Assessment of Physico-Chemical Parameters of Well Water of Katol City, Nagpur District, Maharashtra (India)

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Abstract:

This research is aimed at assessing the Physico-Chemical analysis of well water of Katol city with view to determining it suitability for domestic utilization. Samples taken randomly from seven different locations of city. Attempts were made to study and analyze the Physico-Chemical characteristics of the Well water. Various parameters like pH, Total dissolved solids, Dissolved oxygen, Chemical Oxygen Demand, BOD, DO, EC, Nitrate, Chloride, Sodium, Potassium, Sulphate, Fluoride etc. give a picture of quality parameters of well water. Well water are examined to locate the suitable sources of water and to determine the extent of treatment necessary to make it potable.

Keywords: *Well water, Physico-Chemical parameters, Ground water, Katol city.*

Introduction:

Water is said to be safe for drinking when it is free of pathogens, poisonous substances and excessive amount of mineral and organic matter.Water is a key component in determining the quality of our lives. It is well established that a large number of infectious diseases are transmitted primarily through water supplies contaminated with human and animal excreta. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and does not support human use and undergoes a marked shift in its ability to support its constituent biotic communities. Ground water is that water reservoir found in the saturated part of the ground underneath the land surface. It normally accumulate there when the water seeps into the ground and moves downward due to gravity through the pore spaces found between soil and rock are saturated. Groundwater is an important water resource in both the urban and rural areas of India. Ground water in our country is getting polluted because of percolation of different sorts of wastes being disposed on surface or into subsurface.

The polluted water which is source of water supply causes a number of water related infections and diseases to the human being. Surface water sources are normally a major source of recharge to the groundwater system and consequently, a possible source of contamination of groundwater, when these water courses are polluted as it often happens in an urban environment. Water quality parameters can be divided into two major groups namely physical and chemical according to (Brandvold, et al., 1976).Physical and chemical constituents are useful in deciding water use strategies for various purposes. The quality of ground water is the resultant of all the processes and reactions that act on the water from the moment it condensed in the atmosphere to the time it is discharged by well or spring and varies from place to place and with the depth of the water table (A.K. Rana et al., 2002).Ground water constitutes 97% of global fresh water and many regions, ground water sources are the single largest supply for serving drinking water to the community.

Groundwater constitutes an important source of water for drinking, agriculture and industrial production. The use of groundwater has increased significantly in the last decades due to its widespread occurrence and overall good quality. Ground water is believed to be comparatively much hygienic than the surface water. There are several states in India where more than 90% populations are dependent on groundwater for drinking and other purpose (Tank and Singh, 2010).Physicochemical parameters affect

the quality of a water resource. A good knowledge of the qualities of raw water is necessary to guide its suitability for use.

Ground water contains high amount of various ions, salts etc. So if we were using such type of water as potable water then it leads to various water-borne diseases. During last decade, this is observed that the ground water get polluted drastically because of increased human activities. Well water originates as rain and snow that then filters into the ground. As it soaks through soil, the water can dissolve materials that are present on or in the ground, becoming contaminated. Some contaminants are naturally occurring in soil and rock. These include contaminants such as bacteria, radon, arsenic, uranium and other minerals. Other contaminants find their way onto the land from human activities. Industrial and commercial activities, improper waste disposal, road salting and fuel spills can introduce hazardous substance to the ground. However, even typical residential activities, such as the use of fertilizers and pesticides, fueling of lawn equipment and disposal of household chemicals, can contaminate the ground when done improperly. That is why taking measures to protect well from contamination are so important.

Katol is located at 21.27°N 78.58°E.The town now includes the large adjoining village of Peth Budh war, which lies on the Jam, a tributary of the Wardhariver. The old town-site is crowded, lying in a hollow and traversed only by narrow crooked lanes. Katol has tropical wet and dry climate with dry conditions prevailing for most of the year. The present study is taken up only to assess the quality of well water in Katol. Physico-Chemical characteristics of ground water were studied to find out whether it is fit for drinking or some other beneficial uses.

