Quality Assessment of River Water with Special Reference to Pearson Correlation Study

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Abstract

The present study was conducted with an aim to find out the physico-chemical nature of water at different sites of Ulhas river system system flowing through the Thane district of Maharashtra state to access the physical properties and chemical nature of its water. The physico-chemical parameters studied were colour, temperature, pH, electrical conductivity, total hardness, total dissolved solids, alkalinity, dissolved oxygen, biological oxygen demand, chemical oxygen demand ,total suspended solids and trace metals -iron and copper. The observed values of various physio-chemical parameters of water samples were compared with standard values recommended by WHO. Statistical analysis was carried out by calculating Pearson's correlation coefficient (r) value between different pairs of parameters and it was observed that many of the parameters bear a good positive correlation and some bears a negative correlation.. the present study was taken into consideration in which an attempt was made to access the water quality of ulhas river system and it is believed that this study would be helpful in formulating control strategy in near future.

Keywords: Physico-chemical parameters, Ulhas river system, dissolved oxygen, biological oxygen demand, Pearson's correlation coefficient.

Introduction

Under the pressure of population growth, development aspirations and growing realisation of importance of ecosystem services, water demand is increasing and water availability is therefore becoming a key factor in socio-economic development[1]. But the quality of water is degrading day by day due to human activities like rapid unplanned urbanization, industrialization,agricultural pollutants, improper waste management etc[2]. Many Indian rivers which are used as drinking water contaminated by various sources[3,4,5]. The Ulhas river system drains an area of 4,637 sq km which lies completely in Maharashtra state of India, it rises from Sahyadri hill ranges and mainly flows through Thane district. Ulhas river is an important west flowing river, it flows for about 122 kilometres and finally drains into Arabian sea. The Kalu and Bhasta are the major right bank tributaries which together accounts for 55.7% of the total catchment area of Ulhas. The objectives of this study is to determine the quality of river water with respect to physico–chemical parameters and to study the statistical correlations among various parameters with significant values. The present study of different physico-chemical parameters is important from the point of view that the various parameters of river water like temperature, pH,,electrical conductivity,total hardness, total dissolved solids,alkalinity,dissolved oxygen, biological oxygen demand, chemical oxygen demand ,total suspended solids and trace metals may alter the characteristics of the sediment of the river which support the flora and fauna of the aquatic environment. The changes in sediment characteristics may affect the growth of these flora and fauna.

Material and Methods

Study area description: Thane district lies in the northern part of Maharashtra state between $18^0 42'$ and $20^0 20'$ North latitudes and between $72^0 37'$and $73^0 45'$ East longitudes. It is one of the most populous and industrialised district of Maharashtra state. Ulhas river enters the district through the its southern region, then it merges with combined flow of Kalu and Bhatsai at Kalyan and then the river bifurcates into two branches, one turns west to enter into the Thane creek and the other branch with the bulk flow turns to the north of district and falls into the Arabian sea. The study focuses on the southern part of the district as this region is densely populated, sampling stations were selected across the regions through which Ulhas river and its tributaries Kalu and Bhatsa flows. Table-1 below gives the detailed account of various sampling stations.

Sampling and analytical procedure: The water samples were made as grab samples from the Ulhas river system at eight different points in the pre monsoon season from March 2013 to May2013. The samples were collected in sterilised polyethylene cans of one-litre capacity and analyzed as per the standard method for various chemical constituents. All reagents were of analytical grade and solutions were made of distilled water.

Table-1
Description of Sampling Locations

Sampling Stations	River	Location	Activities
1	Ulhas	Badlapur	Washing, Laundering, Bathing, Cattle bathing
2	Ulhas	Rayate	Idol Immersion ghat and picnic spot nearby
3	Kalu	Titwala	Idol Immersion ghat
4	Bhatsa	Shahpur	Washing, Laundering, Bathing, Cattle bathing
5	Bhatsa	Khadauli	Washing, bathing and picnic spot nearby
6	Kalu	Ambivili	Industrial effects and city discharge
7	Ulhas	Kongaon	Idol Immersion ghat, Industrial effects and city discharge
8	Ulhas	Diwe-anjur	

