Analysis of Ground Water of Hinganghat region using Physico-Chemical Parameters

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Abstract:

The aim of present study was carried out to assess the status of the ground water in Hinganghat city. Attempts were made to study and analyze the Physico-Chemical characteristics of the Ground water. Samples taken randomly from eight different locations of city. Various parameters like pH, Total dissolved solids, Alkalinity, Dissolved oxygen, Chemical Oxygen Demand, BOD, DO, EC, Nitrate, Chloride, Sodium, Potassium, Sulphate, Fluoride etc. give a picture of quality parameters of ground water. The results considered that the ground water of the study area in general can be considered as good quality. Parameters which were taken for study the water quality are below the pollution level for ground water which satisfy the requirement for the use of various purposes like domestic, agricultural, industrial etc. All Physico-Chemical parameters were compared with Indian standards of water quality. It was suggested that there should be regular monitoring and control of human activities to protect the ground water from contaminations.

Keywords: Groundwater, Physicochemical parameters, Hardness, Hinganghat.

Introduction:

One of the biggest challenges that the country faces today is to provide safe drinking water to its ever increasing population. Availability of water is a paramount issue in India with demand for water exceeding supply by as much as 30 percent. Agriculture, industry, and domestic uses are competing for the limited supply. Ground water forms the major source of water supply for drinking purposes in most part of country. For proper utilization of water for various purposes, understanding of geo-chemical controls and study of the extent of ground water contamination are of prime importance [DevendraDohare et.al, 2014]. The quality of ground water is particularly important to humans when the water is used for drinking water supply. Unfortunately, the availability of ground water is not unlimited nor it is protected from deterioration. In most of the instances, the extraction of excessive quantities of ground water has resulted in drying up of well, damaged ecosystems, land subsidence, salt-water intrusion and depletion of the resource. Ground water quality is being increasingly threatened by agricultural, urban and industrial wastes [Prashant N. Rajankar et.al, 2013]. It has been estimated that once pollution has entered the subsurface environment, it may remain concealed for many years, becoming dispersed over wide areas of ground water aquifer and rendering ground water supplies unsuitable for consumption and other uses [Emmanuel Bernard et.al, 2012]. The problems of ground water quality are more acute in the areas, which are densely populated, thickly industrialized and have shallow ground water table. Ground water is mostly polluted from the effluents discharged by industries on land, seepage from the sewage line and sewage tanks, application of fertilizers, pesticides and insecticides on agricultural land, etc. Therefore, the monitoring of ground water quality is very essential because it is the most important source of water supply for drinking purposes.

The hazard of urban landfills to ground water via lactates if one of the major environmental problems our country is facing in the 21st century. Leachates, an inevitable product from landfills, containing mostly volatile organic compounds, synthetic organic compounds and heavy metals, in absence of protective measures like liners, leachate collection and treatment systems undoubtedly poses serious threat to the ground water system. The greater part of the soluble constituents in ground water comes from soluble minerals in soils and sedimentary rocks. The more common soluble constituents include calcium, sodium, bicarbonate and sulphate ions. Another common constituent is chloride ion derived from intruded sea water, connate water, and evapo-transpiration concentrating salts, and sewage wastes for example. Nitrate can be a natural constituent but high concentrations often suggest a source of pollution [J.Dharmaraja,S.Vadivel et.al,2012].

After electrification of wells there has been considerable increase in ground water withdrawals which in turn is depleting the groundwater level below 50-60 meters. At this stage, bore well drilling machinery came to the market and rich farmers went in for bore wells which depleted the ground water table further in an alarming way. Most of the open wells have been abandoned and farmers have gone in for bore wells and pump the water through compressors. Even this is not successful unless groundwater recharge is taken up on a massive scale. 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.

Hinganghat is a rapidly growing textile industrial cluster located on the banks of the Vena River, in Wardha district of Maharashtra. The pollution problems of the textile industry in Hinganghat is closely associated with the bleaching and dyeing (textile processing) segment of the industry. The presence of various chemicals in the waste water makes it highly colored, alkaline and difficult to treat. It is often found very difficult to remove the color completely from the treated effluent and it also requires expensive treatment like using activated carbon. The presence of colour in the treated effluents not only makes it aesthetically unpleasant but also scares the people in using the same for any domestic or irrigation purpose. The high concentration of dissolved salts in the effluents also makes the effluent unfit for agriculture use. The various treatment options of the effluent depend upon where the treated effluent is ultimately proposed to be disposed off. It is more important to make people or industries aware about this way of ground water contamination. Ground water contamination hidden from the direct view can go undetected for years until the particular aquifer is tapped. Further the reclamation and remediation of the contaminated aquifer or cleaning ground water by pumping out and treating before use or in the worst case abandoning the aquifer and location of alternate aquifer to supply water to the area where the contaminated aquifer was supplying water are all very costly and not at all economical especially considering the economic status of our country.

