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Seasonal variations in physico-chemical characteristics of ground water collected from Kondapalli nearby VTPS-Vijayawada

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ABSTRACT

VTPS is one of the major sources for electricity to Andhra Pradesh state. It was located in Kondapalli village on Vijayawada-Hyderabad National Highway. Approximately 13 villages are there around of VTPS. In VTPS electricity is producing by rotating of turbines with steam of Krishna river water. Present study is carried out to determine the physicochemical characteristics of ground water of Kondapalli nearby VTPS-Vijayawada. There is no change in P^H from location to location but there is difference between three seasons. Heavy metals are found in few places. Hardness, D.O, COD, Chloride, Fluoride and remaining parameters are analyzed and compared with IS 10500:2012 drinking water specifications.

Keywords: VTPS, Vijayawada, Kondapalli, Physico- chemical properties, Heavy metals.

INTRODUCTION

DrNarla Tata Rao Thermal Power Plant is also known as Vijayawada Thermal Power Plant. It was developed under 4 stages, with the project cost of Rs 193 Crores and Rs 511 Crores respectively. The station stood first in country during 94-95, 95-96, 96-97, 97-98 and 2001-02 by achieving the highest plant load factor. VTPS is one of the major sources for electricity to Andhra Pradesh state. It is located in Kondapalli village on Vijayawada-Hyderabad National Highway. Approximately 13 villages are there around of VTPS. In VTPS electricity is being produced by rotating of turbines with steam of Krishna river water. In continuous process so many bi products are causing environmental (Air, water, Soil) pollution. In this study we have examined the Physico chemical parameters of drinking water and and impact of VTPS pollution on ground water of villages which are nearby VTPS. Open fly ash dump yards and coal burning are major causes of pollution near thermal power plants. Burning of coal and its smoke was identified as significant threat to the environment [1, 2].

Study Area

In this study 3 season's (Monsoon-2013, Winter-2014, Summer-2014) 6 samples are collected from Kondapalli village. The sampling locations are given in Table.1.

MATERIALS AND METHODS

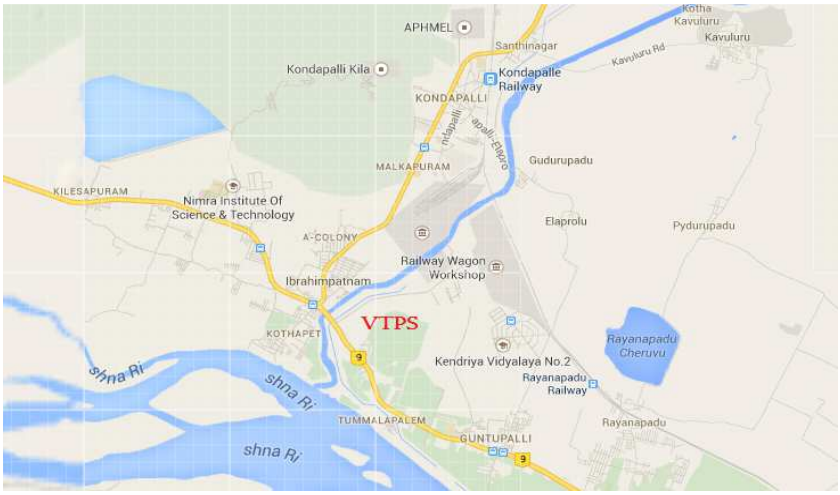

Image.1 Location of VTPS nearby National Highway-9 and Krishna River

Table.1 Sampling location GPS data

1	KP-1	80o 31' 55.55E	16o 35' 3.96N
2	KP-2	80o 31' 55.29E	16o 35' 17.76N
3	KP-3	80o 32'28.55E	16o 35' 27.08N
4	KP-4	80o 32'24.25E	16o 35' 49.62N
5	KP-5	80o 32'21.3E	16o 37' 3.7N
6	KP-6	80o 32' 8.89E	16o 35' 37.56N

