Assessment of Physicochemical Characteristics of Godavari River Water at Trimbakeshwar & Kopargaon, Maharashtra (India)

Patil S. S	**Ghorade I. B**
Dept. of Environmental Science, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad -431004. M.S. (India)	Dept. of Environmental Science, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad -431004. M.S. (India)

ABSTRACT *A systematic study has been carried out to assess the physicochemical characteristics of water samples of Godavari River from Trimbakeshwar to Kopergaon. The parameters were analysed such as Temperature, pH, TDS, Conductivity, Turbidity, DO, BOD, Sodium, Potassium. The Godavari originates near Triambak in the Nasik district of Maharashtra, and flows through the states of Madhya Pradesh, Karnataka, Orissa and Andhra Pradesh. Some important urban centers on its banks include Nasik, Aurangabad, Nagpur, Nizamabad, Rajahmundry and Balaghat Godavari is the largest river of all peninsular rivers in India. It has a total drainage area of 312,812 square km of which 48.6% lies in Maharashtra, 23.8% in Andhra Pradesh (AP), 18.7% in Chattisgarh, 5.5% in Orissa, 2% in Madhya Pradesh (MP) and 1.4 % in Karnataka. This research work shows that Godavari River water at Kopargaon (S2) was more polluted than Trimbakeshwar (S1). The river water at Kopargaon harmful for drinking purposes. So that remedial measures should be adopted to avoid water pollution and related consequences.*

Introduction

Godavari is the largest river of all peninsular rivers in India. It has a total drainage area of 312,812 square km of which 48.6% lies in Maharashtra, 23.8% in Andhra Pradesh (AP), 18.7% in Chattisgarh, 5.5% in Orissa, 2% in Madhya Pradesh (MP) and 1.4 % in Karnataka. Principal tributaries of Godavari are Pranhita, Indravati and Sabari. All these tributaries drain water from high rainfall areas (i.e. more than 100 cm annual rain fall) except the main river Godavari. These tributaries contribute 80% flow of the total river. The average yearly water flow in Godavari is nearly 110 billion cubic meters. Godavari is referred as the Vriddh (Old) Ganga or the Dakshin (South) Ganga. The name may be apt in more ways than one, as the river follows the course of Ganga's tragedy: Pollution in this peninsular river is fast reaching unsafe levels. The Godavari originates near Triambak in the Nasik district of Maharashtra, and flows through the states of Madhya Pradesh, Karnataka, Orissa and Andhra Pradesh. Although its point of origin is just 80 kms away from the Arabian Sea, it journeys 1,465 kms to fall into the Bay of Bengal. Some important urban centers on its banks include Nasik, Aurangabad, Nagpur, Nizamabad, Rajahmundry and Balaghat.Like most other rivers, domestic pollution is the biggest polluter of the river Godavari, accounting for 82 per cent of total pollution, whereas industrial pollution accounts for about 18 per cent. In early days, water was primarily used for domestic needs like drinking, washing, bathing and cooking etc. But due to industrial and urban development, requirement of water for these activities has increased along with domestic purpose. Water of good quality is required for living organisms. The quality of water is described by its physical and chemical characteristics. But if, some correlations were possible among these parameters, then significant ones would be fairly useful to indicate the quality of water (Dhembare et.al, 1997).The studies on physico-chemical parameters of various water bodies have been performed in different countries (Habib et al., 1997).Water resources has been the most exploited natural system since man strode the earth water is an essential requirement for all biological systems. Riverine systems are the major sources of the drinking water and the means of sustaining human animal and plant life despite its abundance its vast resource has come to exist as a scarce commodity. Increased Urbanization and Industrialization caused stress on the self-purification mechanism of rivers. The selected area for study is Trimbak and Kopargaon. These are situated at the banks of Godavavri River in Maharashtra.The lattitude of Kopargaon is 19° 54› N and Longitude is 74° 33›E. The latitude of Trimbak is 190 56' 0" N and Longitude is 730 33' 0" E.

