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A COMPARATIVE STUDY ON THE DISSOLVED OXYGEN CONTENT IN DIFFERENT WATER SAMPLES OF VARIOUS AREAS IN THOOTHUKUDI DISTRICT

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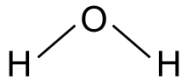
Abstract – Water is aptly described as the mother of life. It contains one oxygen and two hydrogen atoms connected by covalent bonds. Oxygen remains dissolved in water. All aquatic organisms depend on the dissolved oxygen for the respiration. Dissolved oxygen (DO) is a measure of how much oxygen in the water- the amount of oxygen available to living aquatic organisms. The present work mainly concentrates the comparative study of Dissolved oxygen content in different water samples. The Dissolved oxygen content in the river water is 5.071 mg/lr, rain water is 4.226 mg/lr, sea water is 3.099 mg/lr, well water is 2.817 mg/lr, tap water is 1.972 mg/lr, pond water is 0.845 mg/lr and the sewage water is 0.282 mg/lr. In the present study the Dissolved oxygen content in river water is higher when compared to other water samples and the Dissolved oxygen content in sewage water is very low when compared to other water samples.

***Key Words*:** Dissolved oxygen, Aquatic organisms, Water samples, River water, Sewage water.

1.INTRODUCTION

Water is an inorganic transparent, tasteless, odourless and nearly colourless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of most living organisms. It occupies 71% of the Earth's surface.

Water is aptly described as the mother of life. It is the liquid gold and the universal solvent. Its chemical formula is H_2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms, connected by covalent bonds.



Water exists in three states, namely liquid, solid and vapour. Liquid state exists in two forms namely, sea water and fresh water. Fresh water may be present on the surface of the earth as surface water in rivers, lakes, ponds, etc., and under the earth's surface as ground water. The main sources of water are precipitation of ground water, springs, sea, ponds, lakes, rivers, etc.,

Oxygen remains dissolved in water. All aquatic organisms depend on the dissolved oxygen for the respiration. Water receives oxygen from direct diffusion of atmospheric air, water plants and phytoplanktons release oxygen by photosynthesis.

Oxygen is continuously replenished in Earth's atmosphere by photosynthesis, which uses the energy of sunlight to produce oxygen from water and carbondioxide.

Dioxygen is used in cellular respiration and many major classes of organic molecules in living organisms contain oxygen, such as proteins, nucleic acids, carbohydrates and fats as do the major constituent inorganic compounds of animal shells, teeth and bones. Most of the mass of living organisms is oxygen as a component of water, the major constituent of life forms.

Dissolved Oxygen (DO) is a measure of how much oxygen is dissolved in the water- the amount of oxygen available to living aquatic organisms.

Although water molecules contain an oxygen atom, this oxygen is not what is needed by aquatic organisms living in natural waters. A small amount of oxygen, upto about ten molecules of oxygen per million of water, is actually dissolved in water.

Oxygen enters a stream mainly from the atmosphere and in areas where ground water discharge into streams is a large portion of streamflow, from ground water discharge. This dissolved oxygen is breathed by fish and zooplankton and is needed by them to survive.

Dissolved oxygen measurement is commonly a standard part of most hydrographic studies. The data is of interest to Physical, Chemical and Biological Oceanographers.

Physical Oceanographers use it to characterize water masses. Chemical Oceanographers use it study to study the production and destruction of organic matter. Biological Oceanographers use it determine rates of photosynthesis and respiration. Climate Scientists are finding it to be a sensitive indicator of climate-related changes in the ocean circulation and ventilation of intermediate and deep water. It is also used in the quantification of the uptake of Anthropogenic CO_2 by the ocean.

The performance of oxygen sensors have dramatically improved in recent years; however, for the most precise work they still need to be calibrated frequently to correct for drift and temperature and pressure influences. The chemical titration method first described by Winkler (1888) remains the method of choice for the analysis of discrete water samples. The method is fast and inexpensive Largdon (2010).

1.1 Objectives

The important aims of our work study are given below:

- To estimate the Dissolved Oxygen content in River Water, Rain Water, Sea Water, Well Water, Pond water, Tap Water and Sewage Water.
- To determine the BOD of these water samples.
- To identify the quality of these water samples.
- To compare the Dissolved Oxygen content in these water samples using Winkler's method.

2. MATERIALS AND METHODS

2.1 Collection of the Samples

The water samples were collected from Meerankulam (River water), Nazareth (Rain water and Tap water), Manapad (Sea water), Thiruvaranganeri (Well water), Panaikulam (Pond water) and Karunkadal (Sewage water).

2.2 Chemical Preparation

The following reagents were used in this experiment.

2.2.1 Standard 0.025N Sodium Thiosulphate Solution

Weighing accurately 6.150g of chemically pore recrystallized $Na_2S_2O_3$, placed in a 1 litre glass-stopper volumetric flask and dilute to 1 litre with freshly boiled and cooled distilled water.

