

A study on Water Quality Parameters Using Physico- Chemical Parameters In Industrial And Agricultural Areas.

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Abstract

It is needless to emphasize the importance of water in our life. We need water for different purposes. Water for different purposes has its own requirements for the composition and purity and each body of water has to be analyzed on a regular basis to confirm to suitability. The types of analysis could vary from simple field testing for a single analyte to laboratory based multi component instrumental analysis. The analytical process involves sampling and sample storage since changes in composition of water do not stop once the sampling has been taken. Precaution has to be taken to make sure that the water reaching the laboratory has the same composition as it did when the sampling was done. This made our interest to investigate physico – chemical analysis of water sample collected from different areas in and around Salem town. This paper mainly focuses on water quality parameters like pH, TDS, alkalinity etc.

Keywords: General characteristics, water quality parameters, comparative study, graphical representation of data.

1. Introduction

The water cycle, also known as the hydrological cycle, describes the continuous movement of water on, above and below the surface of the Earth. Since the water cycle is truly a "cycle," there is no beginning or end. Water can change states among liquid, vapor, and ice at various places in the water cycle. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go. [1]

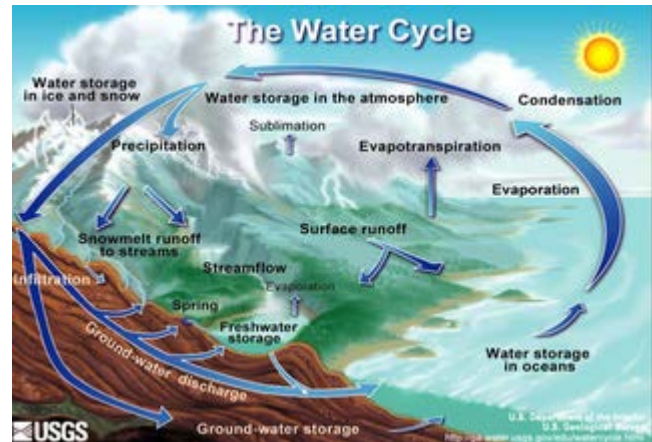


Fig.1 Water cycle

The sun, which drives the water cycle, heats water in the oceans. Water evaporates as vapor into the air. Ice and snow can sublimate directly into water vapor. Evapotranspiration is water transpired from plants and evaporated from the soil. Rising air currents take the vapour up into the atmosphere where cooler temperatures cause it to condense into clouds. Air currents move clouds around the globe; cloud particles collide, grow, and fall out of the sky as precipitation. [2] Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snow packs can thaw and melt, and the melted water flows over land as snowmelt. [2]

Most precipitation falls back into the oceans or onto land, where the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with stream flow moving water towards the oceans. Runoff and groundwater are stored as freshwater in lakes. Not all runoff flows into rivers. Much of it soaks into the ground as infiltration. Some water infiltrates deep into the ground and replenishes aquifers, which store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and

can seep back into surface-water bodies (and the ocean) as groundwater discharge. Some groundwater finds openings in the land surface and comes out as freshwater springs. Over time, the water returns to the ocean, where our water cycle started. [2]

1.1 Ground water

Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations. The study of the distribution and movement of groundwater is hydrogeology, also called groundwater hydrology. Groundwater makes up about twenty percent of the world's fresh water supply, which is about 0.61% of the entire world's water, including oceans and permanent ice. Groundwater is naturally replenished by surface water from precipitation, streams, and rivers when this recharge reaches the water table. It is estimated that the volume of groundwater comprises 30.1% of all freshwater resource on earth compared to 0.3% in surface freshwater; the icecaps and glaciers are the only larger sources of fresh water on earth at 68.7%. Groundwater is the major source of drinking water in both urban and rural India. Besides, it is an important source of water for the agricultural and the industrial sector. Water utilization projections for 2000 put the groundwater usage at about 50%. Being an important and integral part of the hydrological cycle, its availability depends on the rainfall and recharge conditions. Till recently it had been considered a dependable source of uncontaminated water. [3]

The demand for water has increased over the years and this has led to water scarcity in many parts of the world. The situation is aggravated by the problem of water pollution or contamination. India is heading towards a freshwater crisis mainly due to improper management of water resources and environmental degradation, which has led to a lack of access to safe water supply to millions of people. This freshwater crisis is already evident in many parts of India, varying in scale and intensity depending mainly on the time of the year. [4]

Groundwater crisis is not the result of natural factors; it has been caused by human actions. During the past two decades, the water level in several parts of the country has been falling rapidly due to an increase in extraction. The number of wells drilled for irrigation of both food and cash crops have rapidly and indiscriminately increased. India's rapidly rising population and changing lifestyles has also increased the domestic need for water. The water requirement for the industry also shows an overall increase. [4]

1.1.1 Ground Water Pollution

About half the population in the United States relies to some extent on groundwater as a source of drinking water, and still more use it to supply their

factories with process water or their farms with irrigation water. However, if all water uses such as irrigation and power production are included, only about 25 percent of the water used nationally is derived from groundwater. Still, for those who rely on it, it is critical that their groundwater be unpolluted and relatively free of undesirable contaminants. A groundwater pollutant is any substance that, when it reaches an aquifer, makes the water unclean or otherwise unsuitable for a particular purpose. Sometimes the substance is a manufactured chemical, but just as often it might be microbial contamination. Contamination also can occur from naturally occurring mineral and metallic deposits in rock and soil. [5]

For many years, people believed that the soil and sediment layers deposited above an aquifer acted as a natural filter that kept many unnatural pollutants from the surface from infiltrating down to groundwater. By the 1970s, however, it became widely understood that those soil layers often did not adequately protect aquifers. Despite this realization, a significant amount of contamination already had been released to the nation's soil and groundwater. Scientists have since realized that once an aquifer becomes polluted, it may become unusable for decades, and is often impossible to clean up quickly and inexpensively. [5]

