

# Improvement of Physicochemical and Bacterial Parameter of Lake Water

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**ABSTRACT:** Because of pollution from sewage and other garbage, it is unsafe for human consumption and cannot be used in the kitchen, for cleaning, in agriculture or fishing, or for any other activity. From a chemical point of view, water can never be considered completely pure. Rainwater, even in the least polluted areas, may include dissolved carbon dioxide, oxygen, and nitrogen. Moreover, rainfall may contain dust or other particles that have been picked up from the environment in suspension.

The availability of unpolluted water is absolutely necessary for the continuation of the development of human civilization. Regular testing of the water's purity is required because of how important it is to people's wellbeing. If the water supply in the town has been poisoned, then there is a possibility that several ailments may spread across the population. It is essential for the prevention of disease and the enhancement of quality of life to have an in-depth understanding of the numerous physicochemical characteristics that are utilised in the testing and analysis of water. These characteristics include temperature, transparency, hardness, pH, sulphate, chloride, DO, BOD, COD, alkalinity, nitrates, and phosphates. The resolution of water quality concerns in a wide variety of bodies of water necessitates the use of a wide range of tactics. From the beginning of the industrial period, there has been a dramatic increase in the demand for water. This increase may be attributed to the growth in population as well as the general improvement in people's quality of living. A brief literature study is presented on the topic of the problem of the quality of the natural rivers around the world, with the primary focus being on the Indian subcontinent..

**KEYWORDS:** Physical and Chemical Properties, Clarity, Roughness, and the Effects on Human Health.

## I. INTRODUCTION

Water is necessary for many facets of modern civilization, including agriculture, industry, meeting the requirements of households, transportation, sanitation, and the management of waste. The proliferation of industry, urbanisation, and other forms of development has directly resulted in the contamination of the vast majority of the world's ponds, lakes, streams, and rivers. This is the case over the whole planet. When the quality or composition of water has altered, either or indirectly as a direct or indirect effect of disposal facilities and other anthropogenic impacts, the water is said to be contaminated. This means that the water is less acceptable or harmful for drinking, household, agrarian, fishery, or any other purposes. The behaviours of humans may either directly or indirectly lead to environmental contamination.

The temperature range, turbidity, and total suspended particle levels in the water bodies that agricultural practises, forest removal, and cooling systems border all have the potential to increase or decrease respectively.

When wastes from homes or factories that are rich in organic matter are discharged directly into water bodies without first undergoing any sort of treatment, these discharges result in a precipitous decrease in the amount of oxygen present in the water as well as an increase in the amount of ammonia and nitrogen present in the water.

The production of pulp and paper, as well as the processing of food, are two examples of types of industrial processes that create a significant amount of organic waste.

The uncontrolled release of polluted water from industrial processes is one of the primary causes of metal contamination. Metal pollution may also occur from the leachates that come from landfills that are used for municipal solid trash or mining waste dumps. Under some hydrogeological situations, ground water may be considerably polluted with potentially harmful bacteria, nitrate, as well as other pollutants as a result of residential waste that is not transported to a wastewater treatment facility. The source of this contamination may be household garbage. Nitrate, copper, and iron levels have all increased as a result of the injection of toxic wastewater from companies into subterranean aquifers. This practise is responsible for the increase. 2 In addition to that, there are dissolved contaminants that may be found in water. Phosphates, fluorides, nitrates, and metals are all examples of naturally occurring chemicals; on the other hand, man-made compounds like pesticides<sup>3</sup> are also examples of naturally occurring

chemicals. Nutrients such as nitrates and phosphates may be found in a number of the different kinds of pollution, including sewage and fertilisers.

When nitrogen levels are too high, aquatic plants and algae grow at an accelerated pace, which causes them to clog our rivers, drain dissolved oxygen during the process of their breakdown, also prohibit sunlight from reaching warmer waters. As a direct consequence of this, fish as well as other echinoderms are put in a precarious position because their capacity to consume oxygen and expel it is severely compromised.

