International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Status of Subsurface Water Quality of Different Sampling Stations with Respect to Some Physico-Chemical Parameters at Betul City, (M.P.)

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Abstract: ***In the present study an attempt has been made to find the subsurface water quality with a view to water utilization for drinking and domestic use. In this paper, the various physico-chemical parameters as Colour, Odour, Taste, Temperature, Electrical Conductivity (EC), Total Dissolve Solids (TDS), pH, Free co_2, Total Hardness (TH), Chlorides, Dissolve Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were examined. Almost all these parameters satisfy the guidelines of drinking water at maximum places except a few, especially with respect to hardness.***

Keywords: Subsurface Water**,** Ground Water, Physico-Chemical Parameters, Atmospheric Contaminations, Adverse Health effect.

1. Introduction

Fresh water is the most precious material for life on earth. This natural resource is available with surface and subsurface sources. The quality of subsurface water depends upon the quality and quantity of salts that prevail in the soil. The industrial and domestic wastes not only affect the water bodies of the area, but also exert an impact on physico-chemistry of ground water, therefore continuous monitoring of water quality is necessary (Will&Yeh,1987). While the underground water is usually free from pathogens, the long process of natural filtration dissolves some salts and cause health problems to consumers. It has been found that approximately within 30 feet, except soluble metal compounds, almost all bacteria are filtered out (Black,1977).

It is estimated that around 3% of fresh water available on the earth is in the rivers and lakes and the rest 97% is underground (Bollenbach,1983). Rapid industrialization, utilization and consequent increase in population make it imperative to tap ground water resources to meet the increasing water requirements. Improper drainage system, septic tanks and solid waste disposal resulted in contamination of ground water.

The aim of the present study is to analyze the physico-chemical characteristics of subsurface water at Betel City (M.P.), which is, situated nearly about 199 kms. In east of capital city, Bhopal (M.P.) at latitude 21.55^0E and longitude 77.54^0N. In the city region with 18 places including open wells, tube wells and hand pumps were kept under investigation.

2. Material & Methods

The study area was divided into three zones for convenience of collection, transportation and examination of samples. The sampling stations were selected on the basis of water lifting for drinking and domestic uses. Sampling stations are presented in table1. The samples were collected in winter season (Nov.-2018) and between 10.00 a.m. to 06.00 p.m. The collections of samples will be followed as internationally accepted APHA and BIS proposed standard methods. Water samples were collected in one-liter plastic cans. Before sampling, the plastic cans were cleaned thoroughly to remove all surface contamination, rinsed double with distilled water and dried. The collected samples were properly transferred to the laboratory, to avoid atmospheric contamination and to reduce any evaporation loss during storage. The methods for analysis were followed as standard method prescribed in APHA, AWWA, BIS and WPCF.

3. Results & Discussions

The results of the study are given in table 3.

Table 1: List of areas (sampling stations) covered in the study

S.No.	Zone A	Zone B	Zone C
1	Vivekanand ward	Kidwai ward	Kosami industrial area
2	Lohiya ward	Arya Pura	Bhagatsingh ward
3	Rajendra ward	Krishna pura	Azad ward
4	Jawahar ward	Durga-chouk	Subhash Ward
5	Ganesh ward	Desbandu ward	Link-road
6	Civil line	Moti ward	Dist. hospital

Table 2: Information on the type of water sources (sampling stations)

S. No.	Details of sources	No. of types of water sources		
		Open wells	Tube wells	Hand pumps
1	Sampling Source	2	13	3
2	Uses : (i) Drinking	2	13	3
	(ii) Domestic	2	13	3
3	Lifting device: (i) Manual	2	-	3
	(ii) Pump	-	13	-
4	Depth (feet)	40 – 70	80 – 310	60 - 180

Colour : In natural waters, colour may occur due to the presence of humic acids, fulvic acids, metallic ions, suspended matter, phytoplankton, weeds and industrial effluents. In the present study, all the water samples were found to be colorless.

Odour: The odour may be of natural origin, caused by living and decaying aquatic organisms and accumulation of gases like ammonia and hydrogen sulphide etc. Odours of any artificial origin are due to the discharge of industrial wastes, which include many chemicals imparting taste and odour. In the present study, all the water samples were found to be odourless.

