PHYSICO-CHEMICAL CONCENTRATIONS OF GROUND WATER OF KHAJA NAGAR AREA, TIRUCHIRAPPALLI DISTRICT, TAMILNADU

A project work submitted to the

JAMAL MOHAMED COLLEGE (AUTONOMOUS)

Affiliated to the

BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI-20

In partial fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE IN CHEMISTRY

Submitted by

B. BILAL

Reg.No: 19PCH004

Under the guidance of

Dr.J.SIRAJUDEEN, M.Sc., B.Ed., M.Phil., Ph.D.,

Since 1951

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CERTIFICATE

This is to certify that the project work entitled "PHYSICO-CHEMICAL CONCENTRATIONS OF GROUND WATER OF KHAJA NAGAR AREA, TIRUCHIRAPPALLI DISTRICT, TAMILNADU" submitted to the PG and Research Department of Chemistry, Jamal Mohamed College (Autonomous) affiliated to Bharathidasan University, Tiruchirappalli - 620 020, in partial fulfillment of the requirements for the award of degree of **MASTER OF SCIENCE IN CHEMISTRY** is a bonafide record of the work carried out by **B. BILAL, Reg.No: 19PCH004** under my supervision and guidance.

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DECLARATION

I hereby declare that the dissertation entitled "PHYSICO-CHEMICAL CONCENTRATIONS OF GROUND WATER OF KHAJA NAGAR AREA, TIRUCHIRAPPALLI DISTRICT, TAMILNADU" which I submit for the award of the degree of **MASTER OF SCIENCE IN CHEMISTRY**. The original work carried out by me under the guidance and supervision of **Dr. J.SIRAJUDEEN,** Assistant professor, PG and Research Department of Chemistry, Jamal Mohamed College, Tiruchirappalli-620 020.

I further declare that this work has not been submitted earlier in full or in parts to any other university for the award of any other degree or diploma.

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INTRODUCTION

Water is a prerequisite for the existence of life. Human beings, animals, and plants cannot survive without water. When the water content in the body drops by just one per cent, we experience thirst. If it drops by 10 per cent, there is danger of death. Water is the most crucial limiting factor for many aspects of life, such as economic growth, environmental stability, biodiversity conservation, food security, and health care. In most cases there is no substitute for water. We can replace one energy source with another, but water as a resource is largely irreplaceable. The good news about water is that we can reuse it. It may change its form, but we can always retrieve it. In fact, the molecules in the water we use have been around for millions of years. The earth holds the same quantity of water as it did when it is formed. The paradox of the water situation is that there is scarcity amidst plenty. As we shall see, there is a lot of water on earth and yet there are millions of people facing acute water shortage. The total water in the world is estimated to be around 1400 million cu. Km. If all this water was spread over the surface of the earth; it would be three km deep. This is a lot of water. Unfortunately, 97 per cent of this water is the ocean and is too salty to drink. Of the remaining three per cent, two-thirds is locked up in relatively inaccessible icecaps and glaciers. That leaves a mere one per cent or 14 million cu. km. Again half of this is groundwater, and most of it lies deep inside the ground. About 200,000 cu. km can be found in rivers and lakes and 14,000 cu. km can be found in rivers and lakes and 14,000 cu. km in the atmosphere. Though on a global scale, there is abundance of water, but the main problem is the availability of water in the right place at the right time in the right form. Water can be found in solid, liquid or gaseous form in a number of places.

The World Health organization (WHO) international standards for drinking water have been widely followed by many countries in the south-east Asian region and presently national standards are being developed or revised by means of the countries in this region, using the WHO guidelines for drinking water quality (1984). In India, however, water quality standards were set as early as 1940 and the standards were modified in 1975 and 1977.Although there are at least three standards formulated by Indian council of medical research (ICMR), central public Health and Environment Engineering Organization (CPHEEO), the one recommended by CPHEEO is being widely adopted.

Water intended for human consumption should be not only completely safe but agreeable to use or wholesome, such a supply may be termed “acceptable” of potable. Surveillance of Drinking water quality from the public health point of view, involves organization, management and number of other activities including follow up action to keep a constant vigil on the safety and acceptability of drinking water quality from the public health points of view, involves organization, management and numbers of other activities including follow up action to keep a constant vigil on the safety and acceptability of drinking water supplies. It is also an indispensable to ensure that the investments made and assets created there on drinking water supply schemes promote and protect the health of the consumers, unfortunately, proper realization of the importance of this vital function is importance of this vital function is almost nonexistent on our country (TWAD water quality surveillance, 1997). Water is one of the earth’s natural resources and three quarters of the earth’s surface is covered by it. It is a most valuable resource to man and living things, essential for the sustenance of life on earth as exemplified by its diversified uses (drinking, cooking, washing, irrigation, farming etc.). Indeed water is life .The quality of water depends on the location of the sources and the state of environment

CHARACTERISTICS OF WATER

Water is a unique liquid, without which no life can survive. Water is a liquid at room temperature, with mp. 0^0C, bp. 100^0C, high dipole moment (1.84 x 10^{-3} esu), high dielectric constant (80), density (1.0), specific heat (1 Cal g^{-1} $^0C^{-1}$), high heat of evaporation (540 Cal g^{-1}), surface tension (73 dynes cm^{-1} at 20^0C) and viscosity(0.01 poise at 20^0C). These abnormal properties of water are due to hydrogen bonding. The uniqueness of water is attributed to the following properties. Water is a regarded as a universal solvent. No other liquid can be compared to water as a solvent. Natural water is slightly acidic (pH 5.6) due to dissolved carbon dioxide, which gives carbonic acid (H_2CO_3). Therefore, it can dissolve a variety of compounds from simple salts to minerals including sodium chloride and calcium carbonate in limestone rock. Water also reacts with complex organic compounds including many amino acids found in the human body. Water possesses highest heat of fusion and heat of evaporation, collectively known as latent heat, of all known liquid substances at ordinary temperature. The latent heat of water is responsible for moderating the temperature of the biosphere. It also plays a vital role in the evaporation of water and its condensation as rain and as dew. Compared with other common liquids, water has a high surface tension, a characteristic that is very important in many physical and biological processes involving movement of water through and into organisms.

Among common compounds and molecules, water is the only one whose solid form (ice) is lighter than its liquid form; it expands by about 8 per cent when it freezes and becomes less dense. This is responsible for the floating of ice on water. Being transparent to light, water allows photosynthetic organisms to live below the surface of water. Water exerts pressure. Organisms living at the sea level experience a pressure of about 15 psi (~1 atmosphere, which is equal to 360 mm mercury).

IMPORTANT ORGANIC MATTER IN WATER

There is a lower concentration of organic matters in natural waters. These organic matters are derives from decaying weeds, leaves and trees. Humic acid which is a high molecular formed from the composition of plant matter, is found in the surface waters. The organic matter found in the surface waters and several ground waters are formed from the man made activities. The natural organic compounds such as proteins, carbohydrates and lipids are found in higher concentrations comparable to the neutral waters.

Pesticides and agricultural chemicals, cleaning solvent such as acetone, benzene and ethyl alcohol and chlorinated hydrocarbons such as trihalomethane are some of the important organic compounds found natural and ground waters. Several laboratory tests are being carried out to measure the total amount of organic matter. These tests mainly include chemical oxygen demand (COD) and biological oxygen demand (BOD). COD test is mainly used to measure the organic content of natural waters, municipal waste water and industrial wastes. COD test involves the determination of amount of oxygen that is equivalent to the organic matter by using potassium dichromate as an oxidizing agent and silver sulphate as a catalyst at a high temperature. CPD test is much preferred since it takes lesser duration than that of the BOD.

