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PHYSICO - CHEMICAL STUDIES ON DRINKING WATER NEARBY INDUSTRIAL ZONE AT AROUND IN ATTUR REGION

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Abstract

Ground water is the important source of drinking water used bythe rural and urban population. In groundwatermineral and chemical compounds are present. The water is used for drinking in domestic house hold, agriculture, industrial and environmental activities etc. Ground water contamination in urban environment is a major issue in industrial urban areas pollution are caused is from industrial, agricultural, radioactive element and mining source. Water Pollution is in the form of physical, chemical and biological ways the present study is carried out from the industrial polluted water and analyzed by physico-chemical method. Results are discussed.

Keywords: Ground water, Drinking water, Pollution and Physico-Chemical properties.

1. Introduction

Water is an important source for all living things. The consequences of the urbanization and industrialization lead to the water for agricultural purposes. Ground water gets polluted because of increasing human activities. The quality of water is of vital concern to the mankind. Since this is directly linked with human welfare. It is a matter of a history that facial pollution of drinking water causes water – borne diseases. Water quality assessment is essential for pollution control and protection of surface and ground waters. There are two types of water pollution such as ground water and surface water. Particular organic pollution is due to the bacteria and virus present in the water which is generated by excrement of animal and vegetable waste. Chemical pollution is generated by many chemical compounds, particularly nitrate and Phosphate ofpesticides, human and animal drugs, house hold products, heavy metals and acids used in industries. (K.Jothivenkatachalams et al, 2010).

Groundwater pollution by heavy metals has been given much attention due to biodegradability and toxic effects. The water polluted from sources via, streams, falls, lakes are contaminated with domestic agricultural and industrial wastes. In this present work, the drinking water samples were collected in industrial area and analyzed using physicochemical method.

1.1 Location of Study area

The present study was concentrated in attur taluk of Salem ditrict ,Tamilnadu, India. Which is located innorth latitude between 11º 14’ and 12º 53’ East longitude between 77º 44’ and 78º 50’. Few a factories

are located in and around in Attur. For the Present work the drinking water samples were collected from industrial area in attur region. Which is shown in Fig 1 and 2.

For the presentstudy the drinking water samples,were collected from ten differentgrounds. In the industrial area.The samples were collected from twentylocations.The collected samples for the physico-chemical analysed using standard procedure (BIS 2012). Water samples were subjected to Physico-chemical tests such asColour, Taste, Odour, Electrical Conductivity, Total dissolved Solids, Total Alkalinity, Total Hardness, Turbidity and Temperature. Chemical parameters like that Calcium, Magnesium, Sodium, Potassium, Chloride, Fluoride, Sulphate, Phosphate, Nitrate and Carbonate were analyzed by different techniques.

Fig –1 Salem district

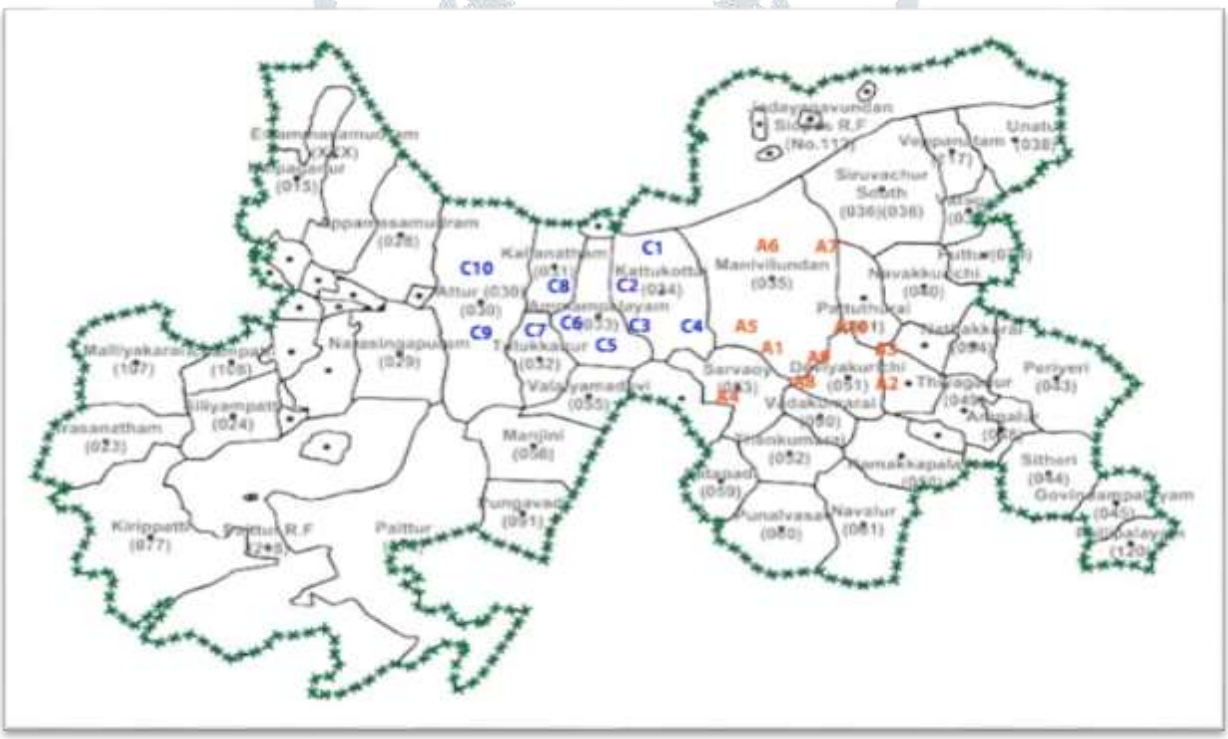


Fig- 2 Sampling locations and map of study area

2. Materials and Methods

In the present study, twenty groundwater samples were collected from different Locationsin atturregion.The samples were collected in cleanand dry bottles (2.0 liter) with necessary precautions. These bottles were labelled with respect to collecting places name and date. To determine both physical and chemical parameters. All the chemicals are used AR grade. Distilled water was used for the preparations of all the solutions and reagents. As per Standard procedures (BIS 2012) Standard methods. The quality of ground water has been assessed by comparing each parameter with acceptable limit of that parameters in drinking water as prescribed by (IS- 10500).Samples were analyzed for different physico– chemical parameters such as pH, Electrical conductivity, Total dissolved solids, Total alkalinity, Total hardness, Turbidity and Temperature. Minerals are Calcium, Magnesium, Sodium, Potassium, Chloride, Fluoride, Sulphate,Phosphate and Nitrate.The samples are collected in the industry area around East (Group – A) and West (Group – C) side location site. Shown in table 1 sample code (A_1 –A_{10}) and table 2 (C_1 – C_{10}).

Table: 1 Group- A (A_1 - A_{10})

S.No	Area of the water sampling locations	Sample Code
1	Samiyarkinaru	A_1
2	Vadakumarai	A_2
3	Thenkumarai	A_3
4	Sarvoy	A_4
5	SarvoyPuthur	A_5
6	Manivizhundhan	A_6
7	Manivizhundhan South	A_7
8	Deviyakurichi	A_8
9	Mummudi	A_9
10	Thalaivasal	A_{10}

Table: 2 Group - C (C_1 - C_{10})

S.No	Area of the water sampling locations	Sample Code
1	Vadachennimalai	C_1
2	Kattukottai	C_2
3	Gandhipuram	C_3
4	Samathuvapuram	C_4
5	Ammampalayam	C_5
6	AmmanNagar	C_6
7	Tullakkanur	C_7
8	BharathiNagar	C_8
9	Mullaivadi	C_9
10	Attur	C_{10}

3. Result and Discussion

The average result of the physico –chemical parametersfor water samples are presented tables are 3 and 4.The Table 3 and 4 shows the Physico – Chemical parameters like Colour, Taste, Odour, Electrical Conductivity, and Total dissolved Solids, Total Alkalinity, Total Hardness, Turbidity and Temperature. Chemical parameters are Calcium, Magnesium, Sodium, Potassium, Chloride, Fluoride, Sulphate, Phosphate, Nitrate and Carbonate.The table 3 shows the Physical properties of Odour in all the samples A_1 to A_{10} within desirable limit. The samples A_1 to A_{10} are within the desirable limit of taste. All the water samples A_1 to A_{10} colourless.The table 4 shows the Physical Properties of Odour in all the samples C_1 to C_{10} within desirable limit. The samples C_1 to C_{10} are within the desirable limit of taste. All the water samples C_1 to C_{10} colourless.