2.2.2 Manganous Sulphate Solution

Dissolve 240g of $MnSO_4$ in water and dilute to 500 ml ($MnSo_4$ $4H_2O$)

2.2.3 Alkaline Iodide Solution

Dissolve 70g of NaOH and 15g of KI in water and dilute to 100 ml. Use a flask with a rubber-stopper for storage.

2.2.4 Concentrated Sulphuric Acid

The commercial Con.CH_2SO_4 with 36N is used.

2.2.5 Starch as an Indicator

1g of soluble starch to 100ml of water and then heat until transparent.

2.3 Winkler's Method

2.3.1 What is Winkler's Method?

The Winkler Method is a technique used to measure dissolved oxygen in fresh water systems. Dissolved oxygen is used as an indicator of the health of a water body, where higher dissolved oxygen concentrations are correlated with high productivity and little pollution. This text is performed on-site, as delays between sample collection and testing may result in an alteration in oxygen content.

2.3.2 How does the Winkler's Method work?

- The Winkler's Method uses titration to determine dissolved oxygen in the water sample.
- The reagent bottle is washed and rinsed with the sample water.
- The reagent bottle is filled with the water sample.
- To this 1ml of $MnSO_4$ solution and 1ml of Alkaline Iodide solution are added.
- The brown colour precipitate (ppt) is formed in the reagent bottle.
- Then 1ml of conc. H_2So_4 is added and the sample becomes clear.
- From this sample 50ml of solution is taken in a conical flask.
- Then add a few drops of 1% starch solution and blue colour is appeared.
- It is titrated against 0.025N Sodium Thiosulphate ($Na_2S_2O_3$) solution taken in a burette.
- The end point is the disappearance of blue colour.
- The titration is repeated to get a concordant value.
- The dissolved O_2 content of 7 different water samples are calculated by using the following formula.

2.3.3 Formula

$$\text{Amount of dissolved } O_2 \text{ in water sample} = \frac{K \times 200 \times 0.698 \times \text{Volume of } Na_2S_2O_3}{\text{Volume of Sample}}$$

where, K

$$= \frac{\text{Volume of reagent bottle}}{\text{Volume of reagent bottle} - \text{Volume of reagent used}}$$

Fig -1: Different Water Samples

3.RESULTS

3.1 Findings

The oxygen supply in water comes chiefly from two sources, by diffusion from the air and from photosynthesis by aquatic plants.

The present work mainly concentrates with the aim to find out the Dissolved Oxygen Content of different water samples - River Water, Rain Water, Sea Water, Well Water, Tap Water, Pond Water and Sewage Water.

The following are the major findings of the present investigations.

1. The Dissolved Oxygen Content in the River Water - 5.071 mg/lr

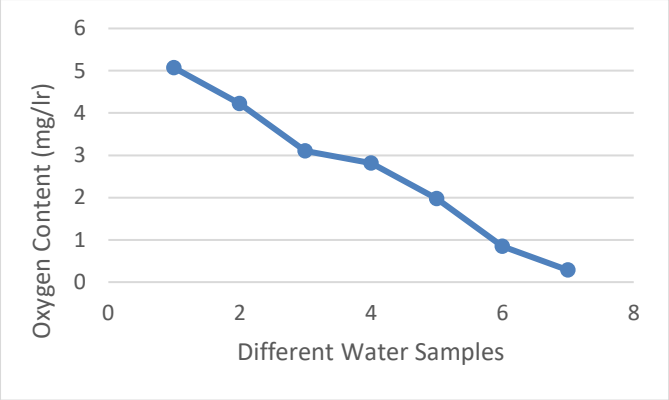
2. The Dissolved Oxygen Content in the Rain Water - 4.226 mg/lr
3. The Dissolved Oxygen Content in the Sea Water - 3.099 mg/lr
4. The Dissolved Oxygen Content in the Well Water - 2.817 mg/lr
5. The Dissolved Oxygen Content in the Tap Water - 1.972 mg/lr
6. The Dissolved Oxygen Content in the Pond Water - 0.845 mg/lr
7. The Dissolved Oxygen Content in the Sewage Water - 0.282 mg/lr

3.2 Graph

The Graph shows the Dissolved Oxygen Content in seven different Water samples

A – River Water
B – Rain Water
C – Sea Water
D – Well Water
E – Tap Water
F – Pond Water
G – Sewage Water

Graph-1 : Different Water Samples Vs Oxygen Content



3.3 Bar Diagram

The simple Bar Diagram shows the Dissolved Oxygen Content in seven different water samples.