The total amount of oxygen required by the metabolic degradation of certain biodegradable organic compounds in water is called BOD. In BOD test, the total amount of oxygen required by the metabolic degradation of certain biodegradable organic compounds is measured. CO_2, H_2O, NH_3 are the principal end products formed from the oxidation of organic matter. The typical BOD values for the raw or untreated sewage water ranges from 200 – 400 mg of O_2 per liter of H_2O (200 – 400 ppm) and of drinking water is less than 1.0 BOD serve as an important measure to find out the strength of organic pollution and any visible reduction in BOD levels is the key indicator in most of the waste water treatment plants.

GROUND WATER

Groundwater is fresh water located in the subsurface pore space of soil and rocks. It is also water that is flowing within aquifers below the water table. Sometimes it is useful to make a distinction between groundwater that is closely associated with surface water and deep groundwater in an aquifer (sometimes called "fossil water"). Groundwater can be thought of in the same terms as surface water: inputs, outputs and storage. The critical difference is that due to its slow rate of turnover, groundwater storage is generally much larger (in volume) compared to inputs than it is for surface water. This difference makes it easy for humans to use groundwater unsustainably for a long time without severe consequences.

Nevertheless, over the long term the average rate of seepage above a groundwater source is the upper bound for average consumption of water from that source. The natural input to groundwater is seepage from surface water. The natural outputs from groundwater are springs and seepage to the oceans. If the surface water source is also subject to substantial evaporation, a groundwater source may become saline. This situation can occur naturally under endorheic bodies of water, or artificially under irrigated farmland. In coastal areas, human use of a groundwater source may cause the direction of seepage to ocean to reverse which can also cause soil salinization. Humans can also cause groundwater to be "lost" (i.e. become unusable) through pollution. Humans can increase the input to a groundwater source by building reservoirs or detention ponds.

SOURCES OF GROUNDWATER

There Are Four Sources of Groundwater

(i) Connate water:

At the time of rock formation water is trapped in the interstices of sedimentary rocks.

(ii) Meteoric water:

It originates in the atmosphere, falls as rain and ultimately becomes groundwater by infiltration. It forms the major part of groundwater.

(iii) Juvenile water:

It originates in the earth's interior and reaches the upper layers of the earth's surface as magmatic water.

(iv) Condensational water:

It is the prime source which replenishes water in deserts and semi-desert areas. During summer, land becomes warmer than the air trapped in the soil, which leads to a huge difference of pressure between the water vapour in the atmosphere and the water vapour trapped in the soil. Thus the atmospheric water vapour penetrates the rocks and gets converted into water due to falling temperature of the water vapour below.

OCCURRENCE OF GROUNDWATER

Water below the ground is available in four zones, viz., soil zone, intermediate zone, capillary zone and saturation zone. The zone where water is available is called the zone of aeration. There are two forces which actively prevent groundwater from moving downward, viz., (a) the molecular attraction between water and the rock and earth materials and (b) the molecular attraction between water particles. The zone of aeration is further sub-divided into three layers—soil moisture zone, intermediate zone and capillary zone, collectively called Vadose Zone.

Some amount of water in this zone is used by plants. At the bottom of the intermediate zone lies the capillary fringe (a thin layer of 2 to 3 cm) from where water moves upward. The capillary condition is temporarily destroyed when heavy rain takes place. In such cases the groundwater body is replenished by recharge. The zone of saturation lies below the zone of aeration and is also called the phreatic zone.

The water available in this zone is known as groundwater. The groundwater table or water table segregates the zone of aeration and the zone of saturation. The maximum elevation of water in a well which penetrates the groundwater zone is known as piezometric water table. Generally, the water table follows the irregularities of the earth's surface; for example, the water table is highest beneath hills and lowest beneath valleys.

A geological structure fully saturated by water, capable of producing sufficient quantities of water that can be economically used and developed, is known as aquifer (Latin; to bear water). Examples include sandstone layer, unconsolidated sand and gravel, limestone, fractured plutonic and metamorphic rocks which act as aquifers. An aquifer can be broadly divided into (a) unconfined and (b) confined aquifers. In the former case, water recharge may take place from lateral groundwater flow or from upward movement of water. The latter (also known as artesian or pressure aquifers) have an impermeable stratum that maintains hydrostatic pressure sufficient enough to raise water higher than the surface of the aquifer. Confining layers of the aquifer can be categorised into aquicludes, aquitards and aquifuges. Aquicludes form small saturated layers above the impermeable layers; examples are clay, shale and most of the igneous and metamorphic rocks.

POLLUTION OF GROUNDWATER

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 or microbial contamination. Contamination also can occur from naturally occurring mineral and metallic deposits in rock and soil. 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. Groundwater is contaminated by the constant addition of industrial, domestic and agricultural waters to it. Excessive mineralization of groundwater degrades water quality by providing objectionable taste, colour and excessive hardness.

SOURCES OF GROUNDWATER POLLUTION

The common sources of groundwater pollution include several manmade sources like discharge of domestic, industrial waste and natural sources.

DOMESTIC SEWAGE

Sewage consists of about 99% of water and 1% of solids. It is very serious pollutant of wells and rivers which are important sources of our drinking water. The drinking water from these sources contain high amount of nitrate, nitrite, chloride, sulphate and total dissolved solids. The seepage of domestic sewage into the soil may pollute the groundwater and making it unfit for domestic usage.

INDUSTRIAL WASTE

The waste from the industries contains toxic heavy metals along with organic and inorganic pollutants. These pollutants percolate into the ground and causes groundwater pollution. The behaviour of an organic substance in groundwater depends on its density and solubility in water.

AGRICULTURAL WASTE

Groundwater becomes contaminated through intense agricultural use of pesticides. Also nitrates formed by nitrification of ammonia fertilizers, are groundwater pollution in many areas. Although nitrates are relatively nontoxic substances, certain bacteria can convert nitrates to nitrites. The consumption of nitrite-rich water can lead to a disease in infants known as "blue babies" (methemoglobinemia.)

DANGERS OF CONTAMINATED GROUNDWATER

Drinking contaminated groundwater can have serious health effects. Diseases such as hepatitis and dysentery may be caused by contamination from septic tank waste. Poisoning may be caused by toxins that have leached into well water supplies. Wildlife can also be harmed by contaminated groundwater. Other long term effects such as certain types of cancer may also result from exposure to polluted water.

CONTROLLING FACTORS OF THE OCCURRENCE OF GROUNDWATER CLIMATE:

Groundwater is easily available at great depths in arid regions while it exists at shallow depth in humid regions. Water table rises during rainy season and sinks in dry season.

TOPOGRAPHY:

The water table tends to be higher near the hilltops and lower near the valleys, because near the valleys water seepages into streams, swamps and lakes cause descending water table.

TYPES OF MATERIALS:

Porosity and permeability of the underground materials have an impact on the storage and movement of groundwater. The variability in porosity exists as the underground materials are heterogeneous in nature. Porosity refers to the percentage of the total volume of rock with voids. Porosity determines the volume of water a rock body can retain. Four types of pore spaces are found—(i) Pore space between mineral grains, (ii) Fractures, (iii) Solution cavities, and (iv) Vesicles. Permeability refers to the capacity of a rock body to transmit water. Sandstone and conglomerate are highly permeable because of the presence of relatively large interconnected pore space between the grains.

NATURE AND MOVEMENT OF GROUNDWATER:

The groundwater movement takes place through pore spaces at extremely slow velocity. The flow velocity of groundwater is expressed in $metres^{-1}$ day. Water percolates from areas of high water table to the areas where water table is lowest i.e., towards lakes and surface streams.

TYPES OF WATER

Hard Water

Water which does not produce lather with soap solution readily but forms a white curdy material is called hard water

Soft Water

On the other hand, water which lathers easily on shaking with soap solution is called soft water.

Hard water is not harmful for drinking purpose but in the laundry work, this hardness causes a waste of soap material.

Cause for hardness of water

Ground water contains appreciable amount of calcium and magnesium salt in it. Water containing bicarbonates, sulphates and chlorides of calcium and magnesium is termed hard water. If these salts are absent, the water is called soft water.

