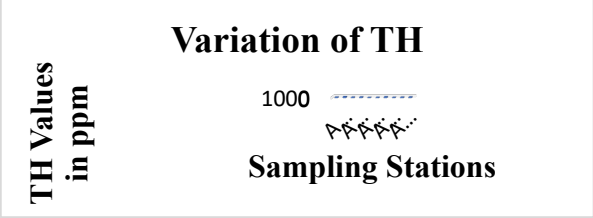
Figure 3: variation of TDS



Total hardness

Total hardness is the parameter of water quality used to describe the effect of dissolved minerals (mostly Ca and Mg), determining suitability of water for domestic, industrial and drinking purposes and attributed to presence of bicarbonates, sulphates, chloride and nitrates of calcium and magnesium (Singh M R *et al* 2010) .The TH value prescribed by WHO 200 - 300 ppm. The TH values of the samples are found to be (316 - 910) ppm which is higher than the level given by WHO. The evidence of the death rates from cardiovascular disease is inversely correlated with hardness of water.

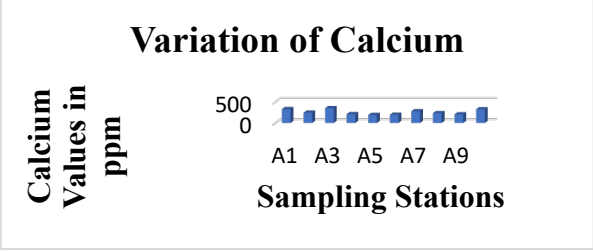
Figure 4: variation of TH



Calcium

Calcium is one among the most abundant ions in freshwater and plays a pivotal role in shell construction, bone building and plant precipitation.The magnesium act similar to calcium ion exchange reaction (Qureshimatva Umerfaruq M and Solanki HA 2015). The Calcium values were found to be in the range of 189-351 ppm. Calcium values of the samples are above the permissible limit of WHO (100 ppm)

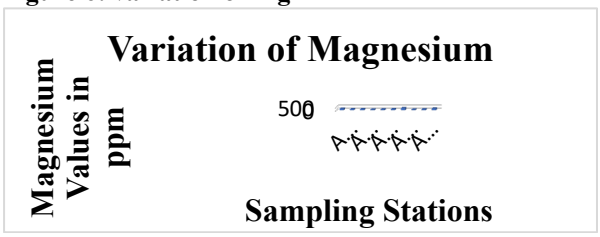
Figure 5: variation of Ca



Magnesium

Magnesium is one of the important sources for chlorophyll development and it acts as a restrictive factor for the growth of phytoplankton (Sivamanikandan P and Ahmed john S 2016). The Magnesium values are found to be in the range of 111-326 ppm. Magnesium values of the ground water samples are exceedingly above than the permissible limit of WHO value (150ppm). The high content of Mg is undesirable for household uses because of consumption of more soap and other cleaning agent. High Mg causes stone formation and diuretic action.

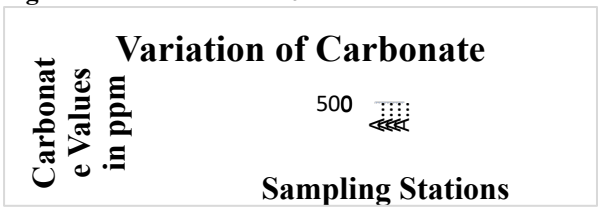
Figure 6: variation of Mg



Carbonate

The presence of carbonate is indicated when pH levels reach 8.3. Its presence can be determined by titration with hydrochloric acid using phenolphthalein as an indicator, or potentiometrically. Below a pH level of 8.3, carbonate will convert to an equivalent amount of bicarbonate (Ritu Singh Rajput *et al* 2017).The Carbonate values of the samples were found to be in the range between 52.5-319ppm. Hence, the carbonate values are below the values suggested by WHO (500ppm).

