PHYSICOCHEMICAL INVESTIGATION AND QUALITY ASSESSMENT OF GROUNDWATER (HAND-PUMP) OF BAGHPAT DISTRICT, UTTAR PRADESH, INDIA

Randhir Singh[1], Ashok Kumar Gupta[4], D R Khanna[3], Udit Mohan[1], Suhas[1], Prem Singh[2], Rakesh Bhutiani[3], and Varun Tyagi[3],

1: Department of Chemistry, Gurukula Kangri Vishwavidyalaya, Haridwar, Uttarakhand

2: Project Directorate for Farming Systems Research, Modipuram, Meerut, Uttar Pradesh

3: Department of Zoology and Environment Sciences, Gurukula Kangri Vishwavidyalaya, Haridwar, Uttarakhand

4: Department of Zoology, Govt. P.G. College, Khrgone, M.P.

Corresponding author: hegpgckhr@mp.gov.in aadiudit@gmail.com,

Abstract

Life on this planet without water is not possible. Water is extremely essential for survival of all living organisms. Thus for contamination studies the groundwater samples were collected from 30 different locations from hand pumps situated in Baghpat district and analysed for physicochemical parameters like pH, electrical conductivity, Acidity, dissolved oxygen, C.O.D., B.O.D., total alkalinity, hardness, chloride, sulphate, total dissolved solids, sodium and potassium during January 2013 to March 2013. All the parameters were compared with the standard desirable limit of that parameter in ground water as prescribed by BIS. The average values of physicochemical and biological parameters were studies. The pH 7.54, Electrical conductivity 1620 mmhos/cm, TH 734.17 mg/l, acidity 79.91 mg/l, total alkalinity 364.25 mg/l, TDS 1045.08 mg/l, chloride 223.93 mg/l, sulphate 273.34 mg/l, COD 46.75 mg/l, DO 1.05 mg/l and BOD 1.99 mg/l were determined respectively.

Keywords:

Groundwater, Physicochemical parameters, District Baghpat, WHO

Introduction

Water is extremely essential for survival of all living organisms. Bore well pumps are widely used in every country in the world for a many activities.

Mostly hand pumps have plungers or reciprocating pistons, and are positive displacement (Jameel A and Sirajudeen J, 2006). Groundwater is generally considered to be much cleaner than surface water. However, there are some

reasons like discharge of industrial waste along with, agricultural and domestic wastes. The contamination persists for more long time because of very slow movement (Jayalakshmi, Belagali S L, 2006). Abdul Jameel and Sirajudeen (2006) evaluated the sources of physicochemical parameters and their present level in groundwater in the Pettavaithalai area in Tamil Nadu and reported groundwater contamination due to high human, industrial and agricultural activities. In recent years an easier and simpler approach based on statistical correlation, has been developed using mathematical relationship for comparison of physicochemical parameters (Shihab A. S.; 1993, Iyer C. S. *et al*; 2003,Mayur Shah *et al;* 2007, MitaliSarkar*et al*; 2006). Water pollution are mainly due to contamination by foreign matter such we know that microorganism, industrial wastes or municipal waste which deteriorate the quality of the groundwater and make it unfit for its potability(Udit *et al* 2013). Groundwater monitoring of bore well hands pump is highly needed for evaluating the water quality. Taking into account these aspects the pollutional load the present study of groundwater monitoring was under taken for physicochemical characteristics of some groundwater samples from different area located in Baghpat district.

EXPERIMENTAL SECTION

Study area

The Baghpat district is located on the banks of river Yamuna at 28^0 57' N Latitude and 77^0 13' E Longitude. Baghpat district is big district so it is divided into three tehsils Baghpat, Baraut and Khekra. Baghpat tehsil constitute two blocks Baghpat and Pilana. Baraut tehsil too comprises three blocks Binauli, Chhaprauli, Baraut. Bagpat, Baraut and Khekada are the main towns in this district. The present study was planned by selecting these towns located in Baghpat district. The literature survey showed that no studies were made on groundwater by hand pumps. Hence the present study was undertaken

Collection of water samples

The samples of groundwater from hand-pump were collected in plastic canes of 2.5liters capacity as per standard procedure. The samples were collected from all the stations at 7.00 am to 12.00 noon for physicochemical investigations.

