IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

ANALYSIS OF GROUNDWATER SAMPLES OF INDORE REGION TO ESTIMATE INORGANIC AND ORGANIC PARTICULATES

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Abstract

Ground water is the most important and vital source which is renewable and it is distributed widely. Ground water is the main source of water supply. The ground water should be very clean and free from any contamination. Groundwater is contaminated from various sources naturally and by human activities also. Municipal, farming, residential, commercial, industrial, activities can all affect ground water quality. Ground water can be used impeccably and persistently only when the quantity and quality is properly determined. Ground water is the main source of a freshwater in the rock and soil layers beneath earth's land surface. Some of the precipitation (rain, snow, sleet, and hail) that falls on the land soaks into earth 's surface and becomes groundwater. The major part of the Indore district has water levels in the range of 2-5m below ground level. some part of the sanwer and depalpur blocks have wats illarange of 5-10 mbgl. The city has no natural lake but there are many lakes and tanks created artificially by building dams on rivers. Yashwant Sagar, Pipliyapala, Sirpur, Bilawali, Berchhia, and Sakhniwas lakes are the main water bodies of Indore among which Yashwant sagar is the largest to supply water to the city.These lakes and tanks provide water to the adjoining areas and their water is widely used for irrigation purposes as well. But how this groundwater becomes polluted by some organic matter and it causes diseases and other hazardous effects if consumed directly. Groundwater pollution is simply called groundwater contamination and it occurs when pollutants are released to the ground and make their way down in the groundwater. This research paper is to determine organic matter in groundwater of Indore region.

Keywords- Contamination, Particulates, Groundwater, Municipal, Quality Parameter.

Introduction

Groundwater in the district is generally medium to high saline as electric conductivity values vary between 586 to 3780 per cm. Nitrate in the groundwater of Indore district is varying between 0.5 to 296mg/l. Geographically, indore is located in the malwa plateau with vindhyas ranges fringing its southern end. At an elevation of 553 metres above sea level. The city experiences a typical continental climate Major portion of indore district is covered by a broad plateau and it slopes towards north from vindhyachal having chambal and its three parallel tributaries viz khan, Gambhir and shipra draining the whole region. The largest city of Madhya pradesh shares its border with Pithampura and betwa in west, Ujjain and sanwer in North. Khandwa, Mhow, choral, and, manpur in south dewas in northeast and simrol in southeast direction. There are majorly five ways of groundwater contamination.

1)Surface contamination, 2)Subsurface contamination, 3) Landfills and waste disposal , 4)Atmospheric contamination, 5)Salt water contamination

Due to all these parameters Groundwater becomes polluted and the content of organic compounds is increasing and due to this if groundwater is consumed directly then it resulted in hazardous effect on health of human being and Animal.

Methods and Materials

Samples were collected directly in pre-washed and rinsed, polyethylene/glass containers identified for respective parameters. Stipulated procedure was followed for washing of sample containers. Field parameters like Temperature, pH and dissolve oxygen, which are non conservative and could not be preserved, were analyzed immediately after collection was per standard procedure. Samples were analyzed based on the standard procedures of water analysis of bacteriological and physicochemical parameters (Standard Methods, 2005. Ca^{2+}, Mg^{2+}, Na^{+} and K^{+} are the cations and Cl, CO_3^{2-}, HCO_3^{-}, SO_4^{2-} and NO_3^{-} are the anions measured in the groundwater.

Temperature

Temperature is an important parameter. It plays a critical role in life processes like growth, reproduction, migration, succession pattern and metabolism of organisms and communities. It is the important factor for calculating the solubility of oxygen and the carbon-dioxide, bicarbonate and carbonate equilibrium. The temperature of water has an influence on its taste and density, viscosity, solubility of gases and dissolved solids are related. The variations in temperature of a water body have great bearing upon the biological productivity. Distribution of aquatic organisms is greatly influenced by water temperature.

Groundwater samples were collected in sampling bottles and temperature was measure by dipping the thermometer in a sample immediately. Temperature was recorded in Celsius scale nearest to 0.1 degree Celsius. A thermometer having a quick response of $\pm$ 0.1^0C was used to measure temperature of water and water samples.

pH

pH of aqueous solution is negative logarithm of hydrogen ion activity. The basic principle of pH measurement is determination of the activity of the hydrogen ions by potentiometer, using a standard hydrogen electrode and a reference electrode. Its value is governed largely by the carbon dioxide/bicarbonate/carbonate equilibrium. The effect of pH on the chemical and biological properties of water makes its determination very important. It is used in several calculations in analytical work and its adjustment is necessary in most of the analytical procedures.

