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Assessing the water Quality Index of Narmada River at Bharuch

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Abstract — *The present work is aimed at assessing the water quality index for the Narmada river of Bharuch city.The water quality index of Narmada River water was carried out for monsoon season 2016. At Bharuch 81 km stretch were studied by locating six sampling stations at downstream of Bharuch city. The water samples collected were analyzed for parameters such as pH, DO, Turbidity, BOD,COD,TDS and Temperature were measured as per standard methods.WQI has been calculated using Delphi technique for waitage of parameter and also by measuring quality of parameters. The results reveals that the Narmada river water quality index is 67.05 means the river quality is good river water needs some degree of treatment before consumption as source of drinking water.*

Keywords- Water quality Index, Narmada river, river water quality, Bharuch city, Shri K J Polytechnic

I. INTRODUCTION

The Narmada, also called Rewa is a river in central India and it is the fifth longest river in Indian subcontinent. It is also known as the lifeline of Gujarat. Bharuch is the small city located at Narmada river bank. Narmada enters in Bharuch and cover approx 161 km and finally meets Arabian sea. For study , 81 km stretch of Narmada river has been taken by locating six monitoring station at different interval throughout the stretch. Grab sampling method has been adopted for sampling.Water quality Index is generally used to measure environmental quality. It is a number that combines multiple water quality factors into a single number to represent the quality of water which is easy to understand for local people.

II. METHODOLOGY

The water sample from Narmada river were collected from 81 km long stretch passes from Bharuch city for monsoonseason for the year 2016 and analyzed for 7 physico-chemical parameters by using standard method .The parameters such as pH ,Turbidity,TDS, DO,BOD,COD and Temperature were analyzed in laboratory using APHA .For calculations IS 10500-drinking water standard compared with measured value and following equation were used to calculate WQI

$$WQI=\sum W_i*Q_i,$$

Where W_i = Weightage of parameter, "i", Q_i =Value of index of parameter "i", i = parameters (i.e. pH,DO,BOD etc)

Water samples collected from 6 sampling stations as shown in Table :1

Table 1- Location of Sampling Station

Sr No	Location	Distance
1	Neelkantheshwar Mahadev Temple	4.8
2	Gayatri Mandir	7.8
3	Siddhivinayak temple	27
4	Gurudwara Chadar Sahib	11
5	Golden Bridge	15
6	Borbattha	16

The weighting of parameters aims to assign relative importance to each variable and explain interrelations between the different parameters. In present study Delphi technique was used to calculate the weightage of parameters. Total 8 experts from environment engineering field have been consulted for ranking various water quality parameters. The rating was done on a scale of 7 (highest relative significance) to 1 (lowest relative significance).Experts have been ranked various water quality parameters as shown in Table:2

Table 2- Weightage of Parameters given by Experts

Expert	Designation	pH	DO	BOD	COD	TDS	Turbidity	Temperature
Mr .M. C. Sanandiya	Lecturer	7	6	5	1	4	2	3
Ms Jini Sunil	Lecturer	5	4	1	2	6	3	7
Ms Rachna Goswami	Lecturer	7	3	3	5	6	5	3
Ms Monali Patel	Lecturer	7	4	3	2	1	5	6
Ms Nilam vasava	Lecturer	4	7	3	1	2	6	5
Ms Dipal Parsania	Lecturer	4	3	2	1	6	5	7
Ms Nidhi Pandya	Lecturer	6	6	2	1	6	5	5
Ms Dhriti Ravat	Lecturer	3	4	5	6	1	2	7

Total		43	37	24	19	32	33	43

From above rank given by above experts the parameters with greater importance were identified as pH, Temperature and Turbidity. The weightage of parameters calculated is shown in Table:3

Table 3- Water quality parameter and its weightage

Parameter	Average Weight	Relative Weight
pH	5.38	0.17
DO	4.62	0.17
Turbidity	3	0.107
BOD	2.37	0.080
COD	4	0.142
TDS	4.12	0.147
Temperature	5.37	0.191
Total	28.88	1.007

For calculating Qi , different value function graphs or function curves developed by NSF have been used for different parameters.

pH: Graph-1 indicate that the peak value is at pH 7.5 and the quality index is 90. If pH is less than 2.0 or greater than 12, the quality index is equal to 0.[3]

DO: The Gujarat Pollution Control Board (GPCB), India has suggested DO value for Class B is 5 mg/L or more. For development of WQI curve of dissolved oxygen, the saturation temperature is considered as 250C. If dissolved oxygen is 8.3 then the quality index equals to 100. For values higher or lower than this the quality index decreases. This is clearly indicated in Graph 2.[3]

BOD: If the BOD value in the river water varies from 1 to 5 mg/L then the water quality index ranges from 95 to 56. Thus it indicates that the water quality deteriorates. If Biochemical Oxygen Demand is greater than 30 mg/L, then the quality index equals 2.As shown in Graph -3.[3]

