PHYSICO- CHEMICAL ANALYSIS OF GROUND WATER SAMPLES OF SOME SELECTED AREAS OF ERODE CORPORATION LIMIT, TAMILNADU

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Abstract-

Twenty different ground water samples were collected from different selected areas of Erode corporation limit places. The collected water samples were subjected for the analysis for its Physico- chemical properties which includes appearance, colour, turbidity, Electrical conductivity, Total dissolved solids, Ph, Total Alkanity, Hardness and Estimation of calcium, Estimation of Magnesium, Estimation of Iron, Estimation of Manganese, Estimation of Ammonia, Estimation of Nitrite, Estimation of Nitrate, Estimation of Chloride, Estimation of Fluoride, Estimation of Sulphate, Estimation of Phosphate, Estimation of Sodium and Potassium, Estimation of Tidys test and checked for its portability.

Key Words - Water Samples, Physio- chemical analysis, Portability, Erode

I. INTRODUCTION

Water is one of the most indispensable materials to the ecosystem and is an elixir of life. It acts as a medium for both chemical and biochemical reactions and also as an internal and external medium for several organisms. Nearly 80% of earth's surface is covered with water. It exists in three phases namely solid, liquid and gas. It keeps alive, moderate climate, sculpts the land, removes and dilutes wastes and pollutants and is circulated in accordance with the hydrological cycle.[1-3]

The history of human civilization reveals that water supply and civilization are almost synonymous. Several cities and civilization have disappeared due to water shortage originating from the climate change. Millions of people all over the world, particularly in the developing countries, are losing their lives every year from water borne diseases.[2] On an average a human being consumes two liters of water every day. It accounts for about seventy percent of the weight of a human body. Owing to increasing industrialization, urbanization and extended modern agricultural activities on one hand and exploding population on the other hand, the demand of water supply have been increasing tremendously. Moreover, considerable part of this limited quantity of water is polluted by sewage, industrial wastes and a wide array of synthetic chemicals. The menace of waterborne diseases and epidemics still threatens the well being of population, particularly in under developed and developing countries. Thus, the quality and quantity of clean water supply is of vital significance. India receives only about 1083 mm of rainfall in 2011.[4] An analysis conducted in 1982 revealed that about 70% of all the available water in our country is polluted.[3]

About 97.4% by volume of water is found in oceans and it is salty and cannot be used for drinking, irrigation and industrial purposes directly. Of the remaining 2.6% of fresh water most of which locked by ice or in deep ground water. Thus only 0.014% of earth's total volume of water is easily available to us as usable ground water.[1,5] Thus, the source of water available to the humans is less than a percent in lakes, streams and ground. One can, therefore realize the value of water and need to preserve the water bodies.

II. MATERIALS AND METHODS

Water Sampling:

In this study water samples of borewells and hand pumps were collected from 20 places *l*ocated in Erode corporation limit. The samples were collected in polyethylene bottles which were cleaned with acid water followed by rinsing twice with distilled water. The analysis of water was done using procedure of standard methods. The period of collection was during south west monsoon of the year 2014. All the collected samples were tested for its appearance, colour, turbidity, Electrical conductivity, Total dissolved solids, Ph, Total Alkanity, Hardness and Estimation of calcium, Estimation of Magnesium, Estimation of Iron, Estimation of

Manganese, Estimation of Ammonia, Estimation of Nitrite, Estimation of Nitrate, Estimation of Chloride, Estimation of Fluoride, Estimation of Sulphate, Estimation of Phosphate, Estimation of Sodium and Potassium, Estimation of Tidys test.

III. RESULTS AND DISCUSSION

The water samples collected was analyzed according to standard procedure and the results are given in the table.1)

A. COLOUR AND APPEARANCE

All the water samples except sample numbers 6, 9, 12, 18 are clean, colourless and odourless indicating that they have no dissolved organic and inorganic matter. The water sample numbers 6, 9, 12, 18 are brownish in colour. This may be due to the presence of natural metallic ions (iron and manganese), humus, peat materials, plankton, weeds or industrial wastes.

B. TURBIDITY

Turbidity measures the concentration of dissolved inorganic and organic matters in a water sample. All samples except 18 exhibit turbidity values range between 0 and 5 NTU. According to Bureau of Indian Standard, BIS (10500: 2012) and World Health Organization (WHO) guidelines, the desirable limits are 1 NTU and permissible limit for turbidity is 5 NTU. All the samples except sample 18 had permissible turbidity level. This shows that there is no suspended particulate matter.

C. ELECTRICAL CONDUCTIVITY

Electrical conductivity refers to the ability of solution to carry current. If electrical conductivity is less than 2500 µS/ cm indicates the absence of dissolved inorganic ions in water. According to ISI and WHO, the prescribed limit of electrical conductivity is 2500 µS/ cm. All the water samples have electrical conductivity less than 2500 µS/ cm indicates the presence of fewer amounts of dissolved inorganic ions in water.

