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A Case Study of Parameters of Physicochemical Analysis of Under Ground Drinking Water of Safidon (Rural Areas), Jind, Haryana, India.

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ABSTRACT

Water is an indispensable natural resource for assisting life and environment. The last few decades water quality has been deteriorated due to over and exhaustive exploitation. Water quality is important parameter to be analyzed when all focus is on subsequent developedment of mankind.It is the substance which influences economic, agriculture and industrial growth of mankind. The present study was conducted to determine various parameter of underground water of rural areas of (Safidon block), Haryana ,Jind, India and to examine its purity for drinking purposes. Chemical parameters are pH,TDS,fluoride, chloride, sulphate, nitrate, phosphate, Potassium, Sodium, Iron, salinity, alkalinity and hardness were analyzed of the samples. All results work compared with drinking water quality standard recommended by the Bureau of Indian standard (BIS) and World Health Organisation (WHO). Most of the water sample were assessed to have total dissolved solids, salinity alkalinity, and and hardness value are more than their prescribed limits. The high value of this parameters might have health hazards & so they required attention. Observed value of the above studies are helpful to know the groundwater quality and their successive fitness or unfitness drinking water for domestic purpose at various sampling areas undertaken. It is found that the water quality of water supply system in different area of Safidon block is of medium and low quality and can be used for domestic purposes after suitable recommendations for treatment of water have been provide to enhance the quality of water.

I. INTRODUCTION

Water is the most valuable gift of nature. Truely status by the imminent Greek philosopher Pindar that "Water is the best of all things." The importance of water led the United Nations General Assembly to designate 22 March of each year as the world day for water by adopting a resolution in 1992 -United Nations Conference on Environmental Development (UNCED) in Rio de Janeiro.

The availability of sufficient water in term of both quality and quantity is essential for human existence. Historically civilization developed around the water body that were utilised to support agriculture and transport as well as for human consumption. After the development of biological,chemical and medicinal sciences method to measure water quality and to determine its effect on human health were identified (Peavy et al, 1987). Water is the mother of all living beings. All living organism need to maintain their life processes. All living organism contain 70% to 95% of water in their body .About 70% of human body is made up of water. Plant tissue also contain large amount of water. Water is the most abundant wonderful and essential natural resource present on the earth. Water is anomalous in its behaviour due to its remarkable unusual and unique physical and chemical properties due to intermolecular hydrogen bonding. Water prevent large fluctuation in surface temperature of earth because of its high specific heat (1 cal./g /cm). It is an excellent universal solvent ,which can dissolved most substances and act as an effective medium for transport in geo chemical cycle also. Most common source of water supply is surface water or the groundwater. The rain water is the surface water which percolate in the underground. " Ground water" is the major source of drinking water in the world. Total volume of water on Earth is estimated as 1.36 billion Km^3, with 97.5% being saline and 2.5% being the fresh water. Mostly fresh water is located in polar ice caps. Only small fraction of available to supply multitude of human uses. Of the fresh water only 0.3% is in liquid form in the form of surface (Howard Perlman, 2016, Eakins and Surman,2010; Rodda and Shiklomanov,2003). Total volume of water in river is estimated at 2120 km^3, or 2% of the surface fresh water on Earth(Howard Perlman 2016). The health implication of poor water quality is expensive. It is observed that around 37.7 million Indian affected by

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water borne disease annually, 1.5 million children are found to die of diarrhoea alone and 73 million working day are lost due to water borne disease each year. The resulting economic load is estimated $600 million per year. The implications of chemical contamination are also prevalent in India. Approximately 195813 habitations in country are affected by the poor quality of water.The major responsible chemical parameter are fluoride and arsenic(Ernst,1991). Iron is also major threat in many habitations showing excess iron in the water samples. The high content of nitrate in ground water is also concerned with the health problem.The main aim of present study is to analyse the various parameters of drinking water of Safidon block.