Groundwater pollution caused by human activities usually falls into one of two categories: point-source pollution and nonpoint-source pollution. Point-source pollution refers to contamination originating from a single tank, disposal site, or facility. Industrial waste disposal sites, accidental spills, leaking gasoline storage tanks, and dumps or landfills are examples of point sources. Chemicals used in agriculture, such as fertilizers, pesticides; and herbicides are examples of nonpoint-source pollution because they are spread out across wide areas. Similarly, runoff from urban areas is a nonpoint source of pollution. [6]

Because nonpoint-source substances are used over large areas, they collectively can have a larger impact on the general quality of water in an aquifer than do point sources, particularly when these chemicals are used in areas that overlie aquifers that are vulnerable to pollution. If impacts from individual pollution sources such as septic system drain fields occur over large enough areas, they are often collectively treated as a nonpoint source of pollution. [6]

Some groundwater pollution occurs naturally. The toxic metal arsenic, for instance, is commonly found in the sediments or rock of the western United States, and can be present in groundwater at concentrations that exceed safe levels for drinking water. Radon gas is a radioactive product of the decay of naturally occurring uranium in the Earth's crust. Groundwater entering a house through a

home water-supply system might release radon indoors where it could be breathed. [6]

The one of the best known classes of groundwater contaminants includes petroleum-based fuels such as gasoline and diesel. Nationally, the U.S. Environmental Protection Agency (EPA) has recorded that there have been over 400,000 confirmed releases of petroleum-based fuels from leaking underground storage tanks. [6]

Gasoline consists of a mixture of various hydrocarbons (chemicals made up of carbon and hydrogen atoms) that evaporate easily, dissolve to some extent in water, and often are toxic. Benzene, a common component of gasoline, is considered to cause cancer in humans, whereas other gasoline components, such as toluene, ethylbenzene, and xylene, are not believed to cause cancer in humans but may be toxic in other ways. One interesting property of gasoline is that it is less dense than water, and so it tends to float on top of the water table. [6]

Another common class of groundwater contaminants includes chemicals known as chlorinated solvents. One example of a chlorinated solvent is dry-cleaning fluid, also known as perchloroethylene. These chemicals are similar to petroleum hydrocarbons in that they are made up of carbon and hydrogen atoms, but the molecules also have chlorine atoms in their structure. [6]

As a general rule, the chlorine present in chlorinated solvents makes this class of compounds more toxic than fuels. Unlike petroleum-based fuels, solvents are usually heavier than water, and thus tend to sink to the bottoms of aquifers. This makes solvent-contaminated aquifers much more difficult to clean up than those contaminated by fuels. [7]

1.2 A brief description of the contamination sources follows.

1.2.1 Natural:

Groundwater contains some impurities, even if it is unaffected by human activities. The types and concentrations of natural impurities depend on the nature of the geological material through which the groundwater moves and the quality of the recharge water. Groundwater moving through sedimentary rocks and soils may pick up a wide range of compounds such as magnesium, calcium, and chlorides. Some aquifers have high natural concentration of dissolved constituents such as arsenic, boron, and selenium. The effect of these natural sources of contamination of groundwater quality depends on the type of contaminant and its concentrations. [8]

1.2.2 Agricultural:

Pesticides, fertilizers, herbicides and animal waste are agricultural sources of groundwater contamination. The agricultural contamination sources are varied and

numerous: spillage of fertilizers and pesticides during handling, runoff from the loading and washing of pesticide sprayers or other application equipment, using chemicals uphill from or within a few hundred feet of a well. Agricultural land that lacks sufficient drainage is considered by many farmers to be lost income land.. The drainage well then serves as a direct conduit to groundwater for agricultural wastes which are washed down with the runoff. Storage of agricultural chemicals near conduits to groundwater, such as open and abandoned wells, sink holes, or surface depressions where ponded water is likely to accumulate. Contamination may also occur when chemicals are stored in uncovered areas, unprotected from wind and rain, or are stored in locations where the groundwater flows from the direction of the chemical storage to the well.[9]

1.2.3 Industrial:

Manufacturing and service industries have high demands for cooling water, processing water and water for cleaning purposes. Modern economic activity requires transportation and storage of material used in manufacturing, processing, and construction. Along the way, some of this material can be lost through spillage, leakage, or improper handling. The disposal of wastes associated with the above activities contributes to another source of groundwater contamination. Some businesses, usually without access to sewer systems, rely on shallow underground disposal. [9] They use cesspools or dry holes, or send the wastewater into septic tanks. Any of these forms of disposal can lead to contamination of underground sources of drinking water. Dry holes and cesspools introduce wastes directly into the ground. Septic systems cannot treat industrial wastes. Wastewater disposal practices of certain types of businesses, such as automobile service stations, dry cleaners, electrical component or machine manufacturers, photo processors, and metal platters or fabricators are of particular concern because the waste they generate is likely to contain toxic chemicals. Other industrial sources of contamination include cleaning off holding tanks or spraying equipment on the open ground, disposing of waste in septic systems or dry wells, and storing hazardous materials in uncovered areas or in areas that do not have pads with drains or catchment basins. Underground and above ground storage tanks holding petroleum products, acids, solvents and chemicals can develop leaks from corrosion, defects, improper installation, or mechanical failure of the pipes and fittings. Mining of fuel and non-fuel minerals can create many opportunities for groundwater contamination. The problems stem from the mining process itself, disposal of wastes, and processing of the ores and the wastes it creates. [10]

1.2.4 Residential:

Residential wastewater systems can be a source of many categories of contaminants, including bacteria, viruses, nitrates from human waste, and organic compounds. Injection wells used for domestic wastewater disposal (septic systems, cesspools, drainage wells for storm water runoff, groundwater recharge wells) are of particular concern to groundwater quality if located close to drinking water wells. Improperly storing or disposing of household chemicals such as paints, synthetic detergents, solvents, oils, medicines, disinfectants, pool chemicals, pesticides, batteries, gasoline and diesel fuel can lead to groundwater contamination.[11] When stored in garages or basements with floor drains, spills and flooding may introduce such contaminants into the groundwater. When thrown in the household trash, the products will eventually be carried into the groundwater because community landfills are not equipped to handle hazardous materials. Similarly, wastes dumped or buried in the ground can contaminate the soil and leach into the groundwater. [12]

Chlorinated Solvents.

