Field Project : 2021-22

"Water analysis of Urban area's drinking water"
(Himatnagar City)

B.Sc.Sem-3

Chemistry Department

THE HNSB.LTD.SCIECNE COLLEGE, HIMATNAGAR

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A

Project report

of

Field Project (Year:2021-22)

on

"Water analysis of Urban area's drinking water"

(Himatnagar City)

Prepared by

students of **B.Sc.Semester: 3**

(129 students)

Submitted to

Chemistry Department

THE HNSB LTD. SCIENCE COLLEGE, HIMATNAGAR

(NAAC Accredited 'B' Grade)

Guided and supervising by

Dr.H.K.Patel and Dr.N.I.Patel

Certificate

This is to certify that the content of this field project (year: 2021-22) entitled "Water analysis of Urban area's drinking water" (Himatnagar City) by B.Sc.Semester-3 students (129 students) are the bona fide work of them submitted to Chemistry Department, The HNSB. Ltd. Science College, Himatnagar.

They have successfully completed the field project in given time period under supervision of Dr. H.K.Patel and Dr. N.I.Patel, Associated professors, Chemistry Department.

We appreciate to all students for them skill diligence and sense of commitment in preparation of this project. The field project work has been prepared exclusively for academic purpose.

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THE HNSB LTD. SCIENCE COLLEGE,

HIMATNAGAR

(NAAC Accredited 'B' Grade)

Field Project (Year:2021-22) report on

"Water analysis of Urban area's drinking water" (Himatnagar City)

Prepared by following student of

B.Sc.Semester: 3

No.	GR No.	Name of student	Sign.
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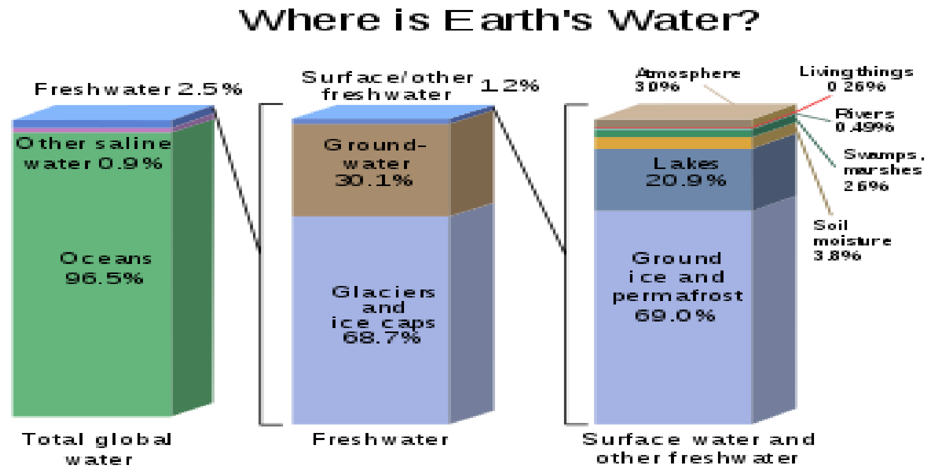
Introduction

Drinking water is one of the basic needs of life and essential for survival. Still more than one billion people all over the world do not have ready access to an adequate and safe water supply and more than 800 million of those unsaved live in rural areas. In India, ground water is being used as raw water for 85% public water supply. (According to world health report 1998) water supply varies widely in terms of region and country. In 1970s, of the approximately 2.5 billion people in developing world, only 38% has safe drinking water. At the beginning of the 1980s, water supply coverage was 75% in urban areas and 46% in rural areas. In developing countries, 75% of the population had access to water supply. So they are always prone to loss of their lives or cost a big toll to save themselves from the occurrence of different water-borne disease. Water contamination due to pathogenic agents, chemicals, heavy metals, pesticides water disinfectants, and thereby product as a consequence of industrial and agricultural activities leaching from soil, rocks, and atmospheric deposition and other human activities has become a hazard to human health in several regions of world.

Water On Earth

- Earth viewed from space looks like mostly (~71% of the surface) water this is very misleading, however.
- The water is concentrated at the Earth's surface, so its relative mass compared to the whole Earth is small. It amounts to about 0.02% of Earth's mass.
- The largest drop here represents the volume of all water, the mid sized drop freshwater, and the smallest drop (near Atlanta) all of Earth's lake water.
- The distribution of water on the Earth's surface is extremely uneven. Only 3% of water on the surface is fresh; 69% resides in glaciers, 30% underground, and less than 1% is located in lakes, rivers, and swamps.
- Looked at another way, only one percent of the water on the Earth's surface is usable by humans , and 99% of the usable quantity is situated underground.
- All one needs to do is study rainfall maps to appreciate how uneven the distribution of water really is. The white areas on the map below had annual rainfall under 400 mm for the last year, which makes them semi-arid. And, remember, projection are for significant aridification to occur in many dry region and for more severe rainfall events to characterize wet regions.

  Water resources



A graphical distribution of the locations of water on Earth. Only 3% of the Earth's water is fresh water. Most of it is in icecaps and glaciers (69%) and groundwater (30%), while all lakes, rivers and swamps combined only account for a small fraction (0.3%) of the Earth's total freshwater reserves.

Water resources are natural resources of water that are potentially useful as a source of water supply. 97% of the water on the Earth is salt water and only three percent is fresh water; slightly over two thirds of this is frozen in glaciers and polar ice caps.[1] The remaining unfrozen freshwater is found mainly as groundwater, with only a small fraction present above ground or in the air. Natural sources of fresh water include surface water, under river flow, groundwater and frozen water. Artificial sources of fresh water can include treated wastewater (reclaimed water) and desalinated seawater.

Uses of water include agricultural, industrial, household, recreational and environmental activities.

Water resources are under threat from water scarcity, water pollution, water conflict and climate change. Fresh water is a renewable resource, yet the world's supply of groundwater is steadily decreasing, with depletion occurring most prominently in Asia, South America and North America, although it is still unclear how much natural renewal balances this usage, and whether ecosystems are threatened.[3] The framework for allocating water resources to water users (where such a framework exists) is known as water rights.

Sources of useful water

Natural sources of fresh water

Natural sources of fresh water include surface water, under river flow, groundwater and frozen 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 groundwater recharge.

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 loss.

Human activities can have a large and sometimes devastating impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wetlands. Humans often increase runoff quantities and velocities by paving areas and channelizing the stream flow.

The total quantity of water available at any given time is an important consideration. Some human water users have an intermittent need for water. For example, many farms require large quantities of water in the spring, and no water at all in the winter. To supply such a farm with water, a surface water system may require a large storage capacity to collect water throughout the year and release it in a short period of time. Other users have a continuous need for water, such as a power plant that requires water for cooling. To supply such a power plant with water, a surface water system only needs enough storage capacity to fill in when average stream flow is below the power plant's need.

Nevertheless, over the long term the average rate of precipitation within a watershed is the upper bound for average consumption of natural surface water from that watershed.

Natural surface water can be augmented by importing surface water from another watershed through a canal or pipeline. It can also be artificially augmented from any of the other sources listed here, however in practice the quantities are negligible. Humans can also cause surface water to be "lost" (i.e. become unusable) through pollution.