Water samples from 30 sampling points situated at different zones were collected and analysed during a post-monsoon period of three months (*January 2013 to March 2013*). The collected samples were stored in an icebox and brought to laboratory for determining both physical chemical and biological parameters. The samples were kept in refrigerator maintained at 4^0 C before the analysis. AR grade chemicals were used for this study. Double distilled water was used for the preparation of all the reagents and solutions.

Glassware‘s were cleaned with Thomas Baker Thromaklin liquid soap followed by distilled water and dries in the oven before the analysis.

Analysis of water samples

The pH and Electrical Conductivity were measured by using Systronic digital pH meter (model 335) with an accuracy of ± 0.01 and Systronic digital Conductivity meter (model 304) with an accuracy of ± 0.01. TDS was determined by using Century TDS meter. Total Hardness was measured by EDTA titration method. Total Alkalinity was measured by titration method. Chloride was determined by silver nitrate titrimetric method using potassium

chromate as indicator and was calculated in terms of mg/L. Sulphate was measured by Gravimetric method using Barium chloride as precipitating agent. DO was measured by Winkler's titration method. COD was measured by closed reflux method and BOD is measured by the 5 days incubation method. The physicochemical analysis was carried out according to standard methods.

Results and Discussion

The limit of pH value for drinking water is specified as 6.5 to 8.5. pH value below 4 produces bitter taste and a higher value above 8.5 give basic taste. In the present study, the pH values of water samples fluctuates between 7.10 – 7.85 (Table 2) and samples were found in the limit prescribed by BIS. Electrical conductivity indicates the concentration of ions present in water as soluble salt. EC values were observed in the range of 953.33 to 1559.62 µS/cm. EC value in the studied area varied between 992-2492 µS/cm. 47% sampling points exhibited higher conductivity than the prescribed limit by WHO and BIS. Total Alkalinity is a total measure of substance in water that has —acid-neutralizing‖ capacity. Total Alkalinity value in the studied domestic area varied between 180 – 556 mg/L. 30 sampling points showed higher alkalinity values than the prescribed limit by WHO. High concentrations of total dissolved solids may cause adverse taste effects. TDS values varied from 394 to 2560 mg/L. In the present study of water samples, DO value varied from 0.90 to 1.45. All the sampling points showed low DO values indicating borderline contamination by organic matter according to WHO. High amount of DO imparts good taste to water. COD in the studied area varied between 27.13 to 129.02mg/L. Water with high COD indicates that there is inadequate oxygen available in the water samples. BOD value in the studied area varied between 1.18 to 5.61mg/L. All sampling points showed BOD values within the prescribed limit by WHO. Ground water with huge amount of BOD is due to microbial activities related to the dumpsites and industries. The total hardness is relatively high in all samples due to the presence of calcium, magnesium,

chloride and sulphate ions or it may enter from direct pollution by industrial effluents. In the present study, total hardness varied from 25 to 925 mg/L. High amount of hardness in drinking water leads to heart diseases and kidney stone formation. 12 sampling points showed higher hardness values than the prescribed limit by WHO. Exceeding the acceptable limit of hardness causes poor lathering, decline of the quality of clothes and skin irritation. The most important source of chlorides in the waters is the discharge of domestic sewage. In the present analysis, chloride concentration was found in the range of 106.50 to 532.50mg/L. The values were higher than the permissible limit according to BIS and WHO. Excessive chloride concentration increase rates of corrosion of metals. This can lead to increased concentration of metals in the supply. The higher values of chloride can cause corrosion and pitting of iron pipes. Sulphate occurs naturally in water as a result of leaching from gypsum and other sources. Sulphate content in drinking water exceeding the 400 mg/L impart bitter taste and may cause gastro-intestine problems. Sulphate value in the studied area varied between 74.76 to 630.70 mg/L. 13 sampling points showed higher sulphate values than the prescribed limit by WHO. Ingestion of water with high sulphates leads to laxative effect and gastro-intestinal irritation. According to the Vinod K. Singh *et al* 2013 high values of chloride, alkalinity, bicarbonates, sodium and potassium were found in most of the groundwater samples in district Ghaziabad, U.P., India

Conclusion

Over exploitation of resources and improper waste disposal practices affected the drinking water quality. According to WHO, nearly 80% of all the diseases in human beings are caused by water? In the current study, the groundwater samples collected from hand-pumps showed deviations from water quality standards indicating groundwater contamination. The ground water from the Baghpat block zone showed large concentration EC, TDS, TA, TH than the prescribed limits given by water quality standards indicating poor water quality and water from this sites is unfit for drinking purpose and on other hand pump

water samples from other zones showed most of the parameters within the limits of water quality standards showing good water quality and the water from these sampling points is fit for drinking purpose and house-hold use. Hence, drinking water in the studied area requires precautionary measures before drinking so as to protect human beings from adverse health effects.

