iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** VIII **Month of publication:** August 2015

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Assessment of Multi Parameters of Water Quality in Surface Water Bodies-A Review

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Abstract-The various Physico–Chemical and Biological parameters such as Water temperature, pH, EC, TDS, DO, COD,BOD, Chloride, Alkalinity, Total Hardness, Calcium and Magnesium, Sulphate, Nitrate, Nitrogen as Ammonia, Nitrogen as Nitrate and Nitrogen as Nitrite are discussed and studied in this paper. The objective of study was to know the important water quality parameters for Drinking, Irrigation and Aquatic life i.e. multipurpose from surface water bodies. Various researchers explained their views about water quality parameters that are explained below. From this study it will seen that ,all parameters are equally important but some are the broad range and simple field parameters in surface water bodies such as Water Temperature, pH , EC,TDS, DO, COD, BOD etc. those are covered maximum water quality for different purposes.
Keywords: Multi parameter, Multipurpose, Reservoir, Water quality

I. INTRODUCTION

The water is a primary natural resource for people for different consumptions such as drinking, irrigation, hydro-electricity, fish fostering and recreation; therefore, it requires at least an acceptable level of water quality [5]. The need of study of surface water quality is one of the major issues today due to increasing the load of pollution from industrial, commercial and residential with its effects on human health and aquatic ecosystems [11]. Human activities that involve urbanization, agricultural development, over use of fertilizers, inadequate management of land use and sewage disposal have directly or indirectly affected the quality of water and making it unfit for different purpose. Therefore now a day's fresh water has become a scare commodity due to over exploitation and pollution. Water quality is largely determined by both natural processes including the lithology of the basin, atmospheric inputs and climatic conditions, and by anthropogenic inputs [2]. In natural waters, the dissolved solids mainly consist of bicarbonates, carbonates, sulphates, chlorides, nitrates and phosphates of calcium, magnesium, sodium, and potassium with traces of iron, manganese and other minerals. Water quality measurements include a variety of physical, chemical and biological parameters. Basic problem in the case of water quality monitoring is the complexity associated with analyzing the large number of variables [12]. Predicting the water quality is also the key factor in the water quality management of stream, and it enables a manager to choose an option that satisfies a large number of identified conditions [10].

II. LITERATURE SURVEY

The relevant literature on water quality parameters of surface water for multipurpose like drinking, irrigation, aquatic life, etc., with respect to all the characteristics, objects, standards, methods, aspect and their impact on environment and on human beings was reviewed and presented here.

A. Importance of Physico- Chemical Parameters On Surface Water Bodies

*1) Temperature***:** Temperature is one of the most important factors for survival of aquatic life. The moderate change in temperature can seriously affect aquatic environment, including bacteria, algae, invertebrates and fish [6; 11]. Water temperatures fluctuate naturally both daily as well as seasonally. Aquatic organisms often have narrow temperature tolerances with the ability to buffer against atmospheric temperature extremes. Verma and Singh [3] stated that as the temperature increases, lesser and lesser amount of oxygen remains dissolved in the sample and hence BOD and COD increases. However, after a certain temperature all living organisms die and hence BOD values falls sharply.

2) pH: The concentration of hydrogen ions in a solution is subjectively called pH; it is the indicator of acidic or alkaline condition of

water status and quantifies the basic or acidic nature of a solution. The pH scale ranges from 1 (acid) to 14 (basic) with 7 as Neutral. Standard range for any purpose such as survival of fish and its use as drinking water in-terms of pH is 6.5-8.5 [1; 4; 9]. Higher values of pH hasten the scale formation in water heating apparatus and reduce germicidal potential of chlorine. The pH value dependent on various phases of water treatment and water supply such as acid-base, neutralization, coagulation, sedimentation, corrosion control [11]. Due to acid rain or discharges, pH changes which in turn increases the bacterial degradation thereby depleting the DO and hence the BOD requirement exponentially rises [3].

