International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org || PP. 25-31

Studies On The Quality Of Ground Waters

Dr.K.Srikanth[1],Dr K.Ramesh Raju[2]& D.S.Pavan kumar[3]
1 and 2 are Associate professors in Chemistry,Sir CRR(A) College,Eluru.
3 is lecturer in chemistry, Sir CRR(A) College, Eluru

Abstract: *Water is one of the most essential natural resource available on earth. For the nation as a whole, the chemical and biological character of ground water is acceptable for most uses. Ground water may contain dissolved minerals and gases, that give it the tangy taste enjoyed by many people. The most common dissolved mineral substances are Sodium, Calcium, Magnesium, potassium, Chlorine, Bicarbonates, and Sulphates. These are called common constituents. In recent years the growth of industry, technology, population,and water use has increased the stress upon the both our land and water resources. Locally the quality of ground water has been degraded. Muncipal and Industrial wastes and chemical fertilizers, herbicides, and pesticides not properly contained have entered the soil, infiltrated some aquifers, and degraded the ground water quality. Other pollution problems include sewer leakage, faulty septic-tank operation and landfill leachates. In some coastal areas, intensive pumping of fresh ground water has caused salt waters to intrude into fresh water aquifers. This paper presents a brief history about the types of wells, potable water, constistuents of water and its effects, Bacteriology of water, and followed by analysis of quality of ground water in Nuzvid and its surrounding areas.*

Keywords:*Bacteriology, Bore wells, Dug wells, Hardness, Potable water.*

I. Introduction

The rain water as it drops down to the surface of the earth percolates into the soil, a greater or lessor part, to become sub-surface water. Some of the sub-surface water is taken up by plants. The hygroscopic water resists evaporation and is held by the soil. The remainder of the percolating water passes downward under the influence of gravity until it reaches an impervious stratum or aquiclude. It then begins to move in a lateral direction toward some outlet.

The portion of the earth to which the lateral movement is taking place is known as " Zone of Saturation" , and its water is the " Ground Water". The water –bearing stratum or formation is an aquifer. A "water-table" is the upper surface of the " Zone of Saturation", except when the aquifer is overlaid by an aquiclude. The level of the water-table is likely to show considerable fluctuation. A long period of dry weather will probably result in lowering the level, where as rain will cause it to raise. During dry periods, therefore, wells, springs and streams draw upon the stored ground water, which is again replenished by percolation during rains.

1.1 Types Of Wells:

In the ordinary or water-table type of well, the water raises to the height of the saturated material surrounding it and there is no pressure, other than atmospheric upon the water in the surrounding aquifer.

Wells under 100 feet in depth are classed as shallow wells. They include a wide variety of types , ranging from the dug wells used in farms to types used for municipal supplies.

Dug wells are those which are excavated by picks and shovels or excavating machinery. They are generally more than 2 feet in diameter and not over 50 feet in depth. Lining or casing is usually of concrete or brick. Dug wells are occasionally used by small towns for public supply.

Shallow wells of small diameter are also driven and bored. The driven well consists of a pipe casing. Bored and drilled wells are generally used in hard ground and rock and may be sunk to depths measuring hundreds and even thousands of feet. Bored wells are 1 to 36 in diameter.

In the rocky regions, where there is no sand or gravel, wells are generally not polluted by lateral seepage into them but polluted at or near the surface of the ground.

1.2 Potable Water:

Absolutely pure water is not be found in nature. As water vapour condenses in the air and falls in the form of rain, it absorbs dust and dissolves oxygen, carbon dioxide and other gases. At the ground surface it takes up slit and other inorganic matter. Bacteria also enter the water from the air, but at the ground surface many more will be picked up as it runs off in streams or rivers. Small amounts of the products of the decomposition of organic matter, nitrites, nitrates, ammonia and carbon dioxide will go into solution.

A potable water is one i.e safe to drink, pleasant to the taste and usable for domestic purposes. A contaminated water is one that contains micro organisms, chemicals, industrial or other wastages, or sewage so that it is unfit for intended use. The term polluted water is synonymous with contaminated water.

The multiple use of water is associated with a variety of standards of acceptable quality. Domestic water supplies must have some standards and should protect the health and promote the well being of consumers and community. Indian council of medical research (ICMR), ministry of health, Govt. of India recommended the below standards for drinking water.