## II. LITERATURE REVIEW

In the last several years, there has been an approximately twofold rise in the number of chemicals that have been thrown into water sources. These chemicals come from sources such as insecticides, associated with the production, drainage water, and industrial effluents. The majority of the contaminants that are released into the environment end up in fish habitats, rather than the habitats of the creatures for whom they were intended (Pimental and other species). (1982, Edwards). [Note: There has been a correlation established between effluents from the pesticide industry and an increase in the number of cases of mass death, stunted growth, and scarring in fishes (Kumarguru, 1995; Sarkar, 1997; Lal and Pandey 1999; Pandey 2000; Kumarguru et al.). In order to evaluate the significance of bacteria and their role in the material cycle in aquatic environments, it is necessary to compile an estimate of the production of bacteria (Azam et al., 1990). During the years 2005 and 2006, the lake Pichhola in Udaipur was tested for its electrical properties (0.3958 ms/cm), total dissolved solids (237.5mg/l), chloride (176mg/l), hardness (174.33mg/l), and alkalinity (207.16mg/l). These data were recorded as the average for each of these parameters. The water's pH level was measured at 7.5. It was discovered that the average concentration of dissolved oxygen was 5.75 mg/l, while the average amounts of nitrate and phosphate were determined to be 3.70 mg/l and 2.79 mg/l, respectively. It was determined that Lake Pichhola had an overall eutrophic condition based on the results of these several water quality measurements. For the whole of the research, it was found that the primary production was rather high (302.085 mgc/m<sup>2</sup>/hr), and the population of phytoplankton (58 forms), zooplankton (104 forms), and fish was very diverse (15 species). An in-depth physicochemical analysis of the water in the region found that the ground water in the Bargarh area of Orissa, India, meets quality criteria that are well below the contamination limit for its intended usage in domestic, industrial, and agricultural settings. This was the conclusion reached after analysing the water in the area. In the case of surface water, it was discovered that the quality of groundwater in small community ponds exceeded the legal limit (Mahanand., Channa punctatus has been shown to undergo changes in its nutritional value owing to pollution, as noted by Srivastava and Srivastava) (2008). The researchers Sachidanandmurthy and Yajurvedi (2006) found that the physico-chemical variables in Bilikere lake in Mysore city, Karnataka, were greater above the prescribed limit. This was because runoff and the occasional flow of sewage into the lake were contributing to the increased levels of these parameters. So, it is possible that the state of the lake remaining mesotrophic will rely on the regulation of the nutrient load that is regularly introduced into the water. Sachidanand Because of the effluent from fertilisers, there were some subtle but noticeable alterations in the biochemistry of freshwater teleosts (Yadav et al., 2007). In a limnological and microbiological study that Sharma (2008) conducted on the lakes Pichhola, Swaroop sagar, Udaisagar, and Fatehsagar, he discovered that all of the criteria fell within a significantly greater range than that which was underlined for water by the central pollution control board. This was the conclusion that he reached. Over the course of this examination, it was discovered that all measures were much higher than the recommended levels for fresh water (CPCB).

## III. PARAMETERS AFFECTING THE QUALITY OF WATER

A vast variety of factors that represent the quality of waters in various usage have been presented as a means of determining whether or not water is suitable for human consumption. A consistent investigation into some of them not only protects people from illnesses and other dangers, but they also stop the water resources from becoming more polluted. The metrics describing the water quality can be loosely grouped into three groups.

1. Physical parameters
2. Chemical parameters
3. Biological parameters

Physical characteristics of water:

**Colour:** When discussing water, the word "colour" refers to the inherent hues brought forth by dissolved chemicals and colloidal particles. Any presence of humic acids, fulvic acids, inorganic salts, particles, phytoplankton, algae, or even industrial effluents may all contribute to the colour of natural rivers. Color may be formed by a combination of these

several variables. Water becomes green when there are plenty of algae in it, and brown when there are lots of bacteria. The presence of biological matter and iron causes the water to appear yellow.