Types of hardness

Hardness is of two types:

i. Temporary hardness and
ii. Permanent hardness

i) Temporary hardness

Temporary hardness of water is caused by the presence of dissolved bicarbonates of calcium and magnesium and carbonates of iron. Temporary hardness is mostly removed by boiling the water.

ii) Permanent hardness

Permanent hardness of water is caused by the presence of chlorides and sulphates of calcium, iron and other heavy metals. Unlike temporary hardness cannot be removed by boiling the water.

Units for expressing hardness of water

Hardness of water is due to the presence of soluble salts of calcium or magnesium. The quantity of these dissolved salts in a certain volume of water measures the extent of hardness or degree of hardness.

The degree of hardness

The degree of hardness is usually defined as the number of parts by weight of calcium carbonate, $CaCO_3$ (or its equivalent present in million parts (106) by weight of water.

Hardness is more frequently expressed as parts per million, ppm. If a sample of water contains in n parts of $CaCO_3$ equivalent per 10, 00,000 (1 million) parts, it possesses n degree of hardness.

Treatment of water for domestic purpose

Water is used for drinking purposes and other domestic purposes and hence the purification of water needed for drinking purposes cities and towns is an important practical problem for the municipalities. The supplied should be colourless, free from suspended impurities, germs and bacteria and should not contain dissolved impurities that are injurious to health.

SOURCES OF WATER

Surface Water

Surface water is water in a river, lake or fresh water wetland. Surface water is naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, evapotranspiration and sub- surface seepage.

Although the only natural input to any surface water system is precipitation within its watershed, the total quantity of water in that system at any given time is also dependent on many other factors. These factors include storage capacity in lakes, wetlands and artificial reservoirs, the permeability of the soil beneath these storage bodies, the runoff characteristics of the land in the watershed, the timing of the precipitation and local evaporation rates. All of these factors also affect the proportions of water quality.

Surface water is the easiest water to understand because we see it every day. It is any water that travels or is stored on top of the ground. This would be the water that is in rivers, lakes, streams, reservoirs, even the oceans-even though we can't drink salt water. Snow can become surface and groundwater. An example of this is when it snows a few times on a mountain. The snow might not melt in between snows. When it warms up in the spring, there could be too much water for the earth to absorb. This causes the melted snow water to run down the mountains as surface water until it reaches a body of water.

Sometimes surface water sinks into the ground and becomes ground water. We visited a few water facilities and each one mentioned runoff. Runoff is the water that runs in gutters, off roofs, and out of mall parking lots when it rains. This is surface water, too. Runoff is a problem because it carries bad things like car oil, road salt, and trash into the water supply.

Under River Flow

Throughout the course of a river, the total volume of water transported downstream will often be a combination of the visible free water flow together with a substantial contribution flowing through sub- surface rocks and gravels that underlie the river and its floodplain called the hyporheic zone. For many rivers in large valleys, this unseen component of flow may greatly exceed the visible flow. The hyporheic zone often forms a dynamic interface between surface water and true ground-water receiving water from the ground water when aquifers are fully charged and contributing water to ground-water when ground waters are depleted.

Ground Water

Sub-surface water, or groundwater, is fresh water located in the pore space of soil and rocks. It is also water that is flowing within aquifers below the water table. Sometimes it is useful to make a distinction between sub-surface water that is closely associated with surface water and deep sub-surface water in an aquifer (sometimes called "fossil water").

Ground water is a little harder to understand than surface water because you can't actually see this water. Any water that is underground is groundwater. Half of the people in the United States use groundwater for drinking water.

In the water cycle, some of the precipitation sinks into the ground and goes into watersheds, aquifers and springs. The amount of water that seeps into the ground depends on how steep the land is and what is under ground. For example: places that have lots of sand underground will allow more water to sink in than ones that have lots of rock.

When the water seeps down, it will reach a layer of ground that already has water in it. That is the saturated zone. The highest point in the saturated zone is called the water table. The water table can raise and lower depending on season sand rainfall.

Groundwater flows through layers of sand, clay, rock, and gravel. This cleans the water. Because groundwater stays underground, things that fall into surface water can't fall into it .This means that groundwater stays cleaner than water on the surface. It has its problems, too. When farmers use fertilizers and insecticides, rain will wash them into the soil where they get into aquifers groundwater.

Gas stations have big, underground tanks where they keep the gas. If these leak, the gas sinks into the groundwater, too. Groundwater doesn't need as much treatment as surface water, but it usually gets some because of these problems.

Desalination

Desalination is an artificial process by which saline water (generally sea water) is converted to fresh water. The most common desalination processes is distillation and reverse osmosis.

Desalination is currently expensive compared to most alternative sources of water, and only a very small fraction of total human use is satisfied by desalination. It is only economically practical for high-valued uses (such as household and industrial uses) in arid areas. The most extensive use is in the Persian Gulf.

Frozen water

Several schemes have been proposed to make use of icebergs as a water source, however to date this has only been done for novelty purposes. Glacier runoff is considered to be surface water.

The Himalayas, which are often called "The Roof of the World", contain some of the most extensive and rough high altitude areas on Earth as well as the greatest area of glaciers and permafrost outside of the poles. Ten of Asia's largest rivers flow from there and more than a billion people's livelihoods depend on them. To complicate matters, temperatures are rising more rapidly here than the global average. In Nepal the temperature has risen with 0.6 degree over the last decade, whereas the global warming has been around 0.7 over the last hundred years.

Reservoirs

Reservoirs are characterized by features which are intermediate between rivers and lakes. They can range from large scale of impoundments, such as Mettur dam Tamilnadu, to small dammed rivers with a seasonal pattern of operation and water level fluctuation closely related to the river discharge, to entirely constructed water bodies with pumped in-flows. The hydrodynamics of reservoirs are greatly influenced by their operational management regime.

Uses of Water

Agricultural

It is estimated that 70% of worldwide water use is for irrigation, with 15-35%

Of irrigation withdrawals being unsustainable. It takes around 2,000 - 3,000 litres" of water to produce enough food to satisfy one person's daily dietary need. This is a considerable amount, when compared to that required for drinking, which is between two and five litres'. To produce food for the now over 7 billion people who inhabit the planet today requires the water that would fill a canal ten meters deep, 100 meters wide and 2100 kilometres long.

Increasing Water Scarcity

Fifty years ago, the common perception was that water was an infinite resource. At this time, there were fewer than half the current numbers of people on the planet. People were not as wealthy as today, consumed fewer calories and ate less meat, so less water was needed to produce their food. They required a third of the volume of water we presently take from rivers. Today, the competition for water resources is much more intense. This is because there are now seven billion people on the planet, their consumption of water-thirsty meat and vegetables is rising, and there is increasing competition for water from industry, urbanization bio fuel crops, and water reliant food items. In future, even more water will be needed to produce food because the Earth's population is forecast to rise to 9 billion by 2050. An additional 2.5 or 3 billion people, choosing to eat fewer cereals and more meat and vegetables could add an additional five million kilometres to the virtual canal mentioned above.

Industrial

It is estimated that 22% of worldwide water is used in industry. Major industrial users include hydroelectric dams, thermoelectric power plants, which use water for cooling, ore and oil refineries, which use water in chemical processes, and manufacturing plants, which use water as a solvent. Water withdrawal can be very high for certain industries, but consumption is generally much lower than that of agriculture. Water is used in renewable power generation. Hydroelectric power derives energy from the force of water flowing downhill, driving a turbine connected to a generator. This hydroelectricity is a low-cost, non-polluting, renewable energy source. Significantly, hydroelectric power can also be used for load following unlike most renewable energy sources which are intermittent. Ultimately, the energy in a hydroelectric power plant is supplied by the sun. Heat from the sun evaporates water, which condenses as rain in higher altitudes and flows downhill. Pumped-storage hydroelectric plants also exist, which use grid electricity to pump water uphill when demand is low, and use the stored water to produce electricity when demand is high.

