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EVALUATION OF WATER QUALITY INDEX FOR RIVER MUTHA BY WEIGHTED ARITHMETIC MEAN METHOD

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Abstract— Rivers play a very important role in social, cultural and economic development of any region. River Mutha in Pune is highly polluted due to discharge of municipal sewage (partially treated or untreated), industrial waste as well as solid waste. Despite of various standards and laws made by government, many industries are discharging their waste directly into the river and making its quality poor day by day. Detailed analysis is needed to evaluate different factors in polluting water. The aim of the work is to calculate water quality index for Mutha River considering the physical, chemical and biological parameters such as pH, Temperature, Turbidity, Dissolved Oxygen, Biological Oxygen Demand, Total Solids, Electrical Conductivity, Sulphates, Phosphates, Nitrates, Chlorides and MPN. The indices computed for winter and summer season for four locations such as: Khadakwasla downstream, near Vitthalwadi, near Omkareshwar Temple and near Sangam Bridge. The result showed that water quality varied from good to very poor range. In general the water quality degrades downstream. Khadakwasla Dam water quality is observed to be better than other three locations. This research has large scope to understand effect of rapid industrialization on deteriorating river water quality leading to environmental problems and health issues.

Keywords—— River Mutha; Water Quality Parameters; Water Quality Index

INTRODUCTION

Increase in globalization and industrialization has regulated the challenges for the country such as, providing clean and safe water to the public. As more number of rivers are getting polluted, the governing bodies such as municipalities are finding it difficult to treat river water to safe levels and supply it to people. In terms of its fast growth and development, Pune city becomes one of the growing and emerging cities of India. More and more people from other towns and cities are migrating into Pune city. The population increase in Pune city during the last 2-3 decades has been particularly rapid with a resultant effect on the increase of water pollution level. River Mutha is one of the major vulnerable Rivers of Pune City.

Water quality is a complex subject, which involves physical, chemical and biological characteristics of water and their complex and delicate relations. From the user's point of view, the term "water quality" is defined as "those physical, chemical or biological characteristics of water by which the user evaluates the acceptability of water". For example, for Drinking, water should be pure, wholesome, and potable. Similarly, for irrigation, dissolved solids and toxicants are important, for outdoor bathing pathogens are important and water quality is controlled accordingly. Textiles, paper, brewing, and dozens of other industries using water, have their specific water quality needs.

I. METHODOLOGY

A. Sampling Locations

Four sampling stations are selected for river Mutha, stretching from Khadakwasla Dam to Sangam Bridge as described in Table I and Figure I.

TABLE I. Sampling Locations

Sr. No.	Stations	Location	Distance in km from Khadakwasla Dam	Latitude	Longitude
1	A	Khadakwasla Dam	0 km	18.44^{0}	73.76^{0}
2	B	Vitthalwadi	9 km	18.48^{0}	73.82^{0}
3	C	Omkareshwar Bridge	15 km	19.23^{0}	72.86^{0}
4	D	Sangam Bridge	18 km	18.52^{0}	73.86^{0}

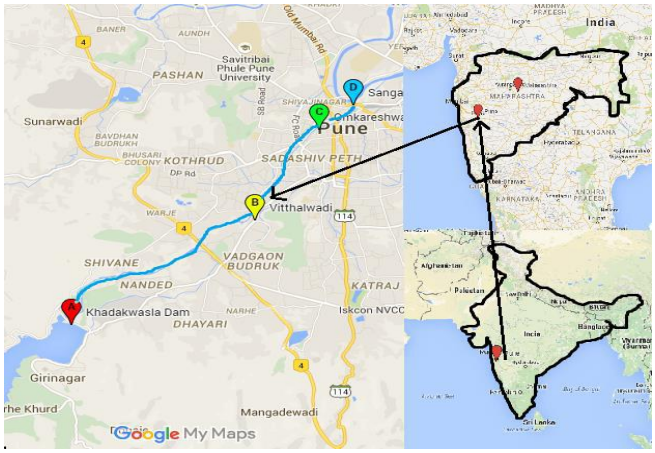

Fig.1. Four sampling locations (A, B, C and D)