**Odour and Taste:** Rotting fish has a smell comparable to that of decaying plants, such as chara, hay, and stravy in water. Hydrogen sulphide gas is emitted if sewage pollutes water.

Fungi feed on decaying plant tissue, which is why decaying vegetation may often have a musty odour. Chlorinated fluids that contain even small levels of phenol emit a strong chlorophenol odour. Both the smell and the flavour of water are altered by the contaminants that are floating about in it.

The threshold odour number (T.O.N. ), which is the standard unit of odour quantification, is equal to the dilution ratio of a sample at which the odour is scarcely perceptible. Then, the sample is diluted with odourless water until only a hint of aroma may be detected by the tester. It's hardly rocket science to realise that a lower T.O.N. rating implies better water quality.

**Turbidity** particles of material that are suspended in the water, such as clay, silt, organic debris, phytoplankton, and other microbes, are responsible for this. Specifically, it is an illustration of the Tyndall effect, which is the scattering of light due to the presence of suspended particles in water. A particle's size, shape, and refractive index all contribute to how much light it scatters. Turbidity makes the water unfit for use in households, the food and beverage industries, and other types of manufacturing. For turbidity measurements, the Jackson Candle Turbid metre is the gold standard.

**Temperature** Exciting regional and temporal changes in water temperature result from the interaction of solar radiation and atmospheric pressure with water in its natural environment. The emergence of convection currents and heat stratification are two outward signs of these alterations. The release of warmed effluents may also contribute to temperature changes in natural streams. The growth of microorganisms and the chemical and biological activities that take place in water are both significantly affected by temperature, making temperature a fundamentally important factor. Water's temperature affects its chemical properties, including the rate at which reactions occur, the solubility of gases, the intensity of flavours and odours, and so on.

**Magnesium:** In addition, calcium may coexist with it in many kinds of natural waters, but often at lower amounts than calcium. Several different kinds of rocks contribute to the chemical make-up of rivers and streams in their natural states. Magnesium concentration is also affected by exchange equilibria and the presence of ions like sodium. Magnesium does not seem to be a health danger to people at the levels typically found in natural streams. It's probable that the first person to use a lot of it will feel a strong need to defecate and purge their system. High concentrations of sulphate have a laxative effect on humans. The most common cation in ocean and river water is sodium. Unlike calcium, for which precipitating methods may be utilised to reduce concentrations, sodium salts dissolve readily in water. There is an increase in the sodium content of certain ground fluids because sodium ions are exchanged for calcium and magnesium ions during the natural softening of water. This chemical is harmless to humans when at low enough concentrations. An increased risk of cardiovascular disease has been linked to a high intake of salt. The best method for analysing the material is the Flame Photometric method.

**Sulphate** It's a common anion that may be found in many different kinds of water. Larger concentrations are seen in arid and semiarid regions due to the accumulation of soluble salts in soils and shallow aquifers. The climate and geography of such areas make this so. Sulfate is produced by the biological oxidation of reduced sulphur species, which further increases the sulphate concentration. The molecule does not precipitate since sulphate salts are typically soluble in water. On the other hand, water's redox potential may cause it to undergo transformations that lead to the production of sulphur and hydrogen sulphide. In India, the maximum allowable level of sulphate in drinking water is 150 milligrammes per litre, as per government regulations.

**Chloride** It is possible to find chloride in every kind of water, since this element occurs naturally. The majority of chlorides in the water come from human waste. Because chloride is very soluble with the vast majority of naturally occurring cations, it can never precipitate. Chloride levels in drinking water shouldn't go over 250 mg/l or 300 mg/l, as recommended by the World Health Organization and the Indian Standards, respectively. Up to 1500 mg/l may be safely consumed without adverse effects; however, between 250 and 500 mg/l, an unpleasant salty aftertaste develops. It may also leach calcium out of concrete, hastening its demise. Most often used methods for calculating chloride concentrations are Mohr's and Volhard's.