3) Electrical Conductivity: Electrical conductivity is a measure of the ability of an aqueous solution to carry an electric current and depends on the presence of ions, on their total concentration, mobility and temperature. It is associated with major water quality parameters due to dilution effect of stream flow and can be used as indicator in determining the suitability of water for irrigation. Higher value of conductivity was due to presence of higher concentration of dissolved salts of cations such as calcium, magnesium and sulphate during the rains. Electrical conductivity is also considered to be a rapid and good measure of dissolved solids which reflects the pollution status as well as tropic level of the aquatic body [6; 8; 9; 11]. The low conductivity might be responsible for the soft nature of the water and the significant changes in conductivity may be an indicator that a discharge or some other source of pollution has entered a stream [2].

*4) Total Dissolved Solids***:** The amount of dissolved solid is important consideration in determining its suitability for irrigation, drinking and industrial uses. TDS indicates the general nature of salinity of water such as higher value will have salty taste. For irrigation water dissolved solid is a very important criterion due their gradual accumulation results in salinization of soil, thus, rendering the agriculture land non-productive. In general, waters with a total dissolved solids <500 mg/l are most suitable for drinking [4]. Higher dissolved solids may leads to impairment in physiological processes in the human body and also are undesirable in industrial water as they form scales, causes foaming in boilers, accelerate corrosion, and interfere with the colour and tastes of many finished products.

5) COD: Chemical Oxygen Demand is an index of organic content of water because the most common substance oxidized by dissolve oxygen in water is organic matter having biological origin i.e. dead plant and animal wastes [6]. It is a valuable parameter of water quality assessment which measures oxygen demand of biodegradable pollutants as well as non-biodegradable pollutants [11]. The mean range of COD for drinking water is 1.2mg/l - 2.6mg/l, however recommended COD level is <2mg/l in drinking water and fish production [9]. Alam [1] showed that mortality due to liver cancer for men and women was positively correlated with the COD in drinking water. The higher the COD concentration of waste water, the more oxygen the discharges demand from water bodies to which it finally joins [3]. The high COD level linked with pollution could have occurred due to high rate of organic decomposition resulting from human activities on the watershed which produce sewage and agricultural run-offs into reservoir and this have negative impact on the water quality [9].

6) BOD: Alam [1] has limited the amount of BOD of 2 mg/l or less (5 days 20 ^{0}C) for drinking water source without conventional treatment but after disinfection. Gupta [6], the untreated discharge of municipal and domestic waste in water bodies increases the amount of organic content. Therefore the microbes present in water require more amount of oxygen for its degradation thus the BOD of water gets increased. BOD is the measure of the extent of pollutant in the water body. Verma and Singh [3] the BOD levels from decomposition are higher than the local DO content in the water, there is not enough oxygen left for other organisms causing them to die.

7) Dissolved Oxygen: Dissolved oxygen is an important indicator of water quality, ecological status, productivity and health of a water bodies. Mustapha [9] reported that dissolved oxygen concentration of 3mg/l to 12 mg/l will promote the growth and survival of fish in reservoir. The range of dissolved oxygen recorded 4.8 mg/l – 8.2 mg/l shows the water to be of good quality and will support fish production [1]. If there is not enough oxygen in the water, the following may happen on aquatic life: Death of adults and juveniles, Reduction in growth, Failure of eggs/larvae to survive, Change of species present in given water body. Higher dissolved oxygen recorded in the rains could be as a result of low temperature and increased mixing of water [9]. Temperature directly affects the amount of oxygen in water, the colder the water, the more oxygen it can hold [3]. Significantly lower dissolved

oxygen might be due to higher turbidity and increased suspended materials which affected dissolution of oxygen. The impact of low DO concentration or of anaerobic conditions is reflected in an unbalanced ecosystem, fish mortality, odors and other aesthetic nuisances [1; 12].

8) Chloride: High chloride content in water sample may be due to the pollution from rich effluent of sewage and municipal waste however chloride in excess imparts salty taste to water and people who are not accustomed to high chloride are subjected to laxative effect [6].