D. TOTAL DISSOLVED SOLIDS

Total dissolved solids indicate the presence of minerals in the dissolved form. According to BIS 10500: 2012 and WHO,[24] the acceptable and permissible limit is 500 and 2000 respectively. All the water samples have total dissolved solids in a range of 589- 1600mg/ L indicates that there is no objectionable level of presence of minerals in that area.

E. pH

The pH value of water is used to express the intensity of acid or alkaline conditions. All the water samples have pH value with in a acceptable limit(6.5- 8.5) as per the standards of BIS and WHO. It indicates that water samples are slightly basic in nature. These are shown in the table

F. TOTAL ALKALINITY

Total alkalinity is due to the presence of carbonates, bicarbonates and hydroxides based salts.[25] The amount of alkalinity for the water samples range from 228 to 580 mg/L which are within the permissible limit of 200 to 600 mg/L according to the BIS and WHO standards. The study has confirmed that there is slightly of alkalinity in these bore well waters.

G. TOTAL HARDNESS

Hardness of water is due to presence of soluble salts of calcium and magnesium in the form of carbonates and chlorides. BIS and WHO guidelines indicates that the desirable and permissible limit of total hardness of water is 200 to 600 mg/L. The study revealed that total hardness varies between 208 to 504 mg/L. All the water samples are having permissible limit of calcium and magnesium ions.

H. CALCIUM

The presence of calcium in water is due to passage through or over deposits of limestone, dolomite and gypsum. Calcium is one of the important mineral in cell construction, bone building and plant precipitation of life.[26]According to BIS and WHO guidelines ,the permissible limit of calcium in water is 75 – 200 mg/ L.

The amount of calcium in all the water samples ranges from 56- 141 mg/ L.

I. MAGNESIUM

The considerable amount of magnesium influences the water quality. Magnesium is often associated with calcium in all kinds of water but its concentration is always lower than the calcium concentration.[27] The amount of magnesium present in water sample ranges from 12- 52 mg/ L. This satisfies the standard values of

BIS and WHO (i.e., acceptable limit 30mg/L and permissible limit 100 mg/L).

J. IRON

All the water samples except 6, 9, 12, and 18 have zero iron content. The amount of iron present in water sample numbers 6, 9, 12, 18 are 1.36, 1.04, 0.54, 15.40mg/L respectively. According to BIS and WHO, the acceptable and permissible limit of iron is 0.3 mg/L. This indicates that the water sample numbers 6, 9, 12, 18 have high iron content and it is a serious problem for water supplies.

Because the presence of large amount of iron content in water promotes the growth of iron consuming bacteria which in turn weaken the pipes.

K. MANGANESE

Manganese present along with iron. It is used for functioning of many cellular enzymes. According to BIS and WHO, the manganese acceptable limit is 0.1 mg/ L and permissible limit is 0.3 mg/L. No water samples have manganese content beyond permissible limit except water sample number 18. The water sample number 18 has the manganese content as 2.48 mg/ L. The excess amount of manganese in water causes staining on laundry. This water is unfit for drinking and irrigation practices.

L. AMMONIA

Ammonia in the environment originates from metabolic, agricultural and industrial processes. All the water samples except 9, 12, 13 and 20 have zero ammonia content. The amount of ammonia present in water sample numbers 9, 12, 13, 20 are 5.12, 18.19, 0.79, 4.31 mg/L respectively. According to BIS and WHO, the acceptable and permissible limit of ammonia is 0.5 mg/L. This indicates that the water sample numbers 9, 12, 13 and 20 have high ammonia content and it is a serious problem for water supplies.

M. NITRITE

According to BIS and WHO, the nitrite in water should be 0 mg/lt. All the water samples except 5, 6, 7, 8, 9, 10, 11,12,13,15, 18,19 and 20 have no nitrite content. The nitrite present in water samples numbers 5, 6, 7, 8, 9, 10, 11,12,13,15, 18,19,20 are 0.02, 0.01, 0.21, 1.93, 2.72, 0.03, 0.29,0.50, 0.09, 0.07, 2.79, 0.01, 2.75mg/ L respectively. Absorbed nitrite is rapidly oxidized to nitrate in the blood and does not allow oxygen transport, owing to the strong binding of oxygen.

N. NITRATE

Nitrates are naturally occurring ions that are part of the nitrogen cycle. The presence of excessive nitrates in drinking water leads to blue baby syndrome and this due to the excessive use of fertilizers in agricultural field[28]. According to BIS and WHO[29], the acceptable limit of nitrate in drinking water is 45 mg/ L . All the water samples have the nitrate content with in 45 mg/L.

O. CHLORIDE

Chlorides enter the water from natural resources, run off from human habitations, sea water intrusions in to ground water etc., Human body releases very high quantity of chlorides through urine and fasces.[30]The presence of chloride in high concentrations makes water hard and brackish. According to BIS and WHO, the acceptable limit of chloride in water is 250 mg/ L and the permissible limit is 1000 mg/lt. All the water samples except 5 have chloride content ranges from 74- 244 mg/ L. So the water sample number 5 is not fit for drinking purpose.