Sample collection

The samples are collected in clean glass bottles. After rinsing the bottles thoroughly with the sample water, the samples were collected. While collecting the samples, the glass bottles were filled completely without leaving some space for aeration as per the requirement [2-5]. The required chemicals are purchased with analytical grade from local vender in Vijayawada. The list of Equipments for this study shown in Table.2. Water samples are analyzed followed by standard methods. The type of methods are given in Table.3

Table:2 List of Equipment

S.NO	Instrument	Make and Model number
1	pH Meter	Elico
2	Electrical Conductivity Meter	Elico
3	U.V-Visible Spectrophotometer	Tech comp, 2301,Hitachi software
4	Ion Selective Electrode Meter	Elico
5	Atomic Absorption Spectrometer	LABINDIA-7000
6	Electrical Balance	Denver-A200DS
7	Flame photometer	Electronics India- 1385

Table.3 Drinking water permissible and required parameters & List of methods

Test Parameter(s)	Test Method	Requirement acceptable Limit as per IS:10500: 2012	Permissible Limit in the absence of Alternative source as per IS 10500:2012
pH	4500. H^+B	6.5 to 8.5	No relaxation
Color	2120. B	5	15
Odor	2150. B	Agreeable	Agreeable
Electrical Conductivity	2510-B		
Total Dissolved Solids at 180ºC	2540. C	500	2000
Turbidity	2130. B	1	5
Total Hardness as $CaCO_3$	2340. C	200	600
Calcium as Ca	3500. Ca.B	75	200
Magnesium as Mg	3500. Mg.B	30	100

Total Alkalinity as $CaCO_3$	2320. B	200	600
Chlorides as Cl^-	4500. Cl^-.B	250	1000
Sulphates as SO_4	4500. SO_4^{2-}.E	200	400
Chemical Oxygen Demand	5220. B	-	-
Biochemical Oxygen Demand	IS: 3025	-	-
Dissolved Oxygen	4500. O.C		
Fluoride as F^-	4500. F^-.C	1	1.5
Nitrates as NO_3^-	4500. NO_3^-.B	45	No relaxation
Sodium as Na	3500-Na.B		
Potassium as K	3500-K.B		
Cadmium as Cd	APHA 3111B/3030E	0.003	No relaxation
Mercury as Hg	APHA 3111B/3030E	0.001	No relaxation
Arsenic as As	APHA 3111D/3030E	0.07	No relaxation
Lead as pb	APHA 3111B/3030E	0.01	No relaxation
Total Chromium as Cr	APHA 3111B/3030E	0.05	No relaxation
Iron as Fe	APHA 3111B/3030E	0.3	No relaxation
Manganese as Mn	APHA 3111B/3030E	0.1	0.3
Copper as Cu	APHA 3111B/3030E	0.05	1.5

RESULTS

The physicochemical qualities of the ground water samples of kondapalli are investigated, and the level of metal ions estimated. The obtained results are compared with IS 10500:2012 drinking water standards. The IS 10500:2012 drinking water standards [6] are given in Table: 3. The concentration of the most significant pollutants in the various locations of Kondapalli in three seasons are shown in Table.4, Table.5, Table.6 respectively.

Table: 4 Physico and chemical parameters of Kondapalli nearby VTPS-Vijayawada in Monsoon-2013