9) Alkalinity: The total alkalinity of the reservoir is a reflection of its carbonates hydroxides and bicarbonate profiles with the likelihood of silicates and phosphates contributing to it [8]. This is so; because phenolphthalein alkalinity was absent in the reservoir [9]. Higher concentration of total alkalinity in the dry season could be due to higher carbon dioxide concentration and release of bicarbonates ions by sediments. The weathering of rocks is the potential source of alkalinity. Singh [14] reported that total alkalinity above 40 mg/l is indicative of high productivity in the reservoir which will support good fish production. Alkalinity is also a buffer for pH changes that helps stabilizing the pH of the reservoir.

10) Total Hardness: The hardness of water is not pollution parameter but indicates low salinity due to the presence of calcium and magnesium ions expressed as $CaCo_3$ (temporary hardness), largely combined with bicarbonate and carbonate and with sulfates, chlorides, and other anions of mineral acids (permanent hardness)[9]. The water containing excess hardness is not desirable for potable water as it forms scales on water heater and utensils when used for cooking and consume more soap during washing of clothes [6; 11]. Higher total hardness levels in the rains could be due to higher concentration of calcium and magnesium ions.

11) Calcium and Magnesium: The main sources of calcium in natural water are various types of rocks, industrial waste and sewage. According to Mustapha [9], waters with calcium levels of <10 mg/l are usually oligotrophic, while those above 25 mg/l are eutrophic. There is evidence that hard water plays a role in heart diseases. Higher concentration of magnesium makes the water unpalatable and act as laxative to human beings [11].

12)Sulphate: Sulphate occurs in natural water in concentration ranging from a few to several thousand milligrams per liter. Mine drainage wastes may contribute high sulphate by virtue of pyrite oxidation. Excess sodium sulphate should not be present in drinking water as they cause cathartic action in human beings. It is also associated with respiratory illness [6; 11].

13) Nitrogen : Nitrogen occurs in natural waters in various forms, including nitrate (NO_3), nitrite (NO_2) and ammonia (NH_3). These three compounds are interrelated through the process of nitrification, the biological oxidation of ammonia to nitrate. In this process nitrite is produced as an intermediate product. Order of decreasing oxidation state:

Nitrate → Nitrite → Ammonia → Organic Nitrogen

(Stable) →→→ →→ → →→ → (Unstable)

In relatively stable, oxygenated natural water systems the oxidation of nitrite to nitrate is rapid, but the conversion of NH_3 to NO_2^- is the rate limiting step in the total process [9].

*a) Nitrogen As Ammonia***:** Ammonia (NH_3) it is one of the most important pollutants in the aquatic environment because of its relatively highly toxic nature and its ubiquity in surface water systems. It is discharged in large quantities in industrial, municipal and agricultural waste waters. In aqueous solutions, ammonia assumes two chemical forms: NH_4^+ - ionized (less/nontoxic) and NH_3 - unionized (toxic). The relative concentration of ionized and unionized ammonia in a given ammonia solution are principally a function of pH, temperature and ionic strength of the aqueous solution

b) Nitrogen As Nitrate: Nitrate (NO_3^-), it is the essential nutrient for many photosynthetic autotrophs and generally occurs in trace quantities in surface water. Nitrate is a less serious environmental problem; however when nitrate concentrations become excessive and other essential nutrient factors are present, eutrophication and associated algal blooms can be become a problem. The main sources of nitrate in water are human and animal waste, industrial effluent, use of fertilizers and chemicals, silage through drainage system [6]. When nitrate concentration is above 40 mg/l, it may leads to a disease called “Methamoglobinemia” or “blue baby” in

children.

c) Nitrogen as Nitrite: Nitrite (NO_2^-:) is extremely toxic to aquatic life, however, is usually present only in trace amounts in most natural freshwater systems because it is rapidly oxidized to nitrate. The conversion process is affected by several factors, including pH, temperature and DO, number of nitrifying bacteria and presence of inhibiting compounds. If pH of the solution increases either naturally or by addition of a base, the concentration of unionized NH_3 increases. As the pH increases the toxicity in terms of NO_2 as N decreases while the toxicity in terms of HNO_2 as N increases.

