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# Assessment of Water Quality Index and Monitoring of Pollutants by Physico-Chemical Analysis in Water Bodies: A Review

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***Abstract*:- Water is said to be polluted when it is changed in its quality or composition directly or indirectly as a result of waste disposal and other human activities so that it becomes less suitable or harmful for drinking, domestic, agricultural, fisheries or other purposes. Water is never pure in a chemical sense. Even in the most unpolluted geographical areas, rainwater contains dissolved carbon dioxide, oxygen and nitrogen and may also carry in suspension dust or other particles picked up from the atmosphere.**

**The existence of human society depends on water. The quality of water should be monitor regularly due to its necessary for good human health. If water will be contaminated and frequently used by living being for drinking purposes, then human population suffers from different of water borne diseases. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life, therefore it is necessary to know details study about different Physico-Chemical parameters such as temperature, Transparency ,hardness, pH, sulphate, chloride, DO, BOD, COD, alkalinity nitrates phosphates used for analysis and testing of water quality. It is necessary to address water quality issues with respect to different water bodies. In addition, since the advent of industrial era, there has been a dramatic increase in the demand for water, commensurate with population growth and improved living standards. In the present study, a review of literature on the quality of natural waters from different parts of Indian sub-continent, in particular, and the globe in general has been discussed briefly.**

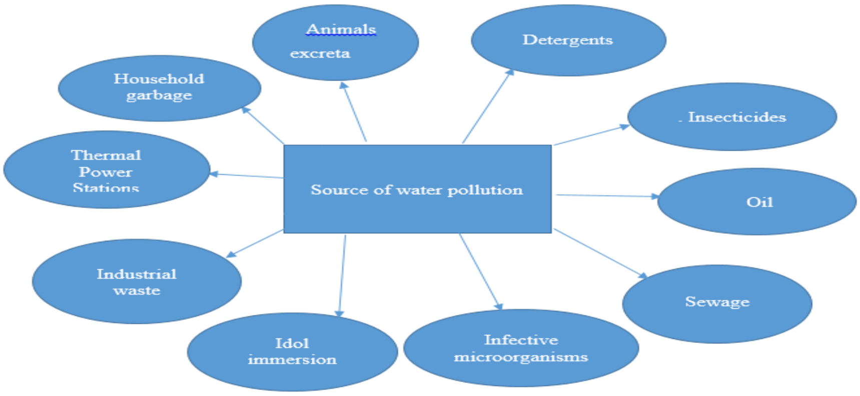
***Keyword: Physico - chemical Parameters, Transparency, Hardness, Human health***

## INTRODUCTION

Modern civilization is dependent on water for irrigation, industry, domestic needs, shipping, sanitation and disposal of waste. Most of our water bodies such as ponds, lakes, streams and rivers have become polluted as a consequence of increasing industrialization, urbanization and other development activities. Water is said to be polluted when it is changed in its quality or composition directly or indirectly as a result of waste disposal and other human activities so that it becomes less suitable or harmful for drinking, domestic, agricultural, fisheries or other purposes. Temperature, turbidity and total suspended solids in water bodies can be greatly affected by human activities such as agriculture, deforestation and the use of water for cooling. The release of untreated domestic or industrial wastes high in organic matter into water bodies results in a marked decline in oxygen concentration and a rise in ammonia and nitrogen concentrations, downstream of the effluent input.[1] Industrial activities which discharge large organic loads include, pulp and paper production and food processing.

Uncontrollable discharge of industrial waste water often causes pollution due to toxic metals. Other sources of metal pollution are leachates from urban solid waste landfills and mining waste dumps. Under certain hydrogeological conditions, unsewered domestic waste can cause severe ground water contamination by pathogenic bacteria, nitrate and other pollutants. Pumping of industrial waste water into ground water has resulted in high nitrate, arsenic and iron content.[2] Many pollutants may also be found in solution form in water. These may be phosphates, fluorides, nitrates and certain metals or may be unnatural materials such as pesticides[3]. Many causes of pollution including sewage and fertilizers, contain nutrients such as nitrates and phosphates. In excess levels, nutrients over stimulate the growth of aquatic plants and algae. Excessive growth of these types of organisms consequently clogs our water ways, use up dissolved oxygen as they decompose, and block light to deeper waters. This in turn proves very harmful to aquatic organisms as it affects the respiration ability of fish and other invertebrates that reside in water.

