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Statistical Evaluation and Water Quality Assessment of Machna River at District-Betul (M.P.)

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Abstract: ***The Present work deals with the study of various water quality parameters of Machna River at District- Betul (M.P.). Monthly variation of important physico-chemical parameters was studied during the period from Jun 2022 to Sep.2022. The samples from five (05) different pollution prone locations were taken and analyzed for Temperature, pH, Turbidity, Total Alkalinity (TA), Total Hardness (TH), Total Dissolve Solids (TDS), Dissolve Oxygen (DO), Chlorides and Nitrates parameters. The Comparative study of these studied parameters was done and shown graphically also. The results of analyzed parameters depicted that almost parameter values are within the permissible limit as prescribed by WHO and BIS (10500), while a few parameters are deviate from limit due to various reasons and some proper treatment and more efficient management are also required to conserve the river water quality.***

Keywords: Physico-Chemical Parameters, Water Quality Parameters, Permissible Limit, Machna River, Betul

1. Introduction

Water is life. No life can exist without water. Water is absolutely essential not only for survival of human being, but also for animals, plants and all other living beings. Water is one of the most valuable natural resources. It is the basic element of social and economic infrastructure and is essential for healthy society and sustainable development. Water, the matrix of life is exposed to pollution, unhealthy environment resulting in human affliction and diseases transmission due to rapid industrialization and population. Man made activities are changing the morphology of the area of the river regimes and causing problem of pollution of water. Most of the cities and towns have developed along the banks of rivers because of the multipurpose use of river water but unfortunately are being polluted by indiscriminate disposal of sewage and industrial wastes. The present study is an attempt to make an assessment of the change in the physico-chemical properties of Machna River at District Betul (M.P.).

2. Study Area

The District Betul is located in the south of Madhya Pradesh and in between 21^0 22' to 22^0 24' North Latitude and 77^0 10' to 78^0 33' East Longitude. Narmadapuram (Hoshangabad) District in its North, Amravati District of Maharashtra State in the South, Chindwara District in the East and Khandwa District (East Nimad) is in the West. Betul District is situated on the height of 365 meters above sea level in Satpura Mountain ranges. According to the 2011 census, Betul District has a population of 15,75,362 and population density is of 157 inhabitants per square kilometer. Betul has a sex ratio of 970 females for every 1000 males and a literacy rate of 72.1%. Machna River is an important tributary of the Tawa River with a catchment area of 82 sq. km in the city Betul. The Machna River originates from Sasawad village near Amla Tehsil, District Betul. The river is lifeline of the people of Betul city and it is an important source of water supply. The river has special cultural and religious significance among the people. Due to increasing population in the region and poor management of urbanization and industrial growth, the water quality of River Machna has significantly deteriorated. The present study was aimed to assess the quality of Machna River water for its domestic and irrigation purpose.

3. Material and Methods

The Machna river samples were collected from five (05) main sampling stations named S_1 (Near Annicut Dam), S_2 (Near Railway Bridge), S_3 (Near Badora), S_4 (Near Karbala) and S_5 (Near Hanuman Temple) in between the Months of Jun 2022 to Sep. 2022 on monthly basis. The sampling stations were chosen considering the location of nearby huts, bathing zone area, domestic and agricultural and industrial wastes which joins the river water and are responsible for pollution load in the river water. Samples were collected in acid clean one liter polyethylene bottles in the morning hours in between 6.00 AM to 8.00 AM. Some of the studied parameters were recorded at the sampling stations whereas the analysis of other physico-chemical parameters followed by the method prescribed by APHA (1995).

4. Result and Discussion

The Physico-Chemical Parameters such as Temperature, pH, Turbidity, Total Hardness, Total Dissolve Solids, Total Alkalinity, Dissolve Oxygen, Chlorides and Nitrates were analyzed for the water samples collected from the Machna River. The results are shown by statistical evaluation as Minimum Value (Min), Maximum Value (Max), Average Value (AV), Standard Deviation (SD), Standard Error (SE), Coefficient of Variance (CL) and Confidence Level (CL,95%). The results are tabulated in table 1 and 2.

