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# SALT ANALYSIS OF WATER OF RURAL AREAS OF SONIPAT, HARYANA

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**ABSTRACT:** Water existed on earth as early as 3000 million years ago. It is the commonest fluid in nature which is consumed by us in all means. We know that with the progress of science and use of certain chemicals for several activities especially agricultural activities the dangers of these chemicals entering our body through drinking water are also increasing at an alarming level. Testing water samples from diferent areas on regular intervals is necessary. This will ensure that the water source is being properly protected from potential contamination, and appropriate treatment is selected and operated properly. This report presents water quality data collected from various sources and analysed by following chemical parameters.The result is focused on the determination of presence of salts in water of rural areas of Sonipat district of Haryana, such as, Chloride, Nitrates, Sulphates, Fluoride and Iron according to BIS standards.

**KEYWORDS:** Water quality analysis, BIS standards, physio-chemical parameters, potability, Ultraviolet Spectrophotometric method,

## Introduction:

When the definition of life is required, we need to define water. In this way, Water is synonym of life. Being the earth or the human body, 70% is water. So we, undisputedly can say that Water is life. Water is ever-increasingly becoming the single most precious and essential item that sustains life in this world, enabling all living beings as well as nature to survive. We perceive water as a crucial element of civilization (Slariya, 2015). There is a Turkish proverb that says, “Water brings life”. This proverb is without a doubt, true. The life had been dependent on water since forever and the future of life and civilization on earth depends on water only. Life is believed to have originated in the aqueous solutions of the world’s oceans, and living organisms depend on aqueous solutions, such as blood and digestive juices for biological processes.

Water, a substance is composed of the chemical elements, hydrogen and oxygen and existing in gaseous, liquid, and solid states. It is one of the most plentiful and essential ingredients of compounds. A tasteless and odorless liquid at room temperature, it has the important ability to dissolve many other substances. Indeed, the versatility of water as a solvent is essential to living organisms.

Water is indispensable natural resource on the earth and is the primary need for every human being and other animals as well as for plants and micro-organisms. The quality of water is of vital concern for mankind since it is directly linked with human health, protection of the environment, plant growth and sustainable development. Due to increase in human population, industrialization, use of fertilizers and pesticides in the agriculture and several other activities, water get polluted with different harmful contaminants in past few decades. Water pollution is a serious problem in India as almost 70 % of its surface water resources and a growing percentage of its groundwater reserves are contaminated by biological, toxic, organic, and inorganic pollutants. In many cases, these sources have been rendered unsafe for human consumption as well as for other activities, such as irrigation and industrial needs. This medicates that degraded water quality can contribute to water scarcity as it limits its availability for both human use and for the ecosystem sustainability .Therefore it is necessary that the quality of drinking water should be checked at regular intervals, as use of contaminated drinking water, may lead to rise in water borne diseases. The quality of ground water varies with location, depth of water table, season and by the extent and composition of dissolved solids.

Generally, higher proportions of dissolved constituents are found in ground water than in surface water because of greater interaction of ground water with various materials in geologic strata. Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers. The greater part of the soluble constituents in ground water comes from soluble minerals in soils and sedimentary rocks.

The growing competition for water and declining freshwater resources, the utilization of marginal quality water for agriculture has posed a new challenge for environmental management. Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms may cause serious major health problems.

In order to avoid the consequences. some parameters are needed to be examined before we call it potable or even useable for any purpose. The short descriptions of the same are given bellow:

## Iron

Anaerobic ground water may contain iron II at concentrations up to several milligrams per litre without discoloration or turbidity in the water when directly pumped from a well. Taste is not usually noticeable at iron concentrations below 0.3 mg/l, although turbidity and color may develop in piped systems at levels above 0.05 to 0.1 mg/l. Iron is an essential element in human nutrition. Estimates of the minimum daily requirement for Iron depend on age, physiological status, sex and iron bioavailability and range from about 10 to 50 mg/day. Coffee may even become unpalatable at concentration of Iron more than 1 mg/L.