Household

It is estimated that 8% of worldwide water use is for household purposes. These include drinking water, bathing, cooking, sanitation, and gardening. Basic household water requirements have been estimated by Peter Gleick at around 50 litres per person per day, excluding water for gardens. Drinking water is water that is of sufficiently high quality so that it can be consumed or used without risk of immediate or long term harm. Such water is commonly called potable water. In most developed countries, the water supplied to households, commerce and industry is all of drinking water standard even though only a very small proportion is actually consumed or used in food preparation.

Recreation

Recreational water use is usually a very small but growing percentage of total water use. Recreational water use is mostly tied to reservoirs. If a reservoir is kept fuller than it would otherwise be for recreation, then the water retained could be categorized as recreational usage. Release of water from a few reservoirs is also timed to enhance white-water boating, which also could be considered a recreational usage. Other examples are anglers, water skiers, nature enthusiasts and swimmers. Recreational usage is usually non-consumptive. Golf courses are often targeted as using excessive amounts of water, especially in drier regions. It is, however, unclear whether recreational irrigation (which would include private gardens) has a noticeable effect on water resources. This is largely due to the unavailability of reliable data. Additionally, many golf courses utilize either primarily or exclusively treated effluent water, which has little impact on potable water availability.

Environmental

Explicit environment water use is also a very small but growing percentage of total water use. Environmental water may include water stored in impoundments and released for environmental purposes (held environmental water), but more often is water retained in waterways through regulatory limits of abstraction.

STUDY AREA

The study area Khaja Nagar is situated in Tiruchirapalli District, which is one of the important cities in Tamil Nadu . The northern part of the area is a vast stretch of flat flood plains of Cauvery alluvium with morphology associated with meandering river system. The slope of the area is 1 to 2 degree (very gentle). It is 280m above Mean Sea Level.

The soil types of the study area are river alluvium, red sandy soil, black soil and red soil. The Cauvery and its branch Coleroon are the most 3 important rivers in this area. Eighteen kilometres west of Tiruchirapalli town, the river Cauvery splits into two branches, of which northern branch called Coleroon while the southern branch retains the name Cauvery. It falls within the Tiruchirapalli taluk and the most of the study area covers the Manachanallur, Andanallur, and Thiruverumbur blocks of Tiruchirapalli districts. The average annual rainfall is 700 mm.

The temperature is generally very high during summer and it ranges from 29.1 to 38.2 degree Celsius. The area has a good transport system of road network and well connected by the adjacent towns namely Tanjore, Perambalur, Namakkal , Madurai and Pudkottai. It also has the good communication facilities. Geologically, the region mainly comprises of charnockites, gneisses and granites of Early Proterozoic age.

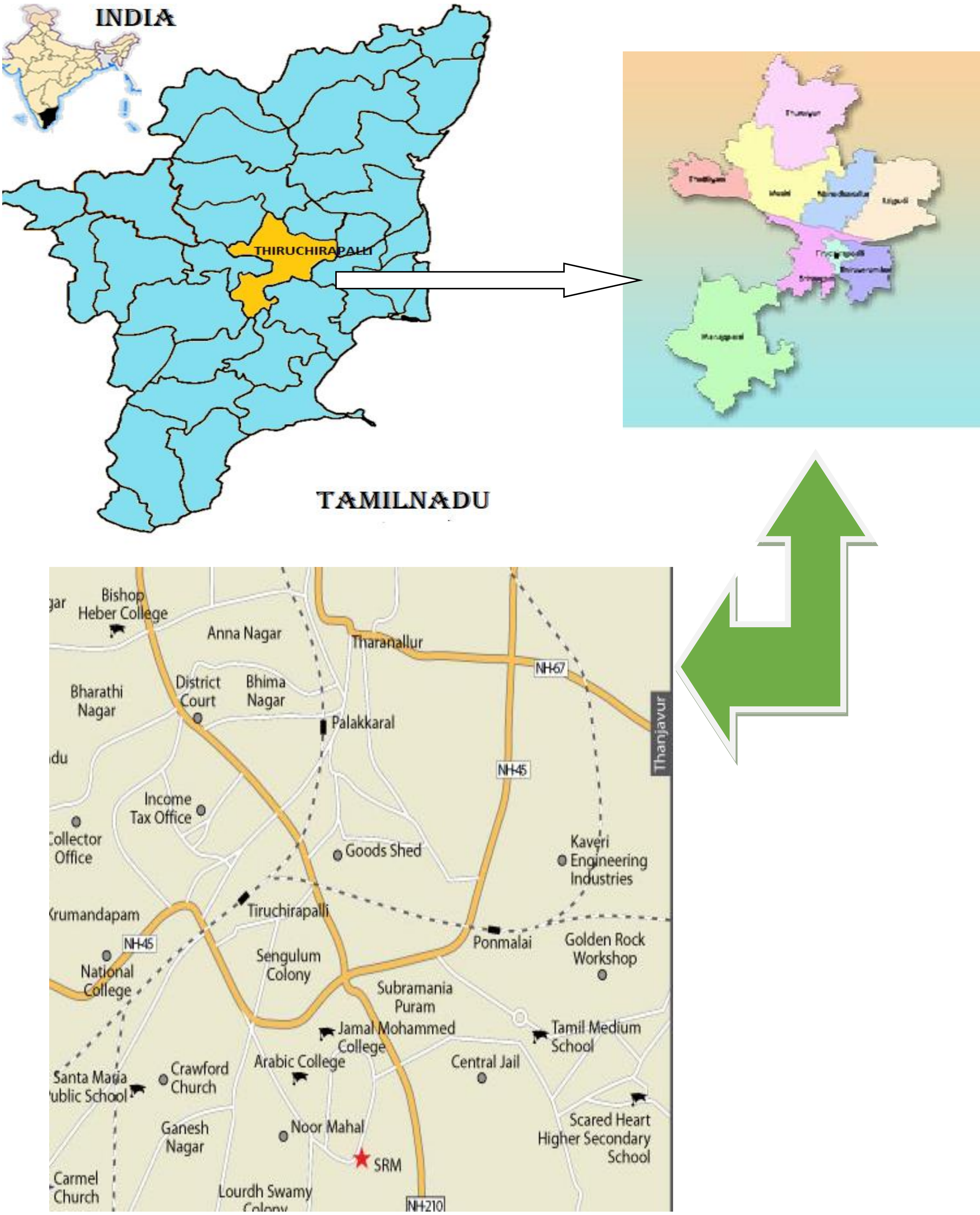
AIM AND SCOPE

The study area Khaja Nagar is located in Tiruchirappalli District. The population of the area is 2000. Most of the people depend on the ground water for, domestic and drinking purposes. Most of domestic wastes and sewage wastes are directly discharged in this area. Hence the present study has been under taken to investigate the physico-chemical parameter of the ground water of Khaja Nagar area in using water quality index. The main objectives are.

- To find the P^H, electrical conductivity.
- To determine the total dissolved solids and total hardness.
- To estimate quantitatively the calcium, and magnesium.
- To determine the DO, COD and BOD.
- To determine the water quality index.

It is expected that this preliminary study may throw light on ground water quality of this region, with the objective of comparing the water quality with WHO standards

LOCATION MAP OF THE STUDY AREA



MATERIALS AND METHOD

Groundwater samples were collected from Khaja Nagar area in Tiruchirappalli District. The water samples were collected in the polyethylene bottles. A total of 8water samples were collected from groundwater during the year 2021. The physico- chemical parameters such as pH, EC, TDS, DO, TH, BOD, COD, Ca, and Mg of ground water samples were determined using standard procedures.

PHYSICO - CHEMICAL ANALYSIS:

Methodology:

Water sampling and the determination on various physico - chemical parameters were carried out according to standard procedures. (APHA, 1985).

pH

The pH of the water sample was measured by a glass electrode and electrometer type pH meter (Elico-model li 12T) after taking necessary precautions in sampling and standardization.