Material and Methods

The water samples were collected for physico-chemical analysis from two stations i.e. Trimbakeshwar (S1) and Kopargaon (S2). These samples are analyzed at regular intervals of one month for a period of ten months from July 2011 to April 2012. The samples were well mixed and stored in 1.5 liter plastic cans for the analysis work. Sample collection was usually completed during morning hours between 6.00 am to 9.00 am every for further analysis. The Water temperature, Water transparency, Dissolved Oxygen and Hydrogen ion concentration (PH) were estimated on the spot at the time of sampling while other parameters were estimated in the laboratory. Standard methods as prescribed APHA (1998) were followed for examination of various physical and chemical parameters of water. Water transparency was measured by Secchi disc having a diameter of 20 cm and divided into black and white quadrants. The depth at which the Secchi disc was visible was determined.

Results and Discussion:-

The analytical results for the various parameters have been shown with Mean and Standard Deviation in the Table No.1-4 and Average is shown in Table No. 5-6.

Table. 1 –The results of physicochemical parameters (2011-2012).

Sr . No.	Parameters			July		August		September		October		November	
				S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
			Max.	26	25	27	27	27	26	28	27	27	27.5
1			Min.	24	24	26	25	25.5	25	26	26.5	25	26
	Temp.(°C)		Avg.	25	24.5	26.5	26	26.25	25.5	27	26.75	26	26.75
			S.D.	1.414	0.707	0.707	1.414	1.061	0.707	1.414	0.354	1.414	1.061
			Max.	8.1	8.2	8.5	8.2	8.3	7	8.1	8.1	8.7	8.3

2	pH	Min.	8	8.1	8.2	7.9	7.9	6.8	7.8	7.8	8.2	7.8
		Avg.	8.05	8.15	8.35	8.05	8.1	6.9	7.95	7.95	8.45	8.05
		S.D.	0.071	0.071	0.212	0.212	0.283	0.141	0.212	0.212	0.354	0.354
		Max.	349	280	304	264	299	249	282	260	255	233
3	TDS	Min.	341	274	300	253	286	241	273	242	242	221
		Avg.	345	277	302	258.5	292.5	245	277.5	251	248.5	227
		S.D.	5.657	4.243	2.828	7.778	9.192	5.657	6.364	12.728	9.192	8.485
		Max.	254	335	268	382	287	384	286	392	294	405
4	Conductivity	Min.	247	328	257	368	279	373	274	390	289	398
		Avg.	250.5	331.5	262.5	375	283	378.5	280	391	291.5	401.5
		S.D.	4.950	4.950	7.778	9.899	5.657	7.778	8.485	1.414	3.536	4.950
		Max.	106	323	98	296	77	253	76	232	49	212
5	Turbidity	Min.	96	320	82	269	56	215	58	210	25	195
		Avg.	101	321.5	90	282.5	66.5	234	67	221	37	203.5
		S.D.	7.071	2.121	11.314	19.092	14.849	26.870	12.728	15.556	16.971	12.021

(S1- Station Trimbak) (S2-Station Kopargaon)

Table. 2 –The results of physicochemical parameters (2011-2012).

Sr . No.	Parameters		December		January		February		March		April	
			S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
		Max.	26	25	27	26.5	27.5	28	28	28	29	28.5
6		Min.	23	24	24	24.5	25	25.5	26	26.5	28	28
	Temp.	Avg.	24.5	24.5	25.5	25.5	26.25	26.75	27	27.25	28.5	28.25
		S.D.	2.121	0.707	2.121	1.414	1.768	1.768	1.414	1.061	0.707	0.354
		Max.	8	8.2	8.8	8.6	8.6	8.7	7.9	8.5	8.3	8.4
7	pH	Min.	7.8	8.1	8.5	8.3	8.2	8.7	7.9	8.3	7.8	8.1
		Avg.	7.9	8.15	8.65	8.45	8.4	8.7	7.9	8.4	8.05	8.25
		S.D.	0.141	0.071	0.212	0.212	0.283	0.000	0.000	0.141	0.354	0.212
		Max.	286	236	298	255	315	269	324	284	354	296
8	TDS	Min.	279	222	287	233	304	252	308	268	347	281
		Avg.	282.5	229	292.5	244	309.5	260.5	316	276	350.5	288.5
		S.D.	4.950	9.899	7.778	15.556	7.778	12.021	11.314	11.314	4.950	10.607
		Max.	296	401	240	406	236	386	223	364	198	347
9	Conductivity	Min.	289	382	228	393	232	379	212	330	183	338
		Avg.	292.5	391.5	234	399.5	234	382.5	217.5	347	190.5	342.5
		S.D.	4.950	13.435	8.485	9.192	2.828	4.950	7.778	24.042	10.607	6.364
		Max.	42	195	76	198	81	182	96	153	108	133
10	Turbidity	Min.	31	173	61	183	67	174	84	144	98	117
		Avg.	36.5	184	68.5	190.5	74	178	90	148.5	103	125
		S.D.	7.778	15.556	10.607	10.607	9.899	5.657	8.485	6.364	7.071	11.314

