PARAMETRIC EVALUATION OF EXISTING WATER QUALITY IN BADDI REGION OF HIMACHAL PRADESH

A

PROJECT REPORT

Submitted in partial fulfilment of the

Requirements for the award of the degree

Of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision

Of

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STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled **"parametric evaluation of water quality in baddi region"** submitted for partial fulfilment of the requirements for the degree of Bachelor of Technology in Civil Engineering at Jaypee **University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Dr. Rajiv Ganguly**. This work has not been submitted elsewhere for the reward of any another degree/diploma. I am fully responsible for the contents of my project report.

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CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"Parametric evaluation of existing water quality in baddi region"** in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering, Jaypee **University of Information Technology, Waknaghat** is an authentic record of work carried out by **Pratiyush kothari (151646) and Nikhil sharma(151692)** during a period from August, 2018 to May, 2019 under the supervision of **Dr.Rajiv Ganguly** Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

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DO	Dissolved Oxygen
TDS	Total Dissolved Solid
pH	Power of hydrogen
BOD	Biological oxygen demand
COD	Chemical ocygen demand

ABSTRACT

In this work, grab samples of groundwater, drinking water and waste water are analysed. The first set of samples was collected in the month of August,September,October, November, 2018 the second set was collected in January, February, March 2019.Over the whole interval of time various parameters regarding the water quality were analysed. The parameters which were analysed are as follows:-

1. Total Dissolved Solids
2. Determination of pH
3. Determination of chloride content
4. Determination of Conductivity
5. Determination of dissolved oxygen
6. Determination of biological oxygen demand
7. Determination of chemical oxygen demand
8. Determination of alkalinity
9. Determination of Hardness

CHAPTER 1

INTRODUCTION

1.1NEED OF STUDY

Earth is a live planet as a outcome of few rare fixings out of which water undertake an fantastic job. It is studied as the most expressive and essential asset for the organic circle like for human civilisation. Unlike specialists that are in count of the biosphere on sphere are Air, Fire, land and Sky. Every of these operators are chained in the middle of themselves to an vastly more provident degree and every rarity in one of them affects others also. Nearby the advancement of our civilisation, water has started being degraded and its quality started degrading because of many reasons like industrialization, local squanders, spill able from urban areas, urban and provincial trash. By the beginning and up gradation of human society, it has continually been seen that the beach front territories like as the waterway banks have been the greatly manned plots because of the accessibility of ample water assets for the mount of day by day life nearby cultivating and some other climatic points of interest. The urban communities and towns reliably have arised rising code of populace due to the easy procuring sources because of the different businesses which are set up to full fill the expanding need of the upgrading civilisation. Ahead these lines, step by step the urban areas are by and large more highly populated and thus, the encompassing territories of the urban communities are having different sorts of contaminations as the air contamination, soil contamination, water contamination and a much more increasingly because of the sludge, dirt, dumps and livestock field fertilizers and so on.

So also, Baddi has been the centre of all trade exercises and numerous enterprises of the state by virtue of simple accessibility. The toxic pollutants from the ventures are likewise intensely striking the climate change and water resources which are the surface water and land water.

The industrial region of Baddi, Nalagarh in Himachal Pradesh was selected as point area to determine the impacts of industrial pollution on subsurface water superiority as this region has boomed with excessively unplanned industrial development in the final some decades. This will aid in suitable managing of water sources and additional help to diminish deterioration of quality of water in the present study area.

1.2 DESCIPTION OF STUDY AREA

Solan is a district of Himachal Pradesh. Solan appeared on first September, 1972. It positions ninth with the locale of the state with a region of 1936 sq. km. (3.48% of all out state territory). It is known as the modern and business area of Himachal Pradesh. It has pulled in substantial modern subsidizing with Baddi, Barotiwala, Nalagarh being home to the greater part of the ventures. Baddi region lies between North Latitude 30°44'53" to 31°22'01" and East Longitude 76°36'10" to 77°15'14".The average elevation lies between 300-3000 m above mean ocean level. The Baddi-Barotiwala area lies in the lap of external Himalayas framing some portion of shivalik hills. The town is arranged at a elevation of 426 meters (1397 ft).

The atmosphere here is mild, generally warm and temperate. In winter, there is considerably less precipitation than in summer. The normal yearly temperature in Baddi is 23.4 °C. Precipitation here midpoints 1186 mm. As shown by the 2011 Census of India, Baddi town had a masses of 29,911 with 19,332 guys and 10,579 females .There were 3,883 adolescents underneath the age of six years. The sex proportion and kid sex proportion of the town stayed at 547 and 831 separately. The capability rate was 86.33%, higher than the state typical of 82.80% .Baddi is home to various pharmaceutical associations which have dove in collecting plants and R&D focus focuses in the town. The town is Asia's most noteworthy Pharmaceuticals focus and is home to without a doubt the greatest pharmaceutical associations, for instance, Cipla , Dr .Reddy's Laboratories, Cadila Healthcare, Abbott Laboratories, Ranbaxy Laboratories, etc..Baddi houses a total of 2,120 preparing plants having a spot with driving pharma, FMCG and material associations among others and which make a yearly turnover of Rs 60,000 crore. Baddi uses 33% surprisingly busy with Himachal's medium and broad scale undertakings. To the extent pay, the town contributes half of the express' hard and fast earnings.

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Fig 1.1 Map of study area

CHAPTER - 2

LITERATURE REVIEW

- **Sharda, A.K Sharma., [1]** water quality of swan river flowing in Himachal Pradesh. Although the industrial units have waste treatment systems to treat their waste but the complexity of the effluent characterization makes it extremely difficult to meet the statutory standards despite the best efforts made by the industries. The lack of proper management of waste water generation, solid waste management and scarcity of fund, the impacts of conservation measures on part of local bodies has proved to be ineffective resulting in increased pollution in study stretch of Swan river.
- **Das, Sahoo and Sinha., [2]** Very less reports have been published regarding the surface and ground water quality of Cuttack city. A study carried out by the researchers shows that the ground water of Cuttack city collected near drains exceeded the value recommended by IS:10500 for NO^{3-} and Na^{2+}
- **Chauhanand Ramanathan., [3]** Severe concentration of dissolved metal in the water due to heavy pollution on account of industrial pollution. The salinity played a major role in the water chemistry. The major reasons behind the pollution were the agricultural inputs and industrial effluents .
- **HP State Pollution Control Board., [4]** It manages to conducts annual tests to investigate the parameters like pH, Total dissolvedsolids, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) etc. which can be used as a handy source of information.
- **Chadetrik Rout and Baldev Setia.,[5]** Assessment of groundwater quality for suitability of industrial purposes. Corrosivity ratio indicates susceptibility of groundwater to corrosion. Corrosive water can mobilize metals like lead, iron, copper etc. from pipes into drinking water and after a period of time may results in leaks in plumbing. The adverse effect of corrosion is loss in hydraulic capacity of metallic pipes.
- **Mayuresh Panda., [6].** Water quality of various water resources in Cuttack city. Samples from various parts of city were collected some areas shows variation from acceptable limits.
- **(Rajkumar Herojeet., [7]** Application of environmetrics statistical models and water quality index. Analyzing the eight heavy metals of the groundwater samples, indicate that groundwater quality from the selected sampling locations cannot be used directly for domestic purposes. The heavy metals like Cd2+ , Pb2+, Cr6+ and Mn2+ were not