The pH of water determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen and carbon) and heavy metals (lead, copper, cadmium, etc.). The pH determination is usually done by electrometric (pH meter with combination of pH electrode) method, which is the most accurate method and free of interference. The pH of samples was measured on pH meter pre-standardize with buffers of pH 4.0, 7.0 and 9.2. Values for pH is reported in standard pH units.

Chemical Oxygen Demand

Chemical Oxygen Demand (COD) test determines the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant. The test can be employed for the same purpose as the BOD test taking into account its limitations. The intrinsic limitation of the test lies in its inability to differentiate between the biologically oxidizable and biologically inert material.

Biochemical Oxygen Demand

Biochemical Oxygen Demand (BOD) is the amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic condition. In the present work, Winkler's method with Azide modification was followed for estimatation of BOD. Samples collected from the source were immediately transferred to ice box, transported to laboratory fixed for 5 days' incubation at 20^0C. Blank sample was also fixed with 1 ml each of manganeous sulphates and alkali iodide azide solution per 300 ml DO/BOD bottles along with the sample. BOD titrations were performed after the completion of incubation period using standard methods. The BOD was calculated using DO values.

Hardness

Hardness of water is the measure of the capacity of water to react with soap. Scaling of hot water pipes, boilers and other household appliances is due to hard water. Total hardness of groundwater samples in the present study was

estimated by complexometric titration with EDTA (0.01M) at pH 10.00 using eriochrome black-T indicator and for calcium hardness at pH 12.00 using muroxide indicator.

Calcium

Calcium (Ca^{++}) is the major component of hardness in water and is usually in the range of 5 – 500 mg/l, as $CaCO_3$. Calcium is derived from nearly all rock, but the greatest concentration come from limestone and gypsum. Calcium ions are the principal cations in most natural waters. Calcium reduction is required in treating cooling tower makeup. Complete removal is required in metal finishing, textile operations, and boiler feed applications.

Magnesium

Magnesium (Mg^{++}) hardness is usually approximately 33% of the total hardness of a particular water supply. Magnesium is found in many minerals, including dolomite, magnesite and many types of clay. It is in abundance in sea water where its concentration is five times the amount of calcium. Magnesium carbonate is seldom a major component in scale. However, it must be removed along with calcium where soft water is required for boiler make-up, or for process applications.

Sodium

Sodium (Na^{+}) is a major component in drinking water. All water supplies contain some sodium. The amount is dependent on local soil conditions. The higher the sodium content of water, the more corrosive the water becomes. A major source of sodium in natural waters is from the weathering of feldspars, evaporates and clay. Intake from food is generally the major source of sodium ranging from 1100 to 3300 mg/day. Persons requiring restriction on salt intake, usually have a sodium limitation down to 500 mg/day. The amount of sodium obtained from drinking softened water is significant compared to the sodium ingested in the normal human diet. Sodium in the body regulates the osmotic pressure of the blood plasma to assure the proper blood volume. The maximum permissible limit of sodium in standard drinking water is 20 mg/l.

Potassium

Potassium (K^{+}) is an alkaline metal closely related to sodium. It is selom that one sees it analyzed separately on a water analysis. Potassium is not a major component in public or industrial water supplies. Potassium is however essential in a well balanced diet and can be found in fruits such as bananas.

Phosphate

The presence of phosphate (PO_4^{-}) in large quantities in fresh waters indicates pollution through sewage and industrial wastes. Among the various forms of phosphates, only total phosphate was estimated by digesting the samples with suphuric acid-nitric acid digestion mixture for 90 minutes followed by neutralization of excess acid with NaOH (6N) using phenolphthalein indicator and then measuring the color intensity of blue colored complex formed by ammonium molybdate-stannous chloride method at 690 nm.

Nitrate

Nitrate (NO_3^{-}) is the final oxidation product of nitrogen compounds in water body and is considered to be the only thermodynamically stable oxidation levels of nitrogen in the presence of oxygen in water. An ultraviolet (UV) technique that measures the absorbance of NO_3 at 220 nm and suitable for screening un-contaminated water (low in organic matter) was used for the estimation of nitrate in water samples.

Table 1: Description of sampling points**.**

Sample Code	Location Name	Location	Sample Code	Location Name	Location
SAMPLE-1	Palasia	2.725116 75.887766	SAMPLE -6	Moti tabela	22.706642 75.852655
SAMPLE-2	Bapat	22.754448 75.878733	SAMPLE -7	Khajuri Bazar	22.719017 75.854470
SAMPLE-3	sanwer road	22.763026 75.847731	SAMPLE -8	Usha Phatak	22.723854 75.862579
SAMPLE-4	navlakha	22.698930 75.877483	SAMPLE -9	Dhar Road	22.708749 75.829324
SAMPLE-5	Race Course Road	22.728295 75.878791	SAMPLE -10	Sadar bajar	22725203 75852679

The monitoring of water quality was carried out for one month January 2017 to February 2017 from eighteen groundwater sources in Indore city. The sampling sites were selected within 0.5 to 2 km from the Nallhas, the source of pollution in the city. Analysis was carried out for assessment of 21 parameters including mineral, demand, nutrient, bacteriological and metal analysis. Parameters including pH, temperature, turbidity and electrical conductivity were monitored on site. Sampling, analysis and preservation of water samples were carried out as per Standard Methods for the Examination of Water and Wastewater [8].