Conductivity:

Conductivity was determined by digital conductivity meter (Elico-model cm-180).

Total Hardness:

50 ml of the water sample was taken in a 250 ml conical flask. An indicator Eriochrome Black - T (EBT) 0.5% dissolved in Triethanolamine 100ml was added (4 to 6 drops) and mixed. It was immediately titrated against a standard EDTA solution with continuous shaking until the colour changed from red to blue. This was taken as the end point.

Total Hardness (C_aCO_3) = 1000 x V_2/ V_1 mg

Where

V_I Volume of the EDTA solution in ml.

V_2 Volume of the sample taken in ml.

Calcium and Magnesium:

Sodium hydroxide solution 8%: 8gm of sodium hydroxide dissolved in 100ml distilled water.

Murexide indicator (1%)

1gm of Murexide indicator dissolved in 100ml of distilled water.

EDTA solution (0.02 M)

8 gm of disodium salt of EDTA dissolved using distilled water and made up to 1 L. Titrations were made in two stages to determine calcium and magnesium. In the first stage Ca and Mg were together determined. In the second stage Ca alone was estimated.

Procedure:

20ml of water sample was taken and buffer ammonia was added to increase pH. Erichrome black -T indicator was used so as to see that the solution turns into purple then the solution was titrated against 0.02M EDTA and the appearance of blue colour was marked as the ent point. Burette reading straight away glyps the Ca and Mg in meq/1. 20ml of water sample was pipette out and added 2ml of 10% sodium hydroxide to precipitate magnesium. Then one or two drops of murexide as indicator was added and the solution was turned orange. It was titrated against NV50 EDTA and the end point was taken only the change of colour from yellow to violet. This reading directly gave the Ca in meq/1. Combining the results of the two experiments the following results were obtained.

Ca in meq/L - Vtra value of second experiment.

Ca in meq/L - Titra value of second experiment.x 20.05.

Mg in meq/L - second titra value value.

Dissolved oxygen:

Sodium thiosulphate solution (0. 01N):

6.20 g of sodium thiosulphate was dissolved using distilled water and made up to 1 liter.

Manganese sulphate solution:

100g of manganese sulphate was dissolved in 200ml distilled water.

Alkaline potassium iodide solution:

100g of potassium hydroxide and 50g of potassium iodide was dissolved in 200ml of distilled water.

Starch indicator

1g of starch was dissolved in 100ml of hot distilled water. A glass stopper BOD bottle was taken and filled it with sample to avoid bubbling. No air should be trapped in bottle after the stopper was placed. The bottle was opened and poured in it 1ml of each manganese sulphate and alkaline potassium iodide solution using separate pipettes. A precipitate was formed. The stopper was placed and shaken well and stored for a few days. 2ml of sulphuric acid was added and shaken well to dissolve the precipitate was formed. 50ml of the sample was 31pipette out into a conical flask. 1ml of starch indicator was added and titrated against sodium thiosulphate solution till the blue color turned to colorless.

If whole content was used for titration

$$DO\ (mg/1) = \frac{V_1 \times N \times 8 \times 1000}{V_2 - V_3}$$

If fraction of the contents was used for titration

$$Do\ (mg/1) = \frac{V1 \times N \times 8 \times 1000}{V_4 (V_2 - V_3) / V_2}$$

Where,

V_1 = volume of titrant (ml)

N = normality of titrant (0.1N)

V_2 = volume of sample after placing the stopper

V_3 = volume of manganese sulphate + potassium iodide solution Added

V4= volume of fraction of the contents used for titration (mL)

Chemical Oxygen Demand (COD):

20ml of water sample was taken in a COD flask. 10 ml of 0.25 potassium dichromate solution, a pinch of H_2S0_4 is added to it. If the sample contains chloride in higher amount H_2S0_4 is added in the ratio of 10:1 in the chlorides. 30ml of conc. H_2S0_4 reflex at least for two hours on a water bath remove the flask and cool. Add distilled water to make the final volume to about 140ml. added two or three drops of ferroin indicator mixes thoroughly and titrated against 0.1N of ferrous ammonium sulphate. Run a blank with distilled water, the end point is the wine red colour.

Calculation

COD (mg/1) (blank –titrate value) x Normality of FAS x 8 x 1000 volume of sample take

Biological Oxygen Demand (BOD):

The samples were diluted before incubation to bring the oxygen demand and supply in to an appropriate balance. One litter of distilled water was mixed with

Nutrients. 1 ml of each of buffer, calcium chloride, magnesium sulphate and ferric chloride. Samples were neutralized to pH 6.5 – 7.5 with H_2SO_4. The DO of

The samples was determined initially and after five days incubation in a BOD incubator at 20◦ C. Blank using distilled water alone was also carried out simultaneously.

The BOD was then worked out by the following formula:

BOD at 20◦C in mg/l $(D_0\text{-}D_5)\text{-}C_0\text{-}\ C_{5)\ x}$ dilution factor

RESULTS AND DISCUSSION

Colour and odour

Almost all groundwater samples are found to be colourless and odourless.

Temperature

Temperature measurement of hotness of any material affects the physical and chemical properties of water and also affects the aquatic vegetation. Organism and their biological activities during this studies temperature ranged from 28.9 to 29C.

pH

pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. Most of the water samples are slightly alkaline due to presence of carbonates and bicarbonates. The mean values are recorded within the range of 7.2-7.9 for groundwater samples. The pH values are observed to be within the permissible limit of WHO (6.5-8.5ppm) in all the sampling stations for groundwater samples.

ELECTRICAL CONDUCTIVITY (EC)

Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts. It is a measure of salinity which greatly affects the taste and thus has a significant impact on the user acceptance of the water as potable. Electrical Conductivity talks about the conducting capacity of water which in turn is determined by the presence of dissolved ions and solids. Higher the ionizable solids, greater will be the EC. The mean EC values ranged from 650 -2007 micro mho/cm^{-1} for the groundwater samples The EC values are well above the permissible limit of WHO (600 micro mho/cm^{-1}) for ground water samples. This is may be due to the increase evaporation effects leading to increasing ionic content.

TOTAL DISSOLVED SOLIDS (TDS)

TDS in nature water is contributed only by six major ions like Calcium, Magnesium, Sodium, Bicarbonate, Chloride and Sulphate. Water containing more than 500 ppm of TDS is unfit for drinking purpose. The mean TDS values are found the range from 444-884 ppm for ground water .All the ground water samples show higher TDS values that are well above the permissible limit of WHO (500ppm) except the S4 Sample, which shows 444ppm.

This is due to the percolation of sewage waste, human wastage and domestic wastage in ground water samples and high organic solids also contributed to high total dissolved solids value. The higher concentration of TDS may cause a gastrointestinal irritation in human beings

TOTAL HARDNESS (TH)

Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. It is due to the presence of excess of Ca, Mg and Fe salts. The mean TH values are within the range of 260-490 ppm for groundwater. All the TH values are within the permissible limit of WHO (500ppm).

DISSOLVED OXYGEN (DO)

Dissolved oxygen is important parameter in water quality assessment and reflects the biological processes prevailing in the water. The values of DO are recorded with the range of 3.4-5.7 ppm for all the groundwater samples.

The DO values of all the ground water samples are lesser than the permissible of WHO (6ppm). Low DO may affect the aquatic life

BIOCHEMICAL OXYGEN DEMAND (BOD)

Biological and Chemical oxygen demands are the good measures of pollution load. They cause dangerous effect on the aquatic lives. The mean values of BOD are between the ranges of 6-8 ppm for the groundwater samples. In the present study, the values of BOD are found above the permissible limit of WHO (6 ppm). This may be due to the heavy pollution load of high amount of organic matter from sewage wastage, human wastage and effluents. High BOD may affect the aquatic life.

