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Research Article

A SURVEY ON UNDERGROUND WATER QUALITY IN TIRUPUR DISTRICT

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ABSTRACT

In Tirupur district and its surrounding areas, the ground water gets polluted by the industrial effluents. This project deals with a detailed study about the ground water and its pollutants. The samples of water are to be collected from Noyyal river belt and also from the sources of water within 30 km of radius from centre of Tirupur. Sequence of laboratory tests are to be done with the collected water sample. These test results are to be observed and inferred for the drinking and construction purpose.

Keywords: Water Hardness, Chlorides, Sulphates, Alkalinity, Acidity, Turbidity, Total Dissolved Solids.

INTRODUCTION

The Millennium Ecosystem Assessment defines an eco-system as a "dynamic complex of plant, animal, and micro-organism communities and the non-living environment interacting as a functional unit". Humans are an integral part of ecosystems. Ecosystem services are the benefits people obtain from ecosystems, which include provisioning services such as food and water regulatory services such as regulation of floods, drought, land degradation, and diseases, supporting services such assoil formation and nutrient cycling; and cultural services such as recreation, spiritual, religious and other non - material benefits.

In this scenario, Industrial pollution has been continues to be a major factor causing the degradation of our environment around us. But the ground water also polluted by the industrial effluents while disposing them in a dry bore holes. By those disposal, the ground water contains more chemicals by the industrial effluents .The polluted water is arguably the most serious threat to current human welfare and construction activities. The polluted ground water may also have more chemical reactions while it will be used in construction purposes. It may have more chances to get chemical attack in the concrete structures.

Some of the water samples are more hazardous to human health and affects the overall life of the concrete structures. Due to that the improper properties in the water it may cause cancer, breathing trouble, etc.., in construction activity it may affect the strength and durability of the concrete and it may get corroded due to the acid attack. For arresting those types of hazardous activities in both drinking and construction activity, by means of conducting the laboratory tests for the water samples in Tirupur. In those tests, the values of the water samples should be in an acceptable limit as per IS: 10500 and IS:456-2000 for the drinking and construction purposes.If the samples are get polluted, that the polluted water must need the treatment process for getting the acceptable limit. This project also deals with the necessary treatment process for getting the specified limit of the water in that polluted area.

SCOPE

The scope of the present work is to study experimentally the characteristics of water samples which are situated in Tirupur and a radius of 30 km from its centre. The laboratory tests are conducted to find the characteristics of polluted water samples. The exact remedies are carried out for the excess content present in the water sample.

OBJECTIVE

To study the characteristics of water samples, the following tests have to be conducted on water samples.

- Determination of pH
- Determination of Chlorides
- Determination of Sulphates
- Determination of Hardness
- Determination of Total Dissolved Solids
- Determination of Acidity
- Determination of Alkalinity
- Determination of Turbidity

GENERAL TERMS:

I. pH

pH is a measure of the activity of the (solvated) hydrogen ion. p[H] which measures the hydrogen ion concentration is closely related to and is often written as pH. Pure water has a pH very close to 7 at 25°C. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline. The pH scale is traceable to a set of standard solutions whose pH is established by international agreement. pH is defined as the decimal logarithm of the reciprocal of the hydrogen ion activity aH+ in a solution.

$$\mathrm{pH} = -\log_{10}(a_{\mathrm{H}^+}) = \log_{10}\left(\frac{1}{a_{\mathrm{H}^+}}\right)$$

Acceptable limit of pH ranges from 6.5 – 8.5.

II. CHLORIDES

The chloride ion is formed when the element chlorine, a halogen, gains an electron to form an anion (negatively charged ion) Cl−. The salts of hydrochloric acid contain chloride ions and can also be called chlorides. The chloride ion and its salts such as sodium chloride, are very soluble in water. It is an essential electrolyte located in all body fluids responsible for maintaining acid/base balance, transmitting nerve impulses and regulating fluid in and out of cells.The word chlorides can also form part of the name of chemical compounds in which one or more chlorine atoms are covalently bonded. Acceptable limits of chlorides are 250 mg/lit and if there is no alternate source, it may be extended up to 1000 mg/lit.

