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Research Article

DETERMINATION OF PHYSICO-CHEMICAL PARAMETERS AND CORRELATION COEFFICIENT OF GROUND WATER SAMPLES IN AND AROUND BANDA CITY

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ABSTRACT

Ground water samples were collected from different locations of Banda City. The parameters examined were Temperature, pH, DO, BOD, COD, TH, Alkalinity Chloride, Nitrate, and Sulphate at nine sampling locations of Banda city it was observed that all the parameters are within the range of permissible limit except BOD and TH. The results were compared with standard prescribed by WHO (1984). All the parameters are correlated with one another and the statistical analysis of the data is presented.

INTRODUCTION

The District is located in the Chitrakoot Dham Division of utter Pradesh with its head quarter at Banda and lies latitude24^0 53' 25^0 55N and longitude 80^0 07' and 81^0 34E.It is bounded in the north by the District of Fatehhpur in the East by the District of Chitrakoot in the West by the District of Hamirpur and Mahoba in the south by Satna, Panna and Chhatarpur the District of adjoining Madhya Pradesh. The study is at Banda City in India. The hydro geological Condition is also responsible for causing significant variation in ground water quality. Water is essential to all forms of life and make up 50-97% of the weight of all Plants and animal and about 70% of human body. The safe portable water is absolutely essential for healthy living. Ground water is ultimate and most essential suitable fresh water resources for human consumption in both urban as well as rural areas. The importance of ground water for existence of human society cannot be over emphasized. There are several state s in India where more than 90% populations are depended on ground water for drinking and other purpose (Ramach, *et al* 2004). There are various ways as ground water is contaminated such as use of fertilizer in forming, municipal sewage disposal to nearby water bodies and seepage or disposal of effluents from Industries in general and textile industries, in particular.

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Most of the industries discharge their effluent without proper treatment in to nearby open pits or pass then through unlined channels, resulting in the contamination of ground water (Rao, *et al.,* 2004). The problem of drinking water contamination, water conservation and water quality management has assumed a very complex shape (Bodhaditya *et al.,* 2008). Attention on water contamination and its management has become a need of the hour because of it's for reaching impact on human health (Sinha *et al.,* 1995). For the present study, Ten sampling station viz, Awas Vikas Colony, District Hospital, Kotwali Chauraha, Maheswri Devi Chauraha, Kalukuwan Chauraha, Bus Stop Chauraha, Balkhandi Naka, Sabjimandi Chauraha and Jal nigam Colony were selected. In this paper, the ground water quality data for Banda District, Utter Pradesh, India. The concentration of significant parameters viz, Temperature, pH, TDS, EC, DO, BOD, COD, TH, Alkalinity, Chloride, Nitrate and Sulphate were compared with BIS: 10500:2004-05 standards for drinking water (http://ddws.nic.in/).

MATERIALS AND METHODS

Only high pure (AR) chemical and double distilled water were used for preparing solutions for analysis. Ground water Samples from different hand pumps of ten sampling stations were analyzed during month April to may-2014.Samples were collected in good quality polythene bottles of 1 lit Capacity.

Sampling was carried out without adding any preservative in rinsed bottles directly for avoiding any contamination and brought to the laboratory. The Temperature, pH, TDS, EC, and DO were measured at the time of sample collection using Portable kits and other chemicals methods (APHA AWWA, 2005).In the present study, the basic statistical analysis like mean, SD, Coefficient Variation, Correlation Coefficient and t-test of the chemical parameter was done by using SPSS Software. The ground water sampling stations are shown in Table 1.

Table 1. Sampling locations of Study Area

S.No.	Name of location	Sampling Source no.	Sampling Source
1	Awas Vikas Colony	S_1	Hand Pump
2	District Hospital	S_2	Hand Pump
3	Kotwali Chauraha	S_3	Hand Pump
4	Maheshwari Devi Chauraha	S_4	Hand Pump
5	Kalu Kuwan Chauraha	S_5	Hand Pump
6	Bus Stop Chauraha	S_6	Hand Pump
7	Balkhandi Naka	S_7	Hand Pump
8	Sabji Mandi Chauraha	S_8	Hand Pump
9	Jal Nigam Colony	S_9	Hand Pump
10	Padmakar Chauraha	S_{10}	Hand Pump