Table-2
Methodology of physico chemical analysis

	Parameter	Method
1	Colour	Visual
2	Temperature	Thermometer
3	pH	pH meter
4	Electrical conductivity	Conductivity meter
5	Total Dissolved solids	Gravimetric method
6	Total hardness	Complexometric titration
7	Total Suspended solids	Gravimetric method
8	Alkalinity	Titrimetric method
9	Dissolved Oxygen	Wrinkler's method
10	Biological Oxygen Demand	"
11	Chemical Oxygen Demand	Using Open reflux method
12	Trace metals	ICPA-AAS

Various water quality parameters like colour, temperature pH, total Dissolved Solids, electrical conductivity, Total Alkalinity, Total suspended Solids, Total Hardness, Dissolved oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand and Trace metals were determined using standard analytical methods [6,7]. The instruments used were calibrated before use for observing readings. The repeated measurements were made to ensure precision and accuracy.

Results and Discussion

Twelve parameters are analysed for water samples from eight sampling stations, as per table-1.The results of the analysis were summarised in the table-3 and compared with WHO levels. The Pearson's correlation coefficients (r) between various pairs of the physico- chemical parameters of river water samples is furnished in the table 4. For the determination of r values among different physico- chemical parameters a readymade Computer Programming is used. The interferences drawn by observing the experimental data are as follows:

Temperature: It was found that the maximum temperature of water was at the sampling stations 6,7 and 8, minimum temperature was at sampling stations 3,4 and 5. The observed

values of temperature indicated that the water quality would be certainly affected by this temperature.

pH: pH of water varied from 7.4 to 8.6 showing alkaline nature of water. Joshi (2009) in his studies on Ganga river water at Haridwar reported that the pH of the was slightly alkaline as it ranged from 7.06 to 8.35.

Electrical conductivity: Lowest value of Electrical conductivity was observed in sampling station 3 and highest value of 2263 µmhos/cm was observed in sampling station 8.

TDS: Total dissolved solids of sampling stations 3,4,&5 was found to be low but it was found to be very high at sampling station 8 and it exceeded the WHO limit of 1000mg/L.

Total hardness: Hardness of sampling station 1 was found to be lowest at 57.3mg/L and it was maximum at sampling station 7 with a value of 855mg/L which exceeded the WHO limit of 500mg/l.

Total suspended solids (TSS): TSS value was lowest at sampling station Shahapur (Bhatsai river) and highest at sampling at sampling station Diwe-anjur (Ulhas river). High values at certain sampling stations may be due to untreated industrial effluents, municipal drainage and sewage waters, drain off from agricultural lands etc ,similar findings are reported by Safari D et.al[8].

Alkalinity: Alkalinity of water is a measure of its capacity to neutralize acids. Natural alkalinity to water sources is imparted mainly by salts of weak acids such as bicarbonates, carbonates, borates, silicates, phosphates and the salts of humic and fulvic acids.. Total alkalinity is the combined activity of the values of carbonates and bicarbonates in water Alkalinity of drinking water has not been reported to be harmful but generally 100 mg/L is desirable for drinking water .It was found that the maximum alkalinity of water was at the points 6,7 and 8 lesser alkalinity was at points 3,4 and 5.

Table-3
Correlation coefficients (r) of some physico-chemical parameters of *of ULHAS river water system from Thane district)*

	Temperature	pH	E.C	Hardness	T.D.S	T.S.S	Alkalinity	D.O	B.O.D	C.O.D
Temperature	1	0.779	0.821	0.825	0.816	0.790	0.803	-0.825	0.838	0.822
pH		1	0.727	0.760	0.909	0.940	0.927	-0.965	0.952	0.950
E.C			1	0.873	0.990	0.876	0.879	-0.881	0.856	0.847
Hardness				1	0.624	0.917	0.983	-0.983	0.922	0.974
T.D.S					1	0.992	0.879	-0.881	0.857	0.848
T.S.S						1	0.912	-0.916	0.890	0.887
Alkalinity							1	-0.939	0.923	0.920
D.O								1	-0.996	-0.996
B.O.D									1	0.999
C..O.D										1

Table-4
Showing average values of various parameters of ULHAS river water system from Thane district