within the desirable limits for drinking water quality as prescribed by BIS and recommended guideline value of WHO.

- **V.A Santhi., [8]** The study scrutinize the level of Bisphenol A (BPA) at the Langat River basin, Malaysia surface water consumed as potable water, drinking water (bottled ,mineral and tap water) and human plasma in the surrounding areas of basin. Upto 93% of the surface water samples contains BPA at different levels fluctuating from below limit of quantification (LOQ; 1.3 ng/L) to 215 ng/L while some samples collected near the industrial and Municipal sewage treatment plants show six fold higher levels due to discharge of effluents from industries.
- **S Shrestha.,[9]** This study demonstrates the usefulness of multivariate statistical techniques for interpretation and analysis of water quality assessment ,complex data sets, locate the pollutant sources or factors and analysing temporal variation in water quality for an strong & effective water quality management.
- **A.Ikem., [10]** The analytical results of the 51 wells analysed in this research, revealed that groundwater from these private wells requires further purification to ensure their suitability for human consumption because the levels of some of the water quality parameters exceeded the WHO guidelines for drinking water. This study also revealed that nutrients and trace metals in the soils and sediments from the two sites were mostly in form of exchangeable metals, carbonate bound metals, and as oxides and hydroxides. These metals are largely of anthropogenic sources from the extractions conducted.
- **Lijun Ren.,[11]** This report reveals about, more rapid the urbanization process is, the urban river pollution becomes serious concern . By taking systematic and logical measures, water quality will become better along with the development of urban city, just as this paper reveals. The complication reflected from regression curves are dominant for the city in its sustainable development plans. For sustainable urbanization in Jinan, it is significant to supervise these coupling factor and understand the most significant variations for sustainable urbanization in Jinan which is the political center and economic capital of Shandong Province. However, sustainable development level is still low and has larger potential for further improvement when we comprehensively evaluate the results, it show that sustainable development level is still very low and have large prospective for further advancement.

- **S. Gupta and S satpati., [12]** In this report the wastewater was collate with Indian standard for irrigation (IS 11624: 1986) which reveals that the values of, cyanide, total suspended solids(TDS) ,grease and oil exceed the given Indian standard values.There are no existing standards for irrigation water for most of the heavy metals.however, heavy metal concentrations which are very rare are of serious concern as they can bioaccumulate through the food chain.The plant available nitrogen, phosphate, and potassium contents of the wastewater-irrigated soil are much lower than the control soil. The lesser potassium and nitrogen content in wastewater-irrigated soil may be also due to longlasting effluent irrigation which reduces the natural microbial activity in the soil, resulting in slower release of plant available nutrients into the soil

- **Rajiv Ganguly., [13]** . The pH results for all of the different industries lie well within the permissible limits. The dissolved oxygen (DO) of the wastewater of different industries was satisfactory. The results of the different parameters tested for the wastewater samples and compares it with the effluent standards of these selected industries with the WHO and Bureau of Indian Standard (BIS) guidelines. In the present study the chemical oxygen demand concentrations of the pharmaceutical and printing industries are very high due to a large number of non-biodegradable and inorganic solvents used in these industries, like dye-stuff and solvent residues, wiping material containing dyes, inorganic compound used in pharmaceutical industries. In contrast, the fruit processing industry has extremely low values of chemical oxygen demand concentrations.
- **R Reza and G. Singh., [14]** .The range of pH in summer was slightly acidic to alkaline {6.0-8.3} while in summer range of pH was {7.6-8.5} during the winter.The high pH of the River water would be the solution in the depletion of heavy metal toxicity. In All the sampling locations there were desirable quantity of dissolved ions in all the samples collected, as the case of TDS. TDS concentration was observed to be higher in the River water near the midway section of the River Basin which was in the range of 164-294 mg/land 166-330 mg/l in winter and summer seasons respectively due to various small and large scale industries concentrated in these areas.
- **Safraz Munir and M. Rizwan Aslam., [15]** According to WHO,the waste water in Haroonabad were absolutely not suitable for unlimited irrigation and it would have

been treated or making its safe use possible . It simply implies that river water in Pakistan in most of the cases does not meet agriculture and health water quality standards . This is basically due to lack of investment for treatment of waste water which increase the chances of disposal of waste water into nearest water bodies . The most pessimistic environmental impacts related with waste water use is ground water contamination through high concentrations of salts , nitrates and microorganisms which post immediate warning to public water supply from effluents originating in ground water.

CHAPTER - 3

METHODOLOGY

3.1 Study Area

It is necessary to have understanding of the present conditions, the current report work was categorised into three sub parts which were proceeded out in the given course of time. Three parts which contribute the current project are :.

1. Detailed waste water analysis discharged by industries.
2. Tap water study
3 Ground water study

Collection of waste water samples was near about P&G pharmaceutical and those for the tap water and ground water were at Housing board Phase-3 Baddi. The sampling locations have been underlined in the following map.