III. SULPHATES

Sulphate is a naturally occurring substance that contains sulphur and oxygen. It is present in various mineral salts that are found in soil. Sulphate forms salts with a variety of elements including barium, calcium, magnesium, potassium and sodium.Sulphate should not be confused with sulphite. Sulphite also contains sulphur and oxygen, but is chemically different than sulphate.

Acceptable limits of Sulphates are 200 mg/lit to 400 mg/lit.

IV. HARDNESS

Hard water is water that has high mineral content (in contrast with "soft water").Hard drinking water is generally not harmful to one's health but can pose serious problems in industrial settings where water hardness is monitored to avoid costly breakdowns in boilers, cooling towers, and other equipment that handles water. In domestic settings hard water is often indicated by a lack of suds formation when soap is agitated in water. Wherever water hardness is a concern the water softening is commonly used to reduce hard water's adverse effects.

Acceptable limits of Total hardness are 200 mg/lit to 600 mg/lit. 9

a) Temporary Hardness

Temporary hardness is a type of water hardness caused by the presence of dissolved bicarbonate minerals (calcium bicarbonate & magnesium bicarbonate). When dissolved these minerals yield calcium & magnesium cations (Ca2+, Mg2+) and carbonate and bicarbonate anions (CO32-, HCO3-). The presence of the metal cations makes the water hard. However, unlike the permanent hardness caused by sulphate and chloride compounds, this temporary hardness can be reduced either by boiling the water, or by the addition of lime (calcium hydroxide) through the softening process of lime softening. Boiling promotes the formation of carbonate from the bicarbonate and precipitates calcium carbonate out of solution, leaving water that is softer upon cooling.

b) Permanent Hardness

Permanent hardness is hardness (mineral content) that cannot be removed by boiling. When this is the case, it is usually caused by the presence of calcium sulphate and/or magnesium sulphates in the water, which precipitates out as the temperature increases. Ions causing permanent hardness of water can be removed using a water softener, or ion exchange column.

Total Permanent Hardness = Calcium Hardness + Magnesium Hardness

The calcium and magnesium hardness is the concentration of calcium and magnesium ions expressed as equivalent of calcium carbonate. Total permanent water hardness expressed as equivalent of CaCO3 can be calculated with the following formula: Total Permanent Hardness (CaCO3) = 2.5 Ca+++ 4.1 Mg++ 10

V. TOTAL DISSOLVED SOLIDS (TDS)

Total Dissolved Solids (often abbreviated TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form. Generally the operational definition is that the solids must be small enough to survive filtration through a sieve the size of two micrometer. Total dissolved solids are normally discussed only for freshwater systems, as salinity comprises some of the ions constituting the definition of TDS. The principal application of TDS is in the study of water quality for streams, rivers and lakes, although TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with1 + health effects) it is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants.

Acceptable limits of Total Dissolved Solids are 500 mg/lit to 1500 mg/lit.

VI. ALKALINITY

Alkalinity measures the ability of a solution to neutralize acids to the equivalence point of carbonate or bicarbonate. The alkalinity is equal to the stoichiometric sum of the bases in solution. In the natural environment carbonate alkalinity tends to make up most of the total alkalinity due to the common occurrence and dissolution of carbonate rocks and presence of carbon dioxide in the atmosphere. Other common natural components that can contribute to that alkalinity include borate, hydroxide, phosphate, silicate, nitrate, dissolved ammonia, the conjugate bases of some organic acids and sulfide. Solutions produced in a laboratory may contain a virtually limitless number of bases that contribute to alkalinity. Alkalinity is usually given in the unit meq/L (milliequivalent per litre). Commercially, as in the swimming pool industry, alkalinity might also be given in the unit parts per million. Acceptable limits of Alkalinity are 200 mg/lit to 600 mg/lit.

