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Water Quality Index of ChitraPuzha River, Ernamkulam, Kerala, India

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Abstract: *The present investigation was carried out for determining the various physico-chemical parameters and biological characteristic of ChitraPuzha River for summer 2014 in Ernamkulam district. The following parameters are analyzed DO, FC, pH, BOD, Phosphate, Nitrates, Turbidity and TDS. All the measured parameters are found to be very high compared to limit prescribed by WHO, and thereby unfit for both drinking and irrigation. The ChitraPuzha Rive has been falling severe anthropogenic activities mostly due to industrial wastes.*

Keywords: *physico-chemical parameters, WHO standard, Chitrapuzha River, Industrial wastes*

1. INTRODUCTION

Pollution of water is largely a problem due to rapid urbanization and industrialization. The large scale urban growth due to increase in population or migration of people from rural areas to urban areas has increased domestic effluents while industrial development manifested either due to setting up of new industries or expansion of the existing industrial establishments resulting in generation copious volume of industrial effluents. Though the point sources like domestic waste and sewage are the first order contamination sources in Chitrapuzha river. Human activity and cattle grazing also add to the river pollution. Once the contaminants enter the water source it is a difficult and expensive to remove them. Unplanned and injudicious disposal of municipal waste causing pollution of water bodies. The industries are also falling in the same line by not following regulation of establishing the effluent treatment plants. Our study revealed that water quality of the Chitrapuzha river is graded as severely polluted category which not fit for human consumption.

Chitrapuha river, one of the tributaries of Periyar river, flows through Amabalamedu, Kochi area, on the southern coast of Indian subcontinent. The river receives a variety of effluents from fertilizer, refinery and other industries. Apart from Fertilizers And Chemicals Travancore(FACT) other major industries around Ambalamedu Kochi area are Hindustan Organics Chemicals Limited (HOCL) and Kochi Refinery Limited (KRL). The effluents contain ammonia, ammonium sulphate, phosphate, calcium sulphate, nitrate and heavy metals Effluents from these industrial units along with agricultural and other anthropogenic effluents find their way into Chitrapuzha River ultimately into Cochin backwaters. There are long standing local complaints about water pollution causing fish mortality and serious damage to agricultural crops resulting in extensive unemployment in the area. The lower reaches of this river became part of National Waterways in 1993 and is now mainly used for transporting chemicals from Cochin Port to the industrial units located on the banks of the river. The total effluent discharge into Chitrapuzha river is about 33,600 m3 per day. This study helps us to assess the impacts of industrial effluents and domestic sewage on surface water quality of Chitrapuzha river.

Figure1. *Image of Chithrapuzha River*

2. MATERIALS AND METHODS

Based on specific geographical features, water flow regimes and anthropogenic activities, 9 sampling locations were selected**.** The samples were collected in acid-washed 5 liter plastic bottles at 10 a.m. every three days, continuously for one month period during summer season. For chemical, biological and microbiological examination, different methods of collection and handling were adopted. The instruments were used of precise accuracy and chemicals used were of AR grade.

pH was measured using Digital pH meter. DO and BOD was measured using Winkler's titrimetric method. The multiple-tube fermentation method was used to determine the bacteria present. The confirmed and complete test was carried out for the samples by using the nutrient froth. The turbidity was measured by using Digital Turbidity meter, 863D 'Bio-Chem make. The evaporation method is used for determining the total solids by using standard procedures. Nitrate ion was determined using Brucine method. To determine the total phosphorus stannous chloride method is used by following the established procedure.