Sr. No.	Parameters	ID	Units	BIS (10500-2012)		WHO (2004)
				Acceptable Limits	Permissible Limits	
1	Temperature	Temp.	^OC	--	--	15-35
2	Potential of Hydrogen	pH	--	6.5-8.5	No relaxation	6.5-8.5
3	Electrical Conductivity	EC	mic.mho/ cm	----	---	300
4	Total Dissolved Solids	TDS	mg/l	500	2000	1000
5	Alkalinity	Alk.	mg/l	200	600	---
6	Total Hardness	TH	mg/l	200	600	---
7	Calcium	Ca	mg/l	75	200	---
8	Magnesium	Mg	mg/l	30	100	---
9	Chloride	Cl	mg/l	250	1000	250
10	Sulphate	SO_4	mg/l	200	400	400
11	Dissolved Oxygen	DO	mg/l	4	6	
12	Biochemical Oxygen Demand	BOD	mg/l	---	---	5
13	Chemical Oxygen Demand	COD	mg/l	---	---	10
14	Nitrogen	NO_3	mg/l	45	---	---
15	Nitrogen as Ammonia	NH_3– N	mg/l	0.5	No relaxation	1.5
16	Nitrogen as Nitrite	NO_2-N	mg/l	---	---	---
17	Nitrogen as Nitrate	NO_3-N	mg/l	45	No relaxation	10

(NOTE: Dissolved oxygen permissible limit is 85% of average saturation concentration at 15^0c and at 25^0c i.e.7.72 mg/l.)

B. Significance Of Water Quality Parameters

1) Temperature: It affects both chemical and biological reactions in the water. High temperature reduces solubility of gases and amplifies taste and odour. At high temperature, metabolic activity of organisms increases requiring more oxygen but at the same time the solubility of oxygen decreases, thus increasing the stress. Change in temperature occurs due to sunlight intensity, climate, industrial and domestic wastes.

2) pH: pH of water gets drastically changed due to disposal of waste, exposure to air, biological activity and temperature changes. A lower value below 4 produces sour taste and higher value above 8.5 an alkaline taste. Extreme pH can result in rapid fish kills and alteration in flora and fauna.

3) Electrical Conductivity: It is a rapid measure of the total dissolved solids. It is an important parameter for determining suitability of water and waste water for irrigation.

4) Total Dissolved Solids: They denote various kinds of minerals present in the water and also organic substances in case of polluted waters. Dissolved solids in higher concentration reduce its palatability.

5) Dissolved Oxygen: It is the most important parameter in water quality assessment. It is essential to maintain presence of higher

Volume 3 Issue VIII, August 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

forms of biological life in the water. Low oxygen in water can kill fish. Fish require oxygen concentration of 2 to 5 mg/l depending on species. In waters heavily contaminated with organic matter, dissolved oxygen disappears. Oxygen saturated waters have a pleasant taste.

6) Chlorides: They occur naturally in waters. Discharge of sewage contributes to chloride. Therefore chlorides serve as an indicator of pollution by sewage.

7) Alkalinity: It is caused due to carbonates and bicarbonates. In polluted waters, silicates, phosphates, borates, hamates also contribute to Alkalinity of water. Alkalinity value is important for calculating alum dosage.

8) Sulphate: Discharge of domestic and industrial waste increases its concentration. It also occurs naturally in water. Rainwater has high conc. of Sulphate in areas of high air pollution. Sulphate produces objectionable taste above 300 mg/l.

9) Calcium: It has no hazardous effects on human health. High concentration is not desirable for washing and bathing due to suppression of lather formation.