Table: 3 Physico– Chemical water quality parameter of water samples different location (A_1 – A_{10})

S.No	Parameters	Samples										BIS (2012) (IS - 10500)
		A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	
1	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	5 -20 Hazen Units
2	Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
3	Taste	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Agreeable
4	PH	8.6	8.4	8.5	8.6	8.5	8.3	8.4	8.3	8.2	8.1	6.5 - 8.5
5	Electrical Conductivity(µs/cm)	1.82	2.38	2.60	1.73	1.75	1.62	1.72	1.56	2.18	1.57	300- 3000
6	Total dissolved Solids (mg/l)	1219	1594	1742	1159	1172	1085	1152	1045	1460	1051	500 -2000
7	Total Alkalinity (mg/l)	102	118	124	144	218	194	254	200	182	194	200 -600
8	Total Hardness (mg/l)	240	234	230	248	238	230	246	228	254	258	200 – 600
9	Turbidity (NTU)	1.0	1.2	1.1	1.3	1.5	1.3	1.1	1.2	1.4	1.1	1- 5
10	Temperature	25	26	24	27	27	25	26	25	26	27	-
11	Calcium(mg/l)	55.80	33.09	16.55	5.82	4.46	8.57	6.88	8.75	7.56	8.90	75 – 200
12	Magnesium(mg/l)	31	18	9	3	2	4	3	4	4	4	30 – 100
13	Sodium(mg/l)	77.58	44.4	57.22	93.23	44.47	78.26	52.03	60.72	54.09	52.60	200 – 250
14	Potassium(mg/l)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12
15	Chloride(mg/l)	450	488	548	468	344	430	556	504	562	408	250 -1000
16	Fluoride(mg/l)	0.5	1.0	0.5	0.0	1.0	0.5	0.0	1.5	0.0	1.5	1 - 1.5
17	Sulphate(mg/l)	124	180	189	130	129	195	120	110	190	130	200- 400
18	Phosphate(mg/l)	7.0	6.1	7.9	6.0	8.7	6.9	6.4	7.2	6.6	6.2	1 – 5
19	Nitrate(mg/l)	7.0	5.1	6.4	8.2	8.5	7.4	6.5	7.3	7.1	7.2	-
20	CO_3-HCO_3 (mg/l)	18	28	12	14	16	12	14	30	20	28	200- 600

All parameters are in mg/l. Except PH, EC and Turbidity. EC in micro ohm / cm and Turbidity in NTU.

Table: 4 Physico – Chemical characteristics of ground water samples of different location (C_1 – C_{10})

S.No	Parameters	Samples										BIS (2012) (IS - 10500)
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	
1	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	5 -20 Hazen Units
2	Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
3	Taste	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Palatable	Agreeable
4	Ph	7.9	7.7	8.0	7.6	7.8	7.7	8.0	8.1	8.2	7.8	6.5 - 8.5
5	Electrical Conductivity(µs/cm)	1.26	1.22	1.14	1.36	1.31	1.49	1.05	1.41	1.37	1.49	300- 3000
6	Total dissolved Solids (mg/l)	844	817	763	911	877	998	703	944	917	984	500 - 2000
7	Total Alkalinity (mg/l)	188	194	202	178	264	208	224	248	238	230	200 -600
8	Total Hardness (mg/l)	310	404	336	394	350	384	378	354	388	406	200 – 600
9	Turbidity (NTU)	1.3	1.6	2.3	2.5	1.8	2.1	1.5	1.9	1.4	2.2	1- 5
10	Temperature(˙c)	27	28	30	29	28	26	27	30	29	27	-
11	Calcium(mg/l)	33.26	40.00	25.07	30.00	45.01	28.02	31.04	47.08	37.01	2.04	75 – 200
12	Magnesium(mg/l)	18	22	14	16	25	15	17	26	20	16	30 – 100
13	Sodium(mg/l)	50.00	46.55	37.02	40.27	52.36	30.22	52.09	61.07	59.10	65.07	200– 250
14	Potassium(mg/l)	3.01	6.07	2.10	7.09	5.08	9.04	10.01	4.00	2.09	3.08	12
15	Chloride(mg/l)	246	220	234	264	268	402	262	398	302	376	250 -1000
16	Fluoride(mg/l)	1.0	1.5	0.5	0.0	1.5	0.5	1.0	0.0	0.5	1.0	1 - 1.5
17	Sulphate(mg/l)	280	290	285	290	310	260	283	340	300	310	200- 400
18	Phosphate(mg/l)	9.4	9.2	9.1	9.0	8.1	8.8	9.2	8.9	9.4	8.0	1 -5
19	Nitrate(mg/l)	3.5	4.0	2.1	3.7	3.9	3.8	3.9	3.4	2.2	2.0	-
20	CO_3-HCO_3 (mg/l)	144	148	196	160	202	184	200	212	198	202	200- 600

3.1. pH

The Hydrogen ion concentration in a solution determines the pH. In the present study, pH range is 8.1 to 8.6 in table 3. The figure 3 shows the A_1 to A_{10} all pH values within the permissible limit.

The Table 4 and Figure 4show the water samples which range from 7.6 to 8.2. C_1 to C_{10}.

The values are higher than the acceptable limit. Low pH can be acidic naturally soft and corrosive. (Inbanila, 2015).

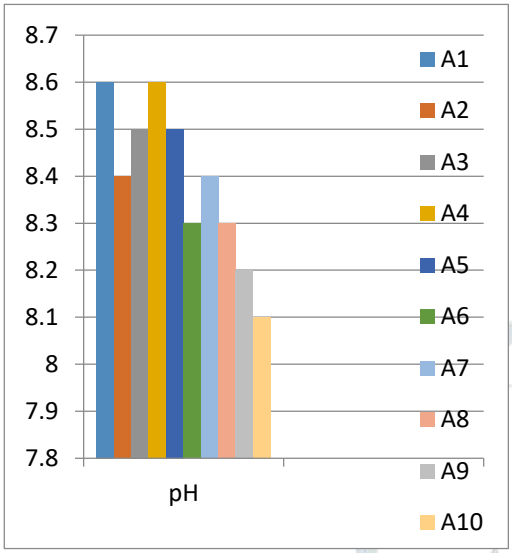


Fig 3: Relative distribution of pH

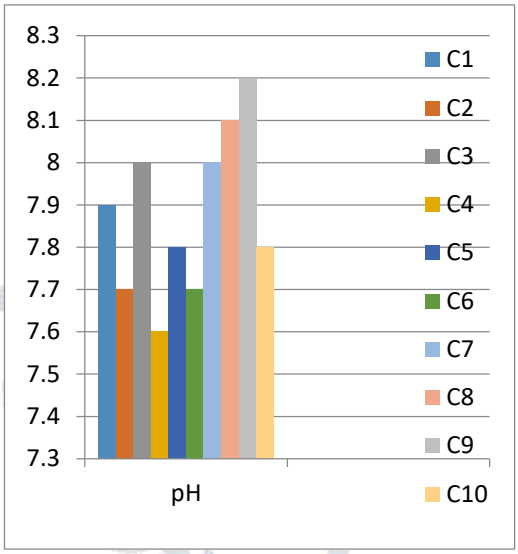


Fig 4: Relative distribution of pH

3.2. Electrical Conductivity

The Electrical Conductivity is a measure of the ability of water to pass an electric current. In the present study EC values range of 1.57 µs/cm to 2.38 µs/cm in table 3. The figure5 shows the A_1 to A_{10} all the values are within the acceptable limit.

