Seasonal variation in physico- chemical characteristics of ground water on the bank Uyyakondon channel of river Cauvery at Tiruchirappalli - Tamil Nadu, India.

A. ABDUL JAMEEL and A. ZAHIR HUSSAIN

PG and Research Department of Chemistry, Jamal Mohamed College, Tiruchirappalli - 20 (India).

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ABSTRACT

The groundwater quality on water samples were taken near the bank of channel on both sides and the other two samples were taken nearly $\frac{1}{2}$ km away from the channel at 5 stations. The study was carried out for summer and rainy seasons of 2003. The samples were subjected to Physico- chemical analysis. High alkalinity, TDS, TH, Na and No₃, BOD and COD were observed at ground water stations.

Key words: Seasonal variation, ground water, Cauvery river, Tiruchirappalli.

INTRODUCTION

Water plays an indispensable role in every species that survive in this world and is required by all living organisms for their existence. Though water is a renewable resource, reckless usage and improper management water system may cause serious problems in availability and quality of water. Water may be contaminated by various means, chemically and biologically and become unfit for drinking and other uses. The increasing industrialization, urbanization, agricultural and other human activities have caused enormous deterioration in the quality of various natural water bodies, particularly rivers and ground water in developing countries like India. In spite of considerable purification of river, unabated disposal of sewage and industrial wastes are deteriorating the quality of both ground and river water. Tiruchirappalli is one of the most important industrial cities in Tamilnadu and it is situated on the bank of river cauvery and at the center of Tamilnadu. Industries of diverse fields such as tanneries, pharmaceuticals, pesticides, fertilizer plants, dying, dairy, steel rolling mills, distillery etc, are located in and around Tiruchirappalli town. Uyyakondan channel is about 65.5 km long running through the heart of Tiruchirappalli as a tributary of river Cauvery. It originates from pettavaithalai and completing its course at Valavanthankottai (20 km east of Tiruchirappalli town). It flows across about 60 villages. The channel water is used for domestic and irrigation purposes and it irrigates 1311 hectares.

There is no proper management and planning for the disposal of municipal sewage at Tiruchirappalli. The city generates the organic and inorganic wastes of about 250-300 tonnes per day and the municipal corporation is dumping them in the Dump yard at Ariyamangalam. The typical sewage comprising of domestic and other wastewater are discharging directly into the channel without any proper treatment. The garbage dumping sites of Palakarai, Ariamangalam, Kattur, Thiruverumbur and Valavanthankottai are located around the bank of the Uyyakondan channel. Moreover the rainwater percolates through the dumping site, which decomposes the waste and liquid leachate thus produced, can easily enter into the watercourses or ground water. Hence the present investigation has been attempted to study the physico-chemical characteristics of the ground water at Tirchirappalli.

MATERIALS AND METHODS

The ground water samples were taken from the bore wells on either side of the bank of Uyyakondan channel [1A-5A, 1B-5B] of each station. Two other samples were collected nearly a kilometer away from the banks at all the stations [1C-5C, 1D-5D].

Sample Collection

The samples were collected in plastic cans. Prior to use, cans were cleaned thoroughly rinsing with distilled water. They were dried, cooled and labeled. For the estimation of DO, BOD and COD, well-sterilized BOD bottles were used. All necessary precautions were taken during sampling analysis and transportations of water samples to the laboratory.

The first part of the analysis includes the physico-chemical parameters such as , pH, electrical conductivity, total dissolved solids, total hardness, carbonate, bicarbonate, chloride, sodium, potassium, calcium, magnesium, nitrate, fluoride, sulphate, biochemical oxygen demand, chemical oxygen demand and dissolved oxygen³. Preservatives such as conc. HCl and conc. H_2SO_4 were added to the samples used for COD.

The pH of the water sample was measured by a glass electrode and electrometer type pH meter (Elico-model L1-12T) after taking necessary precautions in sampling and standardization. Conductivity was measured using Digital Conductivity Meter (Elico-Model CM-180).

RESULTS AND DISCUSSION

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pH value is an important factor in maintaining the carbonate and bicarbonate levels in water. The mean pH values are recorded within the range of 7.7-8.2 and 7.5-8.2 for ground water samples in both summer and rainy seasons respectively (Table 1 & 2). The pH values are found to be within the permissible limit of WHO (6.5 - 8.5) in all the sampling stations for ground water samples. There are no abnormal changes in both seasons. The slight alkalinity seen for ground water as well as water samples may be due to the presence of bicarbonate ions, which are produced by the free combination of CO_2 with water to form carbonic acid, which affects the pH of the water. Carbonic acid (H₂CO₃) dissociates partly to produce (H⁺) and bicarbonate (HCO₄) ions ⁶.