SOURCE OF WATER POLLUTION




## 3.0 PARAMETERS AFFECTING THE QUALITY OF WATER

To ascertain suitability of water for consumption, a large number of parameters signifying the quality of waters in various uses have been proposed. A regular monitoring of some of them not only prevents diseases and hazards but also checks the water resources from going further polluted. The water quality parameters are roughly divided into three categories

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

***Physical characteristics of water:***

***Colour:***

Colour in water means those hues inherent within the water itself which result from colloidal substances and materials in solution. In natural waters colour may occur due to the presence of humic acids, fulvic acids, metallic ions, suspended matter, phytoplankton, weeks and industrial effluents. Algal flora imparts green colour to water while water with excess of slit appears brownish. Organic matter and iron impart a yellow hue to the water.

***Odour and Taste:***

Decaying water weeds like chara, rotten hay and stravy impart an odour like that of decaying fish. Contamination with sewage water may give the odour of hydrogen sulphide. Fungi growing on decaying plant material yield a musty odour. Chlorinated waters with phenol traces give very strong chlorophenol odour. Taste of water too depends upon the impurities in water and it is also linked with the odour.[4] Odour is generally measured as threshold odour number (T.O.N) which is equal to dilution ratio of the sample at which odour is just detectable. The sample is diluted with odour free water until at least perceptible odour is detected by the tester. Obviously, smaller is the value of T.O.N; better is the quality of water.

***Turbidity:***

Turbidity in natural waters is caused by suspended matter like clay, slit, organic matter, phytoplankton and other microscopic organisms.[4] It is actually the expression of the optical property (Tyndall effect) in which light is scattered by the suspended particles present in water. Scattering of light is dependent upon the size, shape, and refractive index of such particles. Turbidity makes the water unfit for domestic purposes, food and beverage industries, and many other industrial uses. The standard method of measuring turbidity is the Jackson Candle Turbid meter.

***Temperature***

Impinging solar radiation and atmospheric pressure bring about interesting spatial and temporal thermal changes in natural water which manifest in setting up of convection currents and thermal stratification. Discharge of heated effluents also brings about thermal changes in natural waters. Temperature is basically an important factor for its effects on chemical, biological reactions and growth of micro-organisms in water. A rise in temperature of water accelerates chemical reactions, reduces solubility of gases, amplifies tastes and odour etc.

***Transparency:***

It is a measurement of the depth of light penetration into the water. Transparency of water depends on the amount of particles present in the water. Particles may be inorganic such as sediment from erosion or organic such as algae, phytoplankton. During the light propagation in the water, the light attenuates due to absorption and dispersion of these particles until completely disappearing. The extinction depth depends on optical phenomena such as absorption or scattering of light caused by the presence of different components in the water, the presence of algae that absorb light for photosynthesis or the presence of dissolved matter and zooplankton that scatter the light, it means the less particles are present in water, the water will be more transparent.

***Conductivity*:**

Electrical conductivity is the ability of a substance to conduct electric current. In water, it is the property caused by the presence of dissolved mineral matter. The conductivity is the reciprocal of the resistance measured between two electrodes kept one cm apart and having a surface area of 1 $cm^2$. The conductivity of distilled water ranges between 1 to 5 µmho but the presence of salts and contamination with waste waters increases the conductivity of the water. Conductivity is highly dependent upon temperature and therefore is reported normally at 25°C to maintain the comparability of data from various sources.[5] The maximum permissible limit of electrical conductivity in drinking waters recommended by WHO is 500 µmho/cm.

***Solids***:

These may be present in suspension or in solution and may be divided into organic matter and inorganic matter. Total dissolved solids (TDS) are due to soluble materials whereas suspended solids (SS) are discrete particles which can be measured by filtering a sample through a fine paper. Settleable solids are those removed in a standard settling procedure using a 1 litre cylinder. They are determined from the difference between SS in the supernatant and the original SS in the sample. The WHO International Standards set the permissible limit for dissolved solids as 500 mg/l.