The Table 4 and Figure 6shows the range of 1.05 µs/cm to 1.49 µs/cm. C_8 and C_{10} indicating the presence of high amount of EC values. All other values are within the permissible limit. Too high causes the Cardiac arrest burn the tissue and organs and muscle spasms. (Devi, 2012).

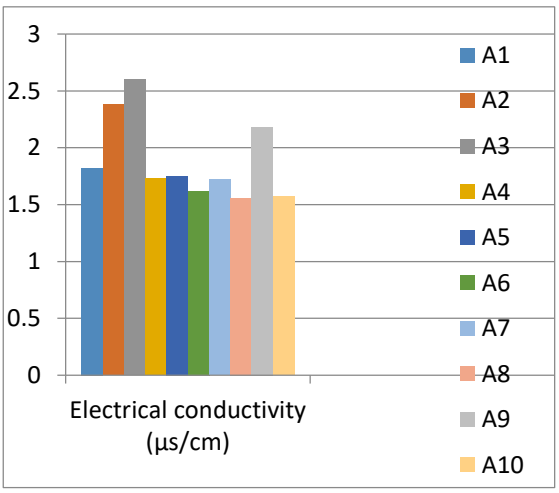


Fig 5: Relative distribution of EC

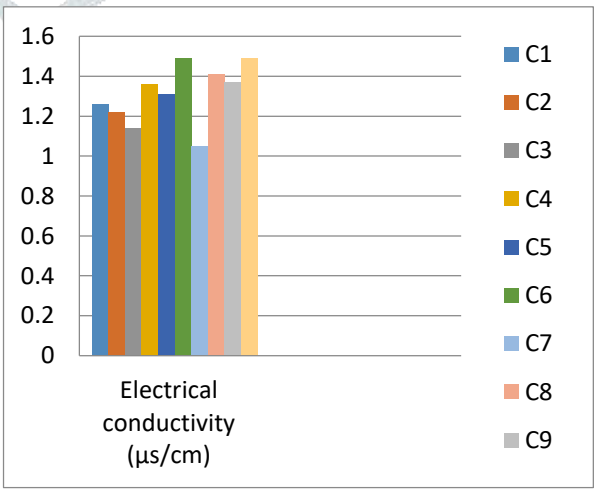
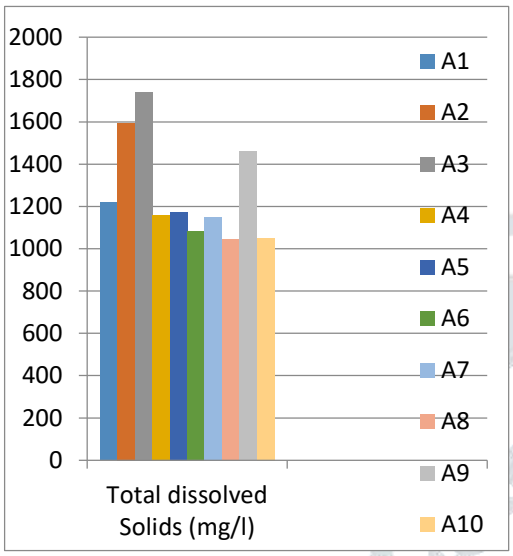


Fig 6: Relative distribution of EC

3.3. Total dissolved solids

Total dissolved solids indicate the salinity behavior of ground water. Water containing more 998 mg/l of TDS is considered as acceptable limit for drinking water. High values of Total dissolved solids in ground water are generally not harmful to human beings. Present study shows the total dissolved solids values are 1045mg/l to 1742mg/l in table 3. The figures 7 shows the A_1 to A_{10} all values are within the permissible limit.

Table 4 and Figure 8 show the total dissolved solids range of 703mg/l to 998mg/l. The samples C_1, C_2 and C_4 are in lower amount which is present in acceptable limit. Other values are within the permissible limit. But high concentration of these may affect propel who are suffering from kidney and heart disease.(P.Arunbalaji, 2017).



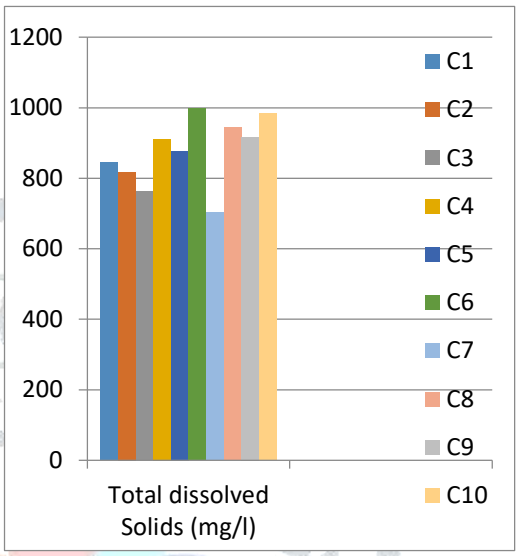
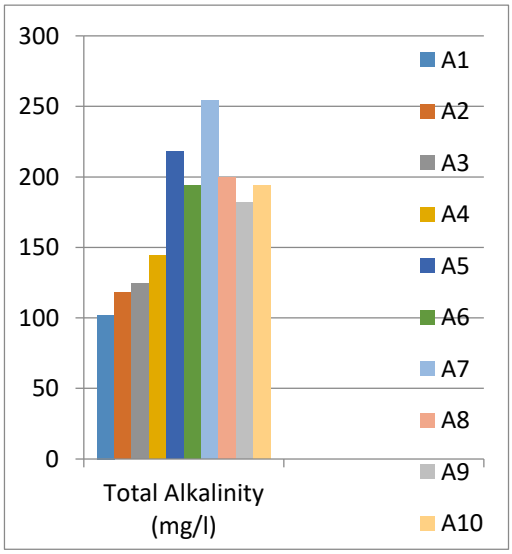


Fig 7: Relative distribution of TDS **Fig 8: Relative distribution of TDS**

3.4. Total alkalinity

Total alkalinity of water is primarily due to salt of weak acids. In the present study total alkalinity range between 102mg/l to 254mg/l are shown in table 3. The figure 9 shows the A_5 and A_7 high value of the acceptable limit. Other values within the permissible limit.

The Table 4 and Figure 10samples C_1, C_2 and C_4 are inlow amount of acceptable limit. C_3, C_5 and C_{10} values are within the permissible limit. An overall excess of alkalinity in the body may cause gastrointestinal issues and skin irritations.(Tharanitharanvenkatesan, 2014).



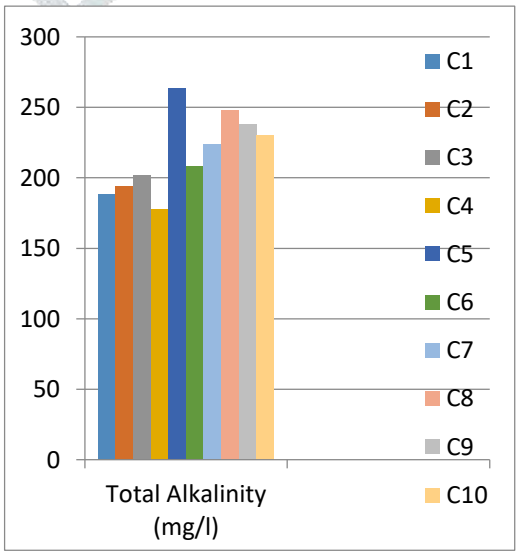


Fig 9: Relative distribution of Total Alkalinity **Fig10: Relative distribution of Total Alkalinity**

3.5. Total Hardness

Hardness of water mainly depends upon the calcium and magnesium salt. In the study,area TH was in the range of 228mg/l to 258mg/l in table 3. The figure 11 shows the A_1 to A_{10} all values are of higher amount of acceptable limit.