RESULTS DISCUSSION

Physico-chemical Characteristics of ground water samples of Banda City have been carried out for Temperature, pH, DO, BOD, COD, Total hardness, Alkalinity, Chloride, Nitrate and Sulphate. Analyzed all the results and the mean values of ten parameters of groundwater analyzed in ten stations together with their SD and CV are presented in Table-2, the correlation coefficient(r) among various water quality parameters are given in Table 3.

greater deviation together all the each parameters. Temperature varied from 30.0^0C to 35.2^0C which is highest in Awas Vikas Colony. Arya *et al.* 2011 studied the assessment of underground water quality: A case Study of Jhansi city, Utter Pradesh, India, reported temperature values varied between 12.0^0C to 32.0^0C. The pH values varied from 6.8to 8.4 mg/l, the maximum pH observed in hand pumps of Sabji Mandi Chahura. Shrivastava *et al.* 2014 studied ground water quality assessment of Birsinghpur Area, Satna District, Madhya Pradesh and pH concentration was found ranged from 6.8 to 7.8. DO Values varied from 4.0 to5.2mg/l, the highest value 5.2 (S_6) at Bus Stop Chauraha and lowest value 4.0 (S_7) Balkhandi Naka. Das *et al.*2013 Studied Physico-chemical characteristics selected ground water samples of Ballarpur city of Chandrapur District, Maharashtra, India and Observed the Dissolve Oxygen values were found ranged from 6.4 to 9.3 mg/l. BOD ranged 1.9 to 14.5 mg/l. value of BOD at (S_1) sampling station Awas Vikas Colony 14.5 and sampling station (S_2) District hospital (10.6) mg/l are higher than the permissible limit prescribed by BIS (1992). Sharma *et al.* 2013 studied the monitoring of water quality of Yamuna River at Mathura, U.P. Biochemical oxygen demand was found ranged between 6.8 to 24.5 mg/l.

The COD values ranged between 2.0 to 6.0 mg/l.COD values of all the sampling station s are below the permissible limit prescribed by WHO as 10 mg/l. Watkar *et al.* 2014 studied the impact of idol immersion water quality of Kolar River in saoner, District Nagpur, India and reported the chemical oxygen demand found to be 54.12 to 59.14mg/l. The results of study revealed that TH of the samples varied from 110 to300 mg/l. Alkalinity from 100 to 178 mg/l. nitrate 4.5to 37 mg/l and Sulphate 1.0 to 145 mg/l. Concentration of Total hardness, Alkalinity, Nitrate, and Sulphate were found within the permissible limit prescribed by WHO as 600 mg/l, 250 mg/l, 45.0 mg/l and 250 mg/l respectively. Tripathi *et al.* 2014 studied assessment of ground water quality in Umaria District, Vindhya Pradesh, India, reported the sulphate content ranged between 5.0 to 398 mg/l. The CV values of Temperature (6.76), pH (6.25), DO (8.52), COD (35.04), TH (27.28), Alkalinity (16.42), Chloride (46.52) and Sulphate (47.03) are lower 50%, there for variation of these parameters are not significant

Table 2. Physico-chemical characteristics of Ground water quality in Banda city

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Sample name	Awas vikas colony	District hospital	Kotwali chauraha	Maheshwari devi chauraha	Kalu kuwan chauraha	Bus stop chauraha	Balkhandi naka	Sabji mandi chauraha	Jal nigam colony	Padmakar chauraha
Temp.	35.2	30	34	30	31	35	35	33	32	30
pH	7.1	7.6	8.0	6.8	8.1	7.8	7.5	8.4	7.9	8.0
D.O.	4.3	5.0	4.6	4.9	4.3	5.2	4.0	5.1	4.8	5.0
B.O.D.	14.5	10.6	2.2	2.8	1.9	1.6	2.1	1.3	1.6	1.9
C.O.D.	5.3	3.8	2.8	2.8	6.0	4.0	2.0	3.2	2.7	3.0
Total hardness	300	280	310	110	150	290	260	300	300	240
Alkalinity	126.3	178.1	128.3	153.2	140.0	118.0	130.0	120.0	120.0	100.0
Chloride	49	177	69	85	92	120	56	125	37	129
Nitrate	21	5.0	24	12.0	4.8	4.5	17.0	37	15.1	12.5
Sulphate	01	136	62	86	75	74	88	102	130	145