The average analysis results for all the eighteen ground water samples is given in Tables 2 and 3.

Table 2 : Average analysis data for ground water samples SAMPLE-1 to SAMPLE-10.

S. No.	**Parameters**	**Unit**	**Sample-1**	**Sample-2**	**Sample 3**	**Sample 4**	**Sample 5**	**Sample 6**	**Sample 7**	**Sample 8**	**Sample 9**	**Sample 10**
1	Temperature	°C	25	25	25	25	25	25	25	25	25	25
2	Color	Pt. Co. Scale	1	1	1	1	1	1	1	1	1	1
3	Odour		Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
4	pH	pH Unit	7.36	8.1	8.05	7.35	8.25	7.35	7.4	7.75	7.35	7.25
5	Turbidity	N.T.U.	1.25	1.65	1.8	1.2	1.55	1.3	0.95	0.65	0.75	3.2
6	Sp. Conductivity	µMhos/cm	1105.3	929.3	1027.15	1831.4	1046.9	1497.9	1046	986.45	1493.15	850.75
7	Total Dissolved Solids	mg/L	647	531	505	1310	528	1054.5	656.5	569.5	1149.5	521.5
8	C.O.D.	mg/L	7	6.5	10.5	14	5.5	11.5	4.5	7	6	4
9	Total Alkalinity	mg/L	350	295	352	375	296	518	404	304	420	420
10	Total Hardness (as $CaCO_3$)	mg/L	449	288	280	708	98	694	368	190	450	322
11	Calcium	mg/L	92	83.6	85.6	156.8	26.4	145.7	89.6	48	128	80.8
12	Magnesium	mg/L	58.8	18.7	15.81	75.84	7.7	79.2	34.55	16.8	31.2	28.8

13	Chloride	mg/L	131.95	106.05	120.705	359.9	150.5	231.6	117	138	241	62.99
14	Sulphate	mg/L	66.9	65.6	51.905	184.15	45.9	80.2	65.5	64.15	229.9	36.15
15	Ammonia	mg/L	0.023	0.01	0.008	0.0025	0.001	0.0045	0.011	BDL	BDL	0.0015
16	Nitrate	mg/L	7.6015	7.3785	3.2105	11.1255	2.9655	10.0595	10.251	4.0715	9.9625	3.5805
17	Fluoride	mg/L	0.7305	0.672	0.837	0.3115	0.4715	1.041	0.504	0.7615	0.7645	0.951

Results and Discussion

Groundwater Quality Color-Color is measured in Platinum Cobalt Scale. The color obtained in all the ground water samples SAMPLE-1 to SAMPLE- 10 is 1 or less than 1**.**

pH *The* pH value ranges between 6.9 and 8.3. whereas higher pH values were observed in samples SAMPLE-2, all the ground water samples showed good. pH- range or values. It is also observed that all the water samples lie in the range of 6.5 – 8.5 prescribed by Indian Standards for Drinking Water.

Turbidity -Turbidity is measured in Nephelometric Turbidity Unit (NTU). The turbidity for nearly all the samples remained less than 1 NTU except for sample SAMPLE-10 , the turbidity lies in the range 2 – 4.5 NTU. The reason for the high values may be due to organic contaminants coming into the well.

Electrical Conductivity- Electrical conductivity (EC) is a useful tool to evaluate the purity of water. Maximum EC is recorded in SAMPLE-4 (1843.4 µ mhos/cm) .

Total Dissolved Solids -The Total Dissolved Solids (TDS) of the water samples ranged from 425 mg/L to 1350 mg/L., whereas SAMPLE-4 showed a value of 1350 mg/l.

Chemical Oxygen Demand- The Chemical Oxygen Demand (COD) values obtained for the water samples are quite low ranging between 3 – 18 mg/l. The low COD values are shown by samples SAMPLE-2, SAMPLE-9, SAMPLE-10.

Alkalinity-The values of alkalinity in the water samples varied from 206 - 580 mg/l. In all the samples alkalinity values have crossed the desirable limit of 200 mg/l.