Total hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The Table4 and Figure 12 shows the range of 310mg/l to 406mg/l. C_1 to C_{10} allvalues are is high amount of acceptable limit, and within the permissible limit. Increase intake of magnesium salts may cause a diarrhea. (Tajinderkaur et al, 2017).

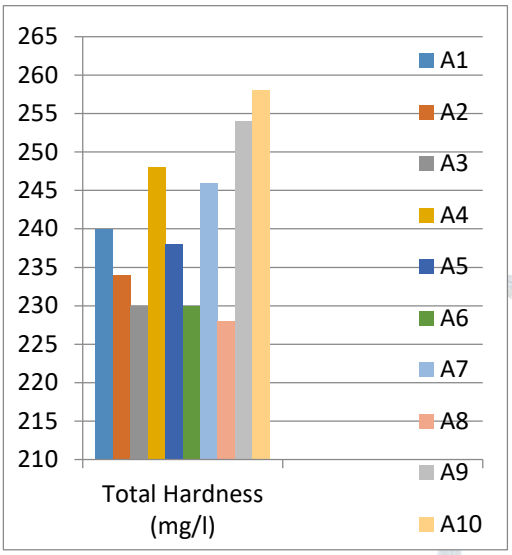


Fig 11: Relative distribution of Total Hardness

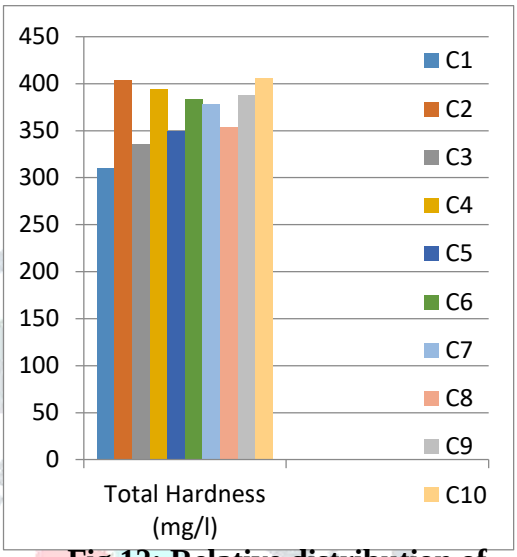


Fig 12: Relative distribution of Total Hardness

3.6. Turbidity

Turbidity affects the growth rate of algae and other aquatic plants in streams and lakes. In the present study turbidity range of 1.0 to 1.5 NTU in table 3. The figure 13 shows the A_1 to A_{10} all values are within the permissible limit.

The Table 4 and Figure 14 show the turbidity range of 1.4 to 2.5 NTU. C_3, C_4, C_6 andC_{10} are high amount of acceptable limit. Other values are within the permissible limit.In drinking water the higher turbidity level ishigh risk, the people may develop gastrointestinal disease.

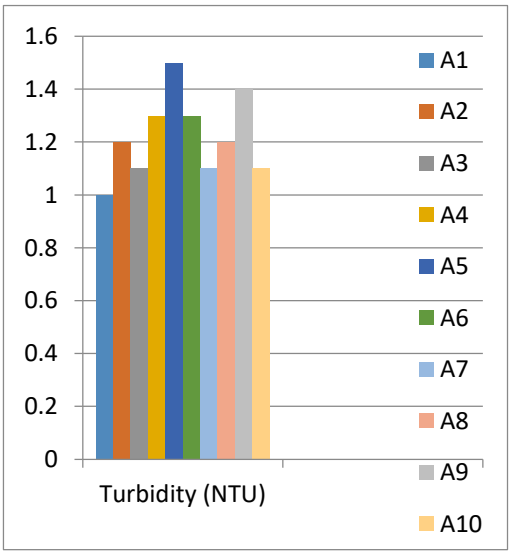


Figure 13: Relative distribution of Turbidity

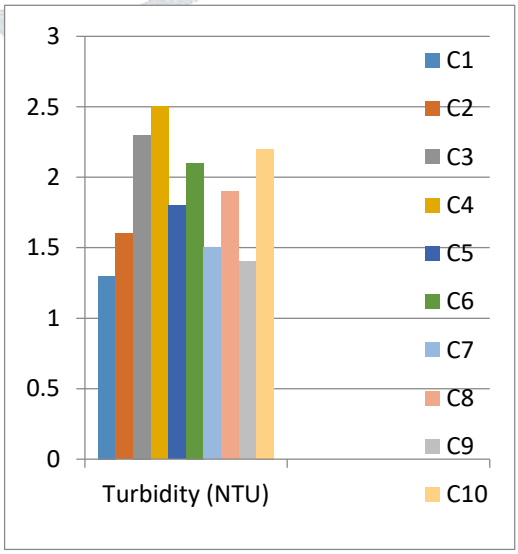


Figure 14: Relative distribution of Turbidity

3.7. Temperature (·c)

Water temperature has direct and indirect effects on all aspects. If water temperature increases their usual ranges on, plants and animals would be disturbed stressed and die. In the study, the temperature values are varied from 24·c to 27·c in figure15 and table 3. Because they have been collected in the summer season.

The Table 4 and Figure 16 show the temperature range of26·c to 30 ·c. C_1 to C_{10} all thetemperature level is normal degrees. Water temperature regulates the metabolism of the aquatic ecosystem. High water temperature stress aquatic ecosystem. (S.Krishnaraj et al, 2015).

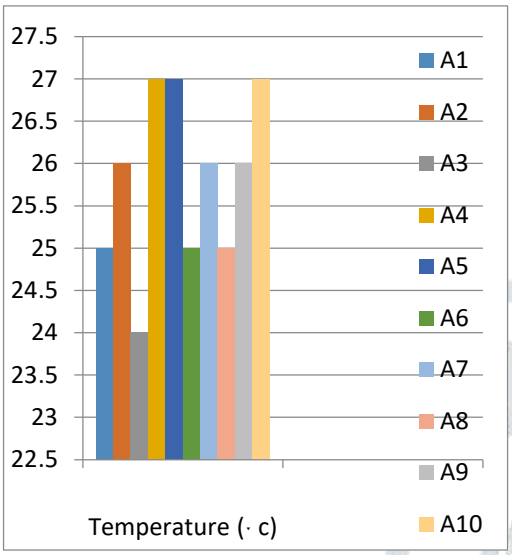


Fig 15: Relative distribution of Temperature (·c)

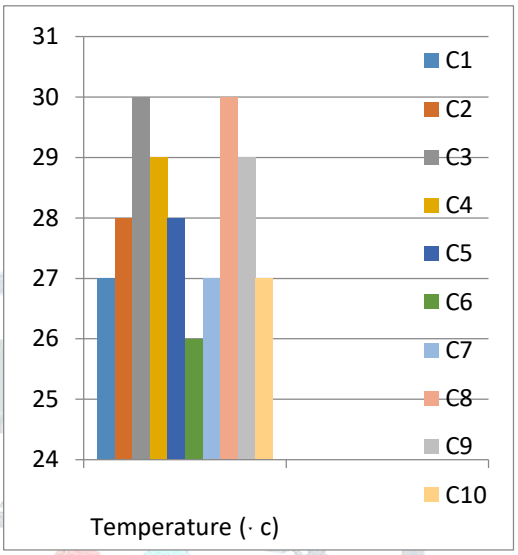


Fig 16: Relative distribution of Temperature(·c)

3.8. Calcium

Calcium is directly related to Hardness. In the present study, calcium range of 4.46mg/l to 55.80mg/l in table 3.The figure 17 shows the A_1 to A_{10} samples are in high amount of Acceptable limit.

The Table 4 and Figure 18 show the calcium range of 2.04 mg/l to 47.08 mg/l. C_1 to C_{10} all the values are within the permissible limit. Too high level of calcium causes the cardiovascular disorder.(Awadho.Aisubaimi et al, 2016).