1.3 Substances and characteristics affecting the acceptability of water for domestic use :

Substances and characteristics	Undesirable affect that may be produced	Acceptable concentration	Maximum permissible limit
Colour	Decolourisation	5 units	25 units
Odour	Odour	Un objectionable	Un objectionable
Taste	Taste	Un objectionable	Un objectionable
Turbidity	Gastro-intestinal irritation	5 units	25 units
Dissolved solids	Gastro-intestinal irritation	500	2000
P^H Range	Taste, Scale formation due to corrosion	7.5 – 8.5	6.5 – 9.2
Total hardness	Taste, Scale formation	200	600
Calcium	Taste, Scale formation	75	150
Magnesium	Taste, Scale formation, Gastro-intestinal irritation in presence of sulphates	50 if there are 200 mg/L sulphates, if the sulphates are less, 'Mg' up to100mg/L may be allowed up to the rate of 1 mg/Lfor every 4 mg/Ldecrease in sulphates	100
Iron	Taste, discolouration, turbidity, deposits, growth of iron bacteria in pipes	0.1	1.0
Chloride	Taste, corrosion in hot water system	250	1000
Sulphate	Objectionable irritation when combined with Mg Or Na	200	400
Nitrate	Infant methimoglobinemia	20	45
Fluoride	Fluorosis	1.0	1.5

Note:- Except P^H, all values are given in mg/L

Nearly all waters contain salts of Calcium, Magnesium, Potassium, Sodium and ammonium in the form of carbonates, bicarbonates, sulphates, fluorides and nitrates. Rarely traces of Iron, Lead, Zinc, nitrites and phosphates may be found.

II. Constituents Of Water And Its Effects:

2.1 P^h And Alkalinity:

The acidity or alkalinity of water is measured in terms of its P^H value or hydrogen ion concentration. The water become acidic if positively charged H ions are in excess, the water become alkaline if negatively charged OH ions are in excess. For neutral water the H ions concentration and OH ions concentration are equal.It is desirable to maintain P^H value of water close to 7. The acidic water causes tuberculation and the alkaline water causes incrustation. The alkalinity of water is due to carbonates and bicarbonates and very rarely hydroxides of minerals.

2.2dissolved Solids And Electrical Conductance:

The presence of dissolved solids in a water sample indicates the presence of some impurities like minerals and salts including some organic matter. The water samples which contain excessive amounts of total dissolved solids are polluted.Generally the electrical conductance of the water is directly proportional to the total dissolved solids present in them.

2.3 Hardness:

Water supply from ground water, usually has a high degree of hardness, due to the chemical composition of the aquifer.The term hardness was evolved in connection with soap waste. Hardness caused by bicarbonates of calcium and magnesium can be eliminated by raising the temperature and is known as temporary hardness and on the other hand hardness caused by sulphates and chlorides of calcium and magnesium does not decrease on moderate heating and is known as permanent hardness. High hardness makes water tasteless.

2.4 Chlorides:

Chlorides are widely distributed in nature. They are present in mineral deposits, in sea and brackish water, in ocean vapours, in human excreta(more particularly urine) and in industrial wastes. In water supply, the chloride determination is of importance. High chloride content produces salty taste.

2.5 Iron:

Potable waters are often found containing traces of iron. It occurs as ferrous carbonate and is kept in solution by excess of carbonic acid. Upon exposure to air, oxidation quickly occurs, and the water becomes more or less brown and opalescent. If more than trace of iron is present a deposit of the oxidized product occurs. It might be expected that headache and constipation to be produced amongst those people who are unaccustomed to its use. For washing purposes the water containing excessive amounts of iron is very objectionable.

2.6 Nitrates And Nitrites:

There is a danger of water contamination with nitrate salts. These salts may accumulate in surface and ground waters as result of contamination by industrial inorganic waste products and chemical fertilizers. The increasing utilization of ground water as drinking water in some areas greatly accelerating the danger to public health from nitrates.

Where nitrate limits in water exceeded it is generally recommended that infantsupto the age of year be supplied with low-nitrate water from other sources. These recommendations carry with them facit assumption that nitrates in water, irrespective, of their concentration, are not harmful to children over one year age or to adults.