B. **Sampling Period and Frequency**

The sampling period selected for this project work is of six months, from December 2015 to May 2016 covering two seasons i.e. winter and summer. The frequency of sample collection is weekly for December and January and remaining bi-weekly. The samples are collected during 7:30 am to 10:30 am for further analysis. Water samples were collected from the surface of the river in previously cleaned 5 litre plastic can and brought to the laboratory immediately.

All the sample cans were labelled previously indicating location name, date and time.

C. **Methodology of Testing**

In situ testing: Water temperature measurement and DO fixation were carried out in-situ.

Laboratory testing: WQ parameters like pH, Nitrate and Electrical Conductivity were measured using Water Quality Monitor (YSI). Other Water Quality parameters were analyzed using Standard Methods

II.RESULTS AND DISCUSSION

The quality rating scale (Qi) for each parameter is calculated by using this expression:

$$Qi = 100[(Vi-Vo/Si-Vo)]$$

Where,
Vi is estimated concentration of ith parameter in the analysed water
Vo is the ideal value of this parameter in pure water Vo = 0 (except pH =7.0 and DO = 14.6 mg/l)
Si is recommended standard value of ith parameter
The unit weight (Wi) for each water quality parameter is calculated by using the following formula:

$$Wi= K/Si$$

Where,
K = proportionality constant and can also be calculated by using the following equation:

$$K =1/ Ó(1/ Si)$$

TABLE II. Rating scale for Quality of water

WQI Value	Rating of Water Quality	Grading
0-25	Excellent water quality	A
26-50	Good water quality	B
51-75	Poor water quality	C
76-100	Very Poor water quality	D
Above 100	Unsuitable for drinking purpose	E

WQI by Weighted arithmetic mean method for station A is as follows:

TABLE III. WQI for Station A

Sr. No.	Parameters	Si	Vi	V0	Qi	1/Si	Wi=k/Si	WiQi
1	pH	7.5	6.96	7	0.00	0.13	0.05	0.00
2	DO	6	7.16	14.6	86.51	0.17	0.06	5.33
3	BOD	6	5.5	0	91.67	0.17	0.06	5.65
4	Chlorides	250	8.76	0	3.50	0.00	0.00	0.01
5	Phosphates	0.5	0.2	0	40.00	2.00	0.74	29.60
6	Sulphates	150	2.23	0	1.49	0.01	0.00	0.00
7	Nitrates	45	0.13	0	0.29	0.02	0.01	0.00
8	Tss	500	18.91	0	3.78	0.00	0.00	0.00
9	Tds	500	135.83	0	27.17	0.00	0.00	0.02
10	Ec	300	80.5	0	26.83	0.00	0.00	0.03
11	Turbidity	10	1.56	0	15.60	0.10	0.04	0.58
12	MPN	10	400	0	4000.00	0.10	0.04	148.00
					Total sum	2.71	1.00	189.23
WQI= WiQi/Wi = 189								

Similarly, for station B, C and D readings are:

TABLE IV. WQI for each Station

Location	WQI
Station A	**42.83**
Station B	**336.07**
Station C	**218.85**
Station D	**266.92**

III.CONCLUSION

During study period, analysis of River Mutha water revealed that the water from all stations is not suitable for drinking purpose without prior treatment. The parameters like BOD, Turbidity, Phosphates, Electrical Conductivity and MPN were observed to be exceeding permissible limits at all stations. The WQI values observed to be less in Station A indicating better quality of water when compared with other locations of the river where WQI ranging from 715 to 9964 indicating severe water pollution. The observed scenario through WQI values warrants immediate steps to be taken to control water pollution and to rejuvenate the Mutha River.

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