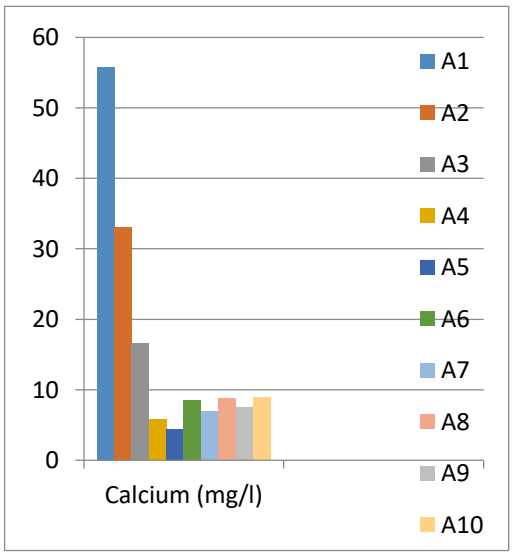


Fig17: Relative distribution of Calcium

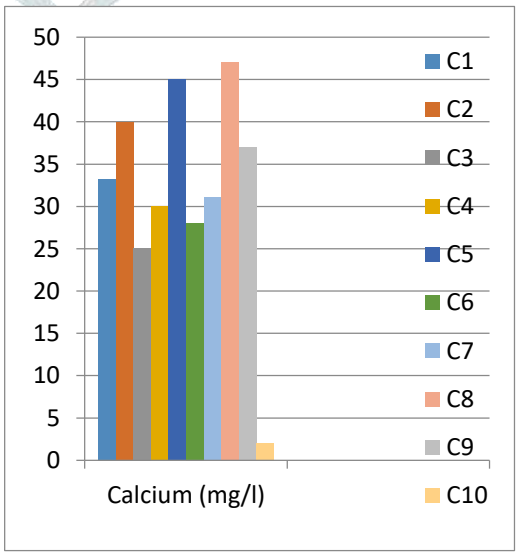


Fig18: Relative distribution of Calcium

3.9. Magnesium

Magnesium is related to hardness. In the present study, magnesium ranges from 2mg/l to 31 mg/l in table 3 and figure 19. A1 is maximum amount of acceptable limit. Other A_1 to A_{10} values are within the acceptable limit.

The Table 4 and Figure 20 show the magnesium concentration 14 mg/l to 26 mg/l. C_1 to C_{10} all the samples are inminimum amount of acceptable Limit. Too high level magnesium causes the nausea, muscular weakness and paralysis in human body.(SandeepK.Pandey, 2009).

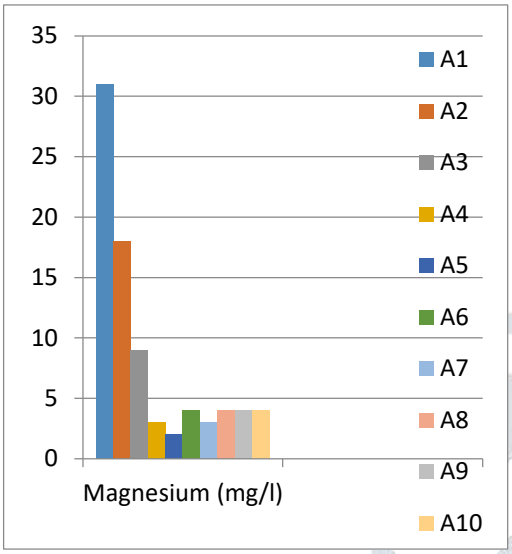


Fig 19: Relative distribution of Magnesium

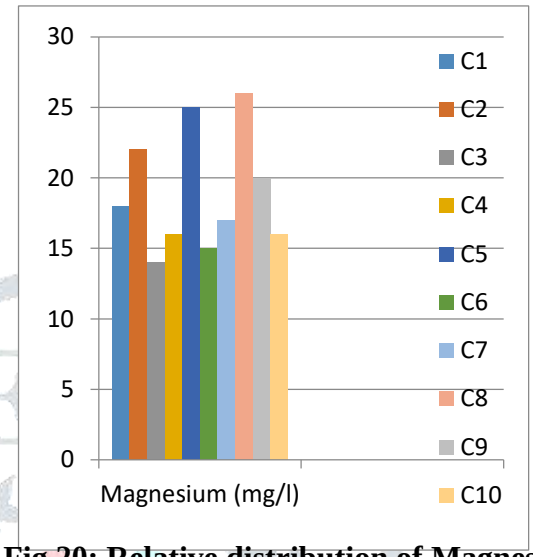


Fig 20: Relative distribution of Magnesium

3.10. Sodium:

Sodium is very reactive.In the present study, sodium ranges 44.4mg/l to 93.23mg/l in table 3. The Figure 21 shows the A_1 to A_{10} all sodium values are within the acceptable limit

The Table 4 and Figure 22 show thesodium range of 30.22 mg/l to 65.07 mg/l. C_1 to C_{10} all the samples value within the permissible limit. Too low level sodium causes the vomiting, Headache and confusion loss of energy. (H.Annapoorna, 2015).

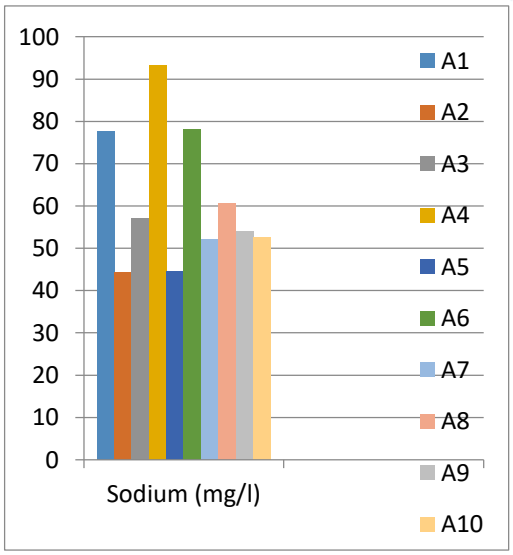


Fig 21: Relative distribution of Sodium

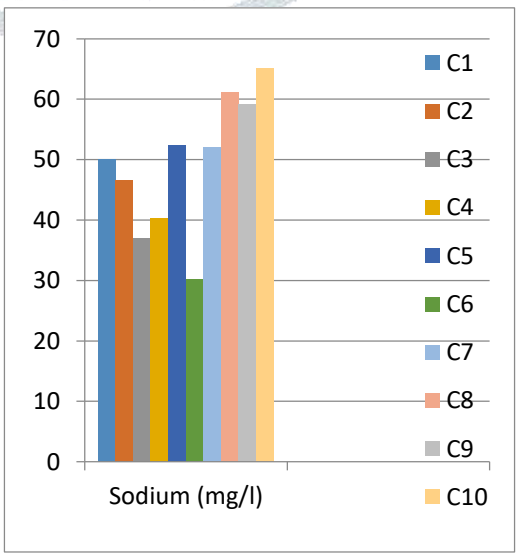
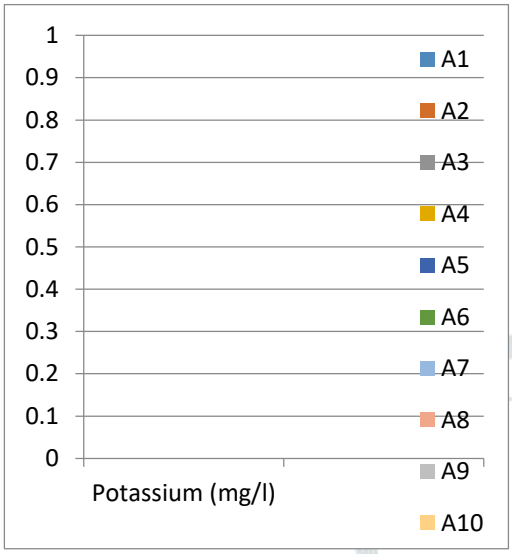


Fig 22: Relative distribution of Sodium

3.11. Potassium

The major source of potassium is presented in natural fresh water. In the present study, table 3 and figure 23 shows the Potassium level is A_1 to A_{10} all values are zero.