Fig 3.1 P&G Industry

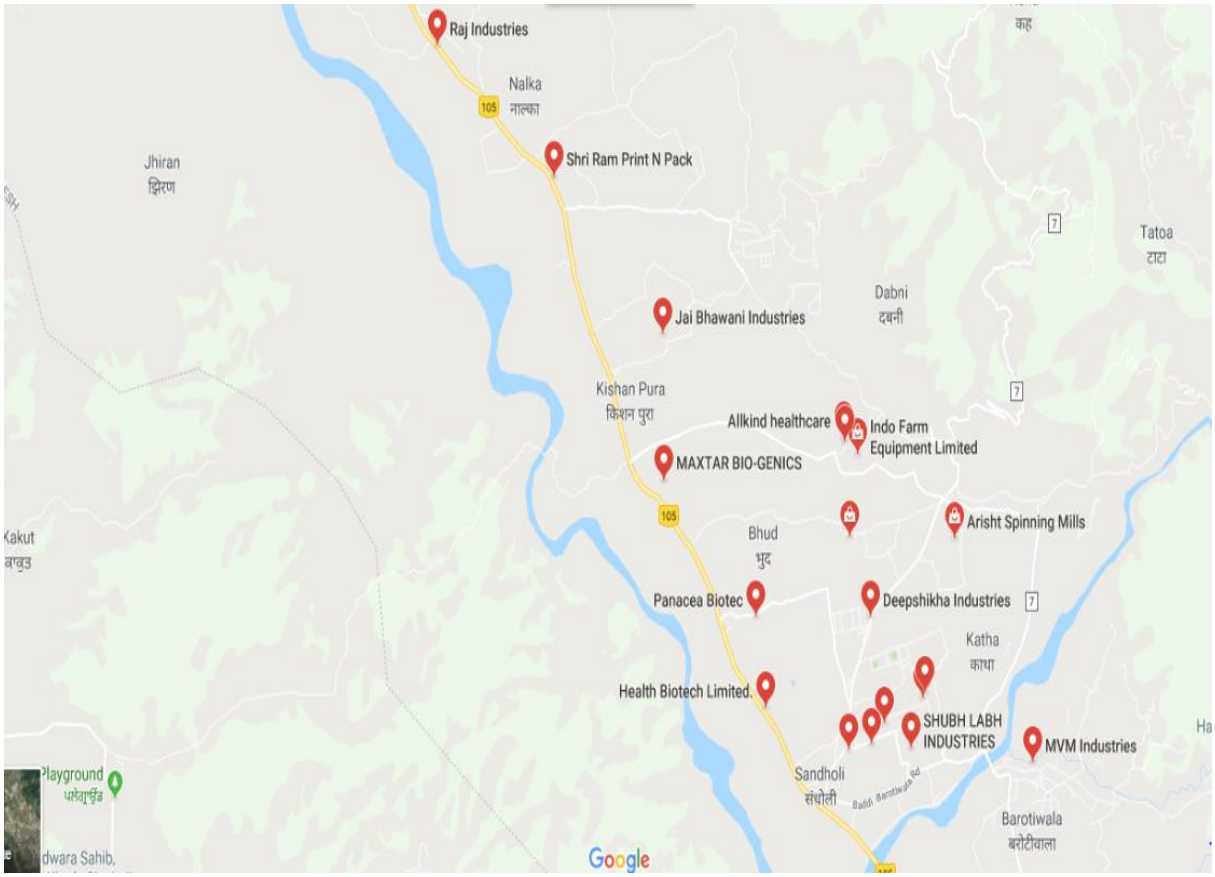

Fig 3.2 (Various points of sampling)

3.2 SAMPLING PROCEDURE

The Grab sampling is done on a weekly basis from all the sites. Samples are collected in plastic bottles of 1.5 litres capacity. Instantly after the sampling, preservatives were compiled to samples collected. These sampling bottles were kept in a bag and that bag was taken to JUIT WAKNAGHAT for carrying out further experimental analysis.

Common rules for sampling:

Take few additional consideration to dodge the sullying of the water sample and the container.

Don'ts :

- Vitiate the collecting bottle by the contacting within container.
- Contaminate the collecting bottle cover through contacting within.
- Set the container cap on the ground while doing examining.
- Wash the bottle before examining .

Sampling Collection Procedure :

1. Move sleeves of the shirt up past elbow , if wearing long sleeves amid test gathering.
2. Take a marked sterile the 250ml example bottle. Guarantee to keep the top on the compartment.
3. Grip the sterile container close by close to it's foundation, and cautiously expel and hold top with the other hand. Try not to contact within the lid when testing.
4. Tip enough water from jug to leave air space of around 1-2 cm from edge of the holder.
5. Cautiously supplant the lid promptly .

CHAPTER – 4

EXPERIMENTS

4.1 EXPERIMENTAL PARAMETERS

After sampling, different experimental analysis were performed on them in order to find out the water quality. The different parameters for which tests were conducted are as following.

- pH determination
- Alkalinity
- Turbidity
- Dissolved Oxygen (DO)
- Biochemical Oxygen Demand (BOD)
- Determination of Total Dissolved Solids (TDS)
- Hardness
- Conductivity
- Determination of Chloride content

All the tests were done at the laboratory of Environmental Engineering of Civil Engineering Department in JUIT Waknaghat. BOD and DO are the variables of incredible significance for arranging waste water originating from different businesses, large scale industries and are interrelated among one another .BOD demonstrates to us the existence of small scale creatures in a water source. Turbidity, TDS straightforwardly grant us a measure to dissect if the water meets the advantageous and required circumstances or not.

4.2 ANALYSIS

The essential reason for directing the investigation work is to think about the various outcomes for different scales of the given water test with the IS:10500 drinking water standard and BIS , WHO standards for industrial waste water.

4.2.1 pH determination method:

pH is basically an extent of the destructiveness or basicity of a watery course of action. arrangements having pH less proportionate to 7. Basic pH standard characteristics are found by using a concentrated cell with transference, essentially by assessing the potential complexity between a standard anode, for instance, the silver chloride cathode and hydrogen anode. Estimation of pH for liquid courses of action should be conceivable with a pH meter or a glass cathode. We can similarly find the estimation of pH by using pointers. pH estimations have basic importance in the field of science, environmental science, science, tranquilize, oceanography, sustenance science, cultivating, sustenance ,normal structuring, mixture building, water treatment and water cleansing and various applications.

Numerically, it will in general be said that pH is the negative logarithm of the action of the hydrogen molecule.

Procedure:

- First rinse the test with twofold deionized water before using it.Get it dry with an immaculate tissue.
- Gather the sample of water in a container.
- Set the meter to alike the sample temperature.
- Put the test into the example .Wait for the meter to come to balance.
- Read the pH measurement of the sample.

4.2.2 Analysis method for Alklanity:

Alkalinity is a measure of the buffering volume of water to counteract sturdy acid. This capacity is attributed to stations that are present in natural waters comprising OH^-, HCO_3^-, and CO_3^{2-}. More alkalinity in your water sample means more buffering capacity of your water sample.