	Parameters	Sampling stations								Permissible limit	standard
		1	2	3	4	5	6	7	8		
1	Colour	colourless	colourless	colourless	colourless	colourless	brownish	brownish	brownish	-	-
2	Temperature (Celcius)	29.1	30.0	27.5	27.4	27.6	29.8	30.2	30.8	_	_
3	pH	7.4	7.6	7.4	7.6	7.7	8.2	8.3	8.6	6.5to 8.5	WHO
4	EC µmhos/cm	272.7	369.3	155.0	157.3	161.0	884.7	1026.0	2263.3		
5	TDS mg/L	184.0	247.0	104.0	106.7	110.6	602.0	673.0	1538.0	1000	WHO
6	Total hardness mg/L	57.3	103.3	55.7	60.7	65.3	557.7	855.0	830.7	500	WHO
7	TSS	62.7	47.7	36.7	32.7	41.3	513.0	641.0	1300.0	5	WHO
8	Alkalinity	51.3	77.0	46.7	48.7	49.0	351.3	817.0	794.0	-	-
9	DO mg/L	6.8	6.4	6.6	6.7	6.7	3.2	2.9	2.4	4	WHO
10	BOD mg/L	5.1	6.4	3.1	3.4	3.5	36.7	37.7	40.0	5	WHO
11	COD mg/L	8.2	10.8	5.2	5.2	5.5	111.3	113.3	118.0	10	WHO
12	Trace metals(ppm) Cu	<.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.05 <1.0	WHO USPH
	Fe	0.022	0.028	0.020	0.031	0.037	0. 620	0. 890	1.770	<0.30	USPH

Dissolved oxygen: Dissolved oxygen is one of the most important parameter in assessing water quality and reflects the physical and biological processes prevailing in the water. Dissolved Oxygen (DO) is essential to all forms of aquatic life including the organisms that break down man-made pollutants. DO levels was highest at sampling station1with a value of 6.8 but it was found to be very low at sampling station 8 with a value of 2.4mg/L . The reason for the low DO content may be due to high decomposition of organic matter, which indicates a high pollution load in the water. These results were positively correlated with the dissolved oxygen values in the river water analysis by Rajiv .P -et al (2012)[5].

Biological oxygen demand: It has been used as a measure of the amount of organic materialism in an aquatic solution which support the growth of microorganism , BOD values ranged from 3.1 at Kalu river water in Titwala to a maximum of 40.0 mg/L at Ulhas river water at Diwe anjur.

Chemical oxygen demand(COD.): Chemical Oxygen Demand values were very high at sampling station at Ambivili(Kalu river),Kongaon(Ulhas river)and at Diwe -Anjur (Ulhas river),this indicates that pollution load in the river is due to untreated industrial effluents, drainage and sewage waters

entering into it from the surrounding urbanised areas, similar observations are mentioned by various other researchers in their study on river water[9,10].

Trace Metals: Amount of Cu trace metal was less than 0.01 mg/L at all sampling stations. Fe trace metal exceeded its limit given by USPH in the sampling stations of Ambivili, Kongaon and Diwe-anjur. Mumtazuddin S.et al; gave similar observation in his study on groundwater water samples along Budhi Gandak[11].