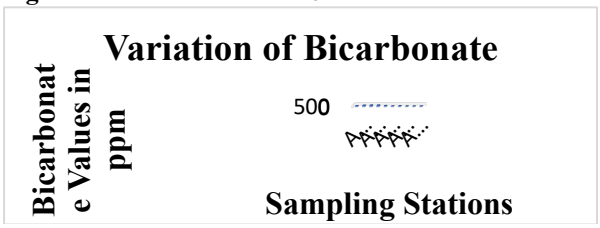
Figure 7: variation of CO_3



Bicarbonate

The Bicarbonate ion concentrations are reflected mainly in alkalinity values in drinking water. This buffers against acidic effect of such water (Sandeep Arya *et al* 2011).The bicarbonate experimental values are found to be in the range of 123-470 ppm. Bicarbonate values of the ground water samples are lower than the permissible limit suggested by WHO (500ppm).

Figure 8: variation of HCO_3

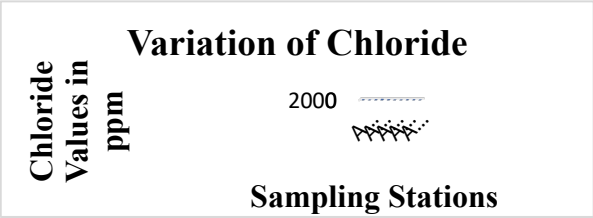


Chloride

The concentration of chloride is the indicator of sewage pollution and also imparts laxative effect. Atmospheric sources or sea water contamination is reason for bulk of the chloride concentration in groundwater which may exceed due to base-exchange phenomena, high temperature, domestic effluents, septic tanks and low rainfall. Porosity soil and permeability also plays a key role in building up the

chloride concentration (Amanial Haile Reda 2016). The permissible level of chloride as suggested by WHO is 200-250 ppm but the level of chloride in the samples was found to be in the range between 223-1062ppm. High concentration of chloride is considered to be an indicator of pollution due to contamination by organic waste of animals and from industries [34]

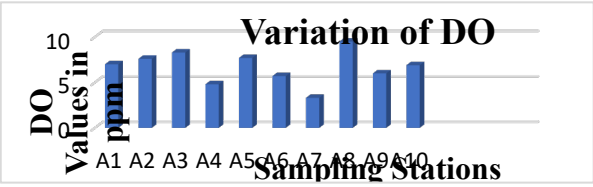
Figure 9: variation of Cl



Dissolved oxygen

Dissolved oxygen is important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. The DO values indicate the degree of pollution in water bodies (Venkateswara Rao. B 2011).The permissible limits for dissolved oxygen given by WHO is 5 ppm. The dissolved oxygen concentration is found to be in the range of 4.8-9.5 ppm. Hence, the samples have higher DO values.

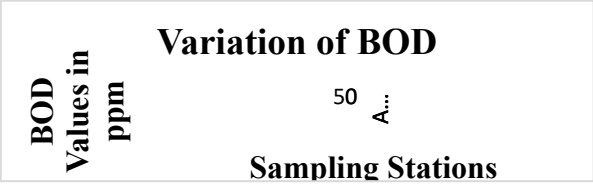
Figure 10: variation of DO



Biological oxygen demand

It is important here to note that, low BOD content indicates of good quality water, while a high BOD indicates polluted water. When BOD level is high, DO level decrease because the oxygen available in the water get consumed by the bacteria (Sarwade A B and Kamble N A 2015). The BOD concentration is found to be in the range of 9.0-37.0ppm. BOD values of all ground water samples are found to be above the permissible limit of WHO (6ppm). High BOD may be due to the presence of several microbes in water bodies which accelerate their metabolic activities with the increase in concentration of organic matter.

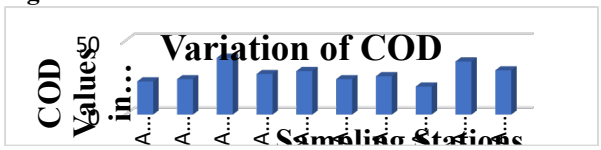
Figure 11: variation of BOD



Chemical oxygen demand

COD is a measure of the oxidation of reduced chemicals in water. It is commonly used to indirectly measure the number of organic compounds in water. The measure of COD determines the quantities of organic matter found in water (Arivoli Appavu *et al* 2016). The COD concentration is found to be in the range of 19-38.5ppm. Hence, COD values of all ground water samples are found to be above the permissible limit of WHO value (10ppm).