It is important for aquatic lifecycle as it guards against rapid pH changes. Living creatures of aquatic life, function optimal in a pH range of 6.0 to 9.0

Reagents:

- Purified water
- Standard 0.02N H_2SO_4
- Phenolphthalein indicator
- Methyl orange indicator

Procedure:-

- Take 50 mL water test, at that point include 3 drops of phenolphthalein marker, 50ml example is titrated with 0.02N sulphuric scid and gauge phenolphthalein alkalinity.
- It will alter colour from pink to colourless, note the change in volume of sulphuric acid .
- If the sample does not change colour there is existence of minerals in the given sample.
- Then add 2-3 drops of methyl orange indicator solution.
- Titrate the example with sulphuric acid till it turns the solution to brick red.
- Note the volume of acid used for the titration.

Total Alkalinity Formulae

= Amount of H_2SO_4 used (ml)×Normality of H_2SO_4 × 1000 × 50 ÷ sample volume (ml)

4.2.3 Analysis method for Turbidity :

Turbidity is defined as the cloudiness of a liquid which is caused by very lage number of individual particles. These particles are not visible to naked eye. These particles may be of many sizes. It can also be defined as the degree to which the water loses its transparency. There are mamy factors that cause turbidity like water discharge,sediments from erosion etc. Unit for estimation of Turbidity is called as the Nephelometric Turbidity Unit(NTU).

Procedure:

Take a small beaker.

- The beaker is appropriately washed and plump with purified water.
- Place the solution beaker inside the turbidity meter and then it is calibrated to 100NTU.
- Distilled water is then swapped in beaker to carry further analysis.
- The monitor displays the value of turbidity and it is taken down.

Turbidity meter We used this type of meter for precise readings and it is especially very useful for determining low turbidity's (less than 5 TU).

Fig 4.1(Turbidity meter)

4.2.4 Analysis Method for Dissolved Oxygen:

Aquatic living organisms need broke down oxygen for survival and decomposition.All aquatic living organisms require oxygen for breathing. The point when submerging deep in the water, the oxygen diffuses in all respects gradually and conveyance depend upon the availability of the flowed air through water. Oxygen is likewise created by ocean plants as a result of photosynthesis. Oxygen is required in different proportion for different aquatic

organisms. Oxygen levels below 3 ppm are sun pleasant to almost all of the sea-going animals. Oxygen levels have been broken down underneath 2 or 1 ppm won't bolster fish. 5 to 6 ppm levels are usually needed for living and action inside water.

Procedure:-

- Water Sampling Bottle should be rinsed with the model water.
- The top of the container should be removed and filled with sample water.
- The sides of the jug to be tapped to remove air bubbles in the bottle.
- Tightly plung the top of the container and further it should be submerged to the ideal profundity.

Fig 4.2 (DO Meter)

4.2.6 Analysis Method for Biochemical Oxygen Demand (BOD) :

It is the total amount of dissolved oxygen that is needed by aerobic biological organisms for breaking down organic material.It provides estimation of degree of measure of oxygen mandatory for completing natural disintegration of unwanted and natural issue present in the water consequently decreasing the carbonaceous substances from water. BOD is estimated utilizing the Oxytop estimating device. The oxytop estimating framework depends on weight estimation which takes note of the weight by perizoresistive electric sensors.Take note of the

highlights such as programmed temperature location, information logging and estimating range esteem.

Procedure: -

- Rinse the BOD bottles properly.
- The oxygen saturation is then precisely measured by DO meter.
- Then put the magnetic stirring rod in the bottle.
- Then ,on the top of the bottle oxytop is screwed directly.
- Then bottles are kept at 200'C for 5 days.
- The DO meter automatically measures the oxygen consumtion during incubation period .
- The recorded value is noted as BOD_5 value.

4.2.7 Analysis Method for Chemical Oxygen Demand(COD):

Chemical oxygen demand is an assessment of the oxygen which is needed to oxidize dissolvable and particulate organic matter present in water. It is an impotant water quality parameter because, similar to BOD, gives a estimate to survey the harmful effects that discharged wastewater would have been on the admitting environment. COD having higher dimensions mean a more account on the measure of oxidizable natural material which would decreases the dissolved oxygen(DO) levels in the water.

- 0.25N standard potassium dichromate
- Sulphuric acid with reagent(conc H_2SO_4 +Ag_2SO_4)
- Standard ferrous ammonium sulphate 0.1N
- Ferroin indicator
- Mercuric sulphate

Procedure:

- Take 2.5ml water sample and distilled water in two tubes.
- Add 1.5ml of potassium dichromate to both the tubes.
- Add 3.5ml pf sulphuric acid reagent to both tubes.
- Keep tubes in COD digestor at 150^0 C for 2 hours.
- After cooling to room temperature add 2 drops of ferroin indicator and titrate it against ammonium sulphate until color changes to reddish brown.

Formulae:

Quantity of Fe $(NH_4)_2(SO_4)$ added for distilled water = A ml

Quantity of Fe $(NH_4)_2(SO_4)$ added for the sample = B ml

COD = (A-B) × Normality of Fe $(NH_4)_2(SO_4)$ × 8 × 1000 ÷ quantity of sample(ml)

4.2.8 Method of Analysis Chloride Content:

These are commonly present in whole water tests and realistic aggregate of chlorides are not harmful anyway but they cause a threat if the point of confinement beats 250mg/ltr. The rule of chloride disclosure wears down the going with structures :

This method uses Silver Nitrate ($AgNO_3$) in light of the way that silver particles unite with chloride particle to make a white hurry of Silver Chloride (AgCl). Potassium chromate pointer direct its end point. Chromate particles unite with silver particles to shape a bronzed dull shaded hurry of silver chromate. This gives the confirmation that the aggregate of what chloride has been hastened. Chloride in water may be essentially extended by action process in which chlorine or chloride is used. Chlorides become essential for life when they combine with metal such as sodium. A little amount of chlorides is also important for cell functioning in plants and animals.

Procedure:

1. 50 ml sample should be pipette out in two porcelain dishes. Add 1 ml of potassium chromate indicator should in the sample .
2. Stir the sample after adding standard silver nitrate solution was added until a persistent reddish colour seems.
3. The quantity of AgNO3 used in titration was renowned and from this the chloride content is evaluated.