Test Parameter(s)	Unit	RESULTS					
		KP-1	KP-2	KP-3	KP-4	KP-5	KP-6
pH	--	7.3	7.4	7.6	7.6	7.5	7.2
Color	Pt.Co	<5	<4	<4	<5	<5	<5
Odor	TON	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed
Electrical Conductivity	µmos/cm	1850	2400	2350	2220	2400	2010
Total Dissolved Solids at 180ºC	mg/L	1450	1650	1200	1450	1550	1390
Turbidity	NTU	1.45	3.02	3.05	3.85	2.40	2.85
Total Hardness as CaCO3	mg/L	510	440	430	425	380	360
Calcium as Ca	mg/L	110	95	85	90	85	95
95Magnesium as Mg	mg/L	60	50	40	55	35	45
Total Alkalinity as CaCO3	mg/L	350	330	350	360	375	410
Chlorides as Cl-	mg/L	590	450	475	480	540	530
Sulphates as SO4	mg/L	340	310	280	375	370	360
Chemical Oxygen Demand	mg/L	<5	<6.3	<5	9.8	<5	<5
Biochemical Oxygen Demand	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Dissolved Oxygen	mg/L	4.1	4.2	4.0	4.1	4.0	4.0
Fluoride as F-	mg/L	BDL	BDL	0.4	0.8	2.6	1.8
Nitrates as NO3-	mg/L	66.8	74.1	55.6	50.2	55.3	59.6
Sodium as Na	mg/L	75	85	90	95	80	85
Potassium as K	mg/L	5	5	6	4	5	6
Cadmium as Cd	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury as Hg	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic as As	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead as pb	Mg/L	1.0	0.5	0.4	0.4	0.6	0.2
Total Chromium as Cr	mg/L	BDL	BDL	0.05	BDL	0.08	0.06
Iron as Fe	mg/L	0.44	0.40	0.35	0.45	0.40	0.42
Manganese as Mn	mg/L	BDL	0.05	0.04	BDL	BDL	BDL
Copper as Cu	mg/L	BDL	0.04	0.02	0.10	BDL	BDL

Table: 5 Physico and chemical parameters of Ibrahimpatnam nearby VTPS-Vijayawada in Winter-2014

Test Parameter(s)	Unit	RESULTS					
		KP-1	KP-2	KP-3	KP-4	KP-5	KP-6
pH	--	7.1	7.2	7.4	7.9	8.3	7.5
Color	Pt.Co	<5	<4	<4	<5	<5	<5
Odor	TON	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed
Electrical Conductivity	µmos/cm	1927	2641	2582	2399	2593	2235
Total Dissolved Solids at 180ºC	mg/L	1501	1732	1319	1464	1602	1460
Turbidity	NTU	1.49	3.15	3.21	4.14	2.61	3.16
Total Hardness as CaCO3	mg/L	532	468	455	461	403	408
Calcium as Ca	mg/L	123	106	129	104	99	107
Magnesium as Mg	mg/L	68	55	49	63	40	52
Total Alkalinity as CaCO3	mg/L	379	352	377	381	394	431
Chlorides as Cl-	mg/L	615	479	492	504	558	561
Sulphates as SO4	mg/L	362	337	306	389	393	397
Chemical Oxygen Demand	mg/L	<5	<6.3	<5	9.8	<5	<5
Biochemical Oxygen Demand	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Dissolved Oxygen	mg/L	4.0	4.1	4.2	4.3	4.2	4.1
Fluoride as F-	mg/L	1.38	1.49	1.41	1.39	1.48	1.43
Nitrates as NO3-	mg/L	46	44	47	47	50	52
Sodium as Na	mg/L	81	92	107	112	86	91
Potassium as K	mg/L	6	7	7	6	7	5
Cadmium as Cd	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury as Hg	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic as As	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead as pb	Mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium as Cr	mg/L	BDL	BDL	0.05	BDL	BDL	0.05
Iron as Fe	mg/L	0.48	0.44	0.39	0.51	0.45	0.48
Manganese as Mn	mg/L	BDL	0.11	BDL	BDL	0.12	BDL
Copper as Cu	mg/L	BDL	0.05	BDL	0.15	BDL	BDL

Table: 6 Physico and chemical parameters of Ibrahimpatnam nearby VTPS-Vijayawada in Summer-2014