The Table 4 and Figure 24 shows the Potassium content in the water samples which range from 2.09mg/l to 10.01 mg/l. Too low level Potassium causes muscle weakness, vomiting and nausea in human body.(R.Udhayakumar et al, 2016).



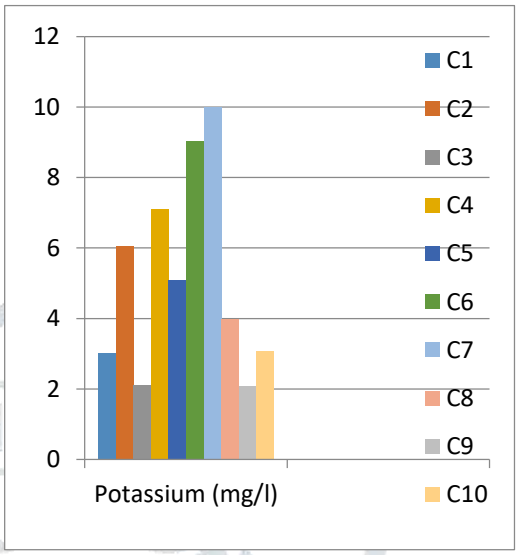
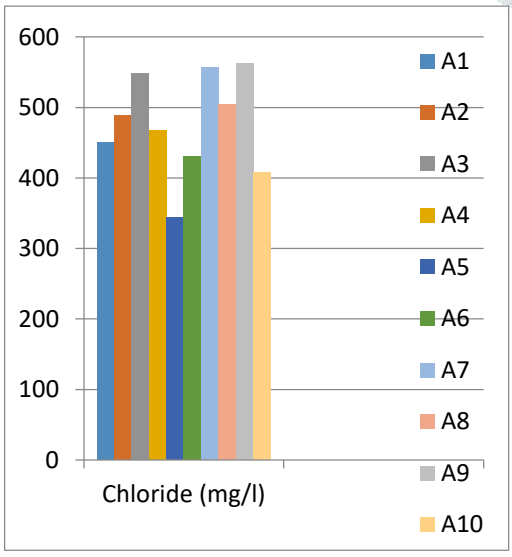


Fig 23: Relative distribution of Potassium **Fig 24: Relative distribution of Potassium**

3.12. Chloride

In the present study, Chloride range is 408mg/l to562mg/l which is shown in table 3.The figure 25 shows the A_1 to A_{10} samples are high amount acceptable limit and within the permissible limit.

The Table 4 and Figure 26 chloride is in the range of 220 mg/l to 402 mg/l. C_1, C_2 and C_3 values only minimum amount of acceptable limit.Other values are within permissible limit. When combined calcium and Magnesium may increase the corrosive activity of water. Increase of Chloride level in water is injurious to people suffering due to heart and kidney diseases. (K.SainulAbidin et al, 2009).



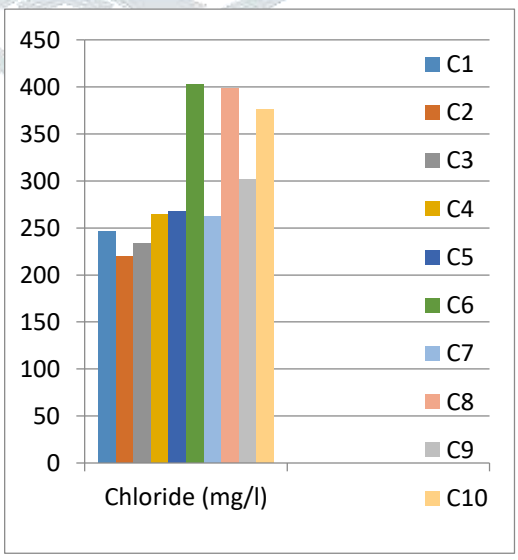


Fig 25: Relative distribution of Chloride **Fig 26: Relative distribution of Chloride**

3.13. Fluoride

In the present study, of Fluoride range between 0.0mg/l to 1.5mg/l which shown in table 3. A_1, A_3, A_4, A_6, A_7 and A_9 values are lower amount of acceptable limit. A_2, A_5, A_8 and A_{10}values are within the permissible limit.

The Table 4 and Figure 28 shows the fluorides range of 0.0mg/l to 1.5mg/l. C_8 and C_{10} values is only high amount of acceptable limit. Other values are within the permissible limit.Low Fluoride level in drinking water causes bone problems. (TirumaleshKeesari et al, 2016).

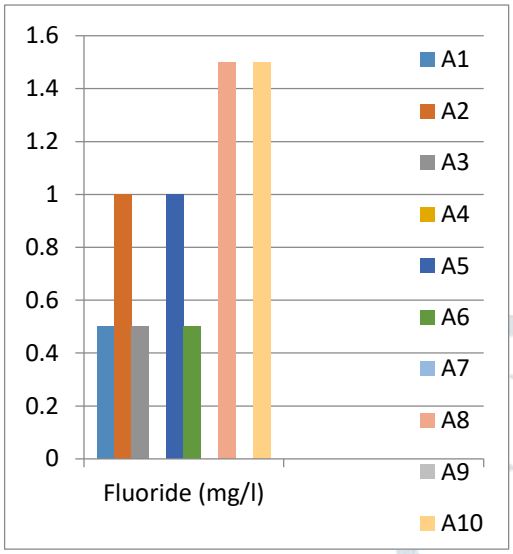


Fig 27: Relative distribution of Fluoride

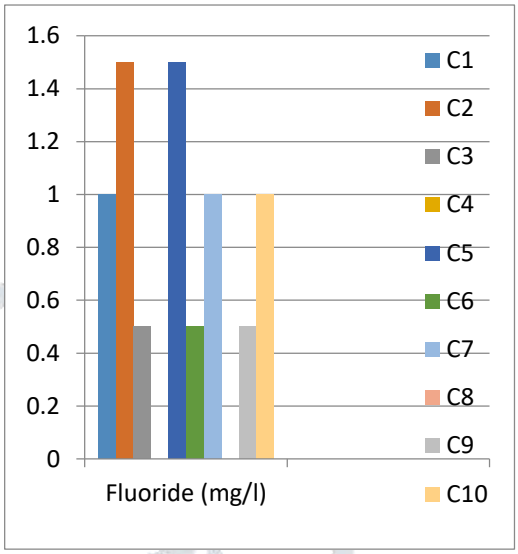


Figure 28: Relative distribution of Fluoride

3.14. Sulphate

Sulphate is found to be high in the leach ate sample due to the decomposition of organic matter.In the present study sulphate range is110mg/l to 195mg/l in table 3. The figure 29 shows the A_1 to A_{10}lower value present in the acceptable limit.

The Table 4 and Figure 30 shows thesulphate concentration range of 260mg/l to 340mg/l. C_1, C_2, C_3, C_4, C_6 and C_7 maximum value of acceptable limit. Other all values are within the permissible limit. Too low amount of sulphate causes irritations to our eyes, skin and mouth. (B.P.Naveen et al, 2018).