Formulae used:-

=Volume of titrant used × Normality of silver nitrate × 35.45) × 1000 ÷ Volume of sample (ml)

4.2.9 Analysis method for Total Dissolved solids (TDS)

It is the sum of all the dissolved organic and inorganic substances that are present in a liquid in different forms like ionized, suspended or molecular is called Total Dissolved Solids (TDS). The solids should be sufficiently minimal to suffer filtration through a channel which has two micrometre (apparent size or humbler) pores. The Study of quality of water quality for rivers, reservoir and lakes is the most huge utilization of TDS. Calcium, phosphates, nitrates, sodium, potassium, sulfates and chloride contain few of the noteworthy mixture constituents. Pesticides rising up out of surface flood are logically uncommon and hazardous parts of TDS. Certain regularly happening total separated solids rise up out of the suffering and deterioration of rocks and soils. Centralization of split up ionized solids in the water is clearly related to the electrical conductivity of water. Particles in the separated solids in water make the limit with regards to that water to coordinate electrical stream, which is assessed by a TDS meter or conventional conductivity meter . Hard water has high TDS levels, which might be the clarification behind ooze improvement in channels, pipes, and valves, lessening execution and adding to the cost of structure upkeep. In aquariums, spas, pools, and switch osmosis water treatment structures, we can see these effects . Complete separated solids are attempted from time to time in all of these applications, and filtration layers are also checked just to hinder negative effects. TDS is generally checked to make a water quality condition which is useful forever structure proficiency by virtue of hydroponics and aquaculture.We did this experiment using TDS meter.

Fig 4.3 (TDS Meter)

4.2.10 Analysis method for conductivity:-

Conductivity is defined as water's ability to permit the flow of electrical current. It is visibly related to the centralization of molecules in water. Conductive ions comes from inorganic materials like chlorides, sulfides and dissolved salts. And the compounds that are dissolved into ions are called as electrolytes. More the number of ions are present the more will be conductivity. Conductivity is moreover suggested as express conductance. Conductivity is measured in Siemens per meter (S/m).

In various mechanical and biological applications, conductivity estimations are used as an efficient, dependable and speedy strategy for receiving the extent of the ionic substance in a report..

We did this test by Conductivity meter.

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Fig 4.4(conductivity meter)

4.2.11 Analysis method for hardness:

Hardness of water indicates the amount of total magnesium and calcium salts that are dissolved in water. The particles required with water hardness, for instance Ca2+(aq) and Mg^{2+}(aq), can be determined by titration with a chelating administrator, ethylene diaminetetra acidic corrosive (EDTA), generally as disodium salt. Typically Erichrome Black T is used as indicator for titration. At pH 10, Ca^{2+}(aq) particles firsts buildings with the marker as $Caln^{+}$(aq) which swine red. As the more grounded ligand EDTA is fused, the $Caln^{+}$(aq) complex is superseded by the CaY^{2-}aq) complex which is blue. The end explanation behind titration is showed up by a sharp shading change from wine red to blue. Titration utilizing

Erichrome Black T pointer chooses supreme hardness because of Ca^{2+}(aq) and Mg^{2+}(aq) particles. Hardness in light of Ca^{2+} (aq) particles is coordinated by a different titration at a higher pH, by including NaOH answer for encourage $Mg(OH)_2$, Carbonate hardness is realized by the divalent metallic particles basically of Ca^{2+} and Mg^{2+} while chlorides, sulfates and nitrates cause noncarbonated hardness.

Procedure:

• Pipette out 50 ml sample of water into the burette.

• To neutralise the pH of the sample ,1ml buffer solution to be added.

• Now,2-3 drops of Erichrome Black T indicator to be added.

• Then titrate it with 0.01M EDTA until the solution turn from wine red to sky blue.

• Replicate the titration for concordant observation. Refer Fig 3.4

CHAPTER – 5

RESULTS AND DISCUSSIONS

5.1 DATA ANALYSIS

5.1.1 RESULTS FOR WASTE WATER

SEASON 1 (AUGUST-SEPTEMBER)

The tables listed below shows the measured parameters of the waste water and drinking water whose samples are collected from the industrial region of Baddi and all the outcomes are compared to Foreign and Indian standards.

Table 5.1 Results of Week 1

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.1	8.3	6-9	5.5-9
Conductivity(mmho/cm)	.627	.461	1	1
TDS(mg/l)	450	309	200	200
Turbidity(NTU)	5	2	-	-
Alkalinity(mg/l)	309	205	-	-
BOD (mg/l)	26.1	31.5	100	350
COD(mg/l)	70	80	150	250
Chloride content(mg/l)	68.2	57.92	600	1000

Table 5.2 Results of Week 2

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.0	7.9	6-9	5.5-9
Conductivity(mmho/cm)	.689	.623	1	1
TDS(mg/l)	497	420	200	200
Turbidity(NTU)	4	6	-	-
Alkalinity(mg/l)	209	256	-	-
BOD (mg/l)	43.3	32.3	100	350
COD(mg/l)	100	92	150	250
Chloride content(mg/l)	61	70	600	1000

Table 5.3 Results of Week 3

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.2	8.6	6-9	5.5-9
Conductivity(mmho/cm)	.870	.997	1	1
TDS(mg/l)	584	668	200	200
Turbidity(NTU)	7	9	-	-
Alkalinity(mg/l)	311	209	-	-
BOD (mg/l)	32	34	100	350
COD(mg/l)	99	108	150	250
Chloride content(mg/l)	201	241	600	1000

Table5.4 Results for Drinking water

TEST	GROUNDWATER	TAP WATER	WHO	BIS
pH	7.9	7.8	6.5-8.5	6.5-8.5
Conductivity(mhos/cm)	480	552	-	-
TDS(mg/l)	241	270	<600	<500
Turbidity	0	0	5	5
Dissolved oxygen(mg/l)	7.79	6.68	>4	>4
Alkalinity(mg/l)	45	62	20-200	20-200
Chloride content(mg/l)	43	23	200	250
Hardness(mg/l)	26	31	500	300

5.2.3 RESULTS FOR WASTE WATER

SEASON 2 (OCTOBER-NOVEMBER)

Table 5.5 Results of week 1

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.7	8.3	6-9	5.5-9
Conductivity(mmho/cm)	.879	.810	1	1
TDS(mg/l)	589	657	200	200
Turbidity(NTU)	9	11	-	-
Alkalinity(mg/l)	311	206	-	-
BOD (mg/l)	33	29	100	350
COD(mg/l)	160	105	150	250
Chloride content(mg/l)	202	260	600	1000