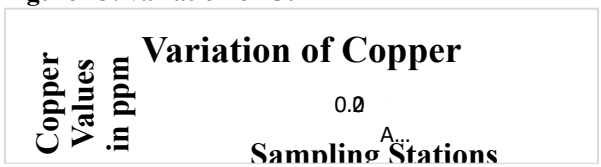
Figure 12: variation of COD



Copper

Cu is another essential element that at high concentrations can produce toxicity to human beings. Cu in high concentrations above 35 mg daily, can cause great biochemical changes in the body and affect the performance of the central nervous system. (Souza A M *et al* 2016). The copper values were found to be in the range of 0.01-0.19ppm. All ground water samples are found to be in the range below the permissible limit of WHO (2ppm).

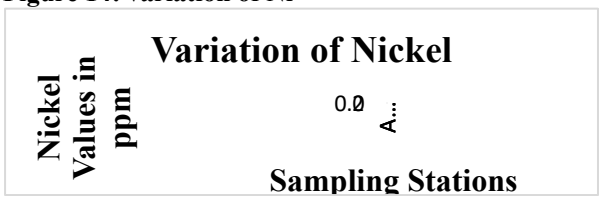
Figure 13: variation of Cu



Nickel

Nickel is a silver-white metal found in the earth's crust that is used to produce steel, nickel-cadmium batteries, heating fuel, nickel plating and ceramics. Certain amounts of nickel are useful to the human body, but too much nickel can be toxic. About 10% of women and 2% of men are highly sensitive to nickel. The most serious effects occur when nickel is inhaled. This can lead to increased risk of respiratory infections, asthma and sinus problems (Emhemmed Alhibshi *et al* 2014). The Nickel level in the given samples was found to be in the range between 0.02-0.19ppm. Therefore, Nickel values in some samples are below the level suggested by WHO (0.1ppm) and in some samples it is found to be in comparable values.

Figure 14: variation of Ni

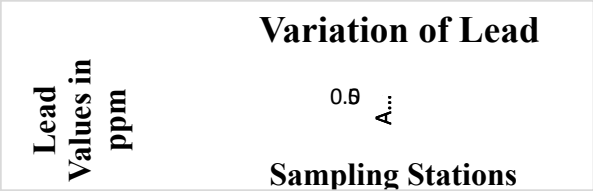


Lead

The high content of Pb in the stream could be due to weathering and leaching of lead from waste rocks dumps. Lead is one of the most significant toxicants of the heavy metals and the inorganic forms are absorbed through ingestion by food and water and inhalation (Samuel J *et al* 2015). The Lead values in the samples were found to be in the range between 0.08-0.27ppm.

Therefore, lead values in some samples are found to be below or comparable to the permissible limit suggested by WHO (0.1ppm) and in some samples it is found to be above than the limit suggested by WHO. The increased levels may cause damage to brain, kidney if taken in high concentration.

Figure 15: variation of Pb



REMEDIATION

The progressive increase of industrial technology leads to the development of enormous industries of various disciplinary. Rapid industrialization and poor effluent treatment processes in many industries have led to a substantial lowering of water quality that is fed to water bodies. In India many small scale and large scale industries were developed in last decades. Of course those industries play a vital role in the growth of the country but also participates depletion of ground water and surface water. Many efforts have been devoted for purification of ground water as well as surface. The present work aimed to investigate the efficiency of gravel, sand and carbon from plant sources used as adsorbent in the treatment of ground water and effluent

Materials and method

Carbon preparation

The leaves of *sennapsidiumguasava* were obtained from the local area. The leaves collected were washed with distilled water to remove adhering sand, mud, dirt and other contaminant and then dried in the shadow for a week. The dried material was powdered by using the domestic mixer. The dried plant materials were mixed in a 1:1 weight ratio with concentrated H_2SO_4 and allowed to soak for 24 hrs at room temperature. The samples were placed in muffle furnace and heated to 200ºC for 24 hrs. After this, the sample was allowed to cool back to room temperature. Then, the samples were washed with distilled water and soaked in 1% $NaHCO_3$ solution to remove remaining acid. The sample was then washed with distilled water until pH of the activated carbon reached 6 then dried at 105°C for 5hrs. The activated carbon was introduced into mesh to obtain the approximate particle size 0.05m.m. This fine powder was stored in an air-tight container for the further experiments.