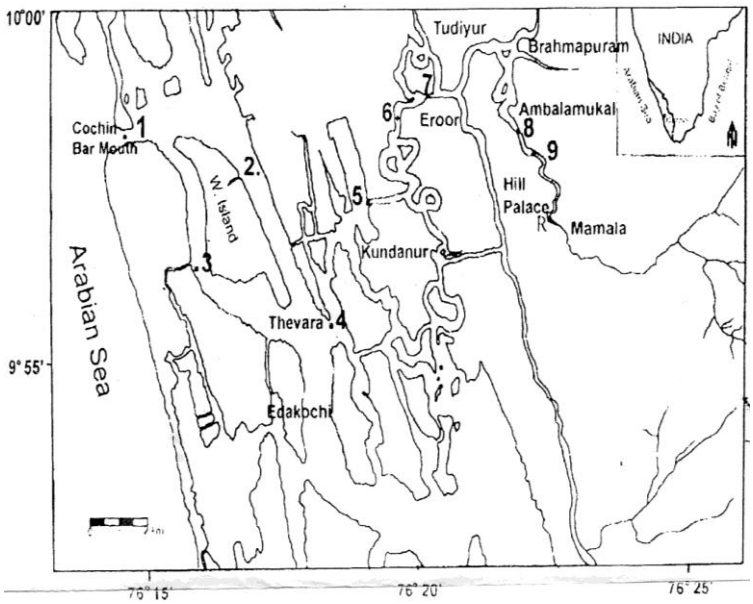

Figure 2. *Sampling Stations in Chithrapuzha River*

3. RESULT AND DISCUSSION

The physico-chemicaland biological characteristics of the samples are given in table 1to9 for summer season along with the respective WQI value. The water quality index was calculated using the eight parameters (Magudeswaran 2004).

The eight resulting values were then added to an overall WQI (Magudeswaren, 2004).

WQI = 0.19 DO + 0.18 FC + 0.12 pH + 0.12 BOD + 0.11 Total phosphate + 0.11 Nitrates + 0.09 Turbidity + 0.08 Total solids.

Dissolved oxygen (DO) plays an important role in water quality determination. The study was that, the DO of river water was maximum at station 1 and less at station 9. The DO % saturation of the river water at station 1 and 9 are 97.6 and 91 (Table 1&9) for summer season.

In summer the DO% saturation was low at station 9 compared to station 1. This due to addition of domestic sewage, industrial sewage and MSW containing oxidisable organic matter and consequent biodegradation and decay of vegetation, which leads to consumption of oxygen present in water (Jammel 1998). Low % of saturation of DO has direct effect to fish community, especially during spawning period because the respiratory system requires DO to breath.

pH is a measurement of the acidity or basic quality of water. The pH of natural water is usually between 6.7 and 8.2. It was found that the pH of water varies from 6.9 to 9.3in summer (table 1&9) showing that the alkalinity of water has increased. The Total solids are important parameters for drinking water and to be used for other purposes. According to WHO the permissible limits of total solids for drinking water is 1500mg/l but the value of Chithrapuzha River water in station 9 exceeds this value due to mixing of sewage and industrial wastes.

Biochemical Oxygen Demand (BOD) was low at station 1 and higher at station 9 during summer seasons. Desirable limit for BOD is 4.0 mg/l and permissible limit is 6.0 mg/l according to Indian standards. BOD below 3 mg/l or less is required for the best use. Fokmare and Musaddiq (2002) recorded high value of biochemical oxygen demand as 20.00 mg/l in river puma and aid that this river is highly polluted due to organic enrichment, decay of plants and animal matter in the river. Thus the high value of BOD encountered in station 9 (table 9) during summer above the permissible limit of WHO (< 2 mg /l) indicates the pollution by biochemical degradable organic waste from various sources.

Faecal coliform bacteria are living organisms, unlike the other conventional water quality parameters. Fecal coliforms are around 16.9 MPN/ 100 ml at station 1, starts to rise and reaches the value 28.2 MPN/100ml in summer season at station 6 (table 6). The rising of Faecal coliform is the direct evidence for mixing of untreated sewage, poorly maintained septic systems, and scooped pet waste into the river water.

