



GROUND WATER QUALITY IN AMRAWATI BASIN OF MAHARASHTRA

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ABSTRACT:

The present paper attempts the physical and chemical character of the ground water in Amrawati basin and its suitability for irrigation, drinking, domestic, and industrial purposes. The ground water samples have been collected for the 42 villages located in different parts of the Amrawati basin to analyze physical and chemical properties for determination its quality. The quality of ground water depends up on aquifer condition. There are two types of aquifer in Amrawati Basin. One is weathered Deccan trap basalt rocks over extensive areas and second older alluvium in limited areas in the lower reach. The ground water from basalt aquifer is of good quality and safe for drinking, domestic irrigations and industrial purposes. While the ground water from older alluvium aquifer is saline and unsafe for its various uses.

INTRODUCTION:

In drought prone monsoon arid or semiarid regions, ground water is the only perennial source of water for irrigation, domestic, drinking and industrial purposes. Ground water never found in pure state. Since its contamination start with the fall of rain, through the atmosphere where free CO₂ mixes with water and rainwater is converted into weak carbonic acid. Weak carbonic acid is a powerful corrosive agent. It reacts with geomaterial and acquires a certain characteristic before entering in the ground. Besides its chemical properties may change from its place of entry at the ground to the point of exit, where it accumulates in the form of reservoir. The chemical characters of the water provide striking evidence of physico-chemical process under different reservoir condition (Trainer

1981). The quality of water depends upon its interaction with litho structure and various geochemical reactions took place within the litho logical framework (Dhokarikar 1982). Water quality varies in its concentration of dissolved substances depending upon the hydro chemical conditions of the areas and according to seasons (Kale, Powar, Gupte 1993).

STUDY REGION:

The Amrawati basin extents between 21° to 21°45' North Latitude and 74° to 74° 45' East Longitude. It covers about 739.975 Sq. kms. area. Amrawati is the sub-basin of river Tapi and belongs to the arid tract of Dhule and Nandurbar district of the Maharashtra. The basin is underlie two well exposed geological formation, one Deccan Trap basalt and second recent alluvial formations. Both are the prime aquifers in the basin and controls the ground water qualities.

OBJECTIVES:

1. To investigate the physical and chemical characteristics of ground water in the basin.
2. To understand the spatial distribution of physical and chemical characteristics in the basin with respect to aquifer conditions.
3. To compare the ground water qualities with the norms suggested by Ministry of Health, Gov. of India to its safe use.

DATA SOURCE AND METHODS:

The water samples are at randomly collected from 42-sample sites which are well distributed in all parts of the Amrawati basin for the determinaion of physical and chemical characters. Besides, the data collected from Maharashtra Engineering Research Institute (MERI), and from Dhule District Ground Water Survey Dept. also have been considered in the present investigation..

The physical properties such as temperature and turbidity and the chemical properties such as, pH, EC, TDS, hardness, and chemical properties like cation Ca^{+2} , Mg^{+2} , K^{+1} and anion like CO_3^{-2} , HCO_3 , Cl^{-1} , NO_3 , SO_4 , alkalinity have been considered in this study. The quality of ground water have been compared with the slandered suggested by Ministry of Health Government of India for its safe use

RESULTS AND DISCUSSION:

The physical and chemical characteristics have been estimated and results discussed below.

I) Physical Characteristics:**a) Temperature:**

The ground water temperature is influenced by the surrounding air temperature. It varies with seasons. The rise in temperature of the water accelerates chemical reactions, reduces solubility of gases, and may also cause bad taste and odor. It also accelerates metabolic activities of organism. The temperature of water sample collected from the study area ranges between 24^oC to 40^oC, and varies with the seasons.

b) Turbidity:-

Natural water is contaminated with suspended matter like clay, silt, organic matter and other microscopic organisms. Its measure is turbidity. Turbidity expresses an optical property of water in which light is scattered by the suspended particles. Scattering of light depends upon the size, shape and refractive index of suspended particles in water.