10) Magnesium- High concentration renders water unpalatable and increases hardness of water.
*11) Nitrogen as Nitrate:*It is the highest oxidized form of nitrogen. Domestic sewage and industrial waste contribute to nitrates. Run-off from agricultural fields also contribute nitrate. Ground waters can get contaminated by sewage rich in nitrates. Nitrates can cause blue baby disease if above 40 mg/l .High concentration is useful in agriculture but their entry into the water increases algal growth and eutrophication.

12) Nitrogen as Ammonia: Occurrence of ammonia in the waters can be accepted as the chemical evidence of organic pollution. High concentration of ammonia is toxic to man. Toxicity of ammonia increases with high pH.

III. RESULT AND DISCUSSION

Selection of Important Water quality parameters for surface water bodies (Reservoir)

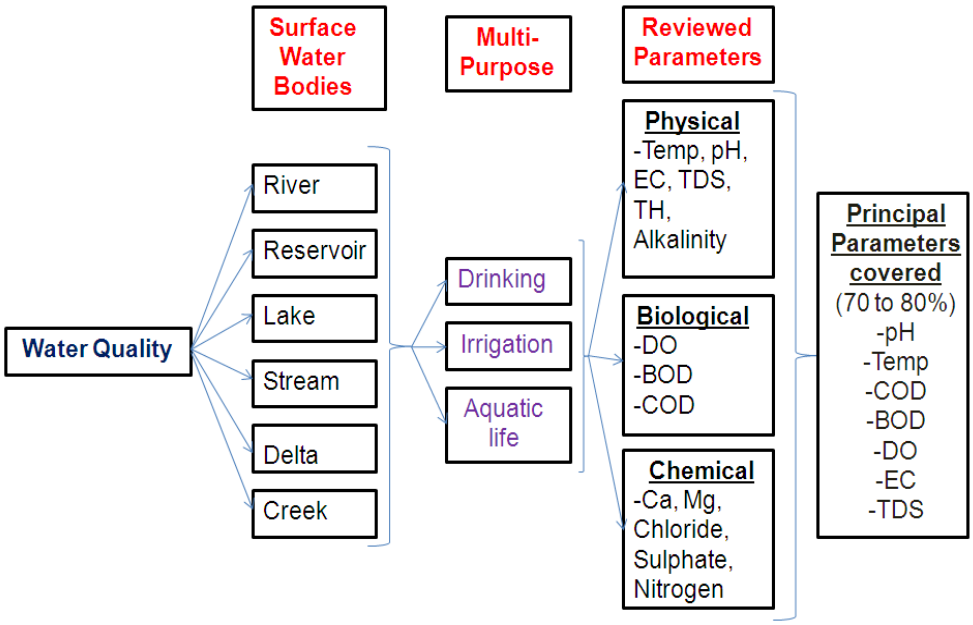


Figure 1 Water Quality parameters for surface water

Verma and Singh [3] showed that DO, BOD and COD are the essential parameters in reservoir water quality. Electrical conductivity is considered as one of important parameter in reservoir for calculating water quality for drinking and irrigation purpose [2; 6; 8; 9;

11]. The WQ of reservoir is normally assessed by measuring a broad range of parameters i.e. temperature; pH; electric conductivity; total dissolved solids; and the concentrations of the heavy metals [14]. Time series of water quality parameters such as temperature, pH, water transparency, EC, DO, and nutrients (N, P) can provide valuable information on the quality of the water, the likely sources of the variation, and their impacts on the functioning of the reservoir [7]. Thus, from maximum researchers and figure 1showed that the essential parameters are Temperature, pH, TDS, DO, BOD, COD, EC, etc are used for water quality testing, analysis, indexing and modeling purpose and considered individually for analysis of reservoir, river, stream water quality.

IV. CONCLUSION

The water qualities of all surface water bodies that may be river, reservoir, lake, stream, delta, and creek are very important. Various researchers explained their views about water quality parameters that are explained above. The physical chemical and Biological factors are investigated in this study to assess the water quality and it is clear that all parameters are equally important and broad range of parameters is to be studied with more details for water quality modeling. Also, those parameters were selected due to their simple, fast and continuous measurement at water quality monitoring stations.