The pH values increase slightly for ground water samples in all the sampling stations in summer. The slight depletion of pH during rainy season may be attributed to seasonal dilution effect². The low pH does not cause any harmful effect¹.

Electrical Conductivity

The mean EC values are within the range of 820 - 2620 µmhocm⁻¹ and 680 - 5600 µmhocm⁻¹ for the ground water samples in summer and rainy seasons respectively (Table 1 & 2). The importance of EC is its measure of salinity, which greatly affects the taste and has a significant impact of the user acceptance of the water as potable⁵. Higher the ionisable solids greater will be the EC. The EC values are well above the permissible limit of WHO (600 µmhocm⁻¹) for ground water samples. The ground water samples which are very near to the channel have maximum EC and that the values decrease for the samples collected far away from the channel. The EC values are high in summer except at station 2A for ground water samples and it EC values may be due to the increase in evaporation of water molecules.

Total Dissolved Solids

The mean TDS values are found within the range of 440 - 3320 ppm and 450 - 3655 ppm for ground water samples in summer and rainy seasons respectively (Table 1 & 2).Most of the ground water samples show higher TDS values that are well above the permissible limit of WHO (500 ppm). The maximum TDS values are observed at stations 1A - 10A and 1B - 10B in summer and rainy seasons.

Total Hardness

The mean TH values are within the range of 300 -1600 ppm and 210 -1500 ppm for ground water samples in both summer and rainy seasons respectively (Table1 & 2). TH values exceed the desirable limit of WHO (300 ppm) in all the stations for ground water samples except at stations 1A-5A and 1B-5B in summer and rainy seasons. These stations are adjacent to the channel. At the same time low TH values are observed at stations 1C-5C and 1D-5D that are located far away from the channel. It clearly indicates that high value of TH of ground water near the channel is due to the impact of channel water containing solid wastes.

Alkalinity (Carbonate And Bicarbonate)

The carbonates are not detectable for ground and channel water samples in both seasons. The mean values of bicarbonate are recorded within the range of 200 - 500 ppm and 118 - 606 ppm for ground water samples in summer and rainy seasons respectively (Table1 & 2).

Even though the carbonate alkalinity is absent, the total alkalinity is found which may be due to the accumulation of bicarbonates .The bicarbonate values are within the permissible limit of 8 (500 ppm) for most of the ground water.

Chloride

The mean values of chloride are found in the range of 180-1450 ppm and 97 -1418 ppm for ground water samples in summer and rainy seasons respectively (Table1 & 2).

The percolation of channel water and intrusion of sewage activities reduce the chloride level when the distance is increased. Thus the samples 1C-5C and 1D-5D have low chloride level. High value of chloride is recorded at station 2A in summer due to the increased rate of percolation of agricultural land water and domestic sewage.

Sodium

The mean values of sodium are within the range of 72-680 ppm and 39-683 ppm for ground water samples in summer and rainy seasons respectively (Table1 & 2).

The sodium values exceed the desirable limit of WHO (200 ppm) in most of the ground water samples. The ground water samples, which are very near to the channel have maximum sodium values than that for the samples collected far away from the channel.

Potassium

The mean values of potassium are recorded between the range of 10-42 ppm and 8-30 ppm for ground water samples in summer and rainy seasons respectively (Table 1 & 2). The values of potassium exceed permissible limit of 12 ppm in most of the ground water samples in summer and rainy seasons. The values of potassium fluctuate in ground water samples stationwise.

Calcium and Magnesium

The mean values of calcium and magnesium are recorded in the range of 40-260 ppm and 29-256 ppm for ground water samples in summer and 22-180 ppm and 19-174 ppm in rainy season respectively (Table1 & 2). The calcium and magnesium values are within the permissible limit of WHO (200 and 150 ppm respectively) for most of the ground water samples. But the calcium values are high at station 2A . High values of magnesium are found at stations 2A and 2B . Stations 2A and 2B are surrounded by agricultural field.