## Chlorides

Chloride is one of the major inorganic anions in water. In potable water, the salty taste is produced due to the Chloride ion concentrations variability and dependent on the chemical composition. There is no known evidence that Chlorides constitute any human health hazard. For this reason, chlorides are generally limited to 250 mg/l in supplies intended for public use

## Sulphate

The major physiological effects resulting from the ingestion of large quantities of sulphate are catharsis, dehydration, and gastrointestinal irritation. Water containing Magnesium Sulphate at levels above 600 mg/l acts as a purgative in humans. The presence of Sulphate in drinking water can also result in a noticeable taste, the lowest taste threshold concentration for Sulphate is approximately 250 mg/l, as the Sodium salt. Sulphate may also contribute to the corrosion of distribution systems.

## Nitrate

Nitrates generally occur in trace quantities in surface water but may attain high levels in some ground water. Nitrite in water is either due to oxidation of Ammonium compounds or due to reduction of Nitrate. It can be toxic to certain aquatic organisms even at concentration of 1 mg/l. In excessive limits, it contributes to the illness known as Methemoglobinemia in infants.

## Fluoride

Traces of Fluorides are present in many water. Higher concentrations are often associated with underground sources. In seawater, a total Fluoride concentration of 1.3 mg/l has been reported. In groundwater, Fluoride concentrations vary with the type of rock that the water flows through but do not usually exceed 10 mg/l. Presence of large amounts of Fluoride is associated with dental and skeletal Fluorosis (1.5 mg/l) and inadequate amounts with dental caries (< 1 mg/l).

## Objectives of Study:

- To study Chemical analysis of drinking water.
- To find out the water quality potable water of Sonipat district.
- To make a Report on chemical analysis of water, with data of different rural areas of Sonipat district.

This would help take essential steps to provide clean water to the rural region people and to restore the water table. Requirement of treatment of water would be validated in the rural areas.

All the required Tests are done and results are analyzed on the basis of the Indian Standard, Drinking water–Specification IS. 10500.1991.

## Study Area:

Haryana is one of the most important states of India which contributes to the economy of the country majorly due to agriculture and related activities. It is enough irrigated with rivers and enough water resources are available. But due to industrialization and use of chemical fertilizers, ground water contamination is a concern. So water analysis in this state could help understand

## Materials and Methodology:

A few parameters were studied and analyzed in the Public Health and engineering Department Water Testing laboratory, Sonipat. The parameters analyzed are:

### Chloride:

Chloride ions present in water samples can be determined by titration using Mohar Salt. Mainly Chloride ions are found in the form of Sodium Chloride the common salt Silver Nitrate is commonly used as a titrant for determining an unknown sodium Chloride concentration. The Silver and Chloride ions react in a 1 to 1 molar ratio, which makes the calculations involved in this particular titration relatively easy.

Use your balance to measure 2.55 grams of solid Silver Nitrate. Add this quantity to your 500 mL beaker and add water until the beaker is filled to the 300 mL mark. Stir the solution until all of the Silver Nitrate is dissolved. This will create a 0.05 Molar (M) Silver Nitrate solution.

Load your titration burette with 0.05 Silver Nitrate. Add 30 mL of your unknown Chloride solution to your 100 mL beaker. Add 3 drops of indicator solution to the beaker, then place it underneath the burette.

Release a slow stream of Silver Nitrate from the burette into the beaker, swirling the Chloride solution all the while. Immediately stop adding Silver Nitrate when a transparent peach color appears in the Chloride solution and does not disappear. This color change indicates that the solution has reached the equivalence point where the amount of Silver ions is equal to the amount of chloride ions.

**Moles of Silver Nitrate used = 0.05 moles/L x 0.015 L = 0.00075 moles**

Calculate the molar concentration of the Chloride solution by dividing the number of moles present by the volume of the solution in liters.

**Chloride solution concentration = 0.00075 moles / 0.03 L = 0.025 M**

**Sulphate:**

Sulphates are widely distributed in nature and may be present in natural water in concentration ranging from few hundred to several thousand mg/L.

**Principal:**

The turbidimetric method of measuring Sulphates is based upon the fact that Barium Sulphates tends to precipitate in a colloidal form of uniform size and that this tendency is enhanced in presence of a Sodium Chloride, Hydrochloric Acid and glycerol.