Another common class of groundwater contaminants includes chemicals known as chlorinated solvents. One example of a chlorinated solvent is dry-cleaning fluid, also known as perchloroethylene. These chemicals are similar to petroleum hydrocarbons in that they are made up of carbon and hydrogen atoms, but the molecules also have chlorine atoms in their structure. [13]

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1.3 Cleaning Up Contaminated Groundwater

Groundwater typically becomes polluted when rainfall soaks into the ground, comes in contact with buried waste or other sources of contamination, picks up chemicals, and carries them into groundwater. Sometimes the volume of a spill or leak is large enough that the chemical itself can reach groundwater without the help of infiltrating water.

Groundwater tends to move very slowly and with little turbulence, dilution, or mixing. Therefore, once contaminants reach groundwater, they tend to form a concentrated plume that flows along with groundwater. Despite the slow movement of contamination through an aquifer, groundwater pollution often goes undetected for years, and as a result can spread over a large area. One chlorinated solvent plume in Arizona, for instance, is 0.8

kilometers (0.5 miles) wide and several kilometers long. [13]

1.3.1 Clean up Laws.

Several federal laws focus on either preventing or remediating groundwater contamination, often caused by industrial, commercial, or petroleum pollutants. While these federal laws have provided an overall framework for these activities, the regulatory implementation of these laws is usually carried out by states in cooperation with local governments. Often, federal laws are adopted by the states largely unchanged.[13]

The two major federal laws that focus on remediating groundwater contamination include the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund. RCRA regulates storage, transportation, treatment, and disposal of solid and hazardous wastes, and emphasizes prevention of releases through management standards in addition to other waste management activities. CERCLA regulates the cleanup of abandoned waste sites or operating facilities that have contaminated soil or groundwater. CERCLA was amended in 1986 to include provisions authorizing citizens to sue violators of the law. [13]

1.3.2 The Cleanup Process

Several steps normally are taken to clean up a site once contamination has been discovered. Initially a remedial investigation is conducted to determine the nature and extent of the contamination. In the risk assessment phase, scientists evaluate if site contaminants might harm human health or the environment. If the risks are high, then all the various ways the site might be cleaned up are evaluated during the feasibility study. The record of decision is a public document that explains which of the alternatives presented in the feasibility study will be used to clean up a site. [14]

Usually, the most protective, lowest cost, and most feasible cleanup alternative is chosen as the preferred cleanup method. The selected cleanup method is designed and constructed during the remedial design/remedial action phase. The operations and maintenance phase then follows. Periodically the remedial action is evaluated to see if it is meeting expectations outlined in the record of decision.

1.3.3 Containment.

Several ways are available to contain groundwater contamination: physically, by using an underground barrier of clay, cement, or steel; hydraulically, by pumping wells to keep contaminants from moving past the wells; or chemically, by using a reactive substance to either immobilize or detoxify the contaminant. When buried in an aquifer, zero-valent iron (iron metal filings) can be used to

turn chlorinated solvents into harmless carbon dioxide and water. [14]

Removal.

The most common way of removing a full range of contaminants (including metals, volatile organic chemicals, and pesticides) from an aquifer is by capturing the pollution with groundwater extraction wells. After it has been removed from the aquifer, the contaminated water is treated above ground, and the resulting clean water is discharged back into the ground or to a river. Pump-and-treat, as this cleanup technology is known, can take a long time, but can be successful at removing the majority of contamination from an aquifer. [15]

Another way of removing volatile chemicals from groundwater is by using a process known as air sparging. Small-diameter wells are used to pump air into the aquifer. As the air moves through the aquifer, it evaporates the volatile chemicals. The contaminated air that rises to the top of the aquifer is then collected using vapor extraction wells.

Remediation.

Bioremediation is a treatment process that uses naturally occurring microorganisms to break down some forms of contamination into less toxic or non-toxic substances. By adding nutrients or oxygen, this process can be enhanced and used to effectively clean up a contaminated aquifer. Because bioremediation relies mostly on nature, involves minimal construction or disturbance, and is comparatively inexpensive, it is becoming an increasingly popular cleanup option. [16]

Some of the newest cleanup technologies use surfactants (similar to dishwashing detergent), oxidizing solutions, steam, or hot water to remove contaminants from aquifers. These technologies have been researched for a number of years, and are just now coming into widespread use. These and other innovative technologies are most often used to increase the effectiveness of a pump-and-treat cleanup.

Treatment.

Depending on the complexity of the aquifer and the types of contamination, some groundwater cannot be restored to a safe drinking quality. Under these circumstances, the only way to regain use of the aquifer is to treat the water at its point of use. For large water providers, this may mean installing costly treatment units consisting of special filters or evaporative towers called air strippers. Domestic well owners may need to install an expensive whole-house carbon filter or a reverse osmosis filter, depending on the type of contaminant.[17]

1.4. Environmental Profile of Salem District

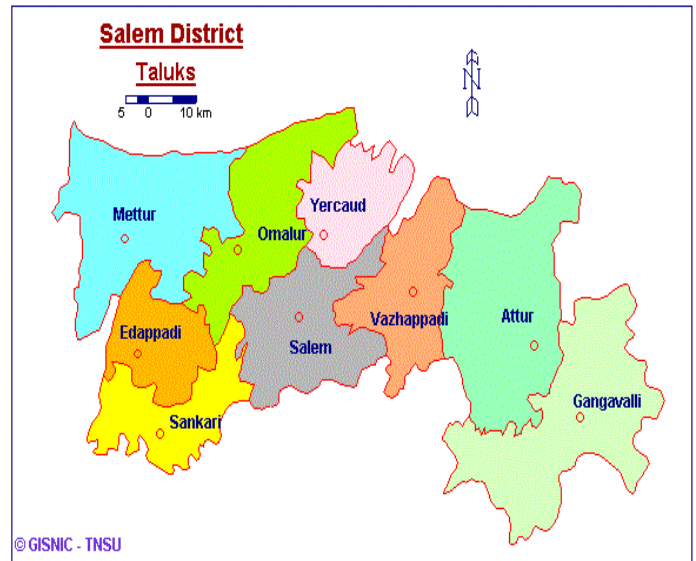


Fig 2. Environmental Profile of Salem District.