TDS: The desirable range of total solids in the river water ranges from 100 to 200 and the quality index ranges from 85 to 73. As values of total solids in the river water increases the water quality index decreases. If total solids are 600 mg/L, the quality index equals 20.refer graph -4.[3]

Turbidity: If the turbidity in river water is less than 5 NTU then the quality index is around 100. As the turbidity increases, the quality index decreases. If turbidity is greater than 90 NTU, the quality index equals 20, which is clearly highlighted in graph 5.[3]

Figure 1 pH Graph

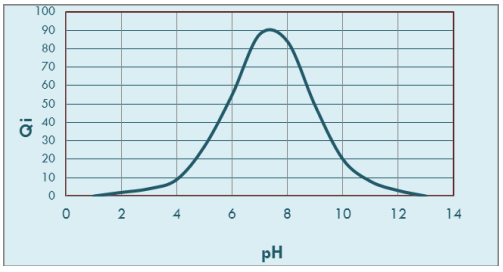

Figure 2 DO Graph

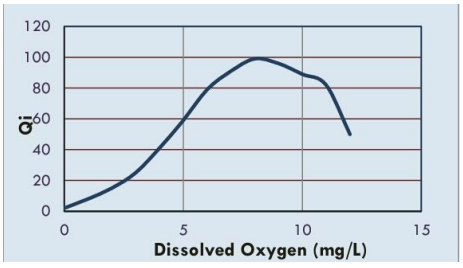

Figure 3 BOD Graph

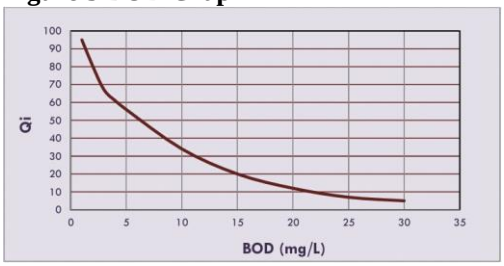

Figure 4 TDS Graph

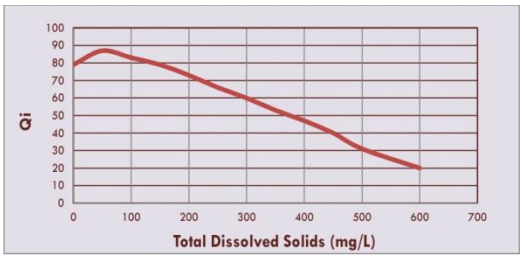

Figure 5 Turbidity Graph

III. RESULT AND DISCUSSION

The measured value of sample analysis are shown in Table -4

Table 4-Analysis Result Day- 1, Sept 2016

St. No.	Location of station	Temp ◦C	pH meter	DO mg/lit	Turbidity in NTU	BOD mg/lit	COD mg/lit	TDS in ppm
1	Neelkanteshwar Mahadev Temple	32	7	5.8	141	1.7	68.66	144
2	Gayatri Mandir	30	7	5.8	129	2.5	192.66	139
3	Siddhi Vinayak Temple	32	7	6.1	790	1.8	60.66	138
4	Gurudwara Chadar Sahib	30	7	5.9	142	2.3	47.3	157
5	Golden Bridge	31	7	5.7	60	2.3	89.3	139
6	Borbattha	30	7	6.3	108	2.3	109.33	140

Table 5 Analysis Result, Day 2, Sept-2016

St. No.	Location of station	Temp ◦C	pH meter	DO mg/lit	Turbidity in NTU	BOD mg/lit	COD mg/lit	TDS in ppm
1	Neelkanteshwar Mahadev Temple	31	7	6.1	149	2.8	33.33	145
2	Gayatri Mandir	31	7	5.6	132	2.5	6.66	172
3	Siddhi Vinayak Temple	28	7	5.6	810	1.7	13.33	160
4	Gurudwara Chadar Sahib	30	7	5.8	149	2.3	20	211
5	Golden Bridge	26	7	5.2	62	2.6	66.66	147
6	Borbattha	25	7	5.7	110	2.1	26.66	159

Table 6 Analysis Result, Day 3, Sept-2016

St. No.	Location of station	Temp ◦C	pH meter	DO mg/lit	Turbidity in NTU	BOD mg/lit	COD mg/lit	TDS in ppm
1	Neelkanteshwar Mahadev Temple	29	7	6.8	147	1.6	40	162
2	Gayatri Mandir	26	7	6	110	1.9	33.33	147
3	Siddhi Vinayak Temple	30	7	6.8	800	3.3	66.66	161
4	Gurudwara Chadar Sahib	32	7	5.9	200	1.7	40	144
5	Golden Bridge	30	7	6.1	62	2.9	60	163
6	Borbattha	31	7	7.1	160	1.4	46.66	157