P. FLUORIDE

Fluorides are minerals present in rocky areas. Ground water in such areas acquire fluoride ion. Fluoride concentration higher than 1.0 mg/ L(acceptable limit of BIS and WHO standards)causes dental problems and skeletal fluorosis[31]. All the water samples except number 7 have fluoride content less than 1.0 mg/L. The water sample number 7 has the fluoride content 1.1 mg/L.

Q. SULPHATE

The sulphate content increase in water due to industrial waste waters and atmospheric deposition. According to BIS and WHO standards the acceptable and permissible limit of sulphate in water is 200 and 400 mg/L respectively. [32] All the water samples have the sulphate content ranging from 6- 156 mg/ L. The presence of higher amount of sulphate in water cause laxative effect.

R. PHOSPHATE

Phosphates are naturally occurring substance present in rocks, guano deposits etc., According to BIS and WHO, the acceptable limit of phosphate in drinking

water is 0 mg/ L. The water samples except 1, 5,7,8,9,10,11,12,13,14,15,16,17,18,19 and 20 have the nil phosphate content The phosphate content present in water samples 1, 5,7,8,9,10,11,12,13,14,15,16,17,18,19 and 20 are 0.01, 0.39, 0.46, 0.25, 0.01, 0.65, 0.51, 0.18, 1.20, 0.66, 0.16, 0.63, 0.96, 0.03, 0.77, 0.42 respectively. The presence of phosphate in water may leads to eutrophication.

S. SODIUM (Na)

Sodium is a natural constituent of raw water, but its concentration is increased by pollution sources such as yolk salt, precipitation run- off, soapy solution and detergent. According to BIS and WHO, standard value for sodium in water is 100 to 200 mg/ L. Estimation of sodium shows that all the value lies between 31 to 185 mg / L. All the water samples have limited sodium content. High concentration of Na^+ ions in drinking water causes hypertension, heart problems and kidney problems in human.

T. POTASSIUM (K)

Potassium is naturally present in soils and rocks. It also reaches the water bodies because of excessive usage of fertilizers. According to BIS and WHO guidelines indicate that the prescribed limit of potassium in water is 150 mg/ L. All the water samples have potassium content varies between 16- 103 mg/ L. It indicates that all the water samples are having permissible limit of potassium.

U. TIDY'S TEST

Tidy's test is the measure of O_2 in mg/ L. According to the BIS standard the tidy's test as O_2 in mg/lt is zero. All the water sample numbers 1- 20 have the tidy's test value 0.40, 0.44, 0.44, 0.40, 0.64, 0.72, 0.80, 1.28, 2.80, 1.00, 1.12, 2.72, 1.24, 0.56, 0.76, 0.52, 0.92, 1.44, 0.96, 2.64 respectively.

Table 1 **- PHYSICO – CHEMICAL PARAMETERS OF GROUND WATER ANALYSIS**

Sample No	Sample Station	Appearance	Odour	Turbidity NTU	Electrical Conductivity (µS / cm)	Total Dissolved Solids (mg /L)	pH	Total Alkalinity (mg /L)	Total Hardness (mg /L)	Ca^{2+} (mg /L)	Mg^{2+} (mg /L)	Fe^{2+} (mg/ L)	Mn^{2+} (mg/ L)	NH_3 (mg/ L)	NO_3^- (mg /L)	NO_2^- (mg /L)	Cl^- (mg /L)	F^- (mg /L)	SO_4^{2-} (mg /L)	PO_4^{2-} (mg /L)	Na^+ (mg /L)	K^+ (mg /L)	Tidy.s Test (mg /L)
1	BN	C & C	Odourless	0	999	699	7.85	272	248	77	13	0.00	0.00	0.00	0.00	29	80	0.5	99	0.01	51	29	0.40
2	TN	C & C	Odourless	0	1357	950	7.36	292	368	99	29	0.00	0.00	0.00	0.00	4	154	0.7	137	0.00	49	19	0.44
3	KKM	C & C	Odourless	0	1530	1071	7.39	300	400	102	35	0.00	0.00	0.00	0.00	8	192	0.7	156	0.00	31	17	0.44
4	BSN	C & C	Odourless	0	1622	1135	7.70	312	504	115	52	0.00	0.00	0.00	0.00	21	244	0.7	131	0.00	66	24	0.40
5	KSS	C & C	Odourless	0	2286	1600	7.58	348	220	56	19	0.00	0.00	0.00	0.02	26	460	0.7	125	0.39	136	85	0.64
6	PC	brownish	Odourless	3	1010	707	7.52	248	240	64	19	1.36	0.00	0.00	0.01	40	104	0.3	58	0.00	53	23	0.72
7	KVS	C & C	Odourless	0	1178	825	7.52	368	392	86	42	0.00	0.00	0.00	0.21	40	112	1.1	45	0.46	87	51	0.80
8	VN	C & C	Odourless	0	841	589	7.42	264	256	77	15	0.00	0.00	0.00	1.93	22	74	0.1	45	0.25	65	34	1.28
9	KV	brownish	Odourless	4	1545	1082	7.38	460	488	134	36	1.04	0.00	5.12	2.72	9	200	0.2	41	0.01	118	82	2.80
10	AMS	C & C	Odourless	0	1591	1114	7.39	348	472	131	35	0.00	0.00	0.00	0.03	44	188	0.4	103	0.65	58	29	1.00