CHEMICAL OXYGEN DEMAND (COD)

Chemical oxygen demand is used to measure the pollution of domestic and industrial waste. The waste is measured in. terms of quantity of oxygen required for oxidation of organic matter to produce carbon dioxide and water. The COD values are with the range of 8-11 ppm for groundwater samples .COD values were above the permissible limit of WHO (10ppm) in some of the sampling stations of groundwater samples, which may be due to the seepage of sewage and industrial effluents in nearby localities. High COD may affect the aquatic life.

Calcium

Calcium is a major constituent of igneous rocks. The calcium is an important element to develop proper bone growth. The main source of the calcium in ground water is around basalt. The calcium values are found to be the range of 102-145 ppm. Calcium values of all ground water samples are above the limit of prescribed by WHO (100ppm).

Magnesium

Magnesium is directly related to hardness. Magnesium concentrated ranged between 151ppm to 174 ppm. In the present investigation Mg values of all ground water samples were above the limit prescribed by WHO (150).

Fig 1: The Physico-chemical parameters were analyzed in the month of Febrauray 2021

Sampling stations	Temp.	pH	Turb.	EC	TDS	Salinity	DO	BOD	COD	Ca	Mg	TH
S1	29.0	7.5	3	1150	884	1.0	3.4	8	12	111	151	380
S2	28.9	7.3	3	710	536	0.5	5.2	7	10	102	156	260
S3	28.9	7.5	3	660	560	0.5	5.3	6	9	132	162	300
S4	28.9	7.7	3	650	444	0.5	5.2	7	11	126	169	302
S5	28.9	7.9	3	1940	700	1.7	5.7	5	8	145	174	351
S6	28.9	7.8	3	2000	702	1.8	5.6	6	11	124	155	490
S7	28.9	7.5	3	2007	806	1.8	5.1	6	11	114	159	480
S8	28.9	7.9	3	1930	708	1.7	5.6	6	11	134	168	402

All the values are expressed in ppm except pH and EC (micromho/cm^{-1})

Fig:2 Mean variation of pH values collected from different sampling sites of Khaja Nagar area.

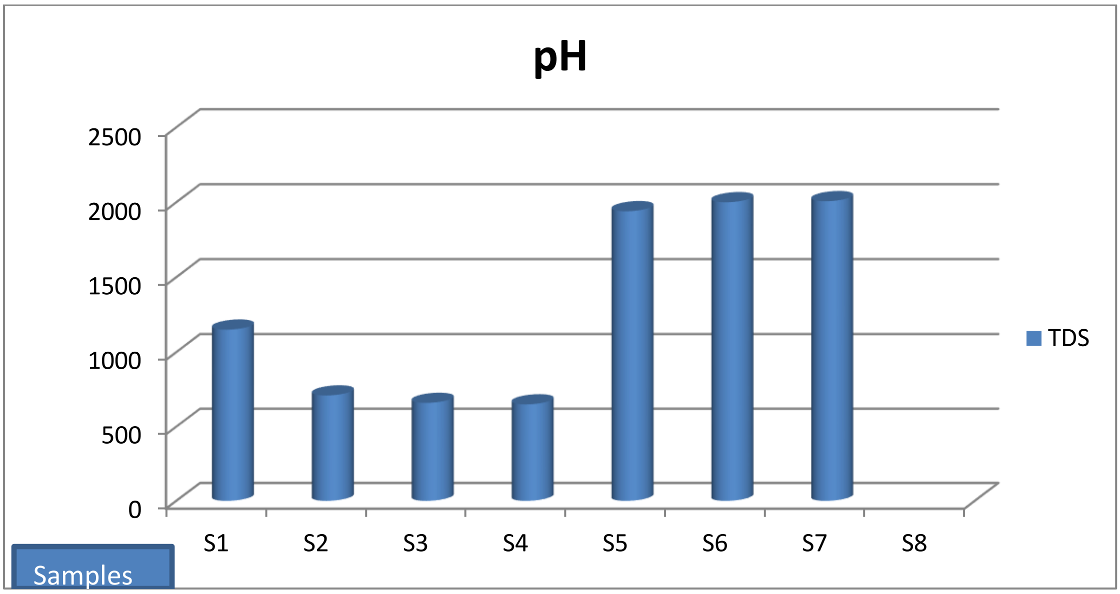


Fig:3 Mean variation of Electrical Conductivity values collected from different sampling sites of Khaja Nagar area

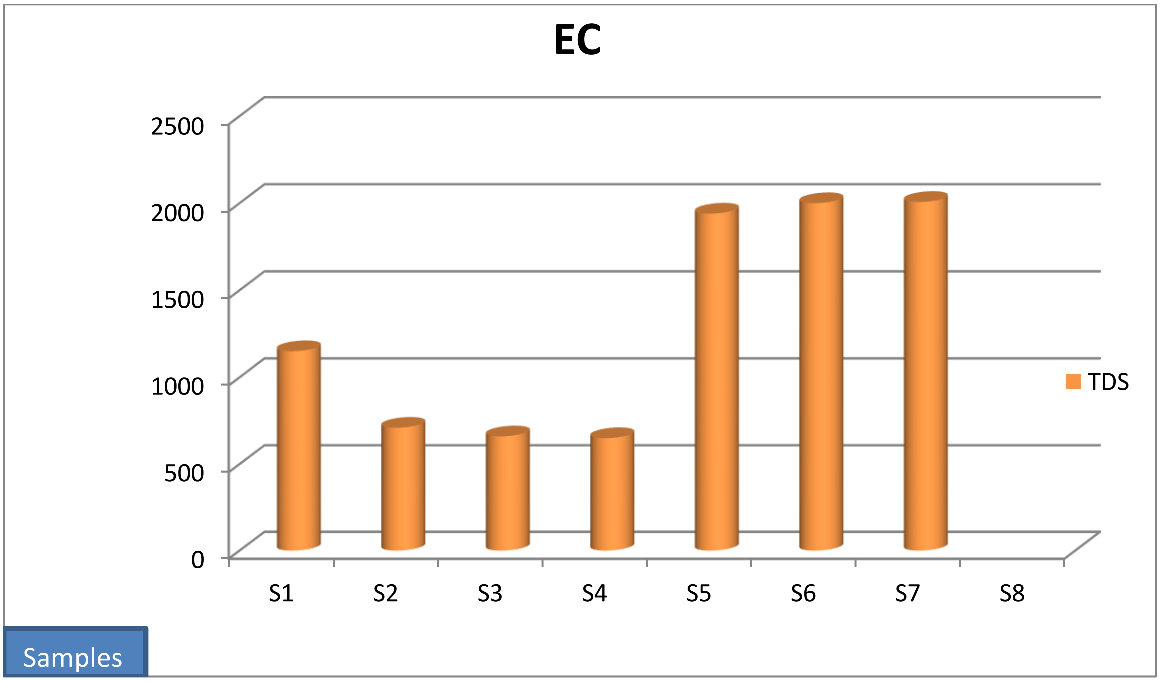


Fig:4 Mean variation of Total Dissolved Solids values collected from different sampling sites Khaja Nagar area.