Table 7 Analysis Result, Day 4,Sept-2016

St. No.	Location of station	Temp ◦C	pH meter	DO mg/lit	Turbidity in NTU	BOD mg/lit	COD mg/lit	TDS in ppm
1	Neelkanteshwar Mahadev Temple	31	7	8.2	140	3.7	60	154
2	Gayatri Mandir	28	7	7.9	105	1.4	26.66	151
3	Siddhi Vinayak Temple	30	7	7.1	790	1.4	73.33	162
4	Gurudwara Chadar Sahib	28	7	6.5	198	3	33.33	167
5	Golden Bridge	25	7	6.2	60	07	73.33	163
6	Borbattha	30	7	6.7	170	1.5	53.33	169

Table 8 Analysis Report, Day 5,Sept 2016

St. No.	Location of station	Temp ◦C	pH meter	DO mg/lit	Turbidity in NTU	BOD mg/lit	COD mg/lit	TDS in ppm
1	Neelkanteshwar Mahadev Temple	32	7	6.8	131	1.9	46.66	114
2	Gayatri Mandir	28	7	6.2	130	1.1	100	115
3	Siddhi Vinayak Temple	30	7	7.4	800	1.7	99.3	124
4	Gurudwara Chadar Sahib	31	7	5.7	210	1.6	66.66	121
5	Golden Bridge	28	7	7.2	65	1.6	93.33	127
6	Borbattha	29	7	6.8	109	1.5	66.66	126

Table 9-Analysis Report, Day-6,Sept-2016

St. No.	Location of station	Temp ◦C	pH meter	DO mg/lit	Turbidity in NTU	BOD mg/lit	COD mg/lit	TDS in ppm
1	Neelkanteshwar Mahadev Temple	31	7	6.8	149	1.6	40	116
2	Gayatri Mandir	28	7	5.7	132	2	80	130
3	Siddhi Vinayak Temple	33	7	7.8	805	2.1	73.33	124
4	Gurudwara Chadar Sahib	32	7	7.4	205	2.2	66.66	127
5	Golden Bridge	31	7	6.2	60	2	13.33	844
6	Borbattha	29	7	6.8	109	1.7	73.33	124

The average value of all parameters collected from different days are shown in below Table

St. No.	Location of station	Temp ◦C	pH meter	DO mg/lit	Turbidity in NTU	BOD mg/lit	COD mg/lit	TDS in ppm
1	Neelkanteshwar Mahadev Temple	29	6.65	6.5	23.8	1.75	48.6	146.5
2	Gayatri Mandir	28.5	6.52	6.1	20	2.01	65.98	265.83
3	Siddhi Vinayak Temple	30.5	6.20	6.2	44	2.1	45.65	150.16
4	Gurudwara Chadar Sahib	30.5	6.1	6.8	0.3	2	47.65	153.16
5	Golden Bridge	28.5	4.43	6.2	2.6	1.9	73.21	138.66
6	Borbattha	31	6.30	6.75	0.9	2.16	48.01	136.6

The water quality index has been determined by using the water quality index equation .To find the water quality index of individual parameter, the mathematical average of the concentration of all the location have been taken. Using water quality index, some prediction would be made for the uses of the water at different purpose.

WQI=0.18*Qi(pH)+0.16*Qi(DO)+0.10*Qi(BOD)5+0.07*Qi(COD)+0.13*Qi(TDS)
+0.14*Qi(Turbidity)+0.19*Qi(Temp)

Table 10-Water Quality Index Calculation

Sr no.	Parameter	S1	S2	S3	S4	S5	S6	Wi	Ave Qi	WQI
1	pH	6.56	6.52	6.2	6.1	4.43	6.3	0.17	55	9.35
2	DO	6.56	6.1	6.2	6.8	6.2	6.75	0.17	90	15.3
3	BOD	1.75	2.01	2.1	2	1.9	2.16	0.1	75	7.5
4	COD	48.65	65.98	45.65	47.65	73.21	48.1	0.08	59.43	4.75
5	TDS	146.5	265.83	150.16	153.16	138.66	136.6	0.142	80	11.36
6	TURBIDITY	23.8	20	44	0.3	2.6	0.9	0.147	75.57	11.11
7	TEMP	29	28.5	30.5	30.5	28.5	31	0.191	40.2	7.68
									WQI	67.05

The water quality index relates the water quality parameter to a scale ranging from 0(very bad) to 100 (excellent) .Based on water quality index the classification of water is shown in Table: 6

Table 11 Description for reporting WQI

WQI	91-100	71-90	51-70	26-50	0-25
Water Quality	Excellent	Good	Medium	Bad	Very Bad

From above table it is very clear that the WQI of Narmada water is 67.05, means the water quality of the river is good. As per the CPCB report, the river falls under class-C which is used for drinking purpose after providing conventional treatment.

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