So it can be conclude that Temperature, pH, TDS, EC, DO, BOD, COD are the broad range of water quality parameters for drinking, irrigation, aquatic life for surface water.

A. Future Scope and Recommendations

From above study it is helpful in future to work on water quality of surface bodies as reservoir with different analysis and tools for prediction, forecasting of above water quality parameters.

REFERENCES

[1] Alam M.J.B., Islam M.R., Muyen Z., Mamun M. and S. Islam S., "Water quality parameters along rivers" International Journal Environmental Science Technology, Vol.4 (1), 2007, pp.159-167, ISSN: 1735-1472.

[2] Najah A., El-Shafie A. and Karim O.A., "Application of artificial neural networks for water quality Prediction" Neural Computational and Application, Vol.22, 2013, pp.180-201, ISSN-187–S201, DOI-10.10 07/s00521-012-0940-3.

[3] Verma A.K. and Singh T.N., "Prediction of water quality from simple field parameters", Springer Environmental Earth Science , Vol. 69, 2013, pp.821–829 DOI-10.1007/s12665-012-1967-6

[4] Bureau of Indian Standards (BIS), "IS: 10500:2012", Drinking Water – Specification (Second Revision), Drinking Water Sectional Committee, FAD25, May 2012, India, pp.1-11.

[5] Emamgholizadeh S., Kashi, H.I. and Zalaghi M.E., "Prediction of water quality parameters of Karoon River (Iran) by artificial intelligence-based models", Springer International Journal Environmental Science Technology, Vol.11, 2014, pp.645-656, DOI-10.1007/s13762-013-0378-x

[6] Gupta P., Vishwakarma M. and Rawtani P.M. "Assesment of water quality parameters of Kerwa Dam for drinking Suitability" International Journal of Theoretical and Applied Sciences, Vol.1 (2), 2009, pp.53-55, ISSN : 0975-1718

[7] Gurpal S.T., Lu Han and Craig D.S., "Temporal variability in water quality parameters—a case study of drinking water reservoir in Florida, USA" Springer Environmental Monitoring Assessment , Vol.185, 2013, pp.4305–4320, DOI-10.1007/s10661-012-2870-z

[8] Heydari M., Hamid E.O. and Kisi M.O., "Development of a Neural Network Technique for Prediction of Water Quality Parameters in the Delaware River, Pennsylvania", Middle-East Journal of Scientific Research, Vol.13 (10), 2013, pp.1367-1376, DOI-10.5829/ idosi.mejsr.2013.13.10.1238.

[9] Mustapha M.K., "Assessment of the Water Quality of Oyun Reservoir, Offa, Nigeria, Using Selected Physico-Chemical Parameters", Turkish Journal of Fisheries and Aquatic Sciences, Vol. 8, 2008, pp.309-319.