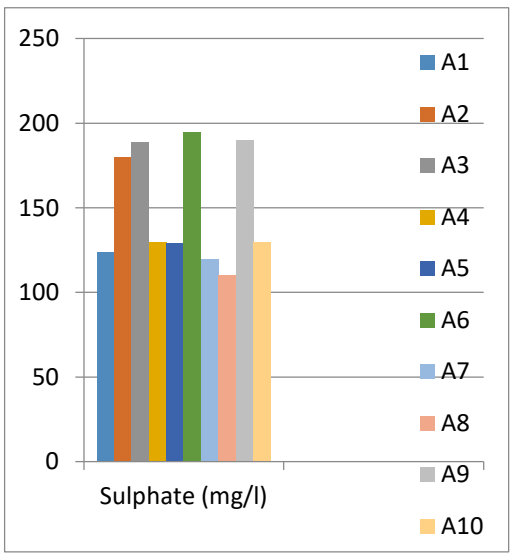


Fig 29: Relative distribution of Sulphate

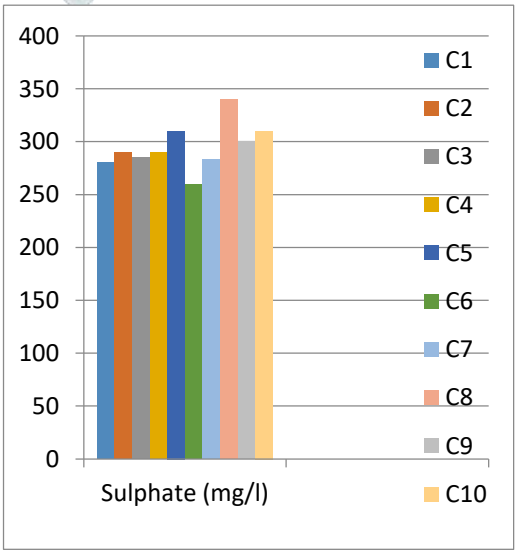
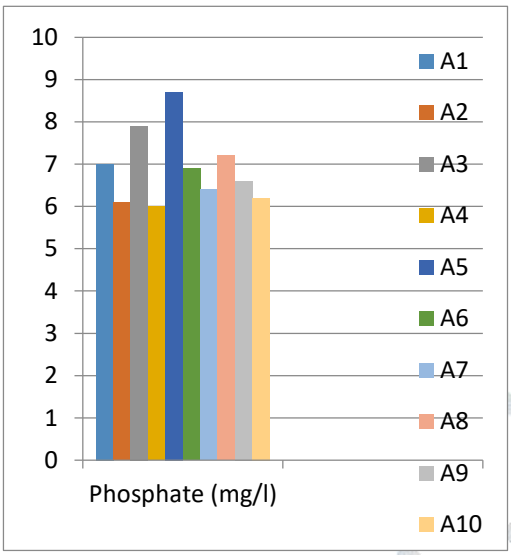


Fig 30: Relative distribution of Sulphate

3.15. Phosphate

In the present study, phosphate ranges from 6.0 mg/l to 7.9mg/l .which is given the table 3. The figure 31 shows the Phosphate samples from A_1 to A_{10} are in higher value of the acceptable limit.

The Table 4 and Figure 32 show the phosphaterange of 8.0 mg/l to 9.4 mg/l.C_1 to C1lall samples are in high amount of acceptable limit. Too high level phosphate causes weak bones, rashes and itchy skin.



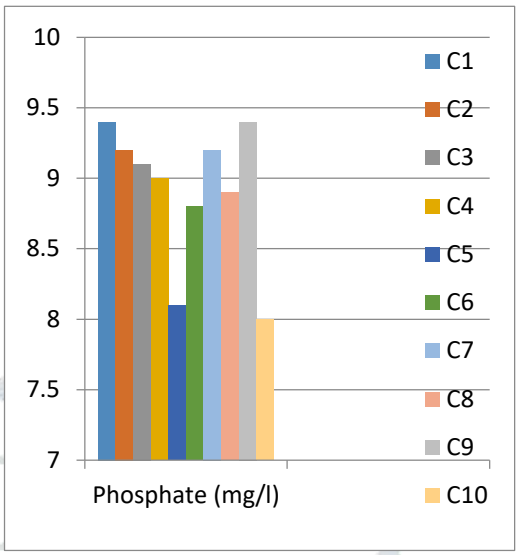
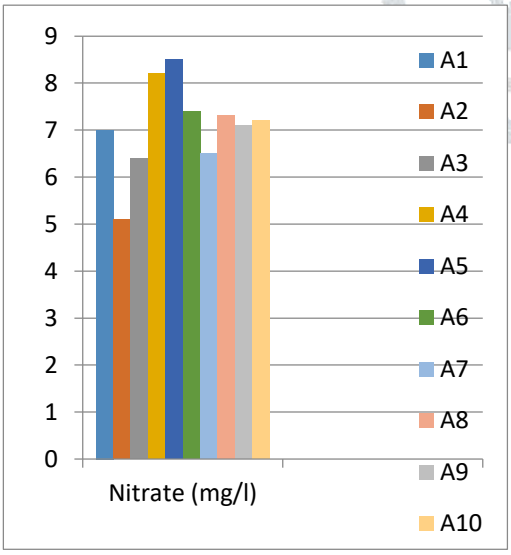


Fig 31: Relative distribution of Phosphate **Fig 32: Relative distribution of Phosphate**

3.16. Nitrate

Nitrate in drinking water level is below 10mg/l.In the present study, nitrate values are 5.1mg/l to 8.5mg/l shown in table 3. The figure 33 shows the A_1 to A_{10}values are noted.

The Table 4 and Figure 34 shows the nitrate range of 2.0 mg/l to 4.0 mg/l. Too high level causes the blue baby disease. (S.Selvakumar et al, 2017).



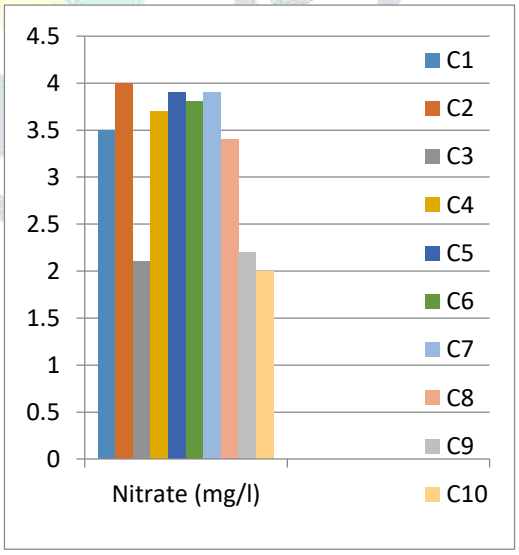
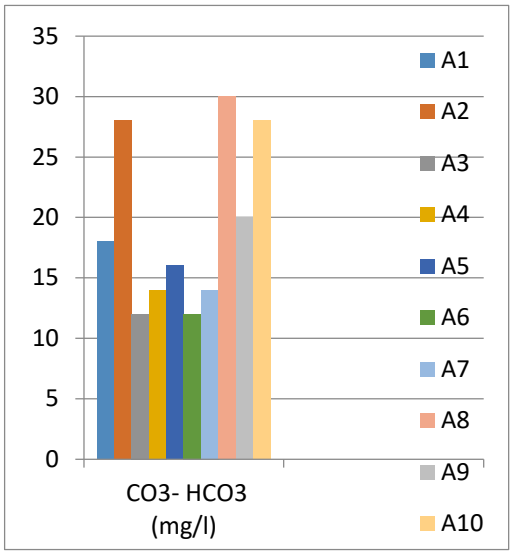


Fig 33: Relative distribution of Nitrate **Fig 34: Relative distribution of Nitrate**

3.17. CO_3-HCO_3

In the Present study carbonate range from 12mg/l to 30mg/l in table 3. The figures 35 shows the A_1 to A_{10} values inlower amount of acceptable limit.

The Table 4 and Figure 36shows the carbonate level 144mg/l to 212 mg/l. C_5, C_8 and C_{10} values are in high amount of acceptable limit. Other samples values are within the permissible limit.