Sampling Stations: BN – Bharathi Nagar, **TN** – Transport Nagar, **KKM** - Kollukattu Medu, **BSN** – Balusamy Nagar, **KSS** - Kalyanasundaram St., **PC**- Periyar Chatram, **KVS** – Karaivaikal St.,**VN** – V.V.C.R Nagar, **KV** - Kuppi Vaikkal, **AMS** – Annai Mary School

Table.2 - PHYSICO – CHEMICAL PARAMETERS OF GROUND WATER ANALYSIS

Sample No	Sample Station	Appearance	Odour	Turbidity NTU	Electrical Conductivity (µS / cm)	Total Dissolved Solids (mg /L)	pH	Total Alkalinity (mg/L)	Total Hardness (mg /L)	Ca^{2+} (mg /L)	Mg^{2+} (mg /L)	Fe^{2+} (mg/L)	Mn^{2+} (mg/L)	NH_4 (mg/ L)	NO_2^- (mg /L)	NO_3^- (mg /L)	Cl^- (mg /L)	F^- (mg /L)	SO_4^{2-} (mg /L)	PO_4^{3-} (mg /L)	Na^+ (mg /L)	K^+ (mg /L)	Tidy,s Test (mg /L)
11	IKS	C & C	Odourless	0	1050	735	7.35	284	308	70	32	0.00	0.00	0.00	0.29	10	106	0.3	95	0.51	150	96	1.12
12	MS	brownish	Odourless	3	1518	1063	7.31	580	500	141	36	0.54	0.00	18.19	0.50	1	140	0.0	6	0.18	99	62	2.72
13	IN	C & C	Odourless	0	860	602	7.61	300	272	80	17	0.00	0.00	0.79	0.09	0	76	0.1	29	1.20	116	73	1.24
14	KMR	C & C	Odourless	1	847	593	7.61	228	232	70	13	0.00	0.00	0.00	0.00	28	94	0.1	47	0.66	88	46	0.56
15	KAS	C & C	Odourless	0	1335	935	7.40	344	400	120	24	0.00	0.00	0.00	0.07	34	150	0.3	103	0.16	81	39	0.76
16	KS	C & C	Odourless	0	1025	717	7.64	272	208	64	12	0.00	0.00	0.00	0.00	41	100	0.3	58	0.63	68	25	0.52
17	KT	C & C	Odourless	1	1363	954	7.35	392	472	138	31	0.00	0.00	0.00	0.00	42	134	0.3	79	0.96	42	16	0.92
18	KN	brownish	Odourless	55	1477	1034	7.42	376	496	134	38	15.4	2.48	0.00	2.79	38	156	0.8	127	0.03	185	103	1.44
19	MGR	C & C	Odourless	0	1184	829	7.68	336	348	70	41	0.00	0.00	0.00	0.01	26	130	0.0	66	0.77	69	32	0.96
20	KMT	C & C	Odourless	0	1418	993	7.30	456	424	118	31	0.00	0.00	4.31	2.75	9	146	0.1	60	0.42	62	23	2.64

Sampling Stations : IKS - Iyyanarappan Kovil St, **MS** – Mosikerranar St, **IN** – Indira Nagar, **KMR** – K.A.S.Nagar, Marappalam Rd, **KAS** – K.A.S.Nagar, Marappalam, **KS**- Kumanan Street, **KT**- Kuilan Thoppu, **KN**- Kalaignar Nagar, **MGR**- M.G.R.Nagar, **KMT**- Krishna Moorthy Thottam

V. PERCENT SODIUM (% Na)

Sodium concentration is important in classifying irrigation water because sodium reacts with soil to reduce its permeability. Soils containing a large proportion of sodium with carbonate as the predominant anion are termed alkali soils; those with chloride or sulphate as the predominant anions are saline soils. The role of sodium in the classification of ground water for irrigation was emphasized because of the fact sodium reacts with soil and as a result of clogging of particles takes place, thereby reducing permeability, (Todd 1980, Domenico and Schwartz 1990) The percent sodium is calculated by the equation.

$$\%Na = \frac{Na^+ + K^+}{Ca^{2+} + Mg^{2+} + Na^+ + K^+} X\,100$$

The concentration of these ions is expressed in mille equivalents/Liter (m eq /L). In the present study % Na values varied from 13.82 to 47. 52 mg/L (Table 3.3) which are slightly higher than expected values

Wilcox (1948) proposed a method for rating irrigation waters based on percent sodium and electrical conductivity. The diagram consists of five distinct areas such as excellent to good, good to permissible, permissible to doubtful, doubtful to unsuitable and unsuitable.