(S1- Station Trimbak) (S2-Station Kopargaon)

Table. 3 –The results of physicochemical parameters (2011-2012).

Sr . No.	Parameters		July		August		September		October		November	
			S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
		Max.	7.1	8.4	7.3	7.8	7.1	7.9	7.6	8.2	7.8	8.5
1		Min.	6.6	8.2	6.9	6.5	7	7.5	7.3	7.8	7.4	8.1
	DO	Avg.	6.85	8.3	7.1	7.15	7.05	7.7	7.45	8	7.6	8.3
		S.D.	0.354	0.141	0.283	0.919	0.071	0.283	0.212	0.283	0.283	0.283
		Max.	2.6	8.5	2.6	9.4	2.9	10.5	2.8	9.9	3.1	9.7
2	BOD	Min.	2.2	7.9	2.1	8.5	2.5	9.5	2.6	8.5	2.8	8.1
		Avg.	2.4	8.2	2.35	8.95	2.7	10	2.7	9.2	2.95	8.9
		S.D.	0.283	0.424	0.354	0.636	0.283	0.707	0.141	0.990	0.212	1.131
		Max.	9	35	7.8	36	7.8	41	8.8	45	8.7	49
3	COD	Min.	6.5	32	6.9	34	7.3	39	8.2	33	8.5	37
		Avg.	7.75	33.5	7.35	35	7.55	40	8.5	39	8.6	43
		S.D.	1.768	2.121	0.636	1.414	0.354	1.414	0.424	8.485	0.141	8.485
		Max.	16	28	21	31	14	23	18	25	19	28
4	Sodium	Min.	12	24	18	26	9	21	13	22	13	21
		Avg.	14	26	19.5	28.5	11.5	22	15.5	23.5	16	24.5
		S.D.	2.828	2.828	2.121	3.536	3.536	1.414	3.536	2.121	4.243	4.950
		Max.	1.9	2.5	2	2.6	2.3	2.9	1.8	2.8	1	3.5
5	Potassium	Min.	1.4	2.3	1.8	2.3	1.9	2.4	1.4	2.7	0.9	2.9
		Avg.	1.65	2.4	1.9	2.45	2.1	2.65	1.6	2.75	0.95	3.2
		S.D.	0.354	0.141	0.141	0.212	0.283	0.354	0.283	0.071	0.071	0.424

(S1- Station Trimbak) (S2-Station Kopargaon)

Table. 4 –The results of physicochemical parameters (2011-2012)