$SO_4{}^{2-} + BaCl^2$ □ $BaSO_4$

The Sulphate ions are precipitated as $BaSO_4$ and absorbance of the Barium Sulphates formed is measured by a spectrophotometer at 420 nm and the Sulphates ion concentration is determined by comparison of the reading with a standard curve.

**Procedure**

PREPARATION OF REAGENTS

**Conditioning reagent**

- Measure exactly 25 ml glycerol and pour it to a dry clean beaker.
- Then, measure 15 mL of concentrated Hydrochloric Acid and add it to the same beaker.
- To the same beaker, add exactly 50 mL of 95 % isopropyl alcohol and mix well.
- Accurate weigh 37.5 g Sodium Chloride and dissolve it in distilled water.
- Then mix all the contents and make up the final volume to 250 mL using distilled water.

**Standard sulphate solution**

- Weigh accurately 1.479 g anhydrous Sodium Sulphate and dissolve it in distilled water.
- Take 1000 mL standard measuring flask and place a funnel over it.
- Transfer it to the 1000 mL standard flask and make up to 1000 mL using distilled water.
- (1 mL = 1.0 mg SO42−) Preparation of Blank, Standards and sample for Testing
- Take six 50 mL glass stoppered standard flask (four for standards, one for the sample and one for the blank).

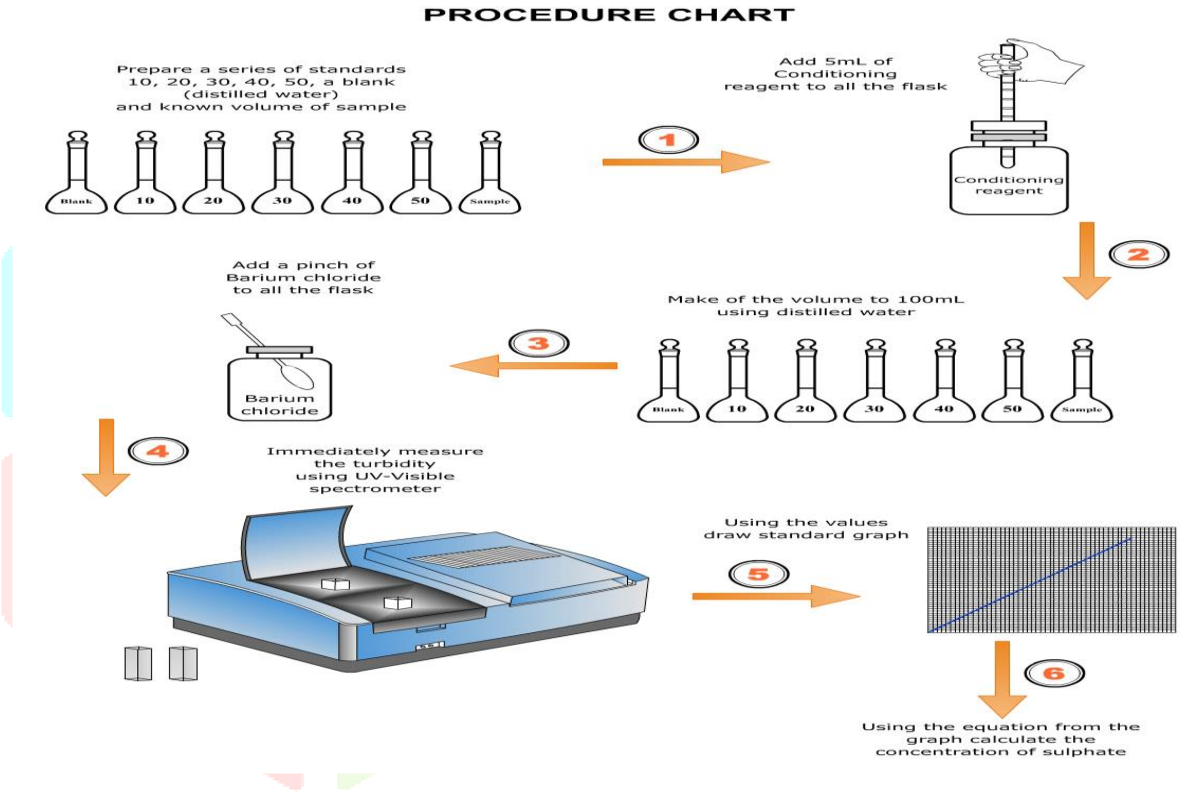
- Add 10 mL of the standard sulphate solution to the first standard flask, 20 mL to the second, 30 mL to the third and 40 mL to the fourth.