Nitrate

The mean nitrate values are observed within the range of 18-230 ppm and 18-260 ppm for all ground water samples in summer and rainy seasons respectively (Table1 & 2). Nitrate values exceed the permissible limit of 45 ppm for most of the ground water samples. The ground water samples, which are nearer the channel, have maximum nitrate values and the values decrease for the samples collected far away from the channel.

Fluoride

The mean fluoride values are recorded within the range between 0.10-2.0 ppm and 0.05-2.30 ppm for ground water samples in summer and rainy seasons respectively (Table1 & 2).In the present study the values of fluoride are in the close range of permissible limit of WHO (1.0-1.5 ppm) for most of the ground water sample.

Sulphate

The mean values of sulphate are found in the range of 80-260 ppm and 39-480 ppm for

Station	Ηd	EC	TDS	Ħ	င်္	нсо₃	C	Na	х	Ca	Mg	NO₃	ш	SO₄	BOD	СОD	DO
1A	8.0	1950	1820	1036	QN	482	330	06	13	73	69	38	0.50	180	64	19	5.8
1B	7.7	1800	1630	840	QN	720	340	160	12	80	40	52	0.50	165	76	30	5.5
1C	7.4	1600	980	740	QN	312	220	110	24	62	64	18	1.00	120	31	37	5.9
1D	7.5	1200	780	560	QN	280	250	169	18	39	22	23	1.00	120	21	24	5.7
2A	8.2	2620	3320	1600	QN	500	1450	680	11	260	180	230	0.50	470	36	21	3.6
2B	7.8	2400	1290	1260	QN	390	840	310	26	86	180	49	1.00	260	42	32	4.8
2C	7.7	1100	642	320	QN	280	260	06	12	80	83	47	0.10	160	19	28	5.6
2D	7.8	1100	660	300	QN	370	255	120	18	76	71	38	0.50	120	21	23	5.7
3A	7.8	1640	980	312	QN	312	180	82	10	76	64	128	0.50	186	34	24	4.8
3B	7.7	1580	820	400	QN	520	250	170	10	92	52	60	0.10	120	39	18	4.9
3C	8.1	096	440	342	QN	200	225	80	17	66	42	40	0.20	182	14	30	5.9
3D	7.9	820	445	340	QN	280	200	160	16	56	42	42	0.20	110	16	21	5.7
4A	7.8	2200	1140	634	QN	510	370	230	32	60	52	65	1.00	195	36	42	4.8
4B	8.0	1600	006	573	QN	245	210	06	42	75	85	40	1.00	176	23	43	4.0
4C	7.8	1270	696	490	QN	260	210	80	15	60	63	38	0.50	139	14	27	5.8
4D	7.9	1100	620	420	QN	230	200	75	22	60	58	55	0.40	160	15	38	5.6
5A	7.9	1400	066	621	QN	320	260	420	15	78	63	20	1.00	123	86	20	2.3
5B	7.6	1200	006	590	QN	200	220	172	25	62	70	40	1.00	80	80	41	2.4
5C	7.8	1012	980	560	QN	230	210	92	15	40	62	38	2.00	120	26	36	5.0
5D	7.8	970	820	330	QN	210	225	72	18	45	60	38	0.20	110	17	23	5.7
All the val				m avcar	H ^C												
	ocm.		ND	- NoN -	detecta	ble											