Sr . No.	Parameters		December		January		February		March		April	
			S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
6	DO	Max.	8	8.3	7.9	8.4	8.2	8.8	7.6	8.3	7	7.9
		Min.	7.8	8.1	7.5	8.1	7.8	8.2	7.4	8	6.7	7.4
		Avg.	7.9	8.2	7.7	8.25	8	8.5	7.5	8.15	6.85	7.65
		S.D.	0.141	0.141	0.283	0.212	0.283	0.424	0.141	0.212	0.212	0.354
7	BOD	Max.	3.3	11	2.6	9.3	2.7	10.3	2.8	9.9	2.2	10.2
		Min.	2.9	8.3	2.3	8.1	2.3	9.5	2.5	8.1	1.9	9.3
		Avg.	3.1	9.65	2.45	8.7	2.5	9.9	2.65	9	2.05	9.75
		S.D.	0.283	1.909	0.212	0.849	0.283	0.566	0.212	1.273	0.212	0.636
8	COD	Max.	8.9	46	6.9	51	8	54	8.9	41	9.5	44
		Min.	8.4	39	6.4	45	7.6	43	8.1	36	9.1	39
		Avg.	8.65	42.5	6.65	48	7.8	48.5	8.5	38.5	9.3	41.5
		S.D.	0.354	4.950	0.354	4.243	0.283	7.778	0.566	3.536	0.283	3.536
9	Sodium	Max.	22	26	16	26	13	24	24	26	25	28
		Min.	19	19	11	22	10	21	19	23	20	19
		Avg.	20.5	22.5	13.5	24	11.5	22.5	21.5	24.5	22.5	23.5
		S.D.	2.121	4.950	3.536	2.828	2.121	2.121	3.536	2.121	3.536	6.364
10	Potassium	Max.	0.9	2.3	1.9	2.9	2.5	3.1	2.9	3.2	2.8	3.4
		Min.	0.8	2.1	1.6	2.5	2.3	2.5	2.6	2.8	2.4	2.4
		Avg.	0.85	2.2	1.75	2.7	2.4	2.8	2.75	3	2.6	2.9
		S.D.	0.071	0.141	0.212	0.283	0.141	0.424	0.212	0.283	0.283	0.707

(S1- Station Trimbak) (S2-Station Kopargaon)

Table- 5. Average Physico-Chemical Analysis of Waterample at Trimbakeshwar Station (S1) (2011-2012).

Parameters	Temp.	pH	TDS	Conductivity	Turbidity	DO	BOD	COD	Sodium	Potassium
July	25	8.05	345	250.5	101	6.85	2.4	7.75	14	1.65
Aug.	26.5	8.35	302	262.5	90	7.1	2.35	7.35	19.5	1.9
Sept	26.5	8.1	292.5	283	66.5	7.05	2.7	7.55	11.5	2.1
Oct	27	7.95	277.5	280	67	7.45	2.7	8.5	15.5	1.6
Nov.	26	8.45	248.5	291.5	37	7.6	2.95	8.6	16	0.95
Dec.	24.5	7.9	282.5	289	36.5	7.9	3.1	8.65	20.5	0.85
Jan.	25.5	8.65	292.5	228	68.5	7.7	2.45	6.65	13.5	1.75
Feb.	26.5	8.4	309.5	232	74	8	2.5	7.8	11.5	2.4
Mar.	27	7.9	316	212	90	7.5	2.65	8.5	21.5	2.75
Apr.	28.5	8.05	350.5	183	103	6.85	2.05	9.3	22.5	2.6

Table- 6. Average Physico-Chemical Analysis of Water Sample at Kopargaon Station (S2) (2011-2012).

Parameters	Temp.	pH	TDS	Conductivity	Turbidity	DO	BOD	COD	Sodium	Potassium
July	24.5	8.15	277	331.5	321.5	8.3	8.2	33.5	26	2.4
Aug.	26	8.05	258.5	375	282	7.15	8.95	35	28.5	2.45
Sept	25.5	6.9	245	378.5	234	7.7	10	40	22	2.65
Oct	26.75	7.95	251	391	212	8	9.2	39	23.5	2.75
Nov.	26.75	8.05	227	401.5	203.5	8.3	8.9	43	24.5	3.2
Dec.	24.5	8.15	229	391.5	184	8.2	9.65	42.5	22.5	2.2
Jan.	25.5	8.45	244	399.5	190.5	8.25	8.7	48	24	2.7
Feb.	26.75	8.7	260.5	382.5	178	8.5	9.9	48.5	22.5	2.8
Mar.	27.25	8.4	276	347	148.5	8.15	9	38.5	24.5	3
Apr.	28.25	8.25	288.5	342.5	125	7.65	9.75	41.5	23.5	2.9