The present study is taken up only to assess the quality of groundwater in around industrial area of Hinganghat. Physico-Chemical characteristics of ground water were studied to find out whether it is fit for drinking or some other beneficial uses. The textile industry consumes large quantities of water. Major portion of the water is used for wet processing of textiles. Humidification of spinning and weaving sheds require about 5 to 10% water. Generally the quantity varies from 125 to 200 liters of water per Kg of cloth produced. Therefore the analysis of groundwater is becoming a essential part to control the groundwater pollution. It is hoped that the results would add to the existing data.

Material and Method:

Eight sampling stations were selected and the samples were received from deep (60-100m) wells and open wells. To assess the groundwater quality, Groundwater samples have been collected throughout the basin on 14 July 2014.Fifteen quality parameters were monitored as follows: pH, TDS, EC, Chlorides, BOD , COD, Sulphates, Nitrates, Fluorides, Calcium, DO, Magnesium etc. The analytical method involved were standard procedures, as recommended by WHO and BIS standards. All the samples collected in pre-washed (with detergent, doubly de-ionized distilled water, respectively) polythene bottles and tested in laboratory. Sulphate ion concentration was determined by using Systronic-108 and 166 Spectrophotometer. Chemical oxygen demand (COD) was determined by dichromate digestion method while biochemical oxygen demand (BOD) was determined by the dilution method. 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. 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.

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.. 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.

Result and Discussion:

Taste of the water of the water sample in most of the sites pleasant in taste. 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. The pH of water shows variation in its ranges. It indicates that they are in range of water quality parameter permissible limits. Conductivity is the capacity of water to carry an electrical current and varies both with number and types of ions the solution contains. The EC of water samples shows wide variation in all eight samples. All type of natural and raw water contains chlorides. It comes from activities carried out in agricultural area, industrial activities and from chloride stones. As per IS: 10500-2012 desirable limit for chloride is 250 mg/l and permissible limit is 1000mg/l. Among factors which control the concentration of fluoride are the climate of the area and presence of accessory minerals in the rock minerals assemblage through which the ground water is circulating. As per IS desirable limit for fluoride is 1mg/l and permissible limit is 1.5mg/l. Chloride content in water is low, the fluoride content in water is low due to this no dental and Skelton problem arises in the study area. Difference of total solids and suspended solids is used to determine the filterable solids by the help of filtrate. In water sample TDS can also be estimated from conductivity measurement. The acceptable and permissible limits as per IS: 10500-2012 is 500 and 2000mg/l respectively.TDS was low in all samples. Nitrate is produced from chemical and fertilizer factories, matters of animals, decline vegetables, domestic and industrial discharge. As per IS desirable limit for Nitrate is max.45 and no relaxation in permissible limit. The concentration ranges of nitrate were observed below the Indian standard of drinking water permissible limit.

Table No.1-Physico-Chemical analysis of Ground water samples

Sample No.	pH	Cl^-(mg/l)	NO_3^-(mg/l)	SO_4^{2-}(mg/l)	F^- (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Na^+ (mg/l)	K^+ (mg/l)
G1	7.2	26	13.12	14	0.21	73	8	28	7
G2	7.4	56	2.45	29	0.86	78	11	25	6
G3	6.7	35	3.54	20	0.22	69	9	43	8
G4	8.4	25	12.23	16	0.23	63	12	46	10
G5	6.8	34	4.67	27	0.43	98	18	43	8
G6	7.7	58	6.79	21	0.57	74	21	23	7
G7	7.4	38	4.09	14	0.32	65	15	27	6
G8	7.9	66	2.76	19	0.24	77	10	35	8

Table No.2 –Physico-Chemical analysis of Ground water samples

Sample No.	EC(µS/cm)	TDS(mg/l)	DO(mg/l)	BOD(mg/l)	COD(mg/l)
G1	371	341	2.30	1.13	2.43
G2	662	452	1.75	1.10	2.87
G3	668	387	2.23	1.30	2.98
G4	521	474	1.52	2.20	1.76
G5	760	625	1.83	1.25	1.09
G6	896	653	2.02	1.50	2.12
G7	430	479	1.33	1.45	1.71
G8	672	432	1.12	2.09	1.61

The source of Calcium and Magnesium in natural water are various types of rocks, industrial waste and sewage.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. BOD is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. BOD is a measure of the oxidation occurring due to microbial activity while COD measures the highest extent of oxidation a material may undergo. 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. The value of DO, BOD and COD were in limits.

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