Table 5.6 Results of Week 2

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.5	9.1	6-9	5.5-9
Conductivity(mmho/cm)	.535	1.239	1	1
TDS(mg/l)	358	830	200	200
Turbidity(NTU)	2	70	-	-
Alkalinity(mg/l)	235	310	-	-
BOD (mg/l)	133	201	100	350
COD(mg/l)	397	431	150	250
Chloride content(mg/l)	58	167	600	1000

Table 5.7 Results of Week 3

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.7	9.3	6-9	5.5-9
Conductivity(mmho/cm)	.887	1.042	1	1
TDS(mg/l)	720	449	200	200
Turbidity(NTU)	50	35	-	-
Alkalinity(mg/l)	270	223	-	-
BOD (mg/l)	180	123	100	350
COD(mg/l)	500	350	150	250
Chloride content(mg/l)	159	110	600	1000

5.2.4 RESULTS FOR WASTE WATER

SEASON 3 (JANUARY-FEBRUARY)

Table 5.8 Results of Week 1

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	ISI
pH	8.9	8.7	6-9	5.5-9
Conductivity(mmho/cm)	.637	1.003	1	1
TDS(mg/l)	427	672	200	200
Turbidity(NTU)	10	73	-	-
Alkalinity(mg/l)	210	360	-	-
BOD (mg/l)	153	177	100	350
COD(mg/l)	376	411	150	250
Chloride content(mg/l)	67	124	600	1000

Table 5.9 Results of Week 2

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	ISI
pH	8.2	9.2	6-9	5.5-9
Conductivity(mmho/cm)	.850	1.128	1	1
TDS(mg/l)	579	764	200	200
Turbidity(NTU)	65	76	-	-
Alkalinity(mg/l)	198	315	-	-
BOD (mg/l)	169	198	100	350
COD(mg/l)	480	554	150	250
Chloride content(mg/l)	114	157	600	1000

Table 5.10 Results of Week 3

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.3	8.4	6-9	5.5-9
Conductivity(mmho/cm)	1.443	.653	1	1
TDS(mg/l)	960	438	200	200
Turbidity(NTU)	80	2	-	-
Alkalinity(mg/l)	420	280	-	-
BOD (mg/l)	207	126	100	350
COD(mg/l)	540	320	150	250
Chloride content(mg/l)	212	62	600	1000

5.11 RESULTS FOR DRINKING WATER

TEST	GROUNDWATER	TAP WATER	WHO	BIS
pH	7.6	7.7	6.5-8.5	6.5-8.5
Conductivity(mmho/cm)	.380	.540	-	-
TDS(mg/l)	275	280	<600	<500
Turbidity(NTU)	0	0	5	5
Dissolved oxygen(mg/l)	7.95	7.05	>4	>4
Alkalinity(mg/l)	285	192	20-200	20-200
Chloride content(mg/l)	40	18	200	250
Hardness(mg/l)	28	35	500	300

5.2.6 RESULTS FOR WASTE WATER

SEASON 4 (MARCH-APRIL)

Table 5.12 Results of Week 1

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.0	7.8	6-9	5.5-9
Conductivity(mmho/cm)	.789	.580	1	1
TDS(mg/l)	580	980	200	200
Turbidity(NTU)	62	78	-	-
Alkalinity(mg/l)	350	405	-	-
BOD (mg/l)	250	280	100	350
COD(mg/l)	670	740	150	250
Chloride content(mg/l)	189	187	600	1000

Table 5.13 Results of Week 2

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	9.0	8.5	6-9	5.5-9
Conductivity(mmho/cm)	.850	.671	1	1
TDS(mg/l)	810	679	200	200
Turbidity(NTU)	67	57	-	-
Alkalinity(mg/l)	246	210	-	-
BOD (mg/l)	238	179	100	350
COD(mg/l)	554	500	150	250
Chloride content(mg/l)	178	105	600	1000

Table 5.14 Results of Week 3

PARAMETERS	SAMPLE 1	SAMPLE2	WHO	BIS
pH	8.1	8.7	6-9	5.5-9
Conductivity(mmho/cm)	.711	.541	1	1
TDS(mg/l)	550	450	200	200
Turbidity(NTU)	45	37	-	-
Alkalinity(mg/l)	184	176	-	-
BOD (mg/l)	167	145	100	350
COD(mg/l)	456	402	150	250
Chloride content(mg/l)	97	125	600	1000