1.4.1 Physical and Geographical Features

Salem District is one of the land locked Districts in Tamilnadu. It is bounded on the North by Dharmapuri district, on the South by Namakkal district, on the West by Erode district and, on the East by Villupuram district. The elevation of landscape generally ranges from 500 ft to 1200 ft. above MSL with the exception of Yercaud which is at 5000 ft. above MSL.[18]

The average rainfall for the first 5 years (1991-96) works out to 851.90 mm which is lower than the State average of 943 mm. The north east monsoon period is the major rainy season accounting for 66% of the normal rainfall, followed by southwest monsoon (30%).

The average mean minimum temperature is 32.4°C while the average mean maximum temperature is 24.20 °C. [18]

1.4.2 Water Resources in Salem

Ground water is the major source of irrigation in the district. The district has maximum number of home wells in Tamilnadu. In many blocks over exploitation of ground water is noticed. Due to this, water table is going down remarkably. Though, watershed programmes and yielding positive result, towards improving water table, it is observed to be not adequate. Cauvery, Thirumanimutharu, Sarapangandhi are the important rivers in the district. Except Cauvery, other rivers flow only during rainy seasons. [19]Cauvery basin is the major river basin in the district. River and ground water are the major source of drinking water in the district. Salem Corporation, Idappadi and Mettur Municipalities and a good number of

town panchayats are covered by Cauvery water schemes. Also about 60% of villages are covered by water schemes. Thus round the year water supply is ensured. Out of 3730 villages, 1409 villages are having water problem as on 1995 – 96. [19]

1.4.2 Why do we need to analyze water?

If water is badly polluted-- like raw sewage it might be obvious from its appearance or odor. It might be colored or turbid (cloudy), or have solids, oil or foam floating on it. It might have a rotten odor, or smell like industrial chemicals. A lot of dead fish floating on the surface of a lake would be a clear sign that something was wrong. But many harmful-- and beneficial-- materials in water are invisible and odorless. In order to go beyond the obvious, to determine what materials are in the water, and how much, we need to be able to conduct chemical or microbiological analyses. [19]

Analysis of a natural body of water will tell us how clean or polluted it is. If there is damage to wildlife, the measurements will help pinpoint the cause-- and the source. In a wastewater treatment plant, analyses are necessary for monitoring the effectiveness of the treatment processes. In the United States, the Clean Water Act requires wastewater dischargers to have permits. These permits set limits on the amounts of specific pollutants which can be discharged, as well as a schedule for monitoring and reporting the results. Usually, the reports must be filed monthly, while the measurement frequency for a particular parameter (measurable property) can run anywhere from "continuously" to just once a year. Only standard analytical procedures specified in the "Code of Federal Regulations" may be used, so that the government agencies can feel reasonably confident that results from different laboratories are comparable. [19]

Similar considerations apply to drinking water. The purity of the water we drink is of more concern to the average person than the quality of the wastewater discharged by the sewage plant. But we should not forget that in many places, especially along a river, one town's wastewater discharge may be part of the next town's water supply.

There are two aspects to water analysis that we need to consider:

1. What substances or organisms are we interested in testing for-- and why?
2. What procedures and equipment do we use to make the measurements, and how do they work?

2. MATERIALS AND METHODS

2.1 Water Sampling and Storage:

For the present study, agricultural and industrial area in and around Salem town. Tamilnadu has been selected selected .It covers about 6 sq.km and ten samples were collected for monitoring the physicochemical status of the ground water. Water samples from the selected sites were collected during Apr- May 2009 and taken in pre – cleaned polyethylene bottles. The sample after collection were immediately placed in dark bottles and processed within 6h of collection.[20]

2.2 Physico-chemical analysis

The samples were analyzed for major physical and chemical water quality parameters like temperature, colour ,odour, turbidity, pH, electrical conductivity(EC),Total Dissolved solids(TDS),Total Hardness(TH), Ca^{2+} , Mg^{2+} , Cl^{-} , SO_4^{2-} Dissolved Oxygen ,Biochemical Oxygen Demand (BOD) The parameters present in the water sample can be calculated by using various methods .The pH of the samples were determined using a pH electrode 9107 and an expandable ion analyzer EA 940. electrical conductivity was measured using Elico CM -180 conductivity meter and sulphate by turbidimetric method using a spectronic -20.The chloride ,total hardness and total alkalinity were estimated by the standard methods of water and waste water.[21]

2.2.1 Determination of pH and Alkalinity

The pH of a water sample measures its hydrogen ion concentration and indicates whether the sample is acidic, neutral or basic. The pH may be measured accurately using a pH meter. The pH meter must be calibrated before making pH measurements. For calibration standard buffers of pH 4.00, 7.00 and 10.00 are used. Alkalinity measures the acid-neutralizing capacity of water. It is attributed to the presence of hydroxide, carbonate, and bicarbonate ions in the sample. Weak bases such as phosphates, silicates and borates may also contribute to alkalinity. Alkalinity is measured by titrating a measured volume of a sample of water against a standard acid solution to a designated end point usually pH 8.3 (phenolphthalein alkalinity).[22]

2.2.2 Determination of water hardness

Analysis is normally performed by complexometric titration using the disodium salt of ethylene diamine tetra acetic acid (EDTA). This forms a 1:1 complex with divalent metal ions: To determine both calcium and magnesium by titration, the pH has be buffered at 10. The end-point is detected using an indicator such as Eriochrome Black T.[22]