Wilcox diagram (Fig.1) has revealed that out of 20 samples, 19 samples fall under good to permissible category and one sample with in doubtful to unsuitable.

W. SODIUM ABSORPTION RATIO (SAR)

Sodium when present in excess produces adverse effect of changing soil properties and reducing soil permeability (Kelly 1951). Hence, the assessment of sodium concentration is necessary while considering the suitability for irrigation. The degree to which irrigation water tends to enter into cation-exchange reactions in soil can be indicated by the Sodium Absorption Ratio (SAR) US – Salinity Laboratory, (1954). Sodium replacing absorbed calcium and magnesium is a hazard as it causes damage to the soil structure. It becomes compact and impervious. SAR is an important factor for the determination of suitability for irrigation water because it is responsible for sodium hazard (Todd 1980). SAR is calculated using the formula,

Table.3 STANDARD SODIUM ABSORPTION RATINGS

S.No	SAR Rating	Comments
1	**<10**	No sodium hazard. May be used on all sensitive crops.
2	**10 – 18**	Medium sodium hazard. Gypsum and leaching needed.
3	**18 – 26**	High sodium hazard. Generally unsuitable for continued use.
4	**>26**	Very high sodium hazard. Generally unsuitable for use.

Table.4 GEO CHEMICAL PARAMETERS OF SAMPLE WATER

S.No.	Sampling Stations	TDS (mg /L)	Electrical Conductivity (µS / cm)	Percent Sodium (% Na)	Sodium Absorption Ratio (SAR)
1	Bharathi Nagar	699	999	28.16	1.41
2	Transport Nagar	950	1357	21.43	1.11
3	Kollukattu medu	1071	1530	13.82	0.68
4	Balusamy Nagar	1135	1622	21.26	1.28
5	Kalyanasundaram Street	1600	2286	47.52	4.01
6	Periyar Chatram	707	1010	30.12	1.49
7	Karaivaikal Street	825	1178	29.48	1.92
8	V.V.C.R Nagar	589	841	32.21	1.77
9	Kuppi Vaikkal	1082	1545	30.40	2.34
10	Annai Mary School	1114	1591	19.88	1.16
11	Iyyanarappan Kovil Street	735	1050	43.19	3.73
12	Mosikerranar Street	1063	1518	27.09	1.92
13	Indira Nagar	602	860	40.99	3.07
14	K.A.S. Nagar, Marappalam Road	593	847	39.99	2.53
15	K.A.S. Nagar, Marappalam	935	1335	28.20	1.76
16	Kumanan Street	717	1025	37.30	0.98
17	Kuilan Thoppu	954	1363	15.64	0.84
18	Kalaignar Nagar	1034	1477	39.25	3.63
19	M.G.R. Nagar	829	1184	28.09	1.62
20	Krishna Moorthy Thottam	993	1418	22.99	1.31