***Chemical characteristics of water:***

Chemical characteristics tend to be more specific in nature than some of the physical parameters and are thus more useful in assessing the properties of a sample. It is useful at this point to set out some basic chemical definitions.

***pH***:

It is the measure of the intensity of acidity or alkalinity of a solution. More precisely, it is the measure of the hydrogen ion activity. Most natural waters are generally alkaline due to presence of sufficient quantities of carbonates. Most chemical and biological reactions occur at a narrow range of pH. Determination of pH is one of the important objectives in treatment of wastes. pH has no direct adverse effect on health, however a lower value below 4 will produce sour taste; and a higher value above 8.5, an alkaline taste. Higher values of pH hasten the scale formation in water heating apparatus and also reduce the germicide potential of chlorine. pH below 6.5 starts corrosion in pipes, thereby releasing toxic metals such as Zn, Pb, Cd and Cu.[5] pH values are positively correlated with electrical conductance and total alkalinity (Gupta, 2009). The standard values for drinking water prescribed by WHO lies in the range 6.5 to 8.5.

***Alkalinity***:

Alkalinity of the water is its capacity to neutralize a strong acid and is characterized by the presence of all hydroxyl ions capable of combining with hydrogen ion. The alkalinity of natural waters is normally due to the presence of bicarbonate, carbonate and hydroxide compounds of calcium, magnesium, sodium and potassium.[6]The maximum allowable limit of Alkalinity in drinking water is 600 mg/l according to WHO standards

***Acidity:***

Acidity of water is its capacity to neutralize a strong base and is usually caused by the presence of free carbon dioxide, mineral acids such as sulphuric and weakly dissociated acids. Determination of acidity is significant as it causes corrosion and influences the chemical and biological reactions.[7]

***Hardness***:

Hardness is a property of water which prevents lather formation with soap and produces scale in hot water systems. It is mainly due to the metallic ions $Ca^{2+}$ and $Mg^{2+}$ although $Fe^{2+}$ and $Sr^{2+}$ are also responsible. The metals are usually associated with $HCO_3^-$, $SO_4^{2-}$, $Cl^-$ and $NO_3^-$. The term "Total hardness" indicates the concentration of calcium and magnesium ions only. The total hardness is expressed in terms of $CaCO_3$. Hardness has been classified into temporary hardness and permanent hardness. Temporary hardness is mainly due to bicarbonates of calcium and magnesium which are precipitated as normal carbonates by the loss of $CO_2$ on mere boiling. The hardness that remains after boiling is known as permanent hardness and is due to sulphates, chlorides and nitrates of calcium and magnesium. The precise terms used for classifying hardness are carbonate hardness and non-carbonate hardness.[7] Among the methods available for the determination of hardness, the EDTA titrimetric method is the precise one and can be performed rapidly. Hardness is expressed in term of mg/l of $CaCO_3$. Total Hardness is defined as the sum of calcium and magnesium concentration. WHO has recommended a limiting value of total hardness as 500 mg/l in terms of $CaCO_3$, above which the water does not remain very useful although it is not harmful. Similarly, limiting values of 30 mg/l and 75 mg/l have been recommended by Indian Standards for magnesium hardness and calcium hardness in water respectively.

***Calcium***:

The presence of calcium in water is mainly due to its passage through or over deposits of limestone, dolomite, gypsum and other gypsiferous materials. Calcium is the major scale-forming constituent in most raw water supplies. Calcium is usually determined in potable and industrial waters only but not in sewages. When it is necessary to determine calcium in an industrial effluent, the organic matter present in it should be destroyed first by evaporation and ignition. Among the methods available for the determination of calcium, the EDTA – titrimetric and gravimetric method are more accurate.

***Magnesium***:

It also occurs in all kinds of natural waters with calcium, but its concentration remains generally lower than the calcium. The principal sources in the natural waters are various kinds of rocks. The concentration of magnesium also depends upon exchange equilibria and presence of the ions like sodium .Magnesium is supposed to be non-toxic at the concentrations generally met with in natural waters. High concentrations may be cathartic and diuretic for the initial user.[8] High concentration combined with sulphate, acts as a laxative to human beings.