COLLECTION OF WATER SAMPLE:

Bore water samples are collected directly through pipe as shown in Figure.1.1 and 1.2.

The stagnant water is not fit for testing because the solids get deposited in the bottom.

Figure 1: Collection of water samples

Figure 2: Collection of water samples

COLLECTION OF WATER SAMPLES

Following Table 1 represents the places of collected water samples:

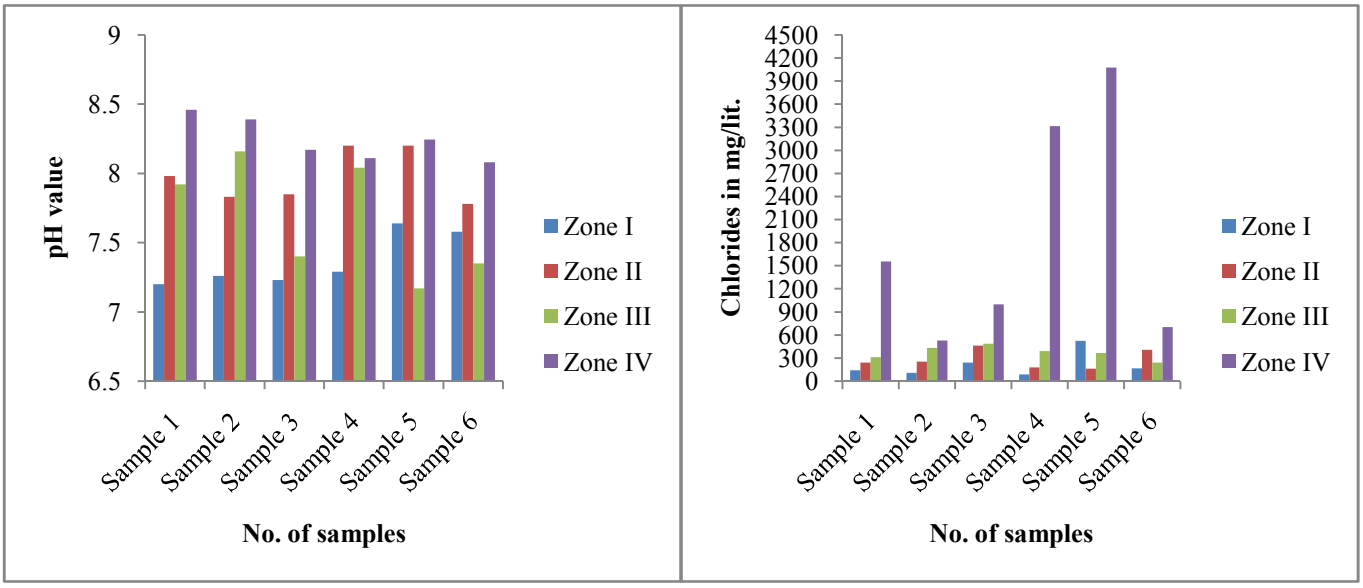
Table 1: SAMPLE NAME AND THEIR PLACES

Sl. NO	SAMPLE NAME	PLACE
1.	PN-1	Sokkannur
2.	PN-2	Vallipuram
3.	PN-3	Perumanallur
4.	PN-4	Kasthoori Nagar
5.	PN-5	Puluvapatti
6.	PN-6	New Bustand
7.	P-7	ThennamPalayam
8.	P-8	Nochippalayam
9.	P-9	Karaippudhur
10.	P-10	Arul Puram
11.	P-11	KoundamPalayam
12.	P-12	KoundamPalayamPirivu
13.	P-13	Rayappalayam
14.	P-14	Varappalayam
15.	P-15	SamrajPalayam
16.	P-16	KomaraPalayam
17.	P-17	PachaamPalayam
18.	A-18	S-Mettuppalayam
19.	A-19	Sri Vignesh Nagar