All the values are expressed in mg/lt. expect pH

In the case of Temperature, pH, D.O, BOD, COD, TH, Alkalinity, Chloride, nitrate and Sulphate the mean value were recorded as 32.52,7.72,4.72,4.05,3.56,254.0,131.39,93.90,15.29 and89.90 mg/l respectively. The stander deviation value of temperature (2.20), pH, DO (0.40), BOD (4.59), COD (1.25), Alkalinity (21.58) and nitrate (10.19) of each parameter between very little deviations, but in the case of total hardness (69.31), Chloride (43.69) and Sulphate (42.28) S.D. value have between sampling station while coefficient value of BOD (113.36) and nitrate (66.61) showed BOD and nitrate indicated their significant variation from one station to another. The correlation coefficient (r) among various water quality parameters are given in Table 2.The temperature of ground water during study period showed positive relationship with BOD, COD and Total hardness and negative relationship with pH, Alkalinity, Chloride and Sulphate.

Table 3. Correlation cofficients (r and t) among various Physico-chemical Parameters of ground water samples collected from Banda City

	Temp.	pH	DO	BOD	COD	Total Hardness	Alkalinity	Chloride	Nitrate	Sulphate
Temp.	1									
pH	-1.011	1								
	-0.003									
DO	-1.322	0.692	1							
	-0.375	0.238								
BOD	0.3014	-1.667	-0.568	1						
	0.106	-0.508	-0.197							
COD	0.005	0.067	-0.565	1.421	1					
	0.002	0.024	-0.169	0.449						
Total	2.024*	1.158	0.3302	0.649	-1.209	1				
Hardness	0.582	0.379	0.116	0.224	-0.183					
Alkalinity	-1.172	-1.312	-0.1302	1.308	0.252	-0.958	1			
	-0.377	-0.421	-0.046	0.420	0.152	-0.321				
Chloride	-1.543	0.764	2.355**	0.995	0.298	-0.082	1.015	1		
	-0.479	0.261	0.640	0.069	0.105	-0.029	0.338			
Nitrate	1.105	0.789	-0.113	-0.184	-1.057	1.327	-1.094	-0.758	1	
	0.364	0.269	-0.040	-0.065	-0.313	0.425	-0.361	-0.259		
Sulphate	-2.559**	1.161	1.619	-1.335	-1.364	-0.138	0.127	1.619	-5.862**	1
	-0.671	0.380	0.497	-0.427	-0.484	-0.049	0.045	0.497	-0.203	

*=1% Significent level
**=5% Significent level

Table 4. Standard for drinking water quality

S.NO.	Parameters	BIS		WHO	
		Max. Desirable	Max. Permissible	Max. Desirable	Max. Permissible
1	Temprature	-	-	-	
2	pH	6.5	8.5	7.0	8.5
6.5	DO	-	-	4	6
4	BOD	2.0	-	6-0	-
5	COD	-	-	10	-
6	Total Hardness	300	-	300	600
7	Alkalinity	200	-	200	600
8	Chloride	250	100	200	600
9	Nitrate	10	10	100	45
10	Sulphate	150	400	200	400

The pH of the ground water showed significant positive relationship between DO, COD, Total hardness, chloride, nitrate and Sulphate and negative relationship with Temperature, BOD and Alkalinity.

DO showed significant positive relationship between pH, Total hardness, chloride and sulphate and negative relationship with temperature, BOD, COD, alkalinity and nitrate.