Temperature: Chemical and Biochemical reactions are greatly affected by temperature. Increase in temperature of

water source increases the rate of chemical reactions in water on one hand and decreases the solubility of gases on the other hand. Hence, measurable variation in temperature of the water affects the aquatic life. In the present study, the water temperature was found minimum as 19.4 ^{O}C at sampling station no. S_4 in the month of Sep. 22 and maximum as 23.8 ^{O}C at S_4 in Jun 22. It showed negative correlation with all studied parameters except nitrates.

pH: pH is defined as the negative logarithm of hydrogen ions concentration. Variation in pH values is mainly due to the hydrolysis of salts of strong bases and week acids or vice versa and also due to the dissolved gases such as carbon dioxide, hydrogen sulphide, ammonia etc. The pH was recorded minimum as 7.5 mg/l at S_3 in the month of Jun 22 and maximum as 8.5 mg/l at S_2 in Sep. 22. It showed positive correlation with all studied parameters except nitrates.

Turbidity: In most water Turbidity is due to colloidal and extremely fine dispersion and indicates the extent of pollution in water sources. It was found minimum as 5.5 NTU at S_2 in the month of Jun 22 and maximum as 6.8 NTU at S_3 in Sep. 22 . It showed positive correlation with all studied parameters except nitrates**.**

Total Hardness: Hardness in water is an important parameter as it is affects the day to day human life and also the industries to a great extent. The presence of calcium and magnesium ions in the form of carbonates, chlorides and sulphates produce hardness in water. It was recorded minimum as 128.4 mg/l at sampling station no. S_1 in the month of Jun 22 and maximum as 138.1 mg/l at sampling station no. S_3 in Sep. 22. It showed positive correlation with all studied parameters except nitrates**.**

Total Alkalinity: Alkalinity of water is described as its quantitative capacity to neutralize acids. Compounds like bicarbonates, carbonates and hydroxides in water decreases the H+ ions and increases the pH of water. In this study, the alkalinity was found minimum as 138.1 mg/l at sampling station no. S_1 in Jun and maximum as 146.9 mg/l at sampling station no. S_3 in the month of Sep. 22. It showed positive correlation with all studied parameters except nitrates**.**

Total Dissolved Solids: Total dissolved solids are the sum of all the chemical ions that are dissolved in the water. It is due to the dissolution of minerals, rocks, soil etc. in water. Total dissolved solids were found minimum as 163.8 mg/l at sampling station S_1 in Jun 22 and maximum as 184.4 mg/l at S_1 in the month of Sep. 22. It showed positive correlation with all studied parameters except nitrates**.**

Dissolved Oxygen: Dissolved oxygen is important parameter in water quality assessment and reflects the physical biological process prevailing in the water. The DO values indicate the degree of pollution in water bodies. In the present study, it was found minimum as 8.5 mg/l at S_4 in the month of Jun 22 and maximum as 9.6 mg/l at S_4 in Aug. 22. It showed positive correlation with all studied parameters except nitrates**.**

Chlorides: The Chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects. In the present study, chloride concentration was found minimum as 81.2 mg/l at sampling station no. S_1 in the month of Jun and maximum as 85.6 mg/l at sampling station no.S_3 in Aug. 22. It showed positive correlation with all studied parameters except nitrates**.**

Nitrates: Surface water contains nitrate due to leaching of nitrate with percolating water. Surface water can also be contaminated by sewage and other wastes rich in nitrates. In the present study, the nitrate content was recorded minimum as 7.2 mg/l at sampling station no. S_3 in the month of Sep. 22 and 7.8 mg/l at sampling station no. S_2 in the month of Jul. 22. It showed positive correlation with all studied parameters except nitrates**.**

Table 1: Standard Permissible Limit of various Physico-Chemical Parameters Suggested by WHO and BIS: 10500

S. No.	Parameters	unit	Permissible Limit	
			WHO	BIS :10500
1	Temperature	^{O}C	-	-
2	pH	-	7.5-8.5	6.5-8.5
3	Turbidity	NTU	5.0	5-10
4	Total Hardness (TH)	mg/l	1000	200-600
5	Total Alkalinity (TA)	mg/l	120	200-600
6	Total Dissolved Solids (TDS)	mg/l	1000	500-2000
7	Dissolved Oxygen (DO)	mg/l	-	>5
8	Chloride (Cl^-)	mg/l	250	250 -1000
9	Nitrate (NO_3^-)	mg/l	5.0	45

Table 1: Monthly Statistical Variation in Studied Physico-Chemical Parameters of Machna River in Jun22 to Sep.22