5.1.2 Seasonal variation of different parameters

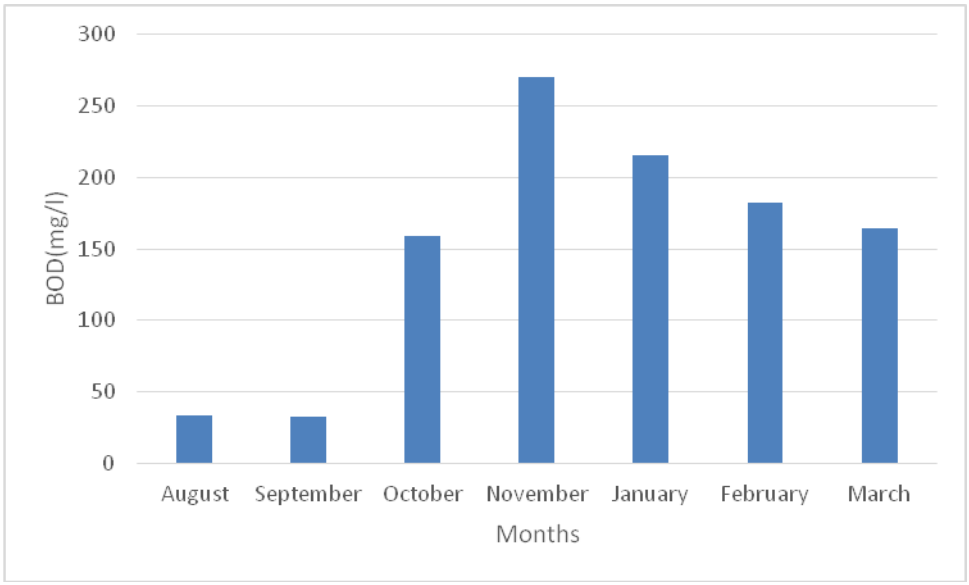

Fig.5.1.a

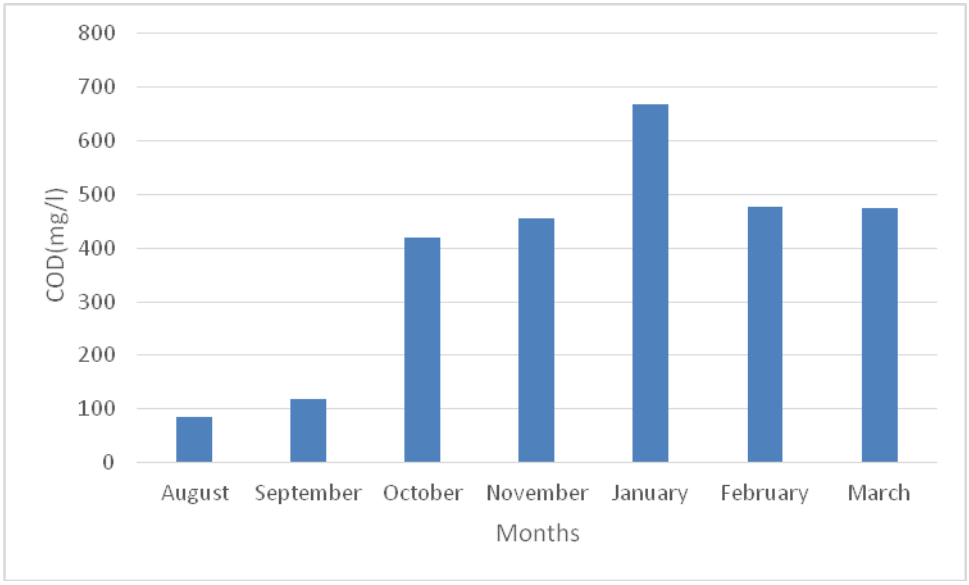

Fig. 5.1.b

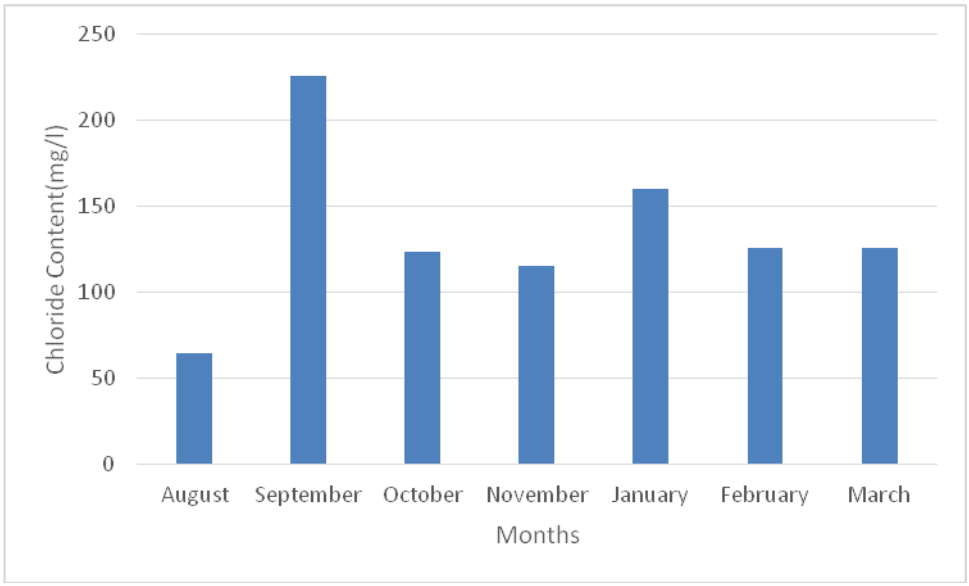

Fig.5.1.c

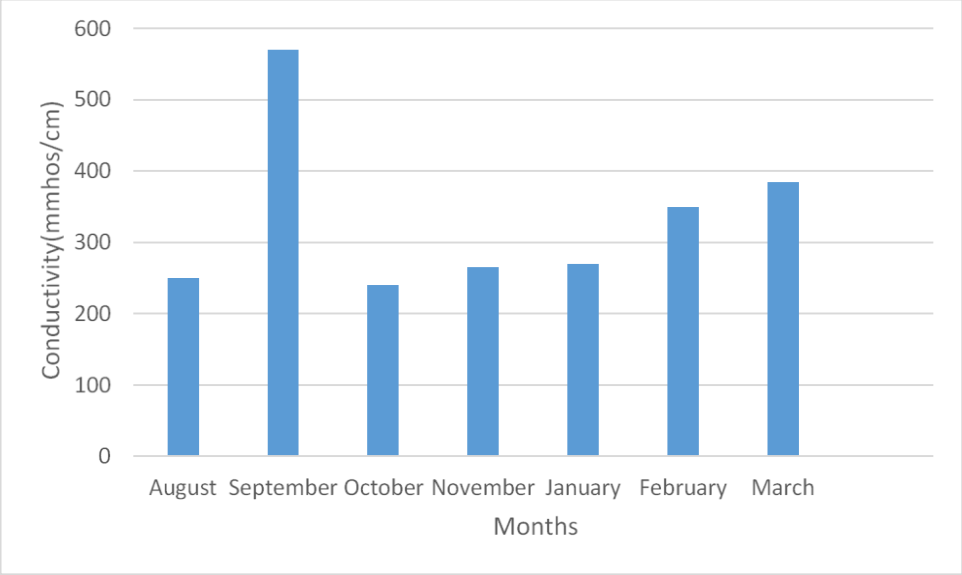

Fig.5.1.d

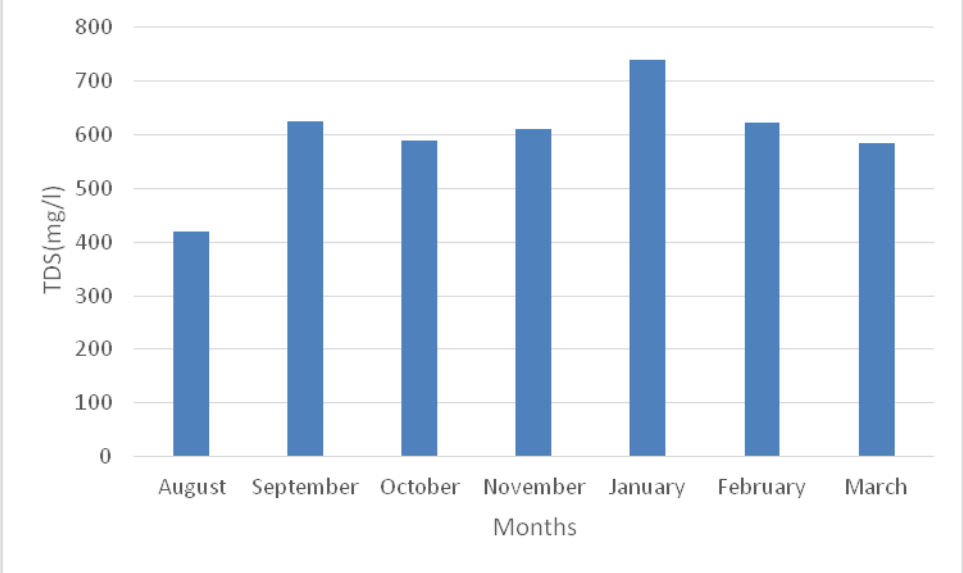

Fig.5.1.e

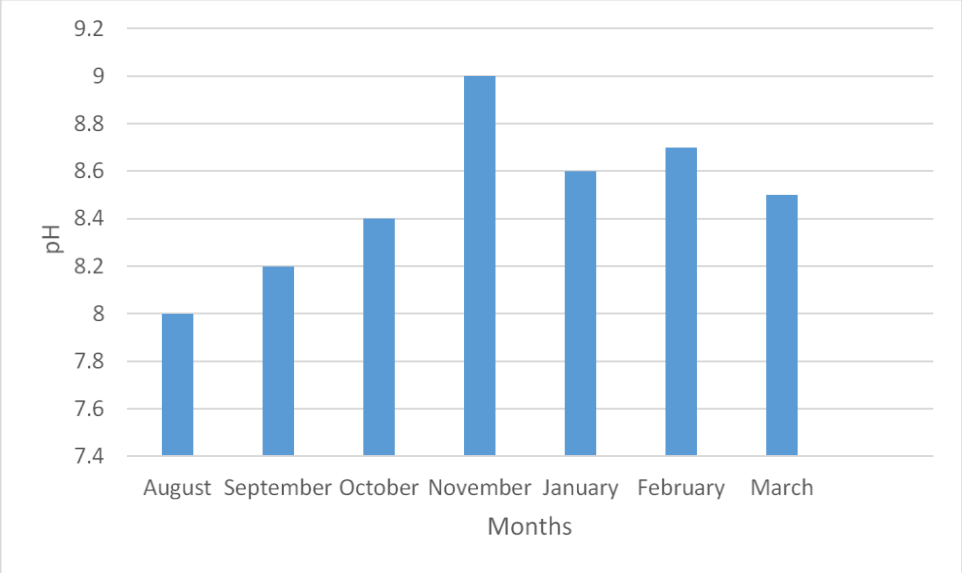
9.2
9
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
pH
August
September
October
November
January
February
March
Months

Fig.5.1.f

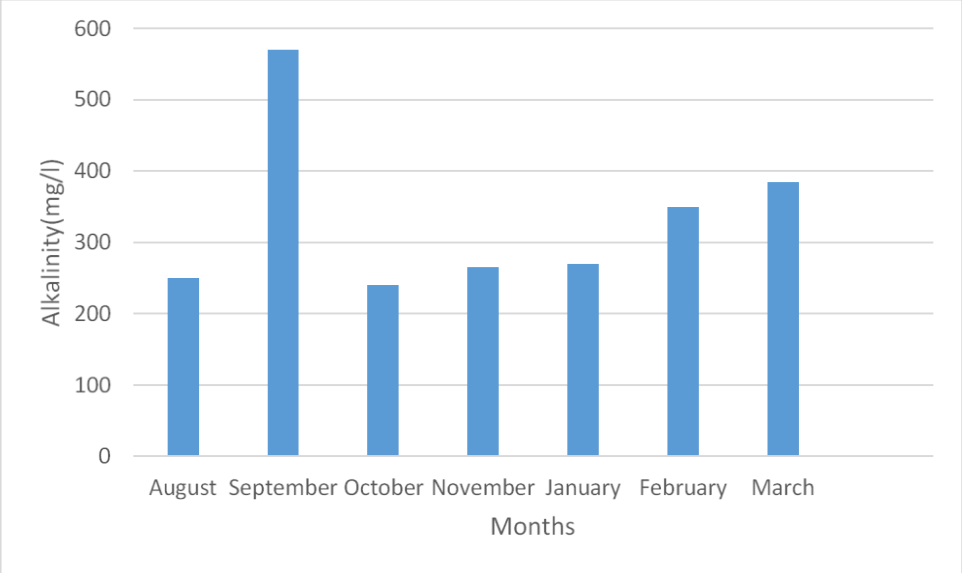
600
500
400
300
200
100
0
Alkalinity(mg/l)
August
September
October
November
January
February
March
Months

Fig.5.1.g

5.2.7Conclusion

- The study of the area shows that the quality of groundwater in Baddi Industrial area is very much close to the drinking water standards adopted in India. So it is fit for consumption as drinking water but not without treatment because the values for drinking parameters are very close to the standard limits. This water can be used for any other purpose eg. for irrigation purpose, bathing purpose subjected to its fulfilment of standards. The analysis of the hand pumps in the given area must made compulsory and the result of the analysis must be documented properly and published for awareness among people.
- The pH of all the samples is in between 7.0 and 9.0. It shows the alkaline nature of water and is fine in the standard limit of 6.5 and 8.5.

- Alkalinity caused due to HCO^{3-} is available in every sample appearing last estimation of 189mg/L and most extreme estimation of 287mg/L . Permissible limit for alkalinity is 600mg/L (BIS, 2003). High alkalinity can confer terrible taste and is also harmful to living organisms in occurrence with high pH, TDS and hardness.

- Iron in follows is basic for sustenance. Be that as it may, while constantly devouring high measures of iron may prompt a state known as iron over-burden; this condition is normally the consequence of a quality change. Untreated iron over-burden can prompt hemochromatosis, a serious sickness that can harm the body's organs. The side effects are weariness, weight reduction and joint torment, however on the off chance that hemochromatosis isn't dealt with, it might prompt coronary illness, some liver issues and diabetes.

- Chemical oxygen demand (COD) and biological oxygen demand (BOD) are the measure of the relative oxygen–depletion of waste-water and have been taken as a indicator of pollution effect. In present study both BOD and COD values are up to the mark but in some of the samples the value of COD exceeds the standard value.

- The conductivity in some cases is higher due to higher amount of TDS in waste water samples.

- Steady groundwater quality observing is must be done to have a check on the superiority of water by different ways.

CHAPTER – 6

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