Temperature

In the present investigation te range of temperature of water was found to be in between 24.5.00c to 28.50c. at both the stations At higher temperature solubility of oxygen and other gases decreases and water becomes tasteless while metabolic activity of organism increases. Tamlurkar et. al. (2006) recorded maximum temperature of water at Nanded in Maharashtra. Lowest temperature 26.0° c was observed during winter season while highest temperature 31.2° c was observed during summer season. Temperature had an appreciable effect on dissolved oxygen and biochemical oxygen demand and the aquatic organism in water (Kasthuri and et. al. 2005).

pH

The analytical results for the various parameters have been shown in the result tables.The pH range was recorded in the range 7.9 to 8.65. at the Trimbak & 6.9 to 8.45 at Kopargaon. pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. Most of the waters are slightly alkaline due to presence of carbonates and bicar-bonates. pH of water is important for the biotic compound because most of the plant and animal species can survive a narrow of pH from slightly acidic to slightly alkaline condition. These values are within maximum permissible limit prescribed by WHO (Table.No- 7)

TDS

Total dissolved solids were recorded in the range between 248 to 350.5 mg/l at Trimbak & 244 to 288.5 at Kopargaon. The TDS values were below the drinking water standards prescribed by WHO. Similar results were also observed by Dhembare and Pondhe [1997]. TDS conductivity and Turbidity are positively related with each other [Tamlurkar and Ambore 2006].Total dissolved solids indicate the salinity behavior of water. Water containing more than 500 mg/L of TDS is not considered desirable for drinking water supplies, but in unavoidable cases 1500 mg/L is also allowed.

Conductivity

It is ranged from minimum 183 µ mho /cm to 291 µ mho /cm at Trimbak & 331.5 to 401.5 at Kopargaon., showing large

measure of soluble ions which is confirmed by the presence of other metals and chlorides as well as other parameters. However, the average conductivity is low. Electrical conductivity is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salt.

Turbidity
In the present investigation the range of turbidity was in 36.5 to 103 NTU at Trimbak & 125 to 321.5 at Kopargaon. Turbidity is an important parameter for characterizing water quality. It is an expression of optical property of a sample (water and wastewater) containing insoluble substance which causes light to be scattered rather than transmitted in straight lines. The amount and angular distributions of this scattered light is governed not only by the quantity of the insoluble substances but also by their size, shape and refractive index. In most of the waters, Turbidity is due to colloidal and extremely fine depressions, suspended matters such as clay slit, finely divided organic and inorganic matter, plankton and other microscopic organisms also contribute to Turbidity.

DO
In the present investigation the range of DO was 6.65 to 9.3 at Trimbak & 7.15 to 8.5 at Kopargaon.The concentration of DO regulates the distribution of flora and fauna. Seasonally the concentration of DO was more during monsoon and least during summer [Yogendra et.al. 2008]. DO play an important role in water quality determination. The introduction of oxygen demanding materials, either organic or inorganic, in to water causes depletion of the dissolved oxygen in the water. This poses a threat to fish and other higher forms of aquatic life if the concentration of oxygen falls below critical point [Ramana et.al. 2008]. There exists no better general indicator of water quality than DO.The DO levels recorded in the study area varied according to the rate of respiration and decomposition of the organic materials in the water (Bankar, et .al., 2005).

B.O.D.
In the present investigation the range of was 2.05 to2.95 at Trimbak & 8.2 to 10 at Kopargaon. Biochemical Oxygen Demand (BOD) is the measure of the degradable organic material present in a water sample and can be defined as the amount of Oxygen required by the Micro Organisms in stabilizing the Biologically Degradable Organic matter under aerobic conditions. The principle of the method involves, measuring the difference of the Oxygen concentration between the sample and after incubating it for five days at 20°C. Samples devoid of Oxygen or containing less amount of Oxygen are diluted several times with special type of dilution water saturated with Oxygen in order to provide sufficient amount of Oxygen for oxidation.