Test Parameter(s)	Unit	RESULTS					
		KP-1	KP-2	KP-3	KP-4	KP-5	KP-6
pH	--	7.5	7.4	7.6	8.1	8.4	7.8
Color	Pt.Co	<6	<4	<5	<4	<5	<5
Odor	TON	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed	No Odor is observed
Electrical Conductivity	µmos/cm	2156	2753	2690	2500	2793	2450
Total Dissolved Solids at 180ºC	mg/L	1637	1864	1516	1571	1689	1501
Turbidity	NTU	2.59	3.87	3.98	4.60	3.12	3.76
Total Hardness as CaCO3	mg/L	565	490	477	481	428	446
Calcium as Ca	mg/L	141	123	149	128	102	174
Magnesium as Mg	mg/L	81	67	59	80	68	75
Total Alkalinity as CaCO3	mg/L	411	398	403	425	436	467
Chlorides as Cl-	mg/L	724	578	552	595	649	613
Sulphates as SO4	mg/L	371	358	338	395	387	398
Chemical Oxygen Demand	mg/L	<5	<5	<5	9.8	<5	<5
Biochemical Oxygen Demand	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Dissolved Oxygen	mg/L	4.9	5.2	4.9	5.3	4.8	5.4
Fluoride as F-	mg/L	1.41	1.53	1.48	1.49	1.50	1.50
Nitrates as NO3-	mg/L	68	52	62	55	59	60
Sodium as Na	mg/L	98	101	118	129	97	107
Potassium as K	mg/L	7.4	7.9	8.2	6.7	8.5	6.8
Cadmium as Cd	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Mercury as Hg	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic as As	mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Lead as pb	Mg/L	BDL	BDL	BDL	BDL	BDL	BDL
Total Chromium as Cr	mg/L	0.06	0.06	BDL	0.05	BDL	BDL
Iron as Fe	mg/L	0.68	0.58	0.65	0.61	0.57	0.59
Manganese as Mn	mg/L	BDL	BDL	0.14	0.19	0.22	BDL
Copper as Cu	mg/L	BDL	BDL	0.08	0.09	BDL	1.2

DISCUSSION

There is a significant change in the pH value during the observation periods, the observed values are in the range 7.2(KP6) to 7.6(KP5) in Monsoon-2013, 7.1(KP1) to 8.3(KP5) in winter-2014, 7.4(KP2) to 8.4(KP5) in summer-2014. In the period of summer has high pH: It may be due to high temperature in summer [7]. EC values are in the range of 1850(KP1) – 2400(KP2, KP4) micromhos/cm in monsoon, 1927(KP1) – 2641(KP2) micromhos/cm and in summer 2156(KP1) – 2793(KP5) micromhos/cm. High EC values were observed for all the samples indicating the presence of high amount of dissolved inorganic substances in ionized formand also Higher electrical conductivity affected the germination of crops and it results in reduced yield [8]. The TDS is found up to 1650mg/l – KP2 in monsoon season, 1732mg/l – KP2 in winter-2014 and 1864mg/l – KP2 in summer-2014. There is a considerable change in Hardness; the observed values are 360(KP6) – 510(KP1) mg/ml in monsoon-2013, 403(KP5) - 532(KP1) mg/ml in winter-2014, 428(KP5) - 565(KP1) mg/ml in summer. There is little change in the samples in summer-2014 because of temperature. There is no turbidity in all places in all seasons. Concentration of nutrients like nitrate, phosphate, is within the permissible limits. The fluoride content of groundwater generally ranges from 0.2 to 1.5 mg L^{-1} [9, 10]. Fluoride is observed in all places in different seasons. KP-5 and KP-2 showed higher value for Fluoride i.e. 2.6, 1.49 and 1.53 mg/l in monsoon, winter and summer seasons respectively. The present study areas are located at Krishna River in 0.5-1.0 km. The COD, BOD, DO levels are within the limits. Most of the samples contained Pb, Cr remaining metals like Hg, As are absent in all seasons.

CONCLUSION

There is no much deviation from IS: 10500: 2012 drinking water standards except Fluoride, Pb, Cr. But these three parameters have impact on human health in long period. Indirectly the VTPS effluents are entering in to ground water in the form of toxic metals. The public have been using mineral water for drinking purpose for the past 4 to 5 years. But very poor people are in a critical position in few slum areas. The government and village development authorities, Public health centers should aware of the problem of pollution in the ground water consumed by poor people.

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