Material and Method:

Seven sampling stations were selected and the samples were received from open wells. Well water samples have been collected on 14 March 2014.Various quality parameters were monitored as follows: pH, TDS, EC, Chlorides, BOD, COD, Sulphates, Nitrates, Fluorides, Calcium, DO, Magnesium etc. All the samples collected in pre-washed (with detergent, doubly de-ionized distilled water, respectively) polythene bottles and tested in laboratory. The organic matter gets oxidized completely by $K_2Cr_2O_7$ in the presence of H_2SO_4 to produce CO_2 + H_2O. The excess of $K_2Cr_2O_7$ remaining after the reaction is titrated with $Fe(NH_4)_2(SO_4)_2$. The dichromate consumed gives the O_2 required for oxidation of the organic matter. Chemical oxygen demand (COD) was determined by dichromate digestion method while biochemical oxygen demand (BOD) was determined by the dilution method. Sulfate ions are precipitated as $BaSO_4$ in acidic media (HCl) with barium chloride. The absorption of light by this suspension is measured by spectrophotometer at 420nm or scattering of light by Nephelometer. Sulphate ion concentration was determined by using Systronic-108 and 166 Spectrophotometer. Chloride is determined in a natural or slightly alkaline solution by titration with standard silver nitrate, using potassium chromate as an indicator. Silver chloride is quantitatively precipitated before red silver chromate is formed.

The determinations of the major ions of the water samples were performed within one week after sample collection. Turbidity, pH and chloride immediately tested after sampling as they will change during storage and transport. The chemicals used were of AR grade. Double distilled water is used for the preparation of solutions and reagents. All equipment like pH, Conductivity meter and Spectrophotometer were checked and calibrated according to the manufacture`s specifications. The analytical method involved were standard procedures, as recommended by WHO and BIS standards.

Result and Discussion:

The result of the Physico-Chemical analysis of water in the present study are shown in Table no.1 and Table no.2 which is necessary to a make a comparison of water given by WHO standards and IS. Guidelines for Drinking Water Quality have been published by IS: 10500-2012. pH was found to be

alkaline in nature in all of the samples. The pH of water shows variation in its ranges. pH value of different samples was within the desirable and suitable range. Too much nitrate in drinking water can cause serious health problems for young infants. Nitrate contamination of a well is often regarded as a first sign of deteriorating groundwater quality. Wells most vulnerable to nitrate contamination include shallow wells, dug wells with casing which is not watertight. Nitrate is produced from chemical and fertilizer factories, matters of animals, decline vegetables, domestic and industrial discharge. The concentration ranges of nitrate were observed below the Indian standard of drinking water permissible limit. Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions or sodium, magnesium, calcium, iron and aluminum cations. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. Sudden increase or decrease in conductivity in a body of water can indicate pollution. The EC of water samples found in the range of 430 to 824 µS/cm.

All type of natural and raw water contains chlorides. Although chlorides are harmless at low levels, well water high in sodium chloride can damage plants if used for gardening or irrigation, and give drinking water an unpleasant taste. As per IS: 10500-2012 desirable limit for chloride is 250 mg/l and permissible limit is 1000mg/l. Chlorides of water samples found in the range of 48 to 124mg/l. Fluoride is a natural substance that comes from the element fluorine, which is found naturally in rocks and soil. Water passes through the earth and absorbs the naturally occurring fluoride. As a result most water contains some amount of fluoride. Groundwater typically contains more fluoride than surface water. Fluoride concentration may be difficult to determine for well water depending on the depth of the well and the seasonal changes that occur. Consuming excess amounts of fluoride over time can accumulate in the bones, eventually resulting in skeletal fluorosis. Skeletal fluorosis can cause pain, stiffness of the joints, damage to bone structure, calcification of ligaments and crippling effects. As per IS desirable limit for fluoride is 1mg/l and permissible limit is 1.5mg/l. If the natural fluoride level of well water exceeds optimal levels, suggest reducing or removing fluoride from the water, especially if the water is being supplied to children under the age of 9.Effective treatment options include using reverse osmosis treatment, activated alumina cartridges, and distillation methods. Fluoride was in desirable limit in all samples. The acceptable and permissible limits as per IS: 10500-2012 is 500 and 2000mg/l respectively.TDS was low in all samples.