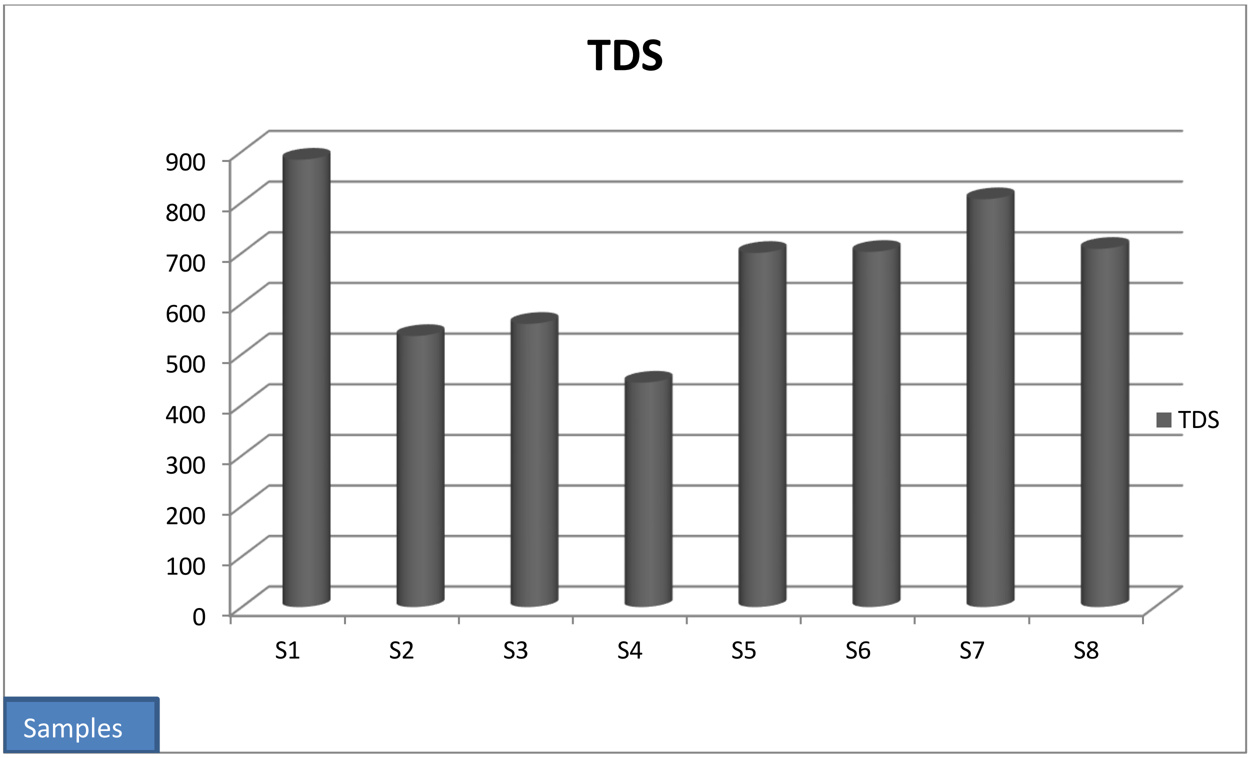


Fig:5 Mean variation of Total Hardness values collected from different sampling sites of Khaja Nagar area.

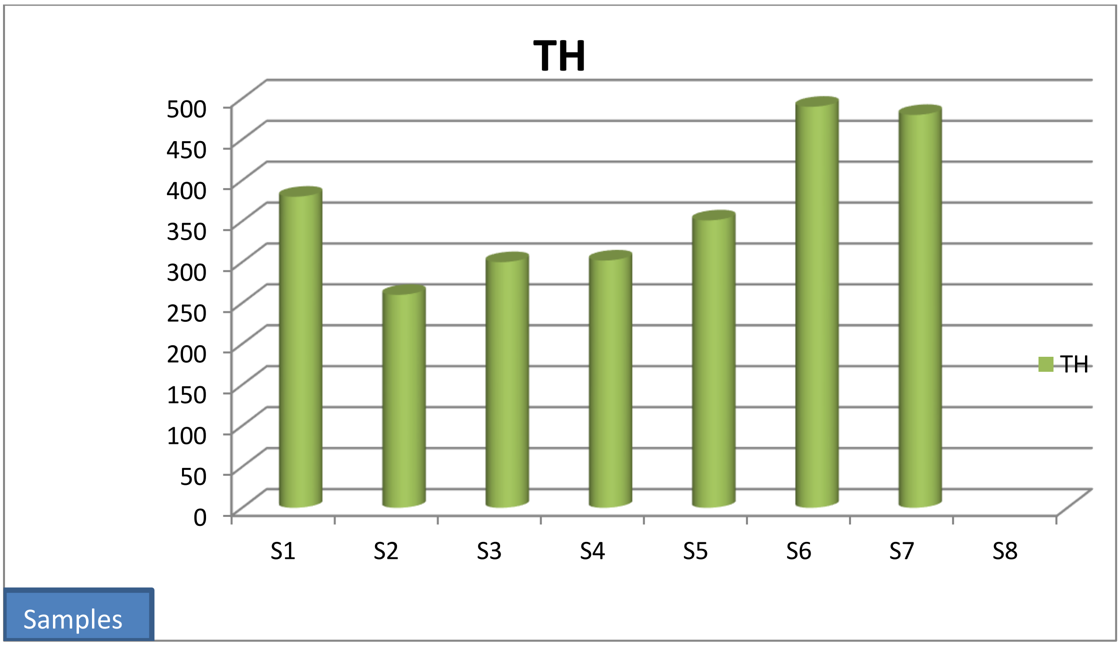


Fig:7 Mean variation of Biological Oxygen Demand values collected from different sampling sites of Khaja Nagar Area.

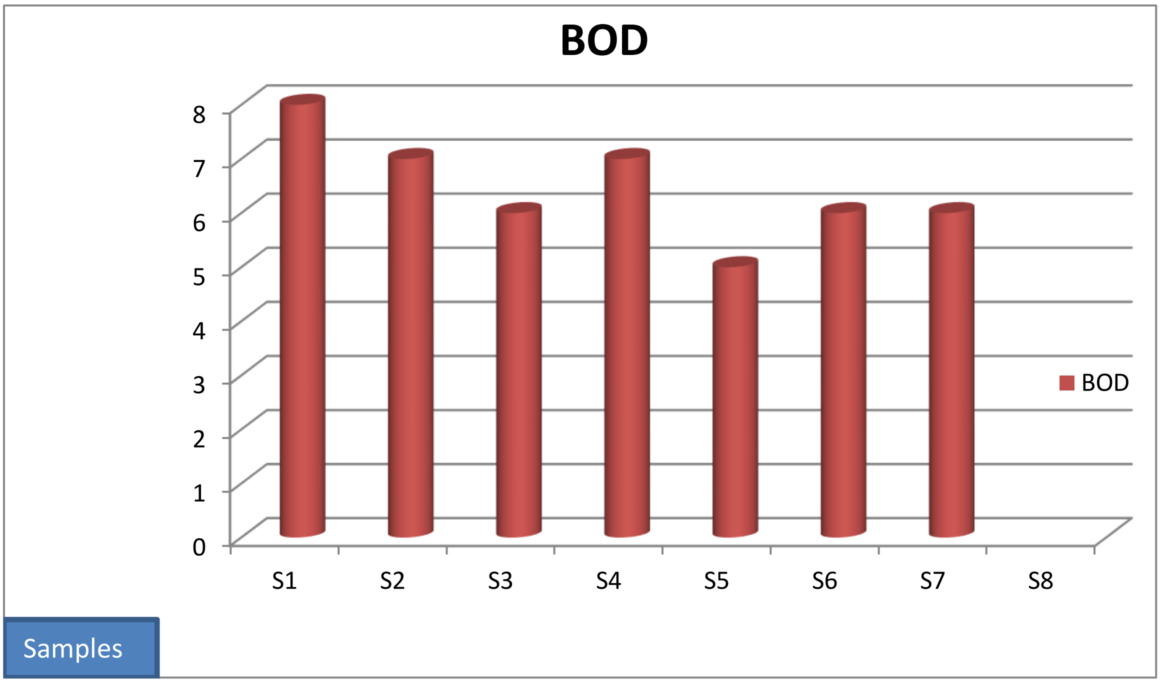


Fig:8 Mean variation of Chemical Oxygen Demand values collected from different sampling sites of Khaja Nagar area.