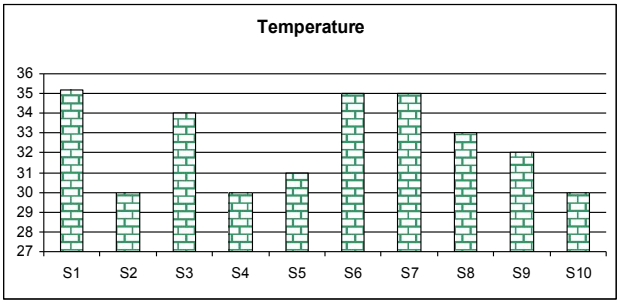

Fig. 1. Graphical representation of temperature

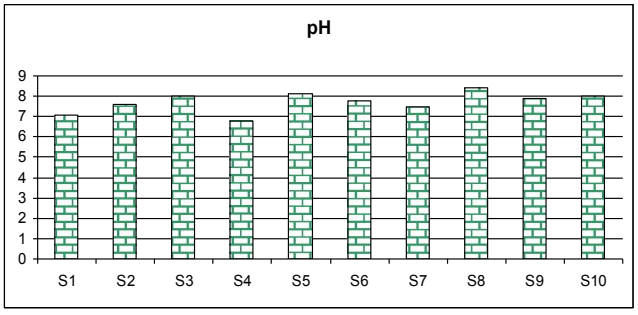

Fig. 2. Graphical representation of pH

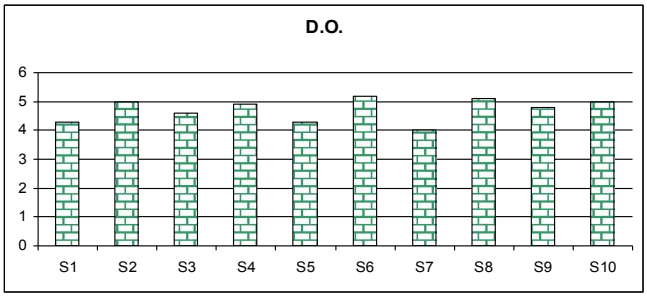

Fig. 3. Graphical representation of DO

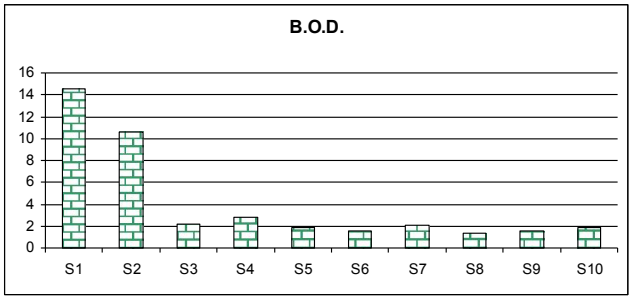

Fig. 4. Graphical representation of B.O.D

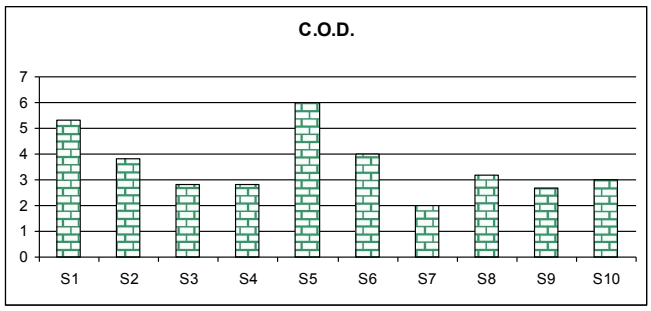

Fig. 5. Graphical representation of C.O.D

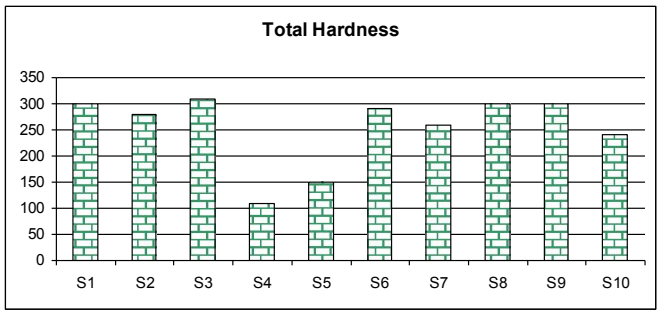

Fig. 6. Graphical representation of Total Hardness

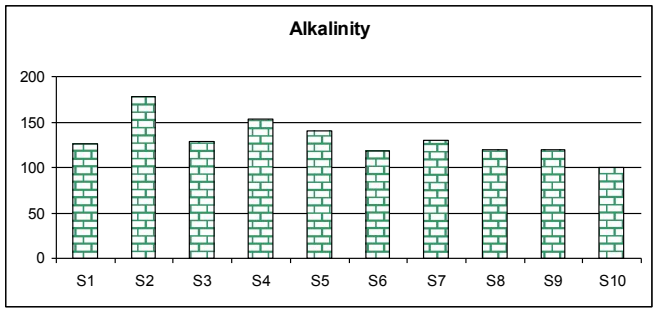

Fig. 7. Graphical representation of Alkalinity

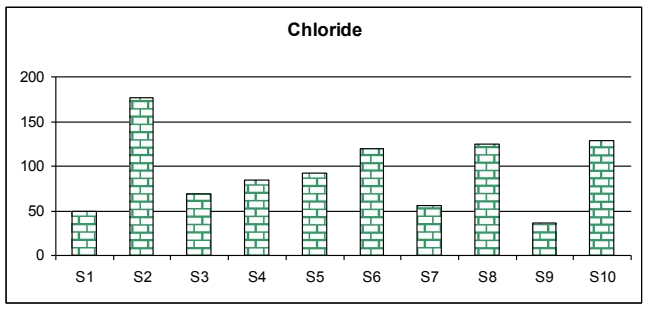

Fig. 8. Graphical representation of Chloride

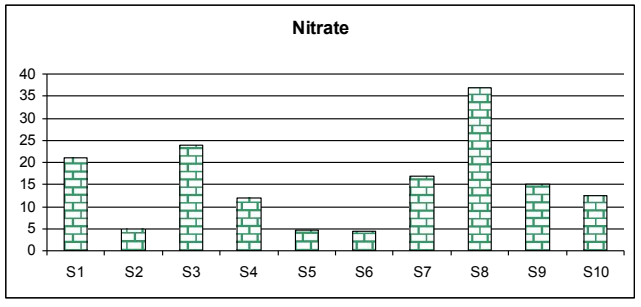

Fig. 9. Graphical representation of Nitrate

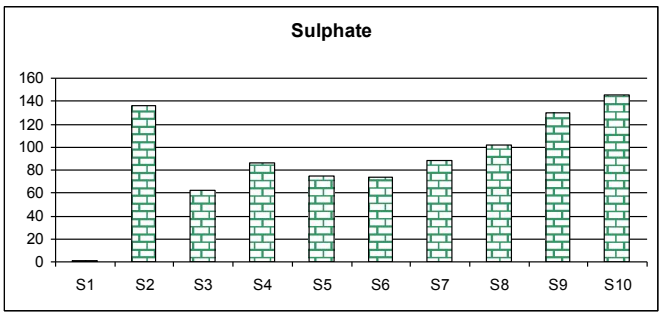

Fig. 10. Graphical representation of Sulphate

Biochemical oxygen demand (BOD) showed positive relationship with temperature, total hardness, chloride and sulphate and negative relationship with pH, DO, nitrate and sulphate. Chemical oxygen demand (COD) showed significant positive relationship with temperature, pH, BOD, alkalinity and chloride and negative relationship with DO, total hardness, nitrate and sulphate. Total hardness showed positive relationship with temperature, pH, DO, BOD, and nitrate and negative relationship with COD, Alkalinity, Chloride and sulphate.

Alkalinity showed negative relationship with temperature, pH, DO, total hardness and nitrate and positive relationship with BOD, COD, Chloride and sulphate. Chloride showed significant positive relationship with pH, DO, BOD, COD, alkalinity and sulphate and negative relationship with temperature, total hardness and nitrate. Nitrate showed positive relationship with temperature, pH, and total hardness and negative relationship with DO, BOD, COD, alkalinity, chloride, and sulphate. Sulphate showed significant positive relationship with pH, DO, alkalinity, chloride and sulphate and negative relationship with temperature, BOD, COD, total hardness and nitrate.