Brazil is estimated to have the largest supply of fresh water in the world, followed by Russia and Canada.[4]

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 rocks and sediments 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 groundwater from aquifers, exchanging flow between rivers and aquifers that may be fully charged or depleted. This is especially significant in karst areas where pot-holes and underground rivers are common.

Groundwater

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 unsustainable 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.

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 research 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 there are rising more rapidly than the global average. In Nepal, the temperature has risen by 0.6 degrees Celsius over the last decade, whereas globally, the Earth has warmed approximately 0.7 degrees Celsius over the last hundred years.

Extending a limited water supply

Water supplies can be extended by several methods. Most common is adapting low usage irrigation systems. Zoning, applying the water to one area or section of plants at a time, will allow a low flow water source to irrigate a larger number of plants. Zones can be sized to utilize the flow from a well or municipal source so that irrigation takes place all day long.

Low flow wells can be set up to be pumped to a storage tank over a many hours. Water from the tank is then used to irrigate plants during the daylight hours.

Collection of rainwater to supplement a well or surface system is also possible. This works best with a gutter-connected greenhouse where the water from the downspouts is piped to an above ground or below ground storage tank. See section on rainwater.

From a conservation standpoint, keeping the piping system in good repair is important. A leak of one drop per second wastes over 113 gallons of water per month.

Particular Introduction

• Water is made up of two Hydrogen atoms and one oxygenatom
• Oxygen has six frontier electrons
• Four of these electrons come in pairs of two: the other two electrons are unpaired.

Water quality parameters:

Water quality is determined by assessing three classes of attributes: physical, chemical, and biological

There are standards of water quality set for each of these three classes of attributes

Physical Parameters of WaterQuality assessment

- Colour
- Odour
- Turbidity
- Temperature
- Conductivity

Chemical Parameters for Water Quality assessment

- pH
- Acidity
- Alkalinity
- Hardness
- Solids

Harmful Chemicals

• Chlorides, Iron, Sulphates, Nitrates , Heavy Metals, Petricide

Common problems

Visible effect	Reasons
Water turns black , smell	Waste water
Acidic taste	Low pH
Alkaline taste	High pH
Boiled rice hard and yellow	High Alkalinity
White deposits on boiling	Hardness

Water Sources

Characteristics of irrigation water that define its quality vary with the source of the water.

There are regional differences in water characteristics, based mainly on geology and climate. There may also be great differences in the quality of water available on a local level depending on whether the source is from above ground (rivers and ponds) or from groundwater aquifers with varying geology, and whether the water has been chemically treated. Municipal system water and deep wells generally provide the best water source for greenhouse operations. Chemical treatment of water may be required when pollutants such as iron, sodium, dissolved calcium and magnesium or bicarbonates are present. Surface water such as ponds and streams may have more particulate matter such as suspended soil particles, leaves algae or weeds that needs to be filtered out.

A sample of a potential water supply should be sent to an irrigation water testing laboratory for analysis.

The main sources for irrigation water are groundwater from wells, surface water, drainage ponds, rain and municipal water.

Drilled wells are a clean source of water for many greenhouse operations however, the water yield from drilled wells is usually limited.

Groundwater is found in aquifers that are located below the earth surface. As rainfall occurs, some of it evaporates, some of it is removed by plant transpiration and the remaining water filters down through the topsoil and flows into sand, gravel and fractured rock. It reaches a depth where all the pore spaces are filled. This saturated zone is call the aquifer.

The flow of water from a well depends on the permeability and size of the aquifer, its recharge area and the amount of rainfall. A well in one location may provide a very low yield, while another area, may provide a high water yield. In most areas, well drillers keep an accurate record of the depth and yield of wells they drill. Groundwater quality varies due to the parent material. For example, in the Berkshires of western Massachusetts groundwater is often drawn from limestone aquifers. Even for one site, the location and depth of the well can have an important effect on water quality. Elemental content and bicarbonate levels can also change with the seasons of the year, and the amount of pumping from the wells.

Since 1974, well drillers have been required to file a Water Well Completion Report with the local board of health, the well owner and the Massachusetts Department of Environmental Management (DEM). This report provides data on the well’s location and depth, the drilling method used, the material it draws water from, and results of water quality and pump tests. The well driller should be registered with the DEM and install the well according to local board of health regulations. There is usually a minimum distance from a septic system or sewer and there may be a minimum distance to a property line.

Surface water includes streams, rivers, lakes and ponds which are dependent on runoff from adjacent land or from ground water springs. These are dependent on rainfall rates that vary from year to year.

Surface water is subject to contamination from sources such as sediment, chemicals and plant growth. High levels of particles can reduce the life of pumps and clog irrigation systems and multiple filters may be required. It is also possible that surface waters can become contaminated with road salt, industrial, agricultural chemicals, algae and plant pathogens.

Drainage ponds are usually a combination of rain water and run-off. Drainage ponds commonly contain fertilizers or other agricultural chemicals. Because of the size and lack of aeration, biological conditions such as algal growth may be a concern.

Rain water can be collected from greenhouses or building roofs without contacting the ground and held in a concrete cistern, fiberglass or polyethylene tank, water silo or other holding tank. It is clean except for any debris that gets into the system. Rain water will be very low in elemental or chemical contamination unless there is industrial air pollution or fallout on the roofs. The pH of collected rain may be low (4.0 – 5.0) but is not considered detrimental to crops because it is not buffered (does not resist change in pH) and changes readily. Rain water is an excellent and underutilized source of irrigation water.

A 1” rainfall on an acre of greenhouse amounts to 27,100 gallons. A common yield is about 65% with losses due to evaporation, wind, leakage of piping system and diversion of the first few minutes of the rainfall to remove debris. To calculate the quantity in gallons that can be collected, multiply the square feet of greenhouse building floor (footprint) by 0.4.

A basic system consists of a storage tank, roof washer, inflow pipes, overflow pipes and a diverter to redirect the excess water when the tank is full. Concrete or plastic tanks can be used but are usually limited to about 15,000 gallons. Corrugated steel tanks can be built to almost any capacity as they are delivered in preformed panels and assembled on site. Before the water is collected for irrigation, a device called a roof washer is normally used to divert the first flush of water that is collected to remove debris from the water. Also an overflow is needed to handle excess water. The excess water is diverted to a drainage area where it will not flood neighboring property.

Once rainwater is collected, it can be distributed to the greenhouses through the normal irrigation system.

Municipal water includes water supplied by city, county or municipality. Either, ground, rain, and/or surface water may be used. The cost and quality are typically high since much of the water is for residential use and drinking water and is treated. The key concerns are whether supply is guaranteed in times of shortages and what water treatment procedures are used that may influence plant growth. Municipal water may have fluoride and/or chlorine added at rates which is not a problem for most crops. Occasionally, sodium compounds are added to treat hard water.