The total hardness is conventionally expressed in mg/l -1 units as calcium carbonate, even if it is due to calcium sulphate, magnesium carbonate or any other polyvalent metal salt. The total hardness is calculated using the relationship.1000 ml of 0.01M EDTA \equiv 100mg

CaCO₃. By titrating a known sample of water and knowing the titre value of the standardized EDTA and its molarity, can be calculated. The terms “hard water” and “soft” water may be defined within very specific concentration ranges. [23]

2.2.2 Measurement of dissolved oxygen:

The dissolved oxygen can be determined either by the Winkler (iodometric) method or by the use of dissolved oxygen electrodes. In the Winkler’s method the dissolved oxygen is reacted with Mn²⁺ immediately after sampling which is added in the form of manganese sulphate, together with an alkaline iodide mixture: The released iodine can then be titrated with sodium using starch as indicator. [24]

2.2.3 Measurement of biochemical oxygen demand (BOD):

Two 300ml bottles are filled with water sample and dissolved oxygen of the first bottle is determined immediately by either of the methods already described.

The second bottle is incubated under 20 °C (adjusted to pH between 6.5 and 8.5 in the dark under standard conditions) for 5 days which are designed to be ideal to promote microbial activity and the dissolved oxygen is once more measured. The difference between the two DO values is the amount of oxygen that is consumed by microorganisms during the 5 days and is reported as BOD₅ (5-day BOD) value of the sample. [25]

3. RESULTS AND DISCUSSION

The physical, chemical and biological parameters are tabulated along with the standard values in Tables 1, 2, 3, 4, 5 and 6. The results indicate that the quality of water considerably varies from location to location. The variation is mainly due to salinity of water, which is reflected by the values of EC and its related parameters TDS, Cl⁻ and SO₄²⁻ values reported for the years 1972 to 1996 are in accordance with the observed values. In majority of the samples, the total hardness is much higher indicating the presence of natural salts like chlorides and sulphates of calcium and magnesium. In general the ground water of this study is saline and in most of the waters, concentration of magnesium was well above the maximum permissible limits prescribed by WHO and ICMR. The EC values are also high in most of the areas.

TABLE 1: Physical parameters, in mg/L

S.I No	Temp., °c	Colour	Odour	Taste	Turbidity
1	32	Cl	Ol	Normal	Clear
2	30.5	Cl	Ol	Normal	Clear
3	29.8	Cl	Ol	Salty	Clear
4	31.3	Cl	Ol	Normal	Clear
5	30.7	Cl	Ol	Sour	Clear
6	29.5	Cl	Ol	Salty	Clear
7	30.2	Cl	Ol	Pleasant	Clear
8	31	Cl	Ol	Normal	Clear
9	29.8	Cl	Ol	Sour	Clear
10	29.3	Cl	Ol	Salty	Clear
11	29.6	Cl	Ol	Pleasant	Clear
12	30.1	Cl	Ol	Normal	Clear
13	30	Cl	Ol	Normal	Clear
14	30.3	Cl	Ol	Normal	Clear
15	29.9	Cl	Ol	Salty	Clear
16	29.7	Cl	Ol	Normal	Clear
17	30.2	Cl	Ol	Normal	Clear
18	29.6	Cl	Ol	Sour	Clear
19	31.1	Cl	Ol	Salty	Clear
20	31.5	Cl	Ol	Normal	Clear

cl – colourless; ol – odourless

3.1 Colour, Odour, Taste, Turbidity and Temperature:

All the water samples were colorless, clear and odourless indicating the absence of colloidal substances, suspended and decomposed vegetation. Temperature is basically important for the chemical and biological reactions of organisms in water. The increase in temperature decreases the portability of water because at elevated temperature carbon dioxide and other volatile gases which impart taste are expelled. The temperature of the samples lies between 29 to 32 °C tabulated in Table 1.

TABLE 2: WATER QUALITY PARAMETERS

Sample No:	pH	TDS	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	TH
1	7.43	854	248	78	90	2.76	465
2	7.34	1035	284	74	94	0.453	497
3	7.26	881	299	52	128	1.988	1085
4	7.06	1083	312	83	116	1.465	1105
5	7.57	637	255	35	286	0.547	1565
6	7.25	640	538	63	160	1.537	643
7	7.71	1142	177	23	76	1.283	466
8	6.97	1129	354	147	120	2.387	1453
9	7.21	807	382	90	49	1.669	198
10	7.59	800	205	170	170	1.866	131
11	7.68	699	179	35	72	2.52	275
12	6.99	765	435	156	88	2.355	589
13	7.28	784	267	59	122	0.683	1268
14	7.53	1043	377	125	159	0.698	1043
15	7.32	865	487	86	96	1.589	321
16	7.14	1085	360	94	129	2.412	1277
17	7.69	877	221	137	57	0.632	734
18	7.53	743	311	148	243	0.571	284
19	7.38	721	474	59	184	2.573	490
20	7.29	1132	529	160	79	2.99	1421

TABLE 3: WATER QUALITY PARAMETERS

Sample No:	TA	EC	DO
1	543	31.4	3.87
2	529	46.8	5.32
3	348	66.9	7.34
4	477	45.6	4.89
5	468	9.8	7.8
6	434	21.9	6.42
7	405	47.8	7.12
8	553	15.3	5.9
9	435	57.7	5.74
10	492	25.4	7.26
11	367	37.5	3.96
12	521	21.9	5.65
13	421	45.1	5.25
14	587	51.41	7.84
15	321	39.3	4.35
16	499	29.8	5.77
17	505	62.3	4.43
18	460	47.5	6.32
19	433	61	6.74
20	380	58.42	3.95

TABLE 4: WATER QUALITY PARAMETERS *

Parameters	Minimum	Maximum	Mean	Maximum permissible limit**
pH	6.97	7.71	7.361	6.5 - 9.2
TDS	637	1142	886.1	1500
Cl ⁻	177	538	334.7	1000
SO ₄ ²⁻	23	170	93.7	400
Ca ²⁺	49	286	125.9	200
Mg ²⁺	0.4531	2.76	1.65	150
TH	131	1565	765.5	600
EC	9.8	66.9	41.14	-
DO	3.87	7.8	5.796	8