II. Review of literature

Tatawati and Chandel (2008) have studied the groundwater quality of Jaipur city, Rajasthan. An extensive study of modelling of Buckingham canal water quality is available in literature (Abbasi et al. 2002) was conducted on the water quality assessment of Purana rever in Buldhana district Maharashtra .(Jha and Tignath 2009) have studied the assessmet and impact of surface water on environment in and around Jabalpur city, Madhya Pradesh. The study on groundwater yields valuable knowledge regarding their possible effect on physico-chemical properties of the soil and its productivity (Sharma and Minhas ,2004). The physico- chemical property of drinking water in town area of Golda district, Bihar reported by (Jha and Verma ,2000). Studies by Singh ,(1975)Singh and Sekhon ,(1976) Singh et al. (1987) concluded that agro chemicals pollute the groundwater. Water pollution is a serious problem, as almost 70% of India's surface water resource and a growing number of its groundwater reserves have been contaminated by biological organic and inorganic pollutants (Rai and Mamta, 2004). (Patnaik et al.2002) reported water pollution in Industrial area. Some studies are available on assessment of fluoride level & entrance of metal in drinking water from various source in and around Jaipur and in many villages, (Jha and Verma, 2000 ;Patnayak 2002; Sharma et al.1990).(Sharma et al. 2004)have studied the industrial wastewater and groundwater, and pollution problem in groundwater. Review on the literature showed that no wide studies have been undertaken in the study area in regard to Physico-chemical characteristic of water yet. The main objective of this study is to investigate the quality of underground drinking water in (Safidon block), Haryana,

Study area and sampling

Twenty water sample were collected in June - July 2024. The sample were collected in pre treated and labelled plastic bottles (1.5 L) and were immediate preserved and analyzed following standard protocols given in APHA (APHA 1992 . Each bottle was washed with 2% nitric acid and rinsed three time with distilled water.The sample sites are numbered as station (S-1 to S-20). The different sampling location are given in Table 1.

Table 1. Sampling site source code and depth of water samples

Sr. No.	Sample Site	Source	Code	Depth
1	Aftabgarth	Submersible	S-1	69
2	Anchar kalan	submersible	S-2	425
3	Anchar khurd	Submersible	S-3	140
4	Anta	Handpump	S-4	46
5	Bagru kalan	Submersible	S-5	89
6	Bahadarpur	Submersible	S -6	127
7	Bahadurgarh	Handpump	S-7	151
8	Barod	Submersible	S-8	37
9	Basini	Handpump	S-9	92
10	Bhuslana	Handpump	S-10	53
11	Chapper	Submersible	S-11	36
12	Didwara	Handpump	S-12	357
13	karkhana	Submersible	S-13	57
14	Malar	Handpump	S-14	123
15	Muana	Submersible	S-15	72
16	Nimnabad	Handpump	S-16	57
17	Rodh	Handpump	S-17	26
18	Safidon	Handpump	S-18	55

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19	Singhpura	Handpump	S-19	53
20	Todikheri	Submersible	S-20	151

Analytic methods, BIS, ICMR, & WHO parameters for drinking water

			Prescribed by				
			BIS(IS 10500-91)		ICMR		WHO
S. No.	Parameter	Method employed	Desirable limit	Max. permissible limit	Desirable limit	Max. permissible limits	WHO
1	Ph	Digital pH meter	6.5-8.5	No relaxation	7.0-8.5	6.5-9.2	6.5-8.5
2	TDS(mg/L)	Digital TDS Meter	500	2000	500	1500-3000	1000
3	TH(mg/L)	Titrimetric (EDTA)	300	600	300	600	500
4	Ca^{+2}(mg/L)	Titrimetric (EDTA)	75	200	75	200	200
5	Mg^{+2}(mg/L)	Titrimetric (EDTA)	30	100	50	-	50
6	Cl^{-}(mg/L)	Titrimetric ($AgNO_3$)	250	1000	200	1000	200
7	Turbidity(mg/L)	Nephelometry	1	5	1	5	5
8	So_4^{-2}(mg/L)	Spectrometric Method	200	400	200	400	400
9	No^{3-}(mg/L)	Spectrometric Method	45	100	20	100	10
10	Po_4^{-3}(mg/L)	Spectrometric Method	-	-	-	-	-
11	Na/K(mg/L)	Flame photometer	-	-	-	-	-
12	Fe^{+3}(mg/L)	Spectrometric Method	0.3	1.0	0.1	1.0	1.0
13	F^{-}(mg/L)	APHA-Method	1.0	1.5	1	1.5	1.5
14	As(mg/L)	APHA-Method	0.0	0.05	0.0	0.05	0.05