What is pH?
You may have heard the word “pH” used to describe drinking water quality, but do you know what it means?
pH is a measurement of electrically charged particles in a substance. It indicates how acidic or alkaline (basic) that substance is. The pH scale ranges from 0 to 14:

- Acidic water has a pH lower than 7. The most acidic substances have a pH of 0. Battery acid falls into this category.
- Alkaline water has a pH of 8 or above. The most alkaline substances, such as lye, have a pH of 14.
- Pure water has a pH of 7 and is considered “neutral” because it has neither acidic nor basic qualities.

What pH is safe for drinking water?
The U.S. Environmental Protection Agency (EPA) is in charge of monitoring public drinking water quality across the United States.
pH isn’t a quality that falls under EPA regulation because it’s considered an aesthetic quality of water. However, the agency recommends that municipal drinking water suppliers keep their water supply at a pH of 6.5 to 8.5.

What does a changing or unsafe pH mean?
Freshwater pH varies across the world depending on weather patterns, human activity, and natural processes.
Water with a very low or high pH can be a sign of chemical or heavy metal pollution.
Water that doesn’t fall in the “safe” pH range of 6.5 to 8.5, particularly if it’s alkaline, isn’t necessarily unsafe. However, very alkaline water can have an unpleasant smell or taste, and it can also damage pipes and water-carrying appliances.
Acidic water with a pH of less than 6.5 is more likely to be contaminated with pollutants, making it unsafe to drink. It can also corrode (dissolve) metal pipes.

Many municipal water suppliers voluntarily test the pH of their water to monitor for pollutants, which may be indicated by a changing pH. When pollutants are present, water companies treat their water to make it safe to drink again.

Common water pH levels

Type of water	pH level
Tap water	Varies; typically about 7.5
Distilled reverse osmosis water	5 to 7
Common bottled waters	6.5 to 7.5
Bottled waters labeled as alkaline	8 to 9
Ocean water	About 8
Acid rain	5 to 5.5

Alkaline water: A new trend

Alkaline water has become a popular drinking water choice over the past few years. Some people say that drinking slightly alkaline water — with a pH between 8 and 9 — can improve your health. They say it may make you age more slowly, maintain a healthy pH in your body, and block chronic disease like cancer.

Despite the many health claims made by alkaline water drinkers and sellers, there's little to any scientific evidence that alkaline water is healthier than other kinds of drinking water.

But there are a few studies suggesting alkaline water may benefit the health of people with certain medical conditions, such as:

- acid reflux
- high blood pressure, diabetes, and high cholesterol

High alkaline, electrolyzed water may also be helpful after dehydration caused by exercise. More research is needed to fully support the findings of these small studies.

The methods of analysis of parameters of water quality

Name of parameter	Instrument used for determination	Method used	Method reference
pH	pH meter	-	APHA (1998)
Conductivity	Conductivity meter	-	Trivedi and Goel (1986)
TDS	TDS meter	Evaporation	Trivedi and Goel (1986)
Total hardness	Burette	Titration	Trivedi and Goel (1986)
Calcium	Burette	Titration	Trivedi and Goel (1986)
Magnesium	Burette	Difference	Trivedi and Goel (1986)
Sodium	Flame photometer	Calibration	APHA (1998)
Potassium	Flame photometer	Calibration	APHA (1998)
Chloride	Burette	Titration	APHA (1998)
Nitrate	Spectrophotometer	Phenol disul fonic acid	APHA (1998)
Fluoride	Spectrophotometer	SPADNS	APHA (1998)
Heavy Metals	Polargraph and atomic absorption spectrophotometer	Standard addition	Khandekar and Mishra (1984)

WHAT ARE TDS?

TDS stands for total dissolved solids, and represents the total concentration of dissolved substances in water. TDS is made up of inorganic salts, as well as a small amount of organic matter. Common inorganic salts that can be found in water include calcium, magnesium, potassium and sodium, which are all cations, and carbonates, nitrates, bicarbonates, chlorides and sulfates, which are all anions. Cations are positively charged ions and anions are negatively charged ions.

WHAT HAPPENS TO THE WATER WHEN THE TDS LEVEL IS HIGH?

Alone, a high concentration of dissolved solids is usually not a health hazard. In fact, many people buy mineral water, which has naturally elevated levels of dissolved solids. The United States Environmental Protection Agency (EPA), which is responsible for drinking water regulations in the United States, includes TDS as a secondary standard, meaning that it is a voluntary guideline in the United States. While the United States set legal standards for many harmful substances, TDS, along with other contaminants that cause aesthetic, cosmetic and technical effects, has only a guideline.

Most people think of TDS as being an aesthetic factor. In a study by the World Health Organization, a panel of tasters came to the following conclusions about the preferable level of TDS in water:

However, a very low concentration of TDS has been found to give water a flat taste, which is undesirable to many people.

Increased concentrations of dissolved solids can also have technical effects. Dissolved solids can produce hard water, which leaves deposits and films on fixtures, and on the insides of hot water pipes and boilers. Soaps and detergents do not produce as much lather with hard water as with soft water. As well, high amounts of dissolved solids can stain household fixtures, corrode pipes, and have a metallic taste. Hard water causes water filters to wear out sooner, because of the amount of minerals in the water. The picture below was taken near the Mammoth Hot Springs, in Yellowstone National Park, and shows the effect that water with high concentrations of minerals can have on the landscape. The same minerals that are deposited on these rocks can cause problems when they build up in pipes and fixtures.

WHY IS IT IMPORTANT TO MONITOR TDS AND PH?

It is important to monitor the TDS level and the pH of drinking water for several reasons. When a water source has a high level of TDS or a low pH, it is likely that there are other harmful contaminants in the water. Both TDS and pH are also easy to measure and if something is happening to a water, such as pollution, chances are both TDS and pH levels will change so keeping track of those changes can act as an early warning signal that something is happening to the water. For these reasons, it is important to monitor the TDS and pH levels, so that if they change, action can be taken immediately.

Temperature

Water temperature regulates the metabolism of the aquatic ecosystem. High water temperature stress aquatic ecosystem by reducing the ability of water to hold essential dissolved gases like oxygen often summer head can cause fish kills in water bodies because high temperature reduce available oxygen in the water.

Hardness

It is defined as the sum of calcium and magnesium concentrations and is a measure of the capacity of water to precipitate soap

Alkalinity

Alkalinity is primarily due to carbonate, bicarbonate and hydroxide contents. It is used in the interpretations and control of water and waste water processes.

Dissolved Oxygen

Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement) and as a waste product of photosynthesis. Environmental impact of total dissolved solids gas concentration in water should not exceed 110% (above 13-14 mg/l). Concentration above this level can be harmful to aquatic life. Fish in waters containing excessive dissolved gases may suffer from “gas bubble disease”; however, this is a very rare occurrence. The bubbles or emboli block the flow of blood through blood vessels causing death. External bubbles emphysema can also occur and be seen on fins, on skin and on other tissue. Aquatic invertebrate are also affected by “gas bubble disease,” but at levels higher than those lethal to fish. Adequate dissolved oxygen is necessary for good water quality

Nitrate and Nitrite

Nitrate and Nitrite are naturally occurring ions that are part of nitrogen cycle. In general, vegetables are the main source of nitrate intake when level in drinking water is below 10 mg/l. When nitrate level in drinking water exceeds 50 mg/l, drinking water becomes the main source of total nitrate intake. The presence of nitrate indicates an old contamination provided nitrites are absent.