Taste: The taste in the water is present mainly due to dissolve impurities often organic in nature. Many algae also impart taste to water. In the present study, all the water samples have pleasant taste.

Table 3: Details of the concentration of various parameters in the study area

S.No.	Parameters	Unit	WHO* Standard values		Zone	Min. and Max. values of vanous kinds of sampling stations					
						Open wells		Tube wells		Hand pumps	
			Min. Permissible limit	Min. permissible limit		Min.	Max.	Min.	Max.	Min.	Max.
1	Colour	-	N.A.	N.A	A	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.
					B	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.
					C	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.
2	Odour	-	N.A.	N.A	A	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.
					B	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.
					C	O.L.	O.L.	O.L.	O.L.	O.L.	O.L.
3	Taste	-	N.A.	N.A	A	pleasant	pleasant	pleasant	pleasant	pleasant	pleasant
					B	pleasant	pleasant	pleasant	pleasant	pleasant	pleasant
					C	pleasant	pleasant	pleasant	pleasant	pleasant	pleasant
4	Temperature	^{o}C	N.A.	N.A	A	12.1	13.1	19.6	19.8	19.4	19.6
					B	12.2	12.3	19.4	19.6	19.0	19.3
					C	12.1	12.4	19.5	19.7	19.3	19.4
5	EC	µ Mhos/cm	N.A.	N.A	A	484	490	452	466	468	474
					B	481	486	448	464	460	465
					C	482	486	453	456	462	466
6	TDS	mg/L	500	3000	A	590	604	532	548	548	556
					B	584	596	542	560	552	562
					C	586	598	548	562	560	568
7	pH	-	7.0-8.5	6.5-9.2	A	8.12	8.24	7.48	7.52	7.54	7.58
					B	8.10	8.18	7.40	7.44	7.46	7.48
					C	7.58	8.10	7.38	7.42	7.38	7.41
8	Free CO_2	mg/L	N.A.	N.A.	A	2.14	2.16	1.36	1.40	1.44	1.47
					B	2.12	2.14	1.34	1.36	1.43	1.45
					C	2.10	2.13	1.36	1.38	1.45	1.47
9	TH	mg/L	200	600	A	232	584	284	618	292	534
					B	224	462	272	508	286	496
					C	218	556	268	510	274	604
10	Chlorides	mg/L	250	1000	A	261	278	210	221	214	224
					B	254	268	206	214	216	230
					C	248	256	208	218	221	226
11	DO	mg/L	-	-	A	8.70	8.74	4.00	4.80	4.20	4.60
					B	8.72	8.78	3.60	4.00	4.60	5.20
					C	8.74	8.80	3.60	3.80	4.00	5.60
12	BOD	mg/L	-	-	A	212.1	214.3	204.5	206.6	206.8	208.3
					B	214.3	216.4	201.3	203.1	204.4	206.1
					C	216.5	220.3	202.8	203.3	201.4	203.5
13	COD	mg/L	-	-	A	8.42	9.62	7.60	8.42	7.72	7.86
					B	8.70	9.12	7.18	7.34	7.61	7.92
					C	8.84	9.22	7.24	7.50	7.48	7.64

* World Heath Organization (WHO) Standard, N.A– Not Available, C.L -Colourless, O.L. – Odourless.

Temperature: Temperature of water bodies is important because it affects bio-chemical reactions proceed by aquatic organisms. A rise in temperature of water leads to the speeding up of the chemical reactions in water, reduce the solubility of gases, amplifies the taste & odours and elevates metabolic activity of organisms. (Shrivastava & patil et.al.2002). In present study, temperature was found to be in range of 12.1 to 13.1, 19.4 to 19.8 and 19.0 to 19.6 ^{0}C in open wells, tube wells and hand pumps respectively.

Electrical Conductance (EC): Rapid estimation of the dissolved solids content of water can be obtained by specific conductance measurements. Such measurements indicate the capacity of a sample to carry an electrical current. It can allow a rough estimate to be made of dissolved salts of water samples. Specific conductance was found to be in the range of 481 to 490, 448 to 466 and 460 to 474 µ mhos/cm in open wells, tube wells and hand pumps respectively.