* All values except pH and EC (mS) are in ppm

** As per WHO standards.

3.2 Chemical parameters

The chemical parameters are tabulated in Table 2. The collected water samples have pH with in the permissible limits ranging from 6.97 to 7.71. Total hardness of collected samples was found to be in the range from 637 to 1142mg/L. Total hardness values for samples and 4,5,8 and 20 are high due to the high concentration of calcium and magnesium salts. Hardness leads to heart diseases and kidney stone formation. These samples were not much suitable for drinking, washing, cleaning and laundering. The chloride content of water samples collected lies in the range from 177 to 538 mg/L. Sample 6 and 20 have high concentration of chloride content .High chloride content in water bodies harms metallic pipes and structure as well as agricultural crops. Total alkalinity of water samples collected lies in the range from 321 to 587 mg/L. . High alkalinity in water bodies leads to sour taste and salinity.Sulphates of water samples collected lies in the

range from 23 to 170 mg/L. At concentrations of sulphate around 1000 mg/L, it has laxative effect and causes gastro intestinal irritation.

Table 5: BOD values of effluents from some industries

Effluents from	BOD in mg/l
1.Domestic wastes	800-2000
2.Dairy wastes	800-4000
3.Farm yard wastes	1500-3000
4.Paper pulp	3000-27,000

Table6:pH ranges for environmental waters

Type of water	pH range
Soft water	5.4-7.8
Hard water	7.7-8.8
Sea water	8.3-9.4
Water affected by acidic pollutants	2.1-4.6

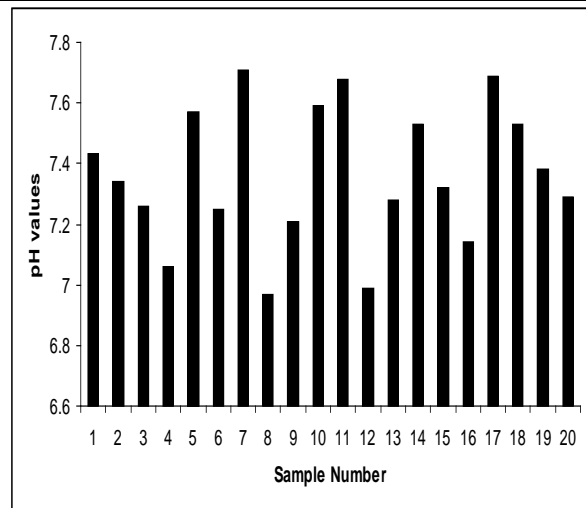


Fig3: pH values of various samples

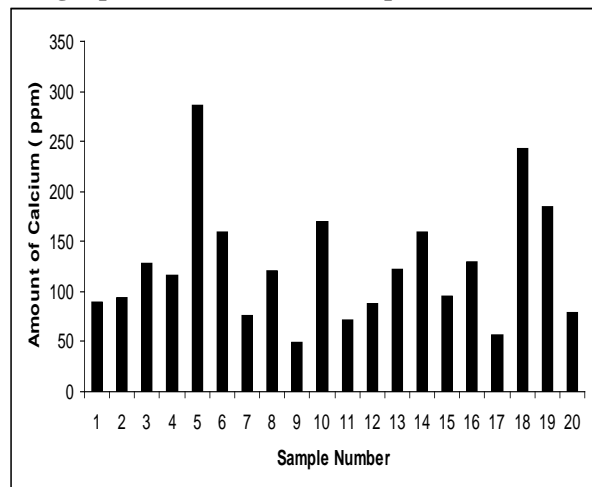
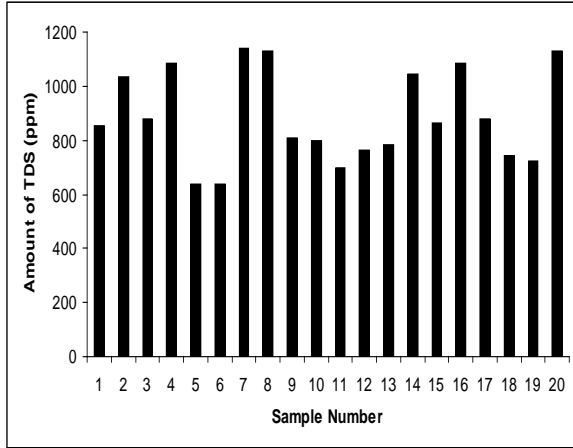
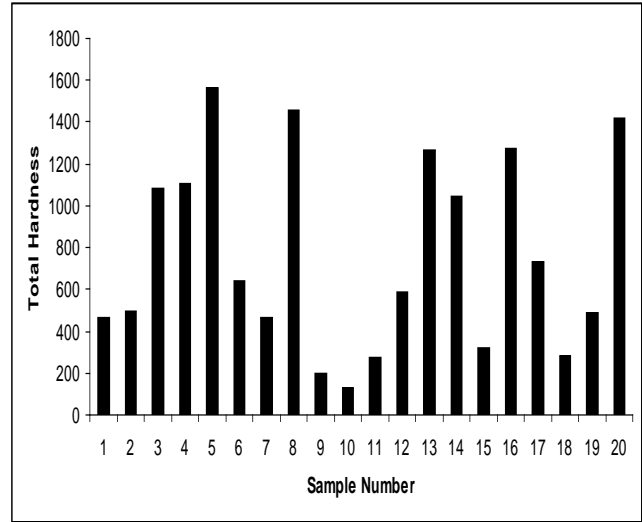