***Sodium***:

It is the major cation occurring in natural waters. Sodium salts are highly soluble in water and unlike calcium there are no precipitating reactions to reduce its concentrations. During natural softening of water, sodium is exchanged by $Ca^{2+}$and $Mg^{2+}$ thus gets increased in concentration in some ground waters. At lower concentrations, there are no adverse effects on the health. Higher concentrations of sodium can be related to cardiovascular diseases. The best method of its analysis is by Flame Photometric method.[7]

***Potassium***:

The concentration of potassium in most drinking waters is trivial. It has a similar chemistry like sodium and remains mostly in solution without undergoing any precipitation. It is not very much significant from the health point of view, but in excessive amounts it acts as cathartic. It is reported that foaming may be caused by more than 50 mg/l of potassium and sodium in water. The concentration of potassium is determined by flame photometric methods.[7]

***Sulphate***

It is a major anion present in all kinds of natural waters. In arid and semi-arid zones, it is found in particularly higher concentrations due to the accumulation of soluble salts in soils and shallow aquifers. Biological oxidation of reduced sulphur species to sulphate also increases its concentration. Most of the salts of sulphate are soluble in water and as such, it is not precipitated. However, it may undergo transformations to sulphur and hydrogen sulphide depending upon the redox potential of water. The maximum allowable limit of sulphate in drinking water is 150 mg/l according to Indian standards.

***Chloride:***

Chloride occurs naturally in all types of waters. The most important source of chlorides in the water is the discharge of domestic sewage. Chloride is highly soluble with most of the naturally occurring cations and does not precipitate. The maximum limit for chloride in drinking water as recommended by WHO and Indian Standards are 250 mg/l and 300 mg/l respectively.It is harmless up to 1500 mg/l concentration but produces a salty taste at 250-500 mg/l level. It can also corrode concrete by extracting calcium. Usual methods for determination of chloride are Mohr's & Volhard's methods.

***Fluoride:***

It occurs in almost all natural water supplies. Fluorides in high concentrations are not a common constituent of surface waters, but they occur in detrimental concentrations in ground waters. In amounts of 1 to 1.5 mg/l, it is an effective preventive of dental caries. Fluoridation is the practice of adding fluoride to the public water supply to prevent dental decay. The fluoride mechanism of action is primarily topical not systemic.[9] However there is no evidence of any disease related to fluoride deficiency. Natural levels of fluoride in human milk (0.01 ppm) are approximately a hundred times less than the baby formulae reconstituted with fluoridated water. Dental fluorosis is a defect of the tooth enamel caused by fluorides interference with the growing tooth. Millions of people in India suffer a crippling bone disease called skeletal fluorosis, caused by moderate to high natural levels of fluoride (1.5 to 9 ppm) in their water. Skeletal fluorosis has several stages of severity with less severe being chronic joint pain. When it concentration much above the permissible limit it is considered toxic and results in osteoporosis of bones. The maximum permissible limit of fluoride has been proposed to be 1.5 mg/l in drinking water by various international regulatory bodies like WHO, USPHS etc.

***Nitrate***:

Nitrate is one of the most water soluble anions known. Nitrogen fertilizers are applied in very large amounts in field crops. Since the plants cannot utilize all the nitrogen applied to the fields, some is left in the soil and it can leach into ground water. In addition, not all the applied nitrogen gets into the soil and some is washed off the fields in the form of run off and it flows into surface waters such as streams and rivers. Nitrate is a wide spread contaminant of ground and surface waters worldwide. [10, 11]Nitrate is a potential human threat especially to infants, causing the condition known as methmoglobinemia, also called the "blue baby syndrome''. Nitrate is converted in the gut to nitrite, which then combines with hemoglobin to form methemoglobin, thus decreasing the ability of the blood to carry oxygen.[12] Nitrate has the potential to cause the following effects from a life time exposure at levels above 10 ppm: diuresis, increased starchy deposits and hemorrhaging of the spleen.[13] A few recent studies have linked high nitrate to bladder cancer especially in woman. . USPHS and other international agencies have proposed that the nitrate level in drinking water should be limited to 10 mg/l for drinking purposes.