It is the nitrite form rather than the nitrate form that cause the formation of methemoglobin. In conversion of NO_3 to NO_2 apparently is essential step pathogeneses of the disease. The need to establish permissible limits for nitrites in water has also been suggested, however nitrites usually occur in water in amounts too small to be physiological importance.

2.7 Phosphates:

Proteid matter whether it is of vegetable or animal origin, during its oxidation yields a trace of phosphate, which consequently are found in all fertile soils, calcium phosphate being a very insoluble salt, only a minute quantity can be held in solution in a potable water. They are no doubt, occasionally founding more than minute traces.

2.8 fluorides:

It is well established that fluoride concentration up to 1mg/L in drinking water is essential for healthy teeth and for prevention of "Dental cavities" in children. On the other hand, presence of excessive amounts of fluorides causes mottling of tooth enamel, entails defective calcification of teeth and causes various enzymatic disorders in human body. More over, the effects due to excessive fluorides ingestion may depend on dietary habits, people taking sufficient quantities of vitamin C in their diet are more resistant to such effects.

2.9 Bacteriology Of Water:

Drinking water supplies liable to contamination with sewage or other excreted matter may cause out breaks of intestinal infections such as typhoid fever. In safe guarding public water supplies, health authorities and water engineers rely on information obtained from the results of frequent bacteriological tests. The demonstration of pathogenic bacteria, e.g the typhoid bacillus, would obviously constitute the most direct proof of a dangerous impurity, but these pathogens, if present, are usually so scanty that the technical difficulty of their isolation makes the test impracticable for ordinary purposes.

Raw waters generally show seasonal variation in the number of coliform organisms, these occur in larger numbers in monsoon than in the rest of the year. This is due to the rains bringing in the contamination through the run off waters.

There have been numerous complaints of dysentery, diarrhoea. Often people complain of stomach aches. Therefore, many people drink only boiled water. Therefore, there was dire need to look for the causes that lead to such complaints.

Bacteriological contamination of water is one of the causes that produce such diseases.

III. Quality Of Ground Water In Nuzvid:

3.1 Introduction:

In Nuzvid, public depend on water for domestic purposes mainly fron dug wells and bore wells. Even though the municipal water supply is there, each and every part of Nuzvid is not catered to by the municipality. Many waters are salty, hard and are highly alkaline. It was known that the water is contaminated with bacteria, amoebae from the data collection. The present work deals with the chemical parameters and bacteriological tests on the quality of water in Nuzvid and its surrounding areas. Further, the present investigation is intended to provide base data for future reference in the event of developing the place with small scale industries.

3.2water Sampling:

In present investigation 12 water samples from Nuzidmandalare collected. The water samples were collected in polythenebottles which were cleaned with acid water and hot water followedby rinsing twice with distilled water. The water samples wereanalyzed by using procedures of standard methods.

3.3methodology:

The pH was measured by using Eutech ion- 2700 PH meter andEC was measured in electrical conductivity meter 304. Totalhardness, calcium, magnesium were measured by EDTA titrationmethods. Total alkalinity was determined volumetrically. Sulphatewas determined by Turbidymetric method using digital Nepheloturbidity meter 132. Fluoride and chloride content in water wasdetermined by using ion selectivity meter Eutech ion - 2700.The Physico-chemical analysis was carried out according tostandard methods. Iron, nitrite and phosphate were determinedby spectrophotometer.

About 12 varities of water samples from different regions of Nuzvid are collected and analysed. The results are recorded in the following table.

3.4 Table: Mean values

Sample no.	P^H	EC	TDS	Alkalinity	TH	Calcium	Magnesium	Chloride	Iron	Nitrate	Nitrite	Phosphate	Fluoride
Bore wells 1	7.6	2400	850	458	436	29.0	42.0	280.1	0.18	9	Trace	2.30	1.4
2	7.3	1200	660	520	530	59.2	72.0	70.9	Trace	6	0.005	2.4	1.5
3	7.4	1500	890	550	484	57.7	93.5	64.8	0.36	9	0.004	2.1	1.3
4	7.6	1400	1100	424	432	84.1	55.6	170.4	Trace	24	0.013	1.7	0.6
5	7.3	1600	950	620	311	62.9	67.2	185.1	0.19	9	Trace	1.85	0.8