Table 1: Physico-chemical characteristics of ground water for April 2003

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1A 1B 1B 1C 1C 13 14 12 14 14 14 14 14 14 14 14 14 14 14 14 14				£ -	,					,	°		٢			3
1B 8:0 14 1C 7:9 14 1D 7:8 13 2A 7:8 56 2B 7.7 15 2C 7.6 12 2D 7.9 9	2002	3 96	875	DN	430	260	82	30	62	48	56	0.20	170	23	22	5.6
1C 7.9 14 1D 7.8 13 2A 7.8 56 2B 7.7 13 2C 7.6 12 2D 7.9 9	180 9	303	710	ΔN	240	290	70	8.0	78	36	49	0.10	210	27	22	5.4
1D 7.8 13 2A 7.8 56 2B 7.7 13 2C 7.6 12 2D 7.9 9	180 8	340	632	DN	210	160	48	12	34	28	36	0.20	112	9.0	12	6.0
2A 7.8 56 2B 7.7 13 2C 7.6 12 2D 7.9 9	370 6	360	320	DN	212	181	39	11	29	19	34	0.10	94	21	10	5.9
2B 7.7 13 2C 7.6 12 2D 7.9 9	300 36	655 1	500	ΔN	494	1418	683	10	256	70	260	0.30	480	15	10	5.0
2C 7.6 12 2D 7.9 9	30 12	232 1	360	DN	384	613	301	20	56	174	47	0.30	133	14	8.0	5.7
2D 7.9 9.	50 8	356	460	DN	270	226	40	26	60	58	35	0.32	96	6.0	12	6.0
	6 06	32	510	QN	382	190	110	24	55	42	30	0.20	84	18	23	5.9
3A 7.8 9	70 4	158 1	065	DN	581	264	71	17	82	130	43	0.05	86	23	26	5.3
3B 8.2 11	20 6	323	970	DN	606	165	165	27	86	43	36	1.20	130	12	13	5.0
3C 7.7 1C	10 4	150	560	DN	180	178	132	16	40	26	34	0.20	62	27	26	5.4
3D 7.5 6	90 4	160	210	QN	270	180	150	13	54	39	36	0.10	64	17	16	5.7
4A 7.6 21	30 1	115	396	DN	500	362	221	30	52	06	62	0.20	48	25	18	4.7
4B 7.9 1C	010 9	. 176	410	DN	244	195	87	15	60	64	30	0.20	29	27	24	4.8
4C 7.8 9,	80 6	325	360	DN	240	180	70	22	38	54	35	0.60	132	8.0	12	5.7
4D 7.2 9.	50 6	310	312	DN	230	170	69	20	35	50	45	0.10	68	8.0	11	5.9
5A 7.6 13	150 9	376	380	DN	272	160	220	20	169	76	61	2.30	92	39	24	3.8
5B 7.6 11	27 8	332	540	DN	228	220	160	12	87	62	15	1.30	39	46	26	2.9
5C 7.7 9,	81 9	330	510	DN	126	97	80	10	29	54	21	1.20	81	16	19	5.8
5D 7.5 6	80 7	,30	496	QN	118	125	62	18	69	49	18	0.20	62	12	22	5.6

Table 2 : Physico - chemical characteristics of ground water for December 2003

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All the values are expressed in ppm except , pH and EC

EC - µmhocm⁻¹ ND - Non - detectable

ground water samples in both summer and rainy seasons respectively (Table 1 & 2).Sulphates occur naturally in water as a result of leaching from gypsum and other common minerals. Sulphate may come into the ground water by industrial or anthropogenic addition and in the form of sulphate fertilizers.The values of sulphate are within the permissible limit of 250 ppm (WHO) in most of ground water samples except stations 1B, 2A.

Biochemical Oxygen Demand (BOD)

The mean values of BOD are between the range of 14 - 86 ppm and 6.0 - 39 ppm for the ground water samples in summer and rainy seasons respectively (Table 1 & 2).

In the present study, the values of BOD are found to exceed the permissible limit of WHO (5.0 ppm) for ground water samples in summer and rainy seasons. High values recorded in summer may be attributed to the maximum biological activity at elevated temperatures where as the lowest BOD in rainy season may indicate lower biological activity. There is an inverse relationship between DO and BOD^{4,7}.

Chemical Oxygen Demand (COD)

The mean COD values are within the range of 18-43 ppm and 8-26 ppm for ground water samples in summer and rainy seasons respectively (Table1 & 2). COD values exceed the permissible limit of 10 ppm in all the sampling stations for ground water, which indicate the pollution by biodegradable and chemically degradable organic matter.

Dissolved Oxygen (DO)

The mean values of DO are recorded within the range of 2.3-5.8 ppm and 2.9-6.0 ppm for all the ground water samples in summer and rainy seasons respectively (Table 1 & 2). During the study period, the seasonal changes in oxygen content have been recorded. The general trend of changes in DO concentration in different seasons are directly or indirectly governed by fluctuations of temperature and BOD. Higher values of DO are recorded in rainy season, the period during which the water temperature was lowest.

CONCLUSION

From the present study it is concluded that most of the ground water samples near the channel are much polluted by the intrusion of channel water. The ground water samples are much polluted in the summer than rainy seasons. Some of the ground water samples that are far away from the channel are also polluted due to anthropogenic activity and the soil nature. Hence, the polluted materials should be avoided while letting them into the channel. Some strict and effective measurements are urgently needed for safe the quality of ground water on the bank of Uyyakondan channel of river Cauvery at Tiruchirappalli

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