- To the fifth standard flask add 20 mL of the sample water.

- The sixth standard flask is for the blank, to this standard flask add distilled water alone.

- Add 5 mL of conditioning reagent to all the standard flasks.

- Then make up the volume to the 100 mL mark using distilled water.



**Nitrate:**

**Ultraviolet Spectrophotometric Method**

- Useful for uncontaminated natural water and potable water supplies with low organic content

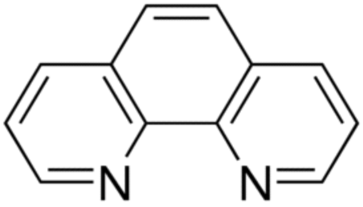
- **Procedure:**

- Filter the sample and add 1 ml of 1N HCl per 50 ml of sample

- Read absorbance or transmittance at 220 nm and 275 nm

- Set 0 absorbance or 100% transmittance with distilled water

**Iron:**



**1,10 Phenanthroline**

The formation of the red/orange-colored iron- Phenanthroline complex requires the iron to be in the $Fe^{2+}$ form, and the procedure thus includes the reagent Hydroxylamine Hydrochloride ($NH_2OH \bullet HCl$ ) that will reduce all the iron in the sample to the ferrous form. Sodium Acetate ($NaC_2H_3O_2$) is used to control the pH of the solution since it can also affects the absorbance. The red/orange Iron- phenanthroline complex absorbs light at 508 nm, which is green light.

$Fe^{2+} + 3\ phen \quad \square \quad Fe(phen)_3{}^{2+}$

### Solutions available

- 0.29 M Hydroxylamine Hydrochloride ($NH_2OH{\bullet}HCI$): measure out about 12 mL to a small beaker.
- 5.0 x10-3 M 1,10-phenanthroline: measure out about 50 mL to a 100 or 200 mL beaker.
- 1.2 M Sodium Acetate: measure out about 50 mL to a 100 or 200 mL beaker.
- 2 M $H_2SO_4$ (strong oxidizing acid.)

### Solution to be prepared

- Standard Iron solution (5.0 $x10^{-4}$ M). Accurately weigh 0.100 g $Fe(NH_4)_2(SO4)^{2-}6H_20$
- Transfer quantitatively into a 500-mL volumetric flask.
- Add 10 mL of 2 M H2SO4 and 50-mL deionized water to the flask to dissolve the Fe(NH4)2(SO4)2·6H2O completely.
- Fill the flask to the mark with deionized water and mix thoroughly.

### Procedure

- **Preparing the working standard solutions**. Pipet out 0, 0.5, 1.0, 1.5, 2.0, and 2.5 mL of the standard iron solution into a series of six 50 mL volumetric flasks.

a) 1 mL of the Hydroxylamine solution

b) 5 mL of the Sodium Acetate solution

c) 5 mL of the 1,10-phenanthroline solution.

Fill each flask to the mark with deionized water and mix thoroughly. Allow the solutions to stand for 10 min. Mix the solutions again before measuring the absorbance.

- Measuring the blank to determine any possible absorbance from the matrix (i.e., the other reagents), deionized water will be used as the blank. Fill in the cuvette place it the holder and blank the spectrometer.
- Measuring the standards Rinse the cuvette with each solution (including the zero-iron concentration sample) three times, and then fill it with the solution, place it in the holder, and measure the absorbance.
  Repeat the measurement with a fresh aliquot of the solution

**Calculation**

(1) Calculate the analytical concentration of iron in the standard Iron solutions. Tabulate the observed absorbance and the derived concentrations (in ppm and molarity) of Iron for all the standards. (Do not forget to consider the dilution factors in your calculations.)