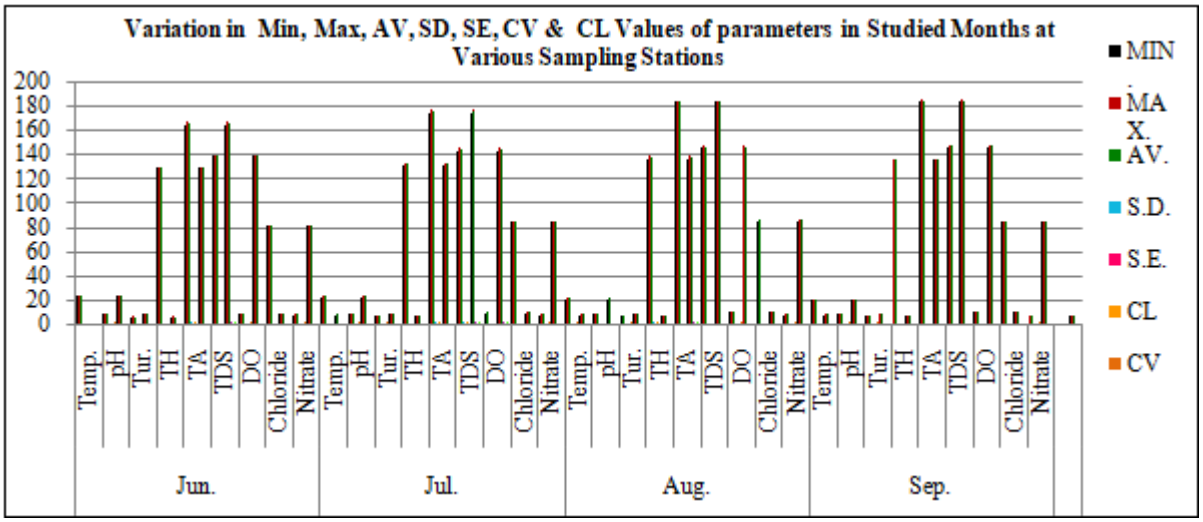
S. No.	Month	Parameter	Sampling Stations					MIN.	MAX.	AV	SD	SE	CV	AV±CL
			S1	S2	S3	S4	S5							
1.	JUN	Temp.	23.6	23.5	23.5	23.8	23.7	23.5	23.8	23.62	0.13	0.06	0.11	23.62±0.11
		Tur.	7.7	7.6	7.5	7.7	7.6	7.5	7.7	7.62	0.08	0.04	0.07	7.62±0.07
		pH	5.7	5.5	5.6	5.8	5.7	5.5	5.8	5.66	0.11	0.05	0.10	5.66±0.10
		TH	128.4	129.1	129.2	129.1	129.2	128.4	129.2	129.00	0.34	0.15	0.30	129.00±0.30
		TA	163.8	165.4	166.8	166.3	165.8	163.8	166.8	165.62	1.15	0.51	1.00	165.62±1.00
		TDS	138.1	139.2	139.1	139.5	139.2	138.1	139.5	139.02	0.54	0.24	0.47	139.02±0.47
		DO	8.7	8.8	8.7	8.5	8.6	8.5	8.8	8.66	0.11	0.05	0.10	8.66±0.10
		Chloride	81.2	81.4	81.5	81.6	81.5	81.2	81.6	81.44	0.15	0.07	0.13	81.44±0.13
		Nitrate	7.3	7.5	7.6	7.4	7.5	7.3	7.6	7.46	0.11	0.05	0.10	7.46±0.10
2.	JULY	Temp.	22.5	22.3	22.4	22.5	22.4	22.3	22.5	22.42	0.08	0.04	0.07	22,42±0.07
		Tur.	7.9	8	8.2	8.1	8.2	7.9	8.2	8.08	0.13	0.06	0.11	8.08±0.11
		pH	6.2	6.4	6.5	6.6	6.3	6.2	6.6	6.40	0.16	0.07	0.14	6.40±0.14