A – River Water

B – Rain Water

C – Sea Water

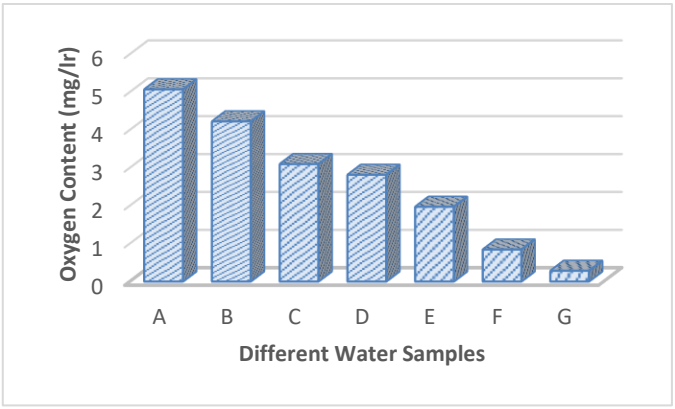
D – Well Water

E – Tap Water

F – Pond Water

G – Sewage Water

Bar Diagram-1: Different Water Samples Vs Oxygen Content



3.4 Pie Chart

The Pie Diagram shows the Dissolved Oxygen Content in seven different water samples.

A – River Water

B – Rain Water

C – Sea Water

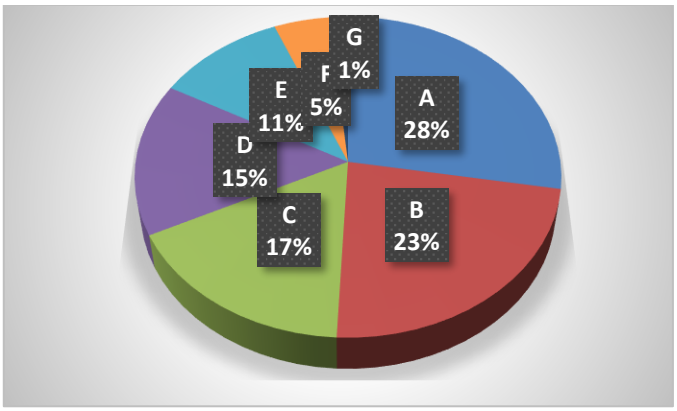
D – Well Water

E – Tap Water

F – Pond Water

G – Sewage Water

Pie Chart-1: Oxygen Content of Different Water Samples



4.DISCUSSION

Oxygen is less available in water than in air. The aquatic animals seem to have a lower weight specific respiratory rate than terrestrial animals of the same size. The adaptation may well affect the tropic structure Misra et.al., (1968).

According to Hutchinson (1944) the formation of reduced nitrogen compound and the production of hydrogen from water and escape from the atmosphere into space have contributed to oxygen accumulation. It is perhaps significant that both the low concentration of CO_2 and the high concentration of CO_2 are now limiting to photosynthesis.

Most plants increase their rate of photosynthesis if either the CO_2 concentration is increased or O_2 concentration

decreased experimentally. This makes green plants very responsive regulators.

All animals of the profound zone are adapted to withstand periods of low oxygen concentration, where as many bacteria are able to carry on without oxygen (Anaerobic).

In contrast to the marine environment, oxygen and CO_2 concentration are often limiting in the fresh water environment. The Dissolved Oxygen Concentration (DO) and Biochemical Oxygen Demand (BOD) are frequently measured. Since O_2 and CO_2 usually behave reciprocally, Pollution Ecologists are more and more concerned with the limiting effect of CO_2 in fresh water.

Rivers are lotic habitat or running water systems. Oxygen is abundant in running water system. The present study clearly shows that dissolved O_2 content is very high in running river water when compared to rain water, sea water, well water, tap water, pond water and sewage water.

The rain water is not saturated with oxygen at the time of arrival to the ground. Using data of radiosonde, ceilometer, radar and aircraft observations, the oxygen content obtained at the ground was compared with the state of the rain cloud. The saturation content in raincloud is usually smaller than that at the ground and rain water conserves approximately the saturation content at the cloud Komabayasi (1959).

The present study reveals that the dissolved oxygen content in rain water is lower when compared to river water and higher when compared to sea water, well water, tap water, pond water and sewage water.

The sea is big, it covers 70% of the Earth's surface. The sea is deep and life extends to all its depth. The oxidized zone has quite then in muddy or silt bottoms. The water above the sediments becomes the depletion of oxygen.

Oxygen remains dissolved in water, all aquatic animals depend on the dissolved oxygen for respiration. The running water system contains oxygen in high concentration when compared to the standing water system. water receives oxygen by the direct diffusion of atmospheric air and water plants, phytoplankton release oxygen by photosynthesis.

In the present study, the dissolved oxygen in sea water is lower when compared to river water and rain water and higher when compared to well water, tap water, pond water and sewage water.