High level of nitrate in drinking water due to excessive use of agriculture fertilizers, decayed vegetable water, domestic effluent, sewage disposal industrial discharges, leachable from refuse dumps, atmospheric and atmospheric precipitation has become a serious problem (Makhijani and Manoharan 1999)

Excess concentration of nitrate causes disease. Methemoglobinemia oxygen transport depends on the maintenance of intra cellular hemoglobin in the reduced (Fe^{2+}) state. When hemoglobin is oxidized to methemoglobin, the heme iron becomes (Fe^{3+}) and is incapable of binding oxygen. Methemoglobinemia is suspected in any cyanotic patient with no evidence of heart and lung disease of cyanosis is due to decreased oxygen saturation.

Nitrites can produce a serious condition in fish called “brown blood disease” Nitrites also react directly with hemoglobin in human blood and other warm-blooded animals to produce methemoglobin. Methemoglobin destroys the ability of red blood cell to transport oxygen. This condition is especially serious in babies under three months of age. It causes a condition known as methemoglobinemia or “blue baby disease”. Water with nitrite levels exceeding 1.0 mg/l should not be used for feeding babies Nitrite/nitrogen levels below 90 mg/l and nitrate levels below 0.5 mg/l seem to have no effect on warm water fish.

Chlorides

Chlorides are the inorganic compound resulting from the combination of the chlorine gas with metal. Some common chlorides include sodium chloride (NaCl) and magnesium chloride ($MgCl_2$). Chlorine alone as (Cl_2) highly toxic, and it is often used a disinfectant. In combination with a metal such as sodium, it becomes essential for life. Small amounts of chlorides are required for normal cell functions in plant and animal life.

Environmental impact of chloridesare not usually harmful to human health; however, the sodium part of the table salt has been linked to heart and kidney diseases. Sodium chloride may impact a salty taste at 250 mg/l; however, calcium or magnesium chloride is usually detected by taste until levels of 1000 mg/l are reached. Public drinking water standards require chloride level not to exceed 250 mg/l. Chlorides may get into surface water from several sources including: rocks contain chlorides, agricultural run-off, waste water from industries, oil well wastes, and effluent waste water from waste water treatment plants. Chlorides can corrode metals and affect the taste of food products. Chlorides can contaminate fresh water streams and lakes. Fish and aquatic communities cannot survive in high level of chlorides. Therefore, water that is used in industry or proceeds for any use has a recommended maximum chloride level.

Fluoride

According to WHO 1984 and Indian standard drinking water specification 1991 the maximum permissible limit of fluoride in drinking water is 1.5 ppm and highest desirable limit is 1.0 ppm. Fluoride concentrations above 1.5 ppm in drinking water cause dental fluorosis and much higher concentration skeletal fluorosis. Low concentration (approximately 0.5 ppm) provides protection against dental caries. India is among the 23 nations around the globe where health problems occur due to the consumption of fluoride contamination water and the extent of fluoride contamination in water varies from 1.0 to 400 mg/l. In India, 20 million people are severely affected by fluorosis and 40 million people are exposed to risk of endemic fluorosis (Chinoy J. N. 1991). In India fluoride endemic states one Andhra Pradesh, Karnataka, Tamil Nadu, Punjab, Haryana, Maharashtra, Gujarat, Rajasthan, Uttar Pradesh, Kerala, Jammu and Kashmir, and Delhi.

Arsenic

Arsenic contamination in drinking water has been reported in different region of the world mainly in china (WHO1996). In India, it had been found to be wide spread in different region of the West Bengal due to dissolution of arsenic containing bed rocks. WHO has prescribed a provisional guideline value of As 10 μg/l in drinking water and according to India standard drinking water specification 1991, the highest desirable limit is 50 μg/l and no relaxation for maximum permissible level. Early clinical symptoms of acute intoxication include abdominal pain, vomiting, diarrhea, muscular pain, and with flushing of the skin. These symptoms are often followed by numbers and tingling of the extremities, muscular cramping and the appearance of a popular erythematous rash.

Chronic exposure due to arsenic contaminated drinking water includes dermal lesions, peripheral neuropathy, skin cancer, and peripheral vascular disease. Major dermatological signs are nelano-keratosis, melanosis, spotted and diffuse keratosis, leucomelanosis, and dorsal keratosis (Saha *et al* 1999).

Lead

From a drinking water perspective, the almost universal use of lead compounds in plumbing fittings and as solder in water distribution systems is important. Lead pipes may be used in older distribution systems and plumbing. Lead is present in tap water to some extent as a result of its dissolution from natural sources but primarily from household plumbing systems in which the pipes, solder, fittings, or service connections to homes contain lead. PVC pipes also contain lead compounds that can be leached from them and result in high lead concentration in drinking water. According to India standard drinking water specification 1991, highest desirable limit of lead in drinking water is 0.05 ppm and no relaxation for maximum permissible limit. Provisional tolerable weekly intake of 25 μg/l lead per kg body wt or 93.5 μg/kg body wt/day for all age group was established (WHO 1993). Lead is a cumulative general poison and associated with several health hazards like anemia (Moore. 1988),reproductive effects.

Phosphorus

Phosphorus is one of the key elements necessary for growth of plants and animals. Phosphorus in elemental form is very toxic and is subject to bioaccumulation. Phosphate PO_4^{3-} formed from this element. Phosphate exists in three forms: Orthophosphate, met-pho sulfate, and organically bound phosphate. Each compound contains phosphorus in a different chemical formula orthoform are produced by natural processes and are found in sewage. Poly forms are used for treating boiler water and in detergents in water they change into the ortho form organic phosphates are important in nature. Their occurrence may result from the breakdown of organic pesticides which contain phosphates. They may exit in solution, as particles, loose fragments, or in the bodies of aquatic organisms.

Rainfall can cause varying amounts of phosphates to wash from farm soils into nearby waterways. Phosphate will stimulate the growth of plankton and aquatic plants which provide food for fish this increased growth may cause an increase in the fish population and improve the overall water quality. However, if an excess of phosphate enters the water way, algal and aquatic plants will grow wildly, choke up the water way, and use up large amounts of oxygen. This condition is known as Eutrophication or over-fertilization of receiving waters. The rapid growth of aquatic vegetation can cause the death and decay of vegetation- and quality life because of the decrease in dissolved oxygen levels. Phosphates are not toxic to people or animals unless they are present in very high levels. Digestive problem could occur from extremely high level of phosphate.

Iron

Iron is the most abundant element, by weight, in the earth's crust. Iron is the second most abundant metal in earth's crust. It is an essential element in human nutrition. The minimum daily requirement of iron is ranged from about 10 to 50 mg/day (FAO/WHO 1988)

Natural water contains variable amounts of iron despite its universal distribution and abundance. Iron in ground water is normally present in the ferrous or bivalent from (Fe^{++}) or insoluble Iron urban exposure to air. Iron is a race elements required by both plants and animal. It is a vital oxygen transport mechanism in the blood all vertebrate and some invertebrate animals.