Hardness-Total Hardness of the analyzed water samples varies from 80 to 744 mg/l. Water samples SAMPLE-4 and SAMPLE-6 exceed the permissible value of 600 mg/l and rest of the water samples show the values above 200 mg/l. The hardness is due the calcium and magnesium salts.

Calcium - *c*alcium ions contribute the greatest portion of the hardness occurring in natural waters. The concentration of calcium varies from 33.6 to 160 mg/l being minimum for SAMPLE-5 and maximum value is obtained in sample SAMPLE-4

The permissible limits prescribed by Indian Standards for Drinking Water is Ca^{++} = 200 mg/l.*Magnesium*- Magnesium ion (Mg^{+2}) concentration varies from 7.7 to 86.4 mg/l being minimum again for sample SAMPLE-5 and the maximum value for sample SAMPLE-4. The permissible limit prescribed by Indian Standards for Drinking Water is Mg^{++} = 100 mg/l.

Chloride-The highest concentration of chlorides was recorded in SAMPLE-4 (365 mg/l) . High chloride content in groundwater can be attributing to lack of underground drainage system and bad maintenance of environment around the sources. Chloride salts in excess of 100 mg/1 give salty taste to water. When combined with calcium and magnesium, may increase the corrosive activity of water. It is recommended that chloride content should not exceed 250 mg/1.*Sulphate* Sulphate concentration is varying from 16.6 to 255.2 mg/l and these values are within permissible limits prescribed by Indian Standards for Drinking Water (400 mg/l).

Nitrate- The minimum and maximum concentration values obtained lies in the range 2.27 to 11.34 mg/l. All these values are less than the desirable limit prescribed by Indian Standards for Drinking Water (45 mg/l). ***Fluoride-*** Fluoride concentration for water samples varies from 0.176 to 1.223 mg/l. The values for fluoride are also less than the desirable limit prescribed by Indian Standards for Drinking Water (1.0 mg/l) except for SAMPLE-6, SAMPLE-10 and *Manganese*-Concentration obtained for manganese lies in the range BDL to 0.041 mg/l. None of the water samples cross the desirable limit (0.1 mg/l) and are far less than the permissible limit (0.3 mg/l) as prescribed by Indian Standards for Drinking Water. *Zinc*- The desirable limit for zinc is 5.0 mg/l as prescribed by Indian Standards for Drinking Water. The concentration for zinc varies from BDL to 0.036 mg/l. The maximum concentration of 0.036 mg/l is obtained for SAMPLE-1.

Conclusion

The analysis data reveals that the quality of groundwater in Indore city has deteriorated to a large extent making it unfit for drinking and irrigation purpose. The chemical composition of groundwater from basaltic aquifer has severely altered due to the percolation of industrial effluents in the past decades and sewage from existing nallahs into the groundwater. Despite the remedial steps, there is no improvement in groundwater quality and pollution is still taking place. The non-usage of the polluted groundwater in the area is not helping in dilution of this water.

References

[1] Wiedemeier, Todd H. et al. Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface. New York: John Wiley & Sons, 1999.

[2] Johnson, Robert et al. "MTBE: To What Extent Will Past Releases Contaminate Community Supply Wells?" Environmental Science & Technology 34 no.9 (2000): 210A. <http://pubs.acs.org/hotartcl/est/2000/research/0666-00may_pankw.pdf>.

[3] Pink, Daniel H. (April 19, 2006). Investing in Tomorrow's Liquid Gold. Yahoo. http://finance.yahoo.com/columnist/article/trenddesk/3748.

[4] Water Systems in Indore – An integrated approach, Indore Municipal Corporation, Indore. 2015.

[5] District Ground Water Information Booklet, 2013, Ministry of Water Resources, Indore District.

[6] Status of Ground Water Quality in India part II, 2008, Ground Water Quality Series 2007-2008.

[7] Comprehensive Environment Pollution Abatement Action Plan for Critically Polluted Area, Indore. Madhya Pradesh Pollution Control Board, Indore, 2012.

[8] APHA (2012), Standard Methods for the Examination of Water and Waste Waters, 22nd Edition, American Public Health Association, Washington, DC.

[9] BIS (2012), Specifications for Drinking Water, IS:10500:2012, Bureau of Indian Standards, New Delhi.

[10] Analysis of Ground Water Quality Parameters: A Review, 2014. Research Journal of Engineering Science, Vol 3 (5), 26-31.

[11] P.K. Goel, Water Pollution Causes, Effect and Control, 2nd Edition, New Age International Pvt. Ltd., 2009.

[12] H.S. Dwivedi, Bhawna Malik and P. Dwivedi, Study of Physico-chemical Parameters – River Khan, International Journal of Research – Granthaalayah. 3(9), 1-3, 2015.