Turbidity and water colour can be regarded as aesthetic pollutants. The observed results are presented in tables 1 to 9. The high turbidity value of 12.6NTU was observed in station 9 during summer season (Table 9). The high content of turbidity station 9 may be due to increase in Total Dissolved Solid (TDS) value or it may be due to organic compounds being introduced in to it either through domestic or location area effluents (Agarwal, 2005).

The concentration of phosphate in Chitrapuzha River was found to be ranged from 0.09mg/l to 1.88mg/l in summer . Among the nine sampling stations, the station 9 during summer season showed high phosphate content when compared to station 1. Phosphate is the indication of pollution by detergents and it leads to formation of algal bloom. The high concentration of phosphate in station 9 (Table 9) may be due to human and animal waste are flushed in to water ways, either from poorly treated sewage, surface runoff and some Industrial waste also carry phosphorous in to the river. The unfiltered water of the catchment area of phosphate rocks, uncontrolled disposal of sewage and biodegradable synthetic detergents also add huge quantities of phosphate (Agarwal, 2005).

The WQ index has decreased from station 1 to 9 by about 24.79 units (Tables 1&9) in summer season. According to WQI legend the water which has the quality characteristics value around 25 is very bad and cannot be used for any purpose.

4. CONCLUSION

The WQI value of the chithrapuzha river (station 8,9) is not suitable for domestic and agricultural purposes as per drinking water standards of Bureau of Indian Standards and WHO guidelines. Regular monitoring of river and taking suitable remedial measures like collection of domestic sewage and setting up the common treatment plant before discharge of sewage in to river system is required. This will control pollution and prevent the depletion of the quality of Chitra Puzha River water

Table1. *Calculation and Results of Water Quality Index (WQI)*

STATION 1- COCHIN BAR MOUTH SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	97.6	% SATURATION	99	0.19	18.81
2	FC	16.9	MPN/100 ML	65	0.18	11.7
3	PH	6.9	PH UNITS	86	0.12	10.32
4	BOD	0.99	MG/L	95	0.12	11.4
5	P	0.09	NTU	96	0.11	10.56
6	N	1.11	MG/L	96	0.11	10.56
7	TURBIDITY	2.42	NTU	92	0.09	8.28
8	TDS	153	MG/L	79	0.08	6.32
					0VER ALL WQI= 87.95	

Table 2. *Calculation and Results of Water Quality Index (WQI)*

STATION 2- OIL TANKER BERTH SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	97.2	% SATURATION	99	0.19	18.81
2	FC	17.8	MPN/100 ML	65	0.18	11.7
3	PH	6.7	PH UNITS	79	0.12	9.48
4	BOD	1.32	MG/L	92	0.12	11.04
5	P	1.06	NTU	39	0.11	4.29
6	N	1.23	MG/L	96	0.11	10.56
7	TURBIDITY	2.93	NTU	90	0.09	8.1
8	TDS	162	MG/L	77	0.08	6.16
					0VER ALL WQI= 80.14	

Table 3. *Calculation and Results of Water Quality Index (WQI)*

STATION 3- THOPPUMPADY FISHING HARBOUR SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	97	% SATURATION	99	0.19	18.81
2	FC	18.3	MPN/100 ML	64	0.18	11.52
3	PH	6.6	PH UNITS	75	0.12	9
4	BOD	1.50	MG/L	90	0.12	10.8
5	P	1.12	NTU	38	0.11	4.18
6	N	1.72	MG/L	95	0.11	10.45
7	TURBIDITY	3.5	NTU	89	0.09	8.01
8	TDS	160	MG/L	78	0.08	6.24
					0VER ALL WQI= 79.01	

