

Study of Physico-Chemical Parameters and Narmada River Water Quality Assessment by Water Quality Index (WQI) Determination at Hoshangabad City, (M.P.)

Dr. D. S. Saluja

Professor, Dept. of Chemistry, Govt. M. V. M. College, Bhopal, India

ABSTRACT: Water quality analysis is one of the most important aspect in surface water studies. The present study was aimed to assess the quality of Narmada River in Hoshangabad city (M.P.) with respect to the physico-chemical parameters including Temperature, pH, Electrical Conductivity (EC), Total Hardness (TH), Total Alkalinity (TA), Total Dissolved Solids (TDS), Chloride, Nitrate and Dissolved Oxygen (DO). The results were evaluated and compared with WHO and BIS water quality standards. From the data obtained, the water quality index (WQI) was calculated to assess the overall river water quality status. On the basis of present study and WQI values it is revealed that, the Narmada River water samples fall under the category “Good” and hence, suitable for domestic and irrigation purposes.

KEY WORDS: Physico-Chemical Parameters, Water Quality Index(WQI), Narmada River, Hoshangabad City.

I. INTRODUCTION

Water is a precious natural resource and important component for human survival. It is an elixir of life and found in abundant amount on the earth. Out of the total water reserves of the world, about 97% is salty water and only 3% is fresh water. Even this small fraction of fresh water is not available to us as most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of ground water and surface water. Water is absolutely essential for life. Water is used for drinking, washing, irrigation, construction, industries and as a coolant for thermal power plants. Most of the life processes take place in water contained in the body. Human beings depend on water for almost every development activity. With Increasing human population and rapid development, the world water withdrawal demands have increased many folds and a large proportion of the water is polluted due to atmospheric activities. Rivers are the most important water resources. It has long been used for discharging the wastes. Unfortunately, the rivers are being polluted by indiscriminate disposal of sewage, industrial wastes and by human activities. The aim of the present study is to assess the water quality of river Narmada.

STUDY AREA - The Narmada is a river in central India and the fifth largest river in the Indian subcontinent. It forms the traditional boundary between North India and South India and flows westwards over a length of 1312 km before draining through the gulf of Cambay (khambat) into the Arabian sea, 30 km west of Bharuch city of Gujarat. It flows through the states of Madhya Pradesh (1077 Km), Maharashtra (35 km border between Madhya Pradesh and Maharashtra and 39 km border between Madhya Pradesh and Gujrat, total 74km) and 161 km in Gujrat. There are 41 tributaries, out of which 22 are from the satpura range and the rest on the right bank are from the Vindhya Range. In order to determine the water quality, total 04 water sampling stations were selected for samples collection in the study area along the stretch of the river Narmada, at Hoshangabad District (M.P.). The sampling stations were station-1 (At Kothibazar), station-2 (near Sethani Ghat), station-3(near Hoshangabad Railway Bridge) and station-4 (near Budhni Ghat).

II. MATERIAL AND METHODS

Water samples were collected in fresh one litre plastic bottles, previously cleaned with 1:3 HNO₃ from 04 pre-selected sampling stations during the period of three months from Jun 2020 to Aug. 2020 on monthly basis. Samples were collected during the first week of every month in the early hours of the day in between 6.00 am to 11.00 am. Physico-chemical parameters like water temperature, pH and DO were measured in the field and other parameters were mostly tested within 24 Hrs of collection. Water quality parameters were analysed by standard methods given by APHA (1992) and Trivedi and Goel (1987).

The experimental results were compared with the permissible limit of drinking and irrigation water quality standard WHO and BIS (IS: 10500). In this study, for the calculation of water quality index (WQI), total 09 important water quality parameters such as Temperature, pH, Electrical Conductivity, Total Hardness, Total Alkalinity, Total Dissolved Solids, Chloride, Nitrate and Dissolved Oxygen were considered.