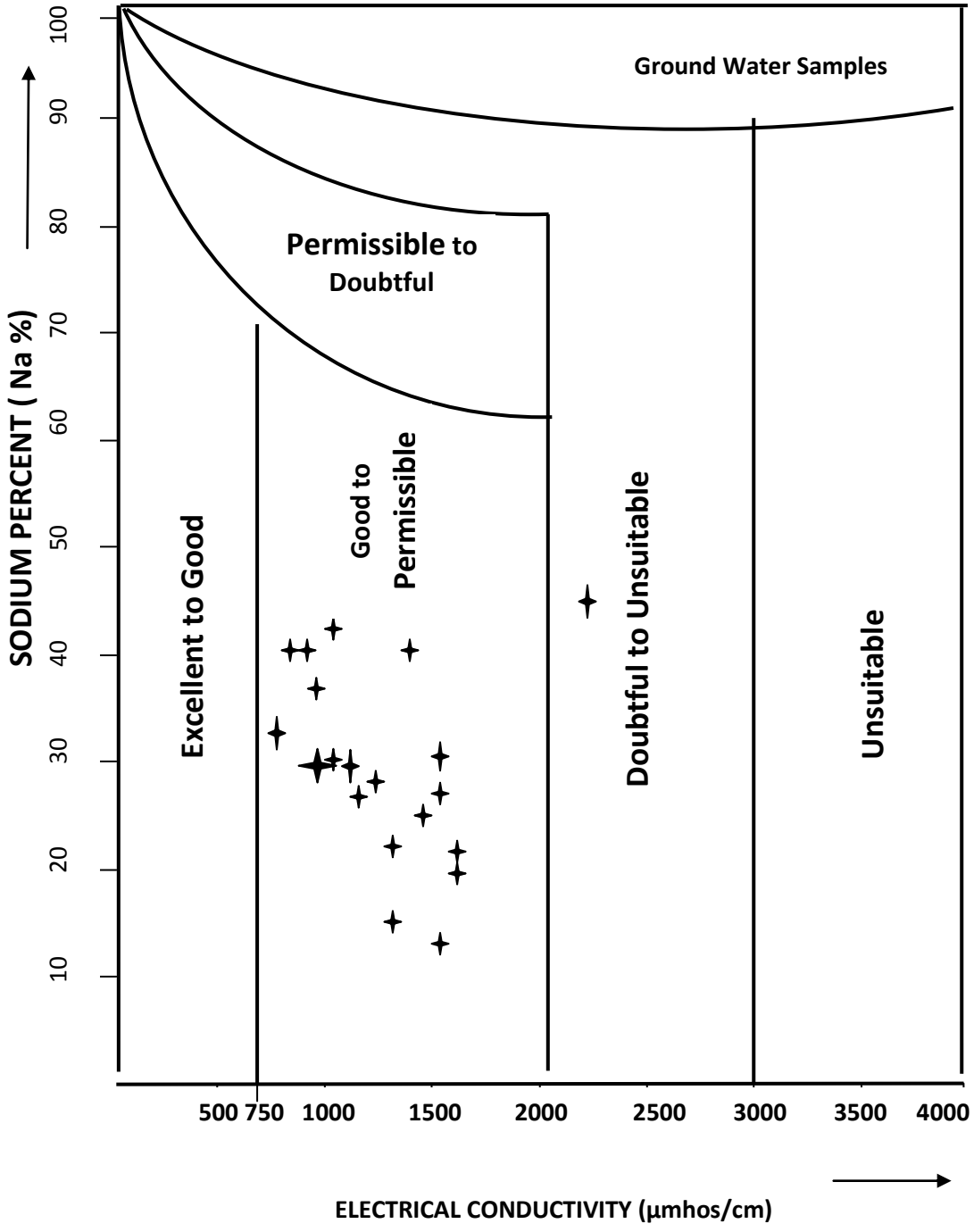

Fig.1 – The Quality of Ground Water in relation to Electrical Conductivity and Sodium Percent