Table 4. *Calculation and Results of Water Quality Index (WQI)*

STATION 4- THEVARA FERRY POINT SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	95.7	% SATURATION	98	0.19	18.62
2	FC	18.9	MPN/100 ML	64	0.18	11.52
3	PH	7.1	PH UNITS	90	0.12	10.8
4	BOD	1.72	MG/L	86	0.12	10.32
5	P	1.23	NTU	35	0.11	3.85
6	N	1.83	MG/L	95	0.11	10.45
7	TURBIDITY	3.9	NTU	88	0.09	7.92
8	TDS	162	MG/L	77	0.08	6.16
					0VER ALL WQI= 79.64	

Table 5. *Calculation and Results of Water Quality Index (WQI)*

STATION 5- THYKOODAM NH BRIDGE SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	95.2	% SATURATION	98	0.19	18.62
2	FC	21.2	MPN/100 ML	63	0.18	11.34
3	PH	7.4	PH UNITS	93	0.12	11.16
4	BOD	1.94	MG/L	81	0.12	9.72
5	P	1.34	NTU	33	0.11	3.63
6	N	1.86	MG/L	95	0.11	10.45
7	TURBIDITY	4.4	NTU	87	0.09	7.83
8	TDS	252	MG/L	66	0.08	5.28
					0VER ALL WQI=78.03	

Table 6. *Calculation and Results of Water Quality Index (WQI)*

STATION 6- KANIYAMPUZHA RLWY BRIDGE SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	94.3	% SATURATION	98	0.19	18.62
2	FC	28.2	MPN/100 ML	59	0.18	10.62
3	PH	8.3	PH UNITS	73	0.12	8.76
4	BOD	2.52	MG/L	70	0.12	8.4
5	P	1.42	NTU	32	0.11	3.52
6	N	1.91	MG/L	95	0.11	10.45
7	TURBIDITY	4.7	NTU	87	0.09	7.83
8	TDS	286	MG/L	61	0.08	4.88
					0VER ALL WQI=73.08	

Table 7. *Calculation and Results of Water Quality Index (WQI)*

STATION 7- EROOR BRIDGE SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	91.7	% SATURATION	96	0.19	18.24
2	FC	23.2	MPN/100 ML	61	0.18	10.98
3	PH	8.7	PH UNITS	59	0.12	7.08
4	BOD	2.73	MG/L	69	0.12	8.28
5	P	1.52	NTU	31	0.11	3.41
6	N	1.94	MG/L	95	0.11	10.45
7	TURBIDITY	8.3	NTU	79	0.09	7.11
8	TDS	336	MG/L	55	0.08	4.4
					0VER ALL WQI=69.95	

Table 8. *Calculation and Results of Water Quality Index (WQI)*

STATION 8- FACT COCHIN DISCHARGE OUT LET SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	91.2	% SATURATION	96	0.19	18.24
2	FC	21.4	MPN/100 ML	62	0.18	11.16
3	PH	8.9	PH UNITS	52	0.12	6.24
4	BOD	2.86	MG/L	68	0.12	8.16
5	P	1.81	NTU	28	0.11	3.08
6	N	1.96	MG/L	95	0.11	10.45
7	TURBIDITY	9.2	NTU	78	0.09	7.02
8	TDS	386	MG/L	48	0.08	3.84
					0VER ALL WQI=68.19	

Table 9. *Calculation and Results of Water Quality Index (WQI)*

STATION 9- FACT BARGE JETTY SUMMER 2014						
SL NO	PARAMETERS	RESULTS	UNITS	Q VALUE	WEIGHING FACTOR(W)	SUB TOTAL(QXW)
1	DO	91	% SATURATION	96	0.19	18.24
2	FC	22.4	MPN/100 ML	62	0.18	11.16
3	PH	9.3	PH UNITS	39	0.12	4.68
4	BOD	3.72	MG/L	63	0.12	7.56
5	P	1.88	NTU	28	0.11	3.08
6	N	1.99	MG/L	95	0.11	10.45
7	TURBIDITY	12.6	NTU	71	0.09	6.39
8	TDS	2422	MG/L	20	0.08	1.6
					0VER ALL WQI=63.16	

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