The present study deals with the various relationship derived statistically by calculation r and t among the physico-chemical characteristics. The r value was negative 22 times and positive 33 times this showed that positive relationship in the present study. During study period we have investigated the different physico-chemical characteristics of ground water of Banda city and established the correlation by using ANOVA statistical software. The table value of 5% significant level 2.23 and at 1% significant level 1.81. In the case of sulphate and temperature and sulphate and nitrate shows negative relationship i.e. -2.559 and -5.862 respectively with each other at 5 % significant levels while chloride and DO shows positive relationship i.e. 2.355 respectively with each other at 5% significant levels. For total hardness and temperature i.e. 2.024, respectively with each other at 1% significant level. It showed that sulphate, temperature, nitrate, chloride, DO, and total hardness play major role in the physico-chemical characteristics of Banda City during study periods.

Conclusion

The present study was under taken with an aim to analyzed certain physic-chemical characteristics in the ground water samples of Banda city. Nine different locations of Banda city and analyzed samples were collected in month of April-2014. Temperature, pH, DO, COD, TH, alkalinity, chloride, nitrate and sulphate are below the permissible limit prescribed by WHO in ground water samples.

The BOD value at sampling location S_1 (Awas Vikas Colony) 14.5mg/l and S_2 (District Hospital) 10.6 mg/l were higher than the permissible limit prescribed by WHO (1994) as 6.0 mg/l. It Is Concluded that the ground water of these areas are not highly contaminated.

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