		TH	131.3	132.5	132.8	132.4	132.7	131.3	132.8	132.34	0.60	0.27	0.53	132.34±0.53
		TA	172.8	175.3	174.2	176.1	175.8	172.8	176.1	174.84	1.35	0.60	1.18	174.84±1.18
		TDS	142.4	144.6	145.1	143.8	144.1	142.4	145.1	144.00	1.02	0.46	0.90	144.00±0.90
		DO	9	9.1	9.2	9.1	9.2	9	9.2	9.12	0.08	0.04	0.07	9.12±0.07
		Chloride	84.2	84.3	84.5	84.4	84.3	84.2	84.5	84.34	0.11	0.05	0.10	84.34±0.10
		Nitrate	7.6	7.8	7.5	7.4	7.6	7.4	7.8	7.58	0.15	0.07	0.13	7.58±0.13
3.	AUG.	Temp.	21.1	20.8	20.5	20.6	20.7	20.5	21.1	20.74	0.23	0.10	0.20	20.74±0.20
		Tur.	8.3	8.4	8.3	8.3	8.2	8.2	8.4	8.30	0.07	0.03	0.06	8.30±0.06
		pH	6.6	6.7	6.5	6.6	6.7	6.5	6.7	6.62	0.08	0.04	0.07	6.62±0.07
		TH	135.7	136.1	135.8	138	138.1	135.7	138.1	136.74	1.21	0.54	1.06	136.74±1.06
		TA	183.4	184.2	183.8	183.5	183.6	183.4	184.2	183.70	0.32	0.14	0.28	183.70±0.27
		TDS	145.3	146.8	145.5	145.4	145.7	145.3	146.8	145.74	0.61	0.27	0.54	145.74±0.54
		DO	9.3	9.5	9.4	9.6	9.5	9.3	9.6	9.46	0.11	0.05	0.10	9.46±0.10
		Chloride	85.1	85.5	85.6	85.4	85.5	85.1	85.6	85.42	0.19	0.09	0.17	85.42±0.17
		Nitrate	7.7	7.6	7.4	7.3	7.5	7.3	7.7	7.50	0.16	0.07	0.14	7,50±0.14
4.	SEP.	Temp.	19.5	19.6	19.7	19.4	19.5	19.4	19.7	19.54	0.11	0.05	0.10	19.54±0.10
		Tur.	8.4	8.5	8.4	8.3	8.2	8.2	8.5	8.36	0.11	0.05	0.10	8.36±0.10
		pH	6.7	6.7	6.8	6.7	6.6	6.6	6.8	6.70	0.07	0.03	0.06	6.70±0.06
		TH	135.9	136.2	136.3	136.1	136.2	135.9	136.3	136.14	0.15	0.07	0.13	136.14±0.13
		TA	184.4	183.9	184	184.1	184.2	183.9	184.4	184.12	0.19	0.09	0.17	184.12±0.17
		TDS	146.2	146.4	146.9	146.7	146.8	146.2	146.9	146.60	0.29	0.13	0.26	146.60±0.26
		DO	9.4	9.4	9.5	9.4	9.3	9.3	9.5	9.40	0.07	0.03	0.06	9.40±0.06
		Chloride	84.7	84.5	84.7	84.6	84.7	84.5	84.7	84.64	0.09	0.04	0.08	84.64±0.08
		Nitrate	7.4	7.3	7.2	7.3	7.4	7.2	7.4	7.32	0.08	0.04	0.07	7.32±0.07

(MIN: Minimum, Max: Maximum, AV: Average Value, SD: Standard Deviation, SE: standard Deviation, CV: Co-efficient of Variance, CL: Confidence Limit)

Table 3: Correlation-Coefficient between Various Physico-Chemical Parameters of Machna River in Jun22 to Sep.22

Parameter	Temp.	pH	Tur.	TH	TDS	TA	DO	Cl^-	NO^{3-}
Temp.	1.00								
pH	-0.88	1.00							
Tur.	-0.86	0.95	1.00						
TH	-0.92	0.91	0.91	1.00					
TDS	-0.95	0.94	0.94	0.98	1.00				
TA	-0.90	0.95	0.97	0.93	0.96	1.00			
DO	-0.89	0.93	0.92	0.96	0.95	0.94	1.00		
Cl^-	-0.79	0.91	0.94	0.91	0.93	0.94	0.93	1.00	
NO^{3-}	0.39	-0.25	-0.19	-0.24	-0.20	-0.13	-0.20	0.00	1.00



5. Conclusion

In the present study, various studied physico-chemical parameters and their characteristic behavior of Machna River water samples collected at different sampling stations in different months were analyzed to assess the water quality of river for drinking, domestic, irrigation and other activities. The obtained results revealed that, the river water quality is being deteriorated due to direct discharge of untreated industrial effluents and domestic wastes into river water besides various human development activities along the banks of the river. On the basis of above study, it is found that except little variation all the studied physico-chemical parameters were in permissible limit at the study site of Machna River and it is suggested that proper measures are necessary to avoid contaminations and

concluded that, at present the river water is suitable and safe for domestic and irrigation purposes and may be used after proper treatment to avoid contaminations.

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