**Fluoride:**All forms of naturally existing water should include it. In general, fluorides are not present in surface waters, but they may be found in ground water at potentially dangerous concentrations. When present at doses of 1.0 to 1.5 mg/l, it serves as an efficient cavity prevention. Fluoridation refers to the process of adding fluoride to public water sources with the goal of lowering the prevalence of tooth decay. Fluoride's mechanism of action is mostly localised, rather than widespread. Yet, there is zero evidence that any disease is linked to low fluoride levels. Infant formulae that are reconstituted with fluoridated water contain about one hundred times more fluoride than the quantity present in human milk. These numbers are expressed as a fraction of a percent (ppm). Tooth fluorosis is a defect of the tooth enamel brought on by fluorides' interference with normal tooth development. Hundreds of thousands, if not millions, of Indians suffer from skeletal fluorosis due to the moderate to high levels of fluoride (1.5 to 9 ppm) in their drinking water. There may be a spectrum of symptoms associated with skeletal fluorosis, with chronic joint pain being one of the milder manifestations. Too much of it is harmful and may lead to bone loss if it builds up in the body over a certain threshold. The World Health Organization, the United States Public Health Agency, and other international regulatory bodies have all recommended a maximum fluoride level of 1.5 mg/l for drinking water. Water solubility is high for anions, and nitrate is one of the most water-soluble. High doses of nitrogen fertilisers are often used on field crops. Some of the nitrogen applied to the soil in the fields is wasted since the plants can't absorb it all. This nitrogen might leach into the groundwater supply. Not all of the nitrogen that is sprayed is taken up by the soil, and some of it runs off the fields and into nearby streams and rivers.

**Phosphate:**It may enter surface or ground water by leaching from minerals or ores, through agricultural runoff, as a component of boiler fluids, as a consequence of industrial wastes, and as a large component of urban sewage through the use of synthetic detergents. It may be brought on by any of these processes. Both freshwater and wastewater may include phosphorus, which can be found in a variety of phosphates. Surface waters seldom have a high phosphate content because plants need them, while ground waters almost always do. USPHS recommends a phosphate limit of 0.1 mg/l for potable water. As all living things need oxygen to survive, dissolved oxygen (D.O.) is often used as a stand-in for data on chemical, physical, and biological activity in aquatic systems. This is due to the fact that the dissolved oxygen content of water is often the only indicator of the overall health of an aquatic ecosystem. Oxygen solubility is influenced by environmental conditions such as temperature, salinity, water flow, etc. Marine life can only survive if there is a constant supply of oxygen in the ocean. The DO is the single most important factor in determining whether or not organisms perform biological activities in an aerobic or anaerobic manner. If you want to know how much DO is in a sample, the titrimetric method is what you need to utilise. Iodine is released in a ratio that depends on how much oxygen was fixed in the water when it reacts with manganous hydroxide. Iodine concentration is measured by titrating a sample with a sodium thiosulfate solution while watching the starch dissolve.