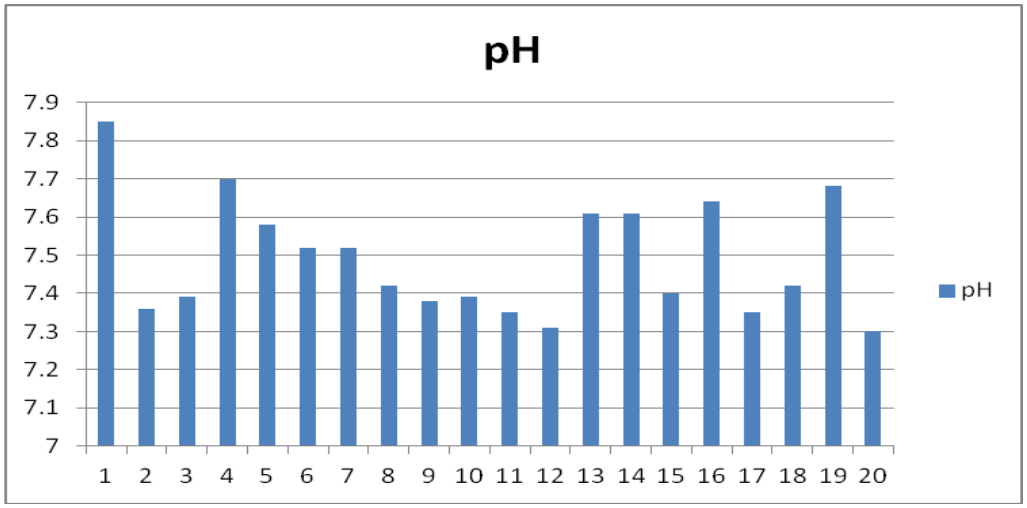

Fig 2 GRAPHICAL REPRESENTATION OF PH

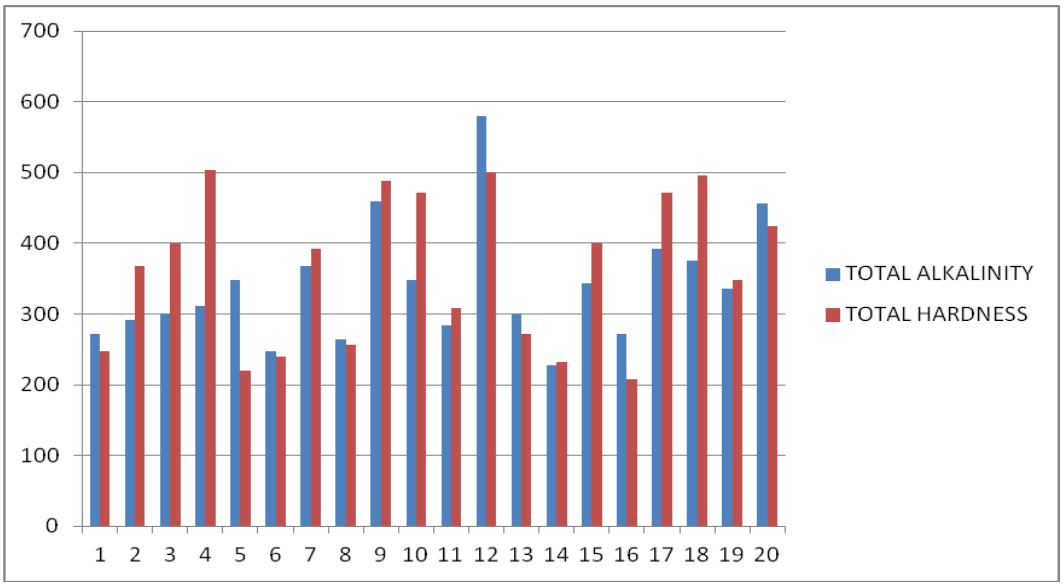

Fig 3 GRAPHICAL REPRESENTATION OF TOTAL ALKALINITY AND TOTAL HARDNESS

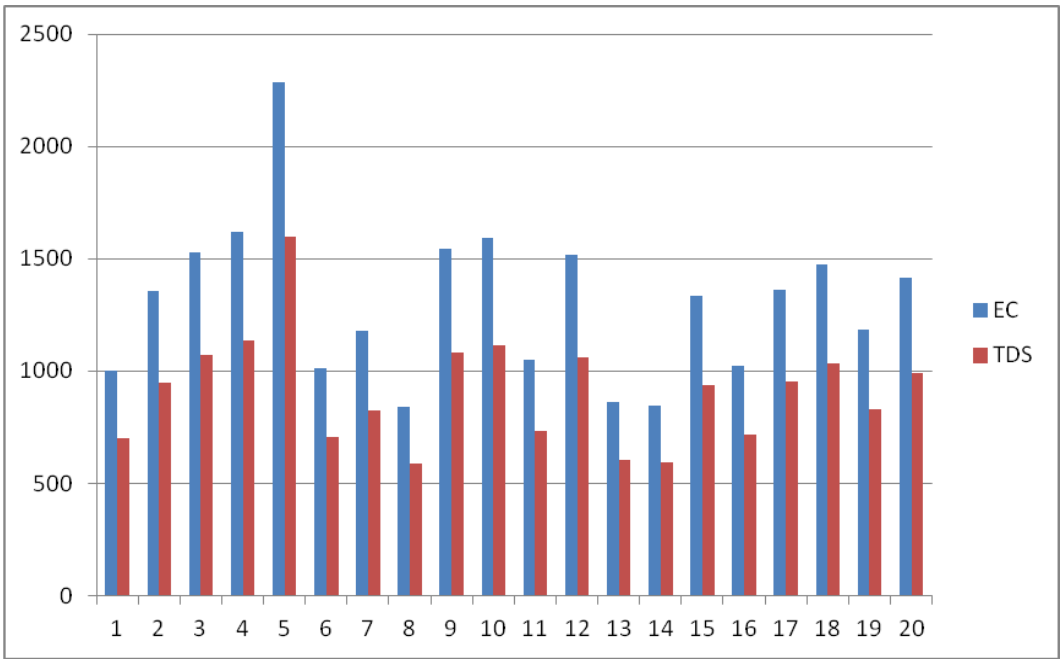

Fig 4 GRAPHICAL REPRESENTATION OF ELECTRICAL CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS

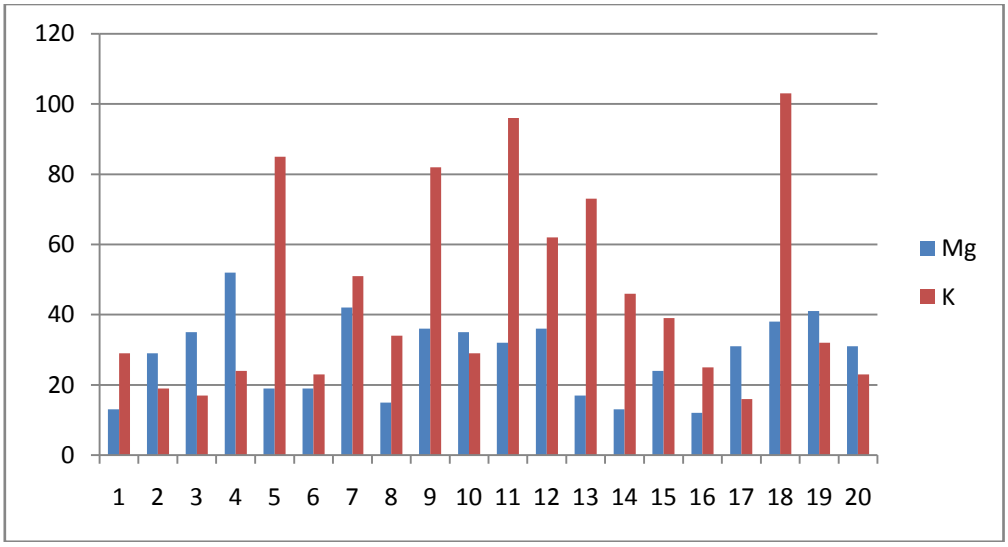

Fig 5 GRAPHICAL REPRESENTATION OF Mg^{2+} Vs K^{+}

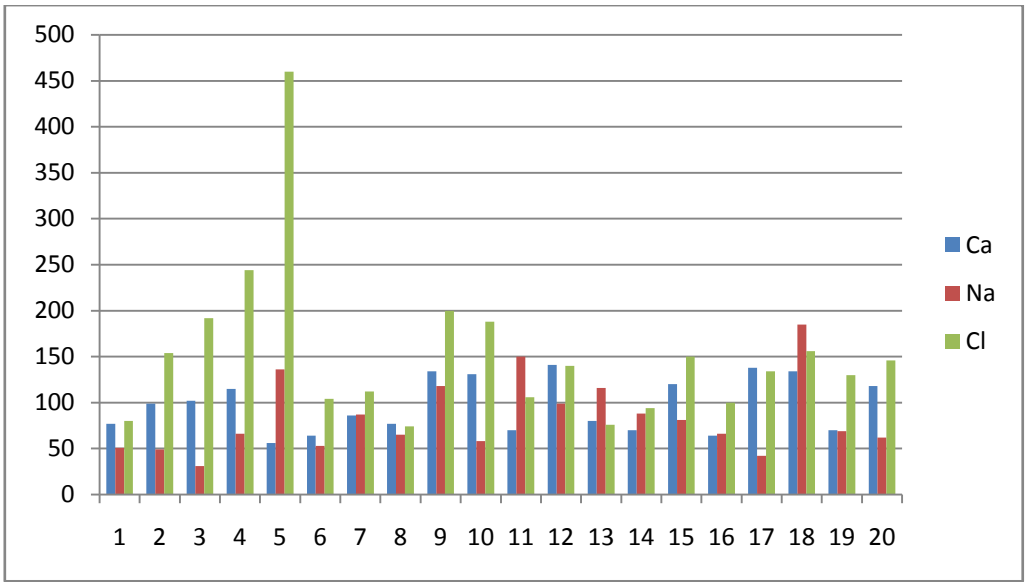

Fig 6 GRAPHICAL REPRESENTATION OF Ca^{2+}Vs Na^{+} Vs Cl^{-}

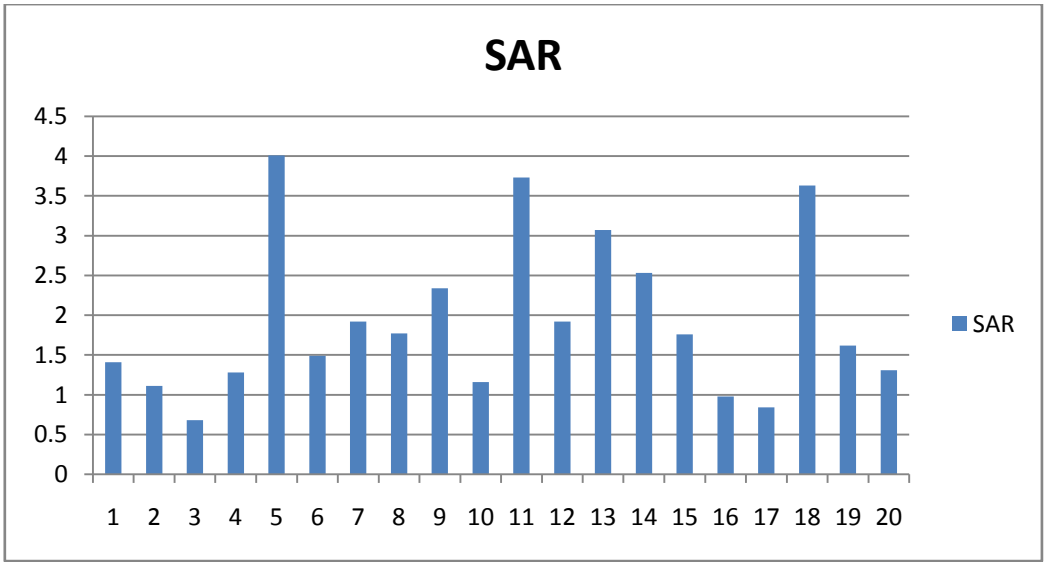

Fig 7 GRAPHICAL REPRESENTATION OF SODIUM ABSORPTION RATIO

IV. CONCLUSION

The result analysis of water samples shows that except water sample numbers 18 and 20, ground water in that areas are potable one. They can be used for domestic, agricultural and industrial purposes. The water sample number 18 has high turbidity, iron, manganese and nitrite. The water sample 20 has high ammonia and nitrite content. Though industrial effluents are discharged in to the Kalingarayan canal, their effect upon ground water of the selected area lying beyond a kilometer from its bank has been found to be ineffective. So people of that area can use ground water of their locality.

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