Majority of the groundwater samples of the study area reveals, the turbidity values within the range between 3 and 5 units of Silica Scale. Turbidity for raw water up to 5 units is permissible unit for drinking purpose. Higher turbidity affects chlorination since suspended matter provides areas where microorganisms do not come into contact with chlorine disinfections (NAS, 1974). A turbidity value more than 10 unit is unsafe for all purposes. Turbidity varies with seasons and maximum in rainy season.

II) Chemical Characteristics:-**a) pH:-**

pH is the –ve logarithm of hydrogen ion concentration in water and it measures alkalinity or acidity of water. In present study the pH value is directly measured by pH meter. 42 water samples from the study area are measured.

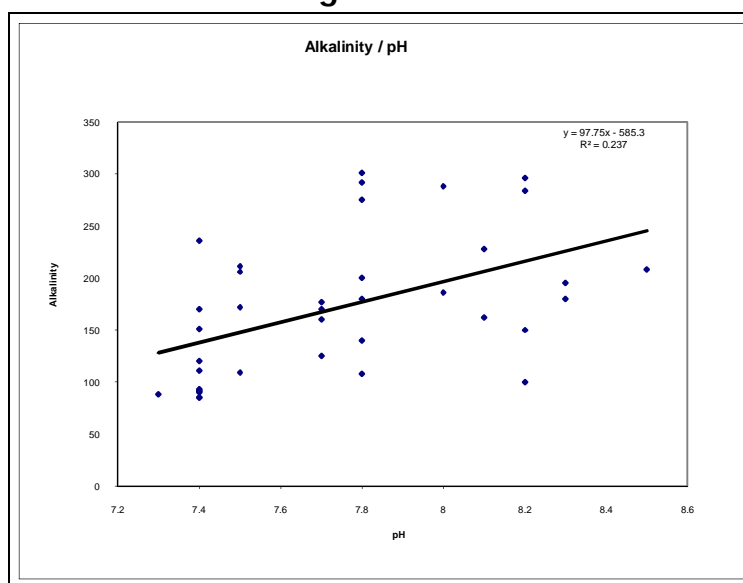
The pH in the study area ranges between 7.3 and 8.5. The average value of pH is 7.74 which indicate the alkaline nature of groundwater. This value is well within the slandered rage suggested by suggested by Ministry of Work and Health in1975. There fore water is safe for its various uses in respect of pH.

b) E C (Electric Conductivity)

Pure water is a poor conductor of electric conductance. Acids, bases and salts in water make it relatively good conductor of electric conductance. Such substances are known as electrolytes. The conductivity of the water varies with temperature but it conveniently reported at 25°C. The average electric conductance of study area is 880 m mhos/cm² in the range of 268 mho/cm and 2730 mho/cm. The electric conductance of Amrawati basin is beyond the permissible limit, of 20 mho/cm² as per WHO standard. Hence it is not suitable for irrigation. The older alluvium is a major aquifer of the ground water in Amrawati Basin in lower reach. The older alluvium in this region is prominently saline.

c) Alkalinity:-

Alkalinity of water is its capacity to neutralize a strong acid. It is characterized by the presence of hydroxyl OH⁻ ions capable of combining with hydrogen H⁺ ions. A number of bases viz., carbonates, bicarbonates, hydroxides, phosphates, nitrates, silicates, borates, etc. contributes to the alkalinity, amongst them carbonates, bicarbonates, and hydroxides are considered to be the predominant bases in ground water. Thus alkalinity may be expressed as total alkalinity on the basis of individual bases present in ground water. The alkalinity is directly proportional to the pH values, as shown in fig. No 1. In the study area the pH value increases from source towards mouth. In the lower regime of Amrawati basin, pH increases up to 8.5 with consequent increase of carbonate up to 40mg/l.