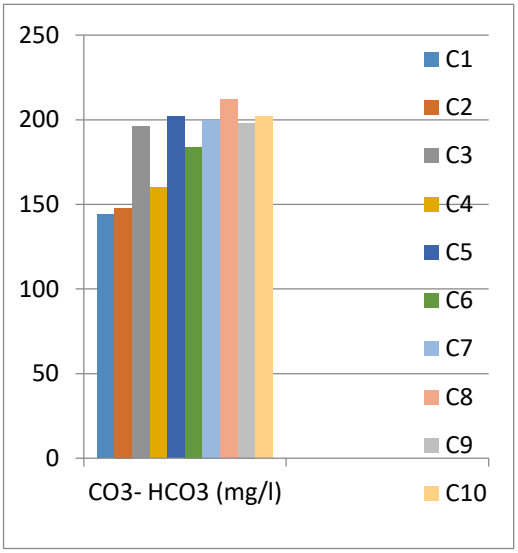


Fig 35: Relative distribution of CO_3-HCO_3

Fig 36: Relative distribution of CO_3-HCO_3

Statistical groundwater samples

The tables5, 6, 7and 8 shows the Statistical Summary of the of the East and West location samples values are noted.

Table: 5

Samples	N	Minimum	Maximum	Mean	Standard Error	Standard Deviation
A1	7	1.00	1219.00	228.202	168.334	445.371
A2	7	1.20	1594.00	283.425	220.818	584.231
A3	7	1.10	1742.00	304.600	241.721	639.534
A4	7	1.30	1159.00	227.090	159.264	421.374
A5	7	1.50	1172.00	238.107	160.482	424.596
A6	7	1.30	1085.00	220.745	148.593	3493.140
A7	7	1.10	1152.00	241.317	157.755	417.382
A8	7	1.20	1045.00	215.580	143.043	378.458
A9	7	1.40	1460.00	276.254	200.936	531.628
A10	7	1.10	1051.00	220.110	143.962	380.889
Total	70	1.00	1742.00	245.543	52.472	439.013

Table: 6

Elements	N	Minimum	Maximum	Mean	Standard Error	Standard Deviation
Calcium	10	0.00	450.00	77.088	43.328	137.018
Magnesium	10	0.00	488.00	80.369	48.326	152.821
Sodium	10	0.00	548.00	84.657	54.592	172.637
Potassium	10	0.00	468.00	72.825	46.178	146.030
Chloride	10	0.00	344.00	55.813	34.356	108.644
Fluoride	10	0.00	430.00	74.263	43.999	139.138
Sulphate	10	0.00	556.00	76.481	54.577	172.589
Phosphate	10	0.00	504.00	73.347	49.114	155.315
Nitrate	10	0.00	562.00	85.135	56.071	177.312
CO_3-HCO_3	10	0.00	408.00	64.640	40.182	127.069
Total	100	0.00	562.00	74.461	14.356	143.546

Table: 7

Samples	N	Minimum	Maximum	Mean	Standard Error	Standard Deviation
C1	7	1.26	844.00	197.065	116.775	308.958
C2	7	1.22	817.00	207.645	116.227	307.509
C3	7	1.14	763.00	191.777	106.836	282.663
C4	7	1.36	911.00	217.637	127.819	338.178
C5	7	1.31	877.00	218.558	122.260	323.470
C6	7	1.49	998.00	232.470	138.801	367.235
C7	7	1.05	703.00	143.078	97.985	259.245
C8	7	1.41	944.00	226.772	130.834	346.156
C9	7	1.37	917.00	226.138	128.268	339.366
C10	7	1.49	984.00	236.927	137.481	363.741
Total	70	1.05	998.00	209.807	36.395	304.505

Table: 8

Elements	N	Minimum	Maximum	Mean	Standard Error	Standard Deviation
Calcium	10	1.00	280.00	78.817	33.594	106.234
Magnesium	10	1.50	290.00	78.732	32.796	103.712
Sodium	10	0.50	285.00	80.489	35.260	111.504
Potassium	10	0.00	290.00	82.006	35.756	113.072
Chloride	10	1.50	310.00	92.095	37.920	119.914
Fluoride	10	0.50	402.00	94.138	44.289	140.054
Sulphate	10	1.00	283.00	86.924	36.108	114.184
Phosphate	10	0.00	398.00	110.045	47.676	150.767
Nitrate	10	0.50	302.00	93.030	39.330	124.375
CO_3-HCO_3	10	1.00	376.00	98.519	45.435	143.678
Total	100	0.00	402.00	89.479	111.838	118.382

Correlations matrix of chemical constituents of groundwater samples

The tables9, 10, 11and 12 shows the correlation matrix of the east and west location samples values. The systematiccalculation of correlation coefficient between water quality variables and regression analysisofwater quality. The correlation matrix for different ground water quality variables are shown in the tables.

Table: 9

Samples	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
A1	1									
A2	0.999	1								
A3	0.998	1.000	1							
A4	0.999	0.997	0.996	1						
A5	0.995	0.993	0.992	0.998	1					
A6	0.995	0.993	0.992	0.998	1.000	1				
A7	0.990	0.988	0.987	0.995	0.999	0.999	1			
A8	0.994	0.992	0.991	0.998	1.000	1.000	0.999	1		
A9	0.999	0.999	0.998	0.999	0.998	0.998	0.995	0.997	1	
A10	0.994	0.991	0.989	0.998	0.999	0.999	0.999	1.0000	0.996	1

Significance at 1.000 level.

Table : 10

	Samples									
Elements	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Calcium	1									
Magnesium	0.989	1								
Sodium	0.990	0.998	1							
Potassium	0.992	0.986	0.992	1						
Chloride	0.985	0.997	0.999	0.992	1					
Fluoride	0.976	0.990	0.992	0.985	0.996	1				
Sulphate	0.991	0.988	0.992	0.993	0.988	0.972	1			
Phosphate	0.991	0.987	0.990	0.995	0.988	0.972	0.999	1		
Nitrate	0.988	0.998	1.000	0.992	0.999	0.991	0.993	0.992	1	
CO_3-HCO_3	0.990	0.996	0.998	0.995	0.998	0.989	0.995	0.995	0.999	1

Significance at 1.000 level.

Table: 11

Correlation matrix for different water quality parameters.

Samples	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	1									
C2	0.992	1								
C3	0.997	0.998	1							
C4	0.997	0.998	0.998	1						
C5	0.997	0.992	0.998	0.993	1					
C6	1.000	0.994	0.998	0.999	0.996	1				
C7	0.937	0.890	0.916	0.908	0.935	0.928	1			
C8	0.999	0.992	0.998	0.995	0.999	0.998	0.940	1		
C9	0.998	0.997	1.000	0.998	0.999	0.998	0.922	0.999	1	
C10	0.999	0.997	0.999	0.999	0.997	0.999	0.992	0.999	1.000	1

Significance at 1.000 level.

Table: 12

	Samples									
Elements	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Calcium	1									
Magnesium	0.996	1								
Sodium	0.987	0.989	1							
Potassium	0.999	0.994	0.990	1						
Chloride	0.993	0.993	0.998	0.995	1					
Fluoride	0.947	0.918	0.929	0.956	0.941	1				
Sulphate	0.990	0.986	0.997	0.993	0.998	0.950	1			
Phosphate	0.986	0.969	0.971	0.989	0.981	0.987	0.984	1		
Nitrate	0.993	0.984	0.990	0.996	0.995	0.966	0.997	0.994	1	
CO_3-HCO_3	0.979	0.958	0.967	0.983	0.973	0.986	0.981	0.995	0.990	1

Significance at 1.000 level.

Table: 13 (Between East and West Locations)

T- Test:

Locations	T	Sig.(2-tailed)
L1 Between East and West location	0.152	0.882
L2 Between East and West location	0.304	0.767
L3 Between East and West location	0.427	0.677
L4 Between East and West location	0.046	0.964
L5Between East and West location	0.097	0.924
L6 Between East and West location	-0.058	0.955
L7 Between East and West location	0.264	0.796
L8Between East and West location	-0.058	0.955
L9Between East and West location	0.210	0.837
L10 Between East and West location	0.084	0.934

4. Conclusion:

The investigated physico-Chemical properties status to water quality are based on all the parameters measured in industrialarea drinking water in Attur region compared with standards. Ground water pollution in general ground water quality of Attur region is not harmful to human beings. The ground water inindustry area was found to the fit for drinking purposes.

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