Well water is ground water. It varies in taste and ingredients from place to place. When rocks are penetrated they start oozing out water and that is the origin of borewell water or well water. Naturally when the salts and other ingredients are more in well water the dissolved O_2 content is thus minimized.

In the present study, the dissolved O_2 content in well water is higher when compared to tap water, pond water and sewage water but lower when compared to river water, rain water and sea water.

In the present study the dissolved oxygen content in tap water is higher than pond water and sewage water and lower than river water, rain water, sea water and well water. Usually tap water contains plenty of dissolved oxygen content but if chlorine is mixed in water tanks it has low level of dissolved oxygen content.

The pond or lake is polluted with excess nutrients, the filamentous-type of algae develop huge "blooms" that rise to the surface, buoyed up by entrapped oxygen. Then the oxygen produced by photosynthesis largely escapes into the air, and when the bloom dies, oxygen in the water is used up, often stressing or killing the fishes.

In the present study, the dissolved oxygen in pond water is higher than sewage water but lower than river water, rain water, sea water, well water and tap water. In pond water the submerged plants are lesser in number. So the animals living in pond use oxygen for respiration.

One of the principal constituents of polluted water and sewage is organic matter in various complex forms, generally unstable in composition and susceptible to the attack of organisms which feed upon it and break it down into simpler, more stable compounds. Bacteria of many species are largely, if not solely, responsible for this decomposition process. When these biochemical changes occur in the presence of oxygen dissolved in the water, they are generally designated as aerobic, but if they proceed in the absence of oxygen, they are called anaerobic Hoskins (1933).

In the present study, the sewage water contains very low level of dissolved oxygen because it is a waste water with impurities. The photosynthetic plants are completely absent in sewage water.

5. CONCLUSIONS

One of the most critical factors in an aquatic environment is the amount of oxygen in the water because most living organisms require the gas for respiration. In contrast to atmosphere, the oxygen becomes limiting factor for aquatic animals as the saturation concentration of oxygen.

In fresh water or sea water the oxygen-retaining capacity is greater at the lower temperature. The deepest layers of water will usually have a very low oxygen concentration in the deeper lakes and oceanic areas because the continual decomposition of organic debris, the respiration of organisms inhabiting the deeper waters, and the complete absence of photosynthetic activity in the lower strata will tend to deplete the oxygen concentration. The deep stratum is entirely dependent upon the slow transport of oxygen from the overlying intermediate layer.

In the present study, the dissolved oxygen content in river water is greater than when we compared to rain water, sea water, well water, tap water, pond water and sewage water. Because river water is a running water it absorbs plenty of oxygen from the Universe. It originate from the top of hills.

The present study reveals that the dissolved oxygen content in sewage water is lower than compared to pond water, tap water, well water, sea water, rain water and river

water. Because in sewage water the BOD is higher when compared to other water samples. It is a waste water with impurities. It has low productivity.

Though the river water has high dissolved O_2 content in many places in several other places water weeds like water hyacinth, water lily, etc., spoil it, so, we should eradicate there cancers of the river.

River water is more precious than any other water but unfortunately storage of water is a big problem. Since we don't have many dams to store the river water flows into the sea.

In many other parts thorny bushes and plants like Seemai Karuvelam tree which is of no use is the present day since all the houses have gas connection the use of fire wood which is very much reduced. So we should takes steps to eradicate these thorny bushes and save the rivers.

Last but not the least many factories mixed their wastage into the river which spoils the river. Such factories should be dealt with an iron hand. Moreover, we should educate the public to save the river and water.

Rain water is also rich in dissolved oxygen. It is used in almost all laboratories replacing distilled water. Of course rain water also carries some impurities mixed in the sky and hence it should be filtered and used. In draught hit areas people can store and use rain water for cooking and drinking.

Sea water is also rich in dissolved oxygen and various salts. To overcome the water scarcity problem sea water should be converted in to portable water which can be used for agriculture and cooking purposes.

Factory wastages should not be allowed to mix with sea water failing which the fishes and sea weeds like samphire will perish.

Many wells are used for agriculture and irrigation. In some places well water is used for cooking and drinking. Sometimes the farmers without knowledge throw the pesticide bottles and tins into the well killing the fishes there. It is also dangerous to the consumers.

Usually chlorine is mixed in water tanks from where portable water is supplied through taps to houses and streets. We should know the value of tap water and save it to the maximum level possible.

Pond water too has dissolved oxygen content. Ponds are also spoiled by Seemai Karuvelam Trees.

Sewage water contains low dissolved oxygen but still it can be used for agriculture and irrigation. The banks of sewage water are the breeding grounds for earthworms. The sewage water is also a breeding place for several harmful bacteria and viruses. Therefore, the Government has implemented Underground Sewage Water System (Pathala Chakkadai) in many places.Water is the elixir of life. So let us Save Water and Preserve Water.

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