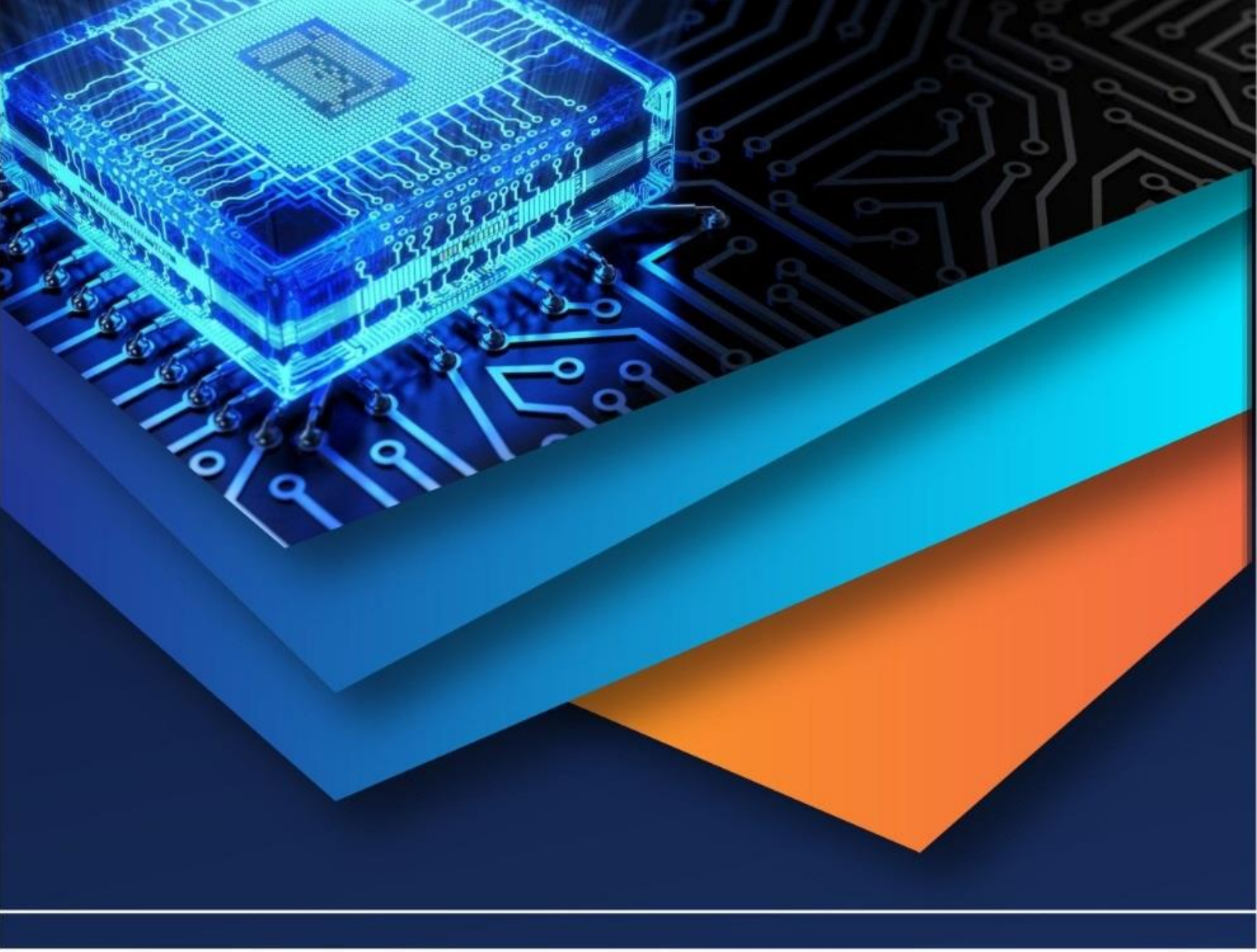
[10] Palani S., Liong S.Y. and Tkalich P., "An ANN application for water quality forecasting", Elsevier Marine Pollution Bulletin, Vol.56, 2008, pp.1586–1597, DOI-10.1016/ j.marpolbul.2008.05.021

[11] Ranjeeta C., Ratwani P. and Vishwakarma M., "Comparative study of Drinking Water Quality Parameters of three Manmade Reservoirs i.e. Kolar, Kaliasote and Kerwa Dam," Current World Environment, Vol. 6(1), 2011, pp.145-149.

[12] Rankovic V., Jasna Radulovi J., Radojevi I., Ostoji A., and Ljiljana C., "Neural network modeling of dissolved oxygen in the Gruˇza reservoir, Serbia," ELSEVIER Ecological Modeling, Vol. 221, 2010, pp.1239–1244

[13] WHO "International Standards for Drinking Water." 3rd Edition Vol.1 Recommendations, World Health Organization, 2008, Geneva, Switzerland.

[14] Singh K., Hundal H.S. and Khurana M.P.S., "An appraisal of groundwater quality for drinking and irrigation purposes in southern part of Bathinda district of Punjab Northwest India", Springer Environmental Earth Science, Vol.70, 2013, pp.1841–1851, DOI-10.1007/s12665-013-2272-8.



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