Determination of water quality index (WQI)

For WQI calculation, above mentioned nine physico- chemical quality parameters have been selected. The weighed arithmetic WQI method was used for the calculation of water quality index of the Narmada river water. Let there be n water quality parameters and Quality rating was calculated as follows:

$Q_n = 100 * (V_n - V_{10}) / (S_n - V_{10})$, Where, Q_n = Quality Rating for the nth water quality parameter,

V_n = Estimated value of nth water quality parameters of collected samples,

S_n = Standard permissible value of nth water quality parameter,

V_{10} = Ideal value of nth water quality parameter in pure water (V_{10} value is 0 for all other parameters except pH and dissolved oxygen which are 7 and 14 respectively).

Unit weight (W_n) for nth water quality parameter is a value inversely proportional to the recommended standard value S_n of the corresponding parameter.

$W_n = K/S_n$, Where, W_n = Unit weight for nth water quality parameter

S_n = Standard permissible value of nth water quality parameter, K = Constant of Proportionality

The standards recommended suggested by Indian Standards Institution (ISI) are considered for quality rating (Q_n) and Unit Weight (W_n). The overall WQI was calculated by aggregating the quality rating with the unit weight linearly and can be given by the following expression.

$WQI = \sum Q_n \cdot W_n / \sum W_n$, Where, Q_n = Quality Rating for the nth water quality parameter

W_n = Unit weight for nth water quality parameter

The ranges of WQI, the corresponding status of water quality and their possible use are summarized in Table 1.

III. RESULTS AND DISCUSSION

The summary of observations of physico-chemical parameters and WQI values of all the water samples from four water sampling stations are presented in table 1, 2 and 3.

pH : pH is a scale of intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. In the present study, the average value of pH was found as 7.2. The pH value of 6.5 to 8.5 is recommended for drinking purpose by WHO.

Turbidity – Turbidity is the cloudiness of water caused by a variety of particles and is another key parameter in the analysis of quality of drinking water. It is also related to the content of diseases causing organisms in water, which may come from soil runoff. Turbidity indicates the muddiness of water therefore measure the extent to which light absorbed or scattered by fine suspended and colloidal solids and is a measure of resistance of water to the passage of light through it. In present study, the turbidity of the water of Narmada river was recorded the average value of 4.8 NTU.

Electrical conductivity (EC) - Water capability to transmit electric current is known as electrical conductivity and serves as tool to assess the purity of water. This ability depends on the presence of ions, their total concentration, mobility, valence, relative concentrations and temperature of measurement. The average value of electrical conductivity was found 214.4 μ mhos/cm.

Total Hardness : Total hardness of water is the sum of concentration of alkaline earth metal cations present in it. during the investigation, the average value of total hardness was found as 112.2 mg/l.

Total Alkalinity : Alkalinity of water is its capacity to neutralize a strong acid and is characterized by the presence of hydroxyl ions capable of combining with hydrogen ions. In natural water most of alkalinity is caused due to the presence of free carbon dioxide. The average value of total alkalinity was found as 118.8 mg/l.

Total Dissolve Solids (TDS) : Total dissolve solids are an important factor for drinking water and water to be used for other purposes. Beyond the prescribed limit it imparts a peculiar taste to water and reduce its palatability. In cases where water softening is needed, the type of softening procedure used may be dictated by TDS content. The average value of total dissolved solids was found 148.1 mg/l.



Chloride : chlorides in reasonable concentration are not harmful to humans. At concentrations above 250 mg/l give a salty taste to water, which is objectionable to many people. Before proceeding for bacteriological testes, chloride test served as the basis of detecting contamination of ground waters by wastewaters. Evaporation tends to increase the chloride and salinity at the root zone of irrigated plants, making it difficult for crops to take up water due to osmotic pressure difference between the water outside the plants and within the plant cells. In the present study, the average value of chlorides was found The average value of chloride was found as 28.4 mg/l.

Nitrate (NO₃) - Nitrates are contributes to freshwater through discharge of sewage and industrial wastes and run off from agricultural fields. The highest amount of nitrate concentration was known to support the formation of blooms. During the present study, the average amount of nitrate recorded in the water of Narmada River was as 0.78 mg/l.

Dissolve Oxygen (DO) : Dissolve oxygen (DO) is one of the most important parameters in water quality assessment and reflects the physical and biological process prevailing in the water. Oxygen can be rapidly removed from the water by discharge of oxygen demanding wastes. In present study, the average value of DO was found as 7.5 mg/l.