20.	A-20	AvinashilinghamPalayam
21.	A-21	JJ Nagar
22.	A-22	AnupparPalayam
23.	A-23	PachaamPalayam
24.	A-24	ThenaamPalayam
25.	A-25	KaalamPalayam
26.	A-26	Poondi
27.	A-27	RakkiyaPalayam
28.	K-28	RettiPalayam
29.	K-29	Kathaanganni
30.	K-30	VayakkattuPudhur
31.	K-31	RettipalayamPirivu
32.	K-32	SanaarPalayam
33.	K-33	ValaSamuthiramPudhur
34.	K-34	VelayuthamPalayam
35.	K-35	BalaSamuthiram Nagar
36.	K-36	RettiValasu
37.	K-37	Nathakkadaiyur
38.	K-38	Marudhurai
39.	K-39	Palayakottai
40.	K-40	Muthur
41.	K-41	Metukkadai
42.	K-42	SengodamPalayam
43.	K-43	VelayuthamPalayam
44.	K-44	Kuttappalayam
45.	K-45	KaspaPalayakottai

Table 1, shows the collection of water samples in Tirupur District. Here PN represents Zone I, P represents Zone II, A represents Zone – III and K represents Zone IV.

RESULTS

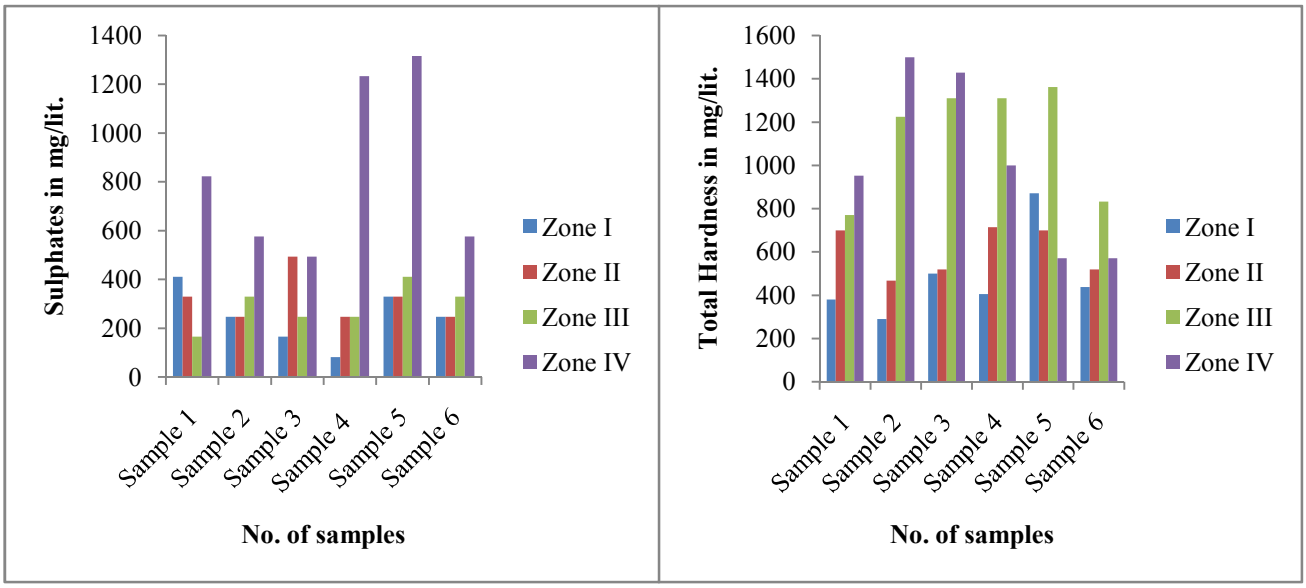
In all results, the maximum values of 6 samples has been taken in each zone.