6	7.6	1700	870	520	281	92.4	72.0	220.1	Trace	14	0.02	1.3	0.9
Dug wells 7	7.7	1850	1200	430	810	80.5	45.7	149.8	0.7	29	0.012	2.79	1.3
8	7.8	2000	2450	306	550	155.0	88.7	180.4	0.19	39	0.030	2.3	1.4
9	7.6	3300	1600	334	444	102.2	107.7	330.1	0.07	42	0.017	3.5	0.75
10	7.8	1366	2500	320	900	118.5	171.1	550.4	0.16	29	0.02	1.85	0.5
11	7.5	1110	1350	250	720	123.0	49.5	630.2	0.19	32	0.04	2.39	0.85
12	7.6	1250	2400	360	690	173.0	132.5	260.4	0.30	34	0.016	1.9	0.6

Note: All values of the constituents given are average values. Except P^H and EC all the values are given in mg/L (PPM=Parts Per Million)

3.5 Results And Discussion :

Physical and chemical parameters are of water samples havebeen tested. Which are collected from the study area. Physicalparameters that were tested are TDS, EC, PH. While chemicalparameters have been tested were Alkalinity, Chloride, Sulphate, Calcium, Magnesium, Hardness, Potassium, Fluoride etc. The results of analysis were then compared with anddiscussed with WHO standards.

3.5.1 pH:PH of the water is a measure of hydrogen ion concentrationin water.(measure of balance between hydrogen ion &hydroxylion). The limits of pH value for drinking is specified as 6.5-8.5.The mean values of pH for the ground water samples in the studyarea varies from 7.3-7.8.which shows that in the study areathe pH values are not exceeded the standard limit however theseare slightly alkaline in nature. pH has no direct effect on humanhealth but its higher ranges increases the scale formation in waterheating apparatus.

3.5.2 EC:pure water is not a good conductor of electric current but agood insulator. EC is a measure of concentration of ion in water,which enhance the EC. The amount of TDS determines the EC.The mean values of EC of the ground water is varying from1110-3300µS/cm.

3.5.3 TDS: The water has the ability to dissolve wide range of inorganicand organic minerals. These dissolved salts give unwanted taste& diluted colour to water. As per Who standards the TDS ofwater must be in the range of 50-200ppm.In the study area ,themean values of TDS range is 660-2500ppm.these ranges areacceptable and concentration of TDS is not harmful.

3.5.4 Alkalinity: Alkalinity of water mainly is due to presence ofhydroxide, carbonates and bi-carbonates. water requires moderateconcentration of alkalinity to stable the effect of acidity. WHOstandards of alkalinity are 300-600ppm. The mean values of thealkalinity ranges from 306-520ppm(sample no . 5 has high valueof alkalinity, remaining all are within the range).indicating thatonly one sample exceeding the recommended limit.

3.5.5 Hardness: Hardness of water is characterised with highmineral content which are useful for human when they are presentin th desirable limit. according to WHO standards hardness ofwater should be with200-400ppm. The mean values of hardnessranges from281-900ppm which shows that all the samplesare beyond the range.

3.5.6 Magnesium: Magnesium is the 8th most abundant element onearth crust.It is essential for proper functioning of living organismsand found in minerals like dolomite, magnesite etc. The quantityof Mg is low except sample 5 .Remaining all other samples arein within the range 42.0-171.1ppm .

3.5.7 Calcium: Calcium is 5th most abundant element on the earthcrust and is an essential and neutritional element for humans which prevents cardio disorder and proper functioning of metabolicprocess and is also useful for bones. About 95% of the calcium inhuman body is stored in bones and teeth. The high deficiency ofcalcium cause rickets, poor blood cloting, bones fracture etc.The permissible range of calcium in drinking water as per WHOis 75-100 ppm. The mean values of calcium in the study arearanges from 29.0-173.0ppm

3.5.8 Chloride: Chloride is mainly due to dissolution of NaCl, KCl,sewage waste etc.It is the important for the metabolism activityin human body and other main physiological process. Accordingto WHO standards the concentration of chloride should be within250-1000ppm. In the study area chloride mean values rangesfrom 64.8-630.2ppm thus all the sample are with in the range ofconcentration of chloride.

3.5.9 Fluoride: The mean valueof the fluoride in the study area ranges from0.2-1.5ppm. All the samples are within the limits.

3.5.10 Nitrates And Nitrites: Nitrates can find its way into water sources through sewage pollution or through percolation of nitrate containing run off water from agricultural fields. All the samples in the study area are within the limit.