***Phosphate:***

It may occur in surface or ground waters as a result of leaching from minerals or ores, from agricultural runoff, as a constituent of boiler waters, as a result of industrial wastes, and as a major element of municipal sewage due to the utilization of synthetic detergents. Phosphorus occurs in natural waters and waste waters in the form of various phosphates. Surface waters seldom contain high concentration of phosphates, since they are utilized by plants whereas ground waters usually contain appreciable amounts of phosphate. USPHS has recommended a maximum permissible limit of 0.1 mg/l total phosphate in drinking water.

***Dissolved oxygen (D.O. :***

Dissolved oxygen of water is of paramount importance to all living organisms and is considered to be the lone factor which to a great extent can reveal the nature of the whole aquatic system at a glance, even when information on other chemical, physical and biological parameters is not available. The solubility of oxygen depends upon temperature, salinity, water movements etc. Dissolved oxygen in water is essential to aquatic life. DO is the most important factor in determining whether aerobic or anaerobic organisms carry out biological changes. The estimation of DO is done by the titrimetric method. The oxygen of the water combines with manga nous hydroxide which on acidification liberates iodine equivalent to that of oxygen fixed. This iodine is titrated by standard sodium thiosulphate solution using starch as an indicator.

$$Mn\,SO_4 + 2\,KOH \longrightarrow Mn(OH)_2 + K_2SO_4$$
$$Mn(OH)_2 + O \longrightarrow MnO(OH)_2$$
$$MnO(OH)_2 + 2H_2SO_4 + 2\,KI \longrightarrow MnSO_4 + K_2SO_4 + 3H_2O + I_2$$

Deficiency of dissolved oxygen in receiving waters gives rise to odiferous products of anaerobic decomposition. If sufficient DO is available, aerobic organisms oxidizes the wastes to innocuous products. If DO is deficient, anaerobes take part in conversion and reduce the waste often to obnoxious end products. Thus the measurement of DO is important for maintaining aerobic conditions in the receiving waters and in the aerobic treatment of sewage and industrial waste waters.[14]

***Carbon Dioxide:***

It is the end product of organic carbon degradation in aquatic environments and its fluctuation is a measure of net ecosystem metabolism. $CO_2$ is also the most important greenhouse gas on Earth. Its fluxes across the air-water or sediment-water interface are among the most important concerns in global change studies and are often a measure of the net ecosystem production/metabolism of the aquatic system. There are various readily measurable parameters of aquatic carbon dioxide system: such as pH ($pCO_2$), total dissolved inorganic carbon (DIC) and total alkalinity (TA). Surface water $pCO_2$ can be measured by photo-metric method and dissolved $CO_2$ will measure by coulometer or by an infrared $CO_2$ analyzer. Total Alkalinity $CO_2$ will determine by HCl titration of the water sample to the $CO_2$ equivalence point.

***Biochemical oxygen demand (BOD):***

It is the most commonly used parameter to define the strength of municipal or organic industrial waste water. BOD is a measure of the amount of oxygen used in the respiratory processes of micro-organisms in oxidizing the organic matter in the sewage and for the further metabolism (oxidation) of cellular components synthesized from the wastes. BOD value approximates the amount of oxidizable organic matter present in the solution. The basic principle underlying the BOD determination is the measurement of dissolved oxygen content of the sample before and after five days incubation at 20°C.[12] A permissible value of 10.0 mg/l recommended to be the drinking water standard by WHO.

***Chemical oxygen demand (COD):***

It is the amount of oxygen required by organic substances in water to oxidize them by a strong chemical oxidant.[14,16] The determination of COD values are of great importance where BOD values cannot be determined accurately due to the presence of toxins and other such unfavorable conditions for growth of micro-organisms. In general, COD is more than the BOD values for most of the industrial wastes. COD values are taken as the basis for calculation of the efficiency of the treatment plants and also figure in the standards for discharging industrial/domestic effluents in various kinds of water. A threshold value of 10.0 mg/l has been proposed to be the drinking water standard by WHO.

***Biological characteristics of water:***

Ideally, drinking water should not contain any microorganisms known to be pathogenic. It should also be free from bacteria indicative of experimental pollution. The primary bacterial indicator of faecal pollution is the coliform group of organisms. F. Coli is a more precise indicator of faecal pollution. Their population is usually expressed in terms of MPN i.e. most probable number. The drinking water should also be free from microscopic organisms such as algae, zoo planktons, flagellates, parasites and toxin producing organisms.