At high levels, sulfate can give water a bitter or astringent taste and can have laxative effects. As water moves through soil and rock formations that contain sulfate minerals, some of the sulfate dissolves into the groundwater. Sulphate was low in all samples. The Biological Oxygen Demand, or BOD, is the amount of oxygen consumed by bacteria in the decomposition of organic material. It also includes the oxygen required for the oxidation of various chemical in the water, such as sulfides, ferrous and ammonia. A high BOD means that there is plenty of organic matter present that is available energy for organisms. The BOD ranges values from 1.12 to 2.45 mg/l. Which represent the amount of oxygen that microbes need to stabilize biologically oxidizable matter. COD is a measure of the oxygen required for the chemical oxidation of organic matter with the help of strong chemical oxidant. High COD may cause oxygen depletion on account of decomposition of microbes to a level detrimental to aquatic life. The chemical oxygen demand ranged from 1.23to 2.98 mg/l. Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids. It is important parameters in assessing water quality because of its influence on the organisms living within a body of water.

A dissolved oxygen level that is too high or too low can harm aquatic life and affect water quality. DO of Well water samples were found in the range of 1.20 to 3.30mg/l. due to the capacity of water to hold oxygen. The most common problem associated with ground water may be hardness, generally associated with an abundance of calcium and/or magnesium dissolved in the water. Hard water has not been shown to cause health problems, but can be a nuisance as it may cause soap curds and deposits to

form on pipes and other plumbing fixtures. Calcium and magnesium are found in ground water that has came in contact with certain rocks and minerals, especially limestone and gypsum. When these materials are dissolved, they release calcium and magnesium. Variations in value of calcium and magnesium found in all seven sample of Well water. Too much sodium has been identified as a risk factor for high blood pressure, Twenty milligrams sodium per liter suggested as safe. Sewage is one of the important sources of sodium. Water with high sodium content is also not suitable for agriculture as it tends to deteriorate the soils for crops. . Sodium of Well water samples were found in the range of 22 to 58 mg/l which are in desirable limit. Natural water normally contains low concentration of Potassium. Potassium in Well water samples were found in the range of 10 to 24 mg/l.

Table.1-Physico-Chemical analysis of Ground water samples

Sample No.	pH	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Cl^{-} (mg/l)	NO_3^{-} (mg/l)	SO_4^{2-} (mg/l)	F^{-} (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)
S1	7.4	337	89	57	24	19	0.19	58	17
S2	7.2	231	78	61	39	42	0.28	44	20
S3	7.7	241	74	94	23	48	0.40	32	10
S4	7.5	121	75	96	34	21	0.65	39	15
S5	8.3	222	80	124	28	18	0.89	49	24
S6	7.4	321	92	48	20	45	0.23	56	22
S7	7.6	342	86	69	14	22	0.56	44	23

Table.2 –Physico-Chemical analysis of Ground water samples

Sample No.	EC (µS/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	TDS (mg/l)
S1	561	1.20	1.23	1.89	391
S2	430	2.34	2.23	2.48	306
S3	698	3.30	2.45	2.66	445
S4	824	2.51	2.20	2.98	589
S5	650	1.92	1.34	1.23	543
S6	568	1.26	1.43	2.67	483
S7	750	2.33	1.12	1.71	553

Conclusion:

The results revealed that Physico-Chemical parameters of well water were found mostly within the limits set up by WHO and IS. It is recommended among others that proper disinfection should be carried out on the water. The general sanitary condition of the area should be improved to eliminate the possible sources of contamination.

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