Table 1-Summary of Water Quality Index (WQI) and Corresponding Water Quality Status (WQS)

S.No.	WQI	WQS	Possible Uses
1	0 - 25	Excellent	Drinking, Irrigation and Industrial
2	26 - 50	Good	Domestic, Irrigation and Industrial
3	51 - 75	Fair	Irrigation and Industrial
4	76 - 100	Poor	Irrigation
5	101 - 150	Very Poor	Restricted use for Irrigation
6	>150	Unfit for Consumption	Proper Treatment Essential before use

Table2- standard permissible limit of various physico-chemical parameters suggested by WHO and IS 10500 : 2012

S. No.	Parameters	unit	Permissible Limit		Average Values of Studied Parameters Obtained
			WHO	BIS 10500 : 2012	
1	pH		7.5 – 8.5	6.5 – 8.5	7.2
2	Transparency	cm	5.0	5 - 10	4.8
3	Electrical Conductivity (EC)	µmhos/cm	1400	-	214.4
4	Total Hardness (TDS)	mg/l	1000	200 - 600	112.2
5	Total Alkalinity (TA)	mg/l	120	200 - 600	118.8
6	Total Dissolved Solids (TDS)	mg/l	1000	500 - 2000	148.1
7	Chlorides (Cl ⁻)	mg/l	250	250 -1000	28.4
8	Nitrates(NO ₃ ⁻)	mg/l	5.0	45	0.78
9	Dissolved Oxygen (DO)	mg/l	-	>5	7.5

Table3 – Calculation of WQI value of water samples of Narmada River during Jun 2020 to Aug. 2020

S.No.	Parameters	Average Test values	Standard permissible limit	Relative Weight (Wn)	Quality Rating (Qn)	Quality Weight (Wn*Qn)
1	pH	7.2	8.5	0.1176	13.3333	1.5686
2	Turbidity	4.8	10	0.1	0.1	4.8
3	Electrical Cond.	214.4	300	0.0033	71.4666	0.2382
4	Total Hardness	112.2	300	0.0033	37.4	0.1246



5	Total Alkalinity	118.8	200	0.005	59.4	0.297
6	TDS	148.1	500	0.002	29.62	0.0592
7	Chloride	28.4	250	0.004	11.36	0.0454
8	Nitrate	0.78	45	0.0222	1.7333	0.0385
9	Dissolved Oxygen	7.5	6.0	0.1666	81.25	13.541

$$\Sigma W_n = 0.42420, \quad \Sigma W_n * Q_n = 20.7133, \quad WQI = 48.8289$$

IV. CONCLUSION

The present study was undertaken to define the quality of water samples with special reference to physico-chemical properties. The water quality data of the analysed samples were compared with the prescribed drinking water standards of WHO and BIS (IS: 10500) and have been considered for the calculation of WQI. The water quality indices (WQI) were found in the range 48.82 indicating the “Good” water quality in the study area. On the basis of results obtained, it is concluded that during the study period the water quality of Narmada River water is good and may be used for domestic and irrigation purposes after some proper treatment.

REFERENCES

- 1.APHA, Standard methods for examination of water and waste water, (20th ed.), American Public Health Association, New York; (1995).
- 2.BIS, Standards for drinking water, IS – 10500;(1983).
- 3.Guideline for drinking water, World Health Organization, (2th ed.); (1996)
- 4.NEERI, Manual on water and waste water analysis, National Environmental Engg. Research Inst; Nagpur, (1988).
- 5.S.Mishra, Singh,A.L. and D.Tiwari; Studies of Physico-chemical status of the Ponds at Varanasi holy city under Anthropogenic Influences; Int. J. Environ. Res; 4; 261-268 (2014).
- 6.S.Shrivastava,V.K.Kanungo;physico-chemical analysis of Pond water of Surguja District, Chhattisgarh, India; International Journal of herbal medicine,1(4);35-43; (2013).
- 7.Trivedi, R.K; Goel, P.K; Chemical and Biological Methods for water pollution studies, Environ. Pub; Karad, India, (1986).
- 8.WHO, International Std. for Drinking Water, Ist Ed; World Health Org; Geneva (1963).