The nitrite content of water samples vary from trace to 0.04 mg per litre. The presence of nitrite in water, even in trace, indicate contamination with sewage which contain nitrate reducing bacteria.

3.5.11 Phosphate: The presence of phosphate in water, though in low concentration, indicate presence of phosphate containing minerals in country rocks and soils. The phosphate content in study area is varies from 1.3-3.5.

3.6 Differences In Characterstics Of Bore Wells And Dug Wells:

It will be seen from the results that water of bore well has uniformly less mineral contents than dug wells. Electrical conductance, Calcium, Magnesium, TDS, TH, Nitrate, Nitrite and other important parameters significantly lower than the corresponding values for dug well water. It is interesting to note that bore holes drilled in existing dug wells to a greater depth yield potable water having all chemical characteristics within permissible limits. The presence of nitrate and nitrites also indicate that the bore wells are less prone to pollution than dug wells.

IV. Bacteriological Quality Of Water:

Sample number	MPN index of coliform bacilli per 100 ml	Helminths, Flora and Fauna
1	60	Nil
2	180	Yeast cells, E.H cysts
3	90	Entamoeba coli (High)
4	Zero	Yeast cells Occasional, some vegetative cells and fibres
5	160	Clear except some vegetative cells and fibres
6	Zero	Clear except some vegetative cells
7	700	TrychomonasTrophozoites and ova of round worm
8	1600	Trichomonas species and E.H cysts
9	800	E.H cysts
10	1000	Yeast cells and Trichomonas species
11	1200	Yeast cells occasional some vegetative cells and fibres
12	500	Clear except some vegetative cells

4.1 Results And Discussions:

It is seen from the data that all dug wells are continuously getting contaminated by external sewage of sullege water. As per quality criteria, water of a good sanitary dug well will not have more than 25 MPN of coliforms in 100 ml. It is highly dangerous to use the dug well water without disinfection by chlorination. The results of chemical anlaysissubstantative the findings of bacteriological examination.

4.1.1Helminths, Flora and Fauna:

Microscopic examination of water samples revealed that samples from all dug wells contains E.H cysts or Amoebae, Trychomonas species, Ova of round warms, Yeast and vegetative cells . They are the normal habitates of faces, Sewage and sullege water. The results show that the well water is getting polluted with sewage or sullege water. It was observed that in the samples containing higher E.H cysts, Amoebae generally the carbonate hardness is more. Further work may be needed to find some relation between them.

V. Conclusions

Quality of water, both bacteriologically as well as chemically is dependent on the depth of well. There is an inverse proportion of these parameters with depth. As the depth increases the mineral and chloride content decreases. Similarly the MPN of coliforms also decreases, sometimes reaching the value of zero with increasing depth of the well.

Waters from open dug wells are not preferable for drinking and domestic purposes in view of high bacteriological contamination and the relatively high values of chemical parameters. They are brackish in taste because of high chloride content and very hard, higher MPN index i.e above 25 shows that they are fully contaminated. If open dug wells are made deep or wide the water out of them is likely to be of better quality.

Waters from bore wells are found to be of somewhat better quality. These waters have low bacteriological contamination and of having low mineral content and less values of chemical parameters than waters from dug wells. Waters from bore holes drilled in the existing dug wells are also having the same quality like that of the dug wells.

All the waters of Nuzvidarea are free from toxic effects of excess fluorides. Many wells are in the vicinity of agricultural fields, nitrates and nitrites from the fields percolates into these waters. So this water is unhealthy to infants.

References

Books:

[1] *G.M. Fair, J.C.Geyer and J.C. Morris, "Water supply and Waste water Disposal" ,Jhon Willey and Sons, New York.*
[2] *J.C. Thresh, " The Examination of waters and water supplies" , J and A Churchil, London.*
[3] *P. Dalinsky, in "Development in water quality Research" , Ed. By Shuval, Ann Arbor Science, Michigon.*
[4] *T.S.Bhakuni, "Proc.Symp. Problems in water treatement" CPHERI, Nagpur.*
[5] *N.M Purhad and N.U Rao, " Proc. Symp. Problems in water Treatment" ,CPHERI, Nagpur.*
[6] *F.J. Welcher, " Satnandard methods of Chemical Analysis" 6 th volume part , R.E. Krieger publishing company, New York.*