pH Comparison chart **Chloride Comparison chart**

Figure 3: pH and Chloride content comparison chart

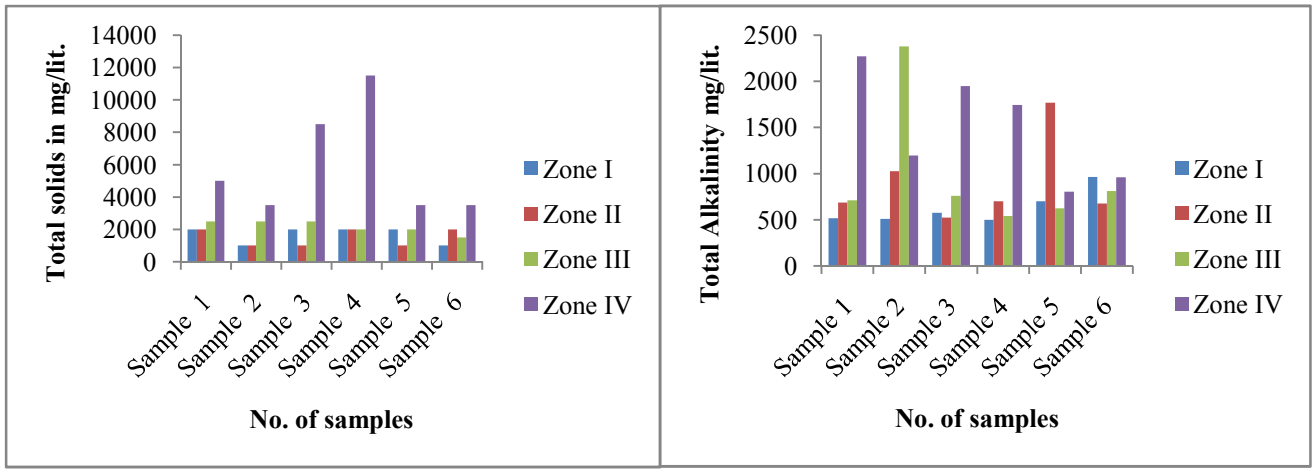
Figure 3, represents the pH and Chloride contents of all zones, in these all pH values are in acceptable limits. But in chlorides Zone IV exceeds 4000 mg/lit., which is not suitable for drinking purpose. The acceptable limit of chlorides is 250 mg/lit., or it may extend up to 1000 mg/lit.



Comparison of Sulphate content **Comparison of Total Hardness**

Figure 4: Sulphates and Total Hardness content comparison chart

Figure 4, represents the sulphate and Hardness in the sample. In which Zone IV exceeds the sulphate content of 1300 mg/lit., the acceptable limit is 200 mg/lit. and it may extend up to 400 mg/lit. In Hardness also, Zone IV exceeds the maximum level. Acceptable limit of Hardness is 300 mg/lit. or it may extend up to 600 mg/lit.



Comparison of Total solids **Comparison of Alkalinity**

Figure 5: Total Solids and Alkalinity content comparison chart

Figure 5, shows the Total Solids and Alkalinity present in the sample. In which Zone IV exceeds the Total solids content of 11000 mg/lit., the acceptable limit is 500 mg/lit. and it may extend up to 1500 mg/lit. In Alkalinity Zone III exceeds 2300 mg/lit. Acceptable limit of Alkalinity is 200 mg/lit. or it may extend up to 600 mg/lit.

- Acidity and Turbidity are in Acceptable limits

Remedies:

The following are the methods which is suited for removing the excess contents in the water:

1. Neutralizing Filters
2. Soda Ash/Sodium Hydroxide Injection
3. Acid Injection
4. Reverse Osmosis
5. Distillation
6. De-ionization
7. Ion exchange
8. Nano-filtration
9. Lime softening

CONCLUSION

The various water samples are tested in the laboratory, some of the samples are exceeds the acceptable limit as per the standards. More contaminated or a maximum values of samples are required to treat before using for drinking and construction purposes. Treatment process for construction and drinking purposes like

1. Reverse Osmosis,
2. Ion Exchange,
3. Sedimentation,
4. De-Ionization,
5. Filtration, etc..,

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