Iron in water may be present in varying qualities depending upon the geological area and other chemical component of the water way. Ferrous Fe^{++} and ferric F^{+++} irons are primary forms of concern in the aquatic environment other forms may be in either organic or inorganic waste water streams. The ferrous form Fe^{2+} can persist in water void of dissolved oxygen and usually originates from ground water or ---- that are pumped or drained. Iron in domestic water supply system, stains laundry and porcelain. It appears to be more of a nuisance than a potential health hazard. Taste thresholds of iron in water 0.1 mg/l for ferrous iron and 0.2 mg/l ferric Iron, giving a bitter or an astringent taste. Water used in industrial processes usually contain less than 0.2 mg/l iron. Black or Brown swaps water may contain iron concentration of several mg/l in the presence or the absence of dissolved oxygen, but this iron form has little effect on aquatic life. The current aquatic life standard is 1.0 mg/l based on toxic effects.

Conclusion

It was found that all parameters of permissible limit of drinking water were not set for all by different agencies i.e. (APHA), (WHO), (ISI), (CPCB), and (ICMR). Public health officers, doctors, and researchers follow these norms. However, there is a bias in permissible limit of drinking water quality set by different agencies (APHA, 1998; part 4500 – OC, p. 4-131). Permissible limits for drinking water parameters such as pH, temperature, hardness, alkalinity, dissolved oxygen, nitrate and nitrite, chlorides, fluoride, arsenic, lead, cadmium, mercury, chromium, phosphorus, iron and microbiological parameter like of fecal coliform bacteria are compared for different agencies in the Tables.

Permissible limits of drinking water quality

Parameters	USEPA	WHO	ISI	ICMR	CPCB
pH (mg/l)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.2	6.5-8.5
Turbidity NTU	-	-	10	25	10
Conductivity (mg/l)	-	-	-	-	2000
Alkalinity (mg/l)	-	-	-	-	600
Total hardness (mg/l)	-	500	300	600	600
Iron *mg/l)	-	0.1	0.3	1.0	1.0
Chlorides (mg/l)	250	200	250	1000	1000
Nitrate (mg/l)	-	-	45	100	100
Sulfate (mg/l)	-	-	150	400	400
Residual (mg/l) free Chlorine	-	-	0.2	-	-
Calcium (mg/l)	-	75	75	200	200
Magnesium (mg/l)	-	50	30	-	100
Copper (mg/l)	1.3	1.0	0.05	1.5	1.5
Fluoride (mg/l)	4.0	1.5	0.6-1.2	1.5	1.5
Mercury (mg/l)	0.002	0.001	0.001	0.001	No relaxation
Cadmium (mg/l)	0.005	0.005	0.01	0.01	No relaxation
Selenium (mg/l)	0.05	0.01	-	-	No relaxation
Arsenic (mg/l)	0.05	0.05	0.05	0.05	No relaxation
Lead (mg/l)	-	0.05	0.10	0.05	No relaxation
Zinc (mg/l)	-	5.0	5.0	0.10	15.0
Chromium (mg/l)	0.1	-	0.05	-	No relaxation
E. coli (MPN/100 ml)	-	-	-	-	No relaxation

Permissible limits of pesticides in drinking water

Pesticides	ISI limit (μg/l)	WHO limits (mg/l)
DDT	42	
Aldrin	17	0.0003
Dieldrin	17	0.0003
Endrin	1	-
Chlordane	3	-
Lindane	56	-
Heptachlor	18	-
Methoxychlor	35	0.020
Heptachlor-epoxide	18	-
Organic-phosphate	100	-
Toxaphene	5	-
Carbamate	100	-

Experiment Work

Sample collection :

2 litter Water sample is collect from borewell at various place of Himatnagar city. After collection filter water sample using simple filter paper and used for various following parameter test.

Observations

Order:__________ Colour:__________________ Temperature:____________

pH: _________________ Conductance:__________________

TDS:____________

Carbonate : _________________ ppm

Bicarbonate :_______________ ppm

Calcium: ____________ppm

Magnesium :______________ ppm

Chloride : __________ ppm

Total 31 of sample are tested in laboratory by 129 students of B.Sc.Sem-3. The above physical and chemical parameter are measured in laboratory using instruments as well as volumetric estimation.

TDS, pH, and conductance are tested through TDS meter, pH meter, and Conductometer. And Carbonate, Bicarbonate, Calcium, Magnesium, and Chloride are estimated using volumetric method. The following volumetric method are used for above parameter.

Sample Testing

Experiment -1

Aim: To determine chloride (Cl^-) of given water sample.

Requirments: pipette 25 ml, 5% $K_2 Cro_4$ indicator, 0.5 gm $caco_3$, 0.01 N $AgNo_3$

Procedure: Pipette 25 ml of the given sample conical flask and 5 to 5 drops of 5% K_2Cro_4 as indicator and add 0.5 gm of $CaCo_3$ an titrate against 0.01 N $AgNo_3$ solution with constant stirring under a bright light at the end point faint reddish brown colour is obtained.

Calculation:

$$ppm\ of\ Cl^- = \frac{R_{ml}\times 35.5\times N_{AgNO_3}\times 1000}{V_{ml}(sample)} \qquad ppm\ of\ Cl^- = R_{ml}\times 14.2$$

Experiment -2

Aim: To determine calcium (Ca^+) and Magnesium (Mg)of a given water sample.

Requirement : Pipette (25 ml) 4.0N NaOH , murexide as a indicator, 0.01 M EDTA.

Procedure : 25 ml of given sample of water add 4 to 5 drops 4N NaOH solution and approximately 1 to 2 drops of ammonium purpurate(Murexide), titrate the solution against 0.01 N EDTA solution using micro burette. At the end point (A ml) the colour changes from orange red to lavender at room temperature.

Calculation :

$$ppm\ of\ Ca^{+2} = \frac{R_{ml}\times 40\times N_{EDTA}\times 1000}{V_{ml}(sample)} \qquad ppm\ of\ Ca^{+2} = R_{ml}\times 16$$

Aim : To determine Magnesium (Mg^+) of given sample.

Requirement : Buffer solution, Eriochrome black T indicator, 0.01 N EDTA.

Procedure: Pipette 25 ml of the water sample and 4 to 5 ml of 10pH buffer solution and 3 to 4 drops of Eriochrome black-T indicator and titrate against 0.01 N EDTA at the tinge of the wine red to blue/green colour should remain at the end point (B ml)

Calculation: Amoutn required for Mg^+ = B-A=______ ml

$$ppm\ of\ Mg^{+2} = \frac{R_{ml}\times 24.93\times N_{EDTA}\times 1000}{V_{ml}(sample)} \qquad ppm\ of\ Ca^{+2} = R_{ml}\times 9.972$$

Experiment:3

Aim : To determine carbonate & bicarbonate of given Sample.