Experimental Data

Code	Temp. ‘c	pH	EC ds	TDS mg/L	TH mg/L	Ca^{+} mg/L	Mg^{2+} mg/L	TA Hco^{3-} mg/L	Cl- mg/L	F- mg/L	Na+ mg/L	K^{+} mg/L	So_4^{2-} mg/L	Po_4^{2-} mg/L	No_{3-} Hco3- mg/L
U-1	27.5	7.82	2.628	615	312	25	82	118 380	111	1.9	818	17	67	3	28 0.24
U-2	26.4	7.79	1.857	322	620	72	53	121 490	233	3.4	520	25	83	5	24 0.37
U-3	28.7	8.46	2.677	277	360	93	64	235 595	375	1.1	560	31	34	6	59 0.46
U-4	28.4	7.38	0.551	565	860	48	45	240 520	315	2.1	301	29	95	7	51 0.54
U-5	29.5	8.85	2.394	2435	565	55	86	250 3425	520	1.3	312	19	23	2	75 0.65
U-6	27.7	7.97	1.272	448	485	118	47	164 390	455	1.6	176	22	76	8	35 0.77
U-7	28.4	7.39	1.953	2238	678	397	186	477 205	703	1.5	456	50	356	4	31 0.50
U-8	29.3	8.24	1.435	3382	385	85	39	272 425	207	4.8	210	60	289	4	39 0.28
U-9	27.9	7.39	2.683	4643	610	815	61	388 265	175	0.7	346	78	263	5	14 1.29
U-10	28.8	7.22	1.471	658	340	58	42	390 465	320	0.9	563	37	174	5	42 0.33
U-11	27.7	8.62	1.830	2365	500	124	63	613 120	340	1.9	516	86	55	7	76 0.60
U-12	28.5	7.74	1.390	1754	790	68	240	225 330	5390	2.9	814	59	190	6	63 0.78
U-13	29.7	8.93	1.924	3775	225	99	53	137 480	280	1.6	332	36	286	6	21 1.40
U-14	28.6	7.27	2.279	535	375	44	45	343	170	1.6	926	79	184	3	21

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								280							0.39
U-15	28.4	8.45	1.656	612	675	78	96	253	300	2.3	258	54	196	4	52
								140							0.46
U-16	28.3	7.53	0.361	734	220	82	47	468	495	2.5	254	31	75	7	62
								310							0.02
U-17	28.3	7.77	1.927	549	492	35	89	272	871	2.6	198	28	97	2	43
								214							0.76
U-18	27.4	7.95	1.488	260	510	88	61	689	543	2.4	420	71	247	4	65
								125							0.86
U-19	28.7	7.43	2.499	477	750	63	42	295	465	1.3	560	42	364	6	49
								336							0.32
U-20	26.9	7.62	2.722	624	850	48	93	110	325	2.2	601	38	98	7	31
								440							0.82

III. METHODS AND MATERIALS

Twenty water sample were collected the villages from various sites such as temples , schools and other places. Submersible,wells and handpumps are the source site of collected water samples. The samples were analyzed for various physicochemical parameters and some heavy metals. The procedure for the analysis for drinking water was found to be studied standard method (APHA/AWWA/WEF(APHA 2005). Portable water analyzer kit (WTW Multi 340 /SET) was used to measure the three quality parameters on the sites and these were pH ,water temperature (WT) and electrical conductance. All the AR grade reagents were used for analysis and double distilled water use for the preparation of solutions. Atomic absorption spectrophotometer (model 3100) Perkin Elemer USA was used for determination of heavy metals. Hydrogen and concentration pH total results solid and conductivity were measured using (pH), TDS and conductivity bridge metre respectively. Total alkalinity calculated titlimetrically using hydrochloric acid and total hardness were analyzed by titrimetrically using standard Disodium ethylene diamine Tetra acetate salt(Na2EDTA). Chloride was estimated using standard silver nitrate (AgNO3) solution and sulphate was analysed with the help of spectrophotometer.The standard formulae were used in calculation for statistical parameters are (BIS ,2012). Detail of the methods are in Table 2.