Fig 4: Calcium content (ppm) of various samples



5: Total dissolved solids (ppm) of various samples



Fig

Figure 6: Amount of total hardness of various water samples

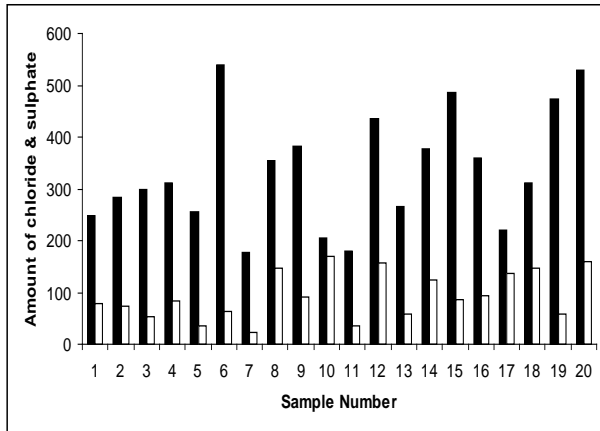


Fig 6: Chloride and Sulphate content (ppm) of various

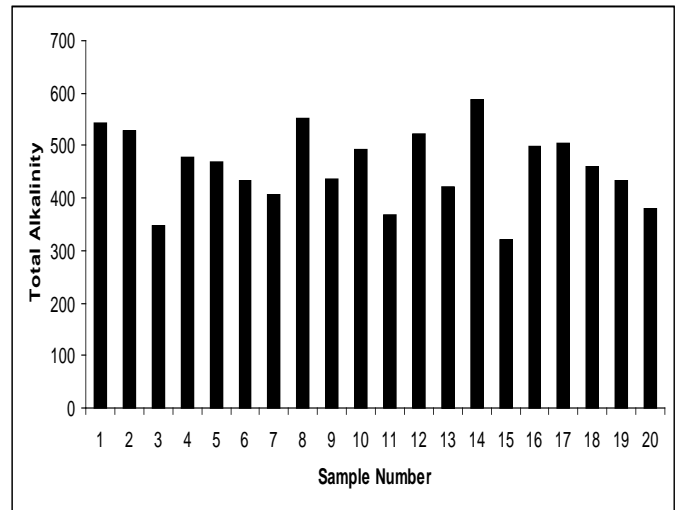


Figure 7: Amount of alkalinity of various water samples

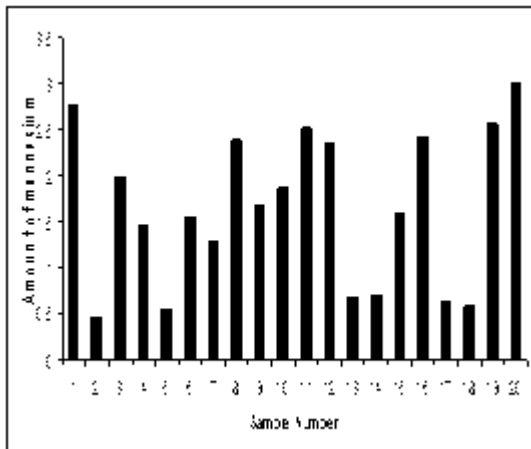


Figure 5: Amount of magnesium of various water samples

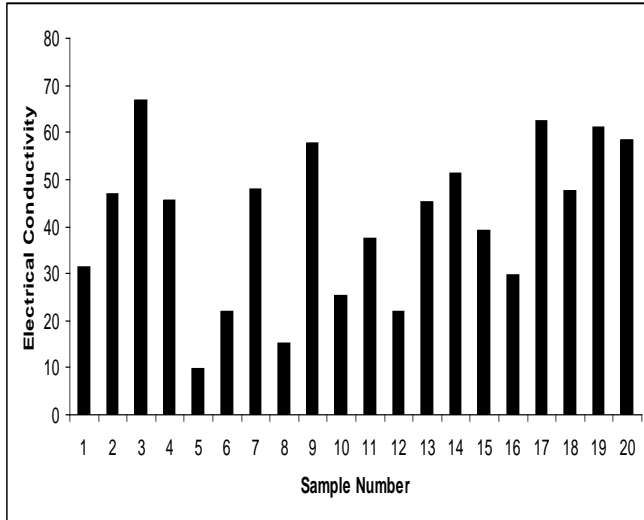


Figure 7: Electrical conductivity of various water samples

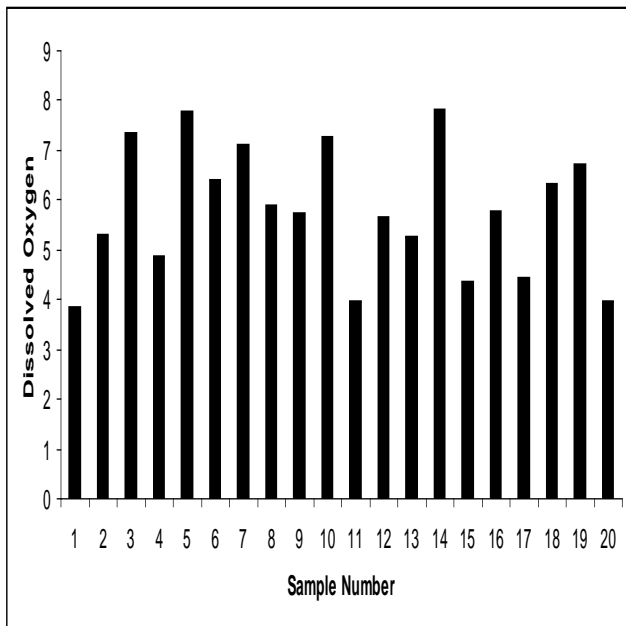


Figure 8: amount of dissolved oxygen of various samples

The representative sample of water that is taken should be the one that truly reflects the composition of the water sample to be analyzed. Due to varying period of time that may lapse between sample collection and analysis, storage conditions must be such as to avoid undesirable losses, contamination or other changes that could affect the results of the analysis. In some situations, a sampling plan or strategy may need to be devised so as to optimise the value

of analytical information collected. For long term variation it may be beneficial to take samples at the same stage of each periodic cycle, whereas for short term variations such as seasonal, weekly or daily several samples have to be taken for each cycle.