Chemical Oxygen Demand (COD)
During the period of present investigation, the average value of COD from Trimbak was 6.65 to 9.3 at Trimbak & 33.5 to 48.5 at Kopargaon.. COD is the oxygen required by organic substances in water to oxidize them by a strong chemical oxidant. (Trivedy and Goel, 1986).Chemical oxygen demand is a method to determine the organic load of water body i.e. susceptible to oxidation.(Jadhavar, et al., 2010). COD as a result of pollution is largely determined by the various organic and inorganic materials (Calcium, magnesium, potassium, sodium, etc.). (Ramana et al., 2008). The level of chemical oxygen demand seems to be the appropriate indices for assessing the pollution level of water bodies (Jakher, 2003). The high COD values are found mainly in water, which may be due to the mixing of domestic and industrial waste (Murugesan et al., 2007). Similar trends were also observed at Raghograh in M.P. (Megha Rai and Shrivastava, 2006).

Sodium (Na)
During the period of present study, the value of Na was found During the period of present study, the value of Na was found 11.5 to 22.5 at Trimbak & 22 to 28.5 at Kopergaon . It is also one of the important cation occurring naturally. Its concentration in natural fresh water is lower than calcium and magnesium. In natural waters, the major source of sodium is weathering of various rocks (Trivedy and Goel, 1986).

Potassium (K)
During the period of present study, the value of Potassium was found 0.85 to 2.75 & at Trimbak 2.2 to 3.2 at Kopergaon.

REFERENCE APHA (1998) Standard Methods For Examination Of Water & Wastewater (20TH Edn). American Public Health Association, Washington D.C. | Bankar, A.B., B.R. Kiran, E.T. Pattaiah, R. Purushoham and S. Manjappa (2005) Hydrochemical characteristics of surface water in Chindravalli pond, near Chitradurga, Karnataka. I.J.E.P., Vol.25 No.3:249-253. | Dhembare, A.J. And Pondhe, G.M.(1997). Correlation Of Ground Water Parameters Of Pravara Area, Maharashtra State,India. Vol.L2 (1 And 2): 32-33. | Habib, O.A., R. Tippett And K.J. Murphy (1997) Seasonal Change In Phytoplankton Community Structure In Relation To Physico-Chemical Factors In Loch Lomond. Scotland. Hydrobiologia 35: 63-79. | Jadhavar,V.R., Ghorade, I.B. And Patil, S.S.(2010) Assessment Of Ground Water Quality In And Around Nagothane Region Dist. Raigad, Maharashtra. . J. Aqua. Biol.,25(2),2010:91-99 | Jakher, G.R. And M. Rawat (2003) Studies On Physico-Chemical Parameters Of Tropical Lake, Jodhpur, Rajasthan, India. J. Aqua. Biol., Vol. 18 (2): 79-83. | Kasthuri, R., S. Lathia, D. Kalaivani, K. Banumathi And N. Nithya (2005) Assay Of Ground Water Quality At Kothatti Of Tiruchiappali, Ijep Vol. 25 (3) 245-248. | Megha Rai And R.M. Shrivastava (2006) Effect Of Fertilizer Industry On Surface Of Ground Water Quality, Raghogarh (M. P.). J.Aqua.Biol., (2) 101-104. | Murugesan, A., A.Ramu And N.Kannan (2007) Ground Water Quality Assessment In And Around Madurai, Ijep Vol.27 No.2: 125-136. | Ramana, P., S.K.Patil And G.Sankri (2008) Evaluation Of Water Quality Of Magadi Wetland In Gadag District Karnataka. Proceeding Of Taal 2007: The 12TH World Lake Conference: 355-359. | Tamlurkar, H.L. And Ambore N.E. (2006) Assessment Of Ground Water Quality Of Nanded City, Maharashtra, J. Aqua. Biol ., Vol 21 (2) 111-114. | Trivedy, R.K. And P.K. Goel (1986) Chemical & Biological Methods Of Pollution Studies Environmental Publication, Karad,, Maharashtra. | Yogendra, K. and E.T.Puttaiah (2008) Determination of water quality index and suitability of an urban water body in shimoga Town, Karnataka. Proceeding of Taal 2007: The 12th world lake conference: 342-346.