IV. RESULT AND DISCUSSION

The value of all water quality parameter inverter sample are illustrated in table 3 all the results are compared with standard permissible limit recommended by the Bureau of Indian Standard (BIS) Indian Council of medical Research (ICMR) and World Health Organisation (WHO) depicted in Table 4.

pH

The pH is used to calculate the acidity or alkalinity of water and the concentration of hydronium ion in water. PH value of all ground water sample is calculated in the range of 7.51 to 8.78. The high value of pH,8.78 is observed at the station S1 (Aftab garh) higher than the (WHO,BIS 2012) permissible limit (6.6-8.50). There is no abnormal change in groundwater samples except (S-1). long term exposure to high pH value affect the mucus membrane of cells.

Electrical conductance

Electrical conductivity is the method of capacity of substance to conduct the electric current where dissolved in are the conductor most of the salt inverter present in their ionic form and capable of conducting electric current. Conductivity is a good indicator to evaluate ground water quality. EC is an useful parameter of water quality for indicating salinity health problems. In the present study case electrical conductance varies 0.435 to 2.56 dS. Electrical conductivity is the capacity of water to conduct an electrical current and the dissolved ions are the conductors. Major positively charged ions are Sodium (Na^+),calcium (Ca^{2+}), Potassium (K^+) and Magnesium (Mg^{2+}). Major negatively charged ions are chloride (Cl'), sulphate (SO4"), carbonate (CO3") and bicarbonates(HCO3'). Nitrate (NO3',) and phophate (PO4"') have minor contribution to the electrical conductivity. Salinity is a measure of amount of salt in The solubility of ions increase the salinity as well as conductivity and both are related. The salinity is an ecological factor, which affects organism that live in water bodies and the growth of plant that will grow either in the water bodies or in the land fed by the groundwater (BIS, 2012; Rani et al. 2003).

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Total dissolved solid (TDS)

In the present study the groundwater samples showed variation between 296 to 1550 mg/L. The maximum permissible value of total dissolved solid is 1000 milligram per litre scribed by whole domestic use. The maximum value of 1550 mg /L is observed at station(S- 17) and minimum value of 206 mg/ L measured at station (S-7). An elevated value of TDS itself has no health hazard. The concentration of dissolved in water may cause the water to be corrosive salty, brackish taste, result in scale formation (BIS, 2012).

Totel hardness (TH)

Total hardness of analyzed water samples were found in the range of 90 to 700 mg/ L. The prescribed value of TH according to the WHO describe value range; (300 to 600 mg/ L).Most of present study samples were within the prescribed limit except S-5,S-13& S-20, which exceeded the limit for drinking water. In the present study Calcium values of water was found in the range of 19 to 120 mg /L. Similarly Magnesium content varied from 11 to 97 mg/ L in the present study samples. Calcium and Magnesium both are essential minerals for living organisms. WHO recommendation for calcium have been made for the maximum and minimum level of 75 - 200 ppm and Magnesium ~50 mg/ L in the drinking water. Except water sample number S -1 and S -11 all other samples were found high value of Magnesium .

Total alkalinity (TA)

The total alkalinity of the present study water samples represented variation from 120 to 650 mg/ L. Water of the sampling site S - 3 ,S -7,S -9, S -11,S -18,S -19 showed normal value and within the guideline as described by the WHO aur total alkalinity 200 mg/ L ,except all others which represented high value of alkalinity. Very high value of alkalinity in water of sampling sites S -5 , S -13 & S -17 is due to high bicarbonate (460,650,&540 ppm respectively)and the contents of sulphate in reported samples.