Pearson correlation analysis establishes strong positive correlation between temperature and all physico chemical parameters except Dissolved Oxygen. pH exhibited strong positive correlation with Total dissolved solids, BOD and COD values under study. Total dissolved solids in various stations demonstrated very significant positive and negative correlations with Total suspended solids and Dissolved oxygen respectively. Dissolved oxygen significantly negatively correlated with COD and BOD. Bhattacharya. T. et al; stated in their study that correlation between the different parameters of groundwater of Anand in all the tehsils showed both positive and inverse relations between the parameters, some moderately correlated and some well correlated[12].
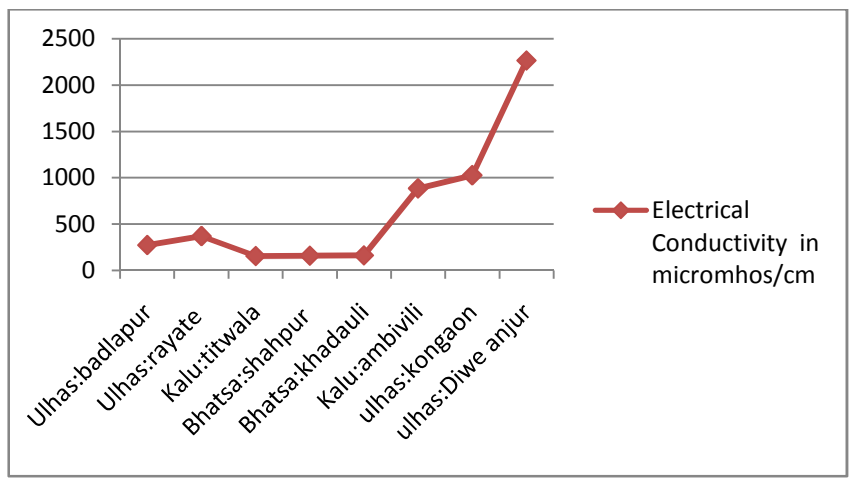
Figure-1
Variation of Electrical conductivity across various sampling stations
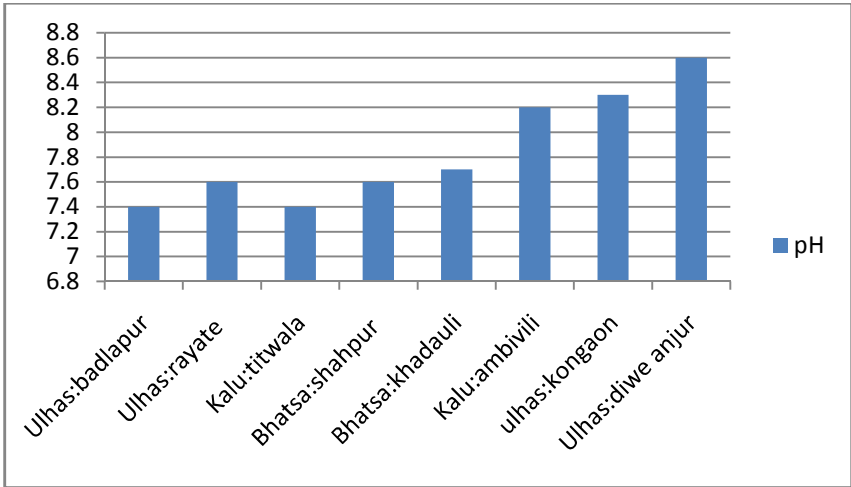
Figure-2
pH of water samples from various sampling stations
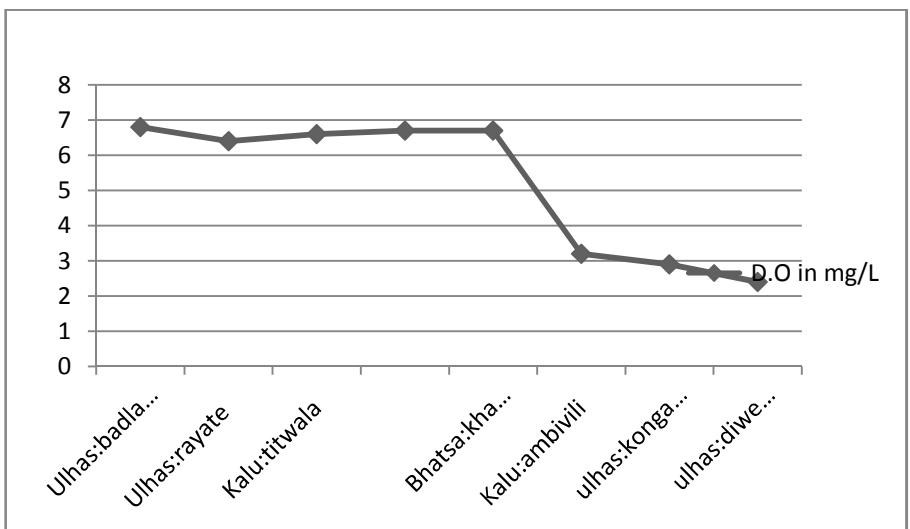
Figure-3
DO of water samples from various sampling stations

Conclusion

This study clearly reveals that Ulhas river system is polluted to a considerable extent at sampling stations at Ambivali -Kalu river, Kon gaon- Ulhas river and Diwe anjur-Ulhas river while flowing through Thane district. Water at these stations is not fit to be used in the light of mandatory values recommended by WHO and USPH. Well directed efforts are absolutely necessary to alleviate and abate such alarming pollution.

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