For example oxygen is produced by photo synthesis in the day time but consumed by respiration or by oxidation of organic material continuously. A decrease in oxygen concentration during the night would be expected. [26]

Variation of nitrate is more complex. It is a nutrient necessary for growth and if there were no additional inputs it would decrease in the spring growing season and increase in winter, but if a farmer puts an excessive amount of nitrate containing fertilizer on a neighboring field, there would be a sudden increase in nitrate concentration in the river into which the field is drained. The container materials to be used for sample collection may be made of glass or polythene. Trace metals may be depleted by adsorption if stored in glass containers, while sodium, potassium, boron and silicates can be leached from the glass into the sample solution. Plastic containers should always be used for such samples. Conversely sample solutions containing organic solvents and other organic liquids should be stored in glass containers because organic compounds may be leached from the walls of the plastic containers. If volatile materials or dissolved gases are to be analysed, the container material must always be full. For other components, it is beneficial not to fill the container completely as the contents can then be more easily mixed before analysis. Standard methods are available for most components to minimise the analyte for storage loss. The method of storage varies according to the physical and chemical properties of the species. [26]

For example samples to be analysed for nitrate should be stored at 4°C to minimize the biological degradation; and samples to be analyzed for pesticides should be stored in dark to avoid photochemical decomposition; and samples to be analyzed for metal ions should be acidified to prevent adsorption of metal ions on the sides of the container; and samples to be analysed for phenols should be made alkaline with sodium hydroxide to lower the volatility. The main physical problem that may be caused by suspended solids in natural water bodies is that they cut down light transmission through the water and so lower the rate of photosynthesis in plants. [26]

Also in less turbulent parts of the river some of the solids may sediment out, smothering the life on the river bed. The suspended solid determination is extremely valuable in the analysis of polluted waters. It is one of the

major parameters used to evaluate the strength of domestic waste waters and to determine the efficiency of treatment units. The analysis of the suspended solids is done by filtration and weighing once again. The suspended-solids determination is subject to considerable error if proper precautions are not taken. Usually the sample size is limited to 50 ml or less because of the difficulties encountered in filtration of larger samples. The weight of solids removed seldom exceeds 20 mg and is often 10mg. Small errors in weighing or losses of filter mat can be quite significant. It is extremely important that the Gooch crucibles be carefully prepared and brought to constant weight before use. Sufficient sample should be filtered, if possible, to yield an increase in weight of about 10 mg.

The hardness in water is derived largely from contact with the soil and rock formations. Rain water as it falls upon the earth is incapable of dissolving the solids found in natural waters. The ability for the rain water to dissolve is gained in the soil where CO₂ is released by the bacterial action. The dissolved CO₂ in rain water is sufficiently acidic to attack the insoluble carbonates in the soil and lime stone formations converting them to soluble bicarbonates. Since lime stone is not pure carbonate, but includes impurities such as sulphates, chlorides and silicates, these materials become exposed to the solvent action of water as the carbonates are dissolved and they pass into solution too. In general, hard waters originate in areas where top soil is thick and lime stone formations are present. Soft waters originate in areas where the top soil is thin and lime stone formations are sparse or absent.[27]

In liquid wastes, dissolved oxygen is the factor that determines whether the biological changes are brought about by aerobic or anaerobic organisms. The former use free oxygen for oxidation of organic and inorganic matter and produce innocuous end products, whereas the latter bring about such oxidations through reduction of certain inorganic salts such as sulphates, and the end products are often very obnoxious. Since both types of organisms are ubiquitous in nature, it is highly important that conditions favourable to the aerobic organisms (aerobic conditions) be maintained. Otherwise the anaerobic organisms will take over and the development of nuisance conditions will result. Thus dissolved-oxygen measurements are vital for maintaining aerobic conditions in natural waters that receive pollutional matter and in aerobic treatment process intended to purify domestic and industrial waste waters. [27]

The presence of oxygen in rivers is the result of photosynthesis by plants and by dissolution of oxygen

from the atmosphere into the water. The solubility of oxygen in water is low. Water saturated with oxygen at 25 °C contains 8.24mg l⁻¹. It would therefore be easy to deplete the oxygen content if any material were present which would react with oxygen. The material could be organic, as already discussed but could also be inorganic.

For example iron in the form of Fe²⁺ can deplete oxygen by oxidation to Fe³⁺. There are two distinctly different analyses which are useful to monitor environmental waters for oxygen. In the first analysis, the oxygen concentration in the sample (eg:river sample) is measured directly. This result would give an indication of the health of the river at a particular location and at the time of sampling. Since the oxygen level in a river can vary dramatically with location and with time, this result would be of less use for assessing the overall health of the river. In the second analysis, the amount of material known as oxygen demand which, given time, could deplete the oxygen in the river is measured. This oxygen demand gives an indication of possibility of oxygen depletion which will occur if the oxygen is not replenished. This measurement would be much more suitable for determining the overall health of the river since the oxygen demand of a water supply is unlikely to change suddenly. Typical BOD values for unpolluted water are of the order of a few mg l⁻¹. The BOD values of the effluents from some industries are shown in Table 4.. It may be recalled that the saturated oxygen level of water is of the order of 8mg l⁻¹ and that the introduction of a small quantity of high-strength effluent can deplete the oxygen in many times its own volume of water. The advantage of BOD measurement is that it parallels the natural processes closely, although it is a lengthy measurement to complete.[28]

4. CONCLUSION

Over exploitation of ground water is observed throughout the district. Due to this water table is going down at a faster rate. Salem district has more number of bore wells when compared with the other districts of the State. Though water harvesting programmes implemented by the Government is giving good result towards improving the groundwater table, the momentum is observed to be slow.

The ground water in Salem Town contains mainly chlorides and sulphate of calcium and magnesium. According to this report, the ground water in and around Salem Town is suitable for drinking purposes, agriculture utilization, and industrial purposes and generally it is not harmful to human beings.

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