Chloride and Fluoride

The content of chloride in the present sample study was found in the range 50 to 420 mg/ L. The high concentration of chloride than 200 mg/L is considered too risky for human consumption and cause unpleasant taste of water (Sharma et t al 2004). In the present study water samples were showed higher values than the permissible range 0.6 – 1.5 mg/ L. The observed range of chloride level in the study area was found 0.5 mg to 10 mg/ L. Higher level of fluoride in sample sites (S -1,S 8 ,S-10, S-13, S- 14 S-17,S -19,& S -20) might be due to the presence of fluoride bearing mineral in the sampling areas. Some cases of dental and skeletal Fluorosis were observed in the study area of villages Aftab gadh, Bahadurgarh, kharkra, Malar, Rodh, Singhpura and Todi khedi.

Nitrate

In the present study nitrate and concentration was found in the range of 2mg/L to 65 mg per litre. Nitrate value are generally represented as either nitrate or nitrate (NO3') nitrogen (NO3-N). The maximum contaminated level (MCL) in drinking water as nitrate (NO3') is 45 mg/ L where as the MCL as (NO3-N) is 10 mg/L. The MCL is the highest level of (NO3' or NO3-N) that is available in public drinking water supplies by the US Environmental Protection Agency (EPA). Methemoglobinemia or Blue baby syndrome in especially in infants less than 6 months is caused by the high nitrate values in water. The stomach acid of an infant is not as strong as in older children and adults. This causes and increase in bacteria that can readily convert nitrate to nitrite. Very high value of nitrate in the water samples of S-14 &S -15 is due to high value Potassium Nitrate.

Iron (Fe3+)

Iron content in the present study was found within the guideline value as prescribed by the NDWQS and WHO. The study explain that all sampling sites found the metal content in the normal range 0.0 to 0.5 mg/L. Iron is one of the most abundant elements in nature ranking 4th by weight. All kind of water including groundwater have sufficient quantity of iron. Although the metal has got little concern health problem but is still considered as the nuisance in exceeding quantities for domestic as well as industrial uses.

Sodium /Potassium ions

Sodium concentration in drinking water sample was found in the range from 29 to 344 mg/L. All the sample except S-4, S -5, S- 8, S -9. S-12, S-13 S-14,S-15 & S-20 given by (WHO and BIS 200 mg/L). The potassium value varied between 4-55 mg/ L. The prescribed value of WHO is 15 mg/L. It has been found that in healthy individual high level potassium (up to 3700 mg/ day) possess no problem but Potassium is rapidly excreted. A very high dose of Potassium results in chest tightness, nausea, vomiting, diarrhea, hyperkalaemia, shortness of breath and heart failure.

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Sulphate

Natural water contains sulphate ions and most of these in are also soluble in water many sulphate ions are produced by oxidation of their ores they are also present in industrial wastes. The quantity of sulphate inverter samples was measured by UV spectrophotometer. As per IS :10500- 2012, the desirable limit of sulphate is 200 mg/L and the permissible limits is 400 mg/L. In the present study samples have sulphate ion concentration 40-287 mg/L, within the desirable and permissible limit.

Phosphate

Phosphorus is an important plant nutrient and mostly control plant growth. The phosphate content was found in present study samples in the range of 0.2 mg/L to 2.0 mg/L. Normally ground water contain only a minimum phosphorus level because of the low solubility of native phosphorus mineral and the ability of soil to keep phosphate.

Turbidity

The suspended particles in water interfering with the passage of light is called the turbidity. Turbidity is produced by wide variety of suspended particles in water. Turbidity can be calculated either by its effect on transmission of light which is called as tribidity or by its effect on scattering of light which is named as nephlometery .As per IS: 10500 -2012, the the acceptable and permissible limit are 1 and 5 NTU respectively.

V. Conclusion

The present study samples ANALYSIS is an attempt to access the drinking water quality.Most of the the sample analysed were found to be contaminated either due to one or more parameters. Only the iron value of all samples were in the permissible range.Certain parameter in all samples crossed the WHO and BIS standard values.

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