Requirement : 0.01 N HCL, phenolphthalein, Methyl-orange

Procedure :

Pipette 25 ml of water sample and 2 to 3 drops phenolphthalein titrate against 0.01 N HCL at the against of the pink to colorless note end point (A ml) and methyl-orange indicator 2 to 3 drops titrate 0.01 N HCL at the Yellow to orange should remain at the end point.(B mi)

Calculation :

Require volume of 0.01 N HCl for CO_3^{-2} is 2P=(2A)_____

$$ppm\ of\ CO_3^{-2} = \frac{R_{ml} \times 60 \times N_{HCl} \times 1000}{V_{ml}(sample)} \qquad ppm\ of\ CO_3^{-2} = R_{ml} \times 24$$

Require volume of 0.01 N HCl for HCO_3^{-2} is M-P=(B-A)_____

$$ppm\ of\ HCO_3^{-2} = \frac{R_{ml} \times 61 \times N_{HCl} \times 1000}{V_{ml}(sample)} \qquad ppm\ of\ HCO_3^{-2} = R_{ml} \times 24.4$$

Result and Discussion:

Following parameter are measured for 31 water sample which are collect from various place of Himatnagar city and listed in following table.

Table : 1- Physical observation through various meter.

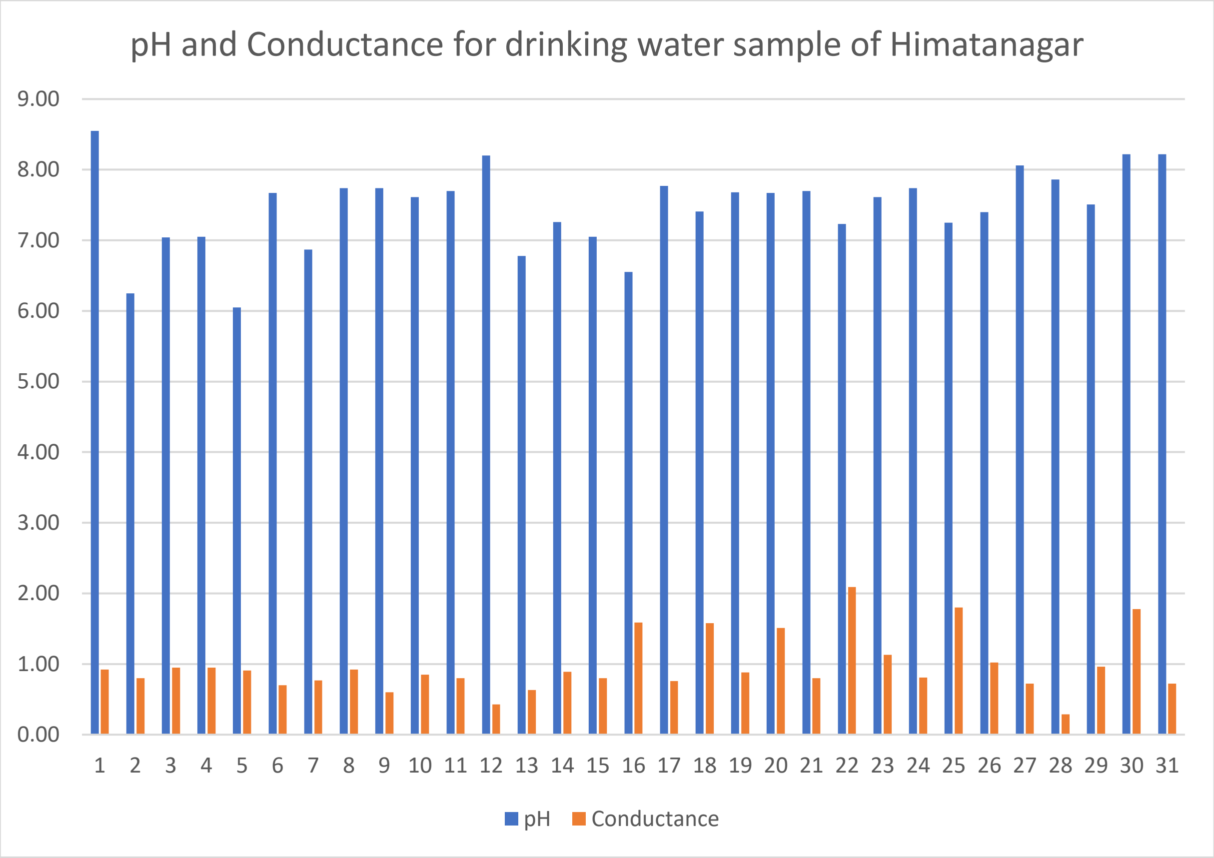
Name of Water Sample	Sample No.	Temp.	pH	Conductance Mili mohs	TDS ppm
Anand Baglows	**1**	30	8.55	0.920	424
Kanknol	**2**	29	6.25	0.800	356
Shamshundar society	**3**	29	7.04	0.950	388
Viratnagar	**4**	29	7.05	0.950	406
Sahakari jin road	**5**	29	6.05	0.910	400
Sector	**6**	30	7.67	0.700	321
Nagarpalika	**7**	30	6.87	0.770	348
Mehtapura	**8**	30	7.74	0.920	626
Mahakali mandir	**9**	30	7.74	0.600	982
Rajveela Society	**10**	30	7.61	0.850	397
Gaytri Mandir	**11**	30	7.70	0.800	311
Sai baba society	**12**	30	8.20	0.430	193
Shantipark society	**13**	29	6.78	0.630	682
Pologround	**14**	31	7.26	0.890	391
CK.residensi	**15**	30	7.05	0.800	351
Mehtapura	**16**	30	6.55	1.590	793
Hastinapur	**17**	30	7.77	0.760	348
Bholeshwar	**18**	29	7.41	1.580	667
Chitrakut society	**19**	29	7.68	0.880	390
Berna	**20**	30	7.67	1.510	756
Sahkarijin road.	**21**	30	7.70	0.800	307
Hadiyol	**22**	30	7.23	2.090	109
Rajtirth	**23**	30	7.61	1.130	463
College Campus	**24**	30	7.74	0.810	356
Mahetapura	**25**	30	7.25	1.800	876
Shaktinagar	**26**	32	7.40	1.020	472
Saibaba society	**27**	30	8.06	0.721	311
Sanatol	**28**	30	7.86	0.288	120
Kubernagar (sahkari)	**29**	31	7.51	0.961	414
RAJPUR	**30**	29	8.22	1.776	100
Dhwarkadhis socity	**31**	30	8.22	0.721	360
	Average value	**29.9**	**7.5**	**0.979**	**432.8**
	Max value	**32**	**8.6**	**2.090**	**982.0**
	Min value	**29**	**6.1**	**0.288**	**100.0**