Figure No.1

d) Hardness

The total hardness of water is the sum of concentration of alkaline earth metal cations present in it. Calcium and magnesium are the principal contents imparting hardness; however, to a lesser extent cations like iron, manganese and strontium are also responsible for it. The hardness due to bicarbonate and carbonates is called as temporary hardness. Since, it can be removed by boiling treatment of water. Usually the hardness is measured as concentration of calcium and magnesium (CaCO_3) which are far high in concentration over other cations. The presence of Sulphates and chlorides represent permanent hardness of ground water Simple water boiling treatment is unable to remove them.

Table No. 2: Hardness Recommended range of Hardness

Class	Range of hardness (mg/L.) Ca CO ₃	Remark
Soft	00-55	Require little or no softening
Slightly hard	56-100	Require Softening
Moderately hard	101-200	Require Softening
Very hard	201-500	Require Softening

The total hardness of the groundwater in the study area ranges from 131 ppm to 779 ppm. According to Freeze and Cherry (1979) the hard groundwater requires softening. The upper reach of the Amrawati basin is slightly hard, i.e. up to 200 ppm. The central and lower reach shows high and very high hardness, respectively. They also require softening. The highest value of hardness is observed at the village Anjanvihire (779 ppm) in middle reach of basin. The overall hardness of the ground water in the basin is beyond the permissible limit and therefore unsafe for its use. It will safe after softening treatment.

e) Metal Cation:-

Three alkaline earth metal cation Ca, Mg, Na, are found prominently found in the ground water of Amrawati Basin.

i) Ca

Calcium found in abundance in groundwater and its source lies in the Parent rock from which it is leached. Calcium is an element of alkaline earth metals and predominantly found in the groundwater. Calcium is an

important micronutrient for aquatic life. It is an important contributor of ground water hardness. Therefore groundwater is restricted to domestic and drinking use. The minimum value of Ca is reported from at Thanepada (only 36 ppm) and maximum at Bamhane (208 ppm). In majority of sample calcium content ranges between 50 ppm to 100 ppm with standard deviation of 44.74. The general trend of calcium concentration increases from source to mouth. In the middle reach calcium is moderate. The overall value of Ca metal cation is beyond the permissible suggested by Ministry of Health Govt. of India and hence requires treatment for its safe use.

ii) Magnesium (Mg):-

Magnesium is alkaline earth metal and usually found in all natural waters. It comparatively more soluble in water than Ca. Therefore concentration of Mg is usually lower than the calcium in groundwater.

Magnesium is a necessary constituent of chlorophyll without which no ecosystem could survive. Its high content reduces the utility of water for domestic use, while their concentrations above 500 mg/l imparts water for its unpleasant taste and render it unfit for drinking purpose. High concentration of magnesium also proves to be diuretic and laxative.

The study area show variation in the concentration of magnesium and it ranges between 10 ppm to 52 ppm. Lowest is Thanepada (10 ppm) and Indeve (52 ppm) reveals lowest and highest concentration of magnesium respectively in basin. The ground water at Indeve is unsafe for drinking purposes because it causing increased excretion of urine. The average magnesium concentration of ground water of Amrawati basin is 25.37ppm, with standard deviation 18.52 ppm and its distribution is asymmetrical. In South and Southeastern part of the basin concentration of magnesium is more than the Northern side. The ground water in the Southern hills having more concentrations of magnesium due to the concentration of Ferro-Magnesium mineral in the Basalt rock. On the North and Northeastern side the magnesium content is low because of change in the aquifer, i.e. older alluvium.

iii) Na (Sodium):-

Na occurs generally in lower concentration than calcium and magnesium in fresh water, as it leaches through the chemical weathering of rocks. Usually saline and brackish water reveals relatively higher concentration of sodium. It is highly soluble in water and imparts softness.