2) Plot the absorbance vs. Iron concentration for the standards (including the iron free solution.) Use the method of least-squares (i.e., linear regression) to derive the Beers law equation in the form of

$$A = m[Fe]^{+b}$$

- Calculate the molar absorptivity of $Fe(phen)_3{}^{2+}$ at 508 nm.

**Fluoride:**
**Principle**

The SPADNS colorimetric method is based on the reaction between Fluoride and a Zirconium-dye lake. Fluoride reacts with the dye lake, dissociating a portion of it into a colorless complex anion ($ZrF_2{}^{-6}$) and the dye.

As the amount of Fluoride increases, the color produced becomes lighter.

The reaction rate between Fluoride and Zirconium-dye ions is influenced greatly by the acidity of the reaction mixture. If the proportion of acid in the reagent is increased, the reaction can be made almost instantaneous.

**Reagents and Apparatus**

**Stock fluoride solution:** 221.0 mg anhydrous of NaF, was dissolved in deionized water and diluted to 1000 mL

**Standard fluoride solution:** 100 mL of stock Fluoride solution was diluted to 1000 mL with deionized water

**SPADNS solution**: 95.8 mg of SPADNS, sodium 2-(parasulfophenylazo)-1,8-dihydroxy-3,6-napthalene disulfonate was dissolved in deionized water and diluted to 50 mL.

**Zirconyl-acid reagent:** 13.3 mg of Zirconyl Chloride Octahydrate, $ZrOCl_2.8H_2O$, was dissolved in about 2.5 ml of deionized water and35 mL of HCl (35%) were added. The solution was made up to 50mL by adding deionized water.

**Zirconyl -SPADNS reagent:** The SPADNS and Zirconyl Chloride solutions were mixed in equal volumes to produce a SPADNS-$ZrOCl_2$complex, henceforth referred to as reagent S. This reagent is stable for more than 2 years if stored away from light. A UV-Visible spectrophotometer for use at 570 nm.6

**Procedure**

- Fluoride standards in the range of 0 to 1.4 mg $F^-$/L were prepared by diluting appropriate quantities of standard Fluoride solution to 50mL.
- 10 mL of the reagent S were added to each of the standards and mixed well.
- The standard which has 0 mg $F^-$/L was taken as the reference solution and the spectrophotometer was set to zero absorbance.
- The absorbance readings of other standards were taken with respect to the reference solution and were used to construct the calibration curve.
- A slightly modified version of the above-mentioned procedure was used to measure fluoride concentrations greater than 1.4 mg/L.
- Through this method we can find Fluoride concentration up to 5 mg/L in water. Fluoride standards in the range of 0 to 5 mg $F^-$/ L were prepared by diluting appropriate quantities of standard Fluoride solution to 50 mL. 5 mL of each of these standards were pipetted out in separate beakers and 5 mL of the reagent S were added to each of these beakers and the volume was made up to 30 mL using deionized water in each beaker.
- A solution of 5 mL of reagents to 25 mL of deionized water was used as a reference.
- The absorbance readings of other standards were taken with respect to the reference solution and were used to construct the calibration curve. Polynomial regression was also done to find the best equation that fits the graph.

**Results:**

There were 21 sources of water sample were taken for analysis of after quality from different rural areas of Sonipat district out of which 16 sources of water have all analyzed parameters within desirable limit and water can be used for drinking or it is potable. 05 sources of water have some analyzed parameters more than the desirable limits and some within or more than permissible limits which are considered as not potable water.

**The limits of parameters are as follows:**

| **Parameters** | **BIS standards Desirable** | **BIS standards Max. Permissible** |
|---|---|---|
| **Chloride (mg/l)** | 250 | 1000 |
| **Sulphate (mg/l)** | 200 | 400 |
| **Fluoride (mg/l)** | 1.0 | 1.5 |
| **Iron (mg/l)** | 0.3 | 1.0 |
| **Nitrate (mg/l)** | 45 | 45 |