***Methods for physoco-chemical parameters***

For analysis of parameters, the water samples will be preserved at the collection site by adding appropriate regents and brought to laboratory. Spectrophotometric work will be performed using Carl-Zeiss Spekol-10 spectrophotometer for analysis of nitrate, phosphate and fluoride etc.[14] Determination of total hardness, TSS, DO, BOD, chloride will be carried out by the standard methods.

Table no 1: Standard methods for physoco-chemical parameters

| S.NO | **Parameters** | **Abbreviations** | **Units** | **Method used** |
|---|---|---|---|---|
| 1 | Temperature | Temp. | $^0C$ | 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 $^0C$ and titration of initial and final DO |
| | Turbidity | ------ | NTU | By Turbiditimeter |
| 7 | Transparency | Trans. | cm | By Secchi disk |
| 8 | Alkalinity | -------- | mg/l | Titrimetric method (with .01 N H2SO4) |
| 9 | Nitrate | $NO_3^-$ | mg/l | Spectrophotometer |
| 10 | Phosphate | $P0_4^{---}$ | mg/l | Spectrophotometer |
| 11 | Calcium ions | $Ca^{++}$ | mg/l | EDTA (.05N) Titrimetric method |
| 12 | Magnesium ions | $Mg^{++}$ | mg/l | EDTA (.05N) Titrimetric method |
| 13 | Total suspended solid | TSS | mg/l | Gravimetric method |
| 14 | Sulphate | $SO_4^{--}$ | mg/l | Spectrophotometer |
| 14 | fluoride | $F^-$ | mg/l | SPANDS Method |
| 15 | Chloride | $Cl^-$ | mg/l | Mohr's & Volhard's methods. |
| 16 | sodium | $Na^+$ | mg/l | By Flam photometer |
| 17 | potassium | $K^+$ | mg/l | By Flam photometer |

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***Water Quality Index (WQI)***

A Water Quality Index (WQI) is a measure by which water quality can be estimated for various purposes [4]. WOI can be used to predict whether the water is suitable for drinking purpose, industrial purpose or aquatic organisms etc. WQI can be measured on the scale 0 to 100. Higher the WQI, better is the quality of water. Below are the classifications of WQI [5]: WQI gets affected by various water quality parameters. In this paper effect of pH level, turbidity, dissolved oxygen and electrical conductivity is analysed.

The water quality index for the river was calculated based on weighted arithmetic index method for eight parameters namely: pH, turbidity, TDS, BOD, DO, alkalinity, chlorides and electrical conductivity for seven stations in which each station got three sampling points (i.e. left side, middle and right side of the river) as indicated in Figure 2. The weighted arithmetic water quality index method was applied [10] in which the water quality parameters were multiplied by a weighting factor and are then aggregated using a simple arithmetic mean using the following equations:

$$Qi = \left(\frac{Mi - Li}{Si - Li}\right) \times 100$$

$$Wi = \frac{K}{Si}$$

$$WQI = \sum_{i=1}^{n} \frac{WiQi}{\sum_{i=1}^{n} Wi}$$

Where Qi is the sub index of the ith parameter. Wi is the unit weightage of the ith parameter, n is the number of parameters included, Mi. is the monitored value of the parameter, Li is the ideal value, and Si is the standard value of the ith parameter.

According to above equation, the quality of water regarding the WQI classification is given in Table

Table no.2 Water Quality Index

| Range | Quality |
|---|---|
| 0-25 | Excellent |
| 26-50 | Good |
| 51-75 | Poor |
| 76-100 | Very poor |
| >100 | Unsuitable for drinking |

***Source of occurrence of water quality parameters used for analysis of quality of water and their potential health effects***

The quality of water is of vital concern for mankind, since it is directly linked with human welfare. There is always a need for and concern over the protection and management of water quality. The task of monitoring the quality of water is facilitated if one can find some correlations among these numerous parameters. When such correlations exist, measuring a few important parameters and then predicting other using these correlations would give an indication of the quality of water. The disposal of large quantity of industrial waste water/solid wastes by open dumping leads to the contamination of soil, which will in turn affect the water quality. Continuous monitoring of water quality is necessary to understand the level and nature of contamination. Based on the level of contamination curative/preventive measures must be applied to restore the quality.