High sodium content, in the form of chloride and Sulphates, makes the water salty and unfit for drinking and domestic purpose. High sodium content water irrigation causes pudding effect of salt. As a result water intake capacity of soil is reduced and it becomes hard to germinate seed. In Amrawati Basin Sodium content of ground water varies greatly and ranges between 50 ppm to 234 ppm. Maximum concentration of Na is found at Jhotwade (234 ppm) and minimum at Thanepade (50 ppm). The average concentration of sodium is 85.66 ppm with standard deviation 41.88 ppm. The distribution of sodium is as symmetrical in basin. Western and southern sides of the Amrawati Basin have moderate concentration of the sodium. The Central- North and the area around the Jhotwade village have higher concentration of sodium in ground. It is hazardous to health and needs water treatment for its safe use for irrigation, drinking and domestic purposes.

f) Total Dissolved Solids:-

A large number of salts are found in dissolved forms in natural water. The common amongst them are carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron, and manganese. A high content of dissolved solids elevates the density of water, influences osmoregulation of freshwater organisms. It reduces solubility of gases (like oxygen). Hence it is unsafe for drinking, irrigational and industrial purposes.

Normally the concentration of total dissolved solids in natural waters is less than 1000mg/lit. The concentration of TDS over 1000mg/lit. enhances degradation of water Freeze and Cherry, (1979) have classified ground water on the basis of TDS content as follows: -

Table-3: Classification of ground water on the basis of TDS content

TYPE OF WATER	T.D.S. CONCENTRATION	Utility
Fresh water	< 1000 mg/lit.	Drinking
Brackish waters	1000 to 10,000 mg/lit.	Domestic
Saline waters	10,000 to 1,00,000 mg/lit.	Irrigation / Industry
Brain waters	> 1,00,000 mg/lit.	-----

(Freeze and Cherry 1975)

While standards laid down by Ministry of Health Government of India are given in the following table. According to the table no..4 permissible limit for TDS is 500 mg/lit.

Statement showing Standards laid down by "Ministry of Health".

Table-4: Government of India

Sr. No.	Tests	Permissible Units in mg/lit.	Excess Units in mg/lit
1	pH	7-8.5	6.5-9.2
2	Total Solids	500	1500
3	Dissolved Solids	500	1500
4	Total Hardness as CaCO ₃	--	--
5	Total Hardness as CaCO ₃	200	600
6	Calcium as Ca	75	200
7	Magnesium as Mg.	30	150
8	Sulphates as SO	200	400
9	Chlorides as Cl	200	1000

The TDS values of the ground water of the present study area vary, greatly and ranges between 221ppm at Thanepada and 1547 ppm at Zotwade. In the upper reach of basin TDS varies from 221 to 300 ppm, which is within the permissible limit. While in the middle and lower reach of the basin it varies from 900 to 1550 ppm. it is above the permissible limit. According to the classification given by the Freeze & Cherry, the water in this area belongs to brackish category.

g) Sulphates (SO₄): -

Sulphates are found in all natural water. Particularly high in arid and semiarid region. Its higher concentration is due to accumulation of soluble salts in soil and shallow aquifers. Sulphates salts are mostly soluble in water and impart hardness. Sulphates concentration in ground water beyond 500 mg/lit is hazardous and cause intestinal disorder.

In the present study area the amount of Sulphates in ground water ranges between 13 ppm to 310 ppm at Thanepada and Chilane respectively The low concentration of Sulphates found in upper part of Amrawati basin. But in the central and lower part of the Amrawati basin it reveals considerable increase. It has been found that the concentration

of sulphate increases with the increase in depth of groundwater. The Sulphates concentration in ground water in this basin is within the permissible limit.

CONCLUSION:

The ground water in Amrawati Basin is found in two aquifer zone. One is Deccan Trap weathered basalt rocks, covering major area of the basin and second older alluvium aquifer in lower reach. The ground water from Deccan trap formation is of good quality for its safe use for drinking, domestic, irrigation and industrial purpose. It will be safe after treatment.

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