**Data of chemically analyzed samples from different sources:**

| S.No. | Sources of Samples | Chloride (mg/l) | Sulphate (mg/l) | Fluoride (mg/l) | Iron (mg/l) | Nitrate (mg/l) | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | Village Nahra R.O Water | 110 | 55 | 0.42 | 0.01 | 0.2 | Potable |
| 2 | Malik Service R.O Water | 20 | 20 | Nil | Nil | 0.1 | Potable |
| 3 | Jangra Service R.O Water | 20 | 15 | Nil | Nil | Nil | Potable |
| 4 | Fazilpur Tube well | 690 | 602 | 1.91 | 0.06 | 1.4 | Not Potable |
| 5 | Submersible Motor-1 | 1000 | 452 | 1.55 | 0.01 | 1.6 | Not Potable |
| 6 | FWROP SO’s Mess | 30 | 14 | 0.11 | 0 | 0.8 | Potable |
| 7 | FWROP officer’s mess | 20 | 9 | 0.06 | 0.02 | 1.5 | Potable |
| 8 | FWROP SEA quarters | 30 | 10 | 0.1 | Nil | 0.1 | Potable |
| 9 | Village Pabsara New Tube well | 2060 | 728 | 0.89 | Nil | 0.1 | Not Potable |
| 10 | Village- Rewali Tube well | 460 | 510 | 1.65 | 0.01 | 1.5 | Not Potable |
| 11 | Village- Sadipur Tube well-1 | 120 | 176 | 0.05 | 0.03 | 7 | Potable |
| 12 | Village- Sadipur Tube well-2 | 210 | 174 | 0.12 | 0.02 | 6.8 | Potable |
| 13 | Village- Liwan Tube well-2 | 260 | 99 | 0.44 | 0.01 | 2.2 | Potable |
| 14 | Village- Kabirpur Tube well-1 | 20 | 165 | 1.2 | 0.01 | 1.4 | Potable |
| 15 | Village- Kabirpur Tube well-2 | 240 | 172 | 1.02 | 0.01 | 9.2 | Not potable |
| 16 | Village- Kabirpur Tube well-3 | 110 | 156 | 0.05 | 0.01 | 3.3 | Potable |
| 17 | Village- Ratdana Tube well- 2 | 200 | 132 | 0.08 | 0.02 | 4.8 | Potable |
| 18 | Village- Baiyapur Khurd Tube well-1 | 360 | 175 | 1.35 | 0.02 | 5.2 | Potable |
| 19 | Village- Mandora Water Works | 80 | 208 | 0.15 | 0.02 | 1.8 | Potable |
| 20 | Village- Mozamnagar Tubewell-1 | 200 | 150 | 0.86 | 0.01 | 2.1 | Potable |
| 21 | Village- Ridhau Tube well-1 | 290 | 245 | 0.2 | 0.01 | 0.7 | Potable |

## Conclusions:

Water samples from various sites of villages of drinking water were collected. Taking into consideration all the data report of samples carefully it is concluded that water quality index of Sonipat is calculated on the basis of the samples collected from various sites i.e. ground water samples. Various physical and physio- chemical parameters were taken into consideration including ions of Chloride,Suphate,Nitrate,Iron and Fluoride for calculation and evaluation of quality of water in view of potability. For different areas different values for all the parameters were obtained. Concentration of dissolved salts of FeSO4/Fe(OH)2 is found low to NIL. Also, concentration of Fluoride ion is low at almost all the locations.

Based on the above analysis the water is stated as potable or not potable. Out of 21 total locations water of 05 locations is marked as not potable means water of that location cannot be used for human consumption. Whereas water samples of 16 locations is stated potable as it is completely fit for human consumption.

Based on the above results we can conclude that most of the ground water supplied in Sonipat area is not polluted to greater extent because the locations of water samples with potable results is away from industrial areas and water which is not good for human use has more concentration of Fluoride and metal like Fe (iron ions) concentration of metals is harmful for human purposes and is thus avoided.

Undisputedly, it is reiterated that water supply resources for humans consumption should be away from industrial sites i.e. in remote areas of villages where it is least probability of mixing of pollutants in ground source of potable water to be supplied. Resultantly health hazards can be minimized by doing so.

On close examination of reports it is also adduced that we can overcome the use of pollutants/pesticides/fertilizers/herbicides/fungicides/insectides etc in order to retain the potability of ground water for human consumption as these contaminants percolate through the pores of soil and intermingle with the beded water.

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