Table no 3: Different analytical water quality parameters used for testing of quality of water and their source of occurrence and its potential health effects

| S no | Parameters | Sources | Effects on living being |
|---|---|---|---|
| **1** | Temperature | Due to presence of dissolved salts | affects fish growth, reproduction and immunity |
| **2** | Transparency | Dissolved and Suspended solids and sediments in different size, shape and composition of particles present in water | acting directly on fish, killing them or reducing their growth rate, resistance to disease, etc.; |
| 3 | pH | pH is changed due to different dissolved gases and solids | Affects mucous membrane; bitter taste; corrosion |
| **4** | Electrical Conductivity | Due to different dissolved solids | Conductivity due to ionizable ions. High conductivity increases corrosive nature of water. |
| **5** | Total dissolved solid | Presence all dissolved salts | Undesirable taste; gastro-intestinal irritation; corrosion or incrustation |
| 7 | Turbidity | Sediments, soil runoff and erosion from upland | It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill function. |
| 8 | Biological oxygen Demand | Organic material contamination in water | High BOD decreases level of dissolved oxygen. |
| 9 | Alkalinity | Due to dissolved gases (CO2) | Embrittlement of boiler steel. Boiled rice turns yellowish |

| | | | |
|---|---|---|---|
| 10 | Total suspended solids | Dust ,sediments, soil | Harm for aquatic animals and fish growth Due to do not supply of oxygen properly in depth of water |
| 11 | Nitrate | Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits | Effect on Infants below the age of six months Symptoms include shortness of breath and blue-baby syndrome. |
| 12 | Phosphate | Nutrient runoff from crop land and other sources; and bottom sediment. | stimulate microbial growth, Rancidity Mold growth |
| 13 | Sulphate | Due to dissolved Ca/Mg/Fe sulphates | Taste affected; gastro-intestinal irritation. Calcium sulphate scale. |
| 15 | Fluoride | Industrial effluents | Dental decay |
| 16 | Calcium ions | Precipitate soaps, anionic | Interference in dyeing, textile, |
| 17 | Magnesium ions | surfactants, anionic emulsifiers | Vomiting and luxurious |
| 18 | Hardness | Presence of calcium (Ca2+) and magnesium (Mg2+) ions in a water supply**.** It is expressed. Hardness minerals exist to some degree in every water supply | Poor lathering with soap; deterioration of the quality of clothes; scale forming |

SOME WORKED ON WATER ON GLOBAL AREAS

Meenakshi et al.[15] have determined the fluoride concentration in underground water in four villages of Jind district of Haryana state (India) where it is the only source of drinking water. Various other water quality parameters such as pH, EC, TDS, total hardness, total alkalinity as well as sodium, potassium, calcium, magnesium, carbonate, bicarbonate, chloride and sulphate concentrations were also measured. A systematic calculation of correlation coefficient among different physico-chemical parameters was performed. The analytical results indicated considerable variations among the analyzed samples with respect to their chemical composition. Majority of the samples do not comply with Indian as well as WHO standards for most of the water quality parameters measured. The fluoride concentration in the underground water of these villages varied from 0.3 to 6.9 mg/l, causing dental fluorosis among people especially children of these villages.

Tyagi, P. et al.[16] have used a time series technique to assess the future conditions for the ground water quality of the Pithampur industrial area of Madhya Pradesh. Using a two year experimental data (September 1999 – May 2001) of ground water, prediction was made for the year 2004-2005. From the predicted values it was found that if the rate of contamination of the ground water remains the same in the forthcoming years, then, in future the ground water of the area would not be suitable for drinking and agricultural purposes.

Gupta, S. et al[17] have investigated the ground water quality of Sanganar area, Jaipur in Rajasthan. The different parameters measured are pH, conductivity, TDS, calcium, magnesium, total hardness, COD, alkalinity, $Cl^-$, $F^-$, $PO_4^{3-}$, $Na^+$, $K^+$, $SO_4^{2-}$, $NO_3^-$, $Cd^{2+}$, $Pb^{2+}$ and $Fe^{2+}$. From the observed data it was found that parameters like conductivity, TDS, alkalinity and $F^-$ have high values in this area, whereas other parameters are approximately within the limit or below limit.