Total Dissolved Solids (TDS): Total dissolved solids are an important parameter for drinking water and water to be used

for other purposes. Beyond the prescribed limit it imparts a peculiar taste to water and reduce its palatability. In cases where water softening is needed, the type of softening procedure used may be dictated by TDS content. TDS less than 1000mg/L in water is classed as non saline. TDS was found in the range of 584 to 604, 532 to 562 and 548 to 568 mg/L in open wells, tube wells and hand pumps respectively.

pH: pH is a scale of intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water, The hydrogen ion concentration affects the taste of water. Low concentration of hydrogen ion favors corrosion control, while high concentration helps in the effective chlorination, chemical coagulation, disinfections and water softening. A pH value of 6.5 to 8.5 is recommended for drinking purpose. In the present study pH was found in the range of 7.58 to 8.24, 7.38 to 7.52 and 7.38 to 7.58 in open wells, tube wells and hand pump respectively.

Free CO_2: Carbon dioxide is normal component of all natural waters. Presence of free carbon dioxide will make the water acidic, which may corrode the pipes through which the contaminated water passes damaging the health. Hence, excessive acidity should be neutralized by addition of lime. Free $CO_2$was found in the range of 2.10 to 2.16, 1.34 to 1.40 and 1.43 to 1.47 mg/L in open wells, tube wells and hand pumps respectively.

Total Hardness (TH): Total hardness of water is the sum of concentration of alkaline earth metal cations present in it. The hardness of waters, varies considerably from place to place. In general, surface waters are softer than ground waters. The hardness of water reflects the nature of the geological formations with which it has been in contact. Rainwater, as it falls upon the earth, is incapable of dissolving the tremendous amounts of solids found in many natural waters. During the investigation TH in samples was found in the range of 218 to 584, 268 to 618 and 274 to 604 mg/L in open wells, tube wells and hand pumps respectively.

Chlorides: Chlorides in reasonable concentration are not harmful to humans. At concentrations above 250 mg/L they give a salty taste to water, which is objectionable to many people. Before proceeding for bacteriological tests, chloride test served as the basis of detecting contamination of ground waters by wastewaters. Evaporation tends to increase the chloride and salinity at the root zone of irrigated plants, making it difficult for crops to take up water due to osmotic pressure difference between the water outside the plants and within the plant cells. In present study, the amount of chlorides was found to be in the range of 248 to 278, 206 to 221 and 214 to 230 mg/L in open wells, tube wells and hand pumps respectively.

Dissolve Oxygen (DO): Dissolve oxygen (DO) is one of the most important parameters in water quality assessment and reflects the physical and biological process prevailing in the water. Oxygen can be rapidly removed from the water by discharge of oxygen demanding wastes (Shrivastava &Patil et.al.2002). In present study, DO was found to be in the range of 8.70 to 8.80, 3.60 to 4.80 and 4.0 to 5.60 mg/L in open wells, tube wells and hand pumps respectively.

Biochemical Oxygen Demand (BOD): BOD is used as an index of organic matter present in water. BOD was found in the range of 212.1 to 220.3, 201.3 to 206.6 and 201.4 to 208.3 mg/L in open wells, tube wells and hand pumps respectively.

Chemical Oxygen Demand (COD): The estimation of COD is of great importance for waters having unfavorable conditions for the growth of microorganisms, such as presence of toxic chemicals. The maximum permissible limit of COD is 10 mg/L for drinking water (De, 1985). COD was found in the range of 8.42 to 9.62, 7.18 to 8.42 and 7.48 to 7.92 mg/L in open wells, tube wells and hand pumps respectively.

4. Conclusions and Recommendations

The values of some parameters in the study were found to be high, which may have adverse effect on diverse uses of water. The preventive measures may be adequate drainage system with proper treatment of sewage before disposal, and the removal of faulty septic tanks and cess pools.

5. Acknowledgement

I extend my sincere thanks to the Principal and the Head, Department of chemistry, J.H. Govt. P.G. College, Betel (M.P.) for providing necessary facilities for the present investigation.

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