Experimental procedure:

A typical instrument containing 3 set of columns arranged consecutively one by one. First column packed with 100gm of finely divided gravels, second packed with 100gm of finely powdered sand and third containing 2gm of activated carbon sieved with 30 meshes. The 250 ml ground water samples were poured separated into the first column; it was filtered through the second and third column. The clear the ground water samples was collected, physicochemical parameters such asTDS,TH HCO_3, Ca, Cl and BOD were analyzed by standard methods prescribed by APHA.

The experimental duration was 30 min and each experiment was replicated three times. The overall percent removal for each parameters were calculated by the

following formula Percent removal = $\frac{(C_0 - C_t)}{C_0} \times 100$

Where C_0 = initial concentration at 0 min C_t = concentration at time t.

Similar experiments were carried out for the effluent samples

Results and discussion:

Table - 3

Physico chemical parameters	Percent removal (%)	
	ground water	Effluent water
TDS	32	28
TH	42	26
HCO_3	24	38
Ca	34	42
Cl	28	58
BOD	26	12

Removal of Physico chemical parameter in Ground water

Removal of Physico chemical parameter in Effluent water

Removal of TDS, TH, HCO_3, Ca, Cl and BOD

From Table 3 it was observed that the TDS concentration of both ground and effluent water samples before treatment was decreased when compared to the after the treatment. The percent reduction of TDS concentration for the ground water samples was 32% and the percent reduction of TDS concentration for the effluent sample was 28%. The results showed that the gravel, sand and carbon filters were the effective filter for the removal of TDS. The percent reduction of TH concentration in the ground water samples was 42% and the percent reduction in the effluent sample was 26%. Total Hardness is a measure of total inorganic substances dissolved in water. The percent reduction of HCO_3 concentration in the ground water sample was 24% and the percent reduction of HCO_3 concentration for the effluent sample was 38%. The percent reduction of Calcium concentration for the

ground water samples was 34% and the percent reduction of Calcium concentration for the effluent sample was 42%. The percent reduction of Chlorine concentration in the ground water samples was 28% and the percent reduction of Chlorine concentration for the effluent sample was 58%. The percent reduction of BOD values for the ground water samples was 26 % and for the effluent sample it was 12%. The results showed that the gravel, sand and carbon filters were the effective filter for the reduction of BOD values. The present investigation indicates that the gravel-sand-carbon filter is the efficient filter to reduce the physico - chemical parameters present in the ground water as well as effluent.

Conclusion

The ground water samples were collected from 10 different stations in and around Veeranam Lake near kattumanarkoil area in Cuddalore district, Tamilnadu, India. The physico - chemical parameters and heavy metal analysis like pH, Electrical Conductivity, Calcium, Magnesium, Total Dissolved Solids, Total Hardness, Dissolved oxygen, Biological characteristics, chemical characteristics were analyzed using standard procedures. Some parameters like pH, EC, TDS, TH, Ca, Mg, BOD, DO, COD shows the values more than the permissible limit, and Some parameters like Carbonate, Bicarbonate, Copper, Nickel, Lead shows the values below the permissible limit. The excess of these parameters will lead to many problems in humans and animals. So it is the time to preserve water around this vulnerable resource from pollution. By adopting proper drainage system around this area, we can minimize these problems. So the water in this all stations is fit for domestic purpose and slightly unfit for drinking purpose. It is necessary to preserve water as we are facing a huge demand for water. A method has been suggested based on the adsorption principle to minimize pollution at the discharge points by using low cost and ecofriendly adsorbent for the better treatment of the effluent prior to letting out following healthy agricultural and domestic practices etc.

Reference

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