Dinesh Kumar, M. and Shah, T**.**[18] have discussed the extent and impacts of ground water contamination and pollution in India. The incidence of fluoride above permissible levels of 1.5 ppm occurred in 14 Indian states, namely Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal affecting a total of 69 districts according to some estimates. High level of salinity was reported from all states except West Bengal and Delhi. Iron content above the permissible level of 0.3 ppm was found in 23 districts from 4 states, namely Bihar, Rajasthan, Tripura and West Bengal and coastal Orissa. High levels of arsenic above permissible levels of 50 parts per billion (ppb) was found in the alluvial plains of Ganges covering six districts of West Bengal. Presence of heavy metals in ground water was found in 40 districts from 13 states, viz. Andhra Pradesh, Assam, Bihar, Haryana, Himanchal Pradesh, Karnataka, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and five blocks of Delhi.

Premlata Vikal[19] (2009) has been work out the physico-chemical characteristics of the Pichhola lake water. He studied various parameters like air and water temperature, pH, free $CO_2$, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, conductivity, total dissolved solids, hardness, total alkalinity, chloride, nitrate, phosphate and sulphate. The results revealed that the values of conductivity, COD, and sulphate were found to cross the standard limits in water samples. The coefficient of correlation (r) among various physico-chemical parameters was also made.

Manjare et. al.[20] (2010) were studies the Physico-chemical Parameters of Tamadalge Water Tank in Kolhapur District, Maharashtra. Monthly Changes In Physical and Chemical Parameters Such as Water Temperature, Transparency, Turbidity, Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbon dioxide, and Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates. Were analyzed for a periods of one year. All Parameters were within the Permissible limits. The results indicate that the tank is Non-polluted and can be used for Domestic and Irrigation

Saravanakumar and Ranjith Kumar[21] (2011) presents paper studies about groundwater quality of Ambattur industrial area in Chennai City. They studied parameters such as pH, total alkalinity, total hardness, turbidity, chloride, sulphate, fluoride, total dissolved solids and conductivity. It was observed that there was a slight fluctuation in the physico-chemical parameters among the water samples studied. Comparison of the physico-chemical parameters of the water sample with WHO and ICMR limits showed that the groundwater is highly contaminated and account for health hazards for human use.

Patel and co-worker [22] (2016) have determined the levels of parameters such as pH, DO, BOD, COD, chloride, sulphate, calcium-magnesium hardness, nitrate and TDS of drink water.

Sharma et al., [23] (2012) did the analysis of the physicochemical parameters of the Narmada River, Madhya

Pradesh. They carried out the investigation for a period of 12 months beginning in August 2009. They have chosen three different sampling stations along the course of the River in order to collect the water samples. The different parameters measured were pH, temperature, transparency, dissolved oxygen, biochemical oxygen demand, chlorides, PO4, NO3, alkalinity, SO4 and total hardness. PO4, nitrate, alkalinity and SO4 were found to be elevated in September and October whereas pH, temperature, chlorides and total hardness were towering in summer. The overall parameters were within the WHO limits.

Namita Saxena1and Alka Sharma [24] have measured physical and chemical parameters such as Colour, Odour, Temperature, pH, Electrical Conductivity, Total Dissolved Solid, Total Alkalinity, Total Hardness, Calcium, Magnesium, Chloride, and Dissolved Oxygen. Almost all these parameters satisfy the guidelines of drinking water at many places except a few. They were also studied the water quality index and the results obtained of water quality index of these samples ranges from 58.66 to 93.75.

## CONCLUSION:

Monitoring water quality has a very effective for the determination of current status for hydrological condition of water and water pollution and longtime safety for contaminated water. The supply of pure and safe water has a significant impact on the anticipation of water transmissible diseases. A regular and frequently monitoring of water will help in taking long-term precautions, which will be helpful in drinking .irrigation and protecting human health in the study area.

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[24] Namita Saxena1∗ and Alka Sharma2Evaluation of Water Quality Index for Drinking Purpose in and Around Tekanpur area M.P. India International Journal of Applied Environmental Sciences ISSN 0973-6077 Volume 12, Number 2 (2017), pp. 359-370