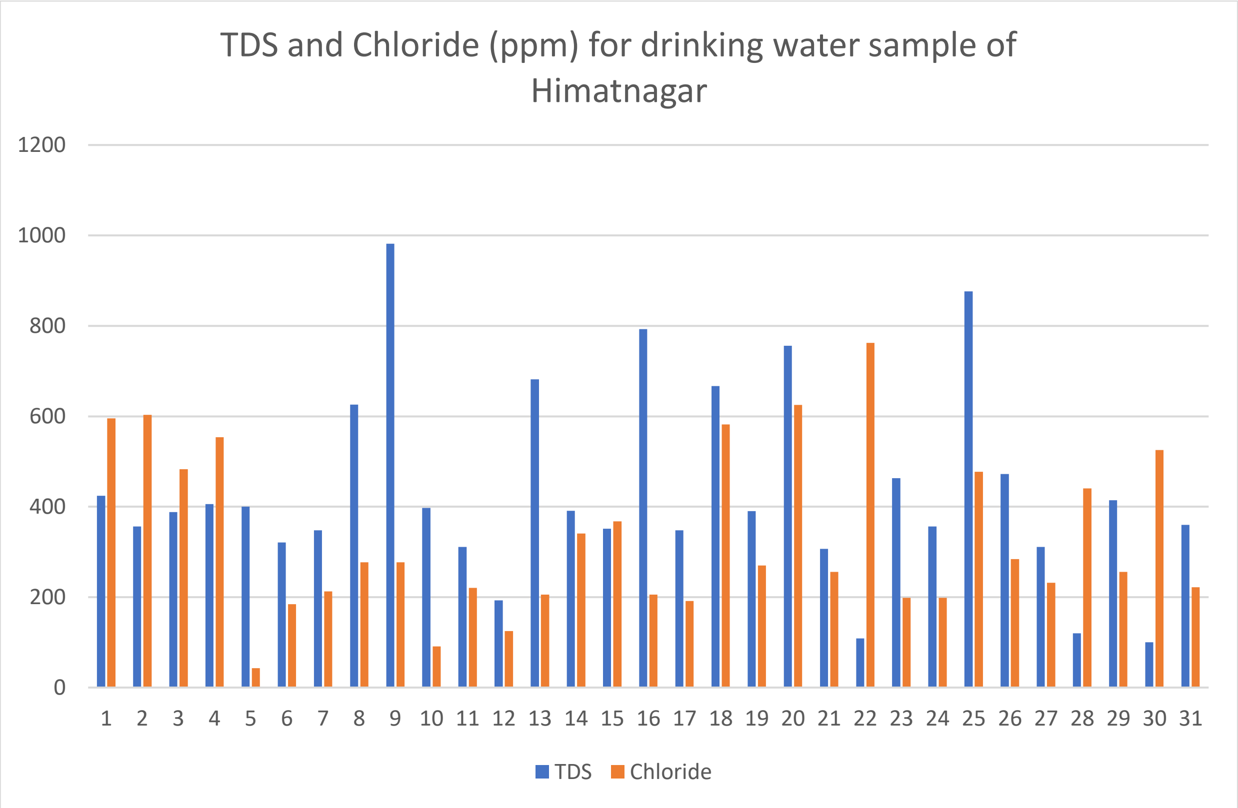
Color of all 31water sample is transparent and order of all sample is order less.

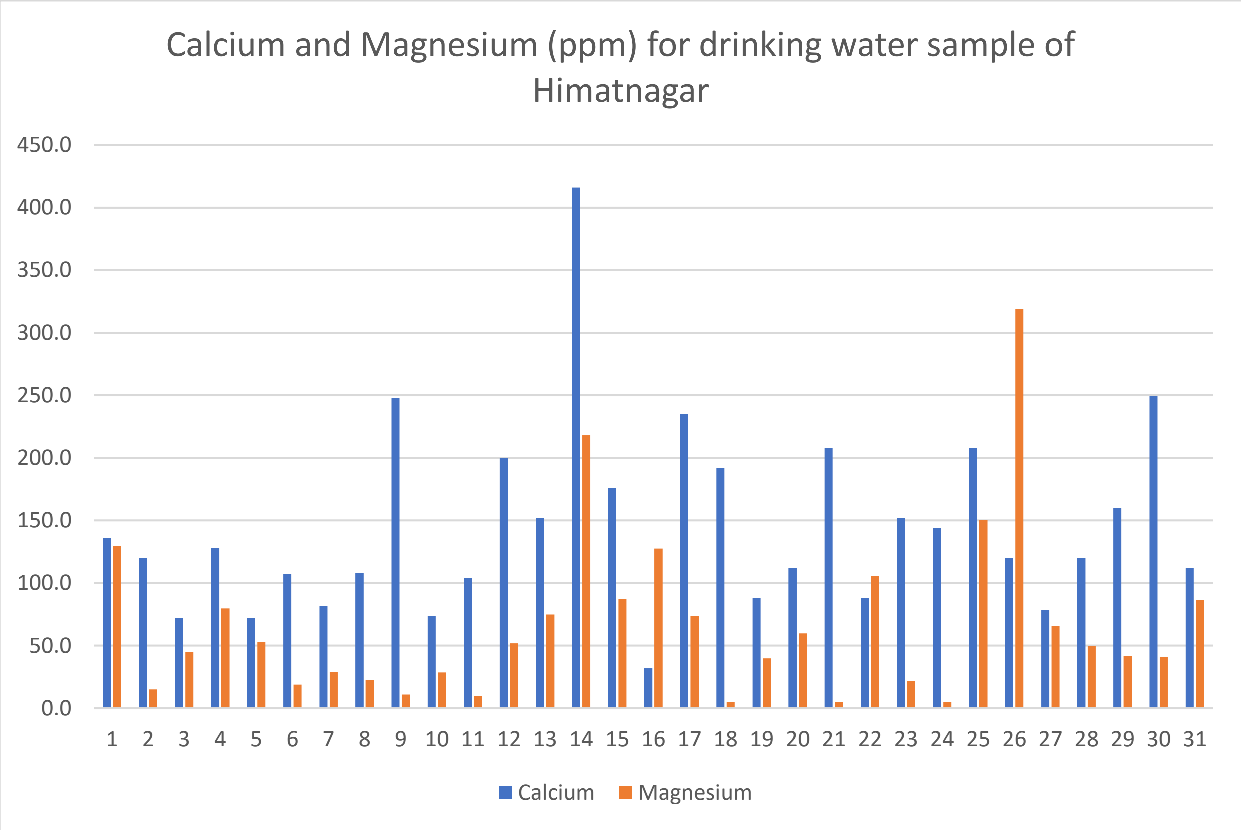
Table : 2 - Chemical observation of sample (in ppm)