Correlation Studies: Interrelationship studies between different water quality parameters are very helpful in understanding geochemistry of the studied area. The regression equations for the parameters having significant correlation coefficients are useful to estimate the concentration of other constituents. Correlation coefficient values samples are presented in table 3. Alkalinity shows significant correlation with calcium indicating that the alkaline nature of ground water is mainly due to calcium salts. Calcium shows good correlation with chlorides indicating that calcium is associated with chlorides in water of the studied area. Conductivity shows significant correlation with calcium, chlorides and DO which reveals that conductance of water samples is mainly due to calcium and chlorides in the ground water of the studied area. Interrelationship studies between totally different water quality parameters are terribly useful in understanding chemistry of the studied space.

The regression equations for the parameters having vital correlation coefficients are helpful to estimate the concentration of different constituents.

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Table 1: Correlation coefficient

	pH	EC	Alkalinity	Acidity	TDS	DO	COD	BOD	So4	Na	K	Cl	Hardness
pH	1.0000												
EC	-0.2187	1.0000											
Alkalinity	-0.4507	0.3874	1.0000										
Acidity	-0.3830	0.3420	0.4692	1.0000									
TDS	-0.2506	0.8243	0.6186	0.6070	1.0000								
DO	-0.3799	-0.1710	-0.2965	0.2762	-0.1977	1.0000							
COD	-0.0083	0.4354	0.2939	0.6237	0.6517	-0.1619	1.0000						
BOD	-0.0650	0.4669	0.3444	0.6852	0.6932	-0.1426	0.9930	1.0000					
SO4	-0.2711	0.5489	0.2912	-0.0289	0.2568	-0.0224	-0.1498	-0.1268	1.0000				
Na	-0.6865	0.3537	0.9128	0.4064	0.5903	-0.0902	0.1391	0.1980	0.3407	1.0000			
K	-0.4129	0.1198	0.3350	0.5532	0.1889	0.6091	-0.0732	-0.0137	0.2183	0.3460	1.0000		
Cl	-0.6141	0.5776	0.3131	0.0722	0.2009	0.1181	-0.1023	-0.0786	0.7387	0.3460	0.2309	1.0000	
Hardness	0.4268	-0.2542	-0.4376	-0.5132	-0.3498	-0.0833	0.0644	-0.0530	-0.1744	-0.4825	-0.4803	-0.1622	1.0000

Table 2: Physico- chemical analysis of water samples

Parameters	Min	Max	Mean	Median	Stddev	Std Error	95 % Conf	99 % Conf
pH	7.10	7.85	7.54	7.64	0.216	0.062	0.137	0.194
EC	1622.25	750	3620	1296	968.86	279.69	615.60	868.73
Alkalinity	180.00	556.00	364.25	352.00	119.531	34.506	75.948	107.177
Acidity	4.00	164.00	79.91	66.00	47.475	13.705	30.165	42.569
TDS	394.00	2560.00	1045.08	1042.50	559.235	161.437	355.329	501.437
DO	0.90	1.45	1.05	1.02	0.154	0.044	0.098	0.138
COD	27.13	129.02	46.75	32.76	30.848	8.905	19.601	27.660
BOD	1.18	5.61	1.99	1.42	1.336	0.386	0.849	1.198
SO_4	74.76	630.70	273.34	224.13	152.067	43.898	96.621	136.351
Na	41.00	147.00	97.33	88.50	33.786	9.753	21.467	30.294
K	3.00	15.00	8.00	8.00	3.219	0.929	2.046	2.887
Cl	106.50	532.50	223.93	168.62	123.278	35.587	78.329	110.537
Hardness	25.00	925.00	125.62	52.50	252.528	72.899	160.452	226.429