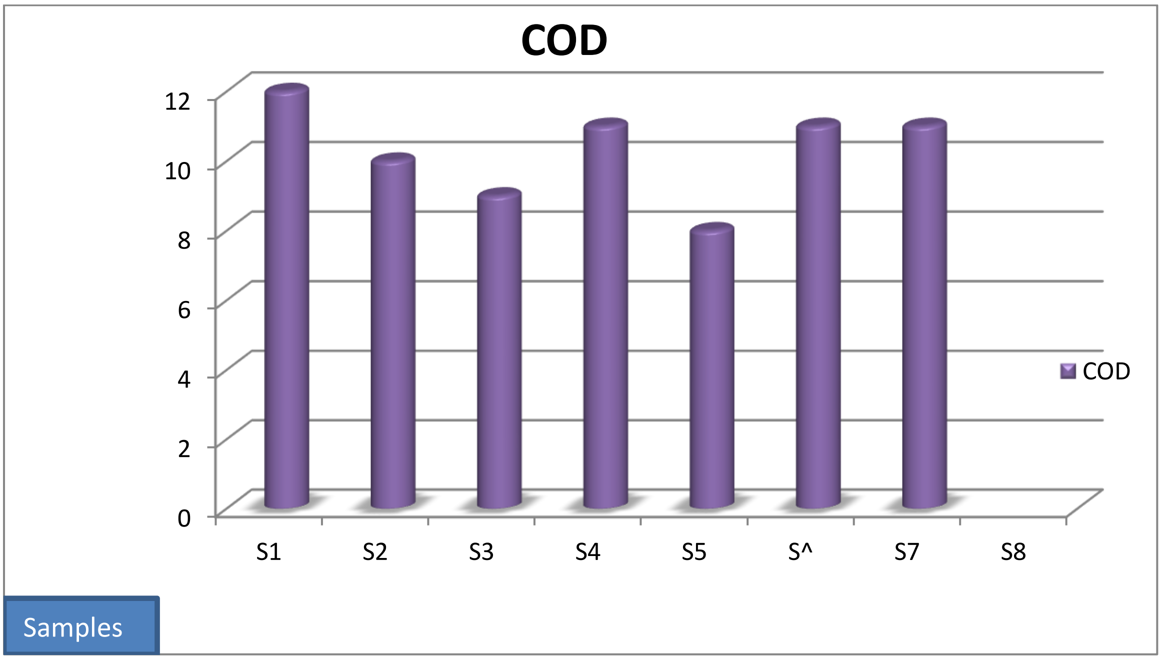


Fig:9 Mean variation of Calcium values collected from different sampling sites of Khaja Nagar area

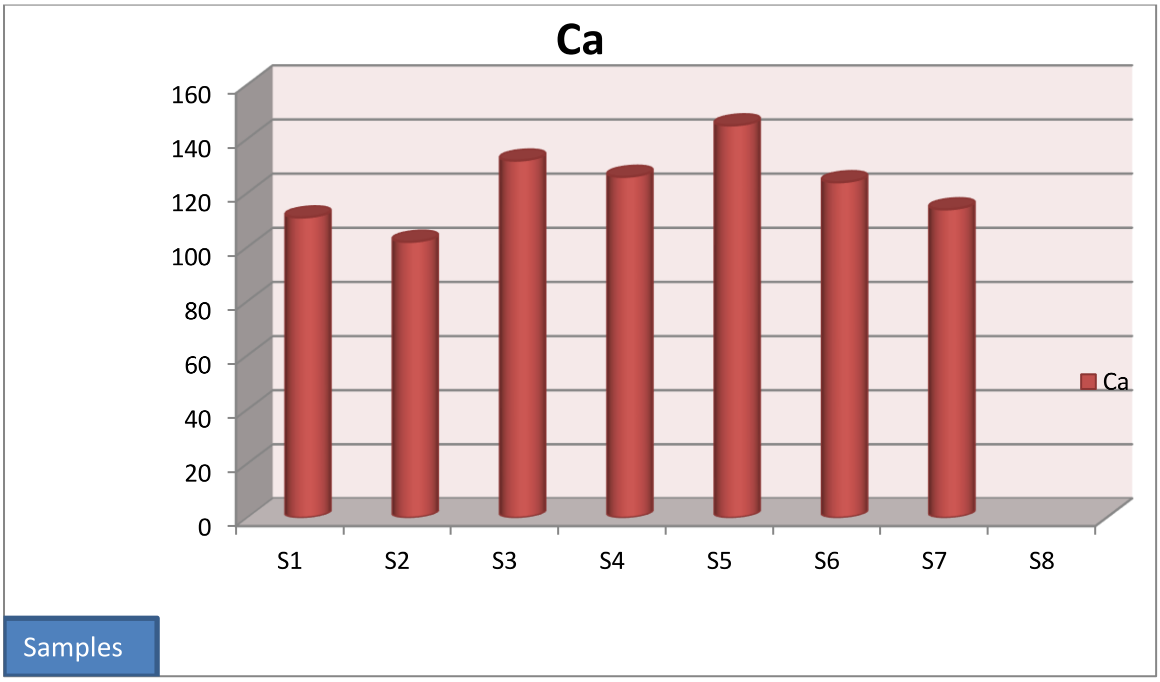
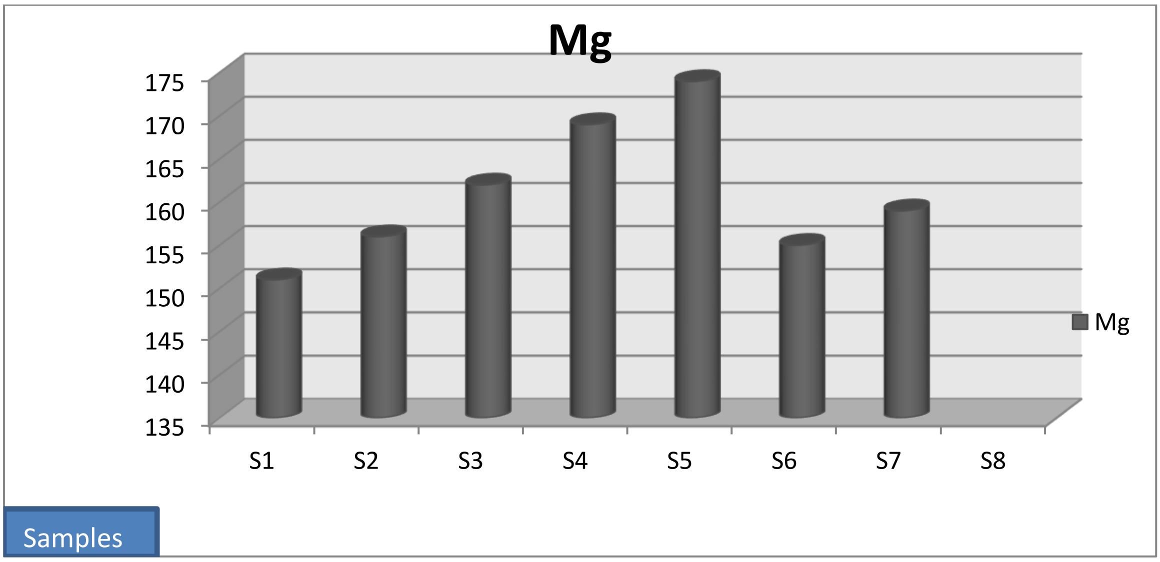


Fig:10 Mean variation of Magnesium values collected from different sampling sites of Khaja Nagar area.



CONCLUSION

The ground water Samples were collected from 8 different places at Khaja Nagar area Tiurchirappalli district. The samples were subjected to physico-chemical analysis. The results are compared with the standards prescribed by the WHO. In the present study shows most of the physico-chemical parameters like EC, TDS, Ca, Mg were above the permissible limit of WHO(2011). The results reveal that the ground water in this area is unfit for drinking and domestic purposes. On the basis of finding of present study it is recommended that the ground water in the study area should be treated before, it is used for drinking purposes.

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