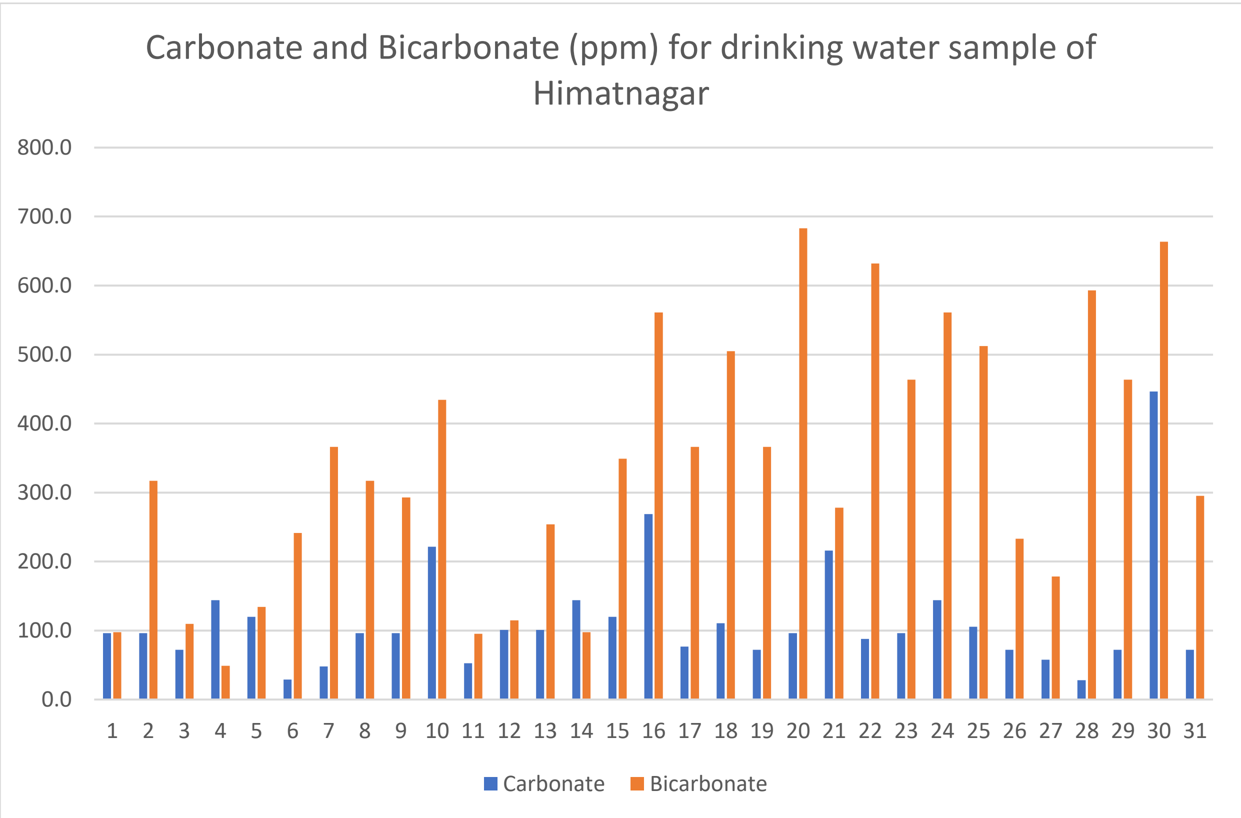
Name of Water Sample	Sample No.	Chloride	Calcium	Magnesium	Carbonate	Bicarbonate
Anand Baglows	**1**	595.4	136.0	129.6	96.0	97.6
Kanknol	**2**	603.5	120.0	15.0	96.0	317.2
Shamshundar society	**3**	482.8	72.0	44.9	72.0	109.8
Viratnagar	**4**	553.8	128.0	79.8	144.0	48.8
Sahakari jin road	**5**	42.6	72.0	52.9	120.0	134.2
Sector	**6**	184.6	107.2	18.9	28.8	241.6
Nagarpalika	**7**	213.0	81.6	29.0	48.0	366.0
Mehtapura	**8**	276.9	108.0	22.4	96.0	317.2
Mahakali mandir	**9**	276.9	248.0	11.0	96.0	292.8
Rajveela Society	**10**	91.2	73.6	28.7	221.5	434.3
Gaytri Mandir	**11**	220.1	104.0	10.0	52.8	95.2
Sai baba society	**12**	125.0	200.0	51.9	100.8	114.7
Shantipark society	**13**	205.9	152.0	74.8	100.8	253.8
Pologround	**14**	340.8	416.0	218.0	144.0	97.6
CK.residensi	**15**	367.8	176.0	87.3	120.0	348.9
Mehtapura	**16**	205.9	31.9	127.6	268.8	561.2
Hastinapur	**17**	191.7	235.2	73.8	76.8	366.0
Bholeshwar	**18**	582.2	192.0	5.0	110.4	505.1
Chitrakut society	**19**	269.8	88.0	39.9	72.0	366.0
Berna	**20**	624.8	112.0	59.8	96.0	683.2
Sahkarijin road.	**21**	255.6	208.0	5.0	216.0	278.2
Hadiyol	**22**	762.5	88.0	105.7	88.0	632.0
Rajtirth	**23**	198.8	152.0	21.9	96.0	463.6
College Campus	**24**	198.8	144.0	5.0	144.0	561.2
Mahetapura	**25**	477.1	208.0	150.6	105.6	512.4
Shaktinagar	**26**	284.0	120.0	319.1	72.0	233.0
Saibaba society	**27**	231.5	78.4	65.8	57.6	178.1
Sanatol	**28**	440.2	120.0	49.9	28.2	592.9
Kubernagar (sahkari)	**29**	255.6	160.0	41.9	72.0	463.6
RAJPUR	**30**	525.4	249.6	41.2	446.4	663.7
Dhwarkadhis socity	**31**	221.5	112.0	86.4	72.0	295.2
Average value		**332.4**	**145.0**	**66.9**	**114.8**	**342.7**
Max value		**762.5**	**416.0**	**319.1**	**446.4**	**683.2**
Min value		**42.6**	**31.9**	**5.0**	**28.2**	**48.8**

For 31 water sample, above parameter values are observed and calculate average, Max and Min values of all parameters and also graphical interpretation for all parameters.


pH and Conductance for drinking water sample of Himatanagar
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
pH
Conductance


TDS and Chloride (ppm) for drinking water sample of Himatnagar
1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
TDS
Chloride


Calcium and Magnesium (ppm) for drinking water sample of Himatnagar
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Calcium
Magnesium


Carbonate and Bicarbonate (ppm) for drinking water sample of Himatnagar
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Carbonate
Bicarbonate

Comparative Study of some parameter for drinking water sample (Himatnagar City)

There is no turbidity and any intense color found in drinking water of Himatnagar city. All 31-water sample are very clean and without any order.

It is found that for all 31 water samples, average pH value is 7.5 and max value of pH is 8.5. Accordingly, WHO the permissible range of pH for water is 6.5 to 8.5. Average Conductivity is 0.979 for all 31 sample. It is not more than 1 for 28 sample.

TDS (Total dissolved solid) for all water sample, average value of TDS is 433 ppm and max value of TDS is 982 ppm. From the table it is found that the only 8 water sample having greeter value of TDS then 500 ppm. Only 8 water sample out of 31 is not prescribe for drinking water without using some removable procedure.

WHO is prescribe amount of chloride is 200 ppm for drinking water. From testing it is found that average amount of chloride is 334 ppm in 31 water sample. So that it is conclude that all sample having higher value of chloride. There are 9 area's water sample contain more than 400 ppm of chloride amount.

Calcium and magnesium are also tested for all sample. And average values of these are calculate, 145 ppm of calcium and 405 ppm of magnesium. It is very higher than WHO permissible ppm value of drinking water. It is found that more than 150 ppm of calcium in 8 water sample these are very high so before using this water for drinking it is necessary to apple some method to remove calcium and magnesium.

There are also found Carbonate and Bicarbonate for all water sample. Average value of carbonate is found 115 ppm and bicarbonate is 342 ppm. Amount of carbonate and bicarbonate is high due to alkaline water. Recently alkaline water is very useful than acidic water. But there are some water samples having very higher values of carbonate and bicarbonate these are not permissible for drinking water.

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