Table no 1: Standard methods for physoco-chemical parameters

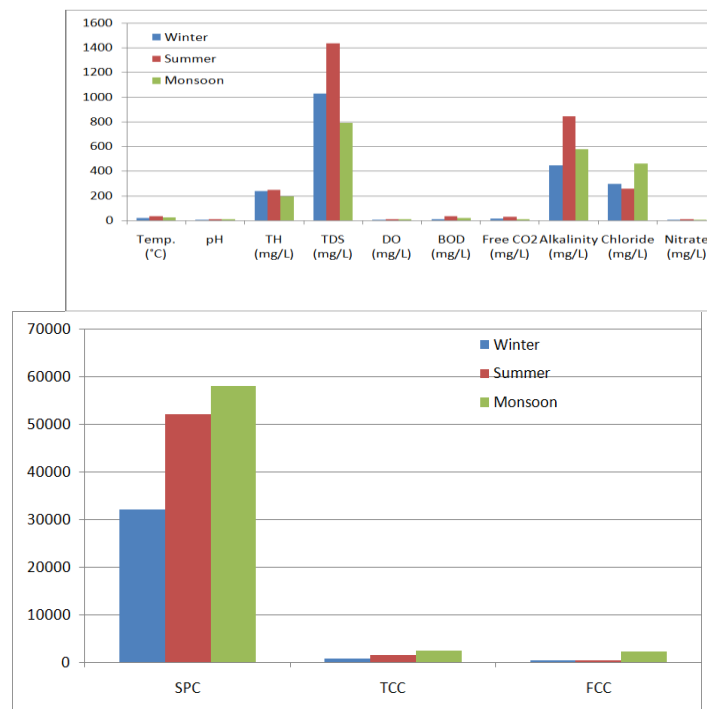
S.NO	Parameters	Abbreviations	Units	Method used
1	Temperature	Temp.	°C	Thermometer
2	pH			Water analyzer kit (systronic ) model no 371
3	Electrical Conductivity	EC	mhos/cm	Water analyzer kit (systronic ) model no 371
4	Total dissolved solid	TDS	mg/l	Water analyzer kit (systronic ) model no 371
5	Dissolved oxygen	DO	mg/l	By Titration method
6	Biological oxygen demand	BOD	mg/l	5 days incubation at 20 °C and titration of initial and final DO
	Turbidity	-----	NTU	By Turbidimeter
7	Transparency	Trans.	cm	By Secchi disk
8	Alkalinity	-----	mg/l	Titrimetric method (with .01 N H2SO4)
9	Nitrate	NO <sub>3</sub> <sup>-</sup>	mg/l	Spectrophotometer
10	Phosphate	PO <sub>4</sub> <sup>3-</sup>	mg/l	Spectrophotometer
11	Calcium ions	Ca <sup>++</sup>	mg/l	EDTA (.05N) Titrimetric method
12	Magnesium ions	Mg <sup>++</sup>	mg/l	EDTA (.05N) Titrimetric method
13	Total suspended solid	TSS	mg/l	Gravimetric method
14	Sulphate	SO <sub>4</sub> <sup>-</sup>	mg/l	Spectrophotometer
14	fluoride	F <sup>-</sup>	mg/l	SPANDS Method
15	Chloride	Cl <sup>-</sup>	mg/l	Mohr's & Volhard's methods.
16	sodium	Na <sup>+</sup>	mg/l	By Flam photometer
17	potassium	K <sup>+</sup>	mg/l	By Flam photometer



**Table 2: Physicochemical parameters of Jaisamand Lake during 2022-23**

parameters	Winter	Summer	Monsoon
Temp. (°C)	17.5	32.1	22.8
pH	7.0	7.4	6.8
TH (mg/L)	237	250	195
TDS (mg/L)	1030	1440	793
DO (mg/L)	5.0	10.6	8.2
BOD (mg/L)	9.6	35.7	18.4
Free CO <sub>2</sub> (mg/L)	15.7	30.2	10.5
Alkalinity (mg/L)	445.1	848	580.3
Chloride (mg/L)	294.5	259	460
Nitrate (mg/L)	4.85	9.07	4.35
SPC	32000	52000	58000
TCC	748	1506	2455
FCC	340	446	2294

**Fig1:**Seasonal variations in physicochemical parameters



**Fig2:** Seasonal variations in bacteriological parameters

**IV. CONCLUSIONS AND RECOMMENDATIONS**

Dissolved oxygen (DO), biological oxygen (BOD), carbon dioxide (CO<sub>2</sub>), sulfate reducing capacity (SRC), fecal coliforms count (TCC), and facultative coliform count (FCC) levels in Lake are all much greater than in other bodies of water (FCC). There was no cause for alarm about the degree of temperature, pH, total hardness, total dissolved solids, total alkalinity, chloride, or nitrates. ISI and WHO may be found in the lake. As a result, it is evident that lakes have

become excessively polluted and eutrophicated, rendering them exceedingly unsuited